

RESEARCH PAPER

Informatics in Behavioral Medicine: Possible Implementations in User-Device Interaction

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ABSTRACT

Smartphones have become deeply integrated into daily life, offering constant connectivity, convenience, and access to information. However, alongside these benefits, a growing body of research points to harmful effects associated with excessive and compulsive use. Physical issues such as musculoskeletal strain and eye fatigue, along with psychological concerns like anxiety, depression, sleep disturbances, and attention problems, are becoming increasingly linked to problematic smartphone behavior. The severity of the issue is now such that clinical tools like the Smartphone Addiction Inventory (SPAI) have been developed to assess the condition, underscoring its recognition as a legitimate public health concern. Traditional interventions-ranging from digital wellness apps to screen time limits, have shown only limited success, often falling short due to lack of personalization, low adherence, and the general tendency to bypass them after implementation. This paper proposes two informatics-driven strategies designed to interrupt habitual device use in subtle, non-intrusive ways: Delayed Response Input, which introduces brief feedback delays to disrupt the instant-reward loop, and Memory Recall Interruption, which asks users to reflect on their intentions before proceeding. Both interventions aim to slow down impulsive interaction patterns, increase user awareness, and ultimately reduce mindless screen time.

Keywords: Behavioral Medicine, Behavioral Informatics, Digital Will-Being, Smartphone Addiction

Smartphones have transformed from luxury items to ubiquitous everyday devices with permanent internet access and global connectivity. While their advantages in communication, organization, and information access are evident, so are the emerging risks. The development and validation of the Smartphone Addiction Inventory (SPAI) underscores the severity of the issue (Lin *et al.* 2016). When a behavior becomes prevalent and problematic enough to warrant its own diagnostic framework, it transitions from a social curiosity to a public health concern. However, interventions are still not widely effective and also, in many cases, there is little knowledge about the possible risks of smartphone use. As we will establish

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later, the fact that smartphone overuse and general problematic user behavior is shame-loaded and not acknowledged by users themselves complicates the issue further. The integration of smartphones in the workflow is a practical problem: for a large number of people, their device functions in a dual fashion. While it is used as an organizer for most work tasks, it is equally used for recreational means and this blurs the lines between problematic use and ‘justifiable’ use. More than just a matter of screen time, excessive smartphone use has been associated with real consequences: anxiety, depression, impaired sleep, and decreased attention are just some of the effects reported across age groups (Billieux *et al.* 2015). These impacts are not isolated or rare, but increasingly widespread and tied to the way smartphones are designed—built to engage, reward, and hold our attention. This paper explores this growing issue through the lens of behavioral medicine and informatics, proposing two subtle but potentially powerful interventions as practical, user-centric strategies to slow the cycle of compulsive use.

Current State of Digital Device Use and Overuse

Smartphones and other digital devices have become ubiquitous in modern life virtually all over the world. In the United States, 91% of adults report owning a smartphone in 2024, which is a dramatic increase from only 35% in 2011. Obviously, the introduction of the smartphone had not been that long in 2011 which explains the relatively low numbers of ownership, considering the lower popularity of the device in general, the less integrated nature in everyday tasks due to limited capabilities in devices and also the higher prices at the time. However, 91% speaks for itself in how important the devices have become for modern human everyday. Obviously, handheld devices today offer many conveniences, especially in terms of mobile connectivity and a pretty full standard user experience of the internet on handhelds. But it has also led to growing concerns about digital device overuse and, more generally termed, *problematic* use of smartphones, sometimes termed smartphone addiction. Public health advocates are now more aware than ever before of the fact that mobile devices indeed carry an addictive potential, depending on the use habits and installed apps on them. It is no longer a secret that people who struggle to limit their device use and general screen exposure can experience negative effects on their physical and mental health (De-Sola Gutiérrez *et al.* 2016; Jo *et al.* 2021; Aarestad *et al.* 2023).

Seamless integration of the devices in workflows and activities during the day makes the distinction between different types of use difficult. While in one moment, an important work e-mail is answered, there may pop up a notification by a game, social media app or a messenger for private communication. The smartphone is used as an alarm by many, which makes it the first thing that is touched in the morning. It is used to tell the time, talk privately and for work, *do* work, help with queries on the internet of whatever nature, keep reminders and much more. These intertwined use cases make it difficult up to impossible to advocate for *less* use in general without further specification. This might also be a reason for why many of the traditional warnings and advocacies to reduce screentime have little effect.

Medical and Health Concerns

Excessive use of digital devices has been linked to various health effects and has had professionals concerned in terms of physical and mental health. On the physical side, spending long hours before a screen often involves poor posture and simple, repetitive motions which puts a strain on the musculoskeletal frame, nowadays referred to as ‘text neck syndrome’ or ‘tech neck syndrome’, with the former particularly

referring to the posture taken when looking at a phone screen and texting messages, and the latter referring in general to the forward-slouched posture usually seen while using different forms of digital devices.

In this paper, it makes sense to name the various health effects only on a superficial level because not only have they been extensively researched in more recent history, but also going into more depth in the variety of effects would certainly exceed the boundaries of this work. Therefore, it be said that what is commonly referred to as ‘problematic’ device use has numerous negative implications for physical and mental health and has been, and still is, subject to ongoing research as well as the concern of health professionals across the globe.

Limitations of Interventions

According to Kim (2020) and Rahmillah *et al.* (2023), one of the main problems in interventions is that there is little data on long-term effects but in general, narrative experience suggests that the implementations of measures to reduce screen time often cause frustration after a while and are bypassed or deleted. Furthermore, the reasons behind the initial addiction problem with smartphones is not easily generalizable and might have important implications for the effectiveness of mitigation strategies. Billieux *et al.* (2015) highlight the perspective that different approaches to understanding the nature and reasons behind the initial condition calls for distinctive measures for treatment. These thoughts may well apply to general intervention ideas as the effectiveness can easily be impaired in a one-size-fits-all approach. Another key concern is the fact that many of the interventions so far rely on self-reported data. Understandably, if there is no hard data but rather qualitative self-reports, it is likely that users will underestimate their total use of digital devices. As with such self-reported data it is biased toward perceiving screen time generally negatively, it is clear that users will hardly report accurate statistics. As Lu *et al.* (2024), apps and input manipulation systems do indeed show promise but still face usability difficulties and have thus not been adopted widely.

Proposed Interventions

In this paper, two possible interventions are discussed that could prove beneficial in cutting between mindless scrolling periods and creating a higher user awareness of their momentary action and inspire reconsideration. The ideas for these interventions are drawn from traditional cognitive psychology and aim to integrate in modern user behaviors with their digital devices. In terms of behavioral medicine, they might help achieve a better and healthier use of digital devices in everyday situations while keeping.

1. Delayed Response Input

Delayed Response Input involves intentionally introducing a very slight delay in the feedback (or reward) that the device provides to the user. One of the reinforcing aspects of today’s devices is the immediacy or response: tapping on an app and it immediately opens with fresh content, pulling down on the screen to refresh, sending a message and receiving a confirmation within moments. This immediacy is a provider of satisfaction to the reward system (Gross, 2024; Nipper, 1966; Cynthia *et al.* 2023; Tyre *et al.* 2015). Thus, the idea behind modification of this satisfactory feedback is creating just a tiny amount of friction in the experience. For example, opening a highly addictive app (such as a social network or a game), the phone introduces a brief loading screen or a countdown of a few seconds before the content appears.

A short delay might be enough for an individual to become more aware of their habit and send them to reconsider whether they truly want to use the app at this particular moment or whether it is rather simply the memorized impulse (comparably to muscle memory). The friction does not forbid the action but creates a delay that is experienced as effort or ever so slight discomfort. By formalizing Delayed Response Input at the operating system level, users who opt in could experience a generally calmer, less instantly gratifying phone experience. The expected result is that the dopamine-driven loop of immediate tap-and-reward is broken. Over time, this could train users to be more patient and intentional. Early evidence supports the logic behind this: in Olson *et al.*'s (2022) nudge intervention, one strategy was changing the phone to grayscale (making it visually less gratifying), which along with other tactics led to reduced usage. This supports the idea that slightly less comfortable- and rewarding-experienced use of the device might create better awareness in the user and likewise make them rely on their phone less for unimportant or reward-seeking reasons.

At the core of the idea are the many particular pickups of the phone during the day that happen in a semi-aware state; many users have reported this in case examples and it has also been subject to extensive research that as smartphones have integrated so seamlessly into our everyday, we often tend to click and scroll 'mindlessly' through apps without a clear purpose. We bridge the slightest waiting times with immediately opening our phones and more often than not, we have no clear intention in doing something specific but only seek immediate distraction and reward (De Segovia Vicente *et al.* 2023; Mowlabocus, 2016).

2 Memory Recall Interruption

The second proposed intervention, Memory Recall Interruption, aims to disrupt automatic behavior and engage the conscious mind by occasionally prompting the user to recall their intention or some information before proceeding with device use. One of the hallmarks of device overuse is the tendency to unlock the phone or open applications 'on autopilot' without a clear goal, reason or conscious intention. For instance, one might pull out their phone, unlock it, and suddenly find themselves scrolling through feeds without even intending to do so. Memory recall interruption seeks to disrupt this autopilot mode.

A concrete example of this approach would be an unlock challenge that poses a simple question. Before the home screen or a frequently used application appears, the phone could display a message such as: "What do you want to do right now?" with a text box for briefly typing the answer. The act of typing a response forces a moment of reflection. If the user genuinely needs to do something (e.g., "check my email for a reply from my boss" or "set an alarm for tomorrow"), they can enter that and proceed. If they opened the phone out of pure habit without a specific goal, the prompt might interrupt them to recognize this and potentially consciously and willfully decide, "Actually, I do not need to use it right now." This approach can be seen as similar to mindfulness techniques where individuals are trained to pause and acknowledge their actions rather than acting on impulse. Interestingly, a research project called *TypeOut* implemented a related idea: it required users to perform an in-situ typing task (with meaningful content) when unlocking the phone, as a form of just-in-time intervention. In a 10-week experiment with 54 users, this technique (which included typing self-affirming statements) led to a 50% reduction in app usage and significantly lowered the frequency and duration of phone use (Xu *et al.* 2022), which is powerful evidence that inserting a small task at the moment of unlock can reduce overall use by targeting conscious reflection.

Ethical Considerations

Any intervention that is intended to modify user behavior, i.e. how people interact with their own devices raises important ethical considerations. In the case of the proposed interventions, we must consider issues in user agency and autonomy, consent, privacy and even broader implications of altering behavior. First and foremost, the question of autonomy and consent are critical: introducing delays or prompts in someone's own device can arguably be seen as a form of paternalism. The system is, to an extent, nudging the user to achieve a healthier outcome. Eventually, it is the user's own decision how they want to interact with their own digital devices and even though the intent of reducing harmful overuse is good, it is crucial that users retain control over their own habits and action. Therefore, it should be considered at all times that these features are opt-in and/or customizable. While users should understand the purpose clearly, they must retain agency over their use. Imposing measures without consent and/or the user's knowledge is overstepping boundaries, even if well-intentioned. On the other hand, introducing the features as sort of a 'digital wellness' feature helping to maintain a healthy balance in device use respects free choice for the user and equips the device with targeted mechanisms in order to support healthy habits. Users thus should be able to see when and in what fashion the interventions are implemented, perhaps with customizable features.

Apple's devices for example have built-in limitation functions for specific apps or websites that help the user track their time spent with a specific service and reminds them of the time remaining; however, when the reminder appears on the screen, the user can choose to either prolong the limitation for 5 minutes or ignore it for the day. These features can be extended across all used devices that are connected to the same Apple ID, and can also be set in a family account connection so that parents have the means to track and limit their children's use of specific apps and websites. This, for example, allows a distribution of screen time that allows for school work without limitations but with strict limits for social media use (see Fig. 2).

Apple's built-in tracking is fairly sophisticated as it allows the user to access detailed statistics on their own habitual use and average screen times on daily and weekly bases (see Fig. 1), which helps prevent overuse if the user cares to set themselves limitations. All of the aforementioned are optional, i.e. the user's consent has to be confirmed prior to the tracking process.

Other ethical considerations concern the collection of user data and their safe storage. Privacy regarding the usage data of devices and services is critical in an age where behavioral economics are at the forefront of generating money from user engagement. Although the proposed interventions are relatively light on personal data, the weight of usage statistics should not be underestimated. Knowing the exact behavioral rituals and whether a user is prone to behavioral manipulation can be a feature susceptible to manipulation. Ethical use of data is paramount in health informatics in general, but the statistics of device use are some of the most interesting data to analytical algorithms that aim to present the user with engagement-maximizing content (Gross, 2024; Gross *et al.* 2024). From that perspective, it should be self-evident that anonymization of data, safe storage and full user control about their own data at any time are foundational.

Conclusively, the implementation of Delayed Response Input and Memory Recall interruption have to function at the safest levels for the user and must be introduced in a user-centric design. Consent,

transparency and flexibility, together with privacy protection are non-negotiable. In alignment with emerging ‘humane tech’ approaches, they have to respect users’ free will and well-being in a balanced fashion.

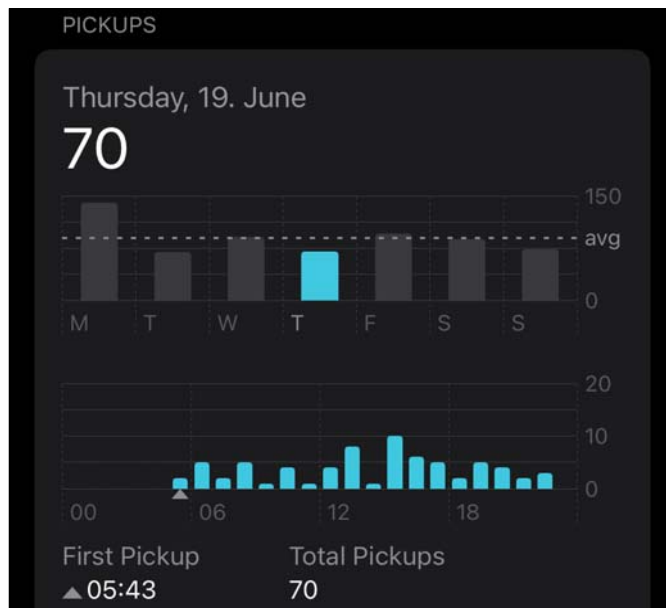


Fig. 1: Tracking of total pickups during a day, tracked from 12 am to 12 pm, with display of a daily average across the tracking period

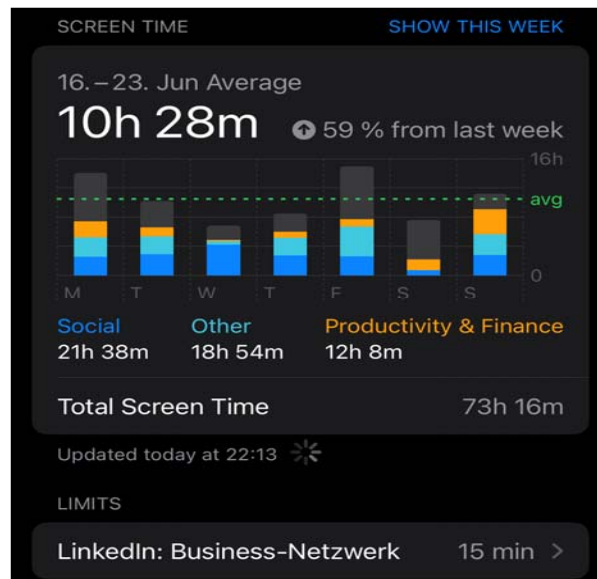


Fig. 2: Distribution of time spent using different services, with display of set limitation for LinkedIn (Categorization automatically, not accurate – includes all used devices and all purposes)

CONCLUSION

The increasing omnipresence of digital devices in modern life has brought with it not only convenience but also profound behavioral and psychological challenges. As smartphones have become an inseparable part of everyday routines, their design, centered around immediacy and gratification, has led to a concerning rise in habitual and often unconscious usage. This form of overuse, commonly referred to as problematic smartphone use or smartphone addiction, has been clearly associated with a range of adverse physical and mental health effects, from musculoskeletal strain and sleep disturbances to anxiety, depression, and cognitive overload.

This paper examined the landscape of smartphone overuse from a behavioral medicine perspective and assessed the limitations of traditional intervention methods. Existing tools, including screen-time trackers and app limiters, often fall short due to poor long-term adherence, bypassing by users, and lack of personalization. Moreover, the diversity of underlying causes for overuse (ranging from social pressures to habitual reinforcement) means that one-size-fits-all strategies are unlikely to work effectively for all users.

To address this, the paper proposed two informatics-driven interventions grounded in cognitive and behavioral science: Delayed Response Input and Memory Recall Interruption. These approaches aim not to restrict or punish, but to gently interrupt automatic, reward-seeking behaviors and create a moment of conscious reflection. Delayed Response Input introduces subtle friction in the feedback loop, weakening the immediate gratification cycle that underpins device overuse. Memory Recall Interruption, on the other hand, asks users to articulate their intent before proceeding, or at least reflect on it for a moment, encouraging mindfulness at the point of device interaction.

Both interventions are designed to act within the user's own behavior patterns without drastically altering the user experience. They align with modern principles of humane technology – design that respects agency, minimizes harm, and promotes psychological well-being. However, as emphasized in the discussion on ethical considerations, such features must be developed and deployed with care. User consent, autonomy, privacy protection, and transparency must be prioritized. Features should be fully optional, clearly explained, and adaptable to individual needs and contexts.

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