Brainy: a Virtual Pet Encouraging Digital Wellbeing

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Abstract

Nowadays, people struggle to find a balance with their smartphone use. Existing tools for digital-self control have proven ineffective in the long term due to their over-restrictive nature. In this paper, we developed Brainy, a gamified mobile application that encourage users towards healthy digital habits using a virtual brain pet that reflect the state of the user's brain concerning their digital wellbeing. Through a 10-day in-the-wild study with 17 users, we found that the app effectively enhanced users' awareness of their smartphone usage patterns and its consequences on their brains. Gamification elements, such as the daily wellbeing bar, were well-perceived by users, helping them reflect and motivating towards healthier habits thus showing promising opportunities for supporting digital wellbeing. Our findings open the way for the use of gamification elements in digital wellbeing apps to better support people.

CCS Concepts

• **Human-centered computing** → **Mobile phones**; *Field studies*; *Empirical studies in HCI*.

Keywords

Digital Wellbeing, Gamification, Smartphone Addiction

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1 Introduction & Background

The pervasive presence of technology today offers many opportunities and advantages that can support people in a wide range of tasks. However, this also comes with several downsides. It has been shown that technology overuse can lead to many negative consequences for daily activities [1, 6], while the Fear Of Missing Out (FOMO) can cause stress and anxiety [5].

It is important to help people regain the ability to self-regulate their technology usage, especially in a world that increasingly encourages compulsive use. Many social media platforms today are part of the so-called "attention economy" [3], which represents their main business model. Their goal is to retain users' attention and time in order to monetize it. To achieve this, they exploit Attention Capture Deceptive Patterns (ACDPs), such as infinite scroll, pull-to-refresh, and many others, which leverage involuntary psychological mechanisms to keep people hooked on their smartphones [9]. This is why many users report the sensation of falling down a "rabbit hole" when they become trapped in prolonged smartphone usage [12].

In response to this problem, the concept of digital wellbeing emerged. Although many definitions of digital wellbeing exist, it can generally be described as maintaining a healthy balance in technology use, such that it provides benefits without causing harm. In an effort to support people in achieving digital wellbeing, many tools with a wide range of functionalities have been developed. These tools are known as Digital Self-Control Tools (DSCTs). They can offer functionalities ranging from monitoring time and activities on the smartphone to blocking the device or individual applications, or setting time limits [10].

Unfortunately, current DSCTs share several limitations that undermine their effectiveness. They often adopt one-size-fits-all approaches [10] and fails to achieve the goal of restoring users' autonomy due to being effective, usually, only as long as people actively use them. Moreover, they are often not grounded in solid foundations, such as psychological and behavioral change theories [10].

Gamification has rarely been employed in DSCTs, although it has shown positive results in behavioral change applications and mental health apps [4]. Our goal is to design a gamified application to encourage healthy digital habits by fostering empathy with a virtual pet that represents user brain. The core concept we adopted is that of a virtual pet whose wellbeing state mirrors that of the user and their own brain, thereby encouraging users to care after the pet both for its own sake and as a reflection of caring for themselves.

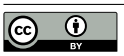
In particular, the pet's wellbeing is influenced by the user's daily activities, both those performed with the smartphone and those carried out offline, as well as by the effects of these activities on the user's brain. To represent these effects, we drew inspiration from neuroscience literature, considering the impact of activities on eight neurotransmitters and on overall wellbeing [2, 8]. To clearly convey this concept to users, we designed the pet in the form of a cartoon brain that interacts with and encourages them. Hence the name: Brainy.

2 Brainy Application

2.1 Application Design

While designing the gamification elements to be included in our application, we selected three main tools:

- **Virtual pet**, which mirrors the user's mental state and encourages the wellbeing of both the pet and the user;
- **Wellbeing bar**, which represents the balance to be maintained daily in technology usage;



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- **Wellbeing streak**, which encourages users to remain consistent and persist in adhering to their goals over time.

2.1.1 Virtual pet. The concept of Brainy as a virtual pet has been deeply influenced by well-known examples such as Pou [1] and Tamagotchi [2], which have engaged multiple generations of players by encouraging them to care for a virtual pet in order to keep it alive and well. In the context of digital wellbeing applications, this concept has already been adopted in a similar manner by Forest [3]; however, our goal is to establish a deeper connection between the user and the pet, so that users are intrinsically motivated to keep it healthy.

In our case, the pet reflects the consequences of the user's daily activities on their brain, allowing users to better understand how different activities affect their brain and overall wellbeing. For this reason, we chose a virtual brain pet as a natural representation of this concept, as shown in Figure 1a. The only way to keep the pet healthy is by maintaining healthy habits. Brainy is influenced by two different types of activities. Online social media activities are automatically detected by the app and have a negative impact on the pet, while users can manually add offline activities through the interface shown in Figure 1b. Added activities are visually represented as food items that users can feed to the pet.

Each activity contributes both to the overall wellbeing percentage and to specific neurotransmitters. Based on neuroscience literature [2, 8], we estimated the impact of different types of activities on general wellbeing and on the presence of eight different neurotransmitters. These contributions represent an estimated impact expressed as a percentage score and do not directly correspond to precise real-world measurements. By clicking on the corresponding brain region, users can access more information about each neurotransmitter; an example of this interaction is shown in Figure 1c.

2.1.2 Wellbeing bar. The wellbeing bar, visible on the homepage (Figure 1a) below Brainy, graphically represents the overall state of Brainy and, consequently, the user's brain, as calculated from the daily registered activities. The wellbeing bar starts full at the beginning of each day. Automatically detected social media activity negatively affects the percentage, while users can rebalance it positively only by manually adding offline activities performed during the day.

All activities are listed in the history page (Figure 1d), where users can view detailed information about the impact of each activity on overall wellbeing and on individual neurotransmitters. In the current version of the app, an arbitrary threshold value of 60% was chosen as the minimum daily wellbeing level. If the value at the end of the day is equal to or greater than 60%, the user maintains their wellbeing streak.

2.1.3 Wellbeing streak. The wellbeing streak (Figure 2a) is inspired by streak-based gamification mechanisms found in applications such as Duolingo[4] and LinkedIn games[5]. The idea is that as users continue to use the app, the streak increases, and the higher it becomes, the stronger the motivation to avoid losing it. This gamification mechanism is expected to show its value over longer periods [11].

2.1.4 Other mechanics. In addition to the previously described gamification mechanics, the app includes several other functionalities. An initial tutorial (Figure 2b) is automatically activated on first login and remains optionally accessible during future sessions. The tutorial briefly explains the main features of the app, facilitating the onboarding process.

The app also sends notifications to users in specific situations. For example, if a session of compulsive usage of an application is detected, a notification is sent to inform the user and suggest changing activity. Additionally, users may receive an evening reminder to add their offline daily activities. Examples of these notifications are shown in Figures 2c and 2, respectively.

2.2 Implementation

The Brainy mobile application was developed using React Native as the main programming framework. A native Kotlin module was implemented to enable the collection of smartphone usage data through interaction with the Android operating system. A Google Firebase Realtime Database was used to store all necessary information. The application was deployed exclusively in Italian, as the user study discussed in the following Section involved only Italian-speaking participants.

3 User Evaluation

3.1 Methodology

We conducted a 10-day in-the-wild study selecting individuals over 18 years old, owning an Android smartphone, and self-reporting problematic smartphone use. 17 participants (8 women) were recruited through snowball sampling. Most of them were young adults, with 12 aged 25–34 and the remaining 5 aged 18–24. All participants provided informed consent before taking part in the study.

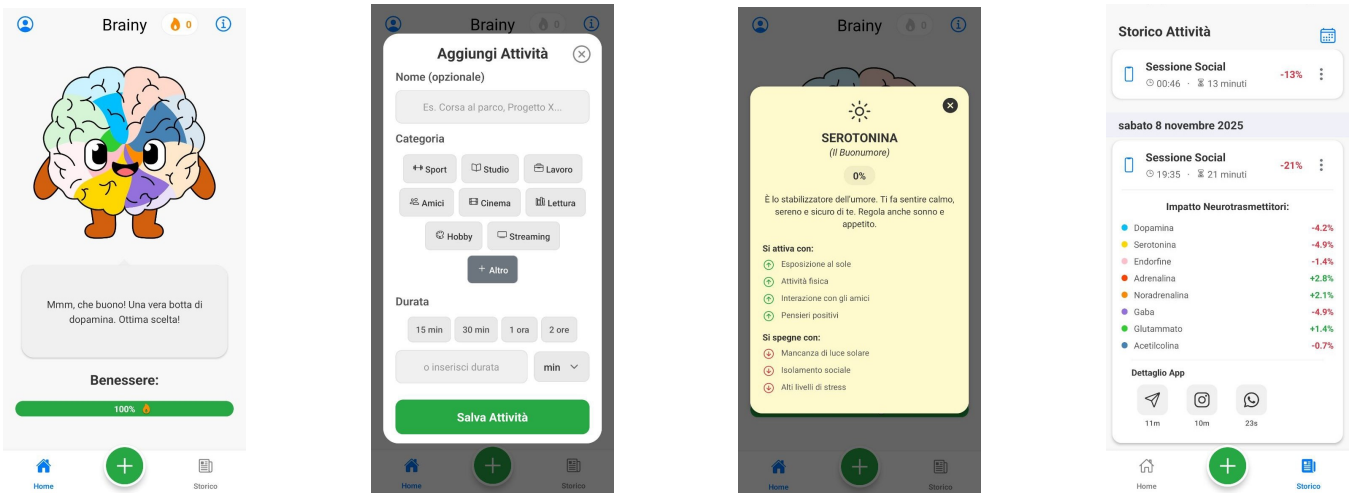
After giving consent and completing an initial screening form to assess their suitability, participants were provided with the APK file of the deployed Brainy application and guided through its installation. They were instructed to freely use the app for 10 days. The app automatically collected usage date during the evaluation and in the 7 days before. At the end of this period, participants completed a questionnaire that included general feedback about the app in the form of open comments and likert-scale questions as well as the System Usability Scale (SUS) [7].

3.2 Results

The results of the study can be examined from three perspectives. First, the usability of the system was evaluated. Second, quantitative data were collected from the database, including the number of interactions and time spent on the smartphone, altogether with answers on the final questionnaire. Finally, qualitative data were obtained from user feedback.

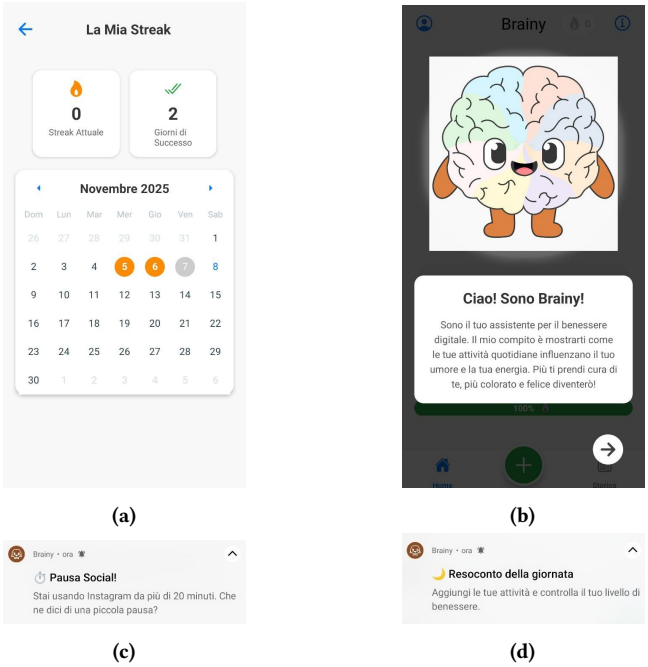
The system achieved a mean SUS score of 87.94 (SD = 8.01), corresponding to an "Excellent rating". Participants reported that the system was easy to use and understand. Some opportunities for

[1] https://www.pou.me/
[2] https://tamagotchi-official.com/
[3] https://www.forestapp.cc/
[4] https://www.duolingo.com/
[5] https://www.linkedin.com/games



(a) (b) (c) (d)

Figure 1: Screenshots from various pages of the app Brainy.



(a) (b) (c) (d)

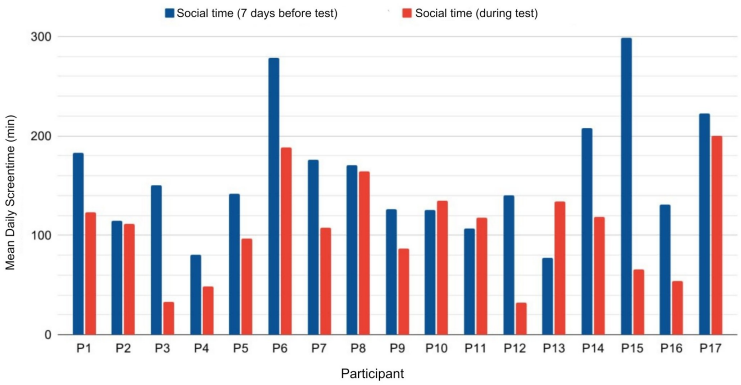
Figure 2: Screenshots from pages and notifications of the app Brainy.

improvement were identified, particularly in terms of integrating the app's different functionalities more seamlessly.

Usage data from participants (Figure 3a) showed a decrease in smartphone usage compared to the seven days preceding the study. All users except three exhibited a reduction in time spent on their smartphones, ranging from negligible decreases for participants P2 and P8 to more substantial reductions for participants such as P3 and P15. Data from the week prior to the study were collected through native APIs and were already aggregated, differing from the more granular data collected during the study. During the study, it was possible to distinguish shorter sessions, which could be classified as non-compulsive, from longer, potentially compulsive sessions.

As expected, participants displayed high curiosity toward the system in the first days of the study, frequently exploring the neurotransmitter explanations associated with the digital wellbeing bar. This initial interest tended to decline over time, although with individual differences: some participants regained interest at certain points, while others maintained moderate curiosity throughout the entire study. In contrast, regarding the logging of offline activities, some participants were more consistent across the 10 days, whereas others were discontinuous in recording activities or stopped midway. In total, 683 offline activities were recorded. On average, 68.3 (SD = 17.33) activities were registered per day across participants, while each participant recorded a mean of 40.18 activities over the study period (SD = 17.15). Notably, comparing the number of activities with the digital wellbeing score (Figure 3b), a high number of daily registered activities did not always correspond to a high digital wellbeing score.

Answering on 1-5 likert questions, results shows that users clearly understood the link between their actions and Brainy's visual feedback (M = 4.18), though the perceived accuracy of the avatar in reflecting users' emotional state was more moderate (M = 3.18). Among the gamification elements, the Wellbeing Bar was the most motivating (M = 3.65), followed by caring for the avatar and maintaining a streak (both M = 3.18), while generic textual advice was less impactful (M = 3.00). The app had a strong effect on digital self-awareness (M = 3.94), with most participants identifying previously unrecognized unhealthy habits; however, encouragement to actively change behavior was weaker (M = 3.24). Specific behavioral tips were rated as moderately useful (M = 2.82), whereas theoretical information on neurotransmitters was highly appreciated (M = 4.47).



(a)

Day of test

Participant	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
P1	100	61.4	0	66.2	40.1	44.4	38.5	48.1	100	100
P2	65	7.4	100	100	0	0	100	35.2	0	100
P3	100	100	64.1	60.8	53.8	69	70.6	86.3	0	100
P4	100	100	100	100	100	89.6	100	100	100	100
P5	100	100	26.2	100	0	100	100	0	100	31.4
P6	80.1	100	34	100	0	93	90.3	100	0	0
P7	56.1	76.2	96	86.1	45.3	38.3	70.3	84.3	100	57.3
P8	0	100	93.1	0	38.3	0	100	0	100	0
P9	100	63.1	49.8	100	100	0	100	38.2	14.1	100
P10	0	86.4	37.1	0	100	0	81.2	0	100	100
P11	40.1	63.6	25.2	12.1	41.2	0	100	0	100	0
P12	100	100	100	54.4	100	100	0	0	0	100
P13	100	0	100	26.3	0	0	100	100	100	100
P14	22.2	45.4	100	93.5	0	100	79.4	100	100	24.8
P15	100	100	100	100	100	100	76.5	100	71.5	100
P16	0	0	32.4	100	23.3	100	0	100	0	82.5
P17	0	0	0	0	71.4	0	0	0	0	0

Score ≥ 60% 30% ≤ Score < 60% Score < 30%

(b)

Figure 3: The graph in Figure (a) shows the mean amount of time in minutes that each participants spent on their smartphone, comparing in blue the time of the seven days before the test and in red the time relative to the days of the test. Figure (b) shows the daily score obtained on the digital wellbeing bar by participants.

Notifications were generally well accepted, with most users judging their frequency as appropriate. User feedback also highlighted technical issues with background monitoring and suggested improvements such as adding widgets and implementing more differentiated weighting of social applications.

4 Discussion

Overall, the app proved to be positive in terms of usability, as reflected in its SUS score. Moreover, most participants reported reduced screen time during the study compared to the week prior. Although a 10-day period is not sufficient to draw conclusions about lasting habit change and considering that the observed reduction may have been influenced by the novelty, these results remain promising and future studies could assess whether this decrease persists over longer periods.

Among the gamification elements, the Wellbeing Bar was the most appreciated by users, primarily due to its immediacy and clarity. Given the short duration of the study, this result was unsurprising: users were able to observe and interact with the wellbeing bar daily and add activities to maintain a positive score. Users did not report downsides to this mechanic, in contrast with the streak feature. Many participants reported that the streak caused feelings of anxiety, as forgetting to log activities for a day resulted in losing the streak, which they found demotivating. The short duration of the study likely contributed to this effect: streak-based gamification mechanisms becomes more effective over longer periods, when users have the chance to build a substantial streak and motivation to maintain it [11]. Nevertheless, anxiety reported by users should not be overlooked. One potential improvement is the introduction of streak-freezers, as implemented in commercial apps, which could reduce stress and prevent users from feeling penalized for missing a single day.

The wellbeing pet, with explanations about neurotransmitters, was appreciated for clarity and ease of communication, suggesting that refinements may make it a mirror effectively encouraging digital wellbeing. The main limitation was the generality of its suggestions and dialogues. Integrating AI could enable more personalized messages, increasing user engagement. Some participants also reported that the pet appeared too childish, suggesting two possible directions: (i) redesigning it to appear less cartoonish to better engage an adult audience, or (ii) targeting a younger audience who may find the current design more suitable and engaging.

4.1 Limitations

To further validate the applicability of this approach, additional and longer-term evaluation is required. Longer usage periods are necessary to determine whether the application can induce lasting behavioral changes and promote digital wellbeing. Moreover, future studies should include a more diverse set of users, not limited to Italian Android users, and participants with a broader range of ages. The neurotransmitter system should also be revised to more closely align with neuroscience evidence, potentially incorporating both negative offline activities and positive online activities. Finally, some participants' experiences were affected by technical bugs, which will be addressed in future versions of the app.

5 Conclusion

The approach of promoting digital wellbeing through a virtual pet that mirrors the user's wellbeing and brain state has shown promising results. Users found the app highly usable and engaging. Certain gamification mechanisms, such as the Wellbeing Bar, were better received than others, like the streak. Implementing the suggestions provided in user feedback, addressing minor technical issues, and conducting more extensive evaluations may pave the way for a novel approach to supporting digital wellbeing emotionally engaging users and encouraging positive behavioral change.

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