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ORIGINAL ARTICLE

The Effect of the Motivation of Wearable Fitness Devices Use on Exercise Engagement: The Mediating Effect of Exercise Commitment

[1]Cheng-Feng Ho, [2]Yu-Sheng Lin, [2,3]Ching-Te Lin, [4,5]Chin-Cheng Yang*, [6]Chih-Chien Shen

[1]Department of Physical Education, Shih Hsin University, Taiwan. [2]General Education Center, Chaoyang University of Technology, Taiwan. [3]Department of Business Administration, National Yunlin University of Science and Technology, Taiwan. [4]Department of Leisure Services Management, Chaoyang University of Technology, Taiwan. [5]Graduate School of Technological and Vocational Education, National Yunlin University of Science and Technology, Taiwan. [6]Institute of Physical Education and Health, Yulin Normal University, China.

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ABSTRACT

Background. In the study of wearable device users, it was found that the intentional motives for using wearable devices were a novelty, fun, and popular trends, but whether the needs and functions of device users will change due to the change the time is the focus of this study. **Objectives.** This study aims to examine the path relationships among motivation of use, exercise commitment, and exercise engagement of users of wearable fitness devices. **Methods.** The subjects of the study were users of wearable fitness devices. The questionnaires were distributed online through purposive sampling. A total of 479 questionnaires were distributed, and 347 valid questionnaires were collected after excluding invalid questionnaires with an effective response rate of 72.4%. The response data were validated by descriptive statistics, confirmatory factor analysis, and a structural equation model. **Results.** The results of the study reveal that users of wearable fitness devices are mainly motivated by "informativeness" and "practicality and instrumentation"; motivation of use does not directly affect exercise engagement ($t = 0.895$, $P < 0.056$). Exercise commitment is mediating between the motivation of use and exercise engagement; motivation of use positively affects exercise commitment, and exercise commitment positively affects exercise engagement ($t = 3.856$, $P < 0.001$). **Conclusion.** Wearable device users believe that the wearable devices can record their own exercise-related information, enhance exercise efficiency, and provide an easy-to-understand interface with a sense of entertainment and novelty technology, which support the device users to engage in physical activities. Commitment to exercise will influence the individual's continued engagement in exercise.

KEYWORDS: ***Fitness, Motivation, Structural Equation Model, Partial Least Square, Wearable Devices.***

INTRODUCTION

Wearable technology products used in exercise and health can record users' body information, making it easy to grasp and access without deliberate use and facilitating their control (1, 2). Wearable devices combine entertainment and information, allowing users to achieve more advanced sensory stimulation and richer resource reception (3, 4); collecting information about their exercises through wearable devices can pursue better exercise performance or maintain basic fitness to stay healthy (4). Nowadays, the technology industry is

*. Corresponding Author:
Chin-Cheng Yang, Ph.D.
E-mail: yccheng@cyut.edu.tw

booming, and through wearable technology, statistical data and information are converted into the mode of intelligent management, which is gradually introduced into people's daily life to provide convenient management information to achieve better exercise and health, to pursue better exercise performance or maintain physical health. Yang et al. (5) conducted a study in 2016 on the influence of wearable device users' motivation on exercise engagement and found that "curiosity and popularity" in the motivation of use positively affected users' exercise engagement ($t=2.007$, $p<.05$). The psychological feelings of fashion, novelty, and popularity associated with the use of wearable devices increased users' exercise engagement. Although the research results have reached a significant level, the explanatory power (R^2) was only 0.10. Now that five years have passed and wearable devices are becoming popular, it is unclear whether the "curiosity and popularity" factor still contributes to users' engagement. Whether the "curiosity and popularity" factor still motivates users to use wearable devices and thus engage in exercise, or whether there are other factors that can influence the motivation of using wearable devices to engage in exercise, are questions that this study would like to explore.

Motivation to use wearable devices refers to a driving force that can guide users to take actions to meet their needs, including four dimensions: entertainment and leisure, informativeness, practicality and instrumentation, and curiosity and popularity. The "curiosity and popularity" dimension connotes fun, curiosity, fashion, technology, modernity, and superiority (5). According to Carpenter et al. (6), sport enjoyment is the feeling and perception of positive emotions, such as pleasure, liking, or fun, experienced during the process of exercising. When an individual spends a lot of time and energy on a favorite sport for fun, such a new evolvement even results in a loyal relationship, which can be called "commitment." Commitment is often seen as a condition that explains an individual's attitude of effort and persistence towards something, which is psychologically driven and produces consistent and continuous behavioral intentions (7). Therefore, commitment can effectively plan a strategy and retain the exercise engagement's continuous exercise behavioral imagery (8). Exercise commitment represents the psychological situation of attachment of exercise participants to the exercise they are engaging in (9), a psychological aspect that affects an individual's persistent behavior with continued engagement in the exercise. The intensity of an individual's motivation to engage in exercise and the motivation to sustain engagement are influenced by the level of exercise commitment, so enhancing an individual's exercise commitment is a key factor in motivating an individual to sustain exercise (6, 10). Wilson et al. (11) defined exercise commitment as a motivational structure, which represents a person’s functional determination and responsibility to maintain the mentality of fitness exercise. They also used the fitness exercise commitment model as a research approach to discover two dimensions: "want-to" and "have-to" commitments, an extended concept that commitment must inherently include both autonomous want-to and involuntary have-to commitments. The empirical study found that want-to commitment predicts fitness exercise behavior, but the have-to commitment is not related to fitness exercise behavior. Therefore, understanding the psychological attachment states and incentives that users of wearable fitness devices have for the devices they wear can help support individuals' continued engagement in exercise and commitment.

In summary, with the rise of exercise and health management, wearable fitness devices have become mainstream culture, and smart wearable devices seem to have become the basic equipment for exercise-engaged people, which enables users to record their exercise trajectory and understand physiological data through the assistance of IT products. The degree of psychological feelings generated will affect the subsequent practice of commitment and the formation of regular exercise behavior. Wearable fitness devices are gaining popularity, and new applications are being developed for their functions. In the study of wearable device users in Taiwan, it was found that the intentional motives for using wearable devices were novelty and fun, and popular trends (5, 12), but whether the needs and functions of device users will change due to the change of the time is the focus of this study. Therefore, in this study, users of wearable fitness devices were studied to investigate the relationships between the motivation of use, exercise commitment, and exercise engagement and to understand the relationship between

exercise commitment and exercise engagement using a structural equation model. The structural equation model was used to understand whether the role of exercise commitment is a mediator between the motivation of use and exercise engagement. This research hypothesis is that the motivation of use will positively influence exercise commitment. Research hypothesis two is that exercise commitment will positively affect exercise engagement. Research hypothesis three is that the motivation of use will positively influence exercise engagement through exercise commitment as a mediator.

MATERIALS AND METHODS

Research Subjects and Scope. In this study, users of wearable fitness devices in Taiwan were taken as the target population, and the free questionnaire software (Google Forms) provided by Google was used as the online survey software for the study. The relevant exercise fitness and road running community websites (Line, Facebook, and Instagram) were used to forward the questionnaire link to conduct the questionnaire survey anonymously. The formal questionnaires of this study were distributed from February 23, 2021, to March 10, 2021, through purposive sampling of online questionnaires. A total of 479 questionnaires were returned, 132 invalid questionnaires were excluded, and 347 valid questionnaires were returned, with a valid return rate of 74.4%.

Research Tools. The motivation for Use Scales. The motivation of use scale was based on Yang et al.'s (5) study and was rated on a five-point Likert scale, with scores of 5, 4, 3, 2, and 1 for "strongly agree," "agree," "average," "disagree," and "strongly disagree" respectively. The higher the score, the higher the participant's feeling of motivation, and vice versa. After item analysis, exploratory factor analysis, and reliability analysis, the pretest scale yielded 20 questions in four domains, including "practicality and instrumentation," "informativeness," "entertainment and leisure," and "curiosity and popularity," with a cumulative variance of 67.74% and the Cronbach's alpha coefficient for the total scale was 0.930, indicating high reliability and validity for the motivation of use scale.

Exercise Commitment Scale. The exercise commitment scale was based on Wilson et al. (11) study and was scored on a five-point Likert scale, with scores of 5, 4, 3, 2, and 1 for "strongly agree," "agree," "average," "disagree," and "strongly disagree" respectively. The higher the score, the higher the participant's feeling towards exercise commitment, and vice versa. After item analysis, exploratory factor analysis, and reliability analysis, the pretest scale yielded 10 questions in two dimensions, "desired commitment" and "necessary commitment." The cumulative variance was 67.42%, and the Cronbach's alpha coefficient for the total scale was 0.921, indicating the high reliability and validity of the exercise commitment scale.

Exercise Engagement Scale. Exercise engagement was calculated by the subject's recall of the past seven days of exercise engagement according to the formula adopted by Fox (13).

1. Exercise frequency: The number of exercises engaged in the past seven days, from the number "0" representing 0 times per week to the number "5" representing more than 5 times of exercise per week.

2. Duration of exercise: the average time spent on exercise, excluding breaks and interruptions, from the number "1" for each duration of 1-30 minutes to the number "6" for each duration of 151 minutes or more.

3. Exercise intensity: refers to the degree of self-perceived physical fatigue after each exercise. The formula of Fox (13) is: exercise engagement = exercise frequency * (exercise intensity + exercise duration). The degree of intensity was measured on scale of 0-10 where 0 = Rest, 1= very very easy, 2 = easy, 3 = moderate, 4 = somewhat hard, 5 = hard, 7 = very hard, 10 = maximal. This range was used to tap the perceived intensity of exercise for all study participants. To convert it to Likert scale 1&2 were regarded as 1= easy, 2 = moderate, 3 = somewhat hard, 4 = very hard, 5 = maximal.

Data Processing. This study used Partial Least Square (PLS) to conduct the Structural Equation Model (SEM) analysis.

RESULTS

Subject Data Analysis. According to the current distribution of demographic variables in this study, wearable fitness devices such as the apple watch, other sports watches, and sports bracelets devices were used by all study users. The users were more likely to be female (60.3%), aged between 19 and 22 (43.4%), with college/university education (73.7%), mostly students (46.1%), with an average monthly income of less than NT$10,000 (27.3%), and

most of the wearable devices purchased cost less than NT$1,000 (41.5%).

Reliability Analysis of each Variable. This study examined the internal consistency of the questions by using component reliability (CR) and Cronbach`s alpha (CA) coefficients. According to Nunnally (14) and Fornell and Larcker (15), the CR and Cronbach`s α coefficients should be greater than 0.7. The overall reliability measure of CR ranged from .893 to .931, and Cronbach`s α coefficients ranged from .754 to .853, showing that this study's measurement indicators have excellent internal consistency.

Table 1. Results of Reliability Analysis for each Potential Variable

	Composite Reliability (CR)	Cronbach`s α (CA)
Motivation of use	0.893	0.839
Exercise commitment	0.931	0.853
Exercise engagement	0.854	0.754

Table 2. Results of Convergent Validity Tests for Potential Variables

	Motivation of Use	Exercise Commitment	Exercise Engagement
Entertainment and Leisure	0.763		
Informativeness	0.871		
Curiosity and Popularity	0.786		
Practicality and Instrumentation	0.862		
Desired Commitment		0.947	
Necessary Commitment		0.919	
Frequency			0.835
Duration			0.818
Intensity			0.785

Table 3. Correlation Coefficients between AVE Square Root and Potential Variables

	AVE	Motivation of Use	Exercise Commitment	Exercise Engagement
Motivation of Use	0.676	0.822		
Exercise Commitment	0.871	0.681	0.933	
Exercise Engagement	0.661	0.202	0.253	0.813

Note: On the diagonal are the AVE square root values, and on the non-diagonal are the correlation coefficients between the potential variables.

Table 4. Influence Summary Table among the Variables of Wearable Fitness Devices

Potential Variable	Exercise Commitment	Exercise Engagement		
	Direct	Direct	Indirect	Total Effect
Motivation of Use	0.681		0.146	0.146
Exercise Commitment		0.215		0.215
Explanatory Power	0.463		0.066	

Table 5. The Goodness of Fit of the Entire Model

	AVE	CR	CA	R^2	GoF
Motivation of Use	0.676	0.893	0.839		0.441
Exercise Commitment	0.871	0.931	0.853	0.463	0.441
Exercise Engagement	0.661	0.854	0.754	0.066	0.441

Convergent Validity Analysis. According to Hair et al. (16), it is recommended that factor loadings must be greater than 0.5. In the overall convergent validity of this study, the factor loadings of the dimensions were between 0.763 and 0.871 for motivation (entertainment and leisure, informativeness, curiosity and popularity, practicality and instrumentation), between 0.919 and 0.947 for exercise commitment (desired, necessary), and between 0.785 and 0.835 for exercise engagement (frequency, duration, intensity), which shows that this study has excellent convergent validity, as shown in Table 2.

Discriminant Validity Analysis. The square root of the average variances extracted (AVE) of the individual potential variables proposed by

Chin (17) was used for the discriminant validity test. The AVE should be larger than the covariance between the potential variables and the potential variables of other constructs in the model. Venkatesh et al. (18) suggest that the square root of AVE should be greater than 0.50. In this study, the square root of the AVE of potential variables ranged from 0.813 to 0.822, and the AVE of each variable was higher than the correlation coefficient in the same column, indicating that the model had excellent discriminant validity, as shown in Table 3.

DISCUSSION

Analysis of the Structural Model for Wearable Device Users. From the path diagram in Figure 1, we can see that in the structural model of wearable device users, motivation of use corresponds to four dimensions: entertainment and leisure (0.763), informativeness (0.871), curiosity and popularity (0.786), and practicality and instrumentation (0.862). Exercise commitment corresponds to two dimensions: desired commitment (0.974) and necessary commitment (0.919). Exercise engagement corresponds to three dimensions: frequency (0.835), duration (0.818), and intensity (0.785). It can be seen that users of the wearable device pay most attention to the access to their exercise information and the ability to check relevant physiological information at any time, which is an important basis for personal health management and can promote the gain of engagement in physical activities.

The coefficient of the positive influence of wearable fitness device users' motivation on exercise commitment is .681, and the explanatory power is 46.3%. It indicates that users value wearable fitness devices for their convenience, practicality, and ability to record exercise trajectory and physiological information in detail, enhancing exercise efficiency. Further studies on wearable devices point out that the main reason is that the device can provide the function of exercise and health monitoring, allowing the wearer to focus more on exercising, which helps to improve physical fitness (19, 20). In summary, the motivation tends to be the individual's internal evaluation of the product. For users of wearable fitness devices, the device's ease of use and the device's functionality, and informativeness to meet the individual's needs are what support the continued use of the device.

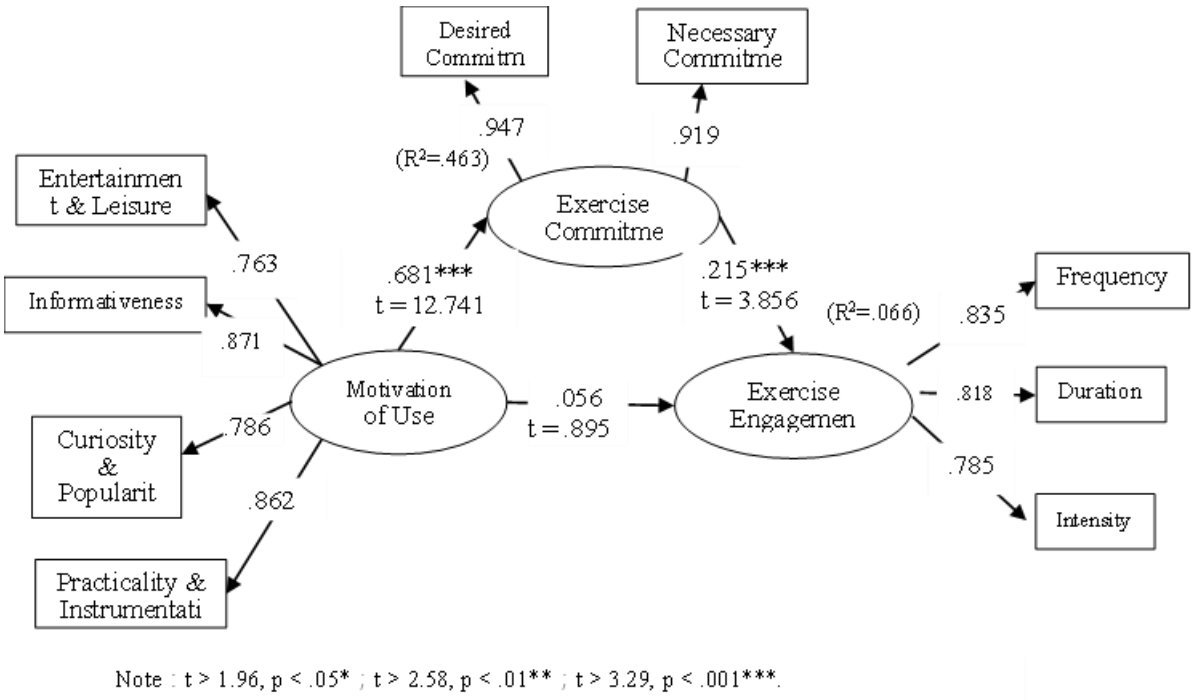

Figure 1. Path Diagram of Smart Wearable Fitness Device User Structural Model

The wearable fitness device users' exercise commitment positively influenced exercise engagement with a path coefficient of 0.215 and an explanatory power of 6.6%. It indicates that the

device can monitor one's exercise status, which motivates the determination and perseverance of individuals to continue using the device, and also supports the continuous exercise behavior of individuals. When an individual identifies with the exercise, he or she will form an internalized psychological attachment tendency because he or she recognizes the object's value (20). Similarly, when wearable device users perceive that the intelligent device meets their needs and values, they will increase their willingness to use it (12). The above results show that when users' evaluation of the wearable fitness devices tends to be positive, it helps individuals to fulfill their commitments and maintain regular physical activity habits.

Table 6. Wearable Devices Use Motivation

Please choose from the following questions to match your situation and feelings when using wearable devices.
Using wearable devices makes me feel that life is full of fun.
Using wearable devices makes me feel relieved.
Using wearable devices makes me feel relax.
Using wearable devices can kill time.
Using wearable devices is a kind of leisure and entertainment activity.
Using wearable devices make me know information about exercise.
Using wearable devices make me know how to training.
Using wearable devices make me know information about this device.
Using wearable devices know how to use the device.
Using wearable devices can quickly share information with others.
Using wearable devices is pursuit new technology.
Using wearable devices improve the sense of superiority.
Using wearable devices is the current mainstream culture.
Using wearable devices is influenced by others.
Using wearable devices make me feel novel.
Using wearable devices provide practical and convenient functions.
Using wearable devices improve exercise efficiency.
Using wearable devices to do the exercise record.
Using wearable devices improve the quality of life.
Using wearable devices is easy to operate.

Table 7. Wearable Device's Exercise Commitment

Please choose from the following questions to match your situation and feelings when using wearable device.
Using wearable devices make me determined to keep exercising.
Using wearable devices make me willing to dedicate time.
It is very difficult for me to give up using wearable devices.
I want to use wearable devices continuously.
I will do everything possible to use wearables devices.
Using wearable devices is a must for me.
I must use wearable devices to monitor my exercise status.
I must use wearable devices to encourage myself to exercise.
I must use wearable devices to get along with others.
Based on certain factors, use wearable devices.

The positive path coefficient (0.056) of wearable fitness device users' motivation of use on exercise engagement was insignificant, indicating that the wearer's motivation of use has to influence exercise engagement through exercise commitment, and thus there is a mediating effect. As in Taiwan, most educated and urban class people use apple, and other brands watch with sports features embedded to feel like normal wear of individuals. This normal feeling of a watch or bracelet may be one reason for not providing specific engagement motivation to users. However, these results had opened a new avenue of future exploration in this area to identify the reasons behind these insignificant results. The device provides information related to exercise to review the physiological changes in oneself at any time, which is an important factor in supporting the continuous engagement of users in physical activities. In a study by Yang et al. (5) on the motivation for the use of wearable fitness devices, it was found that the device not only monitors its exercise track but also helps to increase the frequency of users' exercise engagement due to the stylish and novel appearance of the external device. In Lee and

Lee's (20) study on wearable devices in healthcare, it was also confirmed that for individuals to achieve their own goals, the attitudes that underlie their actions are particularly important. The higher the likelihood that a health app or device will help maintain or improve health, the stronger the continued motivation for use, as the commitment to effective planning is a key factor in an exercise engagement behavior (11). Therefore, when individuals have positive feelings and feedback about the wearable device, the inner satisfaction and self-affirmation they receive are what encourage them to continue to engage in exercise.

The goodness of Fit Indicator. In this study, the indicator used to measure the model goodness of fit in PLS-SEM is GoF (Goodness of Fit), which is mainly based on the least correlation method and is calculated by approximating the model's parameters with the most approximate estimation method. The larger the parameter value, the better the model's goodness of fit (GoF = 0.10, 0.25, and 0.36). From Table 6, the entire model in this study has a GoF = 0.441, which is a high degree of goodness of fit, indicating that the model has excellent goodness of fit.

CONCLUSIONS

In this study, after analyzing the structural model, it was found that the use of wearable fitness device users was mainly motivated by informativeness, practicality, and instrumentation. The motivation of use does not directly affect exercise engagement; while exercise commitment plays a mediating role between the motivation of use and exercise engagement, hypothesis three is valid. The motivation of use positively affects exercise commitment; hypothesis one is valid. Exercise commitment positively affects exercise engagement; hypothesis two is valid. Therefore, the wearable device users can effectively monitor their physiological changes and record the trajectory of exercise to obtain positive evaluation and identity, which can help them enhance their exercise commitment and continuous engagement in physical activities. The application of this research to the practice is significant due to the emerging use of sports bracelets in developing and developed countries. The sports devices may help enhance exercise engagement, motivation, and commitment among sports athletes, coaches, and individuals by utilizing key findings of this research. Future research scholars in sports sciences may also take advantage of this study's findings to understand perceptions about the motivation and engagement of sports individuals in Taiwan.

The limitation of this research is the small sample size and from one country, as well as the cross-sectional data design of the study. Future research studies should include larger data sets with comparative studies of multiple countries and cultures recommended for future explorations. Future studies may also incorporate longitudinal study design for better causality.

APPLICABLE REMARKS

- In this study, it was found that users of wearable fitness devices attach more importance to product informativeness and practical functionality. Therefore, the research and development of wearable fitness devices should strengthen the product's function and add video instruction and guidance through APP software, so that users can better understand how to improve exercise efficiency effectively.
- At present, most of the loyal consumers using wearable devices are young people. However, in the face of the arrival of the aging society, the industry should focus on the research and development of products and marketing services for the elderly group and emphasize the basic functional requirements (health care, health management, information transmission) and the user interface (voice reminders, emergency assistance) to make the operation simple and easy to use, and launch the elderly group discount program to maximize the effectiveness of the product.
- In addition, the motivation to use and exercise commitment are important variables that affect the individual's exercise engagement behavior. If we want to improve the exercise engagement behavior of wearable device users, we need to strengthen the commitment of individuals to exercise.

CONFLICT OF INTEREST

It is stated that none of the authors has any conflict of interest during the conduct and publishing of this research from start to end.

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The research findings may apply to study settings in Taiwan's cultural context, and results may be generalized and used for aggregate academic research purposes only.

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