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Original
Trigger-action Programming for Wellbeing: Insights from 6,590 iOS Shortcuts / Monge Roffarello, Alberto; Purohit, Aditya Kumar; Purohit, Satyam V. - In: IEEE PERVASIVE COMPUTING. - ISSN 1536-1268. - STAMPA. - 23:3(2024), pp. 49-56. [10.1109/MPRV.2024.3416698]

Availability:
This version is available at: 11583/2989590 since: 2024-07-22T12:18:36Z

Publisher:
IEEE

Published
DOI:10.1109/MPRV.2024.3416698

(Article begins on next page)

Trigger-action Programming for Wellbeing: Insights from 6,590 iOS Shortcuts

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Abstract—Trigger-Action Programming (TAP) platforms allow users to personalize their digital ecosystems through the definition of trigger-action rules such as "if I'm leaving home, then turn the smart thermostat off." Yet, little is known about whether such a paradigm can be used to support users' wellbeing. To bridge this gap, we scraped 6,590 trigger-action programs from iOS Shortcuts, and analyzed the dataset to understand what aspects of their wellbeing users are already programming and what opportunities remain untapped. Findings show that users are only capturing a fraction of this opportunity, with a majority of wellbeing-related programs targeting health and physical exercise. To shed light on an under-exploited use case, we showcase two interventions for digital self-control developed through iOS Shortcuts, highlighting challenges and opportunities to use TAP as a viable option to improve existing digital habits and self-regulate technology use, thus mitigating the negative effects of excessive digital engagement.

1. Introduction

The proliferation of interconnected devices and online services enabled by the Internet of Things has highlighted the need for empowering end users to personalize their digital ecosystems [1], with the home environment being one of the most targeted environment [2], [3]. Trigger-Action Programming (TAP) is one of the most used programming paradigms for this purpose [1], enabling users to define rules through which one or more actions are automatically executed whenever a specific event (the trigger) happens, such as "if I'm leaving home, turn the smart thermostat off." In today's digital landscape, numerous TAP platforms empower users to fully embrace these these trigger-action automations, ranging from the well-established and popular IFTTT[1] to the cutting-edge and proprietary solutions like iOS Shortcuts[2].

The pervasive and constant presence of technology in our homes raises opportunities and concerns at the same time. In particular, a new research area in HCI has emerged around the topic of "digital wellbeing," defined by Burr et al. [4] as *"the impact of digital technologies on what it means to live a life that is good for a human being in an information society"* (p. 2313). On the one hand, smart devices and the possibility to personalize them potentially empower users to tailor their technology experiences to suit their individual needs and preferences, supporting their comfort and wellbeing. On the other hand, users' wellbeing is often undermined by the ability of technology to to capture and hold the user's attention: devices pervading our homes – especially those used for entertainment such as smart TVs and smartphones – host interfaces that intentionally make use of "attention-capture" design patterns, from content autoplay to guilty-pleasure recommendations, strategically exploiting users' psychological vulnerabilities to maximize metrics like time spent and daily visits [5].

Recently, researchers have spotlighted the potential of TAP platforms like iOS Shortcuts in use cases that go beyond traditional home-automation personalization and extends to users' wellbeing, e.g., to control and monitor social networks (over)use [6], [7]. While TAP is not the only and prevalent method to support wellbeing, it offers a potential paradigm shift compared to existing wellbeing apps. Specifically, TAP empowers users to create personalized workflows that

Digital Object Identifier 10.1109/XXX.0000.0000000

[1] https://ifttt.com/explore, last accessed: July 22, 2024

[2] https://support.apple.com/guide/shortcuts/welcome/ios, last accessed: July 22, 2024

address their specific and current needs, transforming users from passive consumers into active creators. Researchers have advocated for this level of personalization to enhance the long-term effectiveness of modern wellbeing apps, such as Digital Self-Control Tools (DSCTs) [8]. These tools frequently fall short in adapting to users' individual preferences and contexts, as they are primarily built upon a limited set of predefined intervention strategies [9], [10]. Yet, whether and how TAP could be used to support users' wellbeing in their digital ecosystems – including the home – is still unclear: what aspects of their wellbeing are end users already "programming" through TAP? What opportunities remain untapped? To answer these questions, we first scraped and analyzed 6,590 trigger-action programs publicly shared on a large catalog of iOS Shortcuts as of June 2023, releasing the dataset to other researchers. Despite the potential of TAP platforms to support wellbeing, our findings indicate that users are only capturing a fraction of this opportunity, with only 6.08% of programs developed for this purpose, encompassing a range of personalized interventions from health-related reminders to programs that targets emotional and social wellbeing. Furthermore, we found that just 0.61% of Shortcuts focus on improving digital habits and overcoming technology overuse, e.g., to silence personal devices while sleeping. In light of the increasing interest expressed by users in addressing technology overuse concerns [11], we view this as a missed opportunity that holds potential for exploration. We conclude the paper by showcasing two examples of interventions for digital self-control developed through iOS Shortcuts, discussing the challenges and opportunities associated with this innovative application of trigger-action programming.

2. Background and Related Work

Programming the Smart Home

Several previous works in the HCI community demonstrated the effectiveness of adopting TAP to personalize the functionality of smart devices and online services in the home environment [2], [3], [12], [13]. TAP allows users to connect pairs of devices or online services in such a way that, when an event is detected on one of them, e.g., a weather service is forecasting thunderstorm, an action is automatically performed on the other, e.g., to close a smart window. The work by Ur et al. [2] demonstrated that most of the automation desired by end users in the smart home context can be expressed through trigger-action programming. De Russis and Corno [12] proposed a set of guidelines for TAP solutions for the smart home. Stemming from these guidelines, the authors developed HomeRules, a mobile and tangible TAP tool specifically designed for smart homes' inhabitants. Recently, Mattioli and Paternò [13] developed an Augmented Reality app for creating automations in smart homes in a flexible and situated way.

Given this body of knowledge, it is not surprising that commercial TAP platforms, from IFTTT to iOS Shortcuts, are becoming widespread. The Apple automation tool, specifically, empowers users to automate tasks across their Apple devices and, similar to IFTTT, allows the integration of external applications, making home automation one of the most popular use cases [14]. Users can therefore define trigger-action automations, called "shortcuts," such as "if I'm home at 10 PM, remind me to sleep," or "when the entrance security system arms, turn on the kitchen's lamp." A shortcut is composed of *actions*, which are the building blocks of a task. Users can combine actions from multiple sources, including Apple apps and smart home devices, third-party apps, and online resources. Actions are executed sequentially, similar to lines of code in a programming language. Shortcuts can then be automated based on triggers, called *automations*, such as opening an app or a specific time. This paper focuses on the iOS Shortcuts platform due to its relative lack of research attention compared to similar apps, e.g., IFTTT. By releasing a dataset of trigger-action automation for the Apple ecosystem, we aim to inspire future research and facilitate comparative analyses with existing TAP datasets [3].

Smart Homes and Digital Wellbeing

As discussed by Burr et al. [4], the pervasive presence of technology in our homes has the potential to support our everyday activities and promote physical and mental health, but it also raises concerns about its negative impacts on our wellbeing. This work investigates whether and how end users are making use of iOS Shortcuts to support and mitigate these conflicting aspects, and shows concrete examples of digital wellbeing interventions for digital self-control developed through the Apple automation tool. Indeed, one of the most well-documented concerns regarding the impact of pervasive devices and online services on user's wellbeing – which we target through our digital self-control interventions – is related to the fact that technology use is continuously increasing among users, often more than intended. Numerous experiments have demonstrated that an excessive use of smart devices and their digital services result in adverse effects on users' daily activities and ongoing tasks [15], leading people to experience an undermined sense of agency [16] and lower opportunities for good social interactions. Moser et al [17], for example, showed how using smartphones during mealtimes can create tensions among families. An experiment conducted by Monge Roffarello et al. [11] instead revealed that participants perceived using Instagram immediately upon waking up to be an addictive and compulsive behavior, often leading to a sense of regret. This body of evidence has given rise to a range of different DSCTs [9], i.e., mobile applications or web browser extensions that assist users in self-regulating the usage of other distractive apps or websites. Recently, researchers have spotlighted the potential of iOS Shortcuts as a means to develop interventions that support users' digital self-control, e.g., to monitor time spent on Facebook [7] or limiting Instagram use [6]. Our work aims to uncover such an underexplored possibility.

3. Case Study: iOS Shortcuts

Methodology

We scraped all the shortcuts shared on RoutineHub[3], one of the most popular online catalogs for the Apple's automation tool, as of June 4, 2023. Our analysis aimed to determine whether TAP is currently being employed for purposes beyond its traditional role in personalizing behaviors related to comfort and utility, highlighting trends, challenges, and opportunities for expanding its scope to personalization whose primary purpose is to support users' digital wellbeing. To perform the scraping, we wrote a web scraper using the Selenium browser-automation framework[4]. The scraper extracted relevant information by examining specific HTML tags on each shortcut's webpage, writing them in an Excel file. The following scraped shortcut exemplifies what the dataset includes:

- **ID:** 5391
- **Title:** Set Hue light by Temperature
- **Description:** Set Hue light by Temperature Sets a Philips Hue light to a different color depending on the predicted temperature for today
- **Author:** @rda
- **Version:** 1.1
- **iOS:** 13
- **Updated:** 25/05/20
- **Downloads:** 589
- **Categories:** Lifestyle
- **Required Apps:** Philips Hue

The dataset and the results of the coding procedure explained in Section 3 are publicly available at https://osf.io/p9udq/. Each shortcut included in the dataset can be easily accessed and installed by using the following link, replacing ***[ID]*** with the specific shortcut ID number: https://routinehub.co/shortcut/***[ID]***.

Results

Our dataset comprises a total of 6590 shortcuts created by 1870 unique authors. The number of shortcuts created by each author ranged from 1 to 108, with an average of 7.01 (SD = 151.61). Notably, the distribution was skewed, with a majority of authors (52.13%) contributing only a single shortcut. Conversely, a smaller proportion (6.79%) were prolific creators, publishing more than 10 shortcuts. This distribution aligns with findings from other TAP datasets [3]. As in other platforms, shortcuts shared on RoutineHub can also be adopted by other users: in total, shortcuts in our dataset have been downloaded more than 6 million times as of June 4, 2023, with a median number of downloads for each shortcut of 375 (IQR = 594). Most of the shared programs have a top-level category that falls into *Development Tools* (795), *Entertainment* (716), *Productivity* (666), *Utilities* (654), or *Photo & Video* (464), suggesting that many of these shortcuts are related to productivity tasks, media handling, communication, and organization.

Building upon our initial analysis, we further explored the dataset to determine how extensively end users are creating shortcuts that address their well-being needs. To code the dataset, in particular, we used the Eight-Dimensional Model of Wellbeing [18], which views wellbeing as a holistic balance of physical, emotional, social, intellectual, spiritual, occupational, financial, and environmental aspects. Specifically, we first assessed each shortcut's action or function and classified it as wellbeing related if it met any of the following criteria: a) it enhances or supports a specific aspect of wellbeing as defined by the Eight-Dimensional Model, b) it facilitates behaviors known to contribute to overall wellbeing, or c) it addresses challenges that can hinder wellbeing (e.g., managing finances, reducing stress). For shortcuts identified as relevant to wellbeing, we then coded them into one of the eight dimensions of the exploited model. During this process, we again considered the specific action or function the shortcut facilitated and how it related to the corresponding dimension's definition. To ensure inter-coder reliability, we (the three authors of this

[3]https://routinehub.co/, last accessed: July 22, 2024
[4]https://www.selenium.dev/, last accessed: July 22, 2024

paper) independently coded the dataset and then met to discuss and resolve any discrepancies.

Overall, we found 401 shortcuts (6.08% of the total) related to various dimensions of users' wellbeing (see Figure 1).

The majority of these shortcuts (133) relate to users' **physical** well-being, encompassing programs that automatically log health-related information, such as weight data and blood pressure, and programs that remind users to engage in more physical activity or sleep more. The shortcut #5392, for example, is used to fade out Philips Hue lights at bedtime, while the shortcut #162 automates logging drunk water.

A good number of other shortcuts target either **social** (72) or **financial** (66) wellbeing. Social wellbeing prioritize feelings of being supported by others and connected to our community. Shortcuts in this category are used by users to support their connection with friends, e.g., through social media challenges such as the one exemplified by shortcut #10702, and support their family life, e.g., to automatically send updates to the partner regarding a newborn baby (shortcut #4741). Financial wellbeing, instead, refers to one's ability to manage money and meet financial needs. This category offers shortcuts like bill-splitting programs (e.g., shortcut #5530), expense and tip trackers (e.g., shortcut #182), and even automatic tax calculators (e.g., shortcut #395), helping users manage their finances effortlessly.

Two other dimensions of well-being targeted by a limited number of shortcuts in the dataset are **occupational** wellbeing (43), addressing the relationship between well-being and work, and **intellectual** wellbeing (31), focusing on our ability to learn and grow. Work-related shortcuts include, among others, programs that automatically initiate Pomodoro timers to support focused work sessions (e.g., shortcut #944), and automatic trackers for monitoring work time and setting healthy work-life boundaries (e.g., shortcut #195). Intellectual-supportive shortcuts offer a range of functionalities, including silencing devices to enhance reading focus (e.g., shortcut #4009), facilitating seamless interaction with educational platforms like WolframAlpha (e.g., shortcut #781), and enabling children and teenagers to practice various subjects, from math to foreign languages, through engaging games, quizzes, and pronunciation challenges (e.g., shortcut #2508).

Finally, the remaining shortcuts target **spiritual** (22), **emotional** (19), and **environmental** (15) wellbeing. Spiritual shortcuts offer various tools for personal reflection and growth, including programs that suggest prayers (e.g., shortcut #4075), provide daily readings from religious texts (e.g., shortcut #6884), and remind users to start prayers (e.g., shortcut #5130). Emotional well-being shortcuts primarily focus on mindfulness and stress management, offering tools like initiating meditation sessions through apps like Headspace and logging anxiety levels (e.g., shortcut #14378). In contrast, environmental shortcuts empower users with information and action, enabling them to reduce stress and stay safe, for example, by receiving alerts about approaching thunderstorms (e.g., shortcut #5988).

Looking closely at the extracted wellbeing shortcuts, we found that only 40 of them (0.61% of the total shortcuts) can be classified as interventions that support users' **digital self-control** and help users improve their existing digital habits. While these shortcuts span various well-being dimensions, occupational and physical wellbeing are the most prominent. Specifically, they mainly aim to support focus, studying, or work sessions, by either automatically silencing devices like smartphones or setting Pomodoro timers to minimize digital distractions. Beyond these, other digital self-control shortcuts aim to avoid excessive device use before bedtime, e.g., *"Do Not Disturb While Sleep"* (#847), a shortcut to turn on Do Not Disturb mode on Apple devices when bedtime is approaching. Our analysis of the dataset revealed no shortcuts implementing other popular digital self-control strategies, e.g., tracking time spent or setting usage timers on distracting apps. Building upon the initial implementations explored in recent works [7], we see this as an opportunity to further explore the potential of using TAP to empower users in personalizing their digital habits. Digital self-control and the ability to use technology meaningfully and consciously, indeed, can potentially improve different wellbeing dimensions, from physical to occupational and emotional. Furthermore, concerns about smartphone addiction and technology overuse are growing among users themselves [11], and these concerns will likely intensify as our digital ecosystems expand. The next section sheds light on the opportunities and challenges of targeting this specific aspect of digital wellbeing through two concrete examples.

4. Digital Self-Control Shortcuts

To illustrate the practical application of TAP in supporting users' digital self-control, this section showcases two iOS Shortcuts whose primary purpose is to support users in self-regulating smartphone usage and promote healthier digital habits. Operating on an iPhone 14, we selected two of the most widely used intervention strategies that are currently implemented by contemporary third-party digital self-control tools,

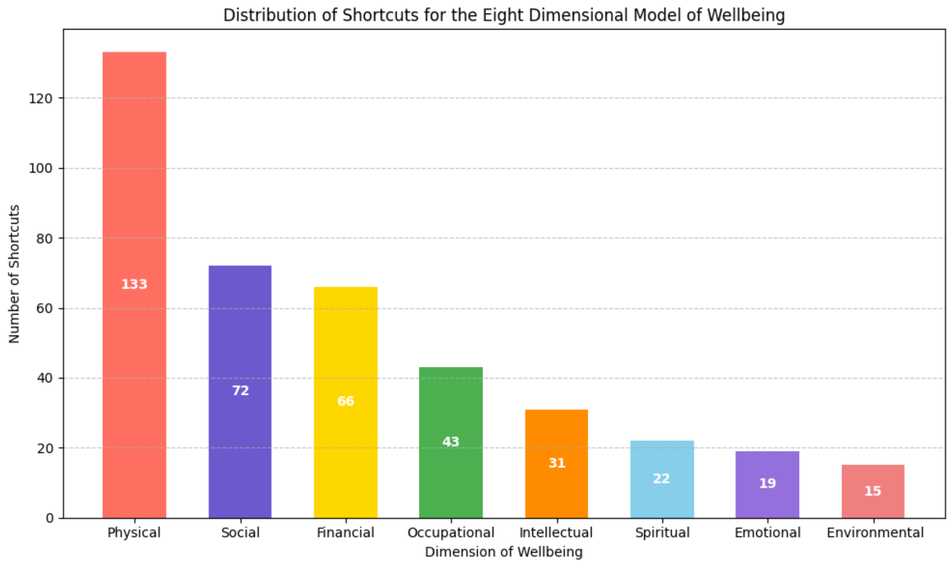

FIGURE 1. Distribution of wellbeing-related shortcuts in the dataset according to the Eight-Dimensional Model of Wellbeing [18].

namely usage limits and concrete usage goals. These strategies align with the state-of-the-art taxonomy of intervention strategies proposed by Lyngs et al. [9]. The mobile app of Instagram was chosen as the target platform for its well-documented tendency to contribute to digital well-being concerns, including a detrimental impact on at-home activities, e.g., when the app is used habitually and compulsively immediately upon waking up [11]. A tutorial on how to install the developed Shortcuts is available at https://osf.io/p9udq/.

Time and Launch Limits for Instagram. Time Limit[5] and Launch Limit[6] are two Shortcuts that are designed to monitor and limit for how long Instagram can be used during the day and how many times Instagram can be opened on a day, respectively. When associated to proper automations, i.e., "When Instagram is opened" and "When Instagram is closed" (Figure 2, A), the two Shortcuts automatically updates usage information on a JSON file on the device's persistent storage. Every time the Instagram app is opened, in particular, Launch Limit (41 actions) increases a counter of how many times Instagram has opened. When Instagram is closed, instead, Time Limit (48 actions) calculates the total duration of the current session and updates the daily time spent. Furthermore, for each Instagram's session, the two Shortcuts determine if the daily usage, be it related to time or number of launches, has exceeded a predefined limit, which can be modified within the Shortcut's instructions. Just before exceeding the limit, an alert is presented to the user as a warning. If the limit is already exceeded, the alert is presented to the user in every app launch (Figure 2, B).

Daily Goals for Instagram Usage. We implemented two complementary Shortcuts, named Set Concrete Goals[7] and Report Of Instagram Usage[8], that allow users to set and monitor concrete daily goals for Instagram usage. The first Shortcut – which must be launched manually – is composed of 59 actions and allows users to define their goals through a menu to specify concrete thresholds for Instagram's daily time spent and daily launches, as well as the number of points that should be awarded if a daily goal is achieved and the number of points that should be removed if a daily limit is exceeded (Figure 3, A).

The second Shortcut, instead, is composed of 60 actions and allows users to access historical data while offering real-time feedback on points. When associated to a time-based automation, the Shortcut accesses previously saved data from the device's persistent storage and compares usage data with the user's defined limit, sending a notification containing a full report for

[5] https://bit.ly/48YKtb2, last accessed: July 22, 2024
[6] https://bit.ly/49eHNWs, last accessed: July 22, 2024
[7] https://bit.ly/3SQfxUZ, last accessed: July 22, 2024
[8] https://bit.ly/3HIjHYv, last accessed: July 22, 2024

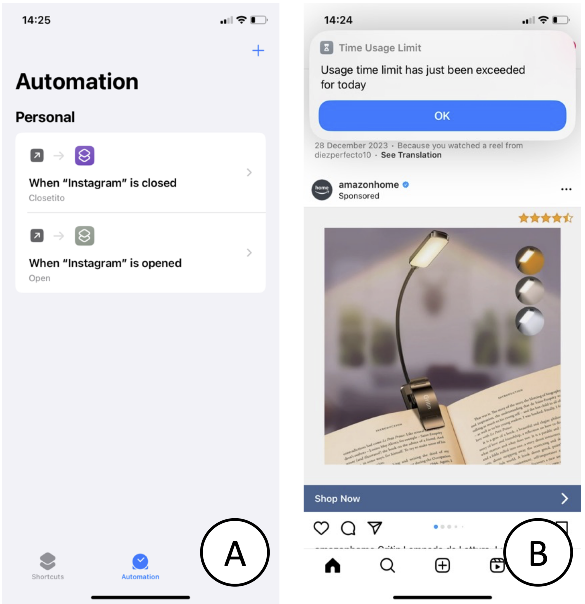

FIGURE 2. Time Limit and Usage Limit are two shortcuts that, when associated to proper automations (A), track Instagram's time spent and number of launches, notifying users when these metrics exceed predefined daily thresholds (B).

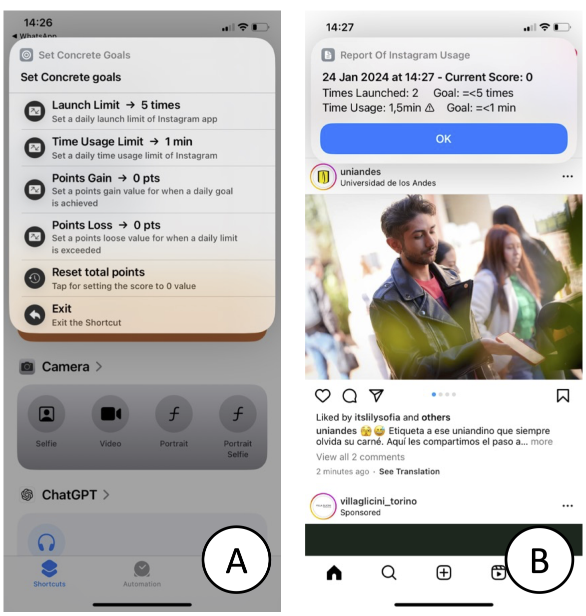

FIGURE 3. Set Concrete Goals and Report of Instagram Usage are two complementary Shortcuts that allow users to set (Figure 3, A) and monitor (Figure 3, B) concrete daily goals for Instagram usage.

the day passed and whether the user is awarded or penalized with an amount of points (Figure 3, B).

5. Discussion

Our work investigated the potential of TAP – a programming paradigm traditionally adopted for home automation – to empower end users to "program" personalized interventions that support different dimensions of their wellbeing. Section 3 revealed that some users are employing iOS Shortcuts for a diverse set of wellbeing applications, with personalizations that target physical and mental health, as well as personalizations that facilitate social interaction, financial management, and even spiritual support. We hypothesize that the prevalence of such use cases will increase as pervasive technologies become more deeply integrated into users' smart homes.

Of all the encountered use cases, digital self-control is fundamental for achieving wellbeing within complex digital ecosystems like the smart home. In such environments, users have easy access to a range of devices for different purposes, ranging from work to leisure. By enabling end users to create custom workflows tailored to their needs, TAP could effectively allow them to become creators of DSCTs rather than just consumers, potentially increasing the interventions' effectiveness. Indeed, contemporary DSCTs do not align well with users' long-term goals [8], as the interventions that can be defined with these tools are mostly "static," e.g., a usage timer that blocks Instagram usage for the rest of the day. In other words, users cannot personalize their interventions beyond a certain limit, and the pre-defined interventions offered by DSCTs poorly adapt to the current user's needs. Through TAP, the possibility to include multiple actions in a shortcut may empower users to integrate diverse intervention strategies, while the possibility of having contextual triggers unlock the potential to associate these strategies with evolving use cases, maximizing their effectiveness. Furthermore, having a programming platform that integrates a diverse range of devices and online services, e.g., those in the smart home ecosystem, could overcome well-known gaps in contemporary DSCTs, such as their single-device conceptualization [19].

Although we did not find shortcuts that implemented multi-device digital self-control strategies, e.g., cross-platform usage timers, our analysis revealed some promising instances of multi-device shortcuts for other digital-wellbeing dimensions. Examples include those shortcuts that control Philips Hue lights based on some smartphone information, like the user's preferred bedtime in shortcut #5392. Another example is shortcut #713, which retrieves the last two days of heart rate data from an Apple Watch and displays this information on an iPhone app. This further demonstrates the potential for multi-device shortcuts to integrate data across different devices for a more holistic view of wellbeing, including digital self-control. Furthermore, being a proprietary tool, iOS Shortcut potentially allows end users to act on devices' sensors, settings, and data that are typically inaccessible by external tools like DSCTs, fostering the design of context-aware interventions that may reduce disciplinary resistance.

6. Limitations and Future Works

Despite the promising potential of TAP for designing digital self-control interventions, our work has limitations that may inspire opportunities for future works.

Although conceptually straightforward, TAP may require a learning curve for non-technical users, as already demonstrated by research conducted in the smart home and IoT domains [20]. The Shortcuts presented in Section 4, for example, demand the creation of several actions, e.g., to store usage thresholds locally. While it is important to emphasize that not all Shortcuts will require this many actions, developing such complex Shortcuts might take users several hours, factoring in the iterative nature of design and testing.

One of the reasons for such a complexity is that most of the intervention strategies included in traditional DSCTs, such as usage timers and lockout mechanisms, are not directly supported by iOS Shortcuts, thus requiring users to employ workarounds to simulate their behavior. Furthermore, TAP also faces technical limitations imposed by the platforms it operates on. For instance, iOS significantly restricts user-defined actions and, in general, provides limited access to usage statistics and app blocking functionalities [8]. These challenges and limitations might explain why, as shown in the findings presented in Section 3, users are not yet fully exploiting the potential of using TAP for digital self-control.

As such, future research and development efforts are crucial to fully embrace the usage of TAP for supporting digital wellbeing. In the short term, the ability to share shortcuts on platforms like RoutineHub could foster a user community that collaboratively develops and shares personalized digital wellbeing solutions, thus reducing the learning curve for creating complex interventions, e.g., those related to digital self-control. In the long term, we see an opportunity for the HCI community to explore novel strategies, tools, and programming metaphors to simplify and democratize the creation of personalized digital wellbeing interventions, making such an approach accessible to a wider range of users. For example, AI-driven troubleshooting (e.g., with ChatGPT or similar tools) could help users identify and resolve common issues, enhancing the overall user experience and reducing the development time for complex shortcuts. Our future work aligns with this direction.

7. Conclusions

Our work provided insights into the current usage of TAP platforms – particularly iOS Shortcuts – for supporting users' wellbeing in complex digital ecosystems like the smart home, revealing a limited yet promising landscape. While our analysis of publicly available shortcuts suggests that users are only beginning to explore this potential, the examples of digital self-control interventions presented in this paper showcase the feasibility and effectiveness of employing TAP to devise personalized interventions for improving users' digital habits. To conclude, we envision our work as a first step towards a "digital wellbeing revolution" where end-users can personalize and program interventions to enhance their wellbeing in different contexts, pushing the boundaries of TAP to a novel domain.

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