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Continuous use of fitness apps and shaping factors among college students: A mixed-method investigation

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ABSTRACT

Objective: This current study pursued an exploration of the psychological mechanism that determines college students' continuance intention to use fitness apps.

Methods: This current study adopted a mixed methods research that composed two distinct phases. Study 1 was quantitative research that helped to identify determinants of Chinese college students' continuance intention to use. A self-reported questionnaire was completed by 379 college students to ascertain their user experience. Study 2 was qualitative research. A semi-structured interview was conducted with a sample of 10 college students. Study 2 can be seen as a follow-up study and it pursued an in-depth understanding on how college students use fitness apps in the everyday life and their views towards study 1's major findings.

Results: The results revealed that five factors (confirmed usefulness, confirmed ease of use, satisfaction, fitness achievement and social connection) were found to significantly and positively affect college students' continuous intention to use fitness apps. Entertainment did not show obvious impact. In the interview, college students reported that even if they don't obtain entertainment from fitness apps, they will still push themselves to use them, because they have a very specific goal when using fitness apps, which is to achieve health and fitness.

Conclusion: These findings indicated that successful fitness apps should make users feel convenient to use and indeed improves the fitness user's efficiency. Besides, people are more eager to get the information with strong credibility with the negligible effort. This implies more efforts should be made to design apps that can provide high-quality services. Moreover, if apps designers can pay more attention to protecting the personal information and data, it will inspire more people to use social connection functions.

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What is known?

- The previous works have studied 1) the general features and functions of fitness apps; 2) younger users' initial acceptance and adoptive behaviors of using fitness apps.

What is new?

- This current study has further confirms that 1) five factors that determine younger users' continuance intention to use fitness apps: confirmed usefulness, confirmed ease of use, fitness achievement, satisfaction and social connection; 2) impacts of different factors on younger users' continuance intention to use fitness apps are different; 3) younger users attributed their fitness achievement to self-efficacy.

1. Background

Today, our daily lives rely intensively on the "omnipotent" smart phones. The management of personal health and fitness is no

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exception to this trend [1]. Fitness apps serve as a major component of the health apps for smart phones. In addition to tracking and recording users' health and fitness activities, these apps can provide users with tailored and detailed exercise instructions. With the help of fitness apps, users might find it easy to maintain motivation to achieve their fitness goals [2,3]. As "digital natives" [4], an increasing number of college students proactively choose this novel way to monitor and improve their health [5]. In China, college students have formed a strong user base.

Due to the fact that fitness apps are gaining ever more popularity, literature has emphasized the importance of this new phenomenon. Broadly speaking, previous works has been carried out in the following aspects. A group of studies have investigated the general features of health and fitness apps, attaching great attention to the design and the functions of those apps [6—10]. While these studies' main findings have helped to explain the functional aspects of health and fitness apps, their main limitation has been a lack of concern for the actual ways in which health and fitness apps are being used. That is, such studies seldom collected and analyzed people's actual attitudes toward health and fitness apps and their behaviors in using those technologies. For this reason, some scholars have explored the users' experience with using this latest technology, that is, their behavioral, perceptual, and emotional aspects of using fitness apps [11—14]. Most of these studies have examined the potential of fitness apps to address specific fitness and health issues, such as weight loss, muscle building, and body lines' shaping [14—16]. Nevertheless, apart from their theoretical and practical contributions, these studies do share a major constraint: they did not figure out the reasons people use these apps. Lately, the focus has shifted to motivations behind users' choice. These studies focused on the reasons why people are using health apps for the first time [17—19]. Methodologically, most of the studies have adopted the quantitative study and investigated various constructs to determine the factors influencing people's adoption of fitness apps.

From systematically reviewing the current works, the researcher found scholars overwhelmingly focused on the users' initial adoptive behaviors and little research investigated younger users' continuance usage behaviors. Additionally, literature showed that most young people use fitness apps only for a very short time and then remove them from their smart phones [1,11]. Few scholars has explored the cause of this phenomenon. It is vital to explore the reasons behind it, after all, the long-term survival and ultimate success of fitness apps depend more on continuous usage. Therefore, this paper aims to pursue an exploration of the psychological mechanism that determines college students' continuance intention to use fitness apps.

2. Theoretical framework and hypotheses building

In the study of post-adoptive behaviors, the most widely used theory is the expectation confirmation model of information system continuous (ECM-ISC) [20]. It is used to study consumers' intentions to repurchase or reuse products (services) from a marketing perspective. This theory argues that consumers' intentions to repurchase a product (service) is influenced by their level of satisfaction, and the satisfaction is influenced by factors such as expectation, perceived performance, and confirmation. By comparing their experience with their original expectations, consumers will develop a positive or negative opinion towards the product (service), which will have an impact on their satisfaction. Ultimately, satisfaction will affect their willingness to repurchase or reuse the product (service). To make this model more applicable to the information system (IS) environment, Bhattacherjee [20] made some modifications by drawing on the widely accepted technology

acceptance model (TAM) proposed by Davis in 1989. He introduced a new construct—perceived usefulness—and suggested it as a critical factor affecting users' post-adoption of IS (see Fig. 1). However, the ECM-ISC model failed to involve a hedonic factor, so this study also employs uses and gratifications (U&G) as a theoretical framework.

Fig. 1: The expectation confirmation model of information system continuous ECT-ISC model (Bhattacherjee, 2001).

The researcher extended the key variables of the ECM-ISC model and generated the following new variables: confirmed usefulness, confirmed ease of use and satisfaction. Additionally, the researcher introduced the following key variables of U&G: entertainment and social connection. In the following section, each variables will be reviewed in more detailed way.

2.1. Confirmed usefulness and confirmed ease of use

Confirmed usefulness and confirmed ease of use evolved from the influencing factors of the ECM-ISC model, which are "confirmation", "perceived usefulness" and "perceived ease of use". The ECM-ISC model argued that a person's perceived usefulness and perceived ease of use is affected by the degree of their expectation confirmation. The researcher combined these constructs into two new constructs: "confirmed usefulness" and "confirmed ease of use". This study focuses on people who are currently using fitness apps. More specifically, these people have chosen to use fitness apps to remain fit, so their perceived usefulness and perceived ease of use of an app will no longer be crucial factors influencing their satisfaction and continuous use behaviors. Instead, their true feelings and experience can be a crucial determinant. Hence, the researcher created the two new constructs of confirmed usefulness and confirmed ease of use. These constructs are used as major factors to build the hypotheses.

2.2. Satisfaction

Satisfaction is the key construct of the ECM-ISC model. Satisfaction is conceptualized as "a psychological or affective state related to and resulting from a cognitive appraisal of the expectation-performance discrepancy" [21, p. 49]. According to the ECM-ISC model, "users' continuance intention is determined primarily by their satisfaction with prior use with IS use. Considering that satisfaction is a positive and pleasurable state of attitude and emotion, it is logical to hypothesize that confirmed usefulness and confirmed ease of use would be positively associated with a user's satisfaction with a particular piece of technology.

2.3. Entertainment

Rather than borrowing key constructs from the ECM-ISC model, this study introduced an important construct from the U&G approach. Drawing on U&G, many previous studies found that "entertainment" is the main factor for users to adopt the latest technology [[11,21],22]. They found some motivations for ritual uses, such as relaxation, passing time and entertainment would influence people's use of fitness apps.

2.4. Social connection

Social connection is another factor that is frequently used in the study of mobile apps. A social function allows users to communicate with other users within the fitness apps by sharing their progress and knowledge for successful results. Many researchers found that the public sharing of sports activities can encourage users to work harder [23]. Moreover, some scholars found that peer
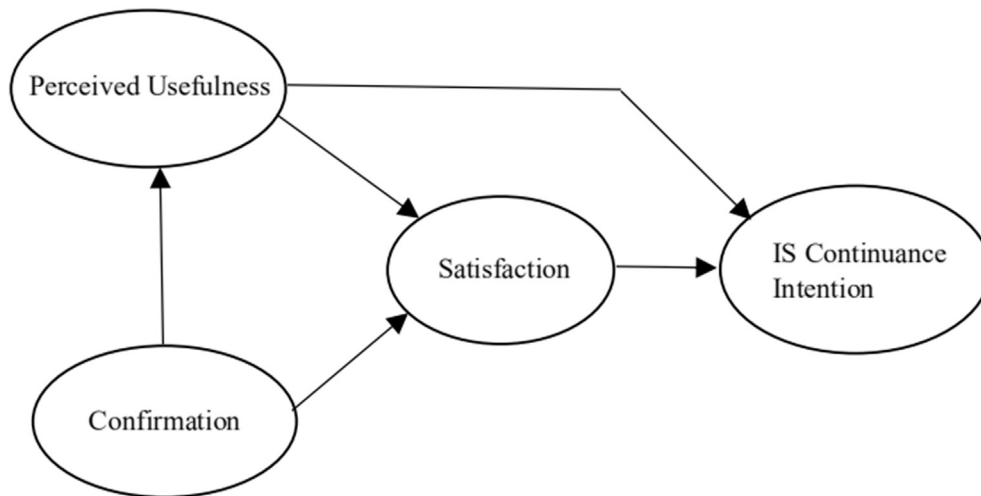
Fig. 1. ECT-ISC model.

feedback through mobile apps was significantly correlated with users' continued adoption of these apps [18,24,25]. Compared with other age groups, young people are more likely to interact with their friends via a mobile phone. Encouragement and support from friends and even competition can contribute to the continuous use of fitness apps. Therefore, this study will use social connection as a crucial factor.

2.5. Fitness achievement

In addition to the confirmation of usefulness and ease of use, this study developed a new construct—fitness achievement. The researcher believed that people's fitness achievements are also one of the reasons for the apps' continuous use. Put differently, if people achieve their desired goals in the process of using fitness apps, such as losing weight, becoming strong and improving their level of health, then they are more likely to continuing using these digital tools. Although in the field of mobile apps research no one has yet focused on this influencing factor, there are many studies outside this field focusing on how obtained achievement affect users' continued use. For example, Bhattaccherjee [20] examined the factors that influence online banking users' intention to continue using IS. The results suggested that their continuous intention is determined by their confirmation of achievements from prior system use. Similarly, Bøe, Gulbrandsen and Sørebø [26] explored the motivations influencing teachers' willingness to continue using new communication technology in higher education and they found teachers tend to use new technology when their expectations are fulfilled by using digital tools. Therefore, this study created a new construct with achieved fitness as a major factor and proposed the following hypotheses:

Based on a systematic review of the previous literature, the following hypotheses are proposed. A new research model was formulated, and selected potential relationships are described in Fig. 2.

H1. Confirmed ease of use is positively associated with college students' confirmed usefulness of fitness apps.

H2. Confirmed usefulness is positively associated with college students' level of satisfaction with fitness apps.

H3. Confirmed usefulness is positively associated with college students' continuance intention to use fitness apps.

H4. Confirmed ease of use is positively associated with college students' level of satisfaction with fitness apps.

H5. Confirmed ease of use is positively associated with college students' continuance intention to use fitness apps.

H6. Students' level of satisfaction with fitness apps is positively associated with college students' continuance intention to use fitness apps.

H7. The entertainment from using fitness apps is positively associated with college students' continuance intention to use fitness apps.

H8. Social connection is positively associated with college students' continuance intention to use fitness apps.

H9. Fitness achievement is positively associated with college students' level of satisfaction with fitness apps.

H10. Fitness achievement is positively associated with college students' continuance intention to use fitness apps.

3. Methods

3.1. Design

This study was approved by the institutional review board at the University of Nottingham. A sequential explanatory mixed-method design was used in this study and it was composed of two distinct phases. Study 1 was quantitative research that helped to identify determinants of Chinese college students' continuance intention to use fitness apps. A self-reported questionnaire was completed by 379 college students to ascertain their opinion and experience. Study 2 was qualitative research. Semi-structured interviews were conducted with a sample of 10 college students. Study 2 was a follow-up to the study 1. The interview questions were constructed based on the findings from the first phase. Study 2 pursued a comprehensive and in-depth understanding of how college students use fitness apps in their everyday lives and their views towards study 1's unproven hypotheses.

3.2. Study 1: Quantitative research

3.2.1. Participants

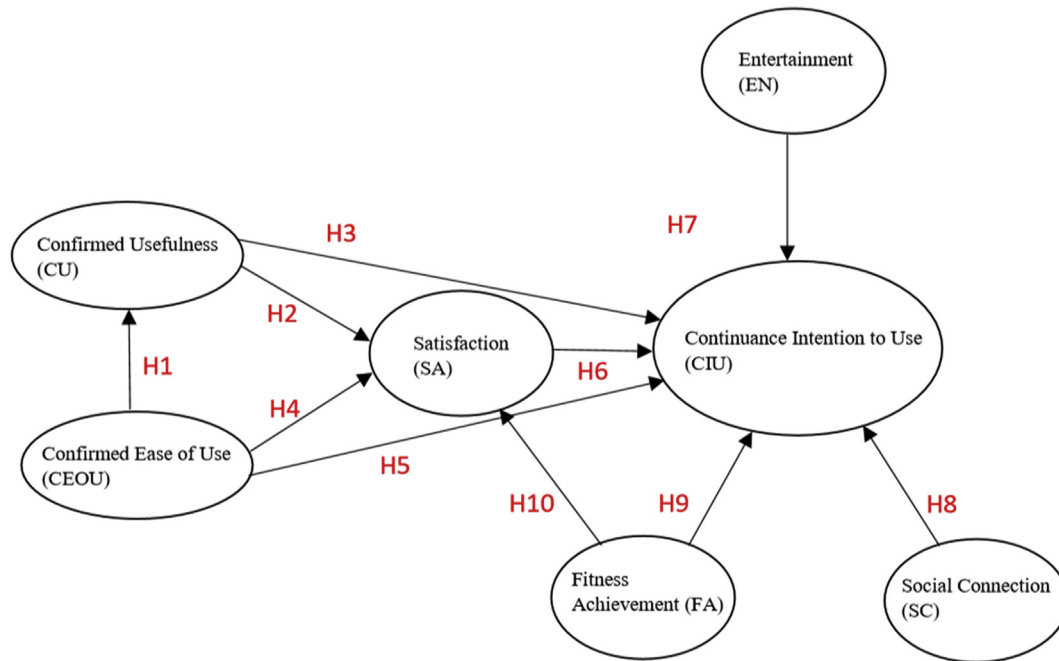Study 1 adopted a cross-sectional web-based survey design. The

Fig. 2. Proposed research model for determinants of college students' continuance intention to use fitness apps.

participants are college students who are currently using fitness apps. The sample data were collected by a self-report questionnaire. Data collection started from May 25, 2019 and ends on June 25, 2019. Participants were asked to complete a survey hosted on the online survey platform *Wenjuanxing*. The researcher sent 450 questionnaires and 400 questionnaires were returned. Twenty-one responses were excluded because 10 had conflicting answers or incomplete responses and 11 were not from our target participants. The remaining 379 responses were used in the data analysis. The majority of participants were female (69.9%); males accounted for 31.1%. The respondents were between 18 and 30 years of age, with an average age of 23 years. Of these, 48.5% had obtained a bachelor's degree and 31.9% had obtained a master's degree; the remaining had a doctorate degree.

3.2.2. Measures

Based on some mature scale of information system researches, the researcher designed a questionnaire for the current study. Each dimension of the variable is measured by a 5-point Likert scale with the following anchors: 1-Strongly disagree and 5-Strongly agree.

3.2.3. Data analyses

Data analyses have been performed for this study via structural equation modelling (SEM), which was supported by AMOS 21.0 software. There are two stages of data analysis. Firstly, the validity and reliability of the scale were examined, followed by the analysis of the proposed research model. The results of each CFA are given below. Further, reliability scores in terms of internal consistency were computed for all composite measurements, and all scores were statistically acceptable (i.e., larger than 0.70). Table 1 includes the descriptive statistics for each variable and a complete list of the items used to measure each variable. Secondly, the collected data are processed by the structural equation model analysis.

3.3. Study 2: Qualitative research

3.3.1. Participants

In study 2, semi-structured interviews were conducted with 10 people who had participated in study 1. The researcher used criterion sampling to select the participants. There were three criteria: 1) college students should be a participant in Study 1 and show interest in the subsequent study and 2) they can attend a face-to-face interview or a video interview. 3) Using fitness apps for more than 2 months. The majority of participants were female (70%) with an average age of 23.4 years. The average time spent on fitness apps is 11.2 months and the average frequency of using a fitness app is 2.8 times per week (see Table 2).

3.3.2. Data collection procedure

The institutional review board at the University of Nottingham approved the study. Data collection begins on July 5, 2019 and ends on July 15, 2019. Prior to the interview, the researcher will inform participants of the purpose of the interview and ask if it is acceptable to record the session. If the participant chooses to continue, he or she first completes an information consent form. Next, the researcher will ask about the participant's demographic information such as age, gender, fitness apps usage, and so on. Then, the interview will be conducted by asking questions; these questions are based on study 1's findings. A participant can terminate the interview if he or she considers a question to be an invasion of privacy or he or she does not want to provide an answer.

3.3.3. Data analysis

The verbatim transcripts were analyzed by using NVivo. The researcher used inductive thematic analysis to analyse the data, including comparing the raw data with the emerging topic tags and definitions and refining them further by merging, adding, and removing redundant topics. Finally, the researcher identified some themes.

Table 1
Operationalization of construct.

Variables	Items	Cronbach's α	Standardised Factor Loadings	Composite Reliability	AVE
Confirmed ease of use	CEOU1. I learned how to use fitness apps quickly and easily.	0.933	0.943	0.9288	0.8133
	CEOU2. I have easily mastered and used most functions of fitness apps.		0.881		
Confirmed Usefulness	CU1. Fitness apps have improved my daily exercise efficiency.	0.931	0.76	0.9048	0.656
	CU2. Fitness apps have provided a lot of content and guidance to enrich my daily exercise.		0.759		
	CU3. Some functions of fitness apps are very practical for me.		0.828		
	CU4. Fitness apps have helped me save money on daily exercise.		0.826		
Entertainment	E1. The fitness apps have some features that I find interesting and fun.	0.93	0.914	0.9328	0.8223
	E2. Using fitness apps has given me a lot of pleasure.		0.923		
	E3. For me, using fitness apps is a very enjoyable process.		0.883		
Fitness Achievement	AF1. By using fitness apps, I can do aerobic exercise for longer periods of time (running, yoga, walking, cycling, swimming, etc.).	0.931	0.928	0.9175	0.7879
	AF2. By using fitness apps, I can do anaerobic exercise for longer periods of time (push-ups, dumbbells, weight lifting, muscle strength training, etc.).		0.829		
	AF3. By using fitness apps, I get stronger (or slim).		0.903		
Social Connection	SC1. Using fitness apps have helped me find more like-minded friends.	0.929	0.756	0.9084	0.7133
	SC2. I have a lot of friends on fitness apps.		0.887		
	SC3. Through the fitness apps I am currently using, I have shared fitness information with other users.		0.855		
Satisfaction	SA1. It is wise to choose a fitness app	0.932	0.914	0.9471	0.8564
	SA2. Choosing a fitness app is a good decision		0.941		
	SA3. overall, I feel very satisfied using fitness apps		0.923		
Continuance intention to use	CU1. After using it for a while, I continued to use the fitness apps	0.932	0.861	0.899	0.6916
	CU2. After using it for a while, I have increased my use of fitness apps.		0.704		
	CU3. I would like to recommend the fitness app I am using to others.		0.878		
	CU4. I have positive comments on the fitness App I am using.		0.871		

Table 2
Demographic characteristics of participants.

Participant	Age	Gender	Fitness app	Usage time (months)	Frequency (per week)
P1	23	Female	Keep	4	2
P2	22	Male	Keep	24	5
P3	22	Female	Keep	2	1
P4	18	Female	Nike training	6	2
P5	25	Female	YueDongQuan	8	3
P6	27	Male	GuDong	36	4
P7	24	Female	Keep	8	2
P8	22	Male	Keep	6	3
P9	23	Female	Nike training	3	1
P10	28	Female	Keep	15	5

4. Results

4.1. Study 1

In reviewing the previous literature, seven model fit indices (i.e., c2/df, GFI, AGFI, IFI, TLI, CFI and RMSEA) for this path analysis were reviewed [28,29]. More specifically, $\chi^2/df = 3.292$, GFI = 0.861, IFI = 0.940 and RMSEA = 0.079. Therefore, the path analysis results achieved acceptable model fits (see Table 3). Specifically, eight hypotheses are confirmed while the remaining two hypotheses were not supported (see Table 3). Continuance intention to use was strongly predicted by confirmed usefulness ($\beta = 0.378$, $P < 0.001$) confirmed ease of use ($\beta = 0.377$, $P < 0.001$); satisfaction and social connection also have a significant and positive impact on continuance intention to use ($\beta = 0.345$, $P < 0.001$; $\beta = 0.091$, $P < 0.01$). Particularly, the inclusion of confirmed usefully and confirmed ease of use in the regression model explained 51.4% and 39.6% of the variance of continuance intention to use respectively ($R^2 = 0.514$; $R^2 = 0.396$), satisfaction explained 50.7% of the variance of continuance intention to use ($R^2 = 0.507$) and the social connection

Table 3
Path analysis results.

Research hypotheses	Path coefficient	P	Finding
Confirmed usefulness ← Confirmed ease of use	0.681	<0.001	Supported
Satisfaction ← Confirmed usefulness	0.175	0.018	Supported
Satisfaction ← Confirmed ease of use	0.285	<0.001	Supported
Satisfaction ← Fitness achievement	−0.030	0.601	Not supported
Continuous use ← Satisfaction	0.345	<0.001	Supported
Continuous use ← Confirmed usefulness	0.378	<0.001	Supported
Continuous use ← Confirmed ease of use	0.377	<0.001	Supported
Continuous use ← Entertainment	−0.008	0.783	Not supported
Continuous use ← Social connection	0.091	0.002	Supported
Continuous use ← Fitness achievement	0.167	<0.001	Supported

explained 29.6% of the variance of continuance intention to use ($R^2 = 29.6$). Therefore, hypotheses 3, 5,6 and 10 are supported. However, the hypothesis of a positive association between entertainment and continuous use was unsupported due to a lack of statistical significance, so that hypothesis 7 is rejected. Additionally, satisfaction was predicted by confirmed usefulness ($\beta = 0.175$, $P < 0.05$) and confirmed ease of use ($\beta = 0.285$, $P < 0.001$). Therefore, hypotheses 2 and 4 are supported. The inclusion of confirmed usefulness and confirmed ease of use in the path model explained 38.7% and 21.3% of the variance of satisfaction ($R^2 = 0.387$; $R^2 = 0.213$). Additionally, the hypothesis of a positive association between fitness achievement and continuance intention to use was supported due to a statistical significance and positive sign with the path coefficient value; thus, hypothesis 10 was confirmed. Nevertheless, the hypothesis between fitness achievement and college students' level of satisfaction were not supported because of poor statistical significance; therefore, hypotheses 9 are not confirmed. Hypothesis 1 is supported. The confirmed ease of use was a significant predictor of confirmed usefulness ($\beta = 0.760$, $P < 0.001$). The inclusion of confirmed ease of use in the path model explained 48.5% of confirmed usefulness ($R^2 = 0.485$). The implications of these results are discussed in the next section.

4.2. Study 2

4.2.1. Factors for continuance intention to use fitness apps

In study 1, the researcher identified some factors that will affect college users' continuance intention to use fitness apps. In the interview, the researcher attempted to understand how these factors affect college users' adoption of new technologies and whether there are additional factors that affect their choices and decisions.

Confirmation of effectiveness. Most college students agreed that the fitness apps they currently use have dramatically improved their efficiency. They agreed with study 1's findings, that is, confirmed usefulness and confirmed ease of use are the two most crucial factors that determine their continuous use behaviors. This is consistent with the results of study 1 and those of many previous findings [1,7–9].

> "Keep is easy to operate and I can easily learn how to use it. And, its interface design is very simple and easy to understand; through navigation you can quickly find what you need." [P4]

> "I use Mi Band. Every day, I transmit my sports data to YueDongQuan (a fitness app) through Mi Band. I think YueDongQuan's information record is very accurate and the feedback and suggestions are timely. The system quality of these fitness apps is quite good." [P6]

High Quality and free of charge. High quality and free of charge are important determinants. College students said fitness apps have many functions, including exercise courses, step counting and coaching appointments. The quality of these functions, such as whether the application can be logged into at any time, the data processing is fast, the content provided is useful, and the various functions can be flexibly used, are all reasons that affect their intention. The participants' views were similar to those of many studies [13,25].

> "The operation is quite smooth. The experience is quite good." [P10]

> "Keep runs pretty fast and provides accurate data." [P7]

Internal dedication and motivation. Many college students said that intrinsic dedication and motivation determine whether they would continue to use mobile apps for fitness and health enhancement. Although they admitted the utility of fitness apps, they believed that an individual's self-motivation is a more important influencing factor. Self-motivation was not adopted as the main factor in study 1, while many previous empirical studies adopted this factor and their results showed that it was the key factor influencing people's use of fitness apps [7,25,28,29].

> "I think the most important thing is whether you want to use a fitness app or not. It is an internal thing. People are motivated from inside. In other words, the fitness app is so well designed and perfect, and the service quality is so high, if people don't want to use it, then all these advantages are meaningless." [P2]

4.2.2. Opinions on the relationship between achieved fitness and satisfaction

Fitness achievements come from self-efficacy. The results of study 1 indicated that achieved fitness has no positive influence on college students' level of satisfaction with fitness apps. This finding is different from many previous studies. In the interviews, we asked participants for their opinions. Most of them attributed their achievements in fitness to their self-efficacy, and they believed their achievements had nothing to do with the fitness apps. In other words, college students became healthier, stronger, or slimmer mainly because they are self-disciplined people and they often push themselves to exercise; fitness apps only play an auxiliary role. Therefore, their fitness achievements do not increase their levels of satisfaction with fitness apps.

> "I use keep (a fitness app) three times a week. I use it for losing weight … Losing weight is a painful thing, but I still persevered … lost almost 20 kg. I should thank myself. I mean if I choose to go to the gym, I can still lose 20 kg in three months. So, I'm not going to increase my satisfaction with fitness apps just because I have lost weight." [P8]

However, there were a small number of people who believed that achieved fitness would improve their level of satisfaction with fitness apps to some extent. Most of them are heavy users who have been using fitness apps for more than two years and use them relatively frequently. These people said they have benefited significantly from using fitness apps.

> "I use fitness apps almost every day. I have used them for over 1200 days. In this process, I became healthier and thinner, and my skin became better. Many thanks to YueDongQuan (a fitness app). I am very satisfied with their services. I often recommend this app to people around me." [P2]

4.2.3. Opinions of entertainment and social connection

Negative opinion of entertainment. Similar to study 1's results, most participants said entertainment, like scoreboards and mini games, are redundant in fitness apps. They said they have a very specific goal when using fitness apps, which is to achieve health and fitness. As adults, even if they do not receive entertainment from fitness apps, they will continue to push themselves to use them. Some students said that they were disturbed by the entertainment functions in fitness apps, which reduce their exercise efficiency. Some students said they hate the entertainment functions in fitness apps because these functions take up too much memory space on a smartphone, slowing down the execution of the fitness apps and affecting their user experience.

"… entertainment is not the main function of fitness apps. Some entertainment functions like leading boards, points, badges, they don't increase my level of satisfaction with fitness apps. In fact, I rarely notice games in fitness apps." [P3]

"I still like the original version of Nike + training (a fitness app). The revised version has many entertainment functions, such as calorie factory, limited badge, calorie bank. These features are fancy, but not really useful. I can't find some courses now. I feel that this app has become complicated." [P5]

Incompatible views on social connections. Study 1's finding suggested that social connections have a positive but weak effect on college students' intention to keeping using fitness apps. In the interviews, we asked participants' views on this phenomenon. Most participants hold incompatible views. They said fitness apps help them communicate and interact with other users, which allows them to obtain more useful information about fitness. Additionally, they can share their diet and exercise status through fitness apps and they can receive "likes" from other users, which makes them exercise more persistently. The results of many previous empirical studies also proved that fitness apps' social functions exert an obvious effect on people's continuous use behaviour [27—29].

"I'd like to share my exercise status…. If someone gives me a thumbs-up, I will be very happy and it will improve my exercise efficiency." [P7]

"Although I don't often share my fitness status, I like to see others share their status. I think it is very interesting. A lot of fitness gurus share tips on how to keep fit. As for myself, I don't like to tell people where I work out or with whom. I think it's personal." [P9]

Nevertheless, they also expressed certain concern about the social functions. The main concerns are privacy exposure and harassment by strangers. Some argued that the sharing function sometimes shows their locations, which makes them feel insecure. Additionally, they are concerned about the release of sports data. Other people said they tended to just show their exercise status to their friends.

"I don't share my fitness status on public social media. I don't think it's very safe. But, I share it with my friends and family who often post comments or a thumbs-up, which I think encourages me to keep exercising." [P10]

5. Discussion and conclusion

The purpose of this mixed-methods study is to identify several determinants of college students' continuance intention to use fitness apps and to understand how they influence college students' daily exercise. In the current study, a research model was formulated and examined. Thus, the factors that influence people's continuance intention to use fitness apps are known. At the same time, in the second part of the mixed method study, the researchers further explored people's experiences and summarized their expectations for good fitness applications. These will contribute to future research.

To be specific, in study 1, eight proposed hypotheses are valid, while two is not. The results revealed that factors such as satisfaction, confirmed usefulness, confirmed ease of use, fitness achievement and social connection are important predictors of college students' continuous use behavior. These factors affected

their continuance intention to varying degrees. Of these, the confirmed usefulness and confirmed ease of use significantly and positively affected college users' satisfaction and continuance intention to use. It is determined that confirmed usefulness has the greatest impact on continuance intention to use, followed by confirmed ease of use and satisfaction. In study 2, most participants attributed their fitness achievements to their self-efficacy. Put differently, college users believed they became healthier, stronger, or slimmer mainly because they are self-disciplined and they push themselves to exercise, whereas fitness apps only play an auxiliary role. Therefore, their fitness achievements do not increase their satisfaction with the fitness apps themselves.

Furthermore, there are other two variables introduced from U&G—entertainment and social connection. Entertainment was confirmed not to have a significant impact on college students' intention to keep using fitness apps, while social connection was confirmed to have a slight impact on their continuous use. This is maybe because fitness apps users' adoptive behaviors are primarily motivated by the functional capabilities, that is, the practical, health-maintenance features available in the apps. The additional features like mini-games and social sharing will not be major determinants.

In study 2, students said the interaction among fitness app users helps motivate them to use of the fitness apps. However, the researchers found fitness app users were worried that using social functions would reveal personal information. Therefore, fitness apps with better social functions will likely help users have more motivation to achieve their health and fitness goals. If app designers can focus additional attention on protecting personal information and data, more people will be inspired to use the social functions. Additionally, many users said that the high-quality information and free classes provided by fitness apps are crucial determinants. The omnipotent internet provides people with a large number of online resources so people can easily access health and fitness information. Under these circumstances, people are eager to obtain information with strong credibility with a negligible effort. This implies additional efforts should be made to design apps that can provide high-quality services. The findings suggested that app designers should provide more user-friendly information that is highly credible and comprehensive.

This study, however, found that entertainment did not show an obvious impact. That is, the entertainment the users obtained from fitness apps does not influence whether they wish to continue using the app. This finding is quite intriguing as it is different from the general understanding that has been argued by U&G research. Previous studies regarded entertainment as one of the major factors that led to the adoption of the latest technology. Obviously, this is not the case for users of fitness apps.

As in study 1 and study 2, the users' intention to use behaviors are primarily motivated by the functions and qualities provided by the fitness apps.

These findings indicated that successful fitness apps should make users feel convenient to use and indeed improves the fitness user's efficiency. Besides, people are more eager to get the information with strong credibility with the negligible effort. This implies more efforts should be made to design apps that can provide high-quality services. Moreover, if apps designers can pay more attention to protecting the personal information and data, it will inspire more people to use social connection functions. Additionally, fitness applications help people keep fit and prevent chronic diseases. According to [30], adults should have at least 2.5 h of moderate to intense aerobic exercise every week to ensure the benefits to the heart and overall health. Aerobic exercise (such as walking, jogging or running) can not only prolong life, but also prolong high-quality life, thus reducing the burden of chronic

diseases to a shorter time at the end of life.

6. Limitations and future research directions

This study has some limitations. First, there is a gender imbalance in the sample group. Most participants are female college students. This gender bias in the sample may affect the accuracy of the results. Additionally, the study group is composed of college students who are more tech-savvy and proficient at using new technology, which limits the generalization of the findings. Moreover, the cross-sectional data does not allow for the analysis of predictive power in understanding people's post-adoptive behaviors. The researcher suggests that future research should collect and analyse longitudinal data. Specifically, it is suggested that a panel study be performed by collecting data from a particular group of health app users at multiple temporal points.

Author contributions

Dr. Xiaoxiao Zhang contributed to leading the whole research design, such as conceptualization, Methodology, Writing-Original draft preparation, Software, Validation, Writing- Reviewing and Editing. Dr. Xiaoge Xu contributed to guiding Zhang Xiaoxiao's research design. He also contributed to writing reviewing and editing.

Declaration of competing interest

The author declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijnss.2020.07.009.

References

[1] Cho J. The impact of post-adoption beliefs on the continued use of health apps. Int J Med Inf 2016;87(10):75—83. https://doi.org/10.1016/j.ijmedinf.2015.12.016.
[2] Conroy DE, Yang CH, Maher JP. Behavior change techniques in top-ranked mobile apps for physical activity. Am J Prev Med 2014;46(6):649—52. https://doi.org/10.1016/j.amepre.2014.01.010.
[3] Yang CH, Maher JP, Conroy DE. Implementation of behavior change techniques in mobile applications for physical activity. Am J Prev Med 2015;48(4):452—5. https://doi.org/10.1016/j.amepre.2014.10.010.
[4] Prensky M. Digital natives, digital immigrants. On the Horizon 2001;9(5):1—6. https://doi.org/10.1108/10748120110424816.
[5] Fox S, Duggan M. Health online 2013. Washington, D.C., USA: Pew Internet & American Life Project; 2013. p. 8. Available from: https://www.pewinternet.org/wp-content/uploads/sites/9/media/Files/Reports/PIP_HealthOnline.pdf.
[6] Kharrazi H, Chisholm R, Van Nasdale D, Thompson B. Mobile personal health records: an evaluation of features and functionality. Int J Med Inf 2012;81(9):579—93. https://doi.org/10.1016/j.ijmedinf.2012.04.007.
[7] West JH, Hall PC, Arredondo V, Berrett B, Guerra B, Farrell J. Health behavior theories in diet apps. J Consum Health Internet. 2013;17(1):10—24. https://doi.org/10.1080/15398285.2013.756343.
[8] Brannon EE, Cushing CC. A systematic review: is there an app for that? Translational science of pediatric behavior change for physical activity and dietary interventions. J Pediatr Psychol 2015;40(4):373—84. https://doi.org/10.1093/jpepsy/jsu108.
[9] Årsand E, Frøisland DH, Skrøvseth SO, Chomutare T, Tatara N, Hartvigsen G. Mobile health applications to assist patients with diabetes: lessons learned and design implications. J Diabetes Sci Technol 2012;6(5):1197—2206. https://doi.org/10.1177/193229681200600525.
[10] Middelweerd A, Mollee JS, van der Wal CN, Brug J, Velde SJ. Apps to promote physical activity among adults: a review and content analysis. Int J Behav Nutr Phys Activ 2014;11(1):1—9. https://doi.org/10.1186/s12966-014-0097-9.
[11] Cho J, Lee HE, Kim SJ, Park D. Effects of body image on college students' attitudes toward diet/fitness apps on smartphones. Cyberpsychol, Behav, Soc Netw 2015;18(1):41—5. https://doi.org/10.1089/cyber.2014.0383.
[12] Gowin M, Cheney M, Gwin S. Health and fitness app use in college students: a qualitative study. Am J Health Educ 2015;46(4):223—30. https://doi.org/10.1080/19325037.2015.1044140.
[13] Peng W, Kanthawala S, Yuan S, Hussain SA. A qualitative study of user perceptions of mobile health apps. BMC Public Health 2016;16(1):1—11. https://doi.org/10.1186/s12889-016-3808-0.
[14] Carter MC, Burley VJ, Nykjaer C, Cade JE. Adherence to a smartphone application for weight loss compared to website and paper diary: pilot randomized controlled trial. J Med Internet Res 2013;15(4):1—17. https://doi.org/10.2196/jmir.2283.
[15] Juarascio AS, Goldstein SP, Manasse SM, Forman EM, Butryn ML. Perceptions of the feasibility and acceptability of a smartphone application for the treatment of binge eating disorders: qualitative feedback from a user population and clinicians. Int J Med Inf 2015;84(10):808—16. https://doi.org/10.1016/j.ijmedinf.2015.06.004.
[16] Cho J, Park D, Lee HE. Cognitive factors of using health apps: systematic analysis of relationships among health consciousness, health information orientation, eHealth literacy, and health app use efficacy. J Med Internet Res 2014;16(5):1—10. https://doi.org/10.2196/jmir.3283.
[17] Kang SJ, Ha JP, Hambrick ME. A mixed-method approach to exploring the motives of sport-related mobile applications among college students. J Sport Manag 2015;29(3):272—90. https://doi.org/10.1123/jsm.2013-0065.
[18] Yuan S, Ma W, Kanthawala S, Peng W. Keep using my health apps: discover users' perception of health and fitness apps with the UTAUT2 model. Telemed. and e-Health 2015;21(9):735—41. https://doi.org/10.1089/tmj.2014.0148.
[19] Lee HE, Cho J. What motivates users to continue using diet and fitness apps? Application of the uses and gratifications approach. Health Commun 2017;32(12):1445—53. https://doi.org/10.1080/10410236.2016.1167998.
[20] Bhattacherjee A. Understanding information systems continuance: an expectation-confirmation model. MIS Q 2001;25(3):351—70. https://doi.org/10.2307/3250921.
[21] Thong JYL, Hong SJ, Tam KY. The effects of post-adoption beliefs on the expectation-confirmation model for information technology continuance. Int J Hum Comput Stud 2006;64(9):799—810. https://doi.org/10.1016/j.ijhcs.2006.05.001.
[22] Elizabeth AB, Thomas MC, Thomas H, James MB. Engagement in digital entertainment games: A systematic review. Comput Hum Behav 2012;28(3):771—80. https://doi.org/10.1016/j.chb.2011.11.020.
[23] Munson S. Beyond the share button: making social network sites work for health and wellness. IEEE Potentials 2011;30(5):42—7. https://doi.org/10.1109/MPOT.2011.941731.
[24] Anderson K, Burford O, Emmerton L. Mobile health apps to facilitate self-care: a qualitative study of user experiences. PLoS ONE 2016;11(5):1—21. https://doi.org/10.1371/journal.pone.0156164.
[25] Santo K, Richtering SS, Chalmers J, Thiagalingam A, Chow CK, Redferm J. Mobile Phone Apps to Improve Medication Adherence: A Systematic Stepwise Process to Identify High-Quality Apps. JMIR Mhealth Uhealth 2016;4(4):1—11. https://doi.org/10.2196/mhealth.6742.
[26] Bøe T, Gulbrandsen B, Sørebø Ø. How to stimulate the continued use of ICT in higher education: integrating information systems continuance theory and agency theory. Comput Hum Behav 2015;50(5):375—84. https://doi.org/10.1016/j.chb.2015.03.084.
[27] AI Ayubi SU, Parmano B, Branch R, Ding D. A Persuasive and Social mHealth Application for Physical Activity: A Usability and Feasibility Study. JMIR Mhealth Uhealth 2014;2(2):1—25. https://doi.org/10.2196/mhealth.2902.
[28] Rabin C, Bock B. Desired features of smartphone applications promoting physical activity. Telemed e Health 2011;17(10):801—3. https://doi.org/10.1089/tmj.2011.0055.
[29] Baabdullah AM, Dwivedi YK, Williams DM. Adopting an extended UTAUT2 to predict consumer adoption of M-technologies in Saudi arabia. In: UK Academy for Information Systems Conference Proceedings; 2014. http://aisel.aisnet.org/ukais2014/5.
[30] Krumholz MH, Peterson DE, Ayanian ZJ, Chin HM, DeBusk FR, Goldman L, et al. Report of the National Heart, Lung, and Blood Institute working group on outcomes research in cardiovascular disease. Circulation 2005;111(23):3158—66. https://doi.org/10.1161/CIRCULATIONAHA.105.536102.