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Katharina Pflügner
University of Bamberg, katharina.pfluegner@uni-bamberg.de

Christian Maier
University of Bamberg, christian.maier@uni-bamberg.de

Yanick X. Lukic
ETH Zürich, ylukic@ethz.ch

Gisbert Wilhelm Teepe
ETH Zurich, gteepe@ethz.ch

Tobias Kowatsch
ETH Zurich, tobias.kowatsch@uzh.ch

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Mobile Stress Management Applications: An Affordance-Theoretic Perspective on the Adoption and Use

Short Paper

Katharina Pflügner

Information Systems and Services
University of Bamberg
katharina.pfluegner@uni-bamberg.de

Christian Maier

Information Systems and Services
University of Bamberg
christian.maier@uni-bamberg.de

Yanick Xavier Lukic

Centre for Digital Health
Interventions, ETH Zurich
ylukic@ethz.ch

Gisbert Wilhelm Teepe

Centre for Digital Health
Interventions, ETH Zurich
gteepe@ethz.ch

Tobias Kowatsch

Institute for Implementation Science in Health Care, University of Zurich
School of Medicine, University of St.Gallen
Centre for Digital Health Interventions, ETH Zurich
tkowatsch@ethz.ch

Abstract

Chronic stress is a burden on mental and physical health. Despite the development and effectiveness of mobile stress management applications, their adoption and continued use remain low. Given that research revealed systematic differences in usage behavior among user types, we aim to investigate what drives these differences. We extend the affordance perspective and argue that accounting for psychological needs, actualized affordances, and actualization costs across different user types provides a deeper understanding of the factors driving the adoption and use of mobile stress management applications. The qualitative interview study of our mixed-methods study reveals eight affordances, eight actualization costs, and initial evidence for systematic differences among the user types. The quantitative questionnaire study will uncover the psychological needs, actualized affordances, and perceived actualization costs of the six user types. This work contributes a new theoretical perspective to overcome the gap in the adoption and usage of mobile stress management applications.

Keywords: Mobile stress management applications, chronic stress, well-being, stress reduction, affordances, actualization costs, user types

Introduction

Chronic stress is a significant burden on individuals' psychological and physical health. It can lead to depression, sleep disorders, and cardiovascular diseases (Richardson et al. 2012; Yang et al. 2015). Chronic stress also comes with substantial societal costs due to absenteeism at work, loss of productivity, and healthcare costs (Hassard et al. 2018). Due to that, there is a consensus to prevent and mitigate chronic stress and its severe consequences.

Researchers and startups alike have developed mobile applications to prevent and reduce chronic stress, and health insurances recommend individuals to use those (UnitedHealthcare 2019). These mobile stress management applications are easily accessible via the smartphone and individuals can use them independently without accompanying therapy (Ebert et al. 2016). Despite its promising effectiveness in reducing chronic stress (Linardon et al. 2019), the adoption remains low and many of those who started, soon stopped using the application (Linardon and Fuller-Tyszkiewicz 2020). Limited adoption and use hinder these applications from being effective. Therefore, it is vital to investigate the factors influencing users' behavior to understand better and address adoption and usage barriers.

The needs-affordance theory (Karahanna et al. 2018) offers helpful insights into what drives individuals' behavior. The theory posits that psychological needs and perceptions drive the adoption and usage of technologies, such as mobile stress management applications. Psychological needs are universal, inherent in individuals, and provide a motivational factor for a behavior (Karahanna et al. 2018). Psychology literature identified three psychological needs: autonomy, competence, and relatedness (Deci and Ryan 2000). Technologies, in turn, have affordances, i.e., action potentials of the application, which can fulfill these needs. However, recent research has highlighted that individuals may encounter difficulties when actualizing the affordances, i.e., actualization costs (Salo et al. 2022). For instance, receiving reminders by the application (affordance) may overload the user with too much notifications (actualization costs), which may cause them not to activate the reminders (no actualization of affordance) or even not to open the application again and stop its adoption.

However, initial research from the digital health literature highlights that there are multiple user types that differ in how they use an application, such as a fitness tracker app (James et al. 2019b). These insights are supplemented by research from the broader (non)adoption literature, suggesting that also different user types exist during the adoption stage. For instance, the *symbolic adopter* has decided to try the application after receiving initial information. In contrast, the *symbolic rejecter* rejects the application after their first evaluation and does not try it (Wolverton and Cenfetelli 2019). We integrate these insights and offer a unified perspective by accounting for six user types throughout the adoption and use process. Accounting for these different user types is relevant, because different users may differ in their psychological needs, how they actualize the affordances (Leidner et al. 2018), and how they perceive actualization costs. For instance, individuals with a need for relatedness (psychological need) may exchange their experiences in the application with other users (actualized affordance), while others do not actualize this affordance. We argue that accounting for differences in psychological needs, actualized affordances, and actualization costs across user types may provide a deeper understanding of the factors driving the adoption and use of mobile stress management applications. Thus, we focus on different user types of mobile stress management applications and reveal their specific characteristics. We ask two research questions (RQs):

RQ1: *What are mobile stress management applications' affordances and potential actualization costs?*

RQ2: *Which psychological needs, actualized affordances, and perceived actualization costs characterize different user types?*

We answer our research questions by conducting a mixed-methods study using two sequential studies. Study 1 identified affordances and potential actualization costs of mobile stress management applications, aiming to answer RQ1. We interviewed 28 individuals, revealing eight affordances and eight potential actualization costs. Study 2 will leverage study 1's findings. Here, we will investigate the psychological needs, actualized affordances, and perceived actualization costs for the different user types. By connecting the needs-affordance theory with different user types, we can help design mobile stress management applications that are more engaging and used more often as they are specific to different user types (Volkoff and Strong 2018). Moreover, this work contributes a new theoretical perspective to overcome the gap in the adoption and usage of mobile stress management applications (Linardon and Fuller-Tyszkiewicz 2020).

Next, we summarize relevant literature on mobile stress management applications. We then introduce the needs-affordance theory as a theoretical lens, extend the lens by including actualization costs, and illustrate six user types. Finally, we outline our methodological approach, present the qualitative results, and discuss the (expected) contributions of the study results.

Theoretical Background

We illustrate research on mobile stress management applications. Next, we emphasize the relevance of psychological needs, affordances, and actualization costs for the adoption and use of mobile stress management applications. Finally, we explain a process perspective on adoption and use resulting in the differentiation of user types.

Mobile Stress Management Applications

Mobile stress management applications aim to fight chronic stress and its serious consequences such as depression, sleep disorders, and cardiovascular diseases (Richardson et al. 2012; Yang et al. 2015). Mobile stress management applications are services delivered via the smartphone, can be downloaded via the application store, and can be used by individuals without accompanying therapy. On their own, individuals navigate through the application and complete trainings to reduce stress based on texts, audio files, and predefined tasks. Such applications come with a variety of advantages. As the smartphone delivers these applications, they are easily accessible anytime and anywhere. These applications assure anonymity if desired and potentially reach stressed individuals earlier than traditional services. Reaching a more significant portion of individuals comes with only a tiny increase in resources (Ebert et al. 2016). Substantial empirical evidence confirms the effectiveness of mobile stress management applications in reducing stress (Ebert et al. 2016; Linardon et al. 2019). Besides others, these applications have empirically shown to reduce perceived stress levels, depression, emotional exhaustion, and sleeping problems. However, there are low rates regarding the adoption and use of mobile stress management applications (Lattie et al. 2019; Linardon and Fuller-Tyszkiewicz 2020), limiting their effectiveness.

Adoption and Use of Mobile Stress Management Applications

Existing research has revealed many factors that drive technology adoption and use. Besides others, user-related factors such as computer self-efficacy, past experiences (Schwarz et al. 2014) and general technology-related perceptions such as perceived ease of use, perceived usefulness (Venkatesh et al. 2016), and persuasive design (Baumel and Yom-Tov 2018) influence technology adoption and use. Moreover, specific technology-related perceptions, such as trust in the provider, are more important in the healthcare domain than in other domains (Laumer et al. 2019). Similarly, some aspects of the technology are more or less critical for the adoption in the stress management context compared to other digital health contexts. For instance, reminder functions are irrelevant for user satisfaction with stress management applications but positive for satisfaction with other digital health applications (Pflügner et al. 2021). Consequently, there is a need for a context-specific investigation.

Current research has highlighted the necessity to not only focus on the technology itself but also on the user's relationship with the technology (Volkoff and Strong 2018). A needs-affordance perspective provides this focus on both. The needs-affordance theory informs us that individuals' psychological needs drive them to adopt and use technology because the technology has multiple affordances that can fulfill these psychological needs (Karahanna et al. 2018) (Figure 1). Psychological needs are inherent in every individual and provide a solid motivational factor for a behavior (Karahanna et al. 2018), such as adopting and using mobile stress management applications. In line with the theory, there are three basic psychological needs (Deci and Ryan 2000) that are relevant in the technological context (Karahanna et al. 2018) (Table 1).

Psychological need	Description
Autonomy	The need to be a causal agent of one's own life and act in harmony with one's integrated self
Competence	The need of being effective in dealing with the environment in which the individual finds oneself
Relatedness	The need to interact, be connected to, and experience caring for others

Table 1. Basic Psychological Needs (Deci and Ryan 2000)

In addition to psychological needs, affordances are relevant. Affordances reflect the potential for achieving a concrete outcome, such as fulfilling psychological needs by using technology (Karahanna et al. 2018). Prior research has identified a variety of technology-specific affordances (e.g., Eismann et al. 2021; Nevo et al. 2021). For instance, social media affordances include building relationships with peers, finding

resources, and acquiring new technology skills (Leidner et al. 2018). We hypothesize that mobile stress management applications are likely to provide multiple technology-specific affordances.

However, individuals may encounter difficulties in actualizing the affordances, i.e., actualization costs. Actualization costs refer to the effort, attention, or other resources needed to realize the affordances, e.g., attention shifting to the technology (Salo et al. 2022). These costs can arise from multiple sources, including personal, technological, and regulatory ones, such as own abilities, procedures in the application, or policies and regulations (Alshawmar 2021). While these costs may be small individually, they may accumulate and become significant. The parallel existence of affordances that can fulfill psychological needs and the perception of actualization costs can create paradoxical tensions (Ciriello et al. 2019). Therefore, actualization costs were identified as a significant factor that does not necessarily, but can potentially hinder the actualization of affordances (Salo et al. 2022) and is relevant for understanding adoption and use (Blut et al. 2022) (Figure 1). When individuals notice these actualization costs, they may modify their technology use, take a break from the technology or quit its use permanently to reduce these actualization costs (Salo et al. 2022).

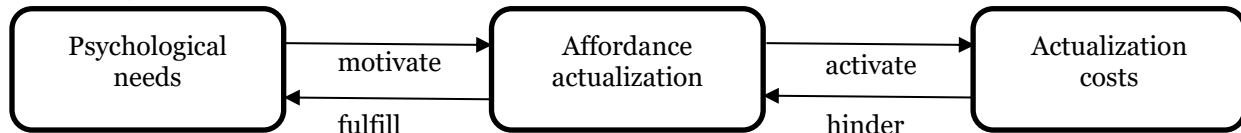


Figure 1. The Interplay of Psychological Needs, Affordances, and Actualization Costs

Different User Types

A technology always has the same set of affordances but users might differ by their needs, actualized affordances, and perceived actualization costs given that there are different user types who differ in whether and how they use an application (James et al. 2019b; Leidner et al. 2018; Wolverton and Cenfetelli 2019). While there are multiple attempts to classify these user types, we follow a process perspective (Schwarz et al. 2014) because we thereby include user types in both the adoption and use stages. Following these considerations, the user types can be distinguished depending on their progress within the adoption and use process (Table 2).

User type	Description
Symbolic rejecter	The symbolic rejecter does not contend to adopt and use the mobile stress management application.
Symbolic adopter	The symbolic adopter has not yet tried the mobile stress management application but is considering using it in the future.
Trial rejecter	The trial rejecter has tried the trial version of the mobile stress management application but does not consider using the full version.
Trial accepter	The trial accepter has tried the trial version of the mobile stress management application and is considering using the full version.
Use rejecter	The use rejecter has used the full version of the mobile stress management application but does not use the application anymore.
Continued user	The continued user continuously uses the full version of the mobile stress management application.

Table 2. User Types Following a Process Perspective

In the beginning, the individual seeks information about the application and evaluates the application. A *symbolic rejecter* after that views the application negatively and does not consider trying out the application (Wolverton and Cenfetelli 2019). In contrast, the *symbolic adopter* has not yet tried the application but rates it positively and is considering trying it out (Wolverton and Cenfetelli 2019). Other users have already tried the application, where there are again different user types. For a *trial rejecter*, the trial was negative, and they did not further adopt or use the application. In contrast, the trial was positive for the *trial accepter*. They engage in trial acceptance and use the application (Wolverton and Cenfetelli 2019). These four user types identified by Wolverton and Cenfetelli (2019) reflect the (non)adoption stages, which can be extended by the usage stage (Maier et al. 2022). Therefore, we integrate two additional user types that account for the usage stage. Some individuals have used the application but decided to quit it (Maier et al. 2022;

Schwarz et al. 2014), which we term *use rejecter*. Finally, the *continued user* accepted the trial of the application and now continuously uses the application.

Overall, in this work, we differentiate between six user types. There is initial evidence for the usefulness of differentiating among user types in nonadoption (Wolverton and Cenfetelli 2019) and affordance literature (Leidner et al. 2018; Mettler and Wulf 2019). We argue that the user types are characterized by specific psychological needs, affordances, and actualization costs that may be of varying importance to the six user types. These different characterizations may be due to users' increased interaction and experience as they progress through the adoption and use process. We offer a unified perspective by accounting for six user types throughout the adoption and use process (Maier et al. 2022; Schwarz et al. 2014) and aim to reveal a characterization of the six user types in terms of psychological needs, affordances, and actualization costs that drive the user behavior and are specific for mobile stress management applications.

Study 1: Identification of Affordances and Actualization Costs

Context. To address RQ1 and investigate mobile stress management applications, we focused on a specific evidence-based application for mindfulness-based stress reduction available in the Google PlayStore and Apple AppStore in Germany. We chose this subform of mobile stress management applications because the evidence supports the effectiveness of smartphone-delivered mindfulness-based stress reduction over eight weeks (e.g., Bostock et al. 2019). The application is self-guided, the costs of using it can be covered by the health insurance, and empirical studies have proved its effectiveness in reducing chronic stress and its consequences. The application offers a structured course for stress reduction, accompanied by information material, individual meditation and breathing exercises, and a personal area. In this personal area, personal settings such as activating reminders can be made and the individual progress be viewed. During a trial period of seven days, some content can be accessed for free.

Sample Characteristics and Procedure. We conducted 28 semi-structured interviews that took about 30 minutes each. The sample consisted of 21 women and seven men, with an average age of 33.00 years, ranging from 20 to 65 years ($SD = 12.93$). Our recruiting strategy aimed at sampling individuals with varying experience in mobile stress management applications. We recruited the participants with posts on social media groups and a snowball sampling strategy that started with the authors' contacts. We conducted purposeful sampling and only included individuals for whom mobile stress management applications are relevant as they experience chronic stress. Chronic stress was assessed with the single-item measure "In the past month [before you started adopting the application], how would you rate the amount of stress in your life (at home and at work)?" (Littman et al. 2006). For the first four user types, we considered someone experiencing stress when they indicated a stress level of at least 6 on a scale ranging from 1 (no stress) to 10 (extreme stress). For the two other user types, i.e., use rejecter and continued user, we considered someone experiencing chronic stress when the level was at least 6 in the month before they started adopting the application. The rationale for considering the month before they started adopting the application is that the use of the application may have led to a substantial chronic stress reduction.

At the beginning of the questionnaire, we based on the description of user types (Table 1) and asked the interviewees about their adoption and usage of the application. Concretely, we asked whether the interviewees contended to adopt the application, had already tried it out, considered using the full version, and still used the application. These questions revealed seven symbolic rejecters, three symbolic adopters, five trial rejecters, three trial accepters, three use rejecters, and seven continued users.

Interview Guideline. We based the design of the semi-structured interview guideline on related literature and established guidelines (Myers 2013). After eliminating inconsistencies and misunderstandings from the pretest results with three students, we started the interview by explaining the purpose of the research. We ensured that those unfamiliar with the mindfulness-based stress reduction application understood it to ensure transparency and confidentiality. After that, we openly asked the interviewees about the application's affordances by questions like "What could you use the application for?" or "What are you able to do with the application". Regarding actualization costs, we asked the interviewees which effort, attention, or other resources they would need to use the application as previously explained. Finally, we asked demographic questions as well as questions regarding meditation experience, technology self-efficacy, and the available amount of smartphone use for private purposes. We remained open to asking additional questions to catch the interviewees' experiences and perceptions despite the interview guideline.

Data Analysis. All interviews were recorded, anonymized, transcribed, and coded with MAXQDA 2022 following an established data analysis methodology (Myers 2013). The data analysis consisted of four steps: descriptive coding, interpretative coding, review of interpretative coding, and categorizing. We started with identifying text passages and assigning descriptive codes. We identified a statement as an affordance when the interviewees described aspects they could do with the application such as “I could use the application for” and “with the application, I was able to.” Then, we applied interpretative coding. For the interpretative coding, we synthesized the descriptive codes that can be summarized under one affordance or actualization cost. The coding was mainly done by one researcher. However, a second researcher reviewed all interpretative codes. Moreover, to ensure accurate coding, two interviews were coded by the second researcher. We assessed the percentage to which the two researchers assigned the text passages the same codes of the coding scheme, leading to a satisfactory intercoder reliability (0.89). In case of coding mismatches or uncertainties, the two researchers discussed and assigned the best matching code. Lastly, we categorized which affordances and actualization costs appeared most relevant for which user type.

Results

The interviews revealed eight affordances (Table 3) and eight actualization costs (Table 4) specific for mindfulness-based stress reduction applications.

Affordances	Supporting quote (each affordance also applies to further user types)
Receiving guidance on stress reduction	“I tried the application because I thought I could do it better with guidance than if I sat down alone and meditated just for myself.” (trial accepter)
Practicing meditation and relaxation	“In the meditations and exercises, there are great impulses. For instance, when the application was new to me, I learned and practiced how much you can do with the breath.” (continued user)
Personalizing the content	“I pick out meditations or tasks that I know fit quite well to my current situation or mood. I have already completed most of them, but I have set favorites and look for meditations that fit to the situation.” (continued user)
Personalizing the intensity/length	“I can do these mindfulness exercises in a relatively short time. Or, if I have more time or feel a need to, I can also choose something longer.” (continued user)
Receiving reminders	“I have engaged in meditation before, but I often forgot to meditate or deferred it. For me, it was really good that the application reminded me about meditating. So it actually brought me to meditating regularly.” (use rejecter)
Setting own goals	“You could set how often you wanted to use it. I set the goal to do a meditation every day.” (use rejecter)
Recognizing the own progress	“I use the coach every now and then to see how regularly I meditate and how long I have practiced over the time.” (trial accepter)
Exchanging experiences with other users	“The community can be good in difficult times for experience sharing. You can ask the community whether they have tips for a specific experience and for ideas what you could try out on your own.” (continued user)

Table 3. Overview of Identified Affordances with Supporting Quotes

Actualization costs	Supporting quote (each actualization cost also applies to further user types)
Reliance on and attachment to the technology	“We already spend so much time with technology. And it feels a bit like a conflict using a smartphone for stress reduction or activating these reminders. So for me, it didn’t feel right using the application for relaxation.” (trial rejecter)
Time consumption	“The only barrier is finding the time to do it. I figured out that the evening works well for me. But the problem might still be that so much is going on before going to bed.” (continued user)
Unpleasant emotions	“I perceived it as negative if I didn't do the exercises on busy days. I noticed in the evening that I was a bit angry and disappointed by myself.” (trial rejecter)
Cognitive effort	“Sometimes you are mentally busy with things and you don't need a change of perspective or suggestions. I try to solve it on my own and I would find it negative if I used the app and had even more input.” (use rejecter)
Financial costs	“That was the reason why I did not continue using the app because I thought: I have to pay for it or take care for the cost coverage again.” (use rejecter)

Overload	“Sometimes I'm faced with the abundance of content and actually take too long, so that the time I have for the activity is over.” (continued user)
Interruptions	“There are always impulses by the app in between, which I sometimes follow, but often not. It depends on what I'm doing at the moment. Sometimes the impulses disrupt me from what I'm currently doing.” (continued user)
Privacy risks	“Well, I am in the community. Every now and then I write something there but basically I'm inhibited when it's something more personal.” (continued user)

Table 4. Overview of Identified Potential Actualization Costs with Supporting Quotes

Study 1 identified affordances and potential actualization costs. In addition, study 1 revealed initial indications of characterizations and differences among the user types. The affordance of receiving guidance on stress reduction is most relevant for the symbolic adopters and trial accepters. At the same time, the continued users do not actualize this affordance anymore. The trial rejecters and use rejecters were more likely to specify their own goals than other user types and were confronted with unpleasant emotions when they did not accomplish their specified goals. These resulting unpleasant emotions let them stop using the application. In contrast, none of the interviewed continued users reported specifying their own goals. They actualize the affordance of practicing meditation and relaxation whenever needed, not dependent upon specified goals.

The application provides social affordances such as virtually exchanging experiences with other users. The results indicate that the individuals do have a psychological need for relatedness, i.e., to interact and be connected with other users. However, the affordance of *virtually* exchanging experiences with other users does not seem to fulfill this need, and the users tend to prefer to exchange their experiences *face to face*. Therefore, none of the user types regularly actualizes this affordance in our study.

Regarding actualization costs, continued users hardly mentioned any perceived actualization costs. This finding indicates that they were able to solve the tension between their psychological needs and potential actualization costs. The actualization cost of overload is especially prevalent among the trial rejecters.

Moreover, the results indicate two subtypes among use rejecters. One subtype does not use the application anymore due to an actual rejection despite the high chronic stress level. The other subtype no longer uses the application due to missing relevance. Among others, this second subtype does not experience chronic stress anymore or internalized the exercises, so they do not need the technological support anymore to actualize the affordance of practicing meditation and relaxation. In addition to these initial insights, we systematically investigate the characterization of the user types in study 2.

Study 2: Characterization of the User Types in Terms of Psychological Needs, Actualized Affordances, and Perceived Actualization Costs

In study 2, we plan to conduct a quantitative or qualitative study within the same context as in study 1, i.e., mindfulness-based stress reduction applications, and recruit at least 30 participants from each user type. We plan to recruit participants through an open call on different platforms, e.g., social media groups. In a self-rating questionnaire based on established and self-developed items, the participants will be first confronted with screening questions assessing their chronic stress level and their experience with mobile stress management applications. Through this screening step, we will assign them to one of the six user types. After that, the participants will be asked about the extent of the three psychological needs (Deci and Ryan 2000), state the extent to which they actualize(d) each of the identified affordances of study 1, or view them as relevant (for the user type symbolic rejecter and symbolic adopter). Moreover, we will assess how they perceive each of the identified actualization costs of study 1. With this approach, we aim to reveal the most prominent dimension(s) of each construct (psychological needs, actualized affordances, and perceived actualization costs) and investigate the characterizations of different user types while accounting for the possibility that a user type may consist of multiple subtypes.

Discussion and (Expected) Contributions

Motivated by the desire to offer a unified perspective on user types and their characterizations in mobile stress management applications, our study offers multiple contributions. First, we contribute to research in the context of mobile stress management applications. We introduce an affordance perspective and

reveal eight affordances specific to mobile stress management applications. Some affordances, such as exchanging experiences with other users, have also been relevant in other contexts, including social media (Leidner et al. 2018). We identified setting own goals as an affordance for mobile stress management applications, which maps to the relevance of goal-related factors identified in the fitness context (James et al. 2019a). Furthermore, we reveal that development-related affordances such as receiving guidance, personalizing the intensity/length or setting own goals are affordances that can mainly be found in our research context that aims to protect or restore individuals' health.

Second, we contribute to research around the adoption and use by basing on the needs-affordance theory (Karahanna et al. 2018) and extending the theory by the concept of actualization costs (Salo et al. 2022). Accounting for actualization costs offers another explanation for adoption and use behavior and sheds light on the tensions that can arise when actualizing affordances. In addition, we showed the subjectiveness of actualization costs, given that different user types perceived the actualization costs differently.

Third, we take the insights into different user types in affordance literature (Karahanna et al. 2018; Mettler and Wulf 2019) but follow a process perspective (Schwarz et al. 2014) to account for further user types. Thereby, we offer a unified perspective that considers six user types throughout the adoption and use process. This unified perspective also provides information on how affordance actualization may change over time by comparing user types in early process stages with those in later ones.

Fourth, we expect to contribute to research and practice on mobile stress management applications by introducing a user-centric perspective. Given the variety of factors identified to drive the adoption and use of health technology (Baumel and Yom-Tov 2018; Laumer et al. 2019), we showed that the relevance of factors influencing adoption and use might differ among the user types. The users appear to differ in how they can be encouraged to adopt and use mobile stress management applications. App developers need to be aware of the relative importance of affordances that varies among different user types and consider these different user types during the application development. Thus, with our expected characterization of user types, we guide research and practice on how to encourage adoption and use.

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