

Functionalities Review of Digital Wellbeing Apps: Towards Research-informed Design Implications for Interventions Limiting Smartphone Use

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Abstract

Background

Much research in Human-Computer Interaction has focused on wellbeing and how it can be better supported through a range of technologies from affective interfaces to mindfulness systems. At the same time, we have seen a growing number of commercial digital wellbeing apps. However, there has been limited scholarly work reviewing these apps.

Objectives

This paper reports on an auto-ethnographic study and functionality review of the most popular 39 commercial digital wellbeing apps on Google Play Store and 17 apps described in academic papers.

Methods

From 1250 apps on Google Play Store we selected 39 digital wellbeing apps and from Google Scholar we identified 17 papers describing academic apps. Both sets of digital wellbeing apps were analyzed through a review of their functionalities based on their descriptions. The commercial apps were also analyzed through autoethnography where the first author interacted with them to understand how these functionalities work and may be experienced by users in their daily lives.

Results

Findings indicate that these apps focus mostly on limiting screen time and we advanced a richer conversation about such apps articulating the distinction between monitoring use, tracking use against set limits, and four specific interventions supporting limited use.

Conclusion

We conclude with six implications for designing digital wellbeing apps including the call to move beyond screen time and support the broader focus of digital wellbeing, supporting meaningful use rather than limiting meaningless use, leveraging (digital) navigation in design for friction, supporting collaborative interaction to limit phone overuse, supporting explicit, time-based visualizations for monitoring functionality, and ethical design of digital wellbeing apps.

Keywords: Digital wellbeing; smartphone applications; tracking use; monitoring against set use limits; interventions for limiting use; barriers; design for friction; screen time; attention; self-regulation.

Introduction

A significant growth of research in wellbeing [74] and affective health [66] has taken place in the last decade across a range of disciplines from Human-Computer Interaction (HCI) and Science and Technology Studies to Clinical Psychology and Psychiatry. This range reflects the interdisciplinary work in this space and we argue the unique position of HCI discipline to articulate the design knowledge required for digital wellbeing interventions. Such work includes novel affective interfaces intended to support real time awareness of emotions or their regulation [11,65,76–78], novel design approaches emphasizing the importance of human body like soma design [3], novel technologies supporting reflection and meaning making [18], those intended to train meditation or mindfulness skills [68] or to conceptualize meaning [50]. Other strands of HCI work have focused on ill health such as mobile applications for cognitive behavioral therapy [17], empirical studies exploring ways to support vulnerable users such as those living with depression [59], dementia [38], addiction or compulsive use of technology including screen time research [62,67]. Much of such work frames mental wellbeing as "positive emotional, psychological and social health" [23, p.189], while digital wellbeing is broadly seen as the result of being able to use technologies in productive and healthy way without the negative consequences of dependency, distraction or risks to users' privacy [10].

A specific body of work has focused on interventions supporting smartphone non-use, for instance by increasing interaction cost in order to discourage smartphone app usage [32]. Both limiting phone usage, and increasing interaction cost can be conceptualized within the slow movement where technology is re-framed with the aim of pausing and reflecting on its use [21]. Other examples of interventions of smartphone non-use include apps such as MyTime to make users aware of their tracked use data, which in turn prompt them to reflect upon their usage and especially the problematic use [25]. In addition, Roffarello and De Russis [61] argued that current digital wellbeing apps' focus on self-monitoring may not be a sufficient mechanism to change users' behavior with smartphones. Moreover, Roffarello and De Russis [61] also pointed out the limited exploration of the effectiveness and theoretical underpinning of digital wellbeing apps, while van Velthoven and colleagues highlighted also the insufficient investigation of the positive effects of regulating problematic smartphone use with digital interventions [79]. The nascent research exploring the effectiveness of digital wellbeing apps has been limited, with only one study focusing on the analysis of users' qualitative reviews of commercial apps [61] whose findings indicate that such apps are liked especially in studying, working, sleeping, parental control, and free time contexts, albeit limited in supporting behavior change and habit formation towards more conscious smart phone use.

In addition, the theoretical underpinning of digital wellbeing apps has also received limited attention. In this respect, most work has looked at their adoption [51,56] leveraging for instance technology acceptance theories [15,80], including the more recent technology acceptance lifecycle model [52] although these models are rather generic, so leveraged also for personal or domestic technologies. Scholars such as Douglas and colleagues [56], Lukoff and colleagues [44], Lyngs and colleagues [45], Kim and colleagues [31], or Colombo and colleagues [11] have also identified other theories more relevant to digital wellbeing applications such as the uses and gratification theory [31,32], theory of planned behavior [2], dual system theory [81], nudge theory [54], framework for behavior change [75] or theories for regulation [20]. However, it is less explored how such theories could actually inform the developing of commercial wellbeing apps.

Given the limited research on the theoretical and evidence based aspects of digital wellbeing apps [56,79], we argue that unpacking the functionalities of most used commercial apps is an important initial step towards better designing them. The exploration of functionalities and features of mobile apps is an emerging research area, with initial HCI work focusing on digital interventions and especially development of apps for specific conditions such as depressions [8,58], or for supporting for instance mindfulness [63,64] or physical activity [47]. In contrast, the functionalities of digital wellbeing apps have been less investigated. A noticeable exception is Roffarello and De Russis' [61] exploration of 42 digital wellbeing apps and their descriptions on Google Play whose findings indicate as key features (i) tracking user behavior through phone unlocks, phone/app time, app checking, (ii) data presentation through phone/app summary, charts, daily/widget recap, social comparison, (iii) phone interventions through timers, blockers, (iv) app interventions through timers, blockers, notification blockers, and (v) extra features such as motivational quotes or rewards. However, given the brevity of apps' descriptions available on marketplaces, a richer source to identify their key functionalities is the actual use of the apps while authors, as HCI experts adopt the role of the user by directly interacting with the apps; a method previously used for app reviews [26,53,58].

Specific functionalities of digital wellbeing applications have been also explored through research prototypes usually implementing tracking and notifications [29,36], while others included also specific interventions for limiting use [25,30]. For instance, Socialize [60,61] app integrates most common functionalities of tracking, data presentation, real-time notifications, and blocking use which were evaluated in the wild with 38 young people over 3 weeks. Findings indicate improvements in terms of problematic use, measured through phone addiction scale, and self-regulation measured through general self-efficacy scale. While this is one of the few studies involving measures to explore the effectiveness of digital wellbeing app, the Socialize app itself does not appear to be novel, borrowing common functionalities of commercial apps, whose theoretical grounding is limitedly unpacked. Focus app [57] is another research prototype that leverages Nielsen's heuristic to support tracking phone use and the blocking of any app, indeterminately or for a limited time set by

user, with the option to unblock them at any time, and provision of educational content on digital addiction. To mitigate overuse from a broader perspective, another research prototype, FeelHabits app [9] tracks and notifies users about their usage of specific apps albeit rather than on smartphone alone, this apps tracks use across devices and blocks them if limits set by the user are exceeded.

Other strand of scholarly work with richer theoretical underpinning has focused on restrictive and coercive interventions intended to be stronger than persuasive interventions by supporting users to commit to self-impose limits of use while the phone is blocked [31]. The framework for influencing behavior change [75] suggests 4 types of influence: persuasive (explicit, weak), coercive (explicit, strong), seductive (implicit, weak) and decisive (implicit, strong) based on influencing force (strong, weak) and salience (explicit, implicit). Inspired by this framework, Kim and colleagues designed and evaluated GoalKeeper [31], a smartphone app featuring both a *weak lockout*, i.e., the phone is locked increasingly longer: 1, 5, 15, 30 and 60 minutes each time the user exceeds the time they have previously set for use, with each lockout being mitigated by a temporary 15 min allowance time; and a *strong lockout*, i.e., the phone is locked until midnight without any allowance. Their findings indicate that both mechanisms were more effective than mere notifications of use, with the strong lockout being the most effective as users set longer limits for not using their phones. While in the latter case users experienced also more frustration, this was mitigated by the flexibility of setting their own limits and one-time opportunity to modify it.

Despite this growing academic interest in digital wellbeing, the commercial apps far outweigh the research prototypes in in terms of uptake. Thus, the increased adoption of commercial wellbeing apps offers an opportunity to explore their potentially richer set of functionalities and the aim of this paper is to articulate these functionalities as well as the novel design implications informed by them in order to better inspire the design of technologies for wellbeing. To address this aim, we focused on the following research questions:

1. Which are the key functionalities of the top rated digital wellbeing apps?
2. What theoretical underpinning support these functionalities?
3. What design guidelines for digital wellbeing apps can be informed by these functionalities?

Our contributions are three-fold. First, we unpacked richer insights about tracking and monitoring functionalities in terms of user profiling, and understanding of monitoring as a *complete, location-based, and flexible practice* that can benefit from tailored, time-based visualizations. Second, we identified four interventions for limiting use including richer understanding of different types of obstacles for limiting use, as well as of specific features for less explored functionalities such as supporting awareness for reaching use limits, focused attention and motivation to keep within set use limits. Third, grounded in our findings, we generated six design implications for digital wellbeing apps.

Method

To identify the digital wellbeing apps, in winter 2019 we searched for free apps in Google Play Store using the following search terms: digital wellbeing, digital detox, detox apps, unplugging, and distraction, which is a new direction given that extensive previous work on such apps has prioritized addiction and screen time [61]. We have focused on Google Play since Android apps represent the largest global market share, over 2.5 greater than iOS apps [72], while the latter is also more restrictive in terms of available information [61]. However, future work could extend this exploration to other platforms.

For each search term, the top 250 most relevant apps returned on Google Play were retained, totaling 1250 apps, with 37 duplicates. At the screening stage, after reading their titles, summary descriptions and main screenshots, we excluded 931 less relevant apps such as fitness, activity planner, or non-digital detox apps. The eligibility of the remaining 282 apps was assessed based on their full descriptions, with further 147 apps being excluded such as utility apps, games, and general wellbeing and meditation practice apps. From the remaining 135 apps, we further excluded those with less than 1000 raters, and with average rating score less than 4, leading to 39 apps to be included in our review. PRISMA diagram for searching and screening process for digital wellbeing apps is shown in Figure 1. We also note that 12 of our 39 apps are also available on Apple store, 7 of them with user rating above 4.2.

Our final set consisted of 39 digital wellbeing apps (Table 1 in Appendices) which were analyzed through two complementary methods. First, a review of their functionalities based on their descriptions from Google Play. Second, an autoethnography with the authors, as HCI experts directly interacting with them in order to viscerally understand how these functionalities work and are experienced by potentially users in their daily lives. Such interactions were iterated, involving at least 2 sessions for each app, lasting for at least 30 minutes. For the autoethnography, we used Samsung Galaxy Note9 phone with Android mobile operating system.

The first author evaluated all 39 digital wellbeing apps, while 20% (8/39) of the apps were evaluated also by the second author. Through the use of both methods, the authors iteratively revised the coding scheme over several months, a process which has followed a hybrid approach. This integrated deductive codes, informed by prior work on functionalities [61] such as tracking, data presentation, and interventions (Table 2). The inductive coding was informed the distinction between tracking and monitoring, the revision of interventions functionalities as tracking phone or app use by setting limits, and of data presentation or visualization and its subcategories such as numerical and diagrammatic format through charts, round diagrams, metaphors, heat maps or reports. Particularly important are the new functionalities capturing four interventions for limiting use.

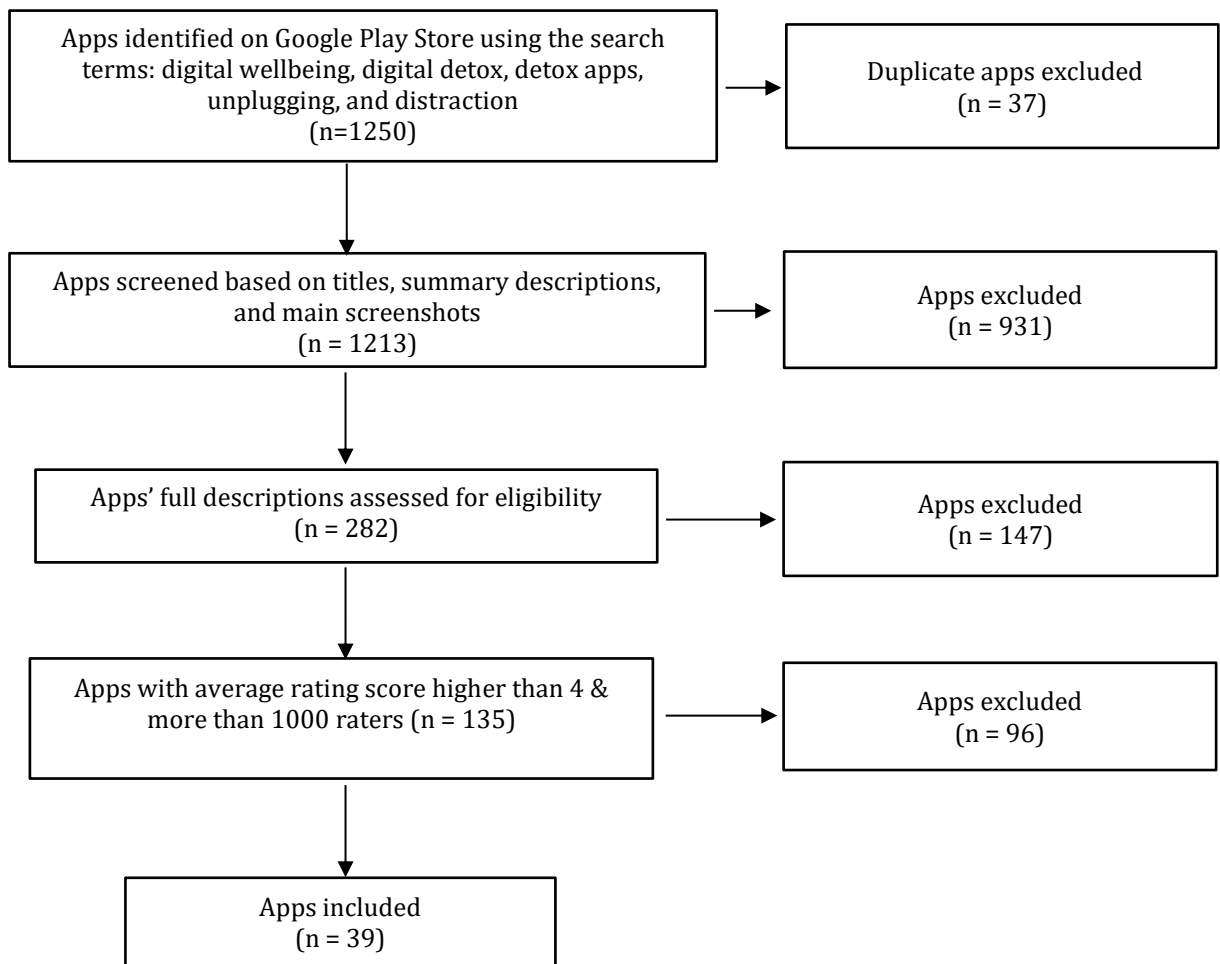


Figure 1: PRISMA diagram for searching and screening of digital wellbeing apps

Functionalities codes and subcodes	Definitions
Tracking	
Recording phone or app use	The tracking functionality supports the recording of phone or app uses
Visualizing tracked use data	The tracking functionality supports the visualization of tracked data
Profiling users	The tracking functionality supports profiling users based on tracked data
Monitoring	
Setting time limits of phone/apps use, their scope and place	The monitoring functionality provides use time limits or support users to customize them in terms of scope and place
Visualizing monitored data	The monitoring functionality supports the visualization of monitored data against set time limits of use
Providing flexibility for limiting monitoring	The monitoring functionality supports flexibility for limiting monitoring through allowances to extend use beyond the set time limit, excluding apps from being monitored, or discontinue the monitoring
Interventions for limiting use	
Creating obstacles to limit phone/apps use	This intervention supports creating different types of obstacles to limit phone or apps overuse
Supporting awareness of reaching the set use limits of phone/apps use	This intervention supports users' awareness of reaching the set use limits through different types of notifications varying in content and form
Supporting focused attention away from phone/apps	This intervention supports users' focused attention on main task and away from habitual phone/apps use through training or white noise
Supporting motivation to keep within limited use	This intervention supports motivation to keep within limited phone/apps use through rewards/penalties, motivational quotes/education, and social motivation

Table 2. The main codes and subcodes from apps analysis

To better contextualize our review in scholarly work, we subsequently extended the list of apps with 17 digital wellbeing apps designed in academia which we found through search on Google Scholar using the keywords: "digital wellbeing application" or "digital wellbeing app". This search returned 42 papers which after reading their abstracts, led to 17 papers describing such apps (marked with an asterisk in Reference list). The remaining 25 papers do not included digital wellbeing apps and for this reason they were excluded. We have explored the functionalities of the apps described in the 17 papers by applying the above coding system to their description, as not all of them were available to download from apps marketplaces. All the tables provided in appendices include information on both commercial and academic apps.

Results

This section starts with a brief overview of the descriptive characteristics and ethical aspects of the 39 apps, continues with identified main functionalities of top rated digital wellbeing applications, and how they compare to the applications developed in academia.

Descriptive Characteristics of Digital Wellbeing Apps: Ethics

The descriptive characteristics captured by our analysis include app category, target users, scientific underpinning and evidence base, and cost. Findings indicate that the top rated digital wellbeing apps belong to 6 categories albeit feature predominantly in Productivity category (27 apps), followed by fewer apps in Tools (4), Personalization (3), Health and fitness (2), Parenting (2), and Lifestyle category (1). Together with their main aim of limiting phone overuse, this is an interesting outcome that can be linked to the ethical principal of *non maleficence* [66] in order to protect users from the negative impact of phone overuse. These can also be aligned to the ethical principle of *beneficence*, in particular, the predominant instrumental value of digital wellbeing apps supporting increased productivity rather than their eudemonic value for supporting meaningful goals [48]. Arguably, the latter would further strengthen their beneficence potential.

Another important outcome, which can potentially hinder their beneficence is the limited science-base of digital wellbeing app, with 38 out of 39 apps not specifying if they are backed up by research, the only exception being the Focus To-Do app described as “science-based app”. This indicates the importance of these app unpacking in their descriptions the scientific underpinnings informing their design and any available outcomes from evaluation studies. In turn, this will support users make more informed choice regarding their beneficence.

The target users of digital wellbeing apps appear to be unrestricted, with most of them available to users of all age, which reflects the principle of *justice*. Indeed, all but 4 apps are rated on Google Play as PEGI 3, which stands for Pan European Game Information. The remaining 4 apps: Brain Focus Productivity Timer, Lock Me Out, SleepTown, and Sma-Phospital do not specify any age. Interestingly, the design of the apps does not vary with age, as we see the same functionalities for both children and adults. We also looked if the target users include clinical population. Findings indicate that 38 out of 39 do not specify clinical user groups while 1 app: AppBlock mentions its suitability for ADHD children or adults. This suggests that digital wellbeing apps predominantly target users without specific conditions or health concerns. However, given their value for supporting attention, some of these apps may be beneficial for users with attention deficit. Future work should further explore this.

Also related to justice, the cost of the digital wellbeing apps is an important aspect which can increase or limit diverse users accessing them. Regarding cost, an important outcome is that while all 39 apps are free to download, only 11 are entirely free to use, while 28 apps offer in-app purchase mostly for removing adds, unlocking premium features, or subscribing to premium versions of the apps. This is an

important outcome indicating that most functionalities of these apps are freely available, making their use particularly inclusive.

Digital wellbeing apps have an interesting relationship with the ethical principle of autonomy. On the one hand, these apps tend to limit one's use of phone or apps, while on the other hand, consistent findings have shown that autonomy is already impaired [41] when people live with some form of addiction such as phone overuse.

Functionalities of Digital Wellbeing Apps

We now turn our attention to the key functionalities of digital wellbeing apps. The iterative analysis led to specific functionalities which can be broadly grouped into 6 main functionalities: tracking use of phone or apps, monitoring use against set limits, together with four functionalities that highlight interventions for limiting use namely: creating obstacles for the phone or apps use, supporting awareness of reaching the set use limits, supporting focused attention, and support motivation to keep within limits of use. Each of these functionalities is further detailed.

Tracking Overall Phone and Apps Use, User Profiling

Findings indicate that 28 digital wellbeing apps automatically track or record overall phone use, use of specific apps or both (Table 3 in Appendices). In particular, (i) the overall use of the time spent on phone was captured by 3 apps through overall screen time across all apps measured per minute, hour, day, or week, or number of time the phone unlocks per hour or day; (ii) the use of specific apps that provide users the choice to select them in order to capture only their screen time was captured by 15 apps, while (iii) 6 apps tracked both the overall use of the phone and the use of specific apps. Other digital wellbeing apps provide users the choice to select the time when the tracking can take place, for instance between 9am and 5pm but not outside of the specified time window. Tracking can also be contextualized, with 3 apps (AppBlock, Instant-Quantified Self, Lock Me Out) allowing its coupling with physical locations specified by users.

With regard to visualization, the tracked use data tends to be provided in numerical and diagrammatic format through reports (27), charts (21), round diagrams (9), metaphors (4), or heat maps (1) (Table 3 in Appendices). The 4 apps providing metaphoric visualizations are Forest: Stay focused, Focus To-Do: Pomodoro Timer & To Do List, SPACE, and SleepTown, with the latter's visualization consisting of raising virtual towns when maintaining regular sleep hours. In addition, from the 27 of apps including reports, 20 apps provided daily and weekly reports of screen time and 7 apps provided only daily such reports.

Findings also indicate that 10 of the 39 apps extend tracking functionality to also inform user profiling. Out of these 10 apps, 4 apps use either the tracked data of app usage (App Usage, Screen Time) to generate categories of used app for broader purposes such as productivity and social, or ask users to identify these categories (SaveMyTime, Boosted). In addition, 3 apps provide users the option of creating different profiles for different settings which could be used to support different levels

of limited use of phone or apps, both with payment (HelpMeFocus) or without payment (Stay Focused). For instance, by allowing them to specify location or specific WIFI network where set limits are activated (AppBlock). This is important indicating flexibility of the interventions for limited use to the situatedness of users' different contexts such as homes or work. Finally, YourHour app also aims to identify levels of phone addiction based on tracked data, while Digital Detox app offers predefined levels of limited use that users can choose from. These two apps are interesting as they attempt diagnosis of smartphone addiction and prediction of the intervention intensity. While smartphone addiction is not yet a clinical condition featuring in the Diagnostic and Statistical Manual of Mental Disorders (DSM), its problematic behaviors as diagnostic criteria have started to be explored [42]. In addition, several scales have been developed for measuring phone addiction [16,37] that meet the psychometric properties of validity and reliability. If digital wellbeing apps aim to identify user's level of addiction which will allow for a better tailored intervention, these scales are useful to consider.

Interestingly, the remaining 11 apps which do not provide tracking functionalities include 8 apps supporting focused attention usually on offline activities (Forest, Boosted, Pomodoro smart timer, Brain focus timer, SleepTown, Engross, Visual timer, Hold), 2 launchers apps minimizing the number of apps being displayed (LessPhone Launcher and Before Launcher), and 1 app for turning off email notifications (Quite for Gmail).

Monitoring Phone/App Use against Set Use Limits or Set Time Limits for Focused Attention

Apart from tracking, most digital wellbeing apps also allow setting use limits to track phone or apps usage against them (25/39) (Table 4 in Appendices). The distinction between tracking and monitoring is that monitoring is based on user intentions to self-limit their use, while tracking merely captures the time spent on apps/phone without any such limits. Thus, tracking becomes a prerequisite activity, performed first in order to explore one's use patterns, and based on this information, use limits can be set. Indeed, all apps supporting monitoring also support tracking, but 13 of the apps, while supporting tracking, they however do not support monitoring. This is an important outcome as arguably, monitoring is better positioned to support behavior change towards limiting use than mere tracking; yet about 35% of the top rated app do not support monitoring.

While most apps (25/39) support setting limits for using the phone or its apps, the remaining 14 apps include 8 apps that allow people to focus attention by setting time for offline activities, and therefore away from phone and apps, 3 apps providing only tracking (Smarter Time, Sma-Phospital, Usage analyzer), 2 launchers apps minimizing the number of apps being displayed, and 1 app for turning off email notifications (Quite for Gmail). The prevalence of apps for focus attention on offline activities is an interesting and less explored monitoring aspect of digital wellbeing apps.

Monitoring functionality allows users setting the scope and place of limited use, visualization of monitored content, and interestingly, options for limiting monitoring. With respect to the scope of the limited use, more than half of our reviewed apps offer options to reduce the use of some of installed apps (13 apps). This means that while using these digital wellbeing apps, some apps' use remains unmonitored. In contrast, the remaining digital wellbeing apps extend this option to monitor use to all apps on user's phone (6), or to the phone itself (7). Setting use limits can also be activated at specific location, either specified through the phone GPS or WIFI network, although only a few apps offer these options: 3 and 1 app, respectively.

Findings also indicate that 22 digital wellbeing apps support a more forgiving or *flexible monitoring* by allowing users to limit their monitoring in three ways. This include allowances to extend use beyond the set time limit (9 apps), and option to exclude specific apps from being monitored (19 apps). Allowances are breaks during the set nonuse time limit so that users can continue to use the phone or the apps despite being during their set nonuse time limit, with or without (financial) penalties, while the number of breaks and/or their duration is either capped or uncapped. This can also include terminating the non use time limit earlier than it is actually due (4 apps). 19 digital wellbeing apps also offer the option of excluding specific apps from being monitored against time limits, especially apps such as App Usage Manage/Track Usage, AntiSocial, and My Phone Time. In addition, 14 apps allow users to discontinue monitoring when they reached the set use limit.

With regard to visualizations, monitoring function engulfs tracking one, so that it supports the visualization of tracked data. However, visualizations specific to monitoring functionality are offered by less than half of the digital wellbeing apps. (19/39). This is an important outcome suggesting the value of considerably extending such visualizations within monitoring functionality. These 19 apps provide monitoring specific visualizations of (i) time unspent out of the use time limit, i.e., count down (12 apps), (ii) time spent out of the use time limit (6 apps), or (ii) even time overspent as percentage of time limit (1 app). These are provided in either text form (12 apps) and/or diagrammatic one as circles or progress bars (un)filled gradually with colors until the set time limit is reached, 4 and 3 apps, respectively. Interestingly, the monitoring of focused attention, usually during offline activities, can also be visualized, usually through time unspent out of the focus time (or time for not using the phone/apps), through countdown timers (3 apps), or circle progressively unfilled with color (1 app).

Interventions for Limiting Use of Phone and Apps

Findings indicate four interventions for limiting the overall use of the phone or its installed apps which include creating obstacles to limit use, supporting awareness of reaching the set limits, supporting focused attention, and supporting motivation for limiting use, which are further detailed.

Creating obstacles to limit phone and apps use

The first intervention consists of creating obstacles for excessive phone or app use (21 apps). Obstacles can be classified according to their force (strong or weak), saliency (explicit or implicit), temporal aspects such as being activated before, during or after excessive use, and social aspects such as parental control or social commitment (Table 5 in Appendices). Obstacles also differ with respect to their source (being generated by the digital wellbeing app or by users) and could be tailored to user profiles.

The identified strong obstacles features predominantly in commercial apps (18 apps). These obstacles cannot be circumvented include lockout of phone/apps beyond the set time limit of use (14 apps), interrupting use while the set use time has been reached (12 apps), and unchangeable time limits of phone/app use (6 apps). In contrast, weak obstacles have features in much fewer apps (5 apps), with only one app providing both strong and weak obstacles, i.e., StayFree. Weak obstacles do not directly restrict use but make it more difficult through notifications from phone or apps after overuse (4 apps), notifications inside the digital wellbeing app when reaching time limit (4 apps), micro boundary interactions that make it more difficult for users to access their apps targeted by limited use (2 apps). Microboundary interactions are particularly interesting as although theoretically explored in academic research, they have been limited implemented through design. Such interactions feature in 2 apps (LessPhone Launcher, and Before Launcher) and consist of “launchers” as substitute home screens for user’s phone which display only a reduced number of apps, so that accessing other apps requires additional clicks for navigating from the launcher to them.

According to their saliency, most obstacles are explicit such as lockout (8 apps), set time limits for phone/apps use (14 apps), and textual or visual notifications (4 apps), while others are implicit such as launchers (2 apps) or activation of dimming mode of phone’s screen when set time limit was reached (1 app). This much lower number of implicit obstacles is interesting, suggesting a less explored design space and their potential value of complementing explicit obstacles.

With respect to temporal aspect, most obstacles are created before the use of phone/app and activated during the set limited time for using the phone or apps. The exception is flexible time limits which can be changed not only during but also after the set time limit for use has ended.

The obstacles also have a social dimension, albeit only 5 apps implemented them, in two forms: parental control (4 apps) or social commitment (1 app). Regarding the latter, Forest app leverages feeling of failure to social commitment is a type of obstacle in order to prevent users from accessing apps while with friends.

With regard to source, the obstacles can be created by the digital wellbeing app or by the user. The former leads to automatically generated obstacles usually through user profiling (11 apps), while the latter leads to customized obstacles (13 apps). Apps

allowing users to set use limits usually restrict this option to specific apps rather than all apps. Examples of automatic setting of use limits feature in YourHour app which provides short users 'quizzes to identify if the app is used for work or entertainment. Another example is SPACE app supporting limited phone use through automatically suggested limits. Interestingly, 2 apps allow users to create multiple profiles, each profile with particular setting to be assigned to different tasks (HelpMeFocus, Stay Focused). This is an interesting option, allowing users different modes of engaging with specific apps, which could for instance help with the context setting such as work or leisure, and different phone usage for each.

Not at least, different types of obstacles may be tailored to different user profiles for matching for instance level of addition (1 app) or users' preference for a specific level of digital detox: easy, medium, and hard detox (Digital Detox) that are proposed to users to choose from (Digital Detox app). Interestingly, no apps attempt to recommend interventions at different level (weak or strong) based on tracked data. This is a less explored feature with potential to provide adaptive interventions better tailored to users' needs.

Supporting awareness of reaching the set use limits of phone/apps use

The second intervention is supporting awareness of reaching the set limits of use and is provided by 13 apps (Table 6 in Appendices). Such awareness is predominantly supported through explicit notifications of reaching the set time limits (12 apps) usually in textual or diagrammatic form, with both push notifications which appear when the screen is both locked or unlocked usually at the top in the status bar) (4 apps) or pull notifications which appear suddenly in the middle of the screen as a small window alerting the user of something, sometimes these are big, covering most of the screen) (7 apps). Notifications can be provided in both the digital wellbeing apps about the use of the phone or its installed apps (13 apps), and as embedded within a specific app when the time limit relates to that app (11 apps). In contrast to explicit notifications, implicit ways to support awareness of reaching time limit include screen dimming. While less common (1 app), these are interesting, more subtle ways to notify users of reaching their use limits for specific apps or phone, and to persuade disengagement. While both notifications and screen dimming are provided in real time, daily reminders to review tracked data support higher level of awareness beyond a specific instance of "in the moment" use and more about the historic user over the day (7 apps).

Supporting focused attention on primary tasks and away from habitual phone/app use

The third intervention supports focused attention, and features in over 70% of digital wellbeing apps (29/39) (Table 7 in Appendices). These include all apps that support monitoring (25) and 4 additional ones: Boosted, Pomodoro Smart Timers, Engross, and Hold. By aiming to limit phone and apps overuse, digital wellbeing apps implementing monitoring functionality implicitly support focused attention on the main task since they prevent user's attention being hijacked by habitual phone/apps use.

Findings also indicate that 8 apps (4 which support monitoring and 4 which do not: Boosted, Pomodoro Smart Timers, Engross) explicitly target the training of focused attention. These apps encourage users to stay away from phone in order to focus on specific offline tasks for a set time. This is a different use of time limit, that the one in monitoring functionality, as people are supported to practice the adaptive behavior of maintaining attention for a set time away from phone, rather than resisting for a set time the temptation to use the phone.

In addition, 5 out of these 8 apps for training focused attention also provide users with white noise to better facilitate concentration. This is an interesting outcome, and although these apps provide limited evidence for its value, scholarly work indicates that white noise defined as “task-irrelevant auditory input containing many frequencies of equal intensities” [3,p.1] has potential to improve cognitive performance in both healthy adults [23] and those with attention deficit [71]. Mechanisms that could explain the benefits of white noise include its ability to moderate brain arousal by inducing neural noise which at specific dopamine-based thresholds could stimulate cognitive performance [4].

Supporting motivation to keep within limited use of phone or apps

The fourth intervention supports motivation for limiting phone and apps use (12 apps) (Table 8 in Appendices). Findings indicate three mechanisms for supporting motivation. First is the reward/penalty feedback usually implemented by those apps that support monitoring (7 apps), with rewards being provided when users successfully kept within their set use limits of their phones and apps. Main types of rewards leverage gamification principles and consist of badges at different levels (2 apps), points (2 apps), virtual coins (1 app), building virtual trees (Forest) or town (SleepTown), or motivational quotes (4 apps). Main categories of penalty content are metaphoric and consist of virtual tree withers (Forest) or town building collapses (SleepTown). Interestingly however, most of monitoring apps (20/29) do not support such motivation through rewards and penalties.

Second, beside the reward/penalty feedback provided on the basis of successful or unsuccessful keeping within set limits of phone or apps use, other type of motivation is provided to support behavior regulation of limiting use, both during or even before the actual behavior of limiting use. This less common type of motivation consists of motivational quotes, either provided by the app (2 apps: Stay Focused, HelpMeFocus) number and names) or generated by the user (2 apps): StayFree, App Usage - Manage/Track Usage), or educational content about phone/life balance (1 app): SPACE, or motivational stories written by other users (1 app): YourHour.

Third, social support is another form of motivation, whose role in facilitating behavior change has been much acknowledged [28]. An important outcome is the limited number of apps that encourage social support to limit use phone or apps use, either through competition (5 apps), collaboration (5 apps) or both (3 apps). This is distinct

from the identified emphasis on competition [46]. For instance, the SPACE app allows comparing such progress of limited use. In contrast to this competition social motivator, our findings also show 5 apps leveraging collaboration, where family members, friends, or broader social networks are used. For instance, SleepTown app allows sharing sleep time goals with friends and setting similar sleep goals with them. Another example is the Hold app that provides different ways to share focus time through finding nearby Bluetooth enabled-devices to encourage focused attention in group. The app Hold also integrates collaborative and competitive aspects, for instance by ranking users according to the points they gained from their time spent on focusing tasks, most often offline ones. Apps leveraging competition can also integrate social recognition. For example, Hold app rewards the top ranked user according to their points with a crown icon next to their username, and Focus app rewards the first 3 users with a trophy icon next to their usernames: gold, silver and bronze.

Comparison of commercial digital wellbeing apps with academic ones

This section focuses on the comparison of the functionalities of the apps developed in academia with those of commercial apps, with a specific focus on how they differ. It is not surprising that most of the academic apps share the tracking and monitoring functionalities available in commercial apps. For example, the lockout mechanism that blocks the phone until midnight when reaching use limit [31] is similar to blocking apps/phone when the user exceed the defined time limit in some commercial apps (e.g. UBhind). Similarly, blocking and scheduling blocking in academic app Forest [57] is comparable to commercial app AppBlock. One interesting distinction concerning tracking and monitoring is the new form of visualization of tracked data in academic apps namely timelines.

In terms of interventions for limiting use, findings indicate additional key distinctions between commercial and academic apps for digital wellbeing. With regard to creating obstacles to limit phone or apps use, important distinctions concern the force and saliency of the created obstacles, their temporal aspect and source. With respect to force, commercial apps employ predominantly strong obstacles such as phone or app block (14/39 apps, 35%) instead of weak obstacles such as notifications or micro boundary interactions (5/39 apps, 13%), with only one app providing both strong and weak obstacles. In contrast, academic apps take a more balance approach, employing equally both strong (10/17, 59%) and weak (11/17, 65%) obstacles, with 5 apps employing both strong and weak. Given the nascent research exploring the effectiveness of digital wellbeing apps, academic work is more likely to employ both types of obstacles in order to compare their effectiveness.

With respect to the saliency of obstacles, almost half of commercial apps (17/39, 44%) specify saliency, with all but one featuring explicit obstacles (which also tend to be strong), while SPACE app features implicit obstacles. In contrast, almost all academic apps (16/17, 94%) involve explicit obstacles, i.e., mostly notifications. Interesting here is the innovative use in academic apps of new type of obstacles for restricting use through design frictions. These could involve mandatory cognitive

tasks such as entering a number of digits as users attempt to start interacting with apps targeted for limited use [55], or entering 30 or 10-digit strings [32], which, when compared to merely pressing OK, indicate that the more complex the cognitive task, the more likely that users will restrain from engaging with those apps. Commercial apps present limited such cognitive tasks, one exception being MMGuardian app which requires entering a password by parents in order to prevent the child from removing the app or modifying the set time limit of use.

Findings also indicate differences regarding the temporal aspects of obstacles to use. While commercial apps employ these obstacles predominantly after use of the targeted apps (15/39 apps, 38%) as opposed to during use (4/39 apps, 10%), academic apps take a more balanced approach employing such obstacles equally during (8/17, 47%) and after the use of targeted apps (8/17, 47%), with 2 apps employing them both during and after use. This suggests the value of providing flexibility and users' choice, but also the importance of real time obstacles in limiting phone or apps overuse in real time.

With regard to obstacles' source, commercial apps use mostly obstacles set and customized by users (15/39, 38%) rather than obstacles set automatically (6/39, 15%), while in contrast, academic apps feature more automatically set obstacles (10/17, 59%) than those set by users (6/17, 35%).

Scholarly work on digital wellbeing apps has also focused on the types of apps that users are more willing to limit use. In this respect, empirical findings indicate that users were willing to restrict the use of specific apps such as messaging ones [43], as well as social media or games apps [25]. Academic work has also explored limited use beyond individual devices such as phones, but also across multi-devices and their context of use [9,30]. Similar work has looked for instance at chatbots in order to notify users of their smartphone usage [1], or video platforms supporting pre-schoolers to self-manage their phone and app consumption [24].

The second intervention intended to increase users' awareness of reaching their limits of phone or apps use, also shows differences. While both sets of apps employ mostly explicit notifications to support such awareness, academic apps do so more (8/17, 47%) than commercial apps (11/39, 28%). Interestingly, both sets of apps also used implicit notifications such as screen dimming featuring in SPACE app, and vibrations for notifying users when they exceeded their set time limit for phone use featuring in Good Vibrations app [54].

Intervention targeting focused attention has been supported by both sets of apps through training for focused attention, with 8/39, 21% of commercial apps and 5/17, 29% of academic apps providing such training. Interestingly, commercial apps also feature white noise, as a specific mechanism for supporting focused attention, whose effectiveness as part of digital wellbeing apps has been less explored, although a body of scholarly work has shown its value for relaxation [23,71].

Finally, the fourth intervention for supporting motivation to keep within set limits, shows similar findings for the two sets of apps, with emphasis on rewarding user behavior when the goal of keeping within limits has been reached (9/39, 23% of commercial apps, and 3/17, 18% of academic apps), albeit commercial apps show more diverse forms of rewarding content, usually leveraging gamification principles, as opposed to academic apps which use merely points. In contrast, findings show much fewer apps leveraging punitive feedback when users fail to keep within set use limits, for both commercial apps (4/39, 10%) and academic apps (1/17, 6%). In terms of social support, a small number of apps provide it in order to support cooperation (5/39, 13% commercial apps, 2/17, 12% academic apps), competition and recognition ((5/39, 13% commercial apps, 3/17, 18% academic apps).

Also unique to research on academic apps for digital wellbeing is the extended focus of their audience to include not only individual users as commercial apps, but also groups of users. For example, such academic apps focused on enhancing self-regulation through groups of users collaborating or competing towards limiting their collective use of phone and apps [35,36], limiting use as a family activity [36], or through providing virtual app spaces for college students to restrict their phone use during class time [29].

Discussion

We now revisit the research questions advanced in the Introduction and articulate the novelty of our key findings. The first two research questions focused on the identifying the key functionalities of the top rated digital wellbeing apps and their theoretical underpinning. Our review of top rated digital wellbeing apps indicate six main functionalities: tracking use, monitoring use against set limits, together with four interventions for limiting use such as creating obstacles to limit use, supporting awareness of reaching the set limits, supporting focused attention, and supporting motivation for limiting use. In this section, we also theoretically position these functionalities, and leverage them to articulate new implications for better designing digital wellbeing applications.

Findings indicate that over 70% of digital wellbeing apps provide tracking of use phone or apps data, visualized mostly through reports and charts. More than a third of the apps providing tracking functionality also support user profiling, either automatically from tracked data or through users' entered data. This aspect of tracking has been limitedly explored in previous work [61,79]. Another key findings is that almost 30% of the digital wellbeing apps do not support tracking phone or apps use, but support instead focused attention or tracking of offline activities. This is a key outcome with important design implications that we revisit later.

The second functionality of monitoring phone or apps use against set time limits which is key for limiting their use. This functionality features in 25 of our reviewed commercial apps. Interestingly, however the remaining almost 35% of the digital wellbeing apps do not support this functionality directly, albeit they monitor the time spent on offline activities, away from the phone and its apps. From the former set of

apps monitoring phone/apps use, most tend to target some of the apps installed on the phone, with fewer digital wellbeing apps monitoring use limits of all the apps. An important implication here is designing for *complete monitoring* of all the apps installed on the phone and provide users with the choice of selecting the ones to monitor, as well as *location-based monitoring* currently limitedly supported, albeit useful for situating the monitoring behavior in a spatio-temporal context. We also suggest supporting *flexible monitoring* allowing circumventing the set use time limit which can support ongoing motivation for monitoring phone consumption and regulating phone overuse behavior. Findings also indicate interesting time-based, monitoring specific visualizations featuring in about half of our reviewed apps, which are useful to be extended to all digital wellbeing apps.

With respect to the first intervention, almost half of our reviewed commercial apps implement strong and explicit obstacles such as blocking in order to limit phone or apps use, with much fewer apps featuring weak or implicit obstacles, usually in the form of notification. Even fewer attempt to implement micro boundary interactions using launchers as substitute home screens. Such obstacles can be generated both automatically or by the users, with only few apps tailing them to user profiles and none mapping the force of obstacles (strong or weak) to such profiles. These approaches suggest the value of using both sources, so that digital wellbeing apps could benefit from the customization of users' set obstacles, and potentially even more so from extending the use of automatically set obstacles. While previous work suggested that strong obstacles, despite inducing frustration, can be preferred by users and likely to be more effective than the less restrictive obstacles [30,61], the value of providing both strong and weak obstacles can be further explored, both in terms of effectiveness as well as user experience for more sustained and long term change of one's relation with their mobile phones. Our findings from academic apps also highlighted new explicit obstacles for restricting use through design frictions such as cognitive tasks which however have been limitedly explored. These innovative obstacles however open up an interesting design space, as frictions support users to pause before compulsively re-engaging with their phones and apps, and thus, a more mindful interaction.

From the 25 apps that support monitoring, less than half (13 apps) support users becoming aware when they reached the set use limits of their phone or apps, mostly through explicit notification, and much less through implicit ones such as screen dimming, while daily reminders support a high level awareness of usage patterns exceeding set limits. Academic apps also started to explore implicit notification, albeit in tactile modality, through vibrations. These implicit notifications open up a less explored design space for this intervention. Arguably, vibration-based notifications, are weak obstacles, but also illustrations of how nudge theory [54] can be leveraged in the design of digital wellbeing apps. Implicit notifications, may be less intrusive and therefore more persuasive, although future work is needed to explore their specific benefits when compared to explicit ones.

An important outcome is the two ways of supported focused attention that digital wellbeing apps implement. First, is implicit support through the monitoring and limiting of phone or apps overuse, and second is the explicit training of attention by focusing on offline activities without phone use, including also exposure to white noise to support concentration, which has strong research underpinning [23][71].

A key functionality, less explored in previous research on digital wellbeing is supporting motivation for keeping within limited use. For this functionality we identified three mechanisms: reward/penalty leveraging gamification principles, educational and motivational content, and social support provided however by a limited number of apps, and where cooperation among users is limited.

The theoretical underpinning of digital wellbeing apps has received limited attention. However, Roffarello and De Russis [61] suggested the value of grounding the design of wellbeing apps to support behavior change, habit formation and self regulation. As shown in Introduction, scholars have identified a range of theories that may inform the design of digital wellbeing apps, such as those of uses and gratification [31,32], planned behavior [2], dual system [81], nudge [54], framework for behavior change [75], or regulation [20]. However, it is less explored how such theories have been actually informing the developing of commercial wellbeing apps. However, the operationalization of these theories in this respect has been limited. In this section, we argue for the value of self-regulation theories.

Prior work has shown that tracking is a key functionality of digital wellbeing applications that captures the use of the phone and its apps [61]. This however does not make the important distinction between the digital wellbeing application running in the background to collect such information, and the user's active effort to minimize phone use. The former is usually important in the early stage of digital detox when people want to understand their consumption patterns, while the latter follows with setting up limits to phone or apps use. For this, we called the former tracking, and latter monitoring which is a better term for capturing or tracking data against a specific target. Most behavior changing application use monitoring towards specific goals such as exercising ones [47] so the link between monitoring and goal setting is crucial. We note the important alignment of monitoring functionality to the three ingredients of self-regulation as reflected in self-regulation theories: setting target standards, monitoring current state against these targets, and activating processes to reduce any identified distance between the current state and the targets [5]. Thus, we argue the designing for monitoring functionality can benefit from theoretical grounding in self-regulation theories.

With regard to the intervention of creating obstacles to limit use, we have seen the value of both strong restrictive mechanism and of weak ones, mostly explored in academic research rather than reflected in commercial apps. We argue that weak and particularly implicit obstacles are illustrations of nudges, which nudge theory describes as persuasive attempts for behavior change which do not limit users'

choices [27,73]. Future work is needed to understand how nudge theory can be sensitively leveraged to rigorously inform such obstacles to use.

The intervention for supporting focused attention is particularly interesting, as it marks a shift away from limiting excessive use, towards more mindful activities, either online or offline, whose valuable side effect is limited use of phone or apps. Rather than steering away from undesirable behavior, this intervention encourages engagement in meaningful and ideally, desirable activities, subsequently supporting the most powerful appetitive rather than aversive motivation. We also highlight in this context, the value of supporting users to understand and support their meaningful goals [48] which subsequently can address the phone overuse and the boredom often associated with it. However, goal theories have been limitedly discussed in relation to digital wellbeing apps.

The final intervention focuses on supporting motivation to keep within use limits. Although limitedly mentioned in relation to digital wellbeing apps, we suggest the value of broaden and build theory [19], where positive emotions are leveraged for increased self-awareness and behavior change. Illustrations of how this theory may be underpinning some of the identified functionalities include the provision of allowances for overruling the set use limits during monitoring. This is important for both instrumental reasons allowing the completion of some immediate tasks, but also for maintaining motivation in case of setbacks in meeting the set limits. In turn, this could broaden users' resilience, and more flexibly support the acknowledged high demands of self-regulation [20]. Future work is needed to explore effective ways for managing the negative emotions associated by setbacks.

Design implications for digital wellbeing applications

The third research question focused on the design guidelines for digital wellbeing apps informed by our identified functionalities. For this, we articulate six implications for designing digital wellbeing apps including the call to move beyond screen time and support the broader focus of digital wellbeing, supporting meaningful use rather than limiting meaningless use, leveraging (digital) navigation in design for friction, supporting collaborative interaction phone overuse, supporting explicit, time-based visualizations for monitoring functionality, and ethical design of digital wellbeing apps. These implications open up a larger design space for digital wellbeing apps, going beyond the main tracking and monitoring functionalities [32,54,55].

Beyond Screen Time: Broader Focus of Digital Wellbeing

While most of these functionalities focus on limiting screen time, echoing previous findings on addiction and phone overuse [61], an important outcome is that about a third of our apps support focus of attention either by limiting distractions or by supporting focused attention often on offline activities, including training of attention. We argue that this bias towards screen time fails to reflect the larger body of HCI research on wellbeing that can inspire novel apps that may better support users' skills for more mindful use of technologies. We call for stronger engagement of HCI research in the design of digital wellbeing apps that addresses this limitation.

Indeed, our findings could mark a shift away from addressing a problematic behavior by explicitly limiting it, but rather by supporting a high level function which can arguably better address the root of the problematic behavior. There is an extensive body of work on mitigating the impact of interruptions [12,13] and a growing interest in mindfulness technologies [14,22,63,64] that can support the design of these apps for digital wellbeing aiming to support focus of attention.

Supporting Meaningful Use vs Limiting Meaningless Use

Findings also indicate an important limitation of digital wellbeing apps reviewed in this work and in particular their rather narrow view of limiting use. We argue that this overlooks the broader goals for using technology in the first place, and users' different avoidance or approach motivations. For this, we can leverage goal theories and the distinction between hedonic and eudemonic or meaningful goals [48] and how the latter can be purposefully designed for. Emphasizing meaningful use of technology [50] may be a better approach to avoid meaningless or habitual use leading to phone overuse, while accounting also for the scarcity of attention [70].

Leveraging (Digital) Navigation in Design for Friction

Findings highlight obstacles for preventing app use which can inform the design for friction [49] as mechanism for slowing down interaction (such as information session at the start of using a meditation app), which we know little about. Our findings suggest harnessing digital distance and navigation to the target application. This is supported by findings showing that virtual navigation in folder hierarchy and in real world share the same neural correlates [7]. One can imagine that information architecture imposing additional digital navigation cost for reaching apps located deeper in the phone's information hierarchy whose use is to be limited, may mitigate against their overuse. We can also think of leveraging physical navigation for instance by allowing access to some apps only in physical locations which the user has to purposefully travel to, supporting thus fitness goals. Kim and colleagues [31] positioned their app and this family of restrictive and coercive interventions within the HCI work on uncomfortable interactions aimed to help people towards important goals while tolerating discomfort [6] and on design frictions through microboundaries consisting of small barriers enforced before an interaction in order to prevent habitual phone use [55].

Supporting Collaborative Interaction for Limiting Phone/Apps Overuse

Much work has shown the value of social support for behavior change and our findings confirm that this is also an important intervention for digital wellbeing apps. Our outcomes echo previous ones showing the benefit of social support for limiting smartphone use, albeit by leveraging competition. We argue that the value of cooperation can be better harnessed in the design of digital wellbeing apps, both for limiting overuse, and for training focus of attention. Our findings indicate that only 9 apps in our app review implements social support as a built in feature. This supports the argument presented in [12] that social support is a feature needed in digital wellbeing apps as current apps seem do not seem to leverage social support as a mechanism to enhance self-regulation.

Supporting Time-based, Explicit Visualizations, Tailored to Monitoring Functionality

In terms of data visualization, findings indicate a richer range of formats available for the monitoring of phone or apps use against set limits compared to their mere tracking. This makes sense since tracking aims primarily to support users' exploration and understanding, while monitoring aims mostly to support behavior change towards set goals [33,40]. Hence, while more ambiguous representations are useful to motivate and engage users during tracking, for the monitoring functionality, more specific formats and particularly those including timelines are more useful. We have seen however that academic apps leverage timeline representations while commercial apps do so to a lesser extent. The latter allow people to easier match on the timeline their behavior with the recorded data to not only understand the data but use it for reaching the goals. These outcomes align with previous work on the value of ambiguity of different type of captured data [65] to support users' engagement in understanding it, particularly relevant in tracking stage. In contrast, while the rationale of timeline visualizations has been limitedly unpacked in scholarly work, it can be grounded in the growing HCI interest in temporality [51] and its value for reflection, both in- and on-action [69]. Future work can compare the value of different visualization forms for supporting such reflection on data.

Supporting Ethical Design of Digital Wellbeing Apps

Despite their potential for supporting users with their phone overuse, most of digital wellbeing apps have limited scientific underpinning and evidence-base. They tend to target users without health conditions, and tend to be inclusive as many of their functionalities appear to be free. We call however for extending the efforts towards more research-informed and evidence-based design of digital wellbeing apps. This is particularly important since their beneficence can be limited by the risk of harming users with mental health conditions, as well as those who experience phone addiction. Such recommendation can be addressed to apps market place, or policy makers for regulating the requirements for their research underpinning. The most ethical challenge pertaining to these apps however is supporting autonomy of users experiencing smartphone addiction [41]. Given however the challenges of diagnosing phone addiction, increased ethical sensitivity is required in this respect. In addition, more work is needed to explore how the shift towards increased autonomy can be best supported and by what features of digital wellbeing apps.

Limitations and Future Work

We have focused on Google Play which limited our review of iOS apps not available on Google Play. Future work could extend this exploration to the other platforms. Future work can also aim to further strengthen the scientific underpinning of design principles of digital wellbeing apps both in terms of their theoretical framing and evidence based evaluation studies. Our findings indicate that despite the growing number of digital wellbeing apps, parts of their design space have been less explored, such as supporting awareness for reaching use limits, and motivation to keep within set use limits, implicit obstacles rather than explicit ones, recommended interventions to determine the right type of obstacles according the tracked data, and mechanisms for supporting focused attention. We encourage researchers and

developers to focus on these aspects and together with the key features identified above, they can significantly improve the design of digital wellbeing apps.

Conclusion

We report on a functionality review of 39 commercial and 17 academic digital wellbeing apps. Findings provide richer understanding of tracking and particularly monitoring functionalities, together with four interventions for limiting use. These provide new understanding of different types of obstacles for limiting use, as well as of specific features for less explored functionalities such as supporting awareness for reaching use limits, focused attention and motivation to keep within set use limits. We conclude with six design implications for digital wellbeing apps including the call to move beyond screen time and support the broader focus of digital wellbeing, supporting meaningful use rather than limiting meaningless use, leveraging (digital) navigation in design for friction, supporting collaborative interaction to limit phone overuse, supporting explicit, time-based visualizations for monitoring functionality, and ethical design of digital wellbeing apps.

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Appendices

App ID	App name	Rating score	Number of app raters
Commercial apps			
1	Google Family Link for parents	4.6	347376
2	Forest: Stay focused	4.7	162902
3	Parental Control - Screen Time & Location Tracker	4.1	40983
4	YourHour - Phone Addiction Tracker & Controller	4.6	37483
5	Focus To-Do: Pomodoro Timer & To Do List	4.7	37278
6	UBhind: No.1 Mobile Life Tracker/Addiction Manager	4	33358
7	SPACE: Break phone addiction, stay focused	4.3	27606
8	StayFree - Phone Usage Tracker & Overuse Reminder	4.6	26437
9	AppBlock - Stay Focused (Block Websites & Apps)	4.5	24385
10	Stay Focused - App Block & Website Block	4.4	21389
11	MMGuardian Parental Control App For Parent Phone	4.1	16909
12	Screen Time - Restrain yourself & parent control	4.7	16887
13	SaveMyTime - Time Tracker	4.5	8968
14	Detox Procrastination Blocker: Digital Detox	4.3	7609
15	Boosted - Productivity & Time Tracker	4.7	7116
16	AntiSocial: phone addiction	4.2	6933
17	App Usage - Manage/Track Usage	4.3	6720
18	Smarter Time - Time Management - Productivity	4.3	5619
19	ActionDash: Digital Wellbeing & Screen Time helper	4	4972
20	Digital Detox: Focus and fight phone addiction	4.5	4403
21	Keep Me Out	4.1	4048
22	Block Apps - Productivity & Digital Wellbeing	4	3728
23	Instant - Quantified Self, Track Digital Wellbeing	4	3367
24	LessPhone - The Original Distraction Free Launcher	4.3	2696
25	Minimalist launcher for focus Before Launcher	4.4	2186
26	Focus - Be Productive!	4.5	2152
27	My Phone Time - App usage tracking - Focus enabler	4.4	2002
28	Usage Analyzer: Apps, Data & History	4.5	1685
29	Pomodoro Smart Timer - A Productivity Timer App	4.6	1287
30	Screen Time & Parental Control App by ZenScreen	4.1	1163
31	Brain Focus Productivity Timer	4.5	8947
32	SleepTown	4.4	6921
33	Engross: Focus Timer, To-Do List & Day Planner	4.4	5027
34	Visual Timer - Countdown	4.7	4702
35	Lock Me Out: Freedom from phone addiction	4.3	2920
36	HelpMeFocus - Block Apps, Stay Focused.	4	2873
37	Hold - make it happen	4.5	2386
38	Sma-Phospital	4	2203
39	Quiet for Gmail	4.7	1478
Academic apps including references			
1	Focus [57]	None	None
2	Socialize [61]	Not available	Not available
3	Toringo [1]	Not available	Not available
4	FeelHabits [9]	Not available	Not available
5	Coco's Videos [24]	Not available	Not available

6	MyTime [25]	Not available	Not available
7	Good Vibrations [54]	Not available	Not available
8	Let's FOCUS [29]	Not available	Not available
9	PomodoLock [30]	Not available	Not available
10	Interaction restraint [55]	Not available	Not available
11	GoalKeeper [31]	Not available	Not available
12	LocknType [32]	Not available	Not available
13	AppDetox [43]	4.4	3000
14	Lock n' LoL [35]	Not available	Not available
15	FamiLync [34]	Not available	Not available
16	NUGO [36]	Not available	Not available
17	The SAMS [39]	Not available	Not available

Table 1: The reviewed top rated digital wellbeing apps and academic apps, their user rating scores from 1 to 5, and their numbers of raters.

App ID	Tracking phone use	Tracking apps use	Visualizing tracked data - formats	Profiling users
Commercial apps				
1	None	Yes	Charts/Reports	None
2	None	None	Metaphors	None
3	None	Yes	Charts/Reports	None
4	None	Yes	Charts/Round diagrams/Reports	The app defines levels of phone addiction based on tracked data: addicted, obsessed, dependent, habitual, achiever and champion. The app categorizes some used apps as productivity apps (and not considered in addiction level)
5	None	Yes	Metaphors/Reports	None
6	Yes	Yes	Charts/Reports	None
7	None	Yes	Metaphors/Round diagrams/Charts/Reports	Usage patterns are extracted from user quiz
8	None	Yes	Round diagrams/Charts/Reports	None
9	None	Yes	None	User can create different profiles for limiting use based on time, location, Wi-Fi, usage limit, or launch count
10	None	Yes	Charts/Reports	User can create different profiles with different settings, i.e., daily usage limit.
11	None	Yes	Charts/Reports	None
12	None	Yes	Charts/Reports	The app categorizes used apps based on tracked data, i.e., social, entertainment, tools
13	Yes	None	Reports	Users can create goals to limit use time or to maximize valuable time.
14	Yes	None	None	None
15	None	None	Round diagrams/Charts/Reports for tracked offline activities	Users can set time to increase offline activities and track them.
16	None	Yes	Charts/Reports	None

17	None	Yes	Heatmap/Round diagrams/ Charts/Reports	The app categorizes used apps based on tracked data, i.e., social, news, productivity.
18	None	Yes	Charts/Reports	None
19	None	Yes	Round diagrams/ Charts/Reports	None
20	Yes	None	Charts	The app provides predefined levels of digital detox, i.e., easy, medium, hard, grand master
21	Yes	None	None	None
22	None	Yes	Charts/Reports	Users can add restrictions based on daily or week limits and launch count limit
23	None	Yes	Reports	None
24	None	None	None	None
25	None	None	None	None
26	Yes	None	Round diagrams	None
27	None	Yes	Charts/Reports	None
28	None	Yes	Round diagrams/ Charts/Reports	None
29	None	None	None	None
30	None	Yes	Round diagrams/ Reports	None
31	None	None	Charts/Reports	None
32	None	None	Metaphors/Charts for tracked offline activities	None
33	None	None	Reports for tracked offline activities	None
34	None	None	None	None
35	Yes	Yes	None	User can create predefined rules to lock phone on specific locations, times of day, total screen time.
36	None	Yes	None	Users can pay to create different profiles with different settings, i.e., work time
37	None	None	None	None
38	None	Yes	Charts/Reports for tracked activities	None
39	None	None	None	None
Academic apps				
1	None	Yes	Charts	None
2	Yes	Yes	Charts, Daily/Widget Recap	None
3	Yes	None	Floating widget	Users specify the total time screen
4	Yes	Yes	None	Users can choose temporal context restriction: "working days", "holidays", "morning", "afternoon", "night" and from 3 categories of screen time: multi-device apps, smartphone while using PC, multi device.
5	None	None	None	None
6	None	Yes	None	User can set daily time limit for the tracked apps

7	None	Yes	None	None
8	Yes	Yes	Timeline	The app can detect users' physical presence with periodic scanning of Wi-Fi fingerprints to provide location-based reminders of engaging in limited use with classmates
9	None	Yes	None	None
10	None	Yes	None	None
11	Yes	Yes	Timeline	User can create different use limits for weekdays vs weekends
12	None	Yes	None	None
13	None	Yes	Charts	None
14	None	Yes	Timeline	The app support setting use limit for a group of users
15	Yes	Yes	Timeline	None
16	Yes	Yes	Timeline	None
17	None	Yes	Timeline, charts	None

Table 3: Tracking functionality for phone/apps use, format for visualizing the tracked data, and user profiling based on tracked data

App ID	Setting scope of limited use	Setting place of limited use - locations	Setting place of limited use WIFI	Setting focus time for offline activities	Visualizing Time use limits; or time for offline focus activities	Option to use allowance beyond time limit/ focus limit	Option to exclude apps from time limit	Option to discontinue tracking when limit reached
Commercial apps								
1	Some apps	None	None	None	Time spent out of time limit; Progress bar gradually filled with color	None	Some Apps	None
2	None	None	None	Yes	Time unspent out of time limit; Countdown timer	None	None	None
3	Some apps	None	None	None	Time unspent out of time limit; Progress bar gradually filled with color	Extra time given by parents to children	Some Apps	None
4	All apps	None	None	None	Time spent out of time limit; Circle gradually filled with color	Phone use allowed after set time limit; with notification: small counter showing the time spent on that app for today	All Apps	None
5	Some apps	None	None	Yes	Time unspent out of focus time limit; Countdown timer	Two modes for setting focus time limit: strict mode where allowance can be requested when the target app cannot be open until user stops the timer; and normal mode when user can open any app.	Some apps	Yes
6	Phone	None	None	None	Time unspent out of time limit; Text	The first time when apps are used during the set time limit is free; but the following uses of the apps incur financial penalty	Some Apps	None
7	All apps	None	None	None	Time spent out of time limit; Text	None	Some Apps	None
8	Some apps	None	None	None	Time spent out of time limit; Text	None	Some Apps	None

9	Some apps	Yes	Yes	None	Time spent – tracked only; Text	None	All Apps	None
10	Some apps	None	None	Yes	Time unspent out of focus time limit; Countdown timer	Only calls allowed for set focus time limit	Some Apps	None
11	Some apps	None	None	None	Time spent – tracked only; Text	Friction: admin password must be entered in order to use the apps after the set time limit	None	None
12	Some apps	None	None	None	None	When the set time limit is reached, it can be ignored in 2 ways; to ignore the limit for today (whole day) or to choose “remind me in 15 mins”	Some Apps	None
13	Phone	None	None	None	Time spent – tracked only; Progress bar gradually filled with color	None	None	None
14	Phone	None	None	Yes	Time unspent out of time limit; Countdown timer	None	None	None
15	None	None	None	Yes	Time spent out of time limit; Text	None	None	None
16	Some apps	None	None	None	None	None	Some Apps	None
17	All apps	None	None	None	Time spent out of daily usage goal: Text	None	Some Apps	Yes
18	None	None	None	None	Time spent – tracked only: Text	None	None	None
19	Some apps	None	None	None	Time spent – tracked only; Text	None	Some Apps	None
20	Phone	None	None	Yes	None	Only calls allowed for set focus time limit	Some Apps	Yes
21	Phone	None	None	Yes	None	None	None	None
22	Some apps	None	None	None	None	None	Some Apps	None
23	All apps	Yes	None	None	Time spent out of time limit; Progress bar gradually filled with color	None	None	None
24	None	None	None	None	None	None	None	None
25	None	None	None	None	None	None	None	None
26	Phone	None	None	Yes	Time unspent out of focus time: Countdown timer;	Friction: Touch the screen while blocked for 5 sec to access	None	Yes

					Circle progressively unfilled with color	the 30 sec break out of focus time to use the phone		
27	All apps	None	None	None	Time overspent as % of time limit; Text	None	Some Apps	None
28	None	None	None	None	None	None	None	None
29	None	None	None	Yes	Time unspent out of time limit; Countdown timer	None	None	Yes
30	Some apps	None	None	None	None	Option ignore app from set time limit; no further notification for apps' overuse	Some Apps	Yes
31	None	None	None	Yes	Time unspent out of time limit; Countdown timer	None	None	None
32	None	None	None	None	None	None	None	None
33	None	None	None	Yes	Time unspent out of time limit; Countdown timer	None	None	Yes
34	None	None	None	Yes	Time unspent out of time limit; Circle progressively unfilled with color	None	None	Yes
35	Phone, all apps	Yes	None	None	None	Free access for 20 sec; end block with penalty, i.e., ~£4	Some Apps	None
36	Some apps	None	None	Yes	Time unspent out of time limit; Circle progressively unfilled with color	None	Some Apps	Yes
37	None	None	None	Yes	None	None	None	None
38	None	None	None	None	None	None	None	None
39	None	None	None	None	None	None	None	None
Academic apps								
1	Some apps	None	None	None	None	None	All apps	None
2	All apps, phone	Yes	None	None	Time spent per app - tracked only; Text, charts	Pop up notification with options: close the app, snooze, or delete	Some apps	Yes
3	Phone	None	None	None	Time spent out of time limit; Gradually filled with darker color - floating widget: > 50% (dark yellow), 75% (orange) and	None	None	Yes

Table 4: Monitoring functionality: setting use/focus time limits, scope and place of limited use, visualizing time limit, and flexibility through 3 options: use allowance beyond time limit, exclude apps from time limit, and for discontinuing tracking when limit was reached

App ID	Creating obstacles - types according to force (strong or weak)	Creating obstacles - saliency (explicit or implicit)	Creating obstacles - time (during use, after overuse)	Creating obstacles - social types	Creating obstacles levels tailored to user profile /preference	Creating obstacles - source (app vs user)
Commercial apps						
1	Strong: strict mode that prevents the child from editing the limits	Explicit; block	After overuse	Parental control	The profile is tailored to specific child by parent	Customized by parent
2	None	None		Social commitment	None	None
3	Strong: strict mode that prevents the child from editing the limits	Explicit; block	After overuse	Parental control	The profile is tailored by parent to specific child	Customized by parent
4	Weak: notification on time limit, block app; Strong: phone block.	Explicit; notification, block app, phone block.	After overuse; for not use (blocking phone)	None	3 levels of challenges: basic, moderate, advanced for specific apps or phone	Automatic
5	None	None	None	None	None	None
6	Strong: apps block	Explicit; block	After overuse	None	None	Customized by user
7	Weak: allows altering the limits	Implicit; screen dimming	After overuse	None	Flexible either take a quiz and tailored to user profile or customized as needed	Customized by user
8	Weak: users choose the obstacle: push notifications on overuse, pop up warning of overuse or Strong: app block	Explicit; notification & pop up warning, phone block	After overuse	None	Users can limit their usage based on categories of usage (Game, Entertainment, Education, Utility)	Customized by user
9	Strong: apps block	Explicit; block	During use	None	User choose which app to block	Customized by user
10	Strong: app block or phone block	Explicit: phone block, apps block	After overuse & for not use (blocking phone)	None	3 modes: normal, lock mode, strict mode	Customized by user

11	Strong: apps block or phone block	Explicit: phone block or apps block	During use or after overuse	Parental control	None	Customized by parents
12	Weak: pop up notification of reaching time limit that can be ignored	Explicit: pop up notification	After overuse	None	User preferences	Automatic
13	None	None	None	None	None	None
14	Strong: phone block	Explicit: phone block	For not use	None	User preferences	Customized by user
15	None	None	None	None	None	None
16	Strong: apps block	Explicit: apps block	After overuse	None	User preference: daily limit, scheduled limit, or timer	Automatic
17	Weak: push notification reminding users of today's usage timer	Explicit: push notification	After overuse	None	None	Automatic
18	None	None		None	None	None
19	Strong: apps block	Explicit; block	During use	None	None	Automatic
20	Strong: phone block	Explicit: phone block	For not use	None	User preference or tailored to user profile: easy, medium, hard, grand master	Customized by user
21	Strong: phone block	Explicit; block	During use	None	None	Automatic
22	Strong: apps block	Explicit: apps block	After overuse	None	User preference	Customized by user
23	None	None	None	None	None	None
24	None	None	None	None	None	None
25	None	None	None	None	None	None
26	Strong: phone block	Explicit: phone block	For not use	None	None	Customized by user
27	None	None	None	None	None	None
28	None	None	None	None	None	None
29	None	None	None	None	None	None
30	Strong: apps block	Explicit: apps block	After overuse	Parental control	None	Customized by parents
31	None	None	None	None	None	None
32	None	None	None	None	None	None
33	None	None	None	None	None	None
34	None	None	None	None	None	None
35	Strong: apps block	Explicit: apps block	Scheduled or after overuse	None	None	Customized by user

36	Strong: app block	Explicit: apps block	After overuse	None	Instant block or users can profile blocking	Customized by user
37	None	None	None	None		None
38	None	None	None	None	None	None
39	None	None	None	None	None	None
Academic apps						
1	Strong: app block	Explicit: app block	During use	None	User preference	Customized by user
2	Weak: pop un notification Strong: app block, phone block	Explicit: notification, app or phone block	During & after use	None	User preference	Customized by user
3	Weak: small floating widget turn to red-maroon color,	Explicit: red-maroon floating widget	After overuse	None	User preference	Automatic
4	Weak: pop up notification	Explicit: notification	After overuse	None	User preference	Automatic
5	None	None	None	None	None	None
6	Weak: pop up notification	Explicit: notification	After overuse	None	User preference	Customized by user
7	Weak: gentle vibrations every five seconds	Implicit: vibration	After overuse	None	User preference	Automatic
8	Strong: phone block Weak: notifications muted	Explicit: phone block, notifications muted	During use	classmates	User preference	Automatic
9	Weak: app block, deactivated if user stops the timer, mute notifications	Explicit: app block, mute notifications	During use	None	User preference	Customized by user
10	Prior interaction. Weak: entering 5 random numbers displayed Strong: entering more random number displayed	Explicit: friction; entering random numbers	Before use	None	User preference	Automatic
11	Weak: phone block followed by allowance time Strong: phone block until midnight	Explicit: phone block; friction: password must be entered in order to use the apps after the set time limit	After overuse	None	User preference	Customized by user

12	Weak: press ok to launch app Strong: enter 30 random digits displayed to launch app	Explicit: press ok, enter 30 random digits prior to launching specific app	Before use	None	User preference	Automatic
13	Strong: app block	Explicit: app block	During use & after overuse	None	The app provides rules for the user to choose from: specific daytimes, number of launches, usage time, activity based, some time, forever	Customized by user
14	Weak: mute all notification	Explicit: mute notifications	During use	None	None	Automatic
15	Strong: app block	Explicit: app block	During use	None	limiting mode overrides all apps except for checking a notification drawer	Automatic
16	Strong: app block	Explicit: app block	During use	None	None	Automatic
17	Strong: app block	Explicit: app block	After overuse	None	The app is tailored to elementary to high-school students	Automatic

Table 5:
Interventions for limiting use: creating obstacles for limiting use differing in force, saliency, temporality, sociality, user profile, and source

App ID	Notifications for reaching use limits	Notifications for reaching use limit - type	Notifications for reaching phone time limit on digital wellbeing app	Notifications on reaching app time limit - on those specific apps	Screen dimming for reaching use limit	Daily reminders to review tracked data
Commercial apps						
1	None	None	None	None	None	None
2	None	None	None	None	None	None
3	None	None	None	None	None	None
4	Yes	Explicit: push notification	Yes: time up	None	None	None
5	None	None	None	None	None	None
6	Yes	Explicit: pop up notification	Yes: lock icon next to app name	Yes: pop up notification	None	None

				and closing the app		
7	Yes	Implicit: screen dimming	Yes: time up	None	Yes	None
8	Yes	Explicit: push or pop up notification	None	Yes: push notification reminder	None	Yes
9	None	None	None	None	None	None
10	Yes	Explicit: pop up notification	None	Yes: pop up notification covers the app	None	None
11	None	None	None	None	None	None
12	Yes	Explicit: pop up notification	None	Yes: transparent pop up notification	None	None
13	Yes	Explicit: progress bar filled with color	Yes: progress bar filled with color	None	None	None
14	None	None	None	None	None	None
15	None	None	None	None	None	None
16	Yes	Explicit: pop up notification	None	Yes: pop up notification covers the app	None	None
17	Yes	Explicit: push notification	None	None	None	Yes
18	None	None	None	None	None	None
19	None	None	None	None	None	Yes
20	None	None	None	None	None	None
21	None	None	None	None	None	None
22	Yes	Explicit: push notification	None	Yes: pop up notification and closing the app	None	None
23	None	None	None	None	None	Yes
24	None	None	None	None	None	None
25	None	None	None	None	None	None
26	None	None	None	None	None	None
27	None	None	None	None	None	Yes
28	None	None	None	None	None	None
29	None	None	None	None	None	None
30	Yes	Explicit	Yes	Yes	None	Yes
31	None	None	None	None	None	None
32	None	None	None	None	None	None
33	None	None	None	None	None	None
34	None	None	None	None	None	None

35	Yes	Explicit: pop up notification	None	Yes: pop up notification and closing the app	None	None
36	Yes	Explicit: pop up notification	None	Yes: pop up notification and closing the app	None	None
37	None	None	None	None	None	None
38	None	None	None	None	None	None
39	None	None	None	None	None	None
Academic apps						
1	None	None	None	None	None	None
2	Yes	Explicit: pop up notification	Yes	Yes	None	None
3	Yes	Explicit: notification from the conversational agent (chatbot)	Yes	None	None	Yes
4	Yes	Explicit: pop up notification	None	Yes	None	None
5	None	None	None	None	None	None
6	Yes	Explicit: pop up notification	None	Yes	None	None
7	Yes	Explicit: gentle vibration	None	Yes	None	None
8	None	None	None	None	None	None
9	None	None	None	None	None	None
10	None	None	None	None	None	None
11	Yes	Explicit: notification dialog	None	None	None	None
12	None	None	None	None	None	None
13	Yes	Explicit: pop up notification	None	Yes	None	None
14	None	None	None	None	None	None
15	None	None	None	None	None	None
16	None	None	None	None	None	None
17	Yes	Explicit: pop up notification	None	None	None	None

Table 6: Interventions for limiting use: supporting awareness for reaching the set limit of use through different notification types, screen diming, and daily reminders.

App ID	Supporting focused attention - training	Supporting focused attention - white noise
Commercial apps		
1	None	None
2	Yes	Yes
3	None	None
4	None	None
5	Yes	Yes
6	None	None
7	None	None
8	None	None
9	None	None
10	None	None
11	None	None
12	None	None
13	None	None
14	None	None
15	Yes	None
16	None	None
17	None	None
18	None	None
19	None	None
20	None	None
21	None	None
22	None	None
23	None	None
24	None	None
25	None	None
26	Yes	None
27	None	None
28	None	None
29	Yes	Yes
30	None	None
31	Yes	None
32	None	None
33	Yes	Yes
34	None	None
35	None	None
36	None	None
37	Yes	Yes
38	None	None
39	None	None
Academic apps		
1	None	None
2	None	None
3	None	None
4	None	None
5	None	None
6	None	None
7	None	None
8	Yes	None
9	Yes	None
10	None	None

7	Punitive	None	Screen dimming	8 days course for phone/life balance	Friends	None	Yes	Yes
8	Rewarding	Inspiring quotations	None	Option for user generated motivational text that appears when exceeding limit	None	None	None	None
9	None	None	None	None	None	None	None	None
10	None	None	None	Option for user generated motivational text that appears when the app is blocked	None	None	None	None
11	Punitive	None	Parents can lock the phone of the child with a button press	None	Family	None	None	None
12	None	None	None	None	None	None	None	None
13	None	None	None	None	None	None	None	None
14	None	None	None	None	None	None	None	None
15	None	None	None	None	None	None	None	None
16	None	None	None	None	None	None	None	None
17	None	None	None	Option for user generated motivational text that appears when exceeding limit	None	None	None	None
18	None	None	None	None	None	None	None	None
19	Rewarding	Levels: bronze, silver, gold, platinum, iron, titanium, vibranium, adamantium	None	None	None	None	None	None

20	Rewarding	Points that can be used at Google Play Games	None	Suggestions for offline activities, i.e., "Ride a bike", "Look at the clouds", "Daydream", "Write a letter", shown on the screen under the time left to use the phone	None	None	None	None
21	None	None	None	None	None	None	None	None
22	None	None	None	None	None	None	None	None
23	None	None	None	None	None	None	None	None
24	None	None	None	Launcher showing the minimum number of apps according to the user needs	None	None	None	None
25	None	None	None	None	None	None	None	None
26	None	None	None	None	None	None	None	None
27	None	None	None	None	None	None	None	None
28	None	None	None	None	None	None	None	None
29	None	None	None	None	None	None	None	None
30	None	None	None	None	Family	None	None	None
31	None	None	None	None	None	None	None	None
32	Rewarding, punitive	Virtual town will be built	If using phone during bed time the user's virtual building will collapse	None	Friends	Yes	Yes	Yes
33	None	None	None	When user feels distracted, can click in the circle and the apps counts	None	None	None	None

				the number of distractions and save it in history. It does not support specifying the type of distraction				
34	None	None	None	None	None	None	None	None
35	Punitive	None	Paying a penalty to end lockouts early	None	None	None	None	None
36	None	None	None	Option for user generated motivational text that appears when the app is blocked	None	None	None	None
37	Rewarding	Points	None	None	Family, friends, wider social network	Yes: Engage together in focus time	Yes: add friends and compete to win	Yes: unlock rewards
38	None	None	None	None	None	None	None	None
39	None	None	None	None	None	None	None	None
Academic apps								
1	None	None	None	None	None	None	None	None
2	None	None	None	None	None	None	None	None
3	None	None	None	None	None	None	None	None
4	None	None	None	None	None	None	None	None
5	None	None	None	None	Family	Yes: parent intervention when the child uses the video platform	None	None
6	None	None	None	None	None	None	None	None
7	None	None	None	None	None	None	None	None
8	None	None	None	None	classmates	None	Yes: ranks based on focus time	Yes: ranks based on focus time among classmates

9	None	None	None	None	None	None	None	None
10	None	None	None	None	None	None	None	None
11	None	None	None	None	None	None	None	None
12	None	None	None	None	None	None	None	None
13	None	None	None	None	None	None	None	None
14	Rewarding	Points	None	None	Friends	Yes: limit together and focus on specific task	None	None
15	Rewarding	Points	None	None	Family	None	Yes: ranks based on points	Yes: summary of family limit state
16	Rewarding	Points	None	None	Friends, Family	None	Yes: ranks based on points	Yes: summary of group limit state
17	None	None	None	None	None	None	None	None

Table 8: Interventions for limiting use: Supporting motivation to keep within limited use involving different types and content, as well as social support of different types involving cooperation, competition and associated social recognition

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