A Perceived Value Perspective on Influencing Factors and Pathways of Users' Continuance Intention for Digital Health Apps: An fsQCA-Based Postprint

Authors: Wu Dawei, Hu Xiaofei, Yuxiang Zhao, Ai Wenhua

Date: 2023-04-01T16:02:56+00:00

Abstract

[Purpose/Significance] The problem of low user retention rates for digital health APPs has long been a persistent challenge. This study aims to identify the perceived value factors influencing users' continuous adoption of digital health APPs and their influence mechanisms, providing insights for future improvements of digital health APPs.

[Method/Process] From the perspective of perceived value, employing research methods of content analysis and fuzzy-set Qualitative Comparative Analysis (fsQCA), this study induces factors influencing continuous adoption from users' negative reviews of digital health APPs, and explores the configurations leading to users' continuous adoption of digital health APPs based on the identified influencing factors.

[Results/Conclusion] The study found that system value, update value, environment value, consultation value, transaction value, and security value are influencing factors affecting users' continuous adoption of digital health APPs; through fsQCA3.0, a total of three effective configurations leading to users' continuous adoption were generated, namely CA1: high update value*high transaction value*high security value*high consultation value; CA2: high update value*high security value*high system value; CB: low system value*high update value*high security value*high consultation value*high environment value. Finally, the authors analyze the influencing factors and configurations, providing practical implications for the future development of digital health APPs.

Full Text

Preamble

Research on Influencing Factors and Paths of Users' Continuous Adoption Intention of Digital Health Apps from the Perspective of Perceived Value: Based on the fsQCA Method

Wu Dawei[1], Hu Xiaofei[1], Zhao Yuxiang[2], Ai Wenhua[3]

[1]School of Management, Nanchang University, Nanchang 330031
[2]School of Economics and Management, Nanjing University of Science and Technology, Nanjing 210094
[3]School of Information Management, Nanjing University, Nanjing 210023

Abstract: [Purpose/Significance] The problem of low user retention rates for digital health apps has been difficult to resolve. This study aims to identify the perceived value factors that influence users' continuous adoption of digital health apps and their impact pathways, providing references for future improvements to digital health apps. [Method/Process] From the perspective of perceived value, this study employed content analysis and fuzzy-set qualitative comparative analysis methods to summarize continuous adoption factors from users' negative comments about digital health apps, and explored the configurations leading to users' continuous adoption based on these identified factors. [Result/Conclusion] The study found that system value, update value, environmental value, inquiry value, transaction value, and security value are the influencing factors of users' continuous adoption of digital health apps. Through fsQCA 3.0, three effective configurations leading to continuous adoption were generated: CA1: high update value * high transaction value * high security value * high inquiry value; CA2: high update value * high transaction value * high security value * high environmental value * high system value; CB: low system value * high update value * high security value * high inquiry value * high environmental value. Finally, the authors analyzed the influencing factors and configurations, providing practical insights for the future development of digital health apps.

Keywords: digital health apps, perceived value, continuous adoption intention, fsQCA, configuration

Classification Number: F49
DOI: 10.13266/j.issn.0252-3116.2021.18.010

eHealth refers to the medical function of enhancing health services and information delivery through the internet or related technologies [1], reflecting the transformation of business and medical fields at the end of the 20th century [2] and representing a technological prototype where a series of technologies converge to provide medical care for consumers [3]. The initial practical significance of eHealth was mainly limited to improving communication efficiency among medical institutions and enhancing the quality of medical information

collection [4]. However, digital health apps supported by advanced digital technologies such as big data and cloud computing are now flourishing. According to the China Mobile Medical App Product Monitoring Report (2018), there are already more than 2,000 domestic medical and health applications, with user numbers exceeding 200 million and active users reaching approximately 28.64 million [3]. Meanwhile, traditional user-end functions such as mobile consultation and pharmaceutical e-commerce have become saturated [6], and severe homogenization of functions among different software has reduced user novelty while increasing choice costs. Research by P. Krebs et al. [8] indicates that 45% of users do not continue using digital health apps after downloading them, and acquiring new users in online services costs much more than retaining existing ones [9]. Therefore, exploring how users continuously adopt digital health apps and improving app user stickiness is particularly important.

In April 2019, the World Health Organization released the Global Strategy on Digital Health (2020-2024), expanding the application of the eHealth concept to digital products including a broader range of smart and connected devices, consolidating concepts such as mobile medical care, mobile health, and medical informatization into "digital health" [5]. Specialized digital health apps break the limitations of time and space, providing new solutions for problems such as uneven distribution of medical resources and cumbersome medical processes. Since the release of the "Good Doctor Online" iPhone app in 2011, the number of domestic digital health mobile apps has been on the rise.

Users' perceived value of information systems affects their continuous adoption behavior, which has been verified in studies on continuous adoption intention of WeChat [10], university library WeChat public accounts [11], and online health communities [12]. Perceived value is considered a multidimensional concept [13] that runs through the entire user experience process with apps. Therefore, exploring the synergistic collinearity between different perceived value dimensions from a configuration perspective may be more helpful in clarifying the mechanisms leading to users' continuous adoption of digital health apps. However, existing research on users' perceived value in apps [10, 14-15] mostly employs regression analysis or structural equation modeling to verify the net effects of various dimensions on users' continuous adoption of digital health services, neglecting the configuration effects of collinearity relationships between dimensions. This makes it difficult to holistically explain the mechanisms leading to user behavior from an impact pathway perspective. Qualitative Comparative Analysis (QCA), proposed by American sociologist C. C. Ragin in the 1980s, combines qualitative and quantitative research paradigms and can holistically grasp the impact pathways leading to certain outcomes. Given this, this study, based on the perspective of perceived value, uses online review data of digital health apps as research material to extract value dimensions, and employs fuzzy-set qualitative comparative analysis (fsQCA) to identify configurations of different dimensional perceived value factors. The aim is to explore the influencing factors and configuration pathways of users' continuous adoption of digital health apps, providing references for clarifying functional improvement

directions and enhancing user retention rates in subsequent digital health apps.

1 Literature Review

As the dilemma of digital health apps intensifies, research on digital health service adoption has shifted from traditional initial adoption studies to exploration of continuous adoption [16], involving different theoretical and research perspectives. From the perspective of assisting suppliers in improving service quality, S. Akter et al. [17-19] conducted a series of representative studies, not only scientifically dividing service quality dimensions but also exploring the impact of different service quality dimensions on users' continuous adoption intention of mobile medical care. In terms of model integration, the Information Systems Success Model (D&M) [20] has been widely applied. Studies within the D&M framework have demonstrated that digital health app users' perceived information quality and perceived service quality positively affect their trust and satisfaction with apps, thereby influencing continuous adoption intention [21], while platform quality, medical advice quality, and interaction quality also indirectly affect continuous adoption of digital health platforms [22].

From the perspective of exploring users' psychological perceptions when using digital health services, continuous adoption research on digital health services has been supported by rich theories and models, mostly using technology acceptance-related models as explanatory tools. Classic models such as the Technology Acceptance Model (TAM) [23], Expectation Confirmation Model (ECM) [24], and Post-Adoption Model (PAM) [16, 23] have been combined to summarize influencing factors including perceived usefulness, perceived ease of use, satisfaction, perceived threat, and perceived trust to better explain users' continuous adoption of digital health services [23-25]. Some studies have chosen to expand concepts and develop models on this basis to explore issues more specifically, such as introducing the concept of "intermittent disruption" to investigate from the perspective of non-continuous use, expanding the research angle on users' continuous use behavior of electronic medical devices [26]. From the perspective of user-related influencing factors, users' personal habits [27] and e-health literacy [28] all affect their continuous adoption of digital health apps.

Broad perceived value includes not only users' overall evaluation of the trade-off between benefits and costs of products or services [29], but also the emotional and experiential value during consumption or service acceptance [30]. Service quality factors with multidimensional divisions in digital health research affect users' perceived value [22]. However, compared with numerous studies that divide service quality dimensions, existing research on continuous adoption intention of digital health apps has not well integrated the perspective of perceived value to divide influencing factors, instead mostly treating it as a one-dimensional mediating variable [22] or as a fictional framework affecting users' continuous adoption of health communities from a benefit-cost perspective [12]. There are few studies that treat perceived value factors as core constructs for

multidimensional discussion to explore their different influencing dimensions and impact on continuous adoption of digital health services, while studies on other related topics have shown that multidimensional division of perceived value can better measure users' continuous adoption intention of information systems [10-12].

Through literature review, we found that previous research mostly used linear regression or structural equation modeling to explore users' adoption and usage behavior of health apps in the digital health field. Although these methods explained causal relationships between influencing factors to some extent, they could not deeply explore how configurations composed of various factors affect outcome variables. QCA is a "case-oriented" method proposed by American sociologist C. C. Ragin in the 1980s. Its core logic is based on set theory, introducing multiple concurrent causal mechanisms to explore the impact of different configurations on outcome variables. It is an effective means to explore the sufficiency relationship between sets of antecedent variable combinations and sets of outcome variables, breaking the limitation of traditional research methods that express linear relationships between single antecedent variables and outcomes [31]. Currently, QCA has been systematically introduced and applied in fields such as management [32], journalism and communication [33], and information science [34]. In user information behavior research, Yang Jinlong and Hu Guangwei [35] and Gan Chunmei et al. [36] conducted configuration analyses on the drivers of transforming mobile learning app adoption into continuous adoption and users' continuous adoption intention of mobile map apps, respectively. Combining perceived value theory, H. Li et al. [37] revealed seven effective configurations leading to users' continuous use of social media through multidimensional division of perceived value factors. This study selects fuzzy-set qualitative comparative analysis (fsQCA) for research. fsQCA is considered the most suitable method for handling complex dependencies among multiple factors [38]. It can not only clarify the necessity relationship of single conditions for achieving outcomes but also explore the sufficiency of multiple coexisting configurations related to the same outcome variable [39]. Most importantly, its determination of case tendencies is not a simple dichotomy of "yes" or "no," but uses precise assignments between (0, 1) as membership scores for cases, which can compensate for the rough classification defects of crisp-set qualitative comparative analysis (csQCA) and multi-value qualitative comparative analysis (mvQCA) [31, 40].

Given this, this study, based on the perspective of perceived value, uses content analysis and fsQCA methods to explore users' continuous adoption intention of digital health apps, focusing on two main questions: (1) From the perspective of perceived value, what are the influencing factors of users' continuous adoption intention of digital health apps, and how can they be dimensionally divided? (2) Can different perceived value dimensions constitute effective configurations explaining users' continuous adoption of digital health apps? What are the specific configurations?

2 Research Variable Extraction and Model Construction

2.1 Variable Sources

Extracting meaningful variables is the guarantee for fsQCA to produce reliable results. If variable extraction deviates from the theme or has low coverage, it is highly likely to produce irreconcilable contradictory configurations. Online reviews have received attention from scholars in the health information field. Domestic literature has used online reviews to extract influencing factors for doctor satisfaction in mobile medical apps [41]. Online reviews can reflect users' value perceptions under real experiences, and users who write reviews must have certain usage experience with the target app, meeting the research condition of "user continuous adoption intention." In terms of emotional tendency of online review content, although positive comments occupy an absolute majority in quantity [42-44], doctors and other patients consider negative comments posted by patients more influential than positive ones [45]. Patients searching online often choose doctors with more positive comments and avoid those with more negative comments [46-47], meaning that in doctor review sections, the higher the proportion of negative comments recognized by patients (mainly reflected by numerous likes or top placements), the lower the likelihood of patients adopting that doctor's service [48]. Meanwhile, negative comments may be more useful for both comment providers and health information system development, potentially making health information system development more responsive to patients' actual needs [49]. This shows that patients' online comments can reflect their attitudes and behavioral intentions toward medical health websites or apps to a certain extent, and negative comments may be more persuasive than positive evaluations. Systematic analysis of negative comments can better clarify factors affecting continuous adoption and help identify deficiencies in digital health apps for targeted improvement. Therefore, based on previous research, this study summarizes factors affecting continuous adoption from users' negative comments about digital health apps.

To ensure research data representativeness, we referred to the classification of mobile medical apps in the "iMedia Report | 2016-2017 China Mobile Digital Health Market Research Report" [50], dividing digital health apps into comprehensive consultation and vertical function categories. For comprehensive consultation apps, we selected three digital health apps with different user review ratings in Apple's App Store: DXY (4.9 points), Ping An Good Doctor (4.4 points), and Good Doctor Online (3.8 points). In the vertical function category, we randomly selected five apps with four different main functions: Kang Aiduo Palm Pharmacy (pharmaceutical e-commerce), iKang Health Checkup Service Platform (appointment for physical examination), BabyTree (serving special populations), and Zhixin Heart Rate Detection/Tang Nurse (self-diagnosis and self-testing). From the "Ratings and Reviews" section of these eight apps in the App Store, we extracted comments sorted by "lowest rating," extracting the latest 100 negative comments from each app (while deleting some short comments without specific reasons, such as "not easy to use" or "deleting it"). Due to the

limited number and single type of valuable user comments in self-diagnosis and self-testing apps, we selected from two apps simultaneously while keeping the total number unchanged, generating 700 negative comments as research material for coding. The basic characteristics of these apps are shown in Table 1 , and examples of negative comments are shown in Figure 1 [Figure 1: see original paper].

2.2 Coding and Model Construction

The entire data collection and coding process lasted from June 2019 to August 2019. Researchers captured screenshots of negative comments on iOS devices and conducted handwritten coding through online annotation and printed annotation. To reduce coding subjectivity and ensure reliability and validity, the research material was independently coded by two researchers. Before coding, both coders conducted participatory observations of the eight digital health apps, gaining full understanding of each app's functional modules. One coder also had a medical informatics education background, being more sensitive to health information classification, which facilitated the coding work.

Second, coders participated in online focus group discussions every two weeks. The focus group consisted of two coders and three domain experts, with experts alternating as moderators. Each meeting lasted approximately 1-2 hours, and a total of five focus group meetings were organized throughout the study. The main content of the meetings was to verify and analyze the coding content of the current stage to more comprehensively, deeply, and reasonably reveal perceived value factors that may affect users' continuous adoption intention of digital health apps.

Finally, through two-level open coding, concepts appearing three times or more were summarized as initial codes [51]. The two groups of coding results were continuously compared, retaining consistent codes and confirming inconsistent codes through meeting discussions for final variable induction. The study found that users' perceived value is mainly reflected in six aspects: system value, update value, environmental value, inquiry value, transaction value, and security value. The specific content is shown in Table 2 .

As can be seen, users' perceived value factors are reflected in multiple aspects of user experience, involving synergistic influences of multiple dimensional factors. These factors may have collinear relationships. Based on this, this study constructed a conceptual model of influencing factors of users' continuous adoption intention from the perspective of perceived value, as shown in Figure 2 [Figure 2: see original paper]. Among them, transaction and inquiry belong to users' intuitive perceptions after experiencing the app's service functions, which this study integrates and categorizes as service function factors. System, update, security, and environment do not involve specific app functions but affect user experience and may consequently affect continuous adoption, which this study integrates and categorizes as auxiliary experience factors. The specific

connotations of each influencing factor are shown in Table 3 .

3 Research Design

3.1 Questionnaire Design and Sample Description

The questionnaire used in this study was developed and distributed through Wenjuanxing. The questionnaire consisted of 24 items. Items 1-3 surveyed basic information about sample users (gender, age, and education). Items 4-23 were designed based on the 20 initial codes included in the six variables from Table 1 and measured using a 6-point scale. This prevents case loss caused by users unintentionally selecting the midpoint in odd-numbered scales after subsequent data calibration. The final item explored users' continuous adoption intention. To clarify this, the question used a binary scale. To ensure survey cases aligned with the research focus, questionnaire distribution used snowball sampling. Several long-term users of multiple digital health apps first completed the questionnaire, then pushed it to friends, colleagues, and members of their digital health app communities who had used core functions of such apps or actively learned about them. The questionnaire distribution period was from February 15, 2020, to March 6, 2020 (20 days), ultimately collecting 145 valid questionnaires. Overall, the sample distribution was relatively balanced. In terms of gender, female users accounted for 58.62% of the sample, which aligns with previous research showing that women are more inclined to use online consultation services than men [52]. In terms of age, 50.34% of sample users were concentrated between 25-50 years old. Education level was predominantly undergraduate, accounting for approximately 59.31% of the sample user group.

3.2 Reliability and Validity Testing

Using SPSS 26 and Amos 24, we conducted reliability and convergent validity tests on the scale. The Cronbach's α coefficients of all variables were greater than 0.7, indicating high reliability and good consistency among items. The factor loadings of each item on its corresponding variable were all greater than 0.5, with the vast majority exceeding 0.7, indicating strong explanatory power of items for their variables, and all indicators could be retained. Additionally, the average variance extracted (AVE) for each variable was greater than 0.5, and the composite reliability (CR) was greater than 0.7, indicating ideal convergent validity. To obtain precise user responses, the outcome variable (whether users continuously adopt) consisted of only one item and therefore did not participate in reliability and validity testing. The reliability and validity test results for each antecedent variable are shown in Table 4 .

3.3 Data Calibration

The variable membership values in fuzzy-set qualitative comparative analysis represent users' attitudinal tendencies, so data need to be qualitatively calibrated according to actual needs. This involves establishing three anchor points

with boundary properties: the full membership point, the full non-membership point, and the crossover point, represented as values of 1, 0, and 0.5 in standardized data. The 6-point scale used in this study naturally forms two anchor points (6, 1), representing full membership and full non-membership, respectively. The average of 6 and 1, 3.5, was used as the crossover point. Due to the good consistency of the questionnaire, the mapping of anchor points to each variable was obtained by multiplying the data at the three points by the number of items included in the variable. The specific anchor points are shown in Table 5 .

3.4 Single Variable Necessity Testing

The purpose of single variable necessity testing is to explore whether there exists a single necessary condition in cases when the outcome occurs, thereby preliminarily determining the core conditions in configurations. From a set theory perspective, necessary conditions can be considered supersets of the outcome [53]. It is generally believed that a necessity consistency greater than 0.9 can be considered a necessary condition [54]. According to the specifications in fsQCA 3.0 software, adding "~" before a variable abbreviation indicates that the current variable does not belong to the target set. The detailed test results for the outcome variable "user continuous adoption (CA)" are shown in Table 6 . As can be seen, no variable has a necessity consistency greater than 0.9, indicating that single variables have weak explanatory power for the outcome. We then explored the sufficiency effect of configurations on the outcome.

3.5 Configuration Analysis

In fsQCA 3.0 software, the case threshold was set to 1 and the consistency threshold to 0.75 for configuration minimization calculation. fsQCA 3.0 analysis typically generates three solutions: the parsimonious solution generated by fully incorporating logical remainders (configurations without corresponding facts), the intermediate solution generated by incorporating some meaningful logical remainders, and the complex solution generated without incorporating any logical remainders. The intermediate solution is generally considered optimal. When a condition appears in both the parsimonious and intermediate solutions, and the cases covered by the parsimonious solution encompass those of the intermediate solution, that condition is considered a core condition leading to the outcome. Conditions that appear only in the intermediate solution or appear in both but with non-corresponding cases are considered auxiliary conditions.

According to the configuration representation method established by C. C. Ragin [55], and represent the presence and absence of core conditions, while and represent the presence and absence of auxiliary conditions, respectively. Blank spaces indicate that the condition may be present or absent and is irrelevant. Table 6 shows that three configurations leading to user continuous adoption were generated. The consistency of individual configurations was 0.758, 0.825,

and 0.833, respectively, with an overall solution consistency of 0.834, indicating that they constitute sufficient conditions for the outcome with significant configuration effects. The overall solution coverage was 0.516, indicating that the three configurations can explain more than half of the cases. Configuration details are shown in Table 7 .

(1) Configurations CA1 and CA2 share three core conditions: high update value, high security value, and high transaction value. They are distinguished into two configuration paths leading to continuous adoption due to different auxiliary conditions. CA1 has high inquiry value as an auxiliary condition, indicating that user cases under the CA1 configuration need good inquiry experience in addition to good transaction experience in service function factors to continuously adopt digital health apps. This configuration covers 43.8% of sample cases, with 5.5% explainable only by this configuration. CA2 has high system value and high environmental value as auxiliary conditions, indicating that user cases under the CA2 configuration need good system experience and low external negative perception in addition to good update experience in auxiliary experience factors to continuously adopt digital health apps. This configuration covers 21.3% of cases, with 0.9% explainable only by this configuration. From the perspective of service function factors, transaction value is a core condition in both configurations, while inquiry value appears only as an auxiliary condition in CA2, indicating that CA1 and CA2 are two transaction-dominant configurations emphasizing transaction value.

(2) Configuration CB indicates that although users under this configuration have low perceived system value, they can still achieve continuous adoption if they simultaneously perceive high inquiry value, high update value, high security value, and high environmental value of digital health apps. Among these, low system value, high update value, and high security value are core conditions. This configuration explains 37.9% of cases, with 0.8% explainable only by this configuration. From the perspective of service function factors, user cases under the CB configuration only emphasize inquiry value of digital health apps, while transaction value is an irrelevant condition, indicating that this is a specialized inquiry configuration focusing only on inquiry value.

4 Discussion and Implications

4.1 Research Findings

Health information behavior is a current research hotspot, and studies on user adoption/continuous adoption of medical health forums and apps have received widespread attention. This study applies the perspective of perceived value to identify influencing factors of users' continuous adoption intention and combines the fsQCA method to explore the configuration pathways of users' continuous adoption of digital health apps.

First, this study selected 700 negative comments from eight digital health apps and conducted coding analysis under the guidance of perceived value theory. Six second-level codes were extracted: system value, update value, inquiry value, environmental value, transaction value, and security value, clarifying the various dimensions of perceived value that lead to users' continuous adoption of digital health apps. By analyzing whether influencing factors involve specific app functions, they were categorized into service function factors and auxiliary experience factors. Second, the different perceived value dimensions extracted were used as antecedent variables for subsequent research with fsQCA. In the analysis of necessary conditions, no single value perception constituted a necessary condition for continuous adoption, while update value and security value existed in all configurations meeting consistency requirements, suggesting they may have relatively high necessity and play important roles in the process of leading to continuous adoption. Finally, through fsQCA analysis, three configurations leading to continuous adoption were obtained. From the comparison of service function factors, transaction value is the most widely covered service function factor and a core condition in the CA configurations, indicating that perceived transaction value may be a more critical factor than perceived inquiry value in users' actual app usage. Configuration CB emphasizes the importance of inquiry function, showing that different configurations present the collinearity of core and peripheral factors. These findings provide important insights for conducting research on user behavior related to digital health apps from a configuration perspective.

4.2 Research Implications

4.2.1 Theoretical Implications Perceived value as a multidimensional variable has unique dimensions in different contexts that differ from other contexts [52]. However, in any context, a multidimensional perspective should depict the overall situation as much as possible, meaning that adopting a holistic, global perspective may more effectively grasp the research. Therefore, this study explores influencing factors and configurations of users' adoption intention of digital health apps from the perspective of perceived value, providing the following insights and contributions for subsequent research:

First, this study clarified multidimensional perceived value attributes affecting users' continuous adoption of digital health apps through coding and induction of users' negative comments. Different from previous studies that extracted perceived value dimensions in different fields through deduction [50] and explained perceived value of continuous use intention in online health communities based purely on a benefit-cost perspective [9], this study chose to induce perceived value dimensions with more phenomenological characteristics from users' negative comments, providing a theoretical foundation for subsequent research in the digital health field.

Second, this study re-examined the impact pattern of single conditions on outcome variables through necessity condition analysis. Previous quantitative anal-

yses have shown that single dimensions of perceived value may have significant effects on outcomes [14-15], meaning nearly inevitable increasing or decreasing correlations between antecedent and outcome variables. However, this study found that single perceived value factors leading to users' continuous adoption of digital health apps are not necessary conditions, meaning no single variable must exist to lead to continuous adoption behavior. For example, in configuration CA2, the absence of inquiry value coordination, and in configuration CB, the absence of transaction value coordination, still led to continuous adoption under the joint promotion of other conditions. Therefore, although different digital health apps provide different perceived values and configurations may contain different perceived value dimensions, the disadvantage or absence of a certain dimension does not necessarily hinder users' continuous adoption.

Finally, this study combines perceived value theory with the fsQCA method to provide a reference for conducting digital health field research from a configuration perspective. Previous research on influencing factors of perceived value in the digital health field has focused on exploring net effects of variables, with few studies attempting to combine it with a configuration perspective. The conclusions of this study show that configurations CA1 and CA2 emphasize the importance of transaction functions, while configuration CB emphasizes the importance of inquiry functions. Different configurations present the collinearity of core and peripheral factors. These findings provide important insights for conducting user behavior research on digital health apps from a configuration perspective.

4.2.2 Practical Implications

(1) **Focus on security value and update value from the perspective of core conditions.** From the auxiliary experience factors in the three configurations, all showed membership in high update value and high security value, indicating that these two factors are difficult to avoid in the main pathways to achieving continuous adoption and should receive attention from digital health app developers.

Regarding information security value, G. Fox et al. [56] found that older adults are reluctant to accept mobile medical care due to high-risk perceptions and strong privacy protection desires. This study similarly found in users' negative comments that many users expressed dissatisfaction with digital health apps publishing their consultation records with doctors and the inability to delete consultation dialogues. Therefore, respecting users' privacy preferences and granting users more privacy protection permissions in apps can effectively alleviate privacy concerns. In addition, security value includes users' perception of information storage security in apps. Some vertical function digital health apps have information recording and cycle analysis functions, such as recording curves for blood glucose, blood pressure, and menstruation. In most cases, storage of such information requires users to synchronize corresponding data to the app's cloud server, and during cloud storage, system vulnerabilities or

data transmission issues may cause recorded data loss or errors [57]. Therefore, improving app information storage stability and conducting multi-end backup of user information are also important aspects of enhancing users' perceived security value.

Attention to update value of digital health apps is the most direct manifestation of users' continuous app usage. With intensifying competition among apps, apps dynamically released on app stores such as Apple App Store and Google Play Store have much higher update frequencies than traditionally downloaded software [58]. However, some users cannot well adapt to changes in app interfaces and functions brought by rapid updates [59]. Therefore, the impact of software updates on user experience is a phenomenon worth attention. Currently, there are few studies directly addressing update value of digital health apps. This study summarized users' negative comments and found that software update issues mainly concentrate on three aspects: function changes, high update frequency, and forced updates. When users choose to update apps, they often have certain expectations and hopes for new functions or problem fixes. Therefore, if app updates do not significantly improve the overall user experience, users may lose balance in benefit-cost perceptions and exhibit prominent negative update cost effects. If functions are reduced after updates, affecting normal use, it may directly lead to user loss. For example, one user stated, "After the update, the safe medication function is gone, can't record drug expiration dates or remind for medication changes, very inconvenient." In summary, updates of digital health apps should adhere to principles of voluntary updates, effective updates, and advance notice of changes, giving users higher initiative in version selection, focusing on update quality rather than frequency, and conducting detailed research on user needs before function changes with change notifications, to achieve higher user satisfaction.

(2) **Distinguish transaction-dominant and specialized inquiry users from the perspective of effective configurations.** Each configuration represents a specific pathway that can lead to users' continuous adoption. Therefore, thinking about key issues reflected by the two pathways may yield more effective practical insights.

Value transaction-dominant users and enhance transaction experience. Previous research on service function factors affecting online medical adoption mostly focused on analyzing influencing factors around online inquiry functions [21, 41], with few studies involving users' transaction experience when using digital health apps. However, analysis of configurations CA in Section 3.5 shows that transaction value is the most widely covered service function factor and a core condition leading to continuous adoption in CA configurations, indicating that perceived transaction value may be a more critical factor than perceived inquiry value in users' actual app usage. In reality, medical e-commerce often lacks strong organization, supervision, and distribution systems, with new media platforms having weak supervision and uneven quality [60]. However, drugs and medical equipment have higher requirements for distri-

bution timeliness and safety than ordinary goods [61], making it understandable that user comments are filled with dissatisfaction about independent medical e-commerce's delivery and refund timeliness, welfare activity rationality, and drug quality. To address capability deficiencies, various online digital health platforms can choose to merge their independent e-commerce systems to build a powerful, independent, standardized medical e-commerce app, or attach to mature shopping apps such as Taobao and JD.com. Users can purchase on designated apps after obtaining prescriptions online or offline, ensuring better quality, efficiency, and authority of transactions.

For small digital health apps with low system value, focus on attracting specialized inquiry users. This insight comes from configuration CB. Since transaction value level does not affect whether user cases under configuration CB continuously adopt digital health apps, small digital health apps with good development environments can choose to directly abandon their own mall functions or attach to other e-commerce platforms for transaction functions, focusing on developing their own online inquiry functions, ensuring security of user inquiry information, and continuously improving the app through high-quality updates to maintain the advantageous position of inquiry functions and improve user retention.

5 Research Limitations and Future Directions

This study still has the following limitations. First, in terms of questionnaire data collection, we could not well ensure average distribution of sample users in demographic terms. For example, undergraduate users accounted for nearly 60% in education level, possibly due to some sample source concentration in snowball sampling. Second, in terms of research material selection and influencing factor formulation, this study had certain subjectivity in selecting digital health apps and extracting online comments. Due to the workload of manual coding, we could not more comprehensively select apps and online comments. To make research conclusions more generalizable, future studies could select other similar digital health apps for negative comment extraction and compare with this study's conclusions, or use technical means to crawl and cluster code online comments from the population rather than samples. Additionally, all influencing factors included in fsQCA analysis in this study were subjectively coded by the authors, and the validity and universality of some variables (such as transaction value) have not been corroborated by other studies. Future research could combine statistical methods for confirmatory analysis. Finally, in terms of comprehensiveness of influencing factor extraction, users' continuous adoption behavior of digital health apps may be affected by factors at different levels, but under the perspective of perceived value, only users' subjective perception factors of apps can be obtained. Personal-level factors such as users' personal habits [27] and e-health literacy [28] that may constitute influences are difficult to identify through online comments. Future research could add interview data or questionnaire data as supplementary coding materials based

on online comments to obtain more comprehensive coding materials for improving research on influencing factors of continuous adoption intention at different levels.

References

[1] Eysenbach G. What is e-health? [J]. Journal of medical internet research, 2001, 3(2): e20.

[2] DeLuca JM, Enmark R. E-health: the changing model of healthcare [J]. Frontiers of health service management, 2000, 17(1): 3-15.

[3] Zhang Pixin, Zhong Huan, Liu Chun. Review and latest progress of foreign research on continuous use intention of digital health information systems [J]. Modern Information, 2020, 40(9): 166-175.

[4] Blaya JA, Fraser HSF, Holt B. E-health technologies show promise in developing countries [J]. Health affairs, 2010, 29(2): 244.

[5] World Health Organization. Guideline on digital health interventions [EB/OL]. [2021-02-01]. https://www.who.int/news/item/17-04-2019-who-releases-first-guideline-on-digital-health-interventions.

[6] Yishi. China Internet Medical Annual Comprehensive Analysis 2018 [EB/OL]. [2021-02-01]. https://www.analysys.cn/article/analysis/detail/20018737.

[7] Du Jing. Research on influencing factors of health app usage intention [D]. Baoding: Hebei University, 2019.

[8] Krebs P, Duncan DT. Health app use among US mobile phone owners: a national survey [J]. Jmir mhealth and uhealth, 2015, 3(4): e101.

[9] Parthasarathy M, Bhattacherjee A. Understanding post-adoption behavior in the context of online services [J]. Information systems research, 1998, 9(4): 362-379.

[10] Zhang CB, Li YN, Wu B, et al. How WeChat can retain users: roles of network externalities, social interaction ties, and perceived value in building continuance intention [J]. Computers in human behavior, 2016, 69(4): 284-293.

[11] Zhao Naixuan, Liu Jiajing, Jie Qinqin. Research on continuous use intention of university library WeChat public account users [J]. Library Forum, 2019, 39(3): 97-103.

[12] Dong Qingxing, Zhou Xin, Mao Fenghua, et al. Research on continuous use intention of online health community users [J]. Modern Information, 2019, 39(03): 3-14, 156.

[13] Gan Chunmei, Xu Jiayi. The impact of perceived value on user behavioral intention in social commerce [J]. News 界, 2018, (10): 92-100.

[14] Zhao Wenjun, Xie Shoumei. The relationship among college students' mobile reading perceived value, satisfaction, and behavioral intention: taking the Chaoxing mobile reading app platform as an example [J]. Library and Information Service, 2019, 63(3): 98-107.

[15] Li Wu, Xu Yaoxin, Cong Ting. Research on the impact of user perceived value of online paid Q&A platforms on payment intention [J]. Information Science, 2020, 38(10): 68-73.

[16] Cho J. The impact of post-adoption beliefs on the continued use of health apps [J]. International journal of medical informatics, 2016, 87: 75-83.

[17] Akter S, D'Ambra J, Ray P. Service quality of mHealth platforms: development and validation of a hierarchical model using PLS [J]. Electronic markets, 2010, 20(3/4): 209-227.

[18] Akter S, D'Ambra J, Ray P, et al. Modelling the impact of mHealth service quality on satisfaction, continuance and quality of life [J]. Behaviour and information technology, 2013, 32(12): 1225-1241.

[19] Akter S, D'Ambra J, Ray P. Development and validation of an instrument to measure user perceived service quality of mHealth [J/OL]. Information and management, 2013, 50(4): 181-195.

[20] DeLone WH, McLean ER. Information systems success: the quest for the dependent variable [J]. Information systems research, 1992, 3(1): 60-95.

[21] Zhang Min, Luo Meifen, Nie Rui, et al. Research on influencing factors of continuous use intention of consultation-based mobile medical apps [J]. Soft Science, 2018, 32(5): 99-104.

[22] Hossain M. Assessing m-Health success in Bangladesh: An empirical investigation using IS success models [J]. Journal of enterprise information management, 2016, 29(5): 774-796.

[23] Zagitat C, Handayani PW, Budi FA. Analysis of factors affecting the loyalty of using online health services: case study of Alodokter [C]//2019 11th international conference on advanced computer science and information systems. New York: IEEE, 2019: 279-284.

[24] Chiu WS, Cho H, Chi CG. Consumers' continuance intention to use fitness and health apps: an integration of the expectation-confirmation model and investment model [J]. Information technology & people, 2020, 34(3): 978-998.

[25] Hong Z, Deng Z, Zhang W. Examining factors affecting patients' trust in online healthcare services in China: the moderating role of the purpose of use [J]. Health informatics journal, 2019, 25(4): 1647-1660.

[26] Shen XL, Li YJ, Sun Y. Wearable health information systems intermittent discontinuance: a revised expectation-disconfirmation model [J]. Industrial management and data systems, 2018, 118(3): 506-523.

[27] Yuans, Ma W Kanthawala S. Keep using my health apps: discover users' perception of health and fitness apps with the UTAUT2 model [J]. Telemedicine and e-health, 2015, 21(9): 735-.

[28] Zhang X, Yan X, Cao X, et al. The role of perceived e-health literacy in users' continuance intention to use mobile health care applications: an exploratory empirical study in China [J]. Information technology for development, 2018, 24(2): 198-223.

[29] Zeithaml VA. Consumer perceptions of price, quality and value: a means-end model and synthesis of evidence [J]. Journal of marketing, 1988, 52(3): 2-22.

[30] Zhao Wenjun. Research on sustainable behavior of knowledge sharing in virtual communities [D]. Wuhan: Central China Normal University, 2012.

[31] Rihoux B, Ragin CC. QCA Design Principles and Applications: A New Method Beyond Qualitative and Quantitative Research [M]. Translated by Du Yunzhou, Li Yongfa. Beijing: Mechanical Industry Press, 2017.

[32] Du Yunzhou, Jia Liangding. Configuration perspective and qualitative comparative analysis (QCA): a new path for management research [J]. Management World, 2017(6): 155-167.

[33] Mao Zhanwen. Qualitative comparative analysis (QCA) and journalism and communication research [J]. International Press, 2016, 38(4): 6-25.

[34] Deng Shengli, Fu Shaoxiong. Application of qualitative comparative analysis (QCA) in library and information science: taking research on influencing factors of health information seeking in online communities as an example [J]. Information Studies: Theory & Application, 2017, 40(12): 23-28, 11.

[35] Yang Jinlong, Hu Guangwei. Research on drivers and configuration effects of transforming mobile learning adoption into continuous adoption [J]. Information Science, 2019, 37(7): 125-132.

[36] Gan Chunmei, Qiu Zhiyan, Xu Weijie. Research on influencing factors of continuous use intention of mobile map apps based on fsQCA [J]. Information Studies: Theory & Application, 2020, 43(11): 110-115.

[37] Li H, Li L, Gan C, et al. Disentangling the factors driving users' continuance intention towards social media: a configurational perspective [J]. Computers in human behavior, 2018, 85(8): 175-.

[38] Park YK, Pavlou PA, Saraf N. Configurations for achieving organizational ambidexterity with digitization [J]. Information systems research, 2020, 31(4): 3-8.

[39] Llopis-Albert C, Rubio F, Valero F. Impact of digital transformation on the automotive industry [J]. Technological forecasting & social change, 2021, 162(C), 120343.

[40] Du Yunzhou, Liu Qiuchen, Cheng Jianqing. What kind of business environment ecology generates high urban entrepreneurship activity?—An analysis based on institutional configuration [J]. Management World, 2019, 36(9): 165-179.

[41] Wang Ruojia, Zhang Lu, Wang Jimin. Research on user satisfaction of online consultation based on grounded theory [J]. Information Science, 2020, 38(10): 68-73.

[42] Emmer M, Meier F, Heider AK, et al. What do patients say about their doctors online? A qualitative content analysis [J]. Journal of general internal medicine, 2012, 27(6): 685-.

[43] Dorfman RG, Purnell C, Qiu C, et al. Happy and unhappy patients: a quantitative analysis of online plastic surgeon reviews for breast augmentation [J]. Plastic and reconstructive surgery, 2018, 141(5): 663e-673e.

[44] Hao H. The development of online doctor reviews in China: an analysis of the largest online doctor review website in China [J]. Journal of medical internet research, 2015, 17(6): e134.

[45] Zhang W, Deng Z, Hong Z, et al. Unhappy patients are not alike: content analysis of the negative comments from China's good doctor website [J]. Journal of medical internet research, 2018, 20(1): e35.

[46] Huang E, Dunbar CL. Connecting to patients via social media: a hyperreality? [J]. Journal of medical marketing, 2013, 13(1): 14-23.

[47] Skrypzak AM, Tressel WA, Ghayour S, et al. Negative online reviews of orthodontists: content analysis of complaints posted by dissatisfied patients [J]. American journal of orthodontics and dentofacial orthopedics, 2020, 158(2): 237-246.

[48] Li S, Feng B, Chen M, et al. Physician review websites: effects of the proportion and position of negative reviews on readers' willingness to choose the doctor [J]. Journal of health communication, 2015, 20(4): 453-461.

[49] López A, Detz A, Ratanawongsa N, et al. What patients say about their physicians online: a qualitative content analysis [J]. Journal of general internal medicine, 2012, 27(6): 685-.

[50] iMedia Research. 2016-2017 China Mobile Digital Health Market Research Report [EB/OL]. [2021-02-01]. https://www.iimedia.cn/c400/49397.html.

[51] Hu Yuan, Ai Wenhua, Hu Zirong, et al. Research on influencing factor framework of data requirement management for university researchers [J]. Journal of Library Science in China, 2019, 45(4): 104-121.

[52] Edwards HB, Marques E, Hollingworth W, et al. Use of a primary care online consultation system, by whom, when and why: evaluation of a pilot observational study in 36 general practices in South West England [J]. BMJ open, 2017, 7(11): e016901.

[53] Cheng Jianqing, Luo Jinlian, Du Yunzhou, et al. When do institutional environment and psychological cognition activate entrepreneurship?—A research based on QCA method [J]. Science of Science and Management of S.&T., 2019, 40(2): 114-131.

[54] Kaiser HF, Rice J. Little jiffy, mark IV [J]. Educational and psychological measurement, 1974, 34(1): 111-117.

[55] Morgan RBSL. Redesigning social inquiry: fuzzy sets and beyond by Charles C. Ragin [J]. Social forces, 2010, 88(4): 1934-1936.

[56] Fox G, Connolly R. Mobile health technology adoption across generations: narrowing the digital divide [J]. Information systems journal, 2018, 28(6): 995-1019.

[57] Qiu Rongrong, Hu Changping, Feng Yafei. Research on security assurance architecture and prevention measures for academic information resources cloud storage [J]. Library and Information Service, 2018, 62(23): 106-.

[58] Li X, Zhang B, Zhang Z, et al. A sentiment-statistical approach for identifying problematic mobile app updates based on user reviews [J]. Information, 2020, 11(3): 152.

[59] Saffarizadeh K, Jabr W, Keil M. Update assimilation in app markets: is there such a thing as too many updates? [C]//Proc 39th international conference on information systems. San Francisco: Association for Information Systems, 2018.

[60] Zuo Weijuan. Research on supervision mechanism of online pharmacies based on mobile drug purchase [D]. Zhengzhou: Zhengzhou University, 2017.

[61] Yu Mengqi, Hu Xiangpei, Huang Minfang. Collaborative delivery optimization method for "multiple items in one order" in online pharmacies [J]. Systems Engineering—Theory & Practice, 2020, 40(10): 2658-2668.

Author Contributions: Wu Dawei: proposed research topic, data processing, and paper writing; Hu Xiaofei: revised paper, reviewed and verified paper; Zhao Yuxiang: adjusted research framework, guided paper writing and finalization; Ai Wenhua: revised paper.

Academic Integrity Statement for Authors of *Library and Information Service*

Library and Information Service has always adhered to the mission of publishing excellent academic paper results and promoting industry academic exchanges, and is committed to purifying the academic publishing environment and creating a good academic ecology. In 2013, the journal took the lead in formulating, publishing, and implementing the "Joint Statement of Library Science Journals on Abiding by Academic Ethics and Purifying the Academic Environment" (referred to as the "Statement") (see: http://www.lis.ac.cn/CN/column/item202.shtml), and

subsequently took the lead in formulating and publishing the "Joint Action Plan of Chinese Library and Information Science Journals to Resist Academic Misconduct" (referred to as the "Joint Action Plan") (see: http://www.lis.ac.cn/CN/column/item247.shtml). To implement and realize this concept, this journal hereby solemnly declares that from now on, all submitting authors must promise that papers submitted to this journal must comply with the above "Statement" and "Joint Action Plan," consciously uphold academic ethics, and resolutely resist academic misconduct. *Library and Information Service* has zero tolerance for all papers suspected of plagiarism, copying, and other forms of academic misconduct, and will adopt corresponding punitive measures.

Library and Information Service Magazine

Note: Figure translations are in progress. See original paper for figures.