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Predicting mHealth Acceptance Using the UTAUT2 Technology Acceptance Model: A Mixed-Methods Approach

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Abstract. Background: Mobile health (mHealth) apps are increasingly used in healthcare to support people with chronic diseases such as diabetes. mHealth acceptance is crucial for using them. Due to acceptance problems, however, mHealth apps are not used by all chronic disease patients. To predict user acceptance, technology acceptance models such as UTAUT2 are used. However, UTAUT2 was not explicitly developed for the mHealth context. Objectives: This study investigates if additional health-related constructs could increase the predictive power of the UTAUT2 model. Methods: A mixed-methods design, comprising an initial qualitative methods triangulation study that consisted of a literature search, expert interviews, and patient interviews, and a subsequent quantitative cross-sectional survey with 413 patients was used. Results: The mixed-methods study revealed and validated two new constructs relevant for predicting mHealth acceptance not represented in the UTAUT2 model: "perceived disease threat" and "trust". Conclusion: The UTAUT2 model was successfully extended by two new constructs relevant to the mHealth context.

Keywords. mobile health units, mobile applications, consumer health informatics

1. Introduction

Mobile health (mHealth) apps contribute significantly to the self-management of chronic diseases, e.g., monitoring blood glucose levels in diabetes [1]. Especially in diabetes, one of the most common chronic diseases, self-management is instrumental in reducing the risk of complications such as hyperglycemia [2]. For example, mHealth apps such as continuous glucose monitoring (CGM) systems, which measure glucose concentrations in almost real-time, have revolutionized self-management for diabetics [1].

However, due to acceptance problems, mHealth apps are still not used by many patients with chronic diseases, especially diabetics, which means their potential is not entirely exploited [2,3].

So-called technology acceptance models, such as the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), are used to predict the acceptance of information technology [4,5]. However, although the UTAUT2 model was developed to focus on the

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users by considering factors such as, e.g., hedonic motivation, it does not consider health-related aspects.

Therefore, this study aims to investigate whether additional health-related constructs could increase the predictive power of the UTAUT2 model and thus be used more frequently in the mHealth context.

2. Methods

This study is based on a mixed-methods approach described by Kuckartz [6] as a so-called two-phase exploratory design. This study design is particularly suitable as it comprises an initial qualitative study phase to identify relevant mHealth acceptance factors and a subsequent quantitative study phase to validate them (see Figure 1).

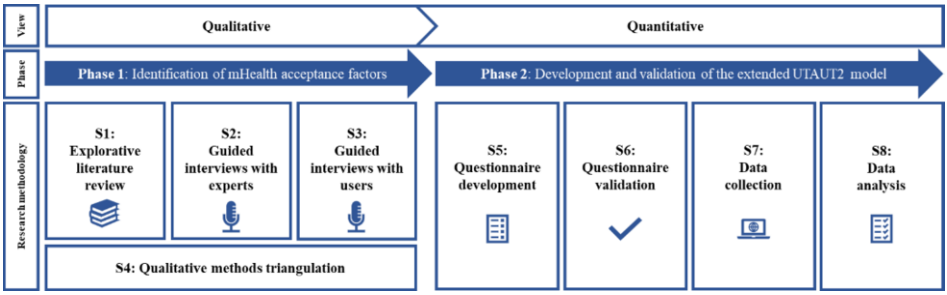

Figure 1. Mixed-methods research design: Phase 1 qualitative study, phase 2 quantitative study.

2.1. Qualitative study phase

The qualitative study phase aimed to identify relevant mHealth acceptance factors to extend the UTAUT2 model. For this purpose, three subsequent research steps were conducted: an explorative literature review (S1), guided interviews with mHealth or technology acceptance experts (S2), and interviews with mHealth users (S3). The categories representing the mHealth acceptance factors were formed based on the qualitative data using structured content analysis, according to Kuckartz [7]. The identified categories were then triangulated in the final step (S4).

Explorative literature review (S1): This review considered 582 scientific mHealth acceptance articles, including systematic reviews, meta-analyses, and original research papers. A systematic screening process, in which titles, then abstracts, and finally full texts were reviewed, identified a total of 34 articles that met inclusion criteria. These were analyzed using content analysis to extract relevant mHealth acceptance factors based on the current state of research.

Guided interviews with mHealth or technology acceptance experts (S2): These guided interviews included recognized scientists from Austrian and German universities in the relevant fields of mHealth or technology acceptance. These interviews aimed to identify additional mHealth acceptance factors from an expert view. A total of eleven interviews were conducted with nine male and two female experts until theoretical saturation was reached. The selection of experts was limited to Austria and Germany, as

both countries are pretty similar concerning aspects such as the healthcare system, thus allowing the comparability of the statements.

Guided interviews with mHealth users (S3): These guided interviews included adult type 1 or type 2 diabetes patients or people caring for a relative with diabetes who had been using mobile diabetes apps for at least three months. These interviews aimed to change the focus to the user perspective and identify additional mHealth acceptance factors from their viewpoint. A total of eight interviews were conducted with five male and three female mHealth users from Austria and Germany until theoretical saturation was reached. Data analysis followed the same process as the interviews with mHealth or technology acceptance experts.

Qualitative methods triangulation (S4): Using the within-method triangulation according to Flick [8], we triangulated the results from the explorative literature review (S1) with the results from the guided interviews with experts (S2) and with mHealth users (S3) to confirm the relevant mHealth acceptance factors.

2.2. Quantitative study phase

The quantitative study phase aimed to extend and validate UTAUT2 for the mHealth context in a survey. For this purpose, four subsequent research steps were conducted: questionnaire development (S5), questionnaire validation (S6), data collection (S7), and data analysis (S8). The mHealth acceptance factors confirmed during the qualitative methods triangulation (S4) formed the basis for questionnaire development (S5) and, thus, the interface between the qualitative and quantitative research phases.

Questionnaire development (S5): The questionnaire development used the validated scales from the German translation of the UTAUT2 questionnaire [9], slightly adapted to the mHealth context, and the validated items from the additional constructs "perceived disease threat" [10] and "trust" [11] confirmed during the qualitative methods triangulation [5]. Additional information, such as sociodemographic data, were assessed using single-item measurement.

Questionnaire validation (S6): Because the items of the additional constructs "perceived disease threat" and "trust" were only available in English, a translation into German and back into English was performed by two independent translators to ensure the items did not lose their original meaning. We conducted a qualitative pre-test using the think-aloud method [12] with five experts for quantitative methods and five mobile diabetes app users to ensure the content validity and understandability of the questionnaire [5]. The overall survey comprises 42 items.

Data collection (S7): The data collection was carried out using an online survey. Participants were mainly recruited via social media (e.g., Facebook groups) but also via diabetes support groups, diabetes associations, and directly in diabetes outpatient clinics in Austria and Germany to ensure that patients without access to social media were also considered. The study was open to adults with type 1, type 2, or other forms of diabetes or those caring for relatives with diabetes who had been using a mobile diabetes app for at least three months [5].

Data analysis (S8): Inferential statistical data analysis was conducted by partial least squares structural equation modeling (PLS-SEM) using SmartPLS3 software, as this method is particularly suitable for evaluating multiple statistical relationships simultaneously. Therefore, only complete and valid data sets were used for the analysis. The data analysis followed the two-stage approach described by Hair et al. [13], in which the measurement models are evaluated in the first step, followed by the structural model.

3. Results

3.1. Qualitative study phase

As a key finding, the qualitative methods triangulation revealed two new categories relevant to mHealth acceptance: "perceived disease threat" and "trust". In addition, the identified category "personal innovativeness" was not pursued further because it is already included as part of the moderating effects of hedonic motivation in the UTAUT2 model [14]. Thus, Figure 2 shows the identified categories (colored boxes) that resulted from content analysis in the individual research steps S1 to S3 (gray boxes) triangulated with each other. The categories are listed in descending order according to the frequency (numbers along connecting lines) they were identified in the corresponding research steps.

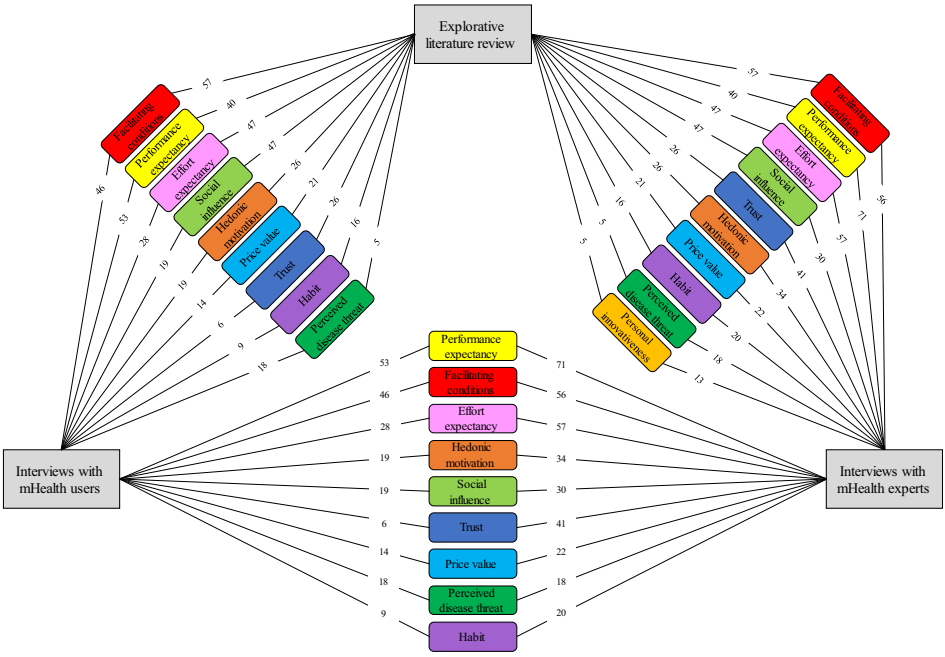

Figure 2. Result of the qualitative methods triangulation [14]

3.2. Quantitative study phase

Based on the results from the qualitative study phase, the UTAUT2 model was extended to include the additional constructs "perceived disease threat" and "trust" (see Figure 3). A total of 413 complete and valid questionnaires were included in the data analysis using PLS-SEM. The data analysis confirmed that in addition to the two UTAUT2 constructs "performance expectancy" and "habit", the new constructs "perceived disease threat" and "trust" in particular were significant and thus relevant for predicting mHealth acceptance represented by "behavioral intention" [5]. In addition, data analysis revealed that the extended UTAUT2 model explained 35% of the variance in "behavioral intention" [5].

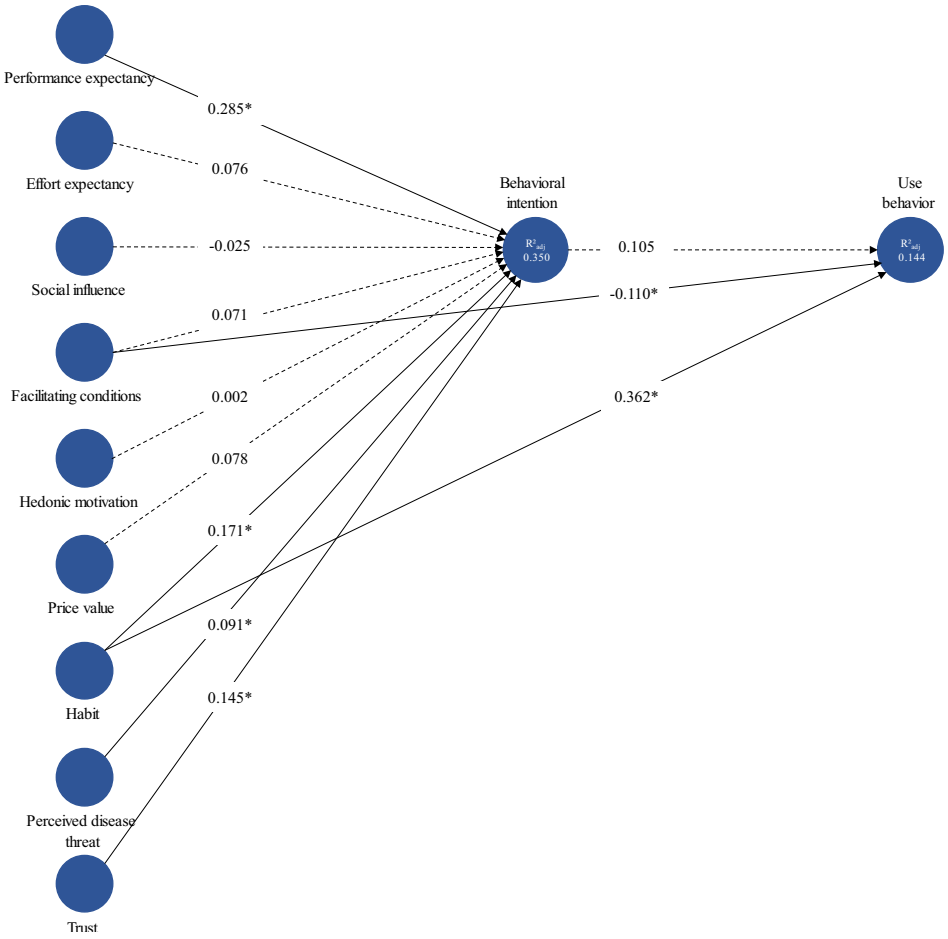

Figure 3. Extended UTAUT2 model, including path coefficients and adjusted coefficients of determination. Solid lines show significant influence. *P<.05

4. Discussion

Adopting a mixed-methods approach, this study identified the two new constructs, "perceived disease threat" and "trust", relevant to predicting mHealth acceptance, thus contributing to explaining the variance in "behavioral intention" of the extended UTAUT2 model. The two-stage exploratory study design enabled relevant mHealth acceptance factors to be identified from three independent sources, comprising different perspectives from literature, experts, and users, in the first qualitative study phase and validated in the subsequent quantitative study phase. Using only validated scales for the online survey ensured the high quality of the questionnaire concerning reliability, objectivity, and validity.

However, despite the solid methodological approach, the extended UTAUT2 model could only explain 35% of the variance in behavioral intention, which is a medium value compared to other mHealth studies in which the explained variance in "behavioral intention" ranged from 19.4% in Schomakers et al. [15] to 56% in Breil et al. [16]. This might be due to different limitations, such as sample composition in the cross-sectional survey or unidentified mHealth acceptance factors in the qualitative study phase. Despite various recruitment channels such as social media, diabetes support groups, diabetes associations, and diabetes outpatient clinics, the sample shows a selection bias: it predominantly contains younger, female, diabetic type 1 patients. Other factors, such as country-specific conditions, e.g., health care system, socioeconomic factors, and infrastructure, may also influence patients' acceptance.

Nevertheless, this study has provided significant insight for mHealth acceptance research. As a central outcome, this study has shown the need to extend the UTAUT2 model for the health sector, which was particularly highlighted by the qualitative study. Thus, this study has revealed and validated key acceptance factors, e.g., "perceived disease threat" crucial for developing new mHealth applications to fully exploit their potential. In addition, this study has also shown that the field of technology acceptance research still has much potential, and thus the results of this study provide a good starting point for future research that is not limited to the field of mHealth acceptance only but includes the entire field of medical informatics. However, this paper provides an aggregated perspective of the entire mixed-methods study and the resulting critical findings derived from the initial qualitative study [14] and subsequent quantitative study [5]. Since technology acceptance is crucial to the acceptance of new information technologies, research into further health-related acceptance factors for the field of medical informatics is desirable.

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