Thinking and Feeling through Mobile Media and Communication: A Review of Cognitive and Affective Implications

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Abstract

In recent decades, mobile media and communication have become integral to human psychology, including how people think and feel. Although the popular press, parents, and educators often voice concerns about the integration of mobile media into everyday life (e.g., "smartphone addiction"), the growing body of scholarship in this area offers a mix of positive, negative, and conditional effects of mobile media use. This review article traverses this variegated scholarship by assembling cognitive and affective implications of mobile media and communication. It identifies information processing, offloading, spatial cognition, habit, attention, and phantom vibrations as cognitive themes, and feelings of pleasure, stress/anxiety, safety/security, connectedness, and control as affective themes. Along the way, it helps bring structure to this growing and interdisciplinary area of scholarship, ground psychological work on mobile media in theorizing on technological embedding, inform academic and public debates, and identify opportunities for future research.

Highlights

- Mobile media are uniquely interwoven into everyday life, with implications for how we think and feel.
- A review was conducted on the cognitive and affective implications of mobile media.
- Cognitive themes include information processing, offloading, spatial cognition, habit (vs. addiction), attention, and phantom vibrations.
- Affective themes include pleasure, stress and anxiety, feeling safe and secure, feeling connected, and feeling in control.
- These themes organize current research, spur future work, and support theorizing on psychological embedding of mobile media.
- Academics must consider the different uses and unique impacts of mobile media.
- The public should be aware of the multivalenced yet broad scope of mobile media.

Content

In the past three decades, mobile media and communication (MMC) have become fundamental to daily life (Ling, 2004, 2008). Unlike other media, MMC allow people to weave the flows of connectivity into everyday moments and movements (de Souza e Silva, 2006; Frith, 2015), such that they can be incorporated into the "the smallest folds of life" (Fortunati, 2002, p. 518). As a result, MMC have captured the attention of scholars, journalists, and citizens alike as they attempt to make sense of rapid technological and social change.

As often occurs in early scholarship on new technology, initial research is somewhat reactionary and disjointed, inviting news media and the public to fill in the gaps (Orben, 2020). Thus, especially for an emerging field of high relevance to the public, literature reviews are formative in setting the agenda for journalists and citizens, as well as future scholarship. For mobile communication, this has been evidenced by literature reviews in a wide array of domains:

cognition (Wilmer et al., 2017), political involvement (Martin, 2014), development (Donner, 2008), health (Chib et al., 2015; Chib & Lin, 2018; Gurman et al., 2012; Harrison et al., 2011; Karger, 2005), relationships (Campbell, 2015), addiction (Billieux, 2012; Goswami & Singh, 2016), method (Taipale & Fortunati, 2014), and theory (Kim et al., 2017), to name just a few.

This article adds to this body of reviews by assembling research on the psychological implications of MMC, particularly for how people think and feel. Our review is justified for several theoretical reasons. First, we focus on the cognitive implications of how people use mobile media, whereas prior reviews on mobile media and cognition (e.g., Wilmer et al., 2017) focused on media multi-tasking and correlates of digital media use. Second, we review affective implications of MMC, while avoiding the clinical approach of pathologizing mobile media use (Billieux, 2012; Goswami & Singh, 2016; see Habit vs. Addiction section). This dual

focus on cognition and affect allows us to more fully understand the psychology of MMC, especially given the interrelations between cognition and affect (Dai & Sternberg, 2004). Third, we review research from communication, psychology, and other fields, in an effort to advance an interdisciplinary understanding of MMC while establishing its roots as a communication phenomenon. Fourth, scholarship on the psychology of MMC has grown and delved into a number of related yet distinct topics. The current review provides a bird's-eye-view of this diverse terrain and charts a course for future research in order to help develop the burgeoning subfield of mobile communication.

This article is also motivated by practical concerns. It arrives at a moment when news media and the public are increasingly questioning the psychological implications of mobile media and digital media more broadly (e.g., *The Social Dilemma*). Our review synthesizes state-of-the-art literature on the cognitive and affective implications of mobile media in order to frame public narratives and debates about the myriad roles of MMC in everyday life.

The article first provides definitions of MMC, cognition, and affect, along with an explanation of the method that guided the review process. It then reviews cognitive and affective implications of MMC. The discussion offers synthesis and interpretation of these themes. Furthermore, it offers theoretical implications, helps inform academic and public debates, and charts next steps in research on MMC.

Definitions and Method

Mobile media refers to devices, services, and content accessed between and beyond places of destination, and mobile communication refers to the social practices enabled by and expressed through them (Campbell, 2015). Papyrus and walking sticks stand out as early examples of innovations that support communication while on-the-go, and citizen's band radio and personal listening devices represent more recent history (Farman, 2012). Although mobile media itself is not new, Ling (2012) pointed out that mobile communication has only recently become embedded into the structure of society as a taken-for-granted resource for connecting with others. This process began with early cell phones and has continued since the smartphone turn. Although these have been the most popular mobile media form factors – and thus represent the majority of articles discussed in the present

review – others today include smart watches, glasses, and other wearables that keep people connected.

We define cognition as "the mental activity of processing information and using that information in judgment" and affect as the "feelings we experience as part of our everyday lives" (Stangor, Jhangiani, & Tarry, 2014, p. 20-1). This approach mirrors classic dual-process theories in social psychology (e.g., Chaiken & Trope, 1999) that are often invoked in communication (e.g., Cooper & Nisbet, 2016) as well as mobile communication (e.g., Kim et al., 2018). Moreover, it reflects growing public debate on the ways that mobile media affect how people think (e.g., Cherry, 2020) and feel (e.g., Cornish, 2017). To be clear, this framework is neither clearcut nor all-encompassing. To the former, the lines demarcating cognition and affect are not absolute (Dai & Sternberg, 2004), and several of the themes naturally involve a mix of cognition and affect. Themes were categorized case-by-case based on whether they lent emphasis to the thinking or feeling side of this review. Moreover, the domain of behavior, often considered alongside affect and cognition as the ABCs of psychology, was not included in the current review because it fell outside of our scope, which entailed a focus on mental processes associated with MMC. To the latter, several themes could have fit better within other domains; these themes were typically retained with an emphasis on cognition or affect. For example, although connectedness may be a social implication of MMC (see Waytz & Gray, 2018), it was treated here as an affective theme (i.e., feeling connected).

The themes emerged from a broad literature review of the cognitive and affective implications of MMC. Initial articles were found using basic keyword searches (e.g., mobile phone, psychology, cognition, affect) in Google Scholar. Further articles were found using additional keyword searches related to emergent themes (e.g., mobile phone, information processing) and by following citation trails and key authors. In total, the first author read over a hundred articles in communication and psychology journals from the last two decades (2000 to 2019, roughly coinciding with the ascendance of the mobile phone and smartphone). Conversations between the first and second author solidified themes emerging from these articles, which were sorted as cognitive or affective. These themes were not exhaustive but rather emergent through our search process.

Our review begins with the cognitive theme of *information processing*, perhaps the most direct mode in which people

think with and through mobile media. We then unpack how MMC is used for *offloading* knowledge, followed by the theme of *spatial cognition*, or how people process spatial information as they use mobile media. The following theme, *habit*, represents one of the most common modes of cognitive processing during mobile media use. The section on cognition concludes with more perceptual themes, including effects on *attention* and the specific case of *phantom vibrations*, which refers to perceptions of the technology beckoning when in fact it is not. Next, we turn to *pleasure* and *stress/anxiety*, which stand out in the literature as primary affective experiences associated with mobile technology. The review then highlights how MMC is used to generate feelings of *safety*, which is especially evident in early work on MMC. Last, we discuss feeling *connected*, an affective correlate of the social dimension of mobile media, as well as feeling in *control*, which also indexes cognitive processes but, at least in the context of MMC, is arguably experienced as a primarily affective phenomenon.

Cognition

The cognitive implications of MMC pertain to how and the extent to which people think during moments of MMC use, as well as the more latent implications associated with the mere possibility for use. Themes reviewed in this section illustrate how MMC offer distinctive uses and consequences for information processing, offloading knowledge, spatial cognition, habit, attention, and phantom vibrations.

Information Processing

First, mobile media use has ramifications for how users engage with and process information. Information access may be more difficult and take more time due to the technological constraints of mobile media. Due to limited screen size, fewer results can appear at one time (Sweeney & Crestani, 2006), meaning mobile users are more likely to rely on the first few results (Kamvar & Baluja, 2006). The keyboard and other interface tools are also smaller and more challenging, contributing to diminished engagement with and organization of information (Dunaway et al., 2018; Kim & Sundar, 2016). Thus, people may alter their information-seeking behavior by using mobile media in a more extractive

(vs. immersive) manner and entering fewer and less complex search terms (Humphreys et al., 2013; Napoli & Obar, 2014).

Another challenge lies in the way the technology is integrated into everyday activities. As noted earlier, MMC characteristically fit into "the smallest folds of life" (Fortunati, 2002, p. 518). Thus, users commonly engage with their mobile devices for short periods of time (Oulasvirta et al., 2012). For example, MMC support "snacking" on news, with users checking multiple times a day in short bursts rather than longer periods (Molyneux, 2018). Although it provides more flexibility for the user, these fleeting sessions may negatively affect one's ability to deeply process information. Further complicating matters, although people could seek out places that support deeper processing, mobile devices are often used in distracting contexts (Vorderer et al., 2016). In sum, MMC appear to suppress deeper information processing in favor of quick and convenient extractions of information.

Offloading

In addition to supporting shorter bursts of information processing, the interwoven nature of MMC distinctively provides planned and spontaneous opportunities for people to offload information, experiences, and memories as they move throughout their daily lives (Boldt & Gilbert, 2019). As smartphones can be used for cognitive offloading in a variety of ways and in a variety of settings, they uniquely enable such practices (Wilmer et al., 2017). Of course, people have been offloading information for some time using media, such as clay tablets, books, calendars, and post-its, not to mention other people, including secretaries, advisors, and spouses (Clark, 2008). However, analog media (and people) can be cumbersome and offer limited amounts of content storage. Smartphones provide anytime access to worlds of information with near-constant connectivity to the Web, maps, contact lists, reminders, and other resources for offloading (Frith, 2015, Ch. 4; Ward, 2013), freeing up cognitive resources to attend to new information and experiences (Storm & Stone, 2015).

Expanded possibilities for offloading, however, do not make cognitive storage obsolete. Encoding information in the brain is essential to provide the schematic foundation for acquiring future knowledge (Ward, 2013). Offloading may also reduce incentives for learning through reassurance

that information will always be available through MMC (Loh & Kanai, 2015). Future learning may be further complicated by challenges in distinguishing between offloaded and encoded information, resulting in people becoming overconfident in their own knowledge and potentially discouraged from future learning (Fisher et al., 2015; Hamilton & Yao, 2018; Ward, 2013). Thus, cognitive offloading is a janus-faced phenomenon that plays out in distinctive ways with MMC. Anytime-anywhere access can make everyday life more convenient; however, it may also dampen motivation to store new information for cognitive retrieval.

Spatial Cognition

One of the main types of information that people offload is spatial information. People offload their mental maps to mobile media, enabling access to information about their immediate surroundings. But these capabilities come with a tradeoff (Frith, 2015), as reliance on mobile navigation hinders familiarity with routes and surrounding geography (Ishikawa, 2019; Willis et al., 2009). GPS use appears to inhibit spatial transformation, or the ability to see places from different perspectives, which impairs navigation ability (Ruginski et al., 2019).

Yet, MMC also open up new spatial possibilities by allowing people to actively connect while on-the-go (de Souza e Silva, 2006; Frith, 2015). This ubiquity of access not only sets mobile communication apart from fixed and portable media; it also restructures the way people orient to space and place (Ling & Campbell, 2009). The constant accessibility of online content and communication interlaces digital content with the physical world, resulting in an integrated "hybrid space" (de Souza e Silva, 2006, p. 272). For example, mobile treasure hunt games encourage spatial exploration by guiding users to collect objects that are both digital (e.g., *Pokémon Go*; Licoppe, 2017) and analog (e.g., Geocaching; Farman, 2012; Gordon & de Souza e Silva, 2011). Unlike traditional computer games where users are stuck behind a screen, mobile games bring people out into public settings as they transform the city into a game board (de Souza e Silva, 2006; Hjorth, 2011). Along with games, a number of other mobile practices contribute to the construction of hybrid space, particularly when the technology is used as locative media while moving about from place to place (Frith, 2015). Thus, the uptake of MMC can displace one's own geographic knowledge and familiarity, but also provide new and unique opportunities to navigate space through locative services.

Habit (vs. Addiction)

It is important to emphasize that the previous themes often occur in a habitual manner. Mobile media are well-situated for the formation and activation of habits, or behaviors done regularly and without awareness (Bargh et al., 1996). A habit yokes a contextual cue to a behavioral outcome and can be triggered without control or intention (Bayer & Campbell, 2012). Whereas other media habits tend to be triggered by a static set of cues, mobile media uniquely support a wide array of technological, spatial, and psychological cues and outcomes that can translate into the acquisition and activation of habits (Bayer et al., 2016; Bayer & LaRose, 2018; Schnauber-Stockmann & Naab, 2019). For example, messaging notifications, a line at the store, and even a funny thought can cue habitual uses of the technology.

Habitual mobile media use has been juxtaposed with immersive use in the literature. Whereas habit involves minimal consciousness, immersion involves high consciousness (Bayer et al., 2016). Although these concepts may seem to reside on opposite ends of the same continuum, studies indicate a positive link between habitual and immersive modes of smartphone use (Bayer et al., 2016; Humphreys et al., 2013). Mobile media use may begin habitually and then become immersive, or habits may interrupt immersive behavior, depending on self-control and other contextual factors (Bayer & LaRose, 2018; Hofmann et al., 2016).

The habitual perspective can be contrasted with frameworks of problematic use (Ross & Bayer, 2021). Users can develop problematic dependencies on MMC as they "become reliant on the gratifications, identity, and support they derive through these media" (Rice & Hagen, 2010, p. 17). Some argue that dependency, when accompanied by loss of control, can lead to mobile phone addiction (Rice & Hagen, 2010), which has been associated with a number of social and psychological problems (Rice et al., 2020). Research in this vein can take on a more clinical approach, involving measures for problematic smartphone use adapted from addiction criteria in other behavioral contexts (Bianchi & Phillips, 2005; Kuss et al., 2018). However, it is important to note that the medical community does not formally recognize

smartphone addiction. Media habits, on the other hand, are well-recognized and pervasive (LaRose, 2010). Furthermore, they may be more manageable to address than addiction, which commonly involves giving up a behavior entirely. Although this debate continues, many scholars recognize that MMC are ripe for habits, and people commonly use MMC in habitual ways.

Attention

We now turn to more perceptual themes of MMC, starting with attention. The allure of mobile media dovetails with theoretical propositions that physical salience, goal relevance, and reward are primary drivers of attention (Anderson, 2016; Corbetta & Shulman, 2002). As a result, users constantly monitor their mobile devices (Pickard-Whitehead, 2020). According to Reinecke and colleagues (2018), attentional monitoring is a reflection of how people orient to MMC in their pursuit to stay continually connected to each other and happenings online. These conditions allow users to be aware of social and informational updates; however, they also widen the possibilities for diminished focus in situations that call for dedicated attention.

Research in this area highlights the potential for mobile media to distract during cognitive tasks, often under frameworks of media multi-tasking (see Wilmer et al., 2017). Ringtones (Clayton et al., 2015) and notifications (Stothart et al., 2015) negatively impact cognitive performance. Further, some studies have identified a "brain drain" effect, where a visible smartphone – even when turned off and face-down – distracts from cognitive tasks (Thornton et al., 2014; Ward et al., 2017). However, this effect has not consistently manifested in subsequent work (Hartmann et al., 2020; Johannes et al., 2018), pointing to a need to better understand the conditions under which it occurs. Interestingly, people in one study self-reported that their smartphone distracted them without displaying reduced performance on the cognitive task (Johannes et al., 2018), suggesting a divide between how mobile media impact perceptions of attention and actual cognitive performance. Ultimately, though, the reviewed literature suggests that MMC capture attention, keeping users in the loop but also shifting their focus from their physical surroundings.

Phantom Vibrations

The second perceptual theme, and the final one in the cognitive portion of this review, is phantom vibrations, which refer to "experiencing ringing and/or vibrations associated with incoming calls and messages, only to find that no call or message had actually registered" (Kruger & Djerf, 2017, p. 360). Phantom vibrations are misguided perceptions that one's technology is beckoning when in fact it is not. Because it centrally entails perception, the phantom vibration is regarded as a cognitive phenomenon in which the brain (mis)interprets signals as incoming calls or messages (Deb, 2015; Rothberg et al., 2010).

Phantom vibrations are widespread, with studies from around the world reporting majorities of participants experiencing them (see Desai et al., 2019). Frequency of and dependency on mobile media use often correlate with experiencing phantom vibrations (Desai et al., 2019; Kruger & Djerf, 2017), and they are also experienced more often by people expecting calls, such as on-duty doctors (Deb, 2015). These findings highlight the importance of broader and situational expectations.

As with the other cognitive themes, phantom vibrations reflect the distinctive implications of MMC for cognitive functioning. They are a manifestation of the pull toward being always accessible via mobile communication (Mazmanian et al., 2013). The fact that a notification can be perceived in the absence of an actual stimulus suggests how deeply these expectations become internalized into the cognitive domain.

Affect

This section switches gears to examine implications of MMC for the affective domain of how people feel. Themes reviewed in this section illustrate how MMC offer distinctive uses and consequences for feelings of pleasure, stress and anxiety, safety and security, connectedness, and control.

Pleasure

One of the primary affective themes in the literature is the extent to which MMC serve as a multi-functional, always-available source of pleasure. Mobile devices and the app

ecology provide myriad opportunities for users to escape negative affective states (e.g., boredom, loneliness, understimulation) in favor of more pleasurable experiences by connecting with others and digital content. Vibrations signaling device activity (Ishitsu & Kubo, 2018) or even the mere possibility of using a smartphone (Hunter et al., 2018; Markowitz et al., 2019) can provide a hedonic lift.

Vincent's (2006, 2010) scholarship shows that enjoyment of mobile media can transcend particular functions. Vincent (2010) noted how the relationships people have with mobile technology are not solely based on the artifact, but rather its overall meaning as a personal resource. This emotional orientation toward the technology may explain some of the pleasure of customizing mobile devices (Katz, 2002; Sugiyama, 2009) and using personal phones in ritualized ways (Ling, 2012; Wirth et al., 2008). Empirically, Melumad and Pham (2020) demonstrated that people experience greater enjoyment when browsing a website on their own smartphone compared to a different one, supporting recent theorizing that distinguishes between utilitarian and personal perceptions of mobile devices (Fullwood et al., 2017; Ross & Bayer, 2021). Although mobile media provide an expanding range of ways for users to seek pleasure, pleasure can also be experienced above and beyond of functionality for those who view the technology through a personal lens.

Some are concerned that MMC may serve as a harmful shortcut in the pursuit of pleasure. People can bypass negative feelings that are necessary for social development and well-being (Turkle, 2015). Mobile media use may also conflict with other sources of pleasure, such as when individuals come to prefer to use the technology over (or during) face-to-face conversations with others (Kushlev et al., 2019). People may experience less pleasure from solitary and social moments when MMC is in the mix.

MMC may contribute to unhappiness in other, more direct ways as well. Excessive use of mobile media may relate to low quality of sleep when it carries over into the bedroom (Hughes & Burke, 2018). MMC can also reduce happiness for those who struggle with compulsive behavior, due to its capacity for habitual use (Samaha & Hawi, 2016; see Habit vs. Addiction above).

In sum, the scholarship on mobile media and pleasure points in numerous directions. The relationship between MMC and pleasure is contingent on who uses the technology, for what purposes, and other aspects of context that condition the experience.

Stress and Anxiety

The inverse of pleasure often relates to feeling stressed and anxious, which reflects another central affective theme in the literature. Stress and anxiety are similar enough to discuss in tandem, but are not synonymous – situations that involve some level of threat give rise to stress, and anxiety emerges as a response to that stress. Using MMC can mitigate stress and anxiety. After a stressful incident, people who use their mobile devices experience less stress and anxiety compared to those who cannot (Hunter et al., 2018) and those who use other devices (Melumad & Pham, 2020). Similarly, users become increasingly anxious when separated from their device (Hartanto & Yang, 2016). In fact, simply having a smartphone can ameliorate anxiety (Hunter et al., 2018), as long as it is not visible (Sapacz et al., 2016). The implication here is that a visible smartphone may provide an anxiety-provoking reminder that it is not in use, whereas a hidden phone offers the comfort of potential use yet is also "out of sight, out of mind."

On the other hand, MMC can fuel stress and anxiety when access is expected yet restricted because the technology is broken, lost, stolen, or otherwise unavailable (Gonzales et al., 2014). This lack of access has been linked to anxiety about missing social activity (Przybylski et al., 2013), which is exacerbated in situations where people cannot respond to rings and notifications (Clayton et al., 2015; Stothart et al., 2015). Collectively, these contributions suggest that MMC can both mitigate and cause stress and anxiety.

The scholarship reviewed so far is complemented by a meta-analysis reporting a small- to medium-sized positive correlation between smartphone use and anxiety (Vahedi & Saiphoo, 2018). People who are psychologically closer to their smartphone are more likely to use it as a coping mechanism, but at the same time experience more overall stress and anxiety trying to keep up with mobile media activity (Carolus et al., 2018). The ubiquity of the technology means that expectations to be accessible to others are higher than ever (Ling, 2012, Ch. 9). These expectations can translate into stress and anxiety as people feel obligated to respond to messages as soon as possible (Mascheroni & Vincent, 2016). Responding to messages perpetuates expectations of future responses, so frequent smartphone users may experience greater expectations and thus anxiety (Cheever et al., 2014). Mazmanian et al. (2013) characterized this phenomenon as the autonomy paradox, with MMC providing flexibility and

control over one's communication in the short term, along with increasing levels of stress in the long term as users try to keep up with rising availability expectations.

These trends can also be viewed through the broader lens of technostress, which recognizes the growing pains involved in adjusting to a new technological landscape (Craig, 1984). Even though mobile phones are no longer new, they still serve as a source of technostress when people experience periods of heavy use (Boonjing & Chanvarasuth, 2017). Hall's (2020, Ch. 8) typology of digital stress can be thought of as manifestations of technostress and apply (albeit not uniquely and in varying degrees) to MMC. Availability stress and fear of missing out have already been discussed, but additional stress may arise as social media is accessed via mobile devices (approval anxiety), a tide of messages are received (connection overload), and awareness of negative information is interwoven in daily life (cost of caring). Yet, MMC also enable people to work around these same stresses – and mobile technostress may be overstated (see Gonzales & Wu, 2016). In sum, users can readily manage stress and anxiety using MMC; however, the technology also comes with its own stress- and anxiety-inducing baggage.

Feeling Safe and Secure

Next, we turn to a theme established in early literature: how MMC make people feel safe and secure. Before mobile phones diffused to the masses, the technology was regarded as having limited utility outside of being used by wealthy businesspeople (Ling, 2004). As it became cheaper and more prevalent in daily life, people increasingly came to appreciate their newly unfettered access to help in acute situations (Aoki & Downes, 2003; Ling, 2004, Ch. 3). Beyond offering instrumental help, mobile media are used to connect individuals with their close-tie support networks to cope with fear and danger during major public crises, such as earthquakes (Suzuki et al., 2020) and terrorism (Ling et al., 2018).

Thus, the mobile phone has become a widely recognized symbol of security – even when not in use. As Vincent (2006) described, "we fondle it, we clutch it in times of crisis ready to turn to it and dial for help or solace, and we know that our loved ones are doing the same" (p. 42). People know that the technology can connect with others when in use, and still "clutch it" even when not in use. The phone can be used to call for help – indeed, women rate a phone as a better weap-

on of self-defense than pepper spray – but it also creates a sense of safety above and beyond its functionality (Cumiskey & Brewster, 2012). It can even be used to create the illusion of interacting with others when feeling insecure about one's immediate surroundings (Ling, 2012). As such, mobile media can act as a security blanket, providing a means to respond to emergencies and lending a feeling of security to novel and awkward situations (Fullwood et al., 2017; Hunter et al., 2018; Ling, 2004). Overall, access to mobile communication has come to be regarded as essential preparation for acute situations, and just having them handy can make people feel safe and secure.

Of course, there is a flip side to this coin: MMC pose clear risks to one's sense of security, particularly with regard to personal information and privacy. The literature reflects scholarly attention to privacy concern in general (Sambada & Bhayani, 2018), which can influence one's privacy behavior while using a smartphone (Boyles et al., 2012). However, there is not as much attention to how people feel about their security in the context of MMC , with the exception of work on mobile data donation (e.g., Ohme et al., 2021). Concerningly, people perceive mobile phones as more private than desktop computers (Melumad & Pham, 2020), even though smartphones entail greater privacy challenges (Gomez-Martin, 2012). Smartphones are particularly vulnerable because of the high degree to which user data, behavior, locations, and movements are collected and commodified by application developers and telecommunication providers, not to mention a higher risk of loss and theft (Sipior et al., 2014). Rather than indications of fear and concern, the more dominant narrative is that people are not fully aware of how serious the situation is (Mayer, 2013; Sipior, 2014). In that sense, more balance is needed in work on feelings of safety and security associated with MMC.

Feeling Connected

Feeling safe and secure is supported in part by the sense of connectedness offered by MMC. MMC ensure that one's social links can be activated when- and wherever. Early cell phones primarily supported interpersonal communication through calling and messaging, which reinforced strong-tie connections (Ling, 2004). Interpersonal communication remains dominant in the smartphone age (Deng et al., 2019), and users now have expanded options for maintaining con-

nections with others (Rice & Hagen, 2010). In fact, research indicates that simply thinking about one's smartphone can spark feelings of connectedness (Kardos et al., 2018), which resonates with propositions that humans are fundamentally driven by a need to belong (Baumeister & Leary, 1995; Srivastava, 2005). Furthermore, people distinctly feel a lack of connectedness without access to mobile media, an affective state that is one of the dimensions of nomophobia (Yildirim & Correia, 2015). Late adopters (Wei & Lo, 2006) and teenagers without access to mobile media (Quinn & Oldmeadow, 2013) feel less socially connected than their counterparts.

The capacity of MMC to make users feel connected has raised questions about the quality and quantity of face-to-face interactions. Sherry Turkle (2012, 2015) has voiced concerns that people rely on mobile technology moreso than those that they communicate with through it. Although MMC can increase well-being through connectedness, it can also reduce well-being by distracting from (Dwyer et al., 2018) or even supplanting face-to-face interaction (Epley & Schroeder, 2014). In some cases, the mere presence of a smartphone can diminish the sense of connectedness with co-present others (Przybylski & Weinstein, 2012), although this effect may be attenuating in light of changing norms (Allred & Crowley, 2017).

For better or worse, MMC inspire a heightened sense of connectedness as people carry their always-accessible personal networks in their pockets. Several terms have been advanced to characterize this phenomenon: perpetual contact (Katz & Aakhus, 2002), connected presence (Licoppe, 2004), permanently connected (Vorderer et al., 2016), and others. Although other media contexts also support social connection, the extent to which one feels connected depends on access to places of media use. MMC uniquely offer the sense of sustained connectivity without the traditional constraints of place and space. Such sustained connectivity may conflict with connecting with co-present others, but enable potential (if not constant) connection with absent others (Gergen, 2002).

Feeling in Control

The final affective theme is a sense of control, or "the freedom to engage in self-determined behavior during leisure time" (Rieger et al., 2017, p. 163). The potential for use when- and wherever uniquely provides individuals with a sense of

being in control, even, and perhaps especially, when they are not. Research links mobile phone use to feelings of empowerment and independence (Jarvenpaa & Lang, 2005), and shows that people who use their smartphones after completing a difficult task experience a greater sense of control (Rieger et al., 2017). Mobile media not only provide control in when and where one pursues self-determined behavior, but also in how they do so, providing a distinctive and growing variety of choices with regard to services, content, and social outlets. In combination, these ingredients are a recipe for control, which is meaningful if there is any truth to the notion that "what we value most is control over where we put our attention" (Turkle, 2015, p. 19).

Work on attachment theory also speaks to MMC's allure of control. Children often form attachments to caregivers, and in cases where primary caregivers are unreliable, they may form relationships with objects (Keefer et al., 2012; Winnicott, 1953/1986). Although smartphones offer wellness resources for social, psychological, and emotional support (Chib & Lin, 2018), they do not offer care in the traditional (i.e., human) sense. Instead, users become attached to their devices because they offer a sense a control (Konok et al., 2016), especially when they perceive close others as unreliable (Keefer et al., 2012).

Of course, people are not always in control of MMC. The sense of control can dissipate when individuals feel pressure to use their device (Halfmann & Rieger, 2019; Jarvenpaa & Lang, 2005) and when smartphone behaviors become compulsive (Lee et al., 2014). Users of mobile media must navigate a number of issues to maintain a sense of control over the technology, including dependency, balancing the needs of self and group, managing coordination and multi-tasking, negotiating privacy, and others (Rice & Hagen, 2010). Simply not using the device can be its own exercise of control (Rosenberg, 2019). As such, MMC presents both challenges and opportunities for users to feel in control.

Discussion

The inventory initiated here points to a number of prominent ways that MMC use structures how people think and feel. With mobile media, people can engage with others, information, and content between and beyond places of destination, giving rise to a host of new prospects and problems with regard to cognition and affect. After a brief recap of the

themes, the discussion situates them in theoretical propositions of technological embedding, leverages them towards academic and public debates, and lays out next steps for future work.

Cognitive and Affective Implications of MMC

In terms of cognition, the review shows how MMC enable the offloading of information that can rearrange mental resources for attending to social and spatial surroundings. MMC can support immersive cognitive processing, habits, or both when one state progresses into the other; however, mobile interfaces and usage contexts generally favor shallower levels of information processing. The urge to use the technology stems, at least in part, from heightened expectations be available, evidenced by phantom vibrations where the user is primed to respond to notifications that do not exist.

On the affective front, MMC are a primary source of pleasure. The review suggests that hedonic characteristics of the technology derive from using it to promote positive emotions, avoid negative emotions, and feel stimulated. Specifically, mobile media can foster feelings of control, connectedness, and safety by providing direct access to other people, information, and content. Mobile media can also mitigate unwanted stress and anxiety through use or by simply having the technology on-hand, while also engendering the opposite effect when users are challenged by expectations to be accessible and connected.

It must be emphasized that these psychological impacts are not novel per se. A variety of media support and suppress the cognitive and affective themes reported above. What is novel about MMC is that it can be *mobile*, and therefore increasingly interwoven into how people think and feel as they traverse everyday life. This constant connectivity has two consequences. First, the mere presence of MMC can create ripples in the lakes of cognition and affect. Phantom vibrations, perhaps the most novel consequence of MMC reviewed above, exemplify this phenomenon. We expand on this point in the next section on the embedding of MMC. Second, cognitive and affective implications increasingly abut and overlap as they are interwoven with everyday life. We point to such interconnections as part of our suggestions for future research.

Theoretical Implications: The Psychological Embedding of Mobile Media

The findings from this study extend Ling's (2012) theory of societal embedding of mobile communication by pointing to ways in which it also becomes psychologically embedded. According to Ling (2012), a technology's journey toward becoming part of the structure of society involves four key stages: critical mass, legitimation, social ecology, and reciprocal expectations. Here, we focus on the social ecology, or how mobile communication has changed routines among social collectives as it progressed from new and useful to a taken-for-granted necessity. Drawing from interviews and the literature, Ling (2012) offered evidence that "It has changed the interaction between parents and their children. It has changed the way we coordinate everyday life, and it has changed business and commerce around the world" (pp. 157-158). Whereas Ling's work on taken for grantedness examines how mobile communication worked its way into social structure, this review offers a view into ways that the technology, and the practices surrounding it, works its way into the psychological domains of cognition and affect. Just as mobile media and communication have implications for the social ecology of how individuals relate with one another, so too do they have implications for the mental ecology of how individuals think and feel. In other words, MMC are psychologically embedded.

By psychological embedding, we suggest that mobile communication practices can rearrange the mental ecology in ways that are comparable to recognized changes in the social ecology. Ling's (2012) proposition that MMC are now embedded into society is evidenced by changes in the social ecology, including new modes of coordinating with others, maintaining relationships, and taking care of business. Similarly, we assemble discernable themes in the literature that point to shifting dynamics with the mental ecology, evidenced by distinctive implications of MMC for how people offload and process information, experience and attend to their surroundings, pursue feelings of pleasure, safety, connectedness, and control, and eschew feelings of stress and anxiety. Even the mere presence and possibility of MMC is enough to shape these dynamics, evidenced through literature within many of the themes in this review. These latent orientations especially illustrate how the technology, as well as the social practices surrounding it, have uniquely and deeply worked their way into the psyche of the user. An excit-

ing step forward would be to enrich these social science contributions with research from neuroscience, as brain activity may help illuminate changes in the mental ecology associated with the psychological embedding of MMC.

Implications for Academic Debates: Multifaceted and Unique Aspects of Mobile Media

Beyond its theoretical contribution, this review has implications for debates surrounding mobile media in academic circles. The most prominent debates center on the effect of digital technology on adolescent well-being, with prominent scholars arguing that these effects are minimal (Orben & Przybylski, 2019) or substantial (Twenge, Haidt, Joiner, & Campbell, 2020). Although such debates focus on social media, the catch-all term of "digital technology" and operationalizations thereof often include or even focus on mobile media.

The current review offers two comments on these discussions. First, mobile media use is not monolithic. To belabor the point, different individuals use different functions for different reasons at different times in different places. It seems challenging to boil this variety down into a positive or negative effect on well-being or any other construct. Our review highlights multivalent implications of specific facets of MMC that can have specific consequences. Second, the voices of communication scholars are often absent in these debates. As such, academic perspectives on (mobile) communication technology are not always shaped by a broader awareness of communication media, and the novel aspects of mobile media can be misattributed. For example, many scholars argue that mobile media are unique because they can be used in a variety of places (e.g., Kushlev & Leitao, 2020), although several non-mobile media (e.g., laptops) also satisfy this criterion. The assembly of literature on the cognitive and affective implications of MMC in the present review provides footing to identify unique aspects of MMC that are oftentimes glossed over. Crucially, these novel aspects can include how the presence of MMC is impactful, above and beyond its use. In sum, we advocate for nuanced research on the multifaceted and uniquely mobile implications of MMC that can inform interdisciplinary academic debates.

Implications for Public Discourse: Multivalenced Impact, Broad Scope, and Awareness

Moreover, this review helps to contextualize public debates surrounding MMC. The popular press is rife with clickbait on the negative impact of mobile media on peoples' brains (Sinicki, 2020; Wise, 2015) and lives (Akbari, 2018; Lusinski, 2018), sentiments that are echoed (albeit ironically) in subreddits like r/PhonesAreBad. Nuanced or even positive perspectives appear outnumbered. However, positive, negative, and conditional implications of MMC emerge throughout our review of cognitive and affective themes. The multivalent and conditional ways that people incorporate MMC into their lives are often overlooked in public discourse.

Moreover, public discourse should reflect the broad scope of MMC in everyday life. For example, the role of MMC in offloading and control, among other themes presented here, garners minimal attention. The current review organizes streams of literature to guide understanding of the different ways smartphones are interwoven in daily life. This effort is important because scholarship can shape lay theories of technology. For example, the academic focus on smartphone addiction has permeated the public sphere (Wallace, 2016), sometimes resulting in users feeling guilty for having positive experiences on their mobile devices (Lanette et al., 2018). This review hopes to nudge lay theories of mobile media towards a more balanced and holistic view.

Ultimately, such a view relies on cultivating awareness of the roles that mobile media play in our lives. The capacity to use mobile media wherever, whenever, and for whatever magnifies the importance of maintaining awareness of why and how we use mobile media. Moreover, mobile media remain cognitively and affectively salient even when not in use. As such, beyond an in-depth understanding of the cognitive and affective implications of MMC, the current review supports more awareness of latent practices and nuanced ways that people incorporate MMC into everyday life. This understanding may not only help individuals guide their own mobile practices, but also contribute to broader conversations and policy discussions about the technology itself.

Next Steps

Although it offers an expanded scope of the ways that MMC is incorporated in how people think and feel, this review is not exhaustive and leaves opportunities for future development. On the cognitive front, attention can be considered at two levels. Some studies examine how MMC capture attention during specific moments, such as cognitive tasks or social engagement (Przybylski & Weinstein, 2012; Ward et al., 2017). Others point towards "permanent" attention that we bestow on the digital world through our mobile devices more broadly (Vorderer et al., 2016). These state- and trait-like notions of attention, albeit interrelated, could be disentangled in future work. In terms of affect, control can be linked to broader literature on self-regulation and delay of gratification (Atchley & Warden, 2012; Hadar et al., 2015; Hofmann et al., 2016; Markowitz et al., 2019; Wilmer & Chein, 2016). Beyond cognition and affect, future research could also explicitly engage with basic psychological processes (e.g., perception, motivation, learning, memory, language), in addition to social and clinical perspectives, in order to fully represent the psychology of MMC.

Psychometric work on MMC is also emerging. Scholarship using psychometric methods corroborate the above work on stress and anxiety (Clayton et al., 2015; Hunter et al., 2018). Some studies find psychometric impacts without self-reported changes (Konok et al., 2017), highlighting the utility of such an approach. Psychometric research has also investigated attentiveness and arousal (Clayton et al., 2015; Dunaway & Suroka, 2019; Markowitz et al., 2019), which also seem ripe for future work. As noted above, neurological approaches would provide valuable insights into how brain functioning indexes different psychological states during mobile media use.

Finally, it is important to reiterate that the boundaries within and between cognition and affect are blurred as mobile media is interwoven throughout daily life. Within cognition, spatial awareness and offloading are intertwined as people rely on Google Maps rather than mental maps (Frith, 2015). Within affect, people likely experience less stress and anxiety if they can safely call someone for help (Ling, 2004). Between cognition and affect, a sense of connectedness may increase the likelihood of phantom vibrations (Deb, 2015), and mobile habits may be pleasurable (see Schnauber-Stockmann et al., 2018). Thus, although it is crucial that we advance our understanding of particular cognitive and affective themes, it is just as necessary to attend to their interconnections.

Conclusion

This review article advances an inventory of cognitive and affective implications of MMC, which people increasingly use in ways that structure how they think and feel. It extends prior literature by offering an expanded and dual focus on cognition and affect, while assembling interdisciplinary bodies of scholarship to identify existing themes and opportunities for future research. This review also helps widen the theoretical lens, presently focused on social structure, to bring greater focus to the psychological embedding of mobile media and communication. Ultimately, it can help guide academic and public debates by calling attention to the ways that uses and effects of the technology are both conditional and directly shaped by its unique characteristics.

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