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## The app caused me to cancel - Understanding mobile health app dissatisfaction: An affordance perspective

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# “THE APP CAUSED ME TO CANCEL” – UNDERSTANDING MOBILE HEALTH APP DISSATISFACTION: AN AFFORDANCE PERSPECTIVE

*Research Paper*

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## Abstract

*The use of mobile health (mHealth) applications to easily track calorie intake and exercise behavior becomes more and more popular. However, research showed that mHealth apps could only be effective in supporting people in their weight loss if used regularly over a long period. Despite a significant amount of work examining the decision to continue to use mHealth apps, less is known about sources of negative user experiences that can act as barriers to long-term use. Drawing upon affordance theory, this study aims to fill this research gap by qualitatively analyzing app reviews from five popular weight loss apps. Our findings reveal nine causes of dissatisfaction that can have adverse effects regarding long-term mHealth app use for weight management. The results contribute to research and practice by shedding light on the barriers to the continued use of mHealth applications for weight management and how designers and developers can overcome these shortcomings.*

*Keywords: Mobile Health, Weight Management, Dissatisfaction, Affordance Theory, Discontinuance.*

## 1 Introduction

According to the Statistical Office of the European Union, 17% of adults in Europe suffer from obesity, and over half are overweight (Eurostat, 2021). Since severe overweight can further increase the health risk of other disorders such as cancer or cardiovascular diseases, affected people need to improve their nutrition and physical activity behavior. With advances in technology, numerous mobile apps emerged in recent years to support weight loss and dietary behavior. The use of mobile health (mHealth) applications promises to offer a variety of possibilities to help individuals lose weight. A few studies have already shown that mHealth apps can effectively help individuals lose weight (Cavero-Redondo et al., 2020; Islam et al., 2020). While future research is needed to examine the long-term effectiveness of mobile-based interventions (Romeo et al., 2019), various studies indicate that adherence to self-monitoring using mHealth apps often declines over time (Hamine et al., 2015; Turner-McGrievy et al., 2019). Since adherence to self-monitoring is a critical success factor in achieving sustainable weight loss, continued long-term use is crucial for the usefulness of such apps (Burke et al., 2012). The continued and discontinued use of Information Systems (IS) is a commonly investigated phenomenon by IS scholars. In mHealth research, previous studies often relied on an expanded version of the technology acceptance model (TAM) or expectation confirmation theory (Beldad and Hegner, 2018; Cho, 2016) to examine the post-adoption behavior of individuals. While such research helps to understand the factors that lead patients to keep using mHealth apps, a gap of knowledge exists in understanding how negative user experiences emerge and how they act as barriers to continued use (Jiang and Cameron, 2020). Especially on a feature level, less is known on how adverse effects can lead

users to discontinue mHealth applications. Therefore, this study aims to examine sources of negative user experiences and barriers to the continued use of mHealth apps for weight management. A particular focus should thereby lie on identifying issues arising from certain features. An affordance lens is used to understand the relationship between individuals and mHealth features. In the past, affordance theory served as a useful perspective to study post-adoption and usage of different health technologies (Abouzahra and Ghasemaghahi, 2021; Benbunan-Fich, 2019). Literature on affordance theory suggests that actualizing affordances is determined by two distinct phases: affordance existence and affordance perception (Bernhard et al., 2013). Furthermore, it is known that actualizing affordances can lead to the accumulation of certain costs (Bernhard et al., 2013; Salo et al., 2022). Building upon prior work, we argue that negative user experience can arise at different stages of the affordance-actualization process: preceding and as a result of affordance-actualization. Thus, the goal of our study is to examine the development of adverse effects alongside the affordance-actualization process.

To attain the objective of this article, reviews from five popular mHealth apps for weight management are collected from Google Play Store and qualitatively analyzed. Using app store reviews as a data source enables us to get insights about actual user experiences from a wide variety of users. The results of this study support our argument that negative user experiences can arise at different stages of the affordance-actualization process. We propose a model of mHealth discontinuance behavior with nine antecedents of negative user experience at the different phases of the affordance-actualization process. Thereby we make several contributions. We extend the literature on mHealth app usage by identifying reasons that lead individuals to stop using mHealth apps for weight management. Furthermore, we show that an affordance-actualization lens can serve as a useful perspective to study why individuals fail to actualize the possibilities of mHealth apps that designers and developers envisioned. Overcoming the so-called novelty effect, where usage of mHealth applications declines shortly after initial use (Jiang and Cameron, 2020), is one of the key challenges for developers and designers of mHealth applications. Knowing why people stop using mHealth apps can address shortcomings and facilitate a user experience that effectively enables individuals to build long-term healthy habits supported by mHealth technology. The remainder of this article is organized as follows. First, a brief overview of the relevant literature on mHealth applications is given, followed by a review of the affordance theory used in IS research. In the next sections, the methodology and findings are presented. Subsequently, the results are discussed and limitations and areas for future research are described. Finally, a conclusion is drawn.

## **2 Theoretical Background**

### **2.1 Mobile Health**

In general, mHealth can be referred to as the use of mobile information and communication technology to access health services and achieve health outcomes (Chen et al., 2019; Ghose et al., 2021). The focus of our article is specifically on mobile applications that run on a mobile device and support individuals in achieving their weight goals. However, it builds upon prior work on different health technologies (e.g., wearables and medical sensors used in companion with a mobile app) in different health contexts (e.g., diabetes self-monitoring, mental health support).

A growing body of literature emerged in recent years that has studied mHealth applications from a consumer perspective. Thereby different research streams developed. One area of the literature has focused on designing and developing mHealth technologies to meet the patients' values and needs. For example, Dadgar and Joshi (2018) and Asbjørnsen et al. (2020) found that mHealth apps should primarily enable patients to self-manage their health (e.g., through continuous self-monitoring, sense-making, and providing feedback). Furthermore, they revealed that users look for health technologies that give them a sense of empathy, autonomy, motivation, and joy. Beyond that, they argue that patients must be able to trust the technology, and they desire personalized care and adaptable mHealth solutions. Another area of mHealth research has focused on adoption and usage. Acceptance of mHealth technology and services is a thoroughly researched field. Different models and theories have been used

to explain users' acceptance behavior. A lot of work has been carried out on the technology acceptance model (Davis et al., 1989), the unified theory of acceptance (Venkatesh et al., 2003), and the expectation-confirmation-model (Bhattacharjee, 2001). Factors such as perceived usefulness, perceived ease of use, confirmation, satisfaction, social norms, and facilitating conditions have proven to be reliable antecedents in predicting users' mHealth adoption behavior (Beldad and Hegner, 2018; Cho, 2016; Hoque and Sorwar, 2017; Jeon and Park, 2015; Okumus et al., 2016; Sun et al., 2013). Moreover, it has been shown that an individual's current health status is an important driver of their willingness to use health technology (Zhao et al., 2018). Therefore, health behavior theories such as the protection motivation theory (PMT) (Rogers, 1975) can be reasonably applied to explain one's individual intention to use mHealth applications.

A major drawback of research on mHealth acceptance is that continued use is examined only in a few cases (Cho, 2016). Furthermore, studies that focus on continued use usually measure the intention to use instead of actual usage. Thereby they do not provide any knowledge on user experiences. Articles that investigated users' perceptions of mHealth technology have mostly been conducted for wearables. While these studies have revealed some interesting findings on what enables (e.g., social influence, technology tendency (Abouzahra and Ghasemaghahi, 2021)) or hinders (e.g., random vibration, no numeric display (Benbunan-Fich, 2019)) long-term health technology use, results are often wearable specific (e.g., lack of wearing comfort (Matt et al., 2019)) and therefore cannot be fully applied to standalone mobile apps.

Another downside of previous research on mHealth technologies is that sources of negative user experiences have often been ignored (Jiang and Cameron, 2020). Again, initial results were achieved for wearables. For instance, Rieder et al. (2020) have examined the adverse effects of wearables through a technostress lens. They identified several technology-related (complexity, inflexibility, inaccuracy, unreliability) and task-related (over-transparency, over-dependence, discrepancy between feeling and data) stressors. Similar to our study Vaghefi and Tulu (2019) analyzed users' assessments of mHealth applications to explain users' decisions to continue to use a mHealth app. According to their exploratory analysis, users base their decision to use or abandon mHealth apps on how well is the overall fit between the users and the system and how well users' preferences are met regarding the following mHealth properties: interface, navigation, notifications, data collection, goal management, depth of knowledge, system rules, actionable recommendations. While the focus of their exploratory study was not on adverse effects, the results show that, especially on a feature level, it can be interesting to analyze unintended consequences that can lead individuals to stop using mHealth apps. Frie et al. (2017) conducted another study similar to ours that analyzed app store reviews to gain insights into users' perceptions of mHealth applications. Their findings are consistent with previous work on mHealth apps. They revealed that patients value simplicity, health data accuracy, customization options, and detailed feedback to self-manage their health.

Unlike past research on mHealth adoption and usage, our study focuses on identifying barriers to long-term use. Related to our study, Epstein et al. (2016) investigated the abandonment of self-tracking tools. According to them, the main reasons for abandoning self-tracking tools are the cost of collecting, integrating, and sharing data, data quality concerns, and people not feeling the need to self-tracking. Their article focused on self-tracking for finance, health, and location rather than specific on mHealth applications. While their work provides initial findings on why people stop using self-monitoring technology, there is still considerable uncertainty regarding reasons for the discontinuance of mHealth applications. As Jiang and Cameron (2020) suggested, our article aims to go further than previous research by investigating sources of negative user experiences and barriers to mHealth application use for specific features. Thereby, we contribute to understanding how negative user experiences emerge and how this can lead to discontinuing mHealth applications. The next section introduces affordance theory and describes how we use an affordance-actualization lens to analyze mHealth dissatisfaction for weight management apps.

## 2.2 Affordance Theory

The term affordances can be traced back to Gibson (1979), who used it to explain the interactions between animals and their environment. According to the definition of Gibson (1979), affordances can be understood as action possibilities that are offered by the environment to an agent. Over the years, affordance theory was used by several IS scholars to study the uses and consequences of IT artifacts (Pozzi et al., 2014). In an IS context, affordances can be defined as “the potential for behaviors associated with achieving an immediate concrete outcome and arising from the relation between an object (e.g., an IT artifact) and a goal-oriented actor or actors.” (Volkoff and Strong, 2013, p. 823). Adapting and applying affordance theory has allowed IS researchers to investigate IT artifacts from a socio-technical perspective, considering social and contextual elements (Volkoff and Strong, 2017). Several studies have used affordance theory to examine health technology from an individual perspective (Abouzahra and Ghasemaghahi, 2021; Benbunan-Fich, 2019; James et al., 2019). Although they often hold different views (Alshawmar, 2021), it has been shown that applying affordance theory can serve as a useful theoretical lens to shape our understanding of the interaction between individuals and different health technologies (Jiang and Cameron, 2020). Prior research has relied on the term affordance-actualization to analyze and describe how specific users interact and take advantage of certain affordances (Strong et al., 2014). Since our study aims to examine how adverse effects arise during the actualization of specific mHealth affordances, our work builds upon existing literature that has studied affordance-actualization. Preliminary work suggests that affordance-actualization is influenced by the existence and perception of affordances (Bernhard et al., 2013). Affordance existence covers the relational nature of affordances and describes how affordance-actualization is shaped by the properties and preconditions of the technology and the users (Bernhard et al., 2013; Pozzi et al., 2014). Affordance perception refers to the process of recognition and how it influences affordance-actualization. Focusing on the effects of affordance-actualization, it is known that actualizing affordances usually leads to certain costs for the users, resulting from the effort of actualizing (Bernhard et al., 2013; Salo et al., 2022). In addition, research on the continued use of IS suggests that users may be dissatisfied after actualizing affordances because their expectations have not been met (Bhattacharjee, 2001). Integrating work on affordance-actualization with research on the continued use of IS, we use the model shown in Figure 1 to study how negative user experiences arise during the affordance-actualization process.

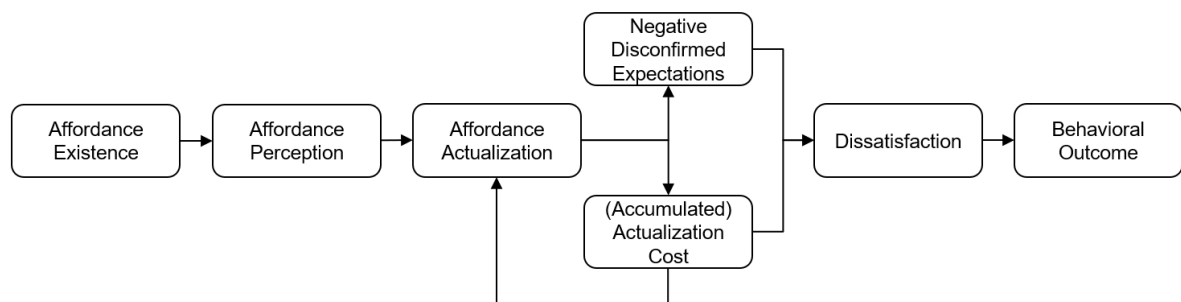


Figure 1. Dissatisfaction through affordance-actualization (adapted from Bernhard et al. (2013), Bhattacharjee (2001) & Salo et al. (2022)).

To conduct our analysis on a feature level our work builds upon the affordance bundles identified by Jiang and Cameron (2020). In their extensive literature review on IT-based self-monitoring (ITSM) Jiang and Cameron (2020) have relied on an affordance-actualization lens to develop an overarching framework to structure their findings of research on ITSM. Thereby they identified four affordance bundles that are usually provided by health technologies that incorporate self-monitoring functionalities: preparation affordance (education and goal), data collection affordance (data entry and auto-capture), user reflection affordance (data display, gamification, and push messages), and social connection affordance (peer-to-peer and patient-provider). Since mHealth apps for weight management rely heavily on self-monitoring as an intervention strategy (Rivera et al., 2016), the affordance bundles identified by

Jiang and Cameron (2020) serve as a useful framework to examine dissatisfaction regarding specific affordances. By using an affordance-actualization lens for our empirical study, we aim to explain which negative user experiences can arise during the actualization process for particular mHealth affordances.

## 3 Methodology

### 3.1 Data Collection

To understand why people stop using mHealth applications for weight management, we scraped and analyzed reviews from five popular mobile apps. The usage of app reviews allowed us to gain insights from actual app usage without any respondent bias. App selection was based on the following criteria: (1) App is available in English, (2) App is targeted for people who want to manage or lose weight (3) App has standalone functionality (meaning that it is usable without any additional device) (4) App has at least 1.000.000 installations and 100.000 reviews. App selection criteria (1) and (4) were used to ensure that a broad population uses the apps and a reasonable amount of reviews can be gathered. The focus on weight management apps was chosen since these apps usually integrate the most common affordances of mHealth apps and a broad population is using or willing to use weight-related health apps (Jiang and Cameron, 2020; Krebs and Duncan, 2015) Criteria (3) was selected to make certain that all negative user experiences that are analyzed result from the app itself and not from any additional devices needed to leverage the intended goal of the app use. Based on these attributes, the following apps were selected by using purposive sampling: MyFitnessPal (A1), Noom (A2), Weight Watchers (A3), LoseIt (A4), Lifesum (A5). Reviews were scraped from Google Play Store for each app with the python package “google-play-scraper”. Since our research design did not allow saturation to occur in the data collection phase, we initially collected review data that was ranging from 01-01-2021 to 05-31-2021. To concentrate on negative user experiences, we considered only reviews with a rating of one. Furthermore, all reviews that had a character length of less than 400 were sorted out. This was done to filter out all single-sentence complaints, which did not indicate why people complained. We finally ended up with the following number of reviews for each app: MyFitnessPal (n = 144), Noom (n = 261), Weight Watchers (n = 53), LoseIt (n = 71), Lifesum (n = 73).

### 3.2 Data Analysis

To analyze review texts, we used thematic analysis following the guidelines of Braun and Clarke (2006). After introductory reading to get engaged with the data, we conducted our analysis using three phases. In the first phase, a data-driven approach was used to develop initial descriptive codes until saturation occurred for reviews of each app. Saturation was defined as the point in which no new codes appeared during the analysis and where the reviews tended to be redundant from the reviews already analyzed (Saunders et al., 2018; Urquhart, 2013). The first author of the paper developed the codes in the first phase. We then developed and reviewed semantic themes across coded reviews from all apps in the second phase. We relied on prior literature of affordance-actualization and the continued use of IS to make sense of our data. We analyzed how the data reflected the different phases of the affordance-actualization process model displayed in Figure 1. This helped us understand how the different causes of dissatisfaction identified evolve over time. New concepts emerging from the data were inductively added to our base model. To ensure reliability a research assistant coded the data according to the formal definition of the thirteen themes synthesized in this phase (see Table 1). We calculated Krippendorff’s  $\alpha$  for all identified themes (Krippendorff, 2004). The values were: 0.689 (Lack of functionality), 0.765 (Lack of connectivity), 0.832 (Unreliability), 0.757 (Lack of usability), 0.702 (Non-Personalized), 1 (Lack of ties), 0.808 (Inaccuracy), 0.695 (Lack of insights), 0.693 (Seeking support), 0.811 (Regressive discontinuance), 0.669 (Quitting), 0.661 (Replacement). Since the values for the themes replacement, quitting, lack of functionality, seeking support, and lack of insights were close to the recommended threshold of 0.667 (Krippendorff, 2004), the two coders discussed the results openly to identify reasons for the contrary interpretations. Based on this discussion, we adjusted the final coding frame and

classifications. Regarding lack of ties a low sample size must be considered with only two observations for one app. Calculations were done with the R package “irr” (Gamer et al., 2019). In the final phase, the first author of the paper reread the coded reviews and checked to which extent they related to a mHealth affordance and assigned them accordingly. Data analysis was performed using qualitative data analysis software MAXQDA.

## 4 Results

Overall, we identified nine sources of negative user experiences that can arise at different stages of the affordance-actualization process. In addition, we discovered the concept of seeking support. The data revealed that many users perceived constraints due to the unreliability of the mHealth apps. Thus, they sought support through the reviews and reported further dissatisfaction if no support was received. Finally, we detected three types of discontinuance as a behavioral outcome of dissatisfaction. Table 1 gives an overview of the thirteen themes identified.

Theme	Description	Example
Lack of Functionality	Limited functionalities and features provided by the mHealth app.	“For example, to count the steps it doesn't have this feature I had to connect the account to another app to do it.” (A4)
Lack of Connectivity	Limited or missing interfaces to other mHealth devices or applications used by the users.	“However, it does not sync with Samsung smart watches for activity tracking which was frustrating.” (A2)
Unreliability	Malfunctioning or instability of the mHealth app.	“Since I updated the app 2 or 3 days ago, it is non-functional. It freezes immediately.” (A2)
Lack of Usability	Ineffective presentation and provision of content and features.	“This is one of the most clunky, unintuitive, poorly designed user interfaces I've ever seen.” (A1)
Non-Personalized	Missing personalization of mHealth affordances (including goals, plans, and coaching advice).	“The app only focuses on people who have eating disorders and cal cutting... Not on those who are active and need balanced & nutritious meals” (A4)
Lack of Ties	Missing connection to other users of the mHealth app regarding social connection affordances.	“The community part throws too many random people together for no clear reason.” (A2)
Lack of Engagement	Limited health advice provided by coaches. Low response regarding health-related questions.	“Coach seems to be impersonal with generic communication.” (A2)
Inaccuracy	Inaccurate recording and presentation of users' health data (e.g., activity or nutritional data).	“Biggest con: the food database is full of incorrect nutritional values.” (A1)
Lack of Insights	The information provided by the mHealth app is not helpful and knowledgeable for the users.	“Any articles or facts in the app could be found on Google for free.” (A2)
Seeking Support	Users seeking support through the reviews or report that they have sought support by contacting the customer service.	“Wrote to support too many times, received never ending 'we will forward to another team'.” (A5)
Replacement	Replacing or indicating to replace the mHealth app with another app or technology-based weight management method	“Literally unusable, I'm switching to a competitor. What a shame.” (A5)
Regressive Discontinuance	Discontinuing or indicating to discontinue a mHealth app after using it for a short period.	“I deleted my account on the 3rd day. CANCELED.” (A5)
Quitting	Discontinuing or indicating to discontinue a mHealth app after using it over a long period.	“I used to be a premium user for two years but stopped paying because of all these numerous issues.” (A1)

Table 1. Overview of the identified causes of dissatisfaction and discontinuance behavior.

Table 2 displays how the nine causes of dissatisfaction identified relate to specific affordances. While some of the antecedents of negative user experiences could be drawn back to specific mHealth affordance bundles (e.g., lack of ties), a few concerned the mHealth apps as a whole (e.g., unreliability). If the themes concerned the app as a whole, we referred to this as “General” in Table 2. The themes that concerned the mHealth apps as a whole were usually also prevalent for multiple specific affordances (e.g., lack of usability). Interestingly, we could not find any objections regarding Push-Messages and Gamification affordances.

Affordance		Theme
General		Lack of Usability, Unreliability, Non-Personalized, Lack of Functionality
Data Collection		Unreliability, Lack of Functionality, Lack of Usability, Lack of Connectivity
Preparation	Goal	Non-Personalized
	Education	Non-Personalized, Lack of Insights
Reflection & Action	Data Display	Inaccuracy, Unreliability, Lack of Functionality
	Push-Messages	-
	Gamification	-
Social Connection	Peer-to-peer	Lack of Ties
	Patient-Provider	Lack of Engagement, Lack of Insights, Non-Personalized

Table 2. Sources of negative user experiences for different mobile health affordances.

Figure 2 summarizes our findings and shows how they organize around the affordance-actualization model illustrated in Figure 1. As displayed in Figure 2, we added the concept of affordance constraints to the initial model as a possible outcome of the affordance perception phase. In addition, we added the concept of seeking support. Since a lack of connectivity resulted either from absent or from malfunctioning connectivity features, we argue that it is a sub-theme for both, a lack of functionality and unreliability. Therefore, it could be a barrier for the affordance existence as well as the affordance perception phase. In the following, we describe our results presented in Figure 2 in detail.

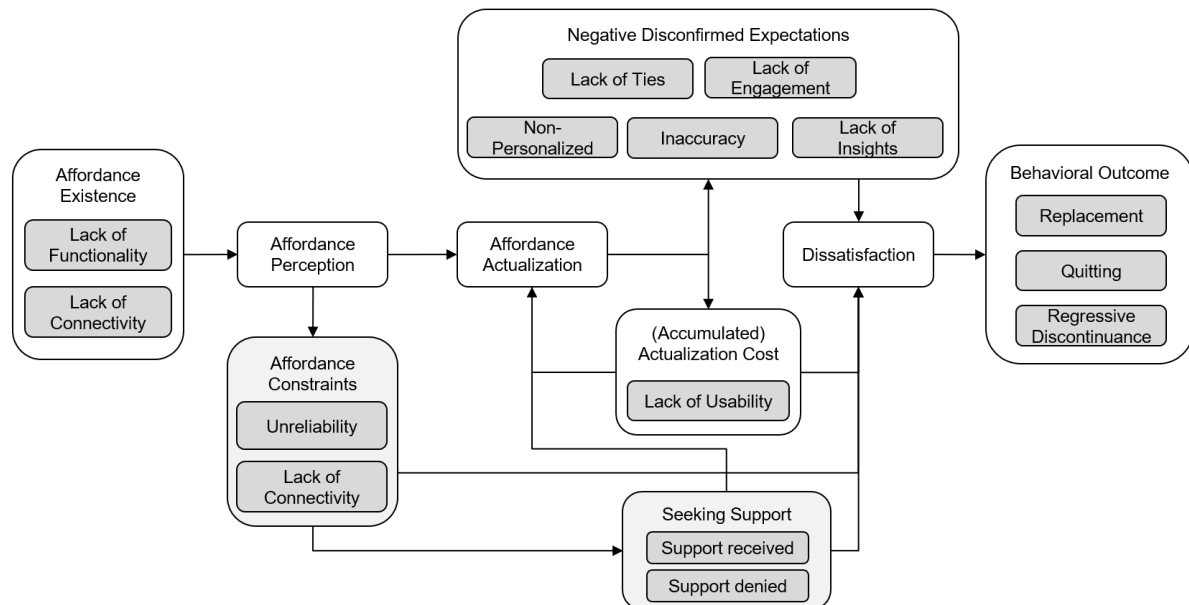


Figure 2. Mobile health discontinuance process.



#### 4.1 Affordance Existence

Understanding affordances as enabling or constraining action possibilities, the mere existence of certain affordances can be viewed as an important driver of the decision to use technologies in the long term (Pozzi et al., 2014). We found that users quite often complained about a lack of functionality during our analysis. While users expressed their dissatisfaction regarding the data collection affordance in most cases, very few also criticized missing data display options. Some of them complained that they could not use the app without specific functionalities as a whole. Using the app as a whole, most users indicated that they wanted to use the app on multiple devices. For example, one user stated that if they cannot use the app on his smartphone and tablet, it is useless to them: *“The App caused me to cancel. I loaded the app on my [iPad]. But I should have only loaded it on my Samsung phone. Come to find out, they do not sync. Which they do not tell you about when you try to start the program.”* (A2). A similar expression was made in regards to a missing web version of the same app: *“it also does not have an online version, which is really a shame”* (A2). These findings suggest that some users have special requirements (e.g., using the app on a bigger screen) and won't use the app at all if these are not met.

The most complaints concerning missing features were about the data collection affordance bundle. Different types of reviews either addressed a lack of functionalities to track specific information or a lack of functionalities to make tracking less cumbersome. Regarding the first type, people complained mainly about the ability to track macronutrients or other useful information such as water intake or blood pressure. Concerning the second type, users mostly criticized the absent affordances for logging their nutrition. One objection that was stated for multiple apps was the ability to create custom recipes. Interestingly for one app, multiple users complained that this feature is available to iOS users but not to android users, indicating that this disparity strengthened the dissatisfaction: *“Unfortunately, this review is going to sit at one star until the devs make feature parity between Apple and Android. It's bullcrap that I can't make custom recipes or delete exercise just because I prefer Android phones [sic].”* (A2). What made tracking additionally challenging for a lot of users was a lack of connectivity provided by the apps. Several users stated that without an interface to other apps or devices that they regularly use, the respective app is useless to them: *“The app itself is easy and straight-forward to use. However, it does not sync with Samsung smart watches for activity tracking which was frustrating.”* (A2).

For only one app also very few users complained about the limited data display options: *“Not only does it not have good input as far as graphs, nutrient analysis, carb intake or any other analysis of any kind other than a color chart that is not helpful”* (A2). In this case, our findings suggest that the simplified visual feedback provided by this specific app is not sufficient for the users to self-monitor their weight management activities.

#### 4.2 Affordance Perception, Constraints, and Seeking Support

While we agree with the argument that affordance theory is a theory of perception per se and that affordances can be actualized without being perceived (Volkoff and Strong, 2013; Volkoff and Strong, 2017), we claim that to study how an individual interacts with an IT object affordance perception construct still serves a benefit. We use affordance perception to explain how users interact with a malfunctioning IT object. According to Bernhard et al. (2013), affordance perception is *“determined by the emergence of an affordance when a user interacts with an object.”* (Bernhard et al., 2013, p. 4). Based on this understanding we argue, that affordance perception has two outcomes: Affordance-actualization or affordance constraints. Either the users perceive that an affordance exists and can actualize it or they perceive that an affordance exists but cannot actualize it, due to the malfunctioning IT object. Thereby we consider that prior to technical errors, users often already successfully actualized the affordance. Consequently, affordance perception is different from affordance existence in that the users know that the technology offers them the affordance to achieve the desired goals and that the developers have intended them to do so. Still, due to the sole unreliability of the technology they cannot actualize it. The unreliability of the mHealth apps was the most common theme in the reviews. Most users complained about errors that did not allow them to use the apps at all. This was followed by several

users that reported issues and frustration due to specific data collection features. A few users also complained about defects in data display and peer-to-peer functionalities.

Inspecting the data about errors that made it impossible for individuals to use the app, we found that often users, before the occurrence of the technical defects, described themselves as satisfied users. Furthermore, instead of directly expressing that due to the error they would quit the app, they frequently required that the developers should fix the error: *“I would have given the highest rating to this app because it's worth it but I have a problem with logging in, I even visited the website to reach out to the technical support but when I try to submit my request it fails with an error. So the app [shrunk] my current days streak to 0 point when my summary days remains 53 and then the progress has frozen. Firstly I couldn't log out so I had to clean app cache&data and now I can't even log in. Please help me. Thank you very much!”* (A5). As illustrated in Figure 2, we, therefore, suggest that seeking support is often an intermediate step, triggered by affordance constraints and resulting in greater dissatisfaction if reliability issues are not resolved. Similar to the previous statement, it was also noteworthy that many users mentioned that all their progress was lost, which often led to further resentment: *“I use this app daily, for [everything I] eat and now I go open the app and all the sudden I'm logged out [. . .] To make it worse, I just recently updated all of my goals, foods, meals, and information. What is going on?!?! BEYOND ANGRY AT THIS RIGHT NOW!!!!”* (A1).

For the data collection affordance bundle, one theme repeatedly expressed in the reviews and prevalent for all apps was a lack of connectivity to other apps and devices that users already used to track their physical activity data. Statements like: *“This app sucks if you're trying to sync it with your Fitbit it will not stay connected for anything it's like every other day I have to go through a headache of trying to resync it.”* (A1), illustrate the frustration that users showed dealing with non-functional connectivity features.

### 4.3 Actualization Cost

As stated by previous research, each realization of an action possibility usually involves a certain effort or cost to actualize the affordance (Bernhard et al., 2013; Salo et al., 2022). Our data analysis revealed that the main driver of (accumulated) actualization cost was a lack of usability. We found that users most often criticized usability regarding the data collection affordance bundle for all apps examined. Besides this, most users blamed the overall user experience while very few reported objections about the data display affordance bundle. Users that complained about the overall user experience mostly complained that the apps are overloaded and difficult to use: *“Everything is everywhere. Confusing, unorganized. They need to re-do selections all in one place in a format that makes it easier to find what you need. You have to go thru so much just to find the [category] you need.”* (A3).

Especially for the data collection bundle, users reported low usability and additional effort resulting from it. Three different topics were stated multiple times for several apps. One was about the inconvenient implementation of specific features (e.g., no way to reuse already added food items to the nutrition diary). Another one was about the limited selection of food database entries that made collecting data much more burdensome for users. The last one was about the cost of collection resulting from editing incorrect food or activity entries: *“Changing accidental loggings is really hard. No kg based [recipes] logging, I have to know in advance how many [portions] my [recipe] has.”* (A5).

Overall, a significant amount of reviews indicated that for multiple apps, there is a non-user-friendly implementation of certain data collection features that hinders them in building a habit to self-monitor their physical and nutritional behavior in the long term. For only one app, individuals complained about a lack of usability regarding the data display affordance bundle. In that case, the reviews implied that due to changes made by updates, previous popular and easy-to-use display options have become much more demanding to use.

#### 4.4 Disconfirmed Expectations

Several researchers found that one of the main drivers of discontinuance after initial adoption comes from negatively disconfirmed expectations (Bhattacharjee et al., 2008; Soliman and Rinta-Kahila, 2020). Our results support these findings by identifying several themes in which users complained about certain expectations that were not met.

The most recent objection to disconfirmed expectations was a lack of personalization. People complained that the overall weight loss or weight management strategy does not fit their needs for different apps. Reviews showed that users expected the apps to be more responsive to their preferences, habits, and other life circumstances, such as their current health condition. Especially for the goal affordance bundle, it was evident that some users felt frustrated through a lack of personalization: *“There's no option (or none I could find) to use this app without centering weight and weight loss. If, like me, struggle with disordered eating and want to be mindful about eating without fixating on numbers on a scale, you're SOL. It seems like a good service specifically for those who want to lose weight, but for people trying to become healthier without making weight loss their central focus, it's not helpful at all.” (A2).*

Besides not adapting the goals to the user's preferences and needs, it was mentioned multiple times that some users felt hung up through very restrictive calorie intake goals set by the apps. Another affordance bundle for which personalization was relevant was the education affordance. The reviews revealed that a lack of personalization regarding educational content can lead to a lack of insights provided by the app and thus, making the education affordance useless: *“The articles and daily info is already info that I knew before hand. I was hoping to actually dig deeper into why my eating habits are the way they are. This did nothing of the sort. I'm better off getting a dietician and therapist.” (A2).*

Furthermore, for one app several users criticized the teaching style of the app, indicating that the app providers should take care on how to address their users with educational content. The same app offered users the functionality to get personalized coaching through a patient-provider affordance. Similar to the education affordance, individuals complained about a lack of insights and a lack of personalized coaching advice. Moreover, several users criticized that the engagement of the coaches was missing and that the advice often felt *“automated and canned” (A2)*. In that, many users reported that they felt that the coaches are bots, which led to further disappointment.

Another major expectation that was not met by almost all apps was data accuracy. In many reviews, users expressed their dissatisfaction due to incorrect nutritional information and activity data captured by the apps. Since tracking and reflecting calorie consumption is one of the key strategies to effectively lose weight, inaccurate data not only leads to a considerable additional expense correcting the data, but it can even lead individuals to achieve the exact opposite of their initial goals. As one user stated: *“We ended up eating more with app than usual as we're always under calorie threshold? Me & my spouse are extremely dissatisfied with this app. We kept it on phone so it reminds us not to do the same mistake again. 80% time a recipe has 1000 different calorie variations.” (A4)*. Very few reviews also dealt with negative disconfirmed expectations in regards to peer-to-peer connection affordances. In this case, the statements of the users imply that due to a lack of ties to other users, the social connection feature is not useful for them.

#### 4.5 Behavioral Outcome

Only in a few reviews' users state their behavioral reactions to negative user experiences they perceived. Overall our findings support the literature on IS discontinuance in that discontinuance comes in different forms (Soliman and Rinta-Kahila, 2020). According to the distinction of Soliman and Rinta-Kahila (2020), we identified the following forms of mHealth app discontinuance: Regressive discontinuance (abandoning the mHealth app shortly after an initial user experience), Quitting (abandoning the mHealth app after a period of continued use) and Replacement (replacing the mHealth app with a similar one). None of the users stated that they would return to a specific app after previously quitting it, so we couldn't directly observe temporary discontinuance.

Overall, our analysis showed that for each form of discontinuance behavior, multiple causes of negative user experience are usually responsible. The most dominant trigger for all types of discontinuance behavior was a lack of reliability. To some extent, we observed different patterns of causes for particular behaviors. For example, negatively disconfirmed expectations or absent affordances were more prevalent for regressive discontinuance and replacement. Whereas quitting was more often associated with unwanted changes made by updates. This is in so far reasonable, as it can be assumed that individuals that use a mHealth app over a certain period are overall satisfied with the app. However, due to negatively perceived incidents or changes, they decide to no longer use the app: *“The app was helpful until it's recent update. It no longer syncs with Google Fit, so I have to enter my steps/exercise manually. [ . . . ] Update: they finally fixed this problem, but now I can't access my account from the app, only my desktop. Minimally useful. Deleted the app.” (A1).*

Replacing was observed for both scenarios, after users have used an app over a long period but also after using it only for a short time. Interestingly some users mentioned that they are going back to an app they have used in the past: *“In the three days I tried this, the app constantly froze and crashed. [ . . . ] Just dealing with the app caused me to stress eat. I'm going back to WW. That may not hit the root cause of my eating but at least I won't gain weight just from using the app.” (A2).* This statement also indicates that to some extent temporary discontinuance plays a role for mHealth apps. When users are not fully satisfied with an app they try to replace it with another one, but when they realize that there are no better options available for them, they return to the apps previously used. Some users also mentioned that instead of replacing the unsatisfactory app with another app, they return to another weight management technique (e.g., calorie counting via excel) they have used earlier.

## 5 Discussion

Our study revealed different sources of negative user experiences and barriers to the continued use of mHealth apps for weight management. Thereby we make several theoretical contributions. First, we extend the literature on mHealth research by identifying factors that lead individuals to abandon mHealth apps for weight management and explaining how these emerge over the affordance-actualization process. Although previous work on post-adoption behavior has yielded some interesting findings on what people value in their decision to continue using a mHealth app. So far still, a research gap has existed in understanding negative experiences in the context of mHealth and their role in discontinuance behavior (Jiang and Cameron, 2020). Utilizing an affordance-actualization lens as theoretical underpinning, we contribute to the vast literature on affordance theory in IS research by demonstrating that it can be usefully employed to capture the social and contextual elements that can constrain long-term mHealth app use. Moreover, by analyzing how adverse effects arise before, and as a result of affordance-actualization, we establish a deeper theoretical understanding of an individual's decision to discontinue a mHealth app. Future work can rely on our mHealth discontinuance model (illustrated in Figure 2) to study how different antecedents of negative user experiences can lead to different types of discontinuance behaviors.

Following our mHealth discontinuance model, we identified three themes that can act as usage barriers prior to affordance-actualization. The first reason can be a lack of functionality. Similar to work on acceptance of mHealth apps, we show that if a mHealth app does not provide the desired functionality, this can lead to dissatisfaction among users (Wang and Qi, 2021). Unlike previous work, we argue that this affects the core affordances of self-monitoring applications and features like using the app on multiple devices, providing a web version alongside the app, or enabling users to connect the app with supplemental devices (e.g., wearables, etc.). According to our model, the second antecedent of discontinuance behavior comes from a lack of reliability resulting in affordance constraints. This is consistent with findings from research on technostress, which has found that techno-unreliability can be a creator of negative emotions towards a technology (Fischer and Riedl, 2015; Matt et al., 2019; Rieder et al., 2020). Although already identified as stressor in the literature, we argue that techno-unreliability and its consequences still not have gained the attention they deserve in research on the continued and discontinued use of IS. Interestingly, we found that in many cases in which people complained about a

lack of reliability, they sought support. This suggests that seeking support is often an intermediate step before actually deciding about discontinuance. While failures in affordance existence and perception frequently result in users not being able to actualize affordances at all, the actualization of affordances can also be a source of adverse effects. In agreement with previous results from Salo et al. (2022), we argue that affordance-actualization usually comes with certain costs. Our analysis shows that the main driver of actualization cost for mHealth app use is a lack of usability. However, a large amount of literature states that the ease of use or usability of mHealth apps is a key factor for individuals to use them (Jeon and Park, 2015; Sun *et al.*, 2013; Vaghefi and Tulu, 2019). Still, app developers fail to deliver user-friendly mHealth applications. While a lack of usability may not initially lead to discontinuing mHealth apps, the continuous actualization of affordances can accumulate the actualization costs and trigger a response behavior (Salo et al., 2022). Negative disconfirmed expectations are another source of negative user experience that can build after affordance-actualization. Similar to previous literature on mHealth continuance, we demonstrate that a lack of personalization and data inaccuracy are important antecedents of the decision to continue use or stop using a mHealth app (Epstein et al., 2016; Frie et al., 2017; Vaghefi and Tulu, 2019). In addition, we confirm the results from Vaghefi and Tulu (2019), in that we found, that information provided through an education affordance needs to serve the right amount of knowledge for a specific user. Furthermore, we extend previous literature in which we revealed that a lack of ties (peer-to-peer) and a lack of engagement (patient-provider) can be sources for negative experiences arising from social connection affordances.

Analyzing different types of discontinuance behavior, our study is limited by the fact that users often did not state their behavioral reactions. However, the data indicates that usually several negative antecedents have to be present for users to discontinue mHealth apps. While we found some patterns of certain triggers that lead to a specific discontinuance behavior (e.g. disconfirmed expectations were more relevant in the case of regressive discontinuance), there is an opportunity for future research to examine how different antecedents relate to particular forms of IS discontinuance. Since replacement was the most prevalent form of discontinuance behavior, we suggest that the switching cost of mHealth apps is quite low and mainly results from collected data about oneself over a longer period (Frie et al., 2017). Considering our model, it is important to keep the relative nature of IT affordances in mind, which evolves through the user-artifact relation in combination with the goal of the user (Volkoff and Strong, 2017). This explains for example, why a lack of certain functionalities is only a source of negative experiences for some users. Depending on the particular goal of the users, it can be that the absence of a specific affordance does not matter to them. Since it can be argued similar for all other themes identified, the personalization of mHealth apps may be the key for designers and developers to unlock the full potential of their apps for the users.

Analyzing the data at an affordance level, our study serves a novel contribution in examining which affordance bundles are provided by commercial mHealth apps for weight management and which of them are relevant for users. The reviews imply that tracking calories was the primary weight loss strategy among users. Accordingly, our analysis suggests that collecting and monitoring data are the main affordances actualized. Yet, these were also the affordances where there has been the greatest number of complaints. This implies, that developers of mHealth apps should focus especially on providing reliable and easy-to-use data collection affordances, alongside accurate data display affordances. Besides this, the goal and the education affordances were the most prevalent. Interestingly, we couldn't find negative expressions regarding push messages or reminders sent by the apps. Only in one review, users stated that they felt invaded by constant push notifications. While research on technostress has already revealed that adverse effects can be triggered by regular reminders (Salo et al., 2022), we argue that in the area of mHealth apps it could be that people do not consider them as disturbing since they consciously view them as means to achieve their goals. Future research is needed to see whether our argument holds. There was no review where users expressed objections in regards to gamification affordance. In line with prior literature, we assume that so far, a lot of popular commercial mHealth apps do not provide and rely on gamification approaches as intervention strategies (Frie et al., 2017; Rivera et al., 2016). For only one app, we found objections regarding social connection affordance bundles. Thus again, we conclude that app developers as well as users up to now do not provide and use such

affordances extensively. However, our results indicate that if not implemented consciously, such features could be drivers of frustration. Therefore, future research should build upon our work to understand the role of ties and engagement in social connection affordances.

## **6 Limitations and Future Research**

Due to some limitations, our findings need to be interpreted with caution. First, we relied on secondary data in the form of online app reviews. Unlike direct interview data, which is collected by explicit questions and enables follow-up communication, app reviews are anonymized and voluntary (Benbunan-Fich, 2019). Similar to data from social media, this could introduce biases due to specific platform demographics and reviews produced by bots (Hacker et al., 2020). Furthermore, users who write app reviews are not necessarily representative of the broader app user population (Frie et al., 2017). Therefore, our results may lack generalizability. However, as we wanted to gather users' perceptions of actual usage, which is not biased by research procedures, the use of app reviews as a data source seemed appropriate. Another limitation stems from the fact that reviews were only collected from one mobile app platform (Google Play Store). Together with the purposive selection of apps from which we collected the reviews, the chosen timeframe, and the criteria to filter the reviews (minimum number of character length, only considering negative reviews), it could be argued that the comprehensiveness of our study is limited. However, we believe that by reviewing data across multiple apps and sticking to our saturation definition, we were able to represent users' concerns adequately. Viewing the data through an affordance-actualization lens and integrating it with work on the continued use of IS instead of other potentially relevant literature, our study may ignore alternative factors that can lead to discontinuing mHealth apps. For example, prior research has demonstrated that an individual's current health status is an important driver in the decision to continue using a mHealth app (Zhao et al., 2018). This aspect is completely ignored by our study and future work could examine how far it mitigates or intensifies sources of negative user experiences regarding a discontinuance behavior. Since our study solely focused on mHealth apps for weight management, future research is needed to understand to what extent our results apply for mHealth apps in other areas such as mental health, smoking cessation, or hypertension. Another interesting area for future studies would be to investigate how far the barriers identified in this study influence individuals' health goals. Since replacing was a common strategy among unsatisfied users, we suggest that a poorly performing mHealth app does not necessarily cause people to abandon their health objectives. Furthermore, future research can use our themes identified to study how designers and developers of mHealth apps can deal with them. For example, a major objection raised by users was data inaccuracy. Since current technologies are often not yet capable of gathering and displaying accurate data about their user's nutrition and activity behavior, scholars can examine how far transparency about such inaccuracies can reduce users' frustrations.

## **7 Conclusion**

Although mHealth apps promise to offer a variety of features to support individuals in their weight loss, a major problem is that users often abandon the use of mHealth apps shortly after an initial period. This study aimed to examine sources of negative user experiences that can act as drivers of discontinuing mHealth apps for weight management. By qualitatively analyzing app reviews of five popular mHealth apps, we identified nine causes of complaints that can have adverse effects regarding long-term mHealth app use. Furthermore, we have shown how certain objections relate to specific mHealth affordance bundles and determined three types of discontinuance behavior in the context of mHealth app use.

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