Smartphone Notifications' Distractions During a Full-attention Activity

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Abstract

The situation under consideration in the present research arises from the ongoing world of ICTs, and we focused on one of the most pervasive ones: smartphones. These devices became an extension of people, with numerous benefits but also several negative aspects to the point that they can bring distraction or even addiction. Notifications are one of their most prominent features, and we wanted to investigate how do people react to them during a specific full-attention activity, i.e. watching audio visual content. Secondly, we proposed two so-called calm technology scenarios (Calm Screen and Calm Tag) as a possible way to mitigate the distracting power of notifications. We discovered that during the two short movies that our participants had to watch in the experiment, the majority of them was not distracted by the staged alerts; nothing much happened, and they enjoyed the 15 minutes full-attention activity. We suggest that notifications are not very distracting when the audio-visual content is short as it was in our experiment. Additional reasons could be that enjoyment of the activity inhibits distraction caused by smartphones. Other factors may have influenced the result, such as the conditions under which the experiment was conducted, and further research is necessary to better understand the phenomenon. Concerning the two examples of calm technology, participants seemed partly favourable to consider them as a solution to mitigate notifications' distraction. Due to small sample sizes we were unable to use statistics, along with other several other limitations; however, this study gives suggestions for directions of future research on the topic of distraction through smartphone notifications.

Introduction

"we don't know who discovered water, but it probably wasn't a fish"
Marshall McLuhan

People cannot clearly perceive a situation they are immersed, especially when it is pervasive. The situation under consideration in the present research arises from the ongoing world of information communication technologies (ICT). Nowadays it is impossible to imagine a world without these digital technologies since they permeate every area of human activity, from economy to culture's domain (Tikhonov & Bogoslovskii, 2015). One of the key roles of ICT is the creation and exchange of knowledge and information around the globe, and that affects citizens' everyday life in many areas (Fraillon et al., 2014). Such an extensive and wide application of them come with benefits and costs that should be monitored. Digital technologies have enriched humanity with a variety of advantages; however, they have also brought new impacts and challenges that are difficult to manage because of the unpredictability, rapid and constant development that characterized them. Our "global village" (a metaphor that describes a more connected world due to media technologies) was predicted by the Canadian sociologist and media theorist Marshall McLuhan; he said that electronic media would produce not only positive effects, but also pain, stress and anxiety (Rauch, 2018).
The media technologies ecosystem began to change in 1970, with the emergent Digital Revolution and its widespread adoption of computers and later the Internet, mobile phones and social media and networks (Rauch, 2018). The revolution is epitomized by a shift from analog, mechanical to digital technologies. Computer was one of the first ICTs to be implemented pervasively in the past decades. Since then, ICT provide a tool to create, store, collect and use information as well as for communicating (Fraillon et al., 2014). At the present time, the Global Information Technology Report observed that we are moving towards an era of embedded, ubiquitous (the extent to which people have universal access to digital services and applications) and invisible computing; a relevant part of everyday real world is already reflected online (Dutta & Bilbao-Osorio, 2012). Internet is the main infrastructure that let our world to be hyperconnected; by doing so, it built an environment characterized by accessible and immediate services and instant communication (Dutta & Bilbao-Osorio, 2012). The most relevant features of hyper connectivity are: be always on, broadband and ubiquitous mobile devices enable people to connect with others 24/7, making them available at any time and location; it is not just about people since connectivity also concerns people to machine or machine to machine communication, e.g. in the Internet of Things (IoT) (Dutta & Bilbao-Osorio, 2012).

Bearing in mind the extensive influence of numerous ICTs, we decided to do the present study on a particular device: the smartphone. Mobile phones became smarter and increasingly relevant for our daily lives, and they are an integral part of culture and identity (Lepp, 2014). They changed the way people communicate and mostly, they are important for maintain social relationships, and they play a role in development of social and personal identities (Lepp, 2014). Above all, they are an important extension of ourselves (Roberts et al., 2014).
One of the negative aspects of smartphone usage is the promotion of constant distraction and technology addiction. There are certain structural characteristics of smartphones that can promote them. One of the most prominent features could be notifications, such as beeps, whistles and compelling graphics signalling incoming messages (Roberts et al., 2014). Alerts can be particularly disrupting when people are performing a primary activity that requires full attention (e.g. reading a book, watching a movie, work on some tasks). Therefore, smartphones challenge our ability to focus on a current activity and could produce harmful multitasking.

Research question and hypotheses

The following research question is central in the present research: *"How do people react when they receive smartphone notifications during a full-attention activity, i.e. watching audio-visual content, and could calm technology positively affect their reactions?"*.

To answer the research question, the first step is to review literature on:

- ICT pervasiveness
- Technological addiction (with a focus on Internet and Mobile Phone addiction)
- Attention and distraction in the digital age
- Smartphone notifications
- Calm technology and peripheral attention

Based on previous works in these areas we develop an experiment and subsequent survey. Watching audio-visual contents is an activity that is commonly performed during leisure time in a private setting, and it is a valid full-attention activity that can be affected by multitasking. In order to approach the first part of the research question, we formulate Hypotheses 1, which concerns interactions with smartphones and the role of notifications during the full-attention activity.
Existing research shows that notifications are considered distracting. The main finding of Pielot's study (2014) is that people do not let notifications accumulate and the majority is viewed within an hour. Stothart (2015) also found that cellular notifications, even when one does not view or respond to messages or answer calls, can significantly damage performance on an attention-demanding task. Based on these findings we predicted that:

H1: Smartphone notifications have a strong distracting effect when watching audio-visual content

The expected outcome of the experiment is thus that notifications are generally distracting during this specific full-attention activity.

One step further in the research is an initial verification of a possible solution to better control the negative effect of notifications. As explained by Stothart et al., notifications can be significantly disrupting to the performance of a full-attention task, that is why we should find solutions to mitigate them. In the current era of hyper-connectedness, notification design is in stark contrast with so-called *calm technology*, an HCI concept formulated by Mark Weiser and John Brown (1996).
Of course, we need to be informed about new messages and other info, however this can be done differently and in a "calmer way", especially during a full-attention activity. Considering the increase of ICT pervasiveness, scientists should understand that what is relevant is not technology itself, but the relationship it creates with people (Weiser & Brown, 1997). The problem with certain design implementations is that they bring the sensation of distress. Whereas, the ones which are perceived as calming are different in the way they engage attention. The concept will be worked out further in the *section 4* of the questionnaire.

H2: Calm technology is a possible solution to mitigate smartphone distraction during a full-attention activity

The main contribution of this thesis in the field of media studies and media technologies is to give insight in how people deal with notifications during this activity and how distracting they are. Furthermore, the research could demonstrate whether calm technology is a possible means to mitigate and partially control the distracting power of these daily present alerts.

Literature review

Media technologies are changing our lives

The media relevance is explained by McLuhan in his concept of *media environment*: technologies extend our bodies and capabilities, however they can at the same time numb minds, bodies and senses (1964). Media are situated between people and the environment, and they can become the new environment (1964). The sociologist Neil Postman added that technological change is ecological, it does not change human life slightly, it can transform everything (Rauch, 2018).
Thus, in the present time, the threshold between here (analog, offline) and there (digital, online) is becoming increasingly blurred. According to Floridi, ubiquitous computing, ambient intelligence, internet of things (IoT) and web-augmented objects will be the next stage in the digital revolution (2007). In a more advanced stage, Floridi argues, ICT will change our conception of what it means to be an agent, and we will become inforgs, which means entities made by information (2007). Digital immigrants, or people who were raised before the digital age, will be the last generation to experience the difference between an online and offline since they also experienced a world without the Internet (2007).
Hyper-acceleration and near instantaneity are already a characteristic of the digital era, as critic Simon Reynolds describes in his book Retromania: "We are documenting our lives obsessively, chatting to our friends, trafficking in digitally encoded entertainment, locating restaurants, gossiping about celebrities" (2012). Furthermore, the media psychologist Pamela Rutledge predicted that the 27/7 connectivity will be seen as an integral part of our life, as it is for electricity; this will bring to serious psychological implications regarding what is considered normal (Pew Research, 2019).
Furthermore, the Pew Research Centre explained in its compendium regarding the next 50 years of digital life, that it may be impossible to unplug from the Internet (2019). This could have subsequent impacts, e.g. to be dependent to devices against our will; connectivity will become more ethereal and divorced from devices; no one will really have the opportunity to live offline and new medical disorders will emerge (Pew Research, 2019).

There are other ICT problematics. Pervasive technology has increased and accelerated our interactions in a considerable way. Grayson Cooke, quoted in the book *Slow Media* said that "we are always on, we are status updated, we are tweet-fed; we are real-time media junkies and everything about our mediascape exists to remind us that we don't have time to slow down" (Rauch, 2018, p. 13). The intensified media use has been quantified by several researches. For instance, the average American spends around 12 hours per day with media (Rauch, 2018), meaning that people ingest three times more information compared to 1960. Millennials check their phone more than 150 times daily (Rauch, 2018). Based on interviews and summarized studies' results, Rauch concluded that, considering the amount of consumption, ICT play a role in undermining human health and well-being by producing the feeling of being distracted, anxious, stressed out, alienated (Rauch, 2018). Furthermore, they drain time, energy, and productivity; they hinder empathy, learning, creativity, self-esteem, and reflective thought (2018).
Distraction is a human condition, however ICTs have made it ubiquitous to the point that inattentiveness can be considered a relevant cost of digital technologies (Rauch, 2018).
Overloading and distraction are not the only negative consequence of intense mediatization, at the end point there is an addiction to ICT (Rauch, 2018), which is taken seriously by researchers, psychologists and technologists. The contradiction lies in the fact that digital media are habit forming by design since companies try to compete for the limited time and attention of their users (Rauch, 2018). Taking in mind that positive and negative effects depend on the use of technology, scientists must assess possible solutions to live in harmony with technology.

Attention and technological distraction

The role of attention in the digital age

Mind wandering is a trait of the human mind, according to numerous researches, humans people think about something else other than they are doing half of the time; they ruminate over things that happened in the past or may occur in the future (Rauch, 2018). Paying attention or resisting to the temptation to drift along is getting more difficult in the digital age. Due to information overload and a high use of ICT, the human attention span has decreased considerately, reflected for example in the observation that people often scan a newspaper headline but do not take the time to click and read the fully story (Rauch, 2018). Particularly, mobile technology diminishes attentional capacity, by producing shorter attention spans (especially among younger ages) (Wilmer et al., 2017).

Two types of attention

Attention can be divided in two categories: focused attention and divided attention.

Focused attention is the ability to attend to only one target stimulus while ignoring other incoming stimuli (Wilmer et al., 2017). Focused interactions require focused attention and they use a great amount of mental resources, are performed consciously, with intention (Bakker & Niemantsverdriet, 2016). This is the most common type of interaction with digital devices, but also very common in everyday life (Bakker & Niemantsverdriet, 2016). A focused interaction occurs, for instance, when we write a message with a mobile phone. Surprisingly, smartphones have the abilities to interfere with focused attention even when people are trying to ignore them (Wilmer et al., 2017).Viceversa, **divided attention** is the capacity to perform two or more tasks at the same time, meaning multitasking. (Wilmer et al., 2017,).

There is a theory based on divided attention, and it says that the human brain only has a fixed amount of mental resources which could be divided over different activities. The activities could be bodily, (e.g. running) sensorial (e.g. listening to music) or cognitive (e.g. studying maths) or a combination of those (Bakker & Niemantsverdriet, 2016).

Another terminology, *continuous partial attention* [1] coined by Linda Stone describes the state of semi-distraction in which people spend a lot of their time (Rauch, 2018).

The multitasking problem

Smartphones challenge our ability to focus on a current activity/task and they are responsible for two types of interruptions.

Endogenous interruptions occur when the user's own thoughts are directed towards a smartphone-related activity, and a possible reason could be the desire of more immediate gratification when ongoing activities are not perceived as rewarding (Wilmer et al., 2017).

Exogenous interruptions occur when some environmental cue catches the user's attention, e.g. notifications directly from the phone or an external event that drive towards smartphone use (Wilmer et al., 2017).

An overall consideration is that multitasking is associated with poorer control over attention, however other findings suggest that multitasking can also produce benefits, such as better performance on various attentional demanding tasks (Wilmer et al., 2017).

Solutions are needed since divided attention can be harmful; according to Rauch, humans are not able to perform multitasking when doing complex tasks (e.g. texting while having a conversation) and when we do that, there could be an increase of stress level, while accuracy and productivity are lowered (2018). Additionally, Pea et al. confirmed that media multitasking (performing multiple task

[1] Stone, L. (2009). *Beyond simple multi-tasking: Continuous partial attention*. Lindastone. net. Nov.

with media) harms cognitive functions and processes, e.g. they found that media use was negatively associated with social-emotional well-being (cited in Rauch, 2018).
Rauch explains that breathing, meditating, resting, taking decisions such as unsubscribing from email lists, switching off notifications or checking mail in a fixed time may help people to be less distracted (Rauch, 2018). However, a more general solution may come from changing the design of human-machine interaction. For instance, Wilmer at al. suggest that several apps, an approach to multitasking or notifications setting may moderate the negative impact of smartphones over attention and other cognitive skills (2017).
Moreover, in the age of ubiquitous computing, developers and designers are thinking of alternative ways to convey attention towards digital technologies. One of these methodologies is positive computing, the design and development of technology to support psychological well-being and human potential, for the purpose of mitigating the negative effects of its pervasiveness (Rauch, 2018). Calvo and Peters, the authors behind the concept, explain that wearables could be changed so they promote not only health, but also psychological well-being by becoming positive feedback devices (Basulto, 2015). Application of positive computing to these and other devices could increase mindfulness and reduce stress caused by technology (2015).

Technological addiction

The raise digital devices' pervasiveness has brought to different challenges. One of them resides in the development of a new type of non-substance addiction, which is the technological addiction. In particular, for our study, we focus on the smartphone addiction, which shares some characteristics with the Internet addiction.

What is addiction in general

Addiction is a crosscutting phenomenon that can be explained by three different perspective: biological, psychological and social/cultural one.
A biological definition is:

"A primary, chronic disease of brain reward, motivation, memory and related circuitry (…). It is characterized by inability to constantly abstain, diminish behavioural control, craving, diminished recognition of significant problems with one's behaviour and dysfunctional emotional response" (Zhang et al., 2017, p. 4)

Addiction affects the circuits and brain reward structures and motivational structures, by altering them and triggering craving and/or engagement in addictive behaviour (Zhang et al., 2017). This perspective relies on the view of addiction as a seek for reward, which is identified with pleasure that bolster the addictive behaviour (Zhang et al., 2017).

The psychological perspective defines addiction as:

"A behaviour in which you use more than you would like to use, and you continue to use despite negative consequences. (…) People believe they cannot live without them. (…). It is a condition that results when a person ingest a substance (e.g. alcohol, cocaine, nicotine) or engages in an activity (e.g. gambling, sex, shopping) that can be pleasurable but the continued use/act of which becomes compulsive and interferes with ordinary life responsibilities, such as work, relationships, or health" (Zhang et al., 2017, p. 6).

The addicted person acts voluntarily, and his actions can be considered an *akrasia*, the weakness of the will described by Aristotle. The disruption of the reward system is a hindrance for the psyche to

perform decisions produced under the normal deliberative process (Zhang et al., 2017).There are seven criteria to define a psychological addiction: tolerance, withdrawal (when the behaviour is stopped), limited control (engage more than they would like), negative consequences, neglected or postponed activities, significant time or energy spent and the desire to cut down (Zhang et al., 2017). Two constructs can be considered relevant in understanding psychological addiction. The former is impulsivity, and it could be the inclination to pursue short-run rewards that, with regular engagement, could lead to an addiction. Then, after a certain amount of time, impulsivity becomes over-trained and develops in the latter construct, compulsivity (Zhang et al., 2017).

The last perspective is the social/cultural one, namely:

"Addiction is meaningful only within the conceptual categories available within culture and framed by social context. (…) behaviour thought to follow from them, are culturally specific" (Zhang et al., 2017, p. 10).

There are three primary social-cultural influences: culture, families and social support; they all have a role in addiction, e.g. negative life events, lack of social support and loneliness are key predictor of future addiction behaviours (Zhang et al., 2017).

Technological addictions: Internet addiction

There are two addiction categories: substance and non-substance. The former is a neuropsychiatric disorder defined by the desire to take the substance (drug, alcohol) despite the harmful consequences (Zhang et al., 2017). The latter is related to the performance of harmful behaviours (e.g. pathological gambling, excessive food consumption) and it has similar reward system circuity as the substance one (2017).
One of the most recent non-substance addictions are technological addictions; they are described as involving excessive human-machine interactions performed when the device produces psychological benefits, e.g. reducing negative mood states (Zhang et al., 2017). In contrast with substance addictions, technological addictions could not produce observable and direct symptoms and addicted people could behave in a socially acceptable way (2017).

The greatest technological addiction is related to the Internet. **Internet addiction** (IA) or **Internet addiction disorder** (IAD) is defined as:
"An individual overuse of the Internet caused by a mental and behavioural disorder, where the re-use of the Internet involves a strong desire to stop or to reduce the withdrawal from the Internet. (…). Creating tensions and tolerances that increase spent time on it, involving psychological and physical dependence" (Zhang et al., 2017, p. 31).
The first study on this topic concluded that Internet is not addictive per se because specific applications are the ones that appear to be significant in the development of pathological internet use (Young, 1998). Some authors suggested that researches should "focus on particular activities on the Internet that could be potentially addictive because people do not become addicted to the medium, but to the actual behaviour they engage online" (Kuss et al., 2013, p. 959). These activities are included in social applications such as online chatting, social networking sites (SNS), online instant messaging and gaming. The study made by Kuss et al. found that the use of social applications significantly increased the addiction risk, in particular the use of SNSs that serve to maintain established offline networks (2013). Subsequently, the most addictive activities are online chat/forums and online instant messaging. Subsequent studies demonstrated the Internet addiction show similar structural alteration in the brain to substance addiction; they occur in areas related to craving, motivation and cognitive control (Altbäcker et al., 2016).

There are consequences of pathological Internet use, and the most drastic include a depressive

disorder, sleep deprivation, lower self-esteem and significant damage to real life activates (Tikhonov & Bogoslovskii, 2015). This type of dependence can lead to problems at several levels, e.g. academic and work performance and relationships issues (Young, 1998). Despite the damaging consequences, the Internet addiction has not been included in the Diagnostic and Statistical Manual of Mental Disorders (DSM). Regarding the physical negative aspects, a prolonged Internet use can provoke headaches, pains in facial and neck muscles, blurred vision and pain handful movements (Tikhonov & Bogoslovskii, 2015).

Technological addictions: mobile phone addition

Mobile phone addiction has some connections with Internet addiction considering that a relevant number of activities on smartphones rely on the Internet. That is the reason mobile phones could cause physical and psychological problems similar to the Internet addiction (Kwon et al., 2013).
Certainly, smartphones have psychological benefits such as the increase of social inclusion and connectedness, improved status, feeling of security and safety (Walsh et al., 2008). However, this great influence comes with the risk of developing a "problematic cell phone use" or "phone dependence", namely an uncontrolled use or overuse of a mobile phone (Zhang et al., 2017). Shambare et al., quoted in Roberts et al., 2014, described this addiction as "possibly the biggest non-drug addiction of 21st century" (p. 259).

Examples of mobile phone addictive behaviours are obsession over mobile phones, substantial increase in the time spent using them, failure to reduce or stop the overuse (Zhang et al., 2017). Researchers from Stanford University conducted a survey on iPhone users already in 2010, and 75% of participants admitted sleeping next to their phone, 69% were more likely to forget their wallet at home and 41% said it would be a tragedy to lose it (cited in Kwon et al., 2013, p. 1). However, it is not always simple to notice the addiction considering that media use has become enough pervasive to be "invisible" (Roberts et al., 2014).

Much of the extant researches are focused on the negative outcomes of mobile phone addiction and as for other technological addiction, researchers developed several scales to diagnose it. Internet addiction criteria must be taken into account when analysing mobile phone criteria, therefore non-smartphone addiction scales are considered out of date. One of the most well-known method is the **Smartphone Addiction Scale** (SAS). it consists of 48 questions clustered in six factors (withdrawal, tolerance, daily-life disturbance, positive anticipation, cyberspace-oriented relationship and overuse (Zhang et al., 2017). Kwon et al. established that SAS represent the level of smartphone addiction with high validity and reliability (Kwon et al., 2013). The SAS in particularly relevant for the questionnaire of our methodology since ten items are selected to understand if our participants are potential smartphone addicted.

Indicators of phone addiction

Focus group discussions involving young participants in Australia has provided insight into indicators of mobile phone addiction (Walsh et al., 2008). Experimenters asked if participants believed addiction could occur in smartphones and what would happen when it is the case. The first indicator is salience, namely how people think about their phones when trying to focus on other activities (Walsh et al., 2008). At a behaviour level, it can be seen by the constant checking of their phones. Phones can also conflict with other activities, e.g. working, studying, driving and other social activities (2008). Compulsive checking and inappropriate use are definitely symptoms of addiction. Moreover, mobile phones produce a sense of euphoria and relief, by feeling valued or loved when receiving messages or calls (2008). Plus, there is a loss of control or tolerance since it is difficult to control the excessive mobile use (2008). Withdrawal is another trait, it is the experience of unpleasant feelings when unable to engage in the behaviour, e.g. feeling disconnected when a person

cannot use the phone. Finally, relapse and reinstatement are indicated when people try unsuccessfully to cut down the behaviour and they engage in similar or higher levels than previously (Walsh et al., 2008). All the listed symptoms could vary in their levels.

Some of the young participants felt that phones are a part of them, and they feel extremely attached to them; this over-attachment is a defining feature of addictive behaviour (2008). The study on young Australians by Walsh et al. shed light on the complexity of mobile phone addiction. Is it evidenced that phones are a useful tool which simplify connectedness, therefore addiction can be classified as positive, since there are benefits from using them (2008). However, the positivity can turn into negativity when the adverse consequences overtake the benefits (Walsh et al., 2008).

Physiological responses to smartphones

An experiment made by DeBoth et al. demonstrated that people separated from their mobile phone can exhibit physiological responses related to anxiety (2015). The two conditions were: participants completing a crossword with their phone by their side and an experimental control condition in which the phone was out of reach. They measured heart rate, respiration and galvanic skin responses or perspiration (GSR) and the results showed that only GSR was statistically significant (DeBoth et al., 2015). An increase in perspiration is one of the indicators of an anxiety response and there was a rise in the average skin conduction after the participants received both text and call (2015).

On the specific effects of mobile phones, Bowler et al. asked whether there is a physiological stress response to a college student cell phone ringing while completing a motivational task (2015). The concluded that a ringing phone cause an increase in electrodermal activity, however heart rates and respiration rates did not increase significantly (Bowler et al., 2015). Therefore, they could not prove if a phone ringing induces a physiological stress response.

A third study to determine what physiological changes occur when there are phone distractions recorder the activity of the sympathetic nervous system, and alpha, beta and delta brain waves that are active during rest, alertness and in distraction (Jasniewski et al., 2017). The experiment was done on students since phones ringing and vibration tone are considered distractors in the classroom. As a result, there were no significant change in heart rate and skin conductivity; the delta wave standard deviation when exposed to a ringing mobile phone increased significantly relative to participants who heard nothing or vibration (2017). According to the experimenters, a possible explanation could be that participants were attempting to block out the distraction (Jasniewski et al., 2017).

The distracting effect of a ringing mobile phone was also investigated by Shelton et al. They started with the demonstration that only a limited amount of information can be attended at any given moment, and the content of it is determined by a voluntary attentional control or an involuntary orienting response (2009). They developed three experiments in which regulate the disruptive effects of ringing phones and other distractors to see whether they can be less or more distractive. The discoveries are: ringing phones are not necessarily detrimental to cognitive performance; a warning could help participants to recover more quickly, the nature of noise in the environment has important implications (Shelton et al., 2009).

Emotional attachment to our smartphones

One of the most know phobia developed within the framework of mobile phone addiction is the nomophobia, the pathological fear or discomfort of being out of touch with one's mobile phone (Melumad, 2017). A behavioural response of the owner could be that he becomes distressed when separated from the phone (Melumad, 2017). Emotional attachment is significant signal of addiction since many adults rely on their smartphone as an attachment object, thus producing the same psychological and behavioural attachment effects which are: its portable and tactile nature, a learned association of positive outcomes, object increases owner's feeling of comfort, relief from discomfort

due to stress and the owner becomes distressed when restricted from the object (Melumad, 2017, p. 18) .

Differences in smartphone activities

Regarding activities performed on smartphones, time spent texting is the most common one for both males and females according to Roberts et al. (2014). The second most time-consuming activity is sending e-mails, followed by SMSs which appears to be a good indicator of a possible mobile phone addiction (2014). In conclusion, they said that the addiction is driven mainly on the desire to connect socially. College students spend around nine hours on their smartphones (2014).
There is a difference in use between males and females. Men see a more instrumental use for mobile phones (e.g. for entertainment, source of information) while women use them a social tool of communication, with the aim of maintaining and nurturing relationships. Females appear to have a higher level of attachment to their mobile phone (Roberts et al., 2014).

Role of notifications

There are certain structural characteristics of smartphones that promote distraction. One of the most prominent could be notifications, such as beeps, whistles and compelling graphics signalling incoming messages (Roberts et al., 2014).

What is a notification

Smartphones have become a pervasive companion which people cannot do without. Applications like social networks, instant messaging, games, email allow to connect almost everywhere in an asynchronous modality (Pielot et al., 2014). The receiving person is not expected to answer immediately, but they are alerted constantly by notifications; in fact, most apps use proactive visual, auditory or haptic alerts to notify users about new messages or events. Even when someone is not using the smartphone, these notifications alert people through visual badges, sounds, vibrations (Pielot et al., 2014,).
A notification is:
"A visual cue, auditory signal, or haptic alert generated by an application or service that relays information to a user outside her current focus of attention. On mobile phones, notifications are typically delivered instantly, e.g. when the user receives a call or a message. In general, they only arrive when a corresponding application is closed, e.g. when the user has an email application open, no notification will be generated by the OS if a new email arrives" (Pielot et al., 2014, p. 2). Notifications are at the core of information awareness (e.g. email messages, a birthday reminder, social networks updates) and they use audio, visual and haptic signal to steer attention (Mehrotra et al., 2016).
Notifications are considered interruptive and they have different negative outcomes. Social applications rely on alerts to draw user's attention to new messages and content and they support immediacy, however instead of avoiding to check the phone frequently they produced the opposite effect; in fact, they force the user to adopt this annoying habit of constantly checking it (Pielot et al., 2014). Interestingly, the level of politeness of an alert affect how annoyed and disputed users feel (Pielot et al., 2014). Mobile phones have generally become disruptive since it is probable that users have to deal daily with hundreds of alerts. However, according to Pielot et al., little is understood about the nature and effect of mobile alerts on everyday life (Pielot et al., 2014) and according to Mehrotra et al. further researches are needed concerning the factors influencing the user's receptivity to notifications (Mehrotra et al., 2016). From these considerations we understand the relevance to

pursue studies in the field of notifications; our work aims to add new knowledge to the smartphone alerts' phenomenon.

Alerts modality

Pielot et al. collected real-world notifications on daily lives of mobile phone users. The main findings are that people do not let notifications accumulate; there were viewed within a few minutes and the majority within an hour largely pre-screening the notification drawer, meaning that they often triggered interaction with the smartphone (2014). The fast view times can be attributed to factors "like expectations of a response from others, time-critical communication, and the relationship between the sender/receiver" (Pielot et al., 2014, p. 8). The time of viewing is significantly influenced by personality traits of extraversion, conscientiousness and neuroticism (Mehrotra et al., 2016).
People often disable sound, but not alerts. In respect of the type of alert, 46.2% were received in normal mode (ringer mode), 41.5% in vibration-only mode, and 12.2% in silent mode (Pielot et al., 2014). Mehrotra et al. found that the seen time is statistically significantly higher for silent notifications, sound only and sound with vibration are the second and the vibration mode has the lowest rate (2016). In contrast, notifications are seen faster in the vibration mode compared to silent mode in the Pielot et al. research, however even if the phone is silent, people seem unable to escape the effects of notifications (Pielot et al., 2014), in fact they are still aware of them (Mehrotra et al., 2016).

Notifications and social pressure

Messenger applications produce a feeling of social pressure (e.g. responding within certain time span on WhatsApp). Social networks alerts have an impact on emotional states: a high volume can increase the feeling of being stressed, interrupted and annoyed, even when they are not relevant to the receiver (Pielot et al., 2014). People cannot ignore their smartphone for a long time "because they start feeling stressed and anxious about missing important information until they finally pick up the phone to check for any new notifications" (Mehrotra et al., 2016, p. 1). If they want to postpone attending notifications, people make an explicit decision to delay them (Pielot et al., 2014).

Notification acceptance

Regarding notifications acceptance, users usually tolerate them when they are free, when they consider the sender as important and when the content is useful. Contrary, they avoid attending to alerts that do not contain relevant, urgent or useful information (Mehrotra et al., 2016). Content importance could be better recognised by developing a different notification presentation (Mehrotra et al., 2016). The study conducted by Mehrotra discovered that the user also perceives more disruption when engaged in intricate tasks. They suggest that the operative system should offer more flexibility when the user is in a busy moment, by having an interruptability management system that learns pattern to predict the engagement (Mehrotra et al., 2016).
In conclusion, the study found that the response time of a notification is influenced by many factors which include: "ongoing task's type, completion level and task complexity, notification's alert modality, presentation and sender-recipient relationship (…) Different people exhibit different reactions and we observed a substantial role of the individual psychological traits on how a person reacts to a mobile notification" (Mehrotra et al., 2016, p. 10).

Notifications and distraction

Regarding alerts, exposure to them significantly decreased attention on a concurrent attention-based task, even when people did not see the notification; hearing the sound or feeling the vibration was

enough to distract participants and diminish focused attention, as seen in the research made by Stothart et al. (2015).
Phone interaction is associated with poorer performance on concurrent tasks because attention is shared between multiple tasks (multitasking) (Stothart et al., 2015). Stothart et al. study questioned whether simply receiving without responding to a mobile phone notification could carry attention cost. They found that "cellular notifications, even when one does not view or respond to messages or answer calls, can significantly damage performance on an attention—demanding task. (…) the tendency for cellular notifications to prompt task-irrelevant thoughts, or mind wandering, which persist beyond the duration of the notifications themselves" (2015, p. 89). Therefore, waiting to respond to a call or text message may itself disrupt attention performance.

Solutions to mitigate the distraction power
Given that ICT will be even more prominent in the future and, since one of the primary roles is communication, they will rely more and more on notifications. That is why researchers need to understand better their implications and find strategies to lower their negative effects.
A possible solution proposed by Pielot et al. is to reduce the number of interruptions by automatically mute alerts according to the context. However even if there are reduced, smartphone users could nevertheless check their phones to be sure they are not missing any urgent (Pielot et al., 2014). Another approach to give a better user experience could be to define times in which users are available and attend to notifications when they are busy with other activities (Pielot et al., 2014). Wilmer et al. propose several solutions to moderate distraction, for instance by making us of some apps, approaches to multitasking or changes in the notification settings (Wilmer et al., 2017).

Designing with calm technology

ICTs are often considered as an enemy of calmness. However, there are some technologies that can bring calm and comfort and Mark Weiser and John Brown are the first authors explaining one of the key challenges in technology design: calm technology (Weiser & Brown, 1996). Considering the increase of ICT pervasiveness, scientists have to understand that what is relevant is not technology itself, but the relationship it creates with people (Weiser & Brown, 1997). The problem with certain design implementations is that they bring to the sensation of distress. Whereas, the ones which are perceived as encalming are different in the way they engage attention. "Calm technology engages both the centre and the periphery of our attention, and in fact moves back and forth between the two" (Weiser & Brown, 1996, p. 2). Tugui explains that in the field of computer science, data processing technologies should induce calm and be a calm technology, instead of producing stress, (2004,) especially considering the amount of ICT and the increasing ubiquity of them.

Ubiquitous computing
This type of technology design is situated in the new computer era called ubiquitous computing formulated by Weiser and Brown. It is the period of time in which there is access to numerous computers via Internet and they will be embedded in walls, chairs, clothing, cars, in everything (Weiser & Brown, 1997). The two researchers predicted that the social impact of imbedded computers will be similar to other essential technologies such as electricity and writing (Weiser & Brown, 1997). Invisibility of ubiquity could be intended as a small and more integrated computer in the environment or as a mental disappearance, where big computers are not perceived as actual computers, but as interactive objects (Peterson, n.d.).
There are two elements, or harbingers of the UC era: an imbedded microprocessor and the Internet. Networked together, it is possible to connect billions of information sources with hundreds of ICT in

our private and public spaces (e.g. ovens that download recipes, clocks that find out the correct time after a power failure, fridge that tells when something is missing) (Weiser & Brown, 1997).
The aim of calm technology, thus, is to be informative without being obtrusive and annoying since we are moving towards a world in which ubiquitous computing will increasingly be more present (Peterson, n.d.).

Moving from the periphery to the centre

Multi-tasking is part of everyday life since we can perform multiple activities simultaneously without consciously paying attention to them. However, when we use most of the digital devices, our focus of attention is positioned on them, making difficult to perform even a small task on the side (Hausen, 2012). That is why peripheral attention – which is the most important concept of calm technology - could be used to reduce the distracting power of smartphone; in fact, it makes a great use of a person's capabilities since it demands a limited amount of mental resources and only a minimal attention (Bakker, 2016) . Periphery is intended as something that people are attuned to without attending to explicitly (everything people are aware of that is happening around but do not have a full attention) but could be at the centre of attention in the next moment (Weiser & Brown, 1996). An interaction can be peripheral when it does not distract the user from another mental demanding activity or at least reduce the interruption to the interaction to a minimum (Bakker & Niemantsverdriet, 2016). Peripheral interaction highly relies on divided attention theory.

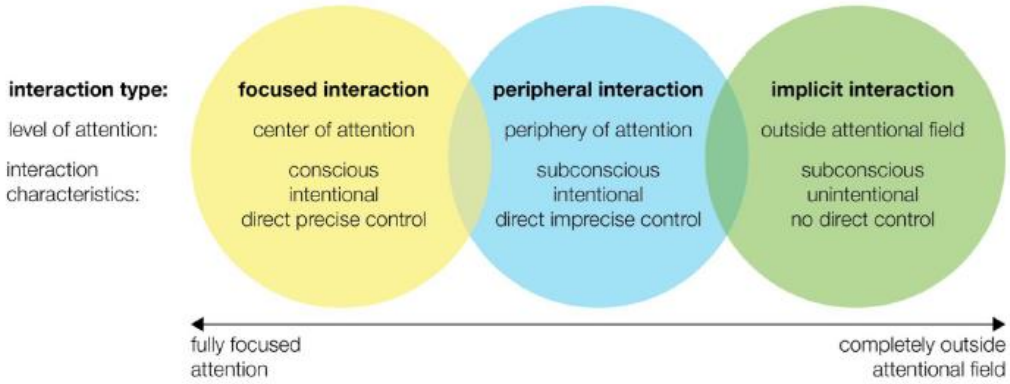


Figure 1: Three types of interaction by Bakker & Niemantsverdriet, 2016, p.3

The three types of interaction described in the graphic above can be performed simultaneously, depending on the activity; when the primary task does not require a lot of attention, it is possible to perform another one in the periphery of attention. In the case of two activities which use the same sensory modality (e.g. watching a movie and writing a text message) it is difficult to perform them at the same (Bakker & Niemantsverdriet, 2016). It becomes easier to perform both in the case of a combination of an auditory and visual activity (Hausen, 2012). Is it important that the activity that take place in the periphery should not require a high cognitive effort.
Calm technology does not involve only peripheral attention and interaction, but allows to move easily from the periphery to the centre for two reasons:
"First, by placing things in the periphery we are able to attune to many more things that we could if everything had to be at the centre (…). Thus, the periphery is informing without overburdening. Second, by recentring something formerly in the periphery we take control of it (…) it is a fundamental enabler of calm technology through increased awareness and power" (Weiser & Brown, 1996, p. 2).
Furthermore, some devices can enable microinteractions (less than 4 seconds), which are a potential solution to control the "cognitive aspect" of the activity, by minimizing the time of interruption so

the user can quickly shift back to its main task. Such interactions could be changing songs, turning off the light, etc. (Ashbrook, 2010).

Other characteristics

For Weiser there are three signs of calm technology. The first way to encalm is the aforementioned move from centre to periphery. The second is that a technology may enhance peripheral reach by bringing more details into the periphery (Weiser & Brown, 1996), thus increasing the ability to act adequately without being overloaded with information (Tugui, 2004). The last is technological connectivity, which "enables a quick anchoring in certain circumstances against the background of a quick shifting from the centre to the periphery of attention (…) determining a quick perception of the past, present and future of the subject" (Tugui, 2004, p. 3). This is known as *locatedness* in Weiser and Brown paper.

Other characterises are developed by Peterson in his guideline for technology in order to be calm: it should be easily perceived at a quick glance; it should be integrated in the environment and be aesthetic; letting the user reflect on the content, what it is and how it works, will contribute to a mental rest and calmness; a natural interaction with the content, where the content looks and functions like real objects, will contribute to calmness (Peterson, n.d.).
The result of calm technology is to "put us at home, in a familiar place" (Weiser & Brown, 1996, p. 2). A calm technology should not cause stress or interrupt and should present information in an easy and accessible way (Peterson, n.d.). Most importantly, this technology allows people to be in the control of it and not the reverse (Peterson, n.d.). With calm technology people can decide when and if they want to pay attention to it (Peterson, n.d.). A positive effect is to reduce the cognitive load brought by information overload, which is a characteristic of the current media landscape (Peterson, n.d.).

Other "calm concepts"

Other concepts have been developed from calm technology.
Ambient information visualization is a way to present information that reduce cognitive load and it is achieved by using "basic perception rules like involving shape, colour, sound, grouping, size to visualize the state of the content" (Peterson, n.d., p. 114). A part of ambient information visualization is *information decoration*[2], a concept created by Van Mensvoort and suggests that information can be visualized through the environment. He suggested that "the patterns around us could be information carriers as a form of information decoration" (Peterson, n.d., p. 116).
Another concept is *natural interaction*[3], coined by Alessandro Valli, which goes beyond the normal interface with icons and menus and suggests a more natural ways of interacting; the purpose is to make the relationship more natural between people and devices (Peterson, n.d.), which is connected with the way people normally communicate in everyday life.

[2] Van Mensvoort, K. (2007). Information decoration: Our environment as an information carrier. *Artvertising: The Million Dollar Building*.

[3] Valli, A. (2008). The design of natural interaction. *Multimedia Tools and Applications*, 38(3), 295-305.

Methodology

There are some studies on the distraction power of smartphone notifications, and these have been done because by dealing daily with them, they have become disruptive for users. However, according to Pielot et al. (2014), little is understood about the nature and effect of mobile alerts on everyday life. According to Mehrotra et al. (2016) further researches are needed concerning the factors influencing the user's receptivity to notifications. Being distracted while doing something that we should be focused on is a downside of smartphone usage. Rauch explains that divided attention can be harmful, "it's not only a bad habit, but also an illusion and misnomer. Humans are not capable of simultaneously performing complex input-rich tasks, like having a conversation while texting. We switch back and forth from activities. (…) Multitasking raises stress level while lowering accuracy and productivity". (2018, p. 84).
With this study we want to focus on notifications' distraction during a full-attention activity in order to shed some light on this phenomenon during a specific activity. The research aimed to answer to *"How do people react when they receive smartphone notifications during a full-attention activity, i.e. watching audio-visual content, and could calm technology positively affect their reactions?"* is divided in two parts, consisting of an experiment and a following questionnaire.
We designed the experiment by following some of the findings on the researches on smartphone alerts quoted in the literature review (mainly Pielot et al., Mehrotra et al., Stothart et al.). However, our experiment was developed in a way that could be performed in a private setting, in a short amount of time (which corresponds to the full-attention activity's time) and without us being present. That is why our methodology is different from other studies made on alerts. Our experiment could represent an alternative way to design an in-situ real setting research with the aim to discover more about digital notifications. Whereas, for the questionnaire, we also used some previous researches discoveries to design some questions; especially, that can be seen in the *section 5* where we select then items from the validated Smartphone Addiction Scale.

Experiment

We live in a world where technology has become pervasive. We are surrounded by ICTs, in fact the Global Information Technology Report observed that we are moving towards an era of embedded, ubiquitous and invisible technologies (2012). The use of them come with a cost, Rauch says that they play a role in undermining human health and well-being by producing the feeling of being distracted, anxious, stressed out, alienated.
What we wanted to focus on in the present study is the role of ***notifications*** in ***distraction*** in a **specific medium that has become pervasive** during a **specific full-attention activity**.
The medium is the **smartphone** since it is a device that is usually at our side and it is considered an important extension of ourselves (Roberts et al., 2014).
The full-attention activity is to **watch two short movies**. They provide audio-visual input and while watching them people can perform multitasking e.g. use a smartphone.
Notifications are particularly relevant to distraction in smartphone usage. As Roberts et al. explain, one of the most prominent sources of distraction could be notifications (2014), especially when they come with alerts that disrupt people while performing a primary activity that requires full attention (e.g. reading a book, watching a movie, work on some tasks).

Before explaining how we designed our experiment, we need to make a point: it is complicated to precisely define the construct "distraction". A conceptual definition of distraction is:

a thing that prevents someone from concentrating on something else; something that prevents someone from giving their attention to something else; "distraction is the process of diverting the attention of an individual or group from a desired area of focus and thereby blocking or diminishing the reception of desired information" (Cambridge, n.d.).
Generally, notifications are viewed in the notification area (usually in the top part of the screen), and there are a few details about the content depending on the user settings. However, what is the threshold that defines when someone is distracted or not by them? In our experiment distraction was considered when someone picks up the phone, whereas simply giving a glance to the screen is only a micro interaction. In any case, we can say that it is possible that distraction plays a role in the reduction of engagement while watching audio visual content.

Private/real-life setting

Originally, it was planned to run the experiment in a laboratory setting, in order to have everything under control and record every session. However, we had to find another way due to the Coronavirus pandemic that has spread in Europe from February 2020. It was not possible to use Leiden University's facilities and several rules applied hat made it impossible to run an experiment in a laboratory elsewhere either. The best solution was to perform the experiment in a private setting by finding someone that has the experimenter's role and will control the inclusion of all the conditions to conduct it.
Certainly, it is not possible to have the same level of experimental control as in a laboratory setting, but there could be more ecological validity since the full-attention activity happens in a private environment and as suggested by Pielot et al. researches are needed in the effect of notifications on daily life.
In the case of this experiment, it takes place in a real-world setting (e.g. in a living room or another room where people typically consume audio visual content), and by doing so we can test the performance that is very close to the real smartphone use behaviour. Thus, the experiment has a high level of ecological validity and findings could be generalisable to real-life situations, if there is statistical relevance.

Type of full-attention activity

In order to probe *H1*, we designed an experiment performed in a private setting. We decided to select a specific activity that often happens in a private environment: watching two short movies: **Modern Educayshun** (Kolhatkar, 2015) and **The Answers** (Goode, 2015). The reason behind the selection of them is that they are both appreciated in the IMDb (Internet Movie Database) and they approximately last around 7 minutes and 30 seconds, which corresponds to the length we were looking for our experiment. *Modern Educayshun* by Neel Kolhatkar is on YouTube and it has 608.006 likes and 37.484 dislikes. It is a short movie about the potential dangers of a hypersensitive culture followed by social media and political correctness; it is indeed a critic on social justice warriors, in the form of a dystopian satire. *The Answers* by Michael Goode is on Vimeo and it has 5.821 likes. This short movie follows the "after-death" of Nathan, when he discovers that he can find out the answer to every question. However, if we want to use a more relevant quantification of their quality, we should look at the IMDb ratings. *Modern Educayshun* has 7,4/10 (287 reviews), whereas *The Answers* has 7,9/10 (828 reviews). The movies are perceived from the critics as good quality short movies with rate that is the in high part of the ranking scale. *Modern Educayshun* is described as a "witty satire, a very compelling multi-layered visual essay, great and well scripted" (IMDb, n.d.). *The Answers* has reviews in which it is considered as "stunning visually, musically and emotionally, with an intriguing tagline, a pure beautiful film" (IMDb, n.d.). There appears to be, therefore, no significant difference in their quality.

Another reason is that for the experiment we were looking for something that did not last too long. Watching a tv series episode (30-45 minutes) or a movie (1.30/2 hours) would make the experiment difficult to perform, especially in the current COVID-19 situation. Furthermore, Pielot et al. (2014) discovered that notifications are usually seen within the first minutes; 15 minutes of videos should be enough to see any effect of notifications.

Type of notifications

The participant will receive certain types of notifications during the two films and an experimenter will take note of the interaction with the smartphone.

The type of notifications selected for the experiment are **instant messaging notifications** and **social media notifications** since they can be responsible for a high degree of distraction. Both come from social applications, which rely on alerts to draw user's attention to new messages and content and they support immediacy (Pielot et al., 2014). If participants are confronted with them, they are more prone to interact with the smartphone. More specifically, Pielot et al. (2014) discovered that messenger applications produce a feeling of social pressure (e.g. responding in certain time span on WhatsApp). While social media alerts have an impact on emotional states: a high volume can increase the feeling of being stressed, interrupted and annoyed, even when they are not relevant to the receiver. For our experiment we took in consideration participants that have instant messaging and social media apps on their phones.

Other factors

There are other factors to take into consideration. In order to standardize the experiment notifications should arrive at the same time for each movie (*time-critical factor*). Secondly, we should know something about the sender-receiver relationship, since it can influence the fast view times (Pielot et al., 2014) (*relationship factor*). The modality is also important: Mehrotra et al. found that the seen time is statistically significantly higher for silent notifications, sound only and sound with vibration are the second and the vibration mode has the lowest rate (2016) (*modality factor*).

We also have to take into consideration that fast-view times can be attributed to factors "like expectations of a response from others, time-critical communication, and the relationship between the sender/receiver" (Pielot et al., 2014).

Participants collection

We will find experimenters by sending out a flyer that contained the minimum information to take part to the experiment (see *attachment 1*). The flyer is sent in a one-to-one way on WhatsApp and Instagram and on WhatsApp groups. Once people are willing to participate, we will send the full instructions via e-mail with the experiment's procedure and requirements.

In order to motivate people to take part of the study, we decided to assign a small prize consisting of 20 euros and 5 Swiss chocolate bars to one of the participants. Both experimenters and real participants take part of the draw.

Experiment setting

There are two participants in the experiment; the first has the role of the **experimenter**, the second is the **real participant**.

The experimenter is a person that is responsible for running the experiment with the right experimental conditions and the compilation of the experiment's report. We had to delegate this role to a third person since it was not possible to work in a laboratory during the COVID-19 pandemic. The experimenter selects a person in the private environment, e.g. a friend, flatmate or family member. The experimenter role is to watch two short movies with someone and taking note on how s/he is distracted by smartphone notifications in a report. The report (*attachment 2*) contains the

information to assess whether the participant was distracted during the activity, for instance the experimenter looks for of how many times the person picks up the smartphone. The experimenter will take notes while watching the short movies by following a Qualtrics report. In this report the experimenter will also follow the instruction step by step (e.g. "tell the sender to send the message after 2 minutes"). The experiment lasts approximately 15 minutes and the experimenter plays the movies in the following order: *Modern Educayshun* and *The Answers*.

These are the instructions that the experiment must follow:

1. Firstly, you must find a person in your private environment who often uses his/her phone. It could be a friend/flatmate/family member/partner.
2. You cannot tell the person that you are going to watch how s/he interact with the smartphone.
   You must use this excuse:
   "I'm taking part of an experiment in which I have to watch two short movies while answering questions about these movies on my phone. I need one more person to watch it with me, who will be asked a few questions after the movies. Do you want to participate in the experiment with me?".
   Don't forget: the person must not be aware that s/he part of an experiment about smartphones and notifications!

   During each movie you must be sure that the person receives at least 2 notifications. See instructions below:

Modern Educayshun	1 WhatsApp notification at minute 2:00 1 notification on a social media (Facebook, Twitter, Instagram, Tumbler etc.) at minute 5:00
The Answers	1 WhatsApp notification at minute 2:00 1 notification on a social media (Facebook, Twitter, Instagram, Tumbler etc.) at minute 5:00

   In order to do that you have to contact 1 person or more than one person (friends/acquaintances/family members that you have in common) and tell him/her/them to send messages on WhatsApp and/or social media while you are seeing the movies at the right time.
   Make sure that this person (or persons) are available to interact with the participant on WhatsApp and social media in the time you want to perform the experiment.
   If you want to keep it simpler you can directly send the WhatsApp messages in a group that you have in common with the participant and you can also tag/share/write something on the participant's social media.
   What matters is that your participant could be potentially distracted by a specific notification in the time selected in the instruction.
3. During the view, look for his/her interaction with the phone. Read the report before the experiment so you are sure what are the info you need.
   Use your phone to take notes on the report, so s/he won't be suspicious that you're doing an experiment about smartphone notifications.
4. After watching the two short movies you can explain that you were doing an experiment on phone distraction and now you can ask him/her if s/he want to take part to it by filling out a questionnaire. The survey should be filled out as soon as possible.
5. Once s/he is willing to participate, I (Francesca, the researcher) will send him/her the link with the survey.
   If s/he is not willing to participate, all data collected so far should be deleted.

Important before the experiment:

1. Make sure that s/he has the phone close to him/her!

2. Do not mention that s/he is part of an experiment about smartphone notifications!
3. Make sure that s/he will receive exactly 4 notifications as instructed by the survey report.

After the experiment, the experimenter informs the participant of the real aim of it and s/he ask for their willingness to participate to the present study. If s/he accepts to take part, we send the questionnaire, which constitutes the second part of the methodology.

Questionnaire

In the experiment we will collect objective information concerning the participants interactions with their smartphone due to the notifications they will receive. This information cannot be influenced by the perception and memory of the participant since there is the experimenter that takes note of it.
At the end of the experiment, participants will be asked to fill out a questionnaire (*attachment 4*). With the questionnaire we will collect subjective data by asking different questions in order to have a better picture of notification distractions and possibly answer to the research question in a more complete way.

Section 1: Smartphone usage questions
This section will be analysed to assess general behaviour toward smartphone (e.g. the amount of usage time, the emotional attachment).

Section 2: Notifications full-activity questions
Section 2 is useful to assess how much they were distracted during the activity. We will have a more complete info by combining the objective data from experiment and participants' answers to the survey, by asking questions concerning how they perceived notifications during the two short movies. It is important, for instance, to discriminate between distractions that arise from notifications and distractions that are not driven by notifications (meaning that people look at their phone just because they "feel the urge to use it"). This will be seen from answers to question "Did you check your phone even if you didn't see/hear a notification?".

Section 3: Notifications general questions
This survey section will be used to assess whether people are generally distracted by notifications (not only during a full attention activity) and how much people are distracted from them.
With the results on this part of the survey we can compare the amount of distraction with the amount of addiction (see section below) to understand if the person can be considered distracted or/and addicted by the smartphone. Furthermore, we can understand whether the conditions of the full-attention activity selected in our study is effective in seeing the distraction caused by smartphone notifications. If people are generally distracted and perform multi-tasking (as asked in this section), but they do not seem distracted during the two short movies, we can suggest possible factors that influenced the experiment.

Section 4: Fictional calm technology scenarios
This part is related to *H2*. In order to verify if people could be interested in using calm technology to mitigate distraction, we developed two example that they will confronted with.
In this section people will give an initial/exploratory evaluation of two type of calm technology (Calm Tag and Calm Screen). In order to do that they will be confronted with a descriptive video, one image

and a descriptive text. Then, they will evaluate them. With the results we can understand more about the likelihood of seeing these two calm tech examples as tools to reduce phone usage during a full-attention activity.

Our Calm technology scenarios

Most interactions with digital devices require full attention. Interaction with smartphone usually require full focus of attention, even if the task is easy, because the User Interface is mainly visual (Insing, 2020) and it involves three senses: sight, touch and hearing. That is why is complicate to perform multi-tasking or two activities if we are distracted by our phone. It is not an action that can be performed unconsciously.
Calm technology is based on the continuous shift from the periphery and the centre of attention (Weiser and Brown, 1997). It could be an interesting alternative to notifications (which are disruptive) since peripheral interaction requires only a limited amount of mental resources and requires only minimal attention by making optimal use of a person's capabilities (Bakker & Niemantsverdriet, 2016).

What a user can do, instead of looking at notifications on the small screen of his phone, is to be informed about what is happening by seeing or hearing it in the periphery of his attention; this means that the interaction should be:

- Fast; the calm technology could promote microinteractions (less than 4 seconds) or a shorter interaction time when compared to a direct smartphone interaction.
- Less intrusive as possible; firstly, it should be well integrated in the environment (Peterson, n.d.) and be presented in a way to reduce cognitive load. Secondly, to avoid intrusiveness, the interaction should be as natural as possible.
- Easily switch back on the focus of attention (the activity that was being performed); when interacting with a notification, which is usually a written text, our focus of attention on the movie is temporarily limited. However, with a calm technology the interaction with the alert could happen in the periphery of attention (Weiser, & Brown, 1997), or at least it can be perceived fastly, so the user can go back faster to the full-attention activity.
- Should avoid direct use of phone until the activity is ended (the goal is not avoiding the use of smartphone in general, but to enjoy some activities as much as possible by avoiding the use of it during these activities).
  Minimize multi-tasking. Calm technology should be designed in a way that it does not produce distress (Weiser and Brown, 1997), and when it is connected to other devices that could potentially create stress (e.g. smartphones), it can reduce it.

What we want to do is to see if people could like an alternative to notifications, which, as predicted for the *Hypothesis 1* in the introduction of the research, play a relevant role in phone distraction. We predicted for *Hypothesis 2* that, when the interaction with notifications is straightforward and requires a reduce amount of time as compared with picking up the smartphone, people will feel less distracted during the full-attention activity.

Presentation of two calm technology examples in the survey

In the part of the questionnaire named *Fictional calm technology scenarios* we present two scenarios with possible calm technology that communicate what is new in a less intrusive way than normal notifications.
The scenarios contain a visual, audio-visual or only audio representation of the calm technology.

These devices can be context aware, therefore they can gather information about their environment at any given time and adapt behaviours accordingly. They can also be content aware, meaning that, depending on the content of the notification, it can be communicated differently.
Before presenting them in the survey, there is a brief definition of what a calm technology is:
"A technology that doesn't attract our attention in an intrusive way. Instead, it requires the smallest amount of attention, it produces calmness and it doesn't feel us stressed by it".

We decided to graphically and conceptually design two examples of possible calm technology: Calm Screen and Calm Tag. In order to design them, we followed some of the Peterson guidelines. The main purpose of them is to reduce the focus of attention on these distractive digital devices. Each one of them is presented in a short video in which people are confronted with a scenario similar to the one seen in the experiment, meaning a person seated in front of a small screen while watching an audio-visual content. By designing a "visual-prototype", we take into account the specific activity of watching a movie; in fact it is an audio-visual activity, however sound is a more parallel communication channel than sight, which demands more attention. In fact, both fictional scenarios take place in a home environment; participants should imagine to be seated on a couch, while watching a movie on their laptop.

The aim of the video is to show a realistic application of the calm technology in a private environment, thus, to give a clear idea of how it could appear. Both videos are available on YouTube (Savoldelli, 2020). After each video, we included a brief description of the technology and its characteristic.

In order to evaluate the likelihood of these example of calm technology, we selected a list of questions.
The goal is to assess whether the participant would like to use it.

To what extend do you agree with these statements?
I think I would like to use (name) in the future [4]
I think that (name) will be easy to use [4]
I think that most people will understand how to use (name) very quickly [4]
I think that (name) is less intrusive than normal smartphone notifications
If I had this technology, I think I would be less distracted from my phone
Is there anything that you would like to see and use in this technology? What would you add?

Fictional scenario 1: Calm Screen

Characteristics

Calm Screen is a glass screen positioned on the wall. It cannot be fully peripheral since it involves both sight and hearing. Furthermore, Calm Screen is especially a visual device, meaning that the two tasks (watching the movie and reading the notification on the Calm Screen) occurs with the same sensory modality (Bakker & Niemantsverdriet, 2016). However, it is not necessary to stop the primary activity since the person can read the notification by looking up to the wall, and easily go back to the movie. What is relevant, particularly, is that Calm Screen can discriminate between non-relevant and important notifications. People will be interrupted only if it is needed. It is an example of ambient intelligence technology, therefore a smart device that senses the environment and adapts

[4] Bangor, A., Kortum, P. T., & Miller, J. T. (2008). An empirical evaluation of the system usability scale. *Intl. Journal of Human–Computer Interaction*, 24(6), 574-594.

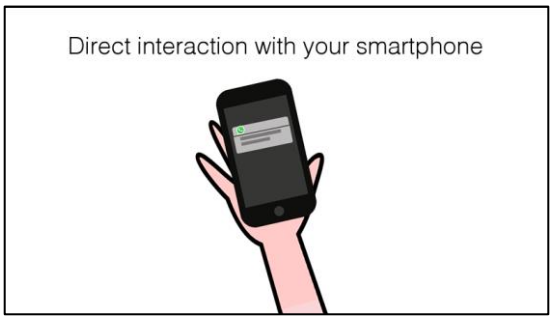
to it. Ambient intelligence is able to sense, predict, and respond to our needs. It is an intersection between IoT and calm technology, and Calm Screen is characterized by ubiquity, invisibility, and a distributed architecture. This technology is designed by following the concept of ambient information visualisation (Peterson, n.d.), by being presented in a way it reduces the cognitive load and by being aesthetically encalming. Finally, Calm Screen can be seen as a form of information decoration of the user's home space (Peterson, n.d.). If there is nothing to communicate, Calm Screen is just a transparent glass screen on the wall, but when there is important information, then it activates in the most natural way as possible (Peterson, n.d.).

Graphical representation

Design flow for the video

Bad scenario with normal notifications:

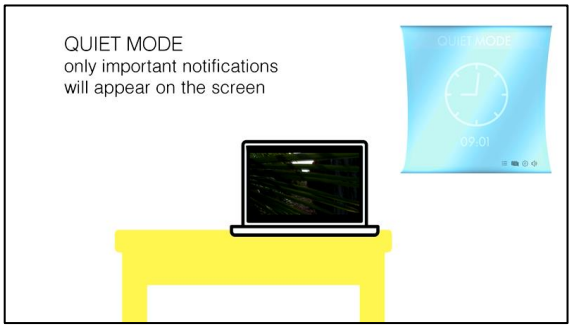
Person watching a movie
Receive notification
Pick up phone
Use phone
Do not follow movie



Video frame minute 00:00:24

Good scenario with calm technology:

Person watching a movie
Receive notification on new device on the wall
Fastly and easily look at it → move from different focus of attention only by moving eyes (no need to pick up phone and look at small screen, unlock the phone and use it)
Go back to the movie in a short amount of time



Video frame minute 00:01:06

Description

Instead of picking up your phone every time you receive a notification, you can see them on the device on your wall. you will look up to the Calm Screen and with a glance you will know what is happening and you can easily go back to the movie, without being distracted too much. Since it is a calm technology the info will be displayed in the less disturbing way as possible, by generating calming sounds and calming sounds and calming graphics.

You can modify the settings and you have different options available, for example:

- Quiet mode: when there is a new notification the device shows it on the screen only if it is important. Calm Screen can distinguish between a notification that you could want to see immediately or a notification that is not urgent by using an AI system. This is the calmest option since you can enjoy your movie without being interrupted, if not necessary.
- If you have guests, you can decide if the device should show the content of the notification, or you can change the privacy by using the voice or tactile activated system.

Fictional scenario 2: Calm Tag

Characteristics

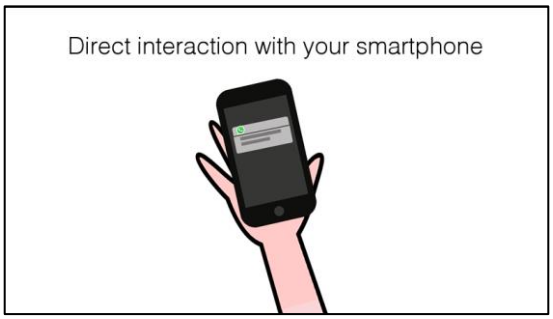
Calm Tag is a tech tag that works through sound and speech. It involves only one sensory modality, and it can be combined with the visual modality of the movie (Bakker & Niemantsverdriet, 2016), so the user attention is switched from the periphery to the centre (Weiser and Brown, 1997) and the interruption is reduced to a minimum (Hausen, 2012). Meanwhile, it will only slightly interfere with the movie's audio, since the notification is a calm, very short sound, that is emitted only when there is something relevant to communicate.
It is content dependant since it projects different sounds depending on the type of notification.
Sound and spoken content are calmer than a visual representation, therefore this calm technology, based only on the sense of hearing, could be perceived as less intrusive and more peripheral (Weiser and Brown, 1997).
Calm Tag is also a wearable technology allowing the interaction to be always accessible for the user. That means it can minimize the distraction in comparison with a smartphone. It simplifies to perform a simple task in parallel with a primary task (Ashbrook, 2010).
Calm Tag is connected to the smartphone via Bluetooth or another wireless technology.

Graphical representation

Design flow for the video

Bad scenario with normal notifications:

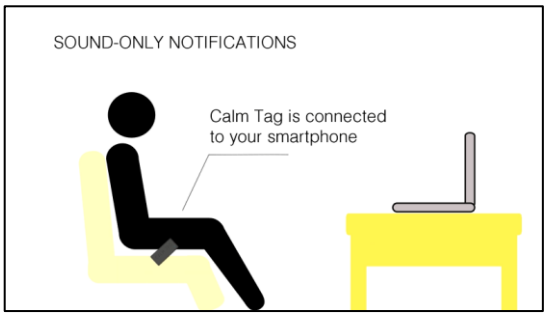
Person watching a movie
Receive notification
Pick up phone
Use phone
Do not follow movie



Video frame minute 00:00:24

Good scenario with calm technology:

Person watching a movie
Receive notification and the tag produce a specific calm sound (e.g. new message on WhatsApp)
Person decides to ask Calm Tag to read it
Tag can recognise if the content is relevant, in that case it will produce another specific sound
Person continues to watch the movie without being interrupted too much



Video frame minute 00:00:42

Description

Calm Tag is a very small device that you can bring everywhere you want, e.g. you can put it in your pocket or just leave it next to you. You don't need to have your phone by your side when you are watching a movie or doing another activity because this device will let you know if there are new notifications through different calm sounds. Distracting notifications will be avoided since you won't see them. When you receive a notification, you can also decide to hear the content by vocally controlling the tag. If the content is visual, Calm Tag will say it to you (e.g. "you received an image from X person"). Calm Tag is able to "talk" with you by using speakers and speech recognition.
Calm Tag can detect when you receive something relevant by using a developed AI system, it won't disturb you if it's not necessary. Therefore, if Calm Tag is at your side, it could reduce your smartphone use. If you want, you can switch between different modalities (a light that starts to flash only when there is an important notification, different calm sounds, small vibrations, …).

Section 5: Questions about smartphone addiction

This section contains ten selected questions from the validated Smartphone Addiction Scale (SAS) in order to understand if participants could be phone-addicted (meaning that they are generally very distracted by smartphones) and how much are they likely to be addicted.

Section 6: Demographic questions

This part has information related to the name of the participant, the age, the education level and the nationality.

Results

In the present study most descriptive statistics are used to understand mainly how much people were distracted during the short movies and whether the two type of calm technology are a possible solution to mitigate distractions. Generally, the results will give insight on what is happening when someone is distracted by notifications while watching audio visual content.

Sample

The data collection lasted 18 days, during which we found 11 couples (11 experimenters and 11 participants). One participant was excluded from the analysis because he cannot be considered part of the reference sample; first of all he described himself as a poor smartphone user, but mostly he did not receive any notification during the experiment since they were disabled or the app was used in a second smartphone). The sample thus comprises data from 10 participants (n = 10), which is not big enough to yield generalizable results. However, the current study is preliminary and the results do, in any case, give some insight into the phenomenon, even if they are not statistically significant.

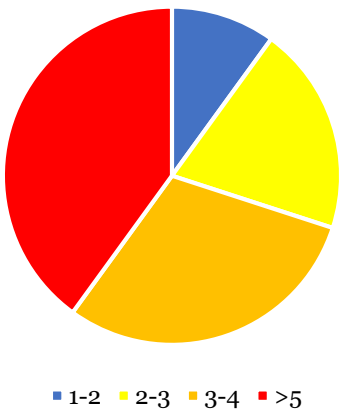
Demographics

The sample is composed by 7 females and 3 males. The age goes from 18 to 62, with a mean of 29,9 years and a standard deviation of 14,6, which indicates that some participants' age is away from the mean. Half of the participants possess a high school degree or equivalent, while three of them have a master's degree. Four people are Swiss, the other nationalities are: two Spanish, two Peruvian, an Indian and an Italian.

Smartphone usage

In the first part of the survey we asked questions concerning smartphone usage. The first chart pie shows the results of smartphone usage every day (in hours). The following tables show results on the rank of the most used applications and the three smartphone personalities.

Chart 1 | Smartphone usage (in hours)



Only 2/10 checked the data usage in their phone, the others said that the number of hours is their own estimation.

Table 1 | Three most used applications

	Social Media	IM apps	E-mails	Games	Functionalities	Others
1st used	4	3	0	2	0	1
2nd used	4	4	2	0	0	0
3rd used	1	2	2	5	0	0

n = 10

Table 2 | Three smartphone personalities

	Not at all like me	Quite like me	Somewhat like me	Very much like me
Heavy user	1	3	2	4
Normal user	0	5	4	1
Light user	5	2	2	1

n = 10

Measure of smartphone addiction

In *section 5* we selected 10 items of the Smartphone Addiction Scale in order to understand if our participants are possibly smartphone addicted. Here there are the numeric results on each specific item, which are also translated into a visual form; a sum of the Likert frequencies is illustrated in the first chart, whereas the last one concerns the self-precepted addiction.

Table 3 | Smartphone addiction

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Having hard time concentrating on a specific activity due to smartphone use	0	1	3	5	1
Feeling impatient and fretful when I am not holding my smartphone	0	4	2	3	1
Having my smartphone in my mind even when I am not using it	1	5	1	1	2
Feeling depressed, anxious, or oversensitive when I am not able to use my smartphone	1	6	0	1	2
Feeling bored while doing other stuff without my smartphone	3	4	2	1	0
Checking SNS (Facebook, Instagram, twitter, …) right after waking up	3	0	2	2	3
Having used my smartphone when I am not supposed to (class, work, during activity)	0	1	3	2	4
Using my smartphone longer than I had intended	0	0	0	6	4
Feeling the urge to use my smartphone again right after I stopped using it	1	2	3	2	2
Always thinking that I should shorten my smartphone use time	0	0	1	4	5
I feel that I am addicted to my smartphone	1	1	2	3	3

n = 10

Chart 2 | Smartphone addiction graph

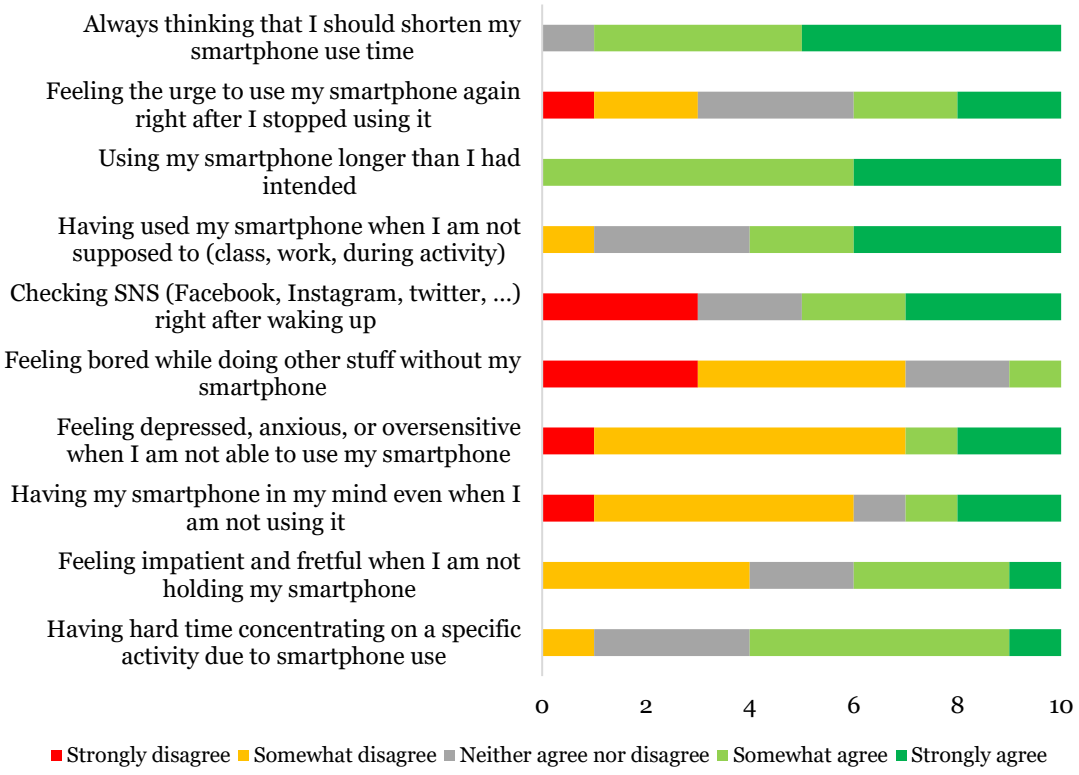


Chart 3 | SAS sum frequency

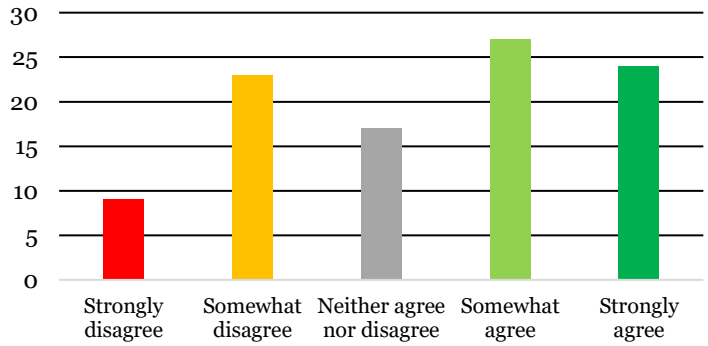
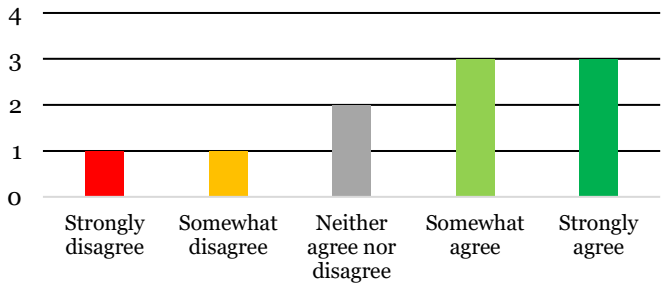


Chart 4 | Self reported addiction



Experiment result

Results on our experiment are illustrated in the following way: a table of frequency related to the alert modality used by our participants; then there is the most relevant table for H1 in which we see the quantification of distraction per each movie; the total number of received alerts (including the staged ones); how many people used their phone while watching the movies; a percentage of usage compared to the movie length multiplied by the sample size; all the answers about the relationship between the sender and the receiver and the type of setting.

Table 4 | Notifications modality

	Frequency
Visual + vibration notifications	1
Sound + vibration notifications	1
Only visual notifications	5
Only vibration notifications	3

n = 10

Table 5 | Number of people distracted per type of notifications

	WhatsApp	Social media	SM +WhatsApp	No distraction
Modern Educayshun	1/10	0/10	1/10	8/10
The Answers	1/10	0/10	1/10	8/10

n° of staged distraction per type of notification = 1
n = 10

Two people received other notifications during *Modern Educayshun* and four people received more than two notifications during *The Answers*.

Table 6 | Other notifications

	Yes	No
Modern Educayshun	2	8
The Answers	4	6

n = 10

The total number of notifications (staged and non-staged) received during *Modern Educayshun* is 22 notifications, whereas for *The Answers* corresponds to 25 notifications. Therefore, during the 14,6 minutes all participants together received only 7 notifications spontaneously, apart from the 40 staged notifications.
None of the participants picked up their phone without hearing or seeing a notification.
Only one participant per movie used their smartphone, which was defined as not simply looking at the screen to see what was happening, but being distracted for more than a few seconds.

Table 7 | Phone usage

	Yes	No
Modern Educayshun	1	9
The Answers	1	9

n = 10

Actually, during *Modern Educayshun* the person used her phone for 2 minutes; during *The Answers*, the other person used her phone for 30 seconds, and that occurred during the credit titles. Considering the length sum of each short movie (the length multiplied by the sample size), there was a phone usage corresponding to 0,28% of the *Modern Educayshun* time and 0,07% of *The Answers* time. None of the participants asked to stop the movies in order to see the notifications or to use their phone.

Table 8 | Relationship sender/receiver of notifications

Acquaintance
Niece
friend and sister
Sister
Friends
Mother
Girlfriend and girlfriend's sister
Cousins
Friends
Sisters

n = 10

Table 9 | Experiment setting

Home, on a couch
At home, in the living room. We watched the videos on the TV, together
In the kitchen (participant's house), close to the table
In my room. Sitting in a couch with the computer in front of us positioned in a table
At home (sofa)
We were in the living room. It was dimly lit. The phone was plugged in to charge
On the bed
In the kitchen (sitted on the table)
Comfortable sofa, the computer on my lap and the mobile phone next to her on the sofa
We sat on top of a bed, the laptop on our laps and the mobile phones next to us

n = 10

Results during the full-attention activity

Here are the subjective answers related to the distraction felt during the full-attention activity. Three charts show, in the following order, the amount of: distraction felt during the short movies, activity enjoyment affected by notifications and interruption felt during the activity due to notifications. *Table 11* shows the amount of movie engagement, *table 12* illustrates how many people looked at their phone without being attracted by the alerts. Finally, the emotions felt during the activity are displayed in a table and a graph.

Table 10 | Perceived distraction during activity due to notifications

	Frequency
Yes	3
No	7

n = 10

Chart 5 | Amount of distraction felt during the activity

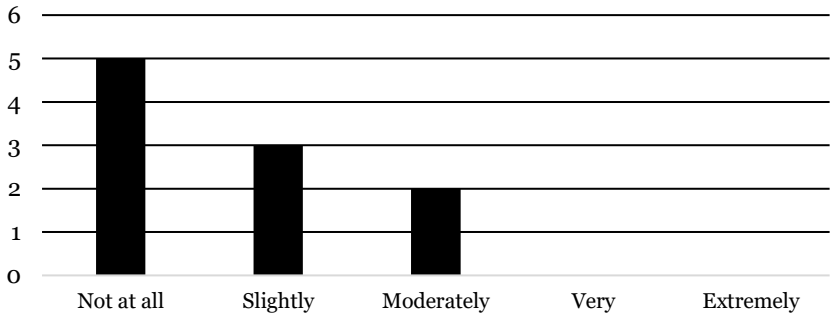


Chart 6 | Amount of activity enjoyment affected by notifications

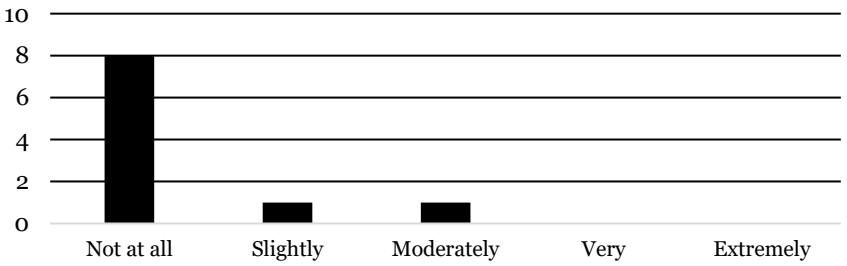
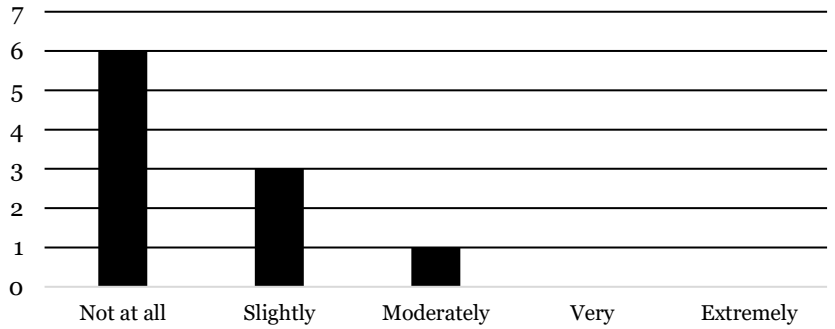


Chart 7 | Amount of interrupution felt during the activity due to notifications



n = 10

Table 11 | Activity engagement

	Not at all	Slightly	Moderately	Very	Extremely
Difficult to stay focused during Modern Educayshun	6	4	0	0	0
Difficult to stay focused during The Answers	6	3	1	0	0
Feeling immersed during Modern Educayshun	1	0	1	4	4
Feeling immersed during The Answers	1	0	1	4	4

n = 10

Table 12 | Check smartphone without notifications stimuli

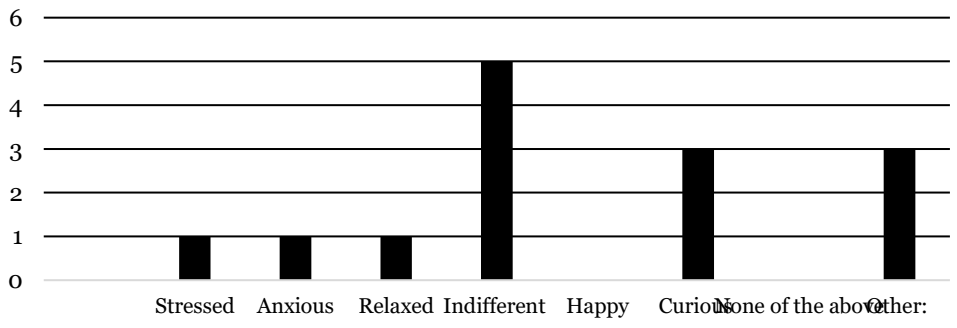
	Frequency
Yes	2
No	8

n = 10

*Table 13 | Feelings towards notifications during activity**

	Frequency
Stressed	1
Anxious	1
Relaxed	1
Indifferent	5
Happy	0
Curious	3
None of the above	0
Other*: * didn't notice/ it's just a habit/I didn't notice the notifications	3

*Chart 8 | Feelings towards notifications during activity**



**multiple answers*

Results on notifications distraction (general)

The following tables show results on the general perception of notifications. *Table 14* is related to the general consideration that alerts are distracting. T*able 15* shows what is the most distracting modality. Then, there are the answers to some notifications distraction statements, the type of solutions used by our participants to be less distracted by alerts (only one did not write something), the first and second most type of received notification (meaning, from which application they come from). *Table 19* relates to the frequency of some behaviour, while *table 20* shows how many people are willing to use an alternative method to notifications. In the end, a table and a graph display the emotions that participants feel toward alerts in general.

Table 14 | General consideration

	Not at all	Slightly	Moderately	Very	Extremely
Notifications are distracting	0	1	4	4	1

n = 10

*Table 15 | Most distracting notification modality**

	Frequency
Sound	7
Visual	2
Vibration	4

**Multiple answers*

Table 16 | Notifications distraction statements

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
When I see a notification, I feel the urge to use my phone	0	2	2	4	2
I can easily avoid using my phone when I see/hear a notification	1	5	1	3	0
I think that notifications can be distracting	0	1	0	4	5
I wish that notifications were not so distracting	0	1	0	5	4
I would like to be less distracted by phone notifications	0	2	0	2	6
In the past I tried to diminish the distracting power of notifications	0	1	1	5	3

n = 10

Table 17 | Solutions to be less distracted by notifications

I mute my phone or keep it at distance from me. Otherwise, I work, since I know I cannot be distracted at work.
I try to flip my phone face down Put my phone on silent mode Set the configuration in a way I only see the name of the sender, but not the message
I disable them. Nothing. I do not care about notifications if I am focused on something.
Nothing
Silent them
-
Turn my phone on the other side, so I don't see the screen. Switch off the sound of notifications. Leave mobile phone in another room

Table 18 | First and second most frequent type of notification

First type	Frequency
Social media	0
IM apps	8
E-mails	1
Games	1
Functionalities	0
Others	0

Second type	Frequency
Social media	4
IM apps	1
E-mails	3
Games	0
Functionalities	2
Others	0

n = 10

Table 19 | Frequency of:

	Never	Rarely	Occasionally	Frequently	Very frequently
Distraction during the day due to notifications	0	1	3	4	2
Distraction during a full-attention activity due to notifications	0	3	4	3	0
Having the smartphone next to them when performing an activity	0	1	2	4	3
Multitasking	0	4	1	3	2

n = 10

Table 20 | Willingness to use an alternative method to notifications

	Frequency
Yes	4
Maybe	5
No	1

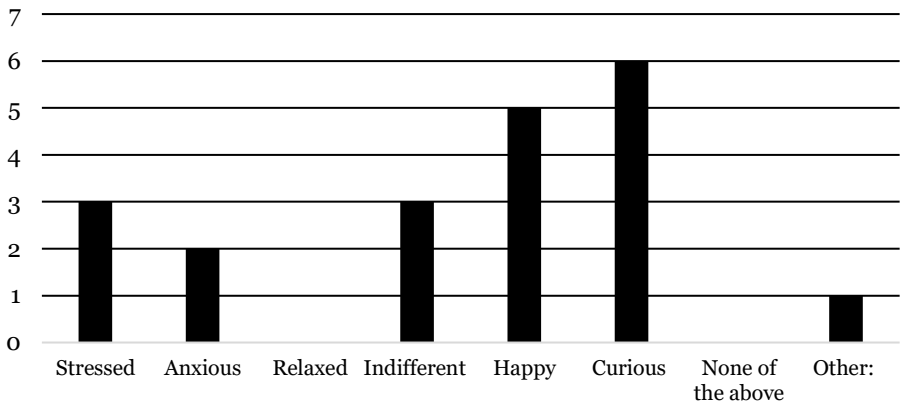
n = 10

*Table 21 | Feelings towards notifications in general**

	Frequency
Stressed	3
Anxious	2
Relaxed	0
Indifferent	3
Happy	5
Curious	6
None of the above	0
Other*:	1

*habit

*Chart 9 | Feelings towards notifications in general**



**Multiple answers*

Calm technology scenarios

In *section 4* of our questionnaire we asked some questions concerning the willingness to use two examples of calm technology, their perceived usability, and whether they could be a possible alternative to normal notifications. Here are the results for Calm Screen and Calm Tag, followed by suggestions of improvement made by some participants.

Table 22 | Calm Screen evaluation

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I think I would like to use Calm Screen in the future	0	1	5	3	1
I think Calm Screen will be easy to use	0	2	1	3	4
I think that most people will understand how to use Calm Screen very quickly	0	2	3	2	3
I think that Calm Screen is less intrusive than normal smartphone notification	1	1	0	8	0
If I had this technology, I think I would be less distracted from my phone	1	1	3	5	0

n = 10

*Suggestions of Calm Screen improvements**

- I would like to know how to set important notifications through an AI system. Precisely, I would like to know how easy it can be, since I am not a digital native, though I like new technologies.
- Maybe there should be a way to personalize what type of things the AI consider important.
- Low light intensity, neutral background
- I think the sound of the notification and the velocity with which it appears are quite "calm", but having it projected in a big screen in a room makes you even more aware that you have a notification.

**open question*

Table 23 | Calm Tag evaluation

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I think I would like to use Calm Tag in the future	2	2	3	3	0
I think Calm Tag will be easy to use	0	1	1	7	1
I think that most people will understand how to use Calm Tag very quickly	0	1	3	4	2
I think that Calm Tag is less intrusive than normal smartphone notification	0	2	4	3	1
If I had this technology, I think I would be less distracted from my phone	0	3	2	4	1

n = 10

*Suggestions of Calm Screen improvements**

- I would like to have the possibility to quickly answer important notifications (that might need important/quick reply) through this calm technology (ex. through pre-existing short sentences like "I understand"; "I will let you know later"; "I can't talk now" etc.). This way, I wouldn't need to pick my phone.
- About Calm Tag: useless if connected to mobile phone through Bluetooth. Moreover, smartwatches already have some similar features (vibration/led for notifications)
- I don't like having to add an extra device. Maybe it could be incorporated to the mobile phone itself

*open question

Discussion

Explanation of participant recruitment

We recruited all the couples through direct contact online (on WhatsApp and social media) and in some case also in person. In a first moment we decided to find them by using a purposive sampling, but when we saw that it was not working, we decided for a convenience sampling. This was surely one of the best solutions during COVID-19 times because the study involves being part of an experiment, which requires a certain level of commitment and looking for experiments in a less direct way would have been complicated. In order to collect the experimenters we sent distributed a flyer (*attachment 1*) in which it was written "Do you live with someone who frequently uses their phone?"; this could constitute a bias in the selection, since the sample does not represent the general population, but it is composed only by heavy phone users. However, since we had a direct contact with the experimenters, we understood that they did not select people who frequently use their phone, but they chose people who have a "normal use" of them or they were not fully aware of the usage frequency (whether this is the reality or not, it could be seen from their answers).
During the 18 days of data collection, we reached 20 people that were interested on being experimenters, 9 of them decided to take part of the experiment, each bringing a participant on their own, and we conducted the experiment on 2 additional participants. The total number of couples were 11, however we had to exclude one couple from the analysis because the participant is outside of the reference sample, since during the experiment he did not receive any notification.
It is interesting to know the behaviour towards the excluded participant's phone since it gave us a different perspective from the smartphone addiction presented in the literature review; he explained to us that almost all push notifications in his phone are off, and he only checks social media and WhatsApp a few times per week. Mainly, he is reachable only via SMS and calls meaning that he is almost never distracted by notifications, if he uses the smartphone it is because he actively wants to do it. Finally, he said to be distracted while watching movies, but for other reasons than smartphone distraction.

Experiment and survey

By analysing different factors in the experiment and the survey filled out by the participants, we can have some insight and partially answer to the research question: *"How do people react when they receive smartphone notifications during a full-attention activity, i.e. watching audio-visual content, and could calm technology positively affect their reactions?"*.
A relevant aspect of this study is that data were collected in a natural-social setting, by observing people who acted normally while watching audio visual content. By doing so there should be no interference from social desirability; it could be that in a laboratory experiment people are more aware of the real aim of the experiment, and being a possible smartphone addict is not something that people are proud of. The natural settings are all in a home environment: on a couch in the living room, in the bedroom or in the kitchen.

Experiment results

The preferred modality by half of the participants while watching the two short movies is visual notifications that appear in the drawer; then the second most used is vibration and only one person had sound notification activated. We do not know if the modality used during the experiment corresponds to their preferred modality in general. As seen in Pielot et al. study (2014) people usually

disable sounds, but not alerts; however, in their results only 12,2% received the notifications in the silent mode, whereas for us the percentage is higher (50%). There are more contrasting findings related to notifications' modality: in Mehrotra et al. experiment the seen time is statistically significantly higher for silent notifications, but for Pielot et al. people can escape the effect of notifications even when the phone is silent. Our results are more consistent with the Pielot et al. findings. In any case, the modality can be affected by the position of the device (the smartphone could be in sight, in the pocket, a few meters from the user). In our situation, we asked the experimenter to make sure that the phone was next to the laptop and with the screen up, therefore every possible modality could be perceived by the participant.

We hypothesized that notifications have a strong distracting effect when watching audio-visual content (Hypothesis 1), however that did not occur in our experiment. While watching the two short movies, the majority of people were not distracted by notifications. In fact, distractions happened two times for each movie and, in any case, they are not particularly relevant since when we sum the movies' time, distractions correspond to 0,28% of the *Modern Educayshun* time and 0,07% of *The Answers* time; we can pressure that most people probably enjoyed the movies. Only one person seemed particularly distracted; she picked up the phone when receiving all the 4 staged notifications and she used her phone for 2 minutes. Interestingly, she is the person having the combination with sound and visual notification. Taking in mind that 5/10 people received the alerts only through visual modality, it is not clear whether they have noticed all the staged and non-staged alerts or they saw them, but they decided to ignore them.
In some cases, we know that people gave a quick look to the screen when it was in silent mode; this is a micro interaction since it lasted less than four seconds to initiate and complete; as said by Ashbrook, microinteactions with a device may minimize interruptions, they allow for a tiny moment of interaction and then the user can quickly go back to the task. Therefore, they cannot be considered as real distractions, in reality they can be a solution to them; attention in mobile situation broke into bursts of four to eight seconds and some researchers suggested to designers to put effort to shorten interaction units (Ashbrook, 2010). Alerts are displayed in the notification drawer, and in most cases they display at least the name of the sender and the application from where they come from; reading this little amount of information, at the precise moment when the person receives the alert, should not require more than 4 seconds per notification.
None of the participants decided to interrupt the films' view in order to interact with their smartphone. A signal of interruption means that the person does not want to perform multitasking, but this was not necessary since they did not feel really distracted.
One of the most logical interpretation of the low amount of distraction could be linked with the perceived movie quality as expressed in the data. It could be that the more people enjoy a certain audio-visual content, the less they are distracted by phone notifications. The ongoing task does certainly play a role into notifications view time (Mehrotra et al., 2016). However, we cannot say if this is the real reason because the sample size is not sufficiently large to observe significant patterns in rating of the movies and susceptibility to distraction. A second reason, more plausible, can be found in the experimental conditions. Probably 15 minutes were not enough to see a relevant effect of notifications distractions. However, there probably are other and multiple reasons that can explain this result, some of which are also mentioned below in the *Future Research* section.

Based on earlier work there are three factors that can influence the fast time responses, which are the expectations of a reply, the time-critical communication, and the relationship between the sender/receiver (Pielot et al., 2014); it could be that these drivers, especially the time-critical communication (they were busy with something that required their full-attention) contributed to the absence of an observed fast or immediate reply.

Moreover, regarding notifications acceptance, users usually tolerate them when they are free, when they consider the sender as important and when the content is useful. Contrary, if they do not contain important information, they tend to avoid attending to them (Mehrotra et al., 2016). Our participants were busy with their mind during the short movies; perhaps the fact that they had to be focused on something was enough to avoid alerts, even if they came from important senders (e.g. family members, partners).

In total, people received 22 notifications during *Modern Educyshun* and 25 notifications during *The Answers*. They received 7 non-staged notifications, which is too low a number to be likely relevant. Stothart et al. (2015) found that people have a disrupted performance on an attention-demanding task due to notifications, even when participants did not directly interact with the smartphone. And Pielot et al. (2014) stated that people frequently check their phone even when it is in silent mode. Finally, in our experiment none of the participants frequently checked their smartphone and they generally did not seem to care about notifications. When we compare the data collected by the experimenters with the self-perceived distraction questions in *section 2* on our survey, we can say that the results are mostly aligned: people did not feel distracted by alerts while watching the two short movies. However, there is an experiment's result that do not correspond with the results on the question "Did you check your phone even if you didn't see/hear a notification?". In the survey two people said that they checked their phone without the notification stimuli, whereas in the experiment none of the experimenters said that their participant used their phone without seeing the alert on the screen Perhaps, this result occurred since they mis-interpreted the question, otherwise some experimenters were not fully attentive, which is a risk to take into consideration when we have less experimental control.

Questionnaire answers: distractions felt during the activity VS distraction in general

Mainly, when we look at the subjective answers, we see that people really did not feel distracted during the short *movies*. 7/10 people said that they did not really feel distracted and 5 of them answered they were not distracted at all. Eight people completely enjoyed the full-attention activity and none of their enjoyment was significantly affected by notifications. Six participants did not feel interrupted by alerts, while three of them felt slightly and one moderately interrupted. If we compare the three histograms, we see that none of them answered to the "very" and "extremely" values, thus responses are positioned above all in the first part of the graphs.

When we look at the activity engagement, we can say that they seem to like what they were seeing. We have responses positioned in the first part of the scale (at least 9 of them) for the negative measure "difficulty to focus on the movie"; whereas we find results on the second part of the scale for the positive measure "feel immersed in the movie" (at least 8 of them). The quality is rated high by most people: *Modern Educayshun* received 5 "above average" and 2 "excellent"; if we translate the result in a numeric form, we obtain 3,7/5, which demonstrates that the first short movie was appreciated. The result is even better for *The Answers*: 3 "above average" and 4 "excellent" for a mean of 4,1/5. We are not sure whether the positive engagement significantly influenced the "distraction variable", but it may have played a role in it.

Half of the participants felt indifferent towards alerts; some of them wrote that they did not notice notifications, or they did not care since "it's just a habit". The other emotions were mostly positive: 3 were curious and one was also relaxed. By analysing the answer to the question "How did you feel with respect to the notifications you saw/heard, during the activity? (you can have multiple answers)" we see that one person felt anxious, stressed and curious, and, in fact it is corresponds to the one who was the most distracted during the full-attention activity.

What can be said about the general perception of smartphone alerts? The results in the third part of the survey gave us interesting insights.
One person thinks that notifications are only slightly distracting, the others find them moderately distracting.
Sound alert is the most distracting modality (7 occurrences), followed by vibration alert (4 occurrences); perhaps that is why most participants had their phone in the silent mode during the experiment. Apart from switching off the sound, the subjects said to use other ways to be less distracted from alerts in general, e.g. they flip their phone face down, they leave it in another room, or they set the configuration in a way they cannot see the content. The most frequent type of notification for our participants comes from instant messaging apps, while the second type arrives from social media. Pielot et al. stated that IM apps and social media alerts produce a feeling of social pressure, meaning that they are the most distracting (2014); this could be also linked to the higher frequency of them, as Roberts et al. illustrates, most smartphone usage time is spent by texting and this is reflected by the high number of notifications received from these apps (2014). It seems that our participants are subject to such social pressure since alerts from social apps are the most prevalent.

We explained that 9/10 participants did not feel any negative emotion toward notifications while watching the short movies. Does it apply to notifications in general? Actually, there are more occurrences in the negative emotions (3 for "stressed" and 2 for "anxious") and less people feel indifferent, with a decrease from 5 to 3. Interestingly, there is an increase also in the positive emotions, with 5 "happy" and 6 "curious" values. Alerts seem to produce mixed feelings. As Walsh et al. said, smartphones have psychological benefits thus they produce positive emotions (2008); on the other hand they develop the feeling of being distracted, anxious, stressed (Rauch, 2018). Negative emotions increase with the volume of alerts, even when they are not relevant to the receiver (Pielot et al., 2014) and especially if they come from social apps. It could be that the number of alerts (4 staged in 15 minutes) during the experiment was not perceived as high since people felt mostly indifferent. Still, it is complicated to know the threshold between the amount of notifications that is perceived as "not much" and "too much". A study on this specific subject should be done.

What is the perception of notifications? By looking at the results in the table "Notification distraction statements" (p.32), we see that nine people think that notifications can be distracting, and they wish they were not so. 8/10 tried to diminish this distracting power. When they see an alert, 6/10 feel the urge to use the smartphone, while two somewhat disagree on that. Seven participants said that they cannot easily avoid using the phone when they see or hear a notification, but three of them somewhat agree that it is not so difficult. Finally, eight people at least somewhat agree on the fact that they would like to be less distracted by alerts, whereas two of them are not particularly interested on it. In broad terms we can state that notifications have a distracting power and people try to be less distracted from them, as showed in the solution applied by some of the participants.

We asked in the survey some questions related to the frequency of certain behaviour during a full-attention activity. The notification's distraction occurs rarely (3), occasionally (4) and frequently (3) during an activity that requires attention; it means that people can partially control the distraction power when their mind is busy with something else, although most of them (7/10) have their phone on the side at least frequently. On the contrary, Stothart et al. found that cellular notifications, even when one does not interact with the phone, can significantly damage performance on an attention-demanding task (2015). The responses on multitasking are contrasting, since four people said to perform it rarely, while five do it frequently or very frequently.

Questionnaire answers: Calm Screen and Calm Tag perception

Before commenting on the calm technology scenarios' results, we saw that there is a partial certainty in wanting an alternative method to notifications, since 5 said they may be interested in it, and 4 were willing to use it. Regarding whether calm technology is a possible solution to mitigate smartphone distraction during a full-attention activity (Hypothesis 2), it seems that both Calm Screen and Calm Tag are perceived positively, even if there is not a strong predisposition towards them.
The acceptance of usage, if they were fully developed technologies, seems relatively high for Calm Screen (3,7/5 in numerical values), while it is not as good for Calm Tag (2,7/5). However, both scored good in terms of estimated usability (second and third questions); the functioning of Calm Tag was as well understood as for Calm Screen since the both obtained a mean of 3,75/5.
More research is needed into what the best alternatives could be to notifications as we know them now (question 4 and 5). These results are not enough to say if the calm technology scenarios proposed by us are a possible solution to mitigate the distraction power of notifications. Results do not appear as clear (see calm technology scenarios results section, pages 34-35), and this is mostly due to the small sample size.

When graphically and conceptually designing them, we followed some of Peterson instructions on calm technology. These technologies are perceived at a quick glance: to see the content of Calm Screen, people only have to quickly look on the wall; Calm Tag can be easily heard since it is a small device that is positioned next to the user. Then, they should be integrated in the environment and be aesthetic: Calm Screen is a rectangular semi-transparent screen that can be seen as part of the wall; Calm Tag is integrated and aesthetic in the sense it is a handy small device that the user do not even really notice if it is not in use. However, there is a relevant difference between them. While Calm Tag can be perceived in the periphery of attention, Calm Screen uses two sensory modality that can conflict with the activity of watching an audio-visual content. Thus, Calm Screen does not involve the periphery of attention, but it can be seen as a calm technology because it calms the interaction by reducing it and making it smoother and less intrusive.

Some participants gave some small suggestions of improvements; for Calm Screen they would like to know how the important notifications are selected by AI, they want also a manual selection of what is relevant. One of them said that having a big screen in a room does make people more aware that they receive a notification, and in fact it is the person who negatively evaluate this calm technology. The comment for Calm Tag are: they wanted the possibility to quickly answer to the important notifications; one thinks that Calm Tag is not very useful if it is connected through Bluetooth and it is similar to already existing technologies (e.g. smartwatches), another explained that she would not like to have an extra device, and Calm Tag functionalities could be integrated in the smartphone. Without doubts, we need more information how to improve these – and other – potential workable calm technology.

Conclusion

With this study we wanted to see how do people react when they receive smartphone notifications during a full-attention activity. In the case of our experiment, there was not a strong reaction to them. The main conclusions of this study are that the majority of people were not much distracted by smartphone notifications during the experiment, and they seem to have enjoyed the 15-minute full-attention activity. One possible explanation is that notifications could not be very distracting when the audio-visual content is short and attractive as it was in our experiment. In the follow-up

questionnaire, however, we saw that generally notifications are perceived as distracting and people try to reduce their negative impact. Here too no hard conclusions can be drawn due to the limited sample size (n=10) of this study.

Are they "simply" generally distracted by smartphones or are they addicted to this device? When we look at their positions on the 10 selected SAS points, results are contrasting because only in some items there is a prevalence of somewhat/strongly disagree. On average, our participants seem to some degree addicted to smartphones, but not very addicted. Interesting results are found in "always thinking that I should shorten my smartphone use time" (9/10 at least somewhat agreeing) and "using my smartphone longer than intended" (all at least somewhat agreeing). This is in conformity with Zhang et al. addiction characteristic of substantial increase in the time spent using them and failure to reduce or stop the overuse (2017) and the loss of tolerance since it is difficult to control mobile use (Walsh et al., 2008). Scores are low when there are statements more related to emotions (e.g. feeling bored, depressed, anxious, oversensitive when not using the phone or feeling impatient and fretful when not holding it). It could be that participants are not so emotionally attached to them. If we compare SAS results with their self-perception of addiction, they seem to perceive themselves as more addicted since three of them somewhat agree and three strongly agree on "I feel that I am addicted to my smartphone"; only one person strongly disagree on that statement. The difference is visible in the SAS values sum and own estimation of addiction histograms. Undoubtedly, their use is high or very high: four people use their smartphone for more than 5 hours a day, while three of them between 3 and 4 hours. However, this does not have to be connected to addiction, since people may need to use their phone for "valid reasons" e.g. for their job.
Regarding *H2*, participants seemed partly favourable to consider Calm Screen and Calm Tag as a solution to mitigate notifications' distraction. In any case we do not see a high predisposition to use them; some of the participants were in doubt ("neither agree nor disagree") whether to use them or not, or if they would be less distracted from their phone. Results appear to be scattered for some points; this is probably due to the low participants number and the limited degree to which the technologies were currently worked out. It is still not clear if calm technology is a valid method to diminish notifications' distraction, but from our study we can see that it could be a possible valid direction. New studies with fully developed calm technology prototypes should be done to better clarify the use of these technologies in the field of alerts.

Our study will be useful for the setup of future experiments in the area of smartphone addiction and distraction, as discussed in the next and final section.

Limitations and recommendations for future research

There are several limitations in the present study. The following considerations are useful for future experiments and researches that will focus on similar topics. We can all agree that smartphones exert a certain degree of control in our lives, and that is because they became increasingly relevant in numerous aspects, we actually live in a technology-pervasive world. The problem occurs when usage becomes be damaging, and previous work has linked such damage to notifications. How can we reduce their distractive power? Future research is needed to address this further. For instance, we should add insight on the reasons that bring us to use our phone, instead of fully enjoy the activity we are performing.
Our study gave some insight, but as stated previously the collection time was short, and we could not have enough responses to reach a significant number. We can consider it as a preliminary study, or

an initial exploration of the issue that could be useful to set future experiments. Certainly, a positive aspect is the natural setting, the less the participants are aware of the experimenter's intention, the better; we would suggest to avoid laboratory settings and to do it in first person without involving other "experimenters" since it is complicated to find people willing to perform this task, and furthermore we cannot check if they meet the experimental conditions. We want to emphasise once more that we used this strategy since it was the best solution during the coronavirus pandemic.
Other suggestions to improve design of (large-scale) studies on smartphones and notifications include more precise diversification of the interactions. In our case we defined distraction when participants picked up their phone to see what was happening, since the entire interaction should take more than 4 seconds; otherwise it was considered a microinteraction. However, there are best possible ways to define and frame more precisely what is a distraction when we are performing an activity. We would suggest defining several thresholds from which distraction has an impact on the primary task. Concerning the experimental conditions, the experiment should be longer since 15 minutes did not seem enough to show the potential distraction power of notifications. More staged notifications are needed, it may be that 4 alerts in 15 minutes are not enough. During the experiment the participant should be completely alone; after the experiment I contacted some of the participants and they said that normally they are more distracted when they are watching something on their own It would be interesting to know how the amount of distraction is influenced by having someone next to us.
The selection effect should be avoided so we can exclude that the results the participants selections have an impact in the conclusion validity; the sampling should also take place in probabilistic way.
As stated by Pielot et al. and Mehrotra et al., new studies are required to investigate the effects of notifications in our everyday life and the factors influencing the user's receptivity to notifications. It is important that researchers ensure that the planned data collection will be meaningful, serve its intended purpose of seeing the distractions due to alerts and follow the principles of a well-designed experiment as possible.
Further studies are also necessary to better understand if calm technology is an effective application to mitigate the distractive power of alerts, or even to smartphone in general. Very useful could be to develop a prototype of one specific calm technology and test specific aspects via actual interaction with it.
Finally, it will be interesting to perform experiments by using different full-attention activities, differentiating them in their level of attention required and different sensory modalities; for instance watching audio-visual content (a film or 2-3 tv series episodes), reading (a book, a magazine), cooking and so on. Another direction could be to focus only on audio-visual content and see if during movies smartphone is the only device that distract (and is the most distracting) or whether there are other, perhaps equally important, reasons of inattention.

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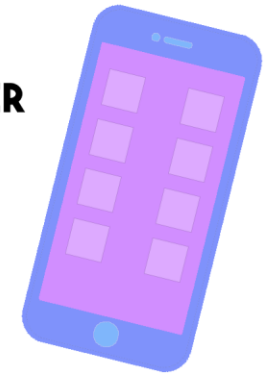
Attachments

Attachment 1: experimenters' collection flyer

DO YOU LIVE WITH SOMEONE WHO FREQUENTLY USES THEIR PHONE?



YOU CAN BE A SCIENCE EXPERIMENTER IN COVID- 19 TIMES!

Write an e-mail to:

francysavo@hotmail.it

saying that you want to participate to my experiment.
I will reply by sending you the instructions.
IMPORTANT: don't tell the other person about it yet!
You will receive instructions first.

What do you have to do?
Watch two very short movies with your participant and take some notes.

What will you win?
You help me to collect data for my thesis and will participate to a prize draw consisting of 20 euros + 5 selected Swiss chocolate bars.

Thank you! :)

Francesca

Attachment 2: experimenter report

NOTIFICATIONS STUDY REPORT

Leiden University
Master thesis in Media Technology
2019/2020

Smartphone notifications report

Dear experimenter, this is the report that contains all the info you need to collect during the experiment. Remember to be ready to follow the instructions before playing the short movies, e.g. if you selected a third person to interact with your participant, make sure s/he is available while you are watching the videos.
When you are ready play the first short movie "Modern Educayshun" on your computer.

At minute 2:00:
make sure that your participant receives a WhatsApp notification
At minute 5:00:
make sure that your participant receives a Social media notification (Facebook, Instagram, Twitter, Tumblr, ...)

After the end of "Modern Educayshun" complete the next information:

Type of notifications received (you can have multiple answers)
Put an "X" on the box/es

	Sound notifications
	Visual notifications
	Vibration notifications

Your participant was distracted by (distracted means that s/he picked up the phone to see the notification)

	WhatsApp notification
	Social media notification
	None of them

Did the person receive other notifications during "Modern Educayshun" apart from the ones setted by you?

	Yes
	No

What is the total number of notifications received during “Modern Educayshun”?

Times that the person pick up his/her phone without hearing or seeing a notification
(if that did not occur write “0”)

Did the person use his/her phone? Meaning that he/she took the phone to read messages, reply to them, use social media, play a game and so on?

	Yes
	No

If the answer to the previous question is “yes”, for how long did the person was completely distracted because he/she was using the smartphone? (this is your approximation; you don’t have to count the time)

	minutes

Did the person ask you to stop the movie in order to see the notifications and use his/her phone?

	Yes
	No

When you are ready play the second short movie “The Answers” on your computer.

At minute 2:00:
make sure that your participant receives a WhatsApp notification
At minute 5:00:
make sure that your participant receives a Social media notification (Facebook, Instagram, Twitter, Tumblr, …)

After the end of “The Answers” complete the next information:

Type of notifications received (you can have multiple answers)
Put an “X” on the box/es

	Sound notifications
	Visual notifications
	Vibration notifications

Your participant was distracted by (distracted means that s/he picked up the phone to see the notification)

	WhatsApp notification
	Social media notification

	None of them

Did the person receive other notifications during “The Answers” apart from the ones setted by you?

	Yes
	No

What is the total number of notifications received during “The Answers”?

Times that the person pick up his/her phone without hearing or seeing a notification
(if that did not occur write “0”)

Did the person use his/her phone? Meaning that he/she took the phone to read messages, reply to them, use social media, play a game and so on?

	Yes
	No

If the answer to the previous question is “yes”, for how long did the person was completely distracted because he/she was using the smartphone? (this is your approximation; you don’t have to count the time)

	minutes

Did the person ask you to stop the movie in order to see the notifications and use his/her phone?

	Yes
	No

General information

Name of the experimenter	
Name of the participant	

What is the relationship between your participant and the sender of the notifications? (if you selected multiple people, specify the relationship for each of them)

Where did you perform the experiment? Describe it in a few words.

Attachment 3: participant questionnaire

Smartphone notifications survey

INTRODUCTION

Dear participant,
Thank you for accepting to take part of my experiment.
I hope you enjoyed seeing the two short movies with your friend/family member. Now you can help me by filling out this questionnaire. Try to do it as soon as possible, so you won't forget how you felt during the movies.

My master research is focused on phone usage and notifications.
I hope you will have fun, it won't last more than 15 minutes.
I recommend using a computer or another device with a medium/big screen.

If you have any questions concerning the questionnaire or you if want to know more about my study write to me: francysavo@hotmail.it.

You will participate to a prize draw that consist of 20 euros + 5 selected Swiss chocolate bars with your experimenter.
The winner will be contacted at the end of July.

All best!

Francesca

SMARTPHONE USAGE QUESTIONS

How many hours per day do you spend on your smartphone?
** if you have an iPhone you can check your phone activity in …*

○	<0.5 hour
○	0.5-1 hour
○	1-2 hours
○	2-3 hours
○	3-4 hours
○	4-5 hours
○	> 5 hours

Is the amount of time your own estimation or did you check the data in your phone?

○	It is my own estimation
○	I checked my data usage in my phone

Out of the six options select **your three most used applications** in your phone and put them in the order from the most to the less used.
(The order from 4 to 6 doesn't really matter).

○	Social media (Facebook, Instagram, Twitter, Tumbler, TikTok, …)
○	Instant messaging apps (WhatsApp, Telegram, WeChat, …)
○	E-mails

○	Games
○	Smartphone functionalities (photos, calendar, settings, …)
○	Others

How much do these statements correspond to your behaviour?

	Not at all like me	*Somewhat like me*	*Quite like me*	*Very much like me*
When I wake up, my phone is always next to me. I begin the day by checking various social media and sending some messages. Then I take my phone everywhere I go and whenever I have a minute to myself, I check whether there are new messages or posts				
I often check my phone during the day, I also try to reply in a reasonable timespan. But I'm not always on my phone and I try not to be too attached to it				
My phone is often in my backpack with the sound switched off. Friends and family sometimes complain that I never pick up				

NOTIFICATIONS FULL-ACTIVITY QUESTIONS
(how they felt during the activity)

First part about the role of notifications on their smartphone distractions.

Did you feel distracted by your phone notifications during the view?

○	Yes
○	No

How much did you feel distracted by phone notifications during the short movies?

	Not at all	*Slightly*	*Moderately*	*Very*	*Extremely*
x					

How would you rate the quality of these short movies?

	Very poor	*Below average*	*Average*	*Above average*	*excellent*
Modern Educayshun					
The Answers					

How much did notifications and your phone affect the enjoyment of the movies?

	Not at all	*Slightly*	*Moderately*	*Very*	*Extremely*
x					

To what extend do you agree on these statements?

	Not at all	*Slightly*	*Moderately*	*Very*	*Extremely*
I found difficult to stay focused while watching Modern Educayshun					
I found difficult to stay focused while watching The Answers					
I was immersed in the movie Modern Educayshun while watching it					
I was immersed in the movie The Answers while watching it					

Did you check your phone even if you didn't see/hear a notification?

○	Yes
○	No

How did you feel with respect to the notifications you saw/heard, during the activity?
(you can have multiple answers)
I felt:

○	Stressed
○	Anxious
○	Relaxed
○	Indifferent
○	Happy
○	Curious
○	None of the above
○	Other:

How much interruption did you feel during the short movies due to the notifications you received?

	Not at all	*Slightly*	*Moderately*	*Very*	*Extremely*
x					

NOTIFICATIONS GENERAL QUESTIONS

To what extent do you consider smartphone notifications to be distracting, in general?

	Not at all	*Slightly*	*Moderately*	*Very*	*Extremely*
x					

To what extent do you agree to these statements?

	Strongly disagree	*Disagree*	*Neither agree nor disagree*	*Agree*	*Strongly agree*
When I see a notification, I feel the urge to use my phone					

I can easily avoid using my phone when I see/hear a notification					
I think that notifications can be distracting					
I wish that notifications were not so distracting					
I would like to be less distracted by phone notifications					
In the past I tried to diminish the distracting power of notifications					

What do you do to be less distracted from phone notifications?
If you don't do anything, write "nothing" in the box

What is the kind of notification that you receive most frequently? (select the first most frequent)

○	Social media (Facebook, Instagram, Twitter, Tumbler, TikTok, ...)
○	Instant messaging apps (WhatsApp, Telegram, WeChat, ...)
○	E-mails
○	Games
○	Smartphone functionalities (photos, calendar, settings, ...)
○	Others

What is the second most frequent kind of notification that you receive?

○	Social media (Facebook, Instagram, Twitter, Tumbler, TikTok, ...)
○	Instant messaging apps (WhatsApp, Telegram, WeChat, ...)
○	E-mails
○	Games
○	Smartphone functionalities (photos, calendar, setting, ...)
○	Others

How often do you feel distracted by phone notifications during the day?

	Never	*Rarely*	*Occasionally*	*Frequently*	*Very frequently*
x					

How often do you feel distracted by phone notifications while doing something that requires full attention (school, work, reading a book, watching a movie)?

	Never	*Rarely*	*Occasionally*	*Frequently*	*Very frequently*
x					

How do you feel when you receive a notification?
(you can have multiple answers)
I feel:

○	Stressed
○	Anxious
○	Relaxed
○	Indifferent

○	Happy
○	Curious
○	None of the above
○	Other:

What type of notification do you find most distracting?
(you can have multiple answers)

○	Sound notifications
○	Visual notifications
○	Vibration notifications
○	None of them

When performing an activity that requires your attention (at work, school, home), how often is your phone next to you?

	Never	*Rarely*	*Occasionally*	*Frequently*	*Very frequently*
x					

How often do you multitask with your phone (e.g. perform an activity and meanwhile use your phone to reply to messages, emails, use social media, ...) ?

	Never	*Rarely*	*Occasionally*	*Frequently*	*Very frequently*
x					

To what degree does multitasking make you feel:

	Not at all	*Slightly*	*Moderately*	*Very*	*Extremely*
Not focused/distracted					
Stressed					
Satisfied					
Productive					

If there is the possibility, would you use another way (not notifications) to be notified about important things on your phone, that makes you feel less distracted?

○	Yes
○	No

CALM TECHNOLOGY FICTIONAL SCENARIOS

A calm technology is:
"A technology that doesn't attract our attention in an intrusive way. Instead, it requires the smallest amount of attention, it produces calmness and it doesn't stress us"

Fictional scenario 1: Calm Screen

Graphical representation

[Calm Screen video] (available on YouTube)

Scenario
Imagine to be seated on your couch. Then you want to watch a movie on your laptop.

Description
Instead of picking up your phone every time you receive a notification, you can see them on the device on your wall. you will look up to the Calm Screen and with a glance you will know what is happening and you can easily go back to the movie, without being distracted too much. Since it is a calm technology the info will be displayed in the less disturbing way as possible, by generating calming sounds and calming sounds and calming graphics.
You can modify the settings and you have different options available, for example:

- Quiet mode: when there is a new notification the device shows it on the screen only if it is important. Calm Screen can distinguish between a notification that you could want to see immediately or a notification that is not urgent by using an AI system. This is the calmest option since you can enjoy your movie without being interrupted, if not necessary.
- If you have guests, you can decide if the device should show the content of the notification, or you can change the privacy by using the voice or tactile activated system.

To what extent do you agree to these statements?

	Strongly disagree	*Disagree*	*Neither agree nor disagree*	*Agree*	*Strongly agree*
I think I would like to use Calm Screen in the future					
I think that Calm Screen will be easy to use					
I think that most people will understand how to use Calm Screen very quickly					
I think that Calm Screen is less intrusive than normal smartphone notifications					

If I had this technology, I think I would be less distracted from my phone					

Is there anything that you would like to see and use in this technology? What would you add?

Fictional scenario 2: Calm Tag

Graphical representation

[Calm Screen video] (available on YouTube)

Scenario
Imagine to be seated on your couch. Then you want to watch a movie on your laptop.

Description
Calm Tag is a very small device that you can bring everywhere you want, e.g. you can put it in your pocket or just leave it next to you. You don't need to have your phone by your side when you are watching a movie or doing another activity because this device will let you know if there are new notifications through different calm sounds. Distracting notifications will be avoided since you won't see them.
When you receive a notification, you can also decide to hear the content by vocally controlling the tag. If the content is visual, Calm Tag will say it to you (e.g. "you received an image from X person").
Calm Tag is able to "talk" with you by using speakers and speech recognition.
Calm Tag can detect when you receive something relevant by using a developed AI system, it won't disturb you if it's not necessary. Therefore, if Calm Tag is at your side, it could reduce your smartphone use.
If you want, you can switch between different modalities (a light that starts to flash only when there is an important notification, different calm sounds, small vibrations, …).

To what extent do you agree to these statements?

	Strongly disagree	*Disagree*	*Neither agree nor disagree*	*Agree*	*Strongly agree*
I think I would like to use Calm Tag in the future					

I think that Calm Tag will be easy to use					
I think that most people will understand how to use Calm Tag very quickly					
I think that Calm Tag is less intrusive than normal smartphone notifications					
If I had this technology, I think I would be less distracted from my phone					

Is there anything that you would like to see and use in this technology? What would you add?

ADDICTION QUESTIONNAIRE

To what extend do these statements correspond to you?

	Strongly disagree	*Disagree*	*Neither agree nor disagree*	*Agree*	*Strongly agree*
Having hard time concentrating on a specific activity due to smartphone use					
Feeling impatient and fretful when I am not holding my smartphone					
Having my smartphone in my mind even when I am not using it					
Feeling depressed, anxious, or oversensitive when I am not able to use my smartphone					
Feeling bored while doing other stuff without my smartphone					
Checking SNS (Facebook, Instagram, twitter, …) right after waking up					
Having used my smartphone when I am not supposed to (class, work, during activity)					
Using my smartphone longer than I had intended					
Feeling the urge to use my smartphone again right after I stopped using it					
Always thinking that I should shorten my smartphone use time					

Self-reported addiction

	Strongly disagree	*Disagree*	*Neither agree nor disagree*	*Agree*	*Strongly agree*
I feel that I am addicted to my smartphone					

SOCIO-DEMOGRAPHIC QUESTIONS

Are you a:

○	Male
○	Female
○	Prefer not to say

Your age:

What is the highest degree or level of school you have completed?

○	Less than a high school
○	High school degree or equivalent
○	Bachelor's degree
○	Master's degree
○	Doctorate

Which national identity do affiliate most with?
