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How to Improve Users' Loyalty to Smart Health Devices? The Perspective of Compatibility

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Abstract: Despite the explosive growth of smart health devices in recent years, the industry faces serious sustainability challenges. From the perspective of compatibility, this study proposed a theoretical model to help understand the formation of users' loyalty. Using an online survey method, we collected empirical data from 375 users with experience of smart health devices. The results indicate that compatibility with online health management and compatibility with value positively affect users' satisfaction, which in turn contributes to users' loyalty to smart health devices. Meanwhile, both compatibility with online and offline health management have significant impacts on users' compatibility with value. Finally, the mediation tests suggested that user satisfaction significantly mediates the effects of compatibility with online practice and compatibility with value on loyalty. Theoretically, this study contributes to the literature by investigating the influence of three compatibilities on loyalty and verifying the underlying mechanism linking them. Practically, the findings of this study can provide valuable insights for practitioners to increase consumers' loyalty.

Keywords: smart health device; loyalty; satisfaction; compatibility

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1. Introduction

With the great enrichment of material life, more and more people suffer from hypertension, hyperglycemia, obesity, and other diseases due to the problems of living habits, and the COVID-19 epidemic has undoubtedly made this situation even worse [1]. As a result, people around the world are paying increasing attention to their health, more than ever before. Under this background, smart health devices, which help users monitor personal health by recording their blood pressure, heart rate, sleep time, and other data, have achieved colossal market growth [2]. The latest statistics show that the market of smart health devices generated $68.99 billion by 2020 and is expected to reach $81.50 billion in 2021 [3].

Although smart health devices are attractive for people worldwide, many consumers lack strong loyalty. As a result, the industry is facing serious sustainability challenges. For example, the research conducted by Ledger and McCaffrey [4] indicated that the continuous use of wearable health devices dropped to 70% in six months after the initial adoption and down to 55% a year later. Lee et al.'s [5] study obtained similar findings, and found that one in three users stop using the device within six months. Therefore, it is necessary to investigate how to improve users' loyalty and guide operators to achieve sustainable development.

Among the extant literature related to smart health devices, most researchers pay attention to users' acceptance or adoption, while rather limited research has explored users' loyalty, such as their recommended and continued use behaviors [6,7]. Based on the technology acceptance model, the expectation confirmation theory, the theory of planned behavior, the diffusion of innovation theory, etc., scholars have empirically examined

a series of significant factors that affect users' loyalty to smart health devices, such as consumer innovativeness [8], perceived ease of use [9], perceived usefulness [10], privacy risk [11], social influence [6], performance expectancy [12], and so on. However, there are three distinct research gaps in this field. First, most of the previous loyalty literature is based on technology adoption-related theories, such as the technology acceptance model [13–15], the theory of planned behavior [16,17], and the privacy calculus theory [18,19], etc., which has certain limitations in understanding users' post-adoption behavior [10,20]. Second, although an increasing body of literature has investigated the factors influencing users' behaviors, most of them focused on the online aspect (e.g., perceived enjoyment, perceived privacy risk, and system quality) of adopting smart health devices [10,13,14], ignoring the offline health management purpose, which actually exerts a critical role in determining users' behaviors [21]. Third, although several recent studies have noted the importance of perceived value in users' sustained intention, they only explored how perceived value (e.g., hedonistic and utilitarian value) affects users' behavioral intention, failing to take the personal value system into consideration [8,22]. As a result, practitioners are still in a dilemma about how to improve users' loyalty.

To address the above-discussed research gaps, this study develops a theoretical model to investigate how to improve users' loyalty to smart health devices. Specifically, the perspective of compatibility, which is extremely appropriate for understanding users' technology usage behavior, is adopted to narrow the first research gap. Furthermore, this study covers compatibilities with online and offline practice simultaneously to capture both the online and offline aspects that determine user loyalty, thus filling the second research gap of ignoring users' offline health management purpose. Meanwhile, this study bridges the third research gap by taking compatibility in terms of a personal value system, that is, compatibility with value, into consideration. Finally, based on the expectation confirmation theory, this study further proposes the mediating role of satisfaction as the key mechanism linking the three compatibilities with user loyalty.

The study contributes to the literature in the following three ways. First, from the perspective of compatibility, this study identified three types of compatibilities (i.e., compatibility with offline practice, compatibility with online practice, and compatibility with value) and investigated their impacts on user loyalty, thus enriching the knowledge on this topic. Second, this study deepens the understanding of user loyalty by examining the mediating role of satisfaction as the key mechanism of compatibility engendering loyalty. Finally, this study found the interactions among the three compatibilities, which have seldom been tested in previous literature, thus advancing the body of knowledge on compatibility.

The remainder of the paper is organized as follows. The theoretical background and related work are reviewed in Section 2, following which we propose the research model and discuss the hypotheses in Section 3. Then, Sections 4 and 5 report the methodology and data analysis results, respectively. Finally, this study concludes with a discussion of the key findings, implications, limitations, and future research directions.

2. Theoretical Background and Literature Review

2.1. The Perspective of Compatibility

Compatibility was first defined by Rogers [23] as the degree of consistency that combines innovation with existing sociocultural values and beliefs, past and present experience, and the needs of potential adopters. In order to better understand how compatibility engenders individual behaviors, previous scholars have conducted extensive discussions and identified various forms of compatibility. For instance, Tornatzky and Klein [24] divided compatibility into value compatibility and practical compatibility, whereby the former represents the adaptability of technology to personal values and norms, while the latter captures the consistency of technology with what people do. Similarly, Moore and Benbasat [25] argued that there are two types of compatibility, normative or cognitive compatibility, which refers to compatibility with what people feel or think about technology,

and practical or operational compatibility, which refers to compatibility with what people do. More specifically, Karahanna et al. [26] identified four compatibility beliefs related to IT innovation in the context of the organization, i.e., compatibility with existing work practices, compatibility with preferred work style, compatibility with prior experience, and compatibility with value.

Due to its strong explanatory power in innovative technology usage, the perspective of compatibility has been increasingly popular in recent literature [27–29]. For example, Groß [28] explored the impacts of normative and functional compatibilities on mobile shopping loyalty; Wang et al. [30] found that compatibility significantly enhanced the positive relationships between personalization with users' performance expectancy and effort expectancy, which in turn led to an increasing intention to continue to use e-banking services. In this study, we investigate how to improve users' loyalty to smart health devices from the perspective of compatibility for the following reasons. On the one hand, it has been widely applied in many research contexts to investigate innovative technology usage and has been confirmed as a well-established perspective for predicting users' continuance intention, recommendation, and other behaviors [27,31,32]. On the other hand, the perspective of compatibility provides an appreciated theoretical lens, which is ideal for integrating different aspects of antecedents into a systematic theme for understanding users' loyalty to smart health devices.

Combining the context of smart health devices with previous compatibility literature, this study identified three types of compatibilities, namely compatibility with offline practice, compatibility with online practice, and compatibility with value. Specifically, compatibility with offline practice refers to the degree of consistency with the individual's past, present, and yearning for offline health management model. Compatibility with online practice measures the degree of consistency with users' past, present, and desired online health management model. Finally, compatibility with values defines the adaptability of smart health devices to users' values and norms, which refers to the degree of consistency with the users' pursuit of the concept of a pleasant consumption experience, the goal of good consumption efficiency, and the personal value system in the use of smart health devices.

2.2. Research on Users' Loyalty to Smart Health Devices

Smart health devices have greatly changed people's understanding of themselves and improved life quality, thus opening up a new era of personal health management [33–35]. As summarized in Appendix A, based on the technology acceptance model, the theory of planned behavior, the diffusion of innovation theory, etc., scholars have conducted a series of empirical studies to investigate users' behaviors that demonstrate their loyalty, which mainly include continuation and recommendation. Specific to continuation, previous literature indicates that users' continuance intention can be determined by factors that lie in technical and personal aspects. The technical aspect includes factors that affect users' online health management experience, such as usefulness [12], ease of use [14], usability [36], service quality [13], privacy risk [18], etc. The personal aspect covers attitude [37], innovativeness [36], perceived behavior control [7], personal appeal [15], habit [10], value perception [8], lifestyle congruence [11], etc. Specific to the recommendations, Talukder et al. [6] found that social influence, innovativeness, compatibility, performance, and effort expectancy have significant effects on users' intention to recommend fitness wearable technology. Gupta et al. [38] found that perceived usefulness, perceived health outcomes, confirmation, and social comparison tendency can effectively predict users' intention to recommend smart fitness wearables. Rahman et al. [12] suggested that performance expectancy, social influence, facilitating conditions, and attitude have statistically significant impacts on users' intention to recommend wearable technologies.

Considering scholars in the field of information systems and marketing have pointed out that loyalty is a complex psychological construct that has multiple specific behavioral manifestations [39,40], such as continuation [8,41,42], recommendation [27,43,44],

and cross-buy [45–47], this study operates with user loyalty as a second-order formative construct involving the above three sub-behaviors. Specifically, continuation means the extent to which users are willing to continue using the smart health devices in the future; recommendation refers to the extent to which users are willing to recommend the smart health devices to others; and cross-buy captures users' additional buying behavior (i.e., products and services) from the existing smart health devices provider that they use.

As mentioned in the first section, there are several research gaps that need to be filled in the current literature on users' loyalty to smart health devices. First, most previous research models were developed based on theories or models related to technology adoption, which has certain limitations in understanding users' post-adoption behavior, such as loyalty [10,20]. Second, offline health management, which corresponds to the online health management functions, has been overlooked in most previous studies [21]. Third, although several studies have emphasized the role of perceived value, the importance of the personal value system in determining users' loyalty has not been fully captured. To narrow the above research gaps, this study introduces the perspective of compatibility and investigates how three types of compatibilities contribute to users' loyalty. The next section will propose our research model and discuss the hypotheses.

3. Research Model and Hypotheses

As depicted in Figure 1, this study focuses on smart health devices users' loyalty, which was conceptualized as a second-order formative construct involving recommendation, continuation, and cross-buy. Specifically, three types of compatibilities, namely compatibility with offline practice, compatibility with online practice, and compatibility with value, were assumed to positively affect users' satisfaction, which in turn contributes to users' loyalty. Moreover, the interactions among the identified three types of compatibilities were also discussed.

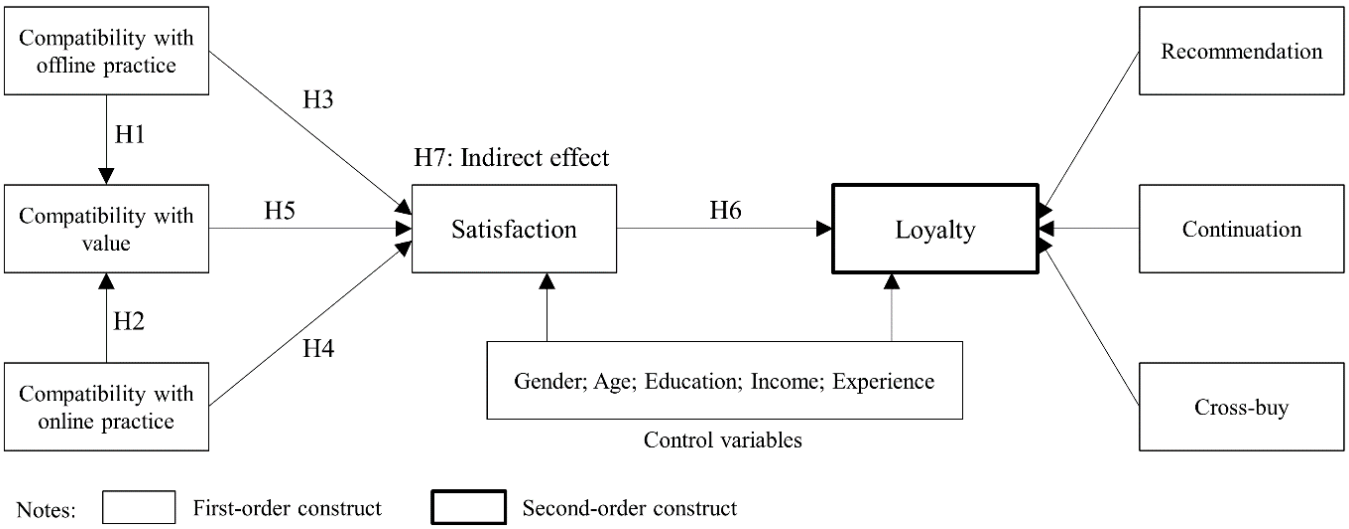

Figure 1. Research model.

3.1. Interactions among Compatibilities

Compatibility with offline practice is used to measure the compatibility with an individual's past offline personal health management style. Put differently, compatibility with offline practice means that individuals do not need to change the existing offline management mode, thus is highly consistent with their yearning for offline individual management mode. Users can use smart health devices to adjust corresponding behaviors, such as running, swimming, and eating for offline health management [48]. In this sense, high compatibility with offline practice can greatly reduce the difficulty, making people feel at ease. Existing studies have shown that ease of use is an external motivation

that can significantly enhance consumers' motivation to engage in social media interactions [49]. Furthermore, according to the self-determination theory, perceived ease of use improves intrinsic and external motivations, providing capability support to enhance internal motivation [50]. Therefore, compatibility with offline practice will enhance the internal driving force through relevant events to improve compatibility with value. That is the following hypothesis:

Hypothesis 1 (H1). *Compatibility with offline practice has a positive effect on compatibility with value.*

Compatibility with online practice represents individuals' use of smart health devices without deliberately changing the adaptation devices. People use smart health devices to collect personal physical data and seek health guidance and advice from doctors for online personal health management [51]. Thus, compatibility with users' needs can be regarded as a sub-dimension of relative advantage or perceived usefulness [52]. Previous studies have shown that usefulness is extrinsic motivation and can produce a series of positive effects [53,54]. Compatibility with existing work practice and prior experience may also provide more useful extrinsic motivation [26], and external events related to behavior can influence people's intrinsic motivation [50]. Hence, compatibility with online health practice can provide more external motivation to improve compatibility with value. Based on the above discussion, we posit the following hypothesis:

Hypothesis 2 (H2). *Compatibility with online practice has a positive effect on compatibility with value.*

3.2. Compatibility and Satisfaction

Compatibility with offline practice indicates that users find compatibility with their past and preferred offline health management methods when using smart health devices. Lifestyle plays a vital role in satisfaction and continuous use [55], and users will spend less effort getting familiar with the devices. Compatibility with existing work practices suggests that using new technology does not require a substantial change in one's work, resulting in less effort to utilize the technology [26]. Therefore, users' satisfaction with devices may be improved. Existing studies have shown that compatibility with preferred working style and existing working practice are the most important factors affecting nurses' satisfaction when using electronic patient records [56]. Sebetci [57] showed that technology compatibility positively impacts user satisfaction in the health information system. In addition, the fit between individual needs and technology will also improve the satisfaction of e-health services in prehospital emergency management [58]. Based on the above discussion, we propose the following hypothesis:

Hypothesis 3 (H3). *Compatibility with offline practice has a positive effect on satisfaction.*

Individuals use smart health devices for online health management, for example, people can carry out early preventive intervention and treatment according to the collected data [51]. According to previous studies, compatibility is an essential prerequisite for technology adoption [59,60]. Specifically, when users perceive compatibility with online practice, the cognitive burden of devices will be reduced. The advantages of devices will be better recognized, which will improve the possibility of satisfaction. Existing studies have shown that compatibility can effectively reduce the cognitive burden to new technologies. Compatibility with previous experience means that people have the cognitive mode to use the technology, which will lead to a lower cognitive burden [26]. More importantly, existing studies have shown that technology compatibility is the main factor determining users' satisfaction with the technology [61]. Any mismatch may require a long learning process to change the way users work and lead to dissatisfaction with the system [62]. Hence, we posit the following hypothesis:

Hypothesis 4 (H4). *Compatibility with online practice has a positive effect on satisfaction.*

Compatibility with values refers to the degree of consistency with the user's pursuit of the concept of a pleasant consumption experience, the goal of good consumption efficiency, and the personal value system in the use of smart health devices. Value compatibility is crucial to the adoption of IT innovation [63]. Specifically, when people perceive that it is compatible with their values, there will be internal motivation that will produce a series of positive results and improve their satisfaction with devices. The higher the compatibility with value compatibility in IT adoption, the lower the potential uncertainty adopters perceive [63]. Meanwhile, compatibility with values represents an intrinsic motivational factor [64], which has been confirmed to significantly promote users' continued use [65,66]. What is more, Maillet et al. [56] found that compatibility with value is an important factor in determining nurses' satisfaction with ERP. Therefore, we propose the following hypothesis:

Hypothesis 5 (H5). *Compatibility with value has a positive effect on satisfaction.*

3.3. Satisfaction and Loyalty

Loyalty refers to consumers' biased (rather than random) behavioral response to a certain brand (goods and service) in their purchase decision [67]. In this study, loyalty is elaborated from the perspective of recommendation, cross-buy, and continuous use. Many studies have suggested that satisfaction will improve users' recommendation tendency, repurchase, and other positive behaviors [68–70]. Specific to smart health devices, the higher user satisfaction is, the smaller the experience between the expected and actual use of the product. As such, they are more likely to continue use and recommend it to others. Consistent with previous literature, we posit the following hypothesis:

Hypothesis 6 (H6). *Satisfaction has a positive effect on loyalty.*

3.4. The Mediating Role of Satisfaction

According to the expectation confirmation theory, satisfaction is a direct determinant of loyalty, and it thus has been regarded as a good mediating variable in previous smart health device studies [42,71,72]. For example, Bölen [72] found that perceived usefulness and aesthetics were direct antecedents of satisfaction, which positively impacted users' continuance intention. Cho and Lee [20] also confirmed the significant mediating role of satisfaction in determining users' continuance intention. As compatibility has been identified as a contributing factor to the success of new technologies [73], we believe that compatibility is an important factor engendering loyalty. Furthermore, since compatibility can increase users' satisfaction [56,74], and satisfaction has been regarded as the direct factor of users' loyalty [75], we in this study naturally suggest the mediating role of satisfaction in the relationship between compatibility and loyalty.

Hypothesis 7 (H7). *Satisfaction will mediate the effect of compatibility (i.e., compatibility with offline health practice, compatibility with online health practice, and compatibility with value) on loyalty.*

4. Methodology

4.1. Measures

All measures of our constructs were adopted from earlier studies. Specifically, three compatibilities were measured with scales adapted from Karahanna et al. [34]. Three items from Pereira and Tam [57] were adapted to measure satisfaction. Finally, users' loyalty is composed of three sub-constructs: Recommendation, which was measured with three items adapted from Luo and Chea [58]; continuation, which was measured with three items from Nascimento et al. [16]; and cross-buy, which was measured with three items from Mukerjee [59]. The questions were answered on a seven-point Likert scale anchored

between "strongly disagree" and "strongly agree." The detailed measurement items can be found in Appendix B.

4.2. Data Collection and Samples

This study adopted an online survey method to collect data. Specifically, Sojump.com, the largest online questionnaire survey platform in mainland China, was used to distribute our questionnaire. To target the research object of this study, several filtering questions were arranged before the formal questionnaire, and respondents who had experience in using smart health devices were allowed to start the formal questionnaire. Meanwhile, we offered a cash reward of 5 yuan (about $0.78) to encourage the respondents to answer the questions seriously. In this way, we collected a total of 375 valid responses. The demographic characteristics of our samples are shown in Table 1.

Table 1. Sample characteristics.

Demographic Characteristics	Types	Frequency	Percentage (%)
Gender	Male	181	48.3
	Female	194	51.7
Age	Younger than 18	56	14.9
	18–25	94	25.1
	26–30	104	27.7
	31–40	51	13.6
	41–50	48	12.8
	Older than 51	22	5.9
Educational level	High school and below	1	0.3
	Junior college	64	17.1
	Undergraduate	281	74.9
	Master and above	29	7.7
Personal monthly income (CNY)	Less than 5000	16	4.3
	5000–8000	79	21.1
	8000–12,000	146	38.9
	12,000–20,000	110	29.3
	More than 20,000	24	6.4
Use experience	Less than 3 months	18	4.8
	3–6 months	88	23.5
	6–12 months	159	42.4
	12–24 months	88	23.5
	More than 24 months	22	5.9

5. Data Analysis and Results

The structural equation modeling (SEM) technique was used to validate the proposed model. The purpose of this study is to explore the formation of user loyalty from the perspective of compatibility rather than to test existing theories. Furthermore, the sample size of this study is relatively small, so we adopted partial least-squares-based structural equation modeling (PLS-SEM), which is believed more appropriate for exploratory study and performs better in small sample analyses [76]. Following the two-stage analysis procedure proposed by Anderson and Gerbing [77], the remainder of this section will report the results using SmartPLS 3 [78].

5.1. Measurement Model

For reflective constructs such as compatibilities, satisfaction, and recommendation, this study examined Cronbach's alpha (CA) and composite reliability (CR) to assess the construct reliability and used item loading and average variance extracted (AVE) to assess the convergent validity. As reported in Table 2, the CA values of our constructs ranged from 0.801 to 0.889, and the CR values ranged from 0.869 to 0.931, all of which are above

the 0.70 thresholds, demonstrating adequate reliability [79]. Meanwhile, all the individual item loadings were greater than 0.70, and all the AVE values exceeded the acceptable standard of 0.50 [80]. Therefore, the measurements of our constructs perform well in convergent validity. Finally, we use two criteria to evaluate the discriminant validity of the measurement model. First, all the square values of AVE were greater than the inter-construct correlations (see Table 3). Secondly, Table 4 suggests that all items loaded with higher respective constructs than other constructs, providing additional evidence for satisfactory discriminant validity [80].

Table 2. Results of reliability and convergent validity.

Constructs	Items	Loadings	CA	CR	AVE
Compatibility with offline practice (COF)	COF1	0.768	0.801	0.869	0.624
	COF2	0.770			
	COF3	0.857			
	COF4	0.762			
Compatibility with online practice (COL)	COL1	0.743	0.827	0.884	0.656
	COL2	0.788			
	COL3	0.865			
	COL4	0.838			
Compatibility with value (CVA)	CVA1	0.849	0.833	0.900	0.751
	CVA2	0.877			
	CVA3	0.871			
Satisfaction (SAT)	SAT1	0.877	0.834	0.900	0.749
	SAT2	0.869			
	SAT3	0.855			
Recommendation (REC)	REC1	0.902	0.874	0.923	0.799
	REC2	0.895			
	REC3	0.884			
Continuation (CON)	CON1	0.918	0.889	0.931	0.818
	CON2	0.890			
	CON3	0.905			
Cross-buy (CRO)	CRO1	0.898	0.871	0.921	0.795
	CRO2	0.906			
	CRO3	0.870			

Table 3. Descriptive statistics, correlation matrix, and squared root of average variance extracted (AVE).

Constructs	Mean	SD	COF	COL	CVA	SAT	REC	CON	CRO
COF	5.157	0.891	**0.790**						
COL	5.284	0.871	0.735	**0.810**					
CVA	5.525	0.803	0.561	0.636	**0.865**				
SAT	5.604	0.797	0.515	0.606	0.671	**0.867**			
REC	5.664	0.901	0.434	0.534	0.598	0.594	**0.894**		
CON	5.862	0.870	0.561	0.608	0.664	0.714	0.593	**0.904**	
CRO	5.236	1.044	0.483	0.522	0.574	0.624	0.580	0.589	**0.891**

Notes: SD—Standard Deviation; COF—Compatibility with offline practice; COL—Compatibility with online practice; CVA—Compatibility with value; SAT—Satisfaction; REC—Recommendation; CON—Continuation; CRO—Cross-buy. The values on the diagonal line are the square roots of AVE. Bold numbers indicate item loadings on the assigned constructs.

For formative construct loyalty, this study follows a previously established procedure to assess its validity and reliability [81]. Specifically, item weights were calculated to reflect the validity of the formative construct, and multicollinearity was evaluated to ensure the reliability of the formative construct. As shown in Table 5, the weights of loyalty's three sub-constructs were 0.240, 0.579, and 0.341, respectively, all of which were significant at the statistic level. Meanwhile, the variance inflation factor (VIF) values were 1.759, 1.783,

and 1.748, lower than the recommended benchmark of 3.00 for potential multicollinearity. Therefore, the formative construct of this study has satisfactory validity and reliability.

Table 4. Item cross loadings.

Items	COF	COL	CVA	SAT	REC	CON	CRO
COF1	**0.768**	0.522	0.406	0.348	0.250	0.349	0.346
COF2	**0.770**	0.517	0.322	0.340	0.246	0.339	0.310
COF3	**0.857**	0.620	0.471	0.455	0.368	0.476	0.424
COF4	**0.762**	0.634	0.529	0.454	0.459	0.555	0.419
COL1	0.605	**0.743**	0.404	0.385	0.313	0.348	0.349
COL2	0.582	**0.788**	0.427	0.387	0.374	0.400	0.381
COL3	0.633	**0.865**	0.572	0.567	0.462	0.550	0.461
COL4	0.579	**0.838**	0.609	0.572	0.535	0.612	0.475
CVA1	0.442	0.503	**0.849**	0.542	0.512	0.521	0.479
CVA2	0.499	0.564	**0.877**	0.593	0.516	0.606	0.497
CVA3	0.511	0.580	**0.871**	0.604	0.525	0.593	0.511
SAT1	0.446	0.535	0.581	**0.877**	0.547	0.641	0.553
SAT2	0.470	0.535	0.592	**0.869**	0.533	0.646	0.539
SAT3	0.422	0.503	0.572	**0.855**	0.462	0.565	0.532
REC1	0.410	0.506	0.576	0.542	**0.902**	0.548	0.520
REC2	0.377	0.454	0.503	0.535	**0.895**	0.520	0.539
REC3	0.378	0.470	0.524	0.516	**0.884**	0.521	0.497
CON1	0.524	0.594	0.631	0.691	0.569	**0.918**	0.558
CON2	0.489	0.530	0.574	0.604	0.507	**0.890**	0.490
CON3	0.507	0.523	0.595	0.638	0.529	**0.905**	0.547
CRO1	0.461	0.483	0.553	0.584	0.538	0.565	**0.898**
CRO2	0.434	0.466	0.490	0.545	0.479	0.546	**0.906**
CRO3	0.394	0.446	0.487	0.539	0.535	0.461	**0.870**

Notes: COF—Compatibility with offline practice; COL—Compatibility with online practice; CVA—Compatibility with value; SAT—Satisfaction; REC—Recommendation; CON—Continuation; CRO—Cross-buy. Bold numbers indicate item loadings on the assigned constructs.

Table 5. Construct reliability and validity of formative construct.

Formative construct	Subconstructs	Weights	*t*-Values	VIF Values
Loyalty	Recommendation	0.240	3.306	1.759
	Continuation	0.579	8.719	1.783
	Cross-buy	0.341	4.303	1.748

5.2. Structural Model

Figure 2 reports the PLS results of our proposed research model, in which 42.4% of the variance in compatibility with value, 51.3% of the variance in satisfaction, and 60.6% of the variance in loyalty were explained, indicating strong explanatory power of the theoretical model. Furthermore, based on the formula suggested by Tenenhaus et al. [82], a goodness-of-fit (GoF) of 0.606 was obtained, which far exceeds the cutoff value of 0.36 for the large effect size [83]. Furthermore, the fit indices of the model, which include SRMR = 0.058 (<0.08), d_ULS = 0.857 (<0.95), d_G = 0.349 (<0.95), χ^2 = 773.387, and NFI = 0.811, indicate a reliable and adequate fit [84]. Taken together, the model proposed in this study has a good fitting effect.

As illustrated in Table 6, most of the hypotheses were well supported. Specifically, compatibility with offline practice and compatibility with online practice were positively related to compatibility with value, with path coefficients at 0.203 (t = 3.220, $p < 0.01$) and 0.487 (t = 7.505, $p < 0.001$), respectively, supporting H1 and H2. Specific to the relationships between compatibilities with satisfaction, the path from compatibility with offline practice to satisfaction was not significant (β = 0.049, t = 0.779, $p > 0.05$), thus there is not enough evidence to support H3. However, the other two compatibilities, i.e., compatibility with online practice (β = 0.266, t = 3.704, $p < 0.001$) and compatibility with value (β = 0.457,

t = 9.492, p < 0.001) were found to affect satisfaction significantly and positively, thus supporting H4 and H5. Finally, the strong and significant path from satisfaction to loyalty (β = 0.729, t = 18.884, p < 0.001) provided sufficient support for H6, suggesting the critical role of satisfaction in determining user loyalty.

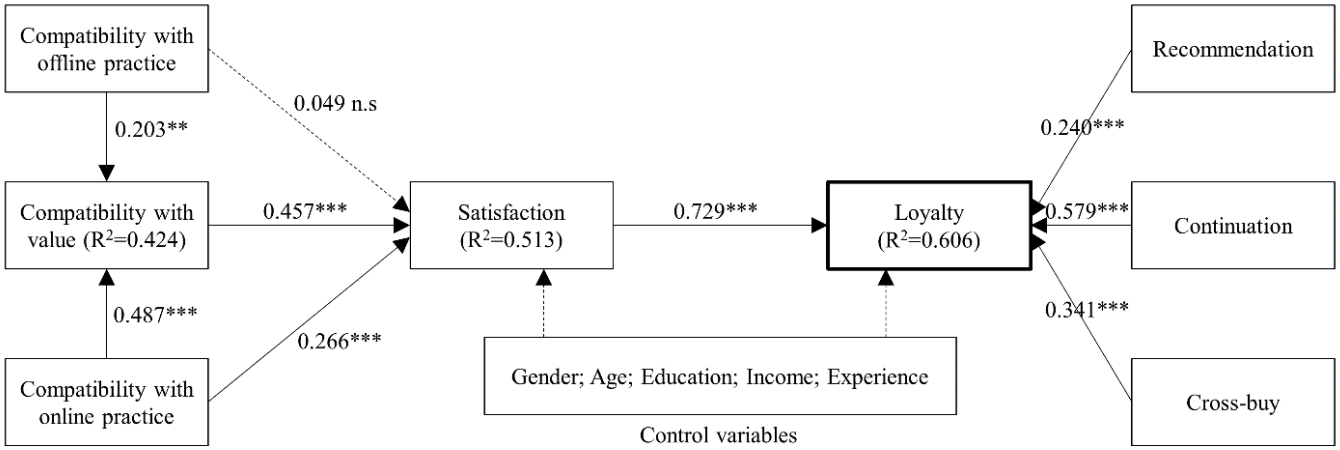

Figure 2. Partial least-squares (PLS) results.

Table 6. Structural model results.

Hypothesis	Paths	Path Coefficient	*t*-Statistics	*p*-Values	Results
H1	COF→CVA	0.203	3.220	0.001	Support
H2	COL→CVA	0.487	7.505	0.000	Support
H3	COF→SAT	0.049	0.779	0.436	Not support
H4	COL→SAT	0.266	3.704	0.000	Support
H5	CVA→SAT	0.457	9.492	0.000	Support
H6	SAT→LOY	0.729	18.884	0.000	Support

Notes: COF—Compatibility with offline practice; COL—Compatibility with online practice; CVA—Compatibility with value; SAT—Satisfaction; LOY—Loyalty.

To examine the indirect effects of compatibilities to loyalty through satisfaction, a bootstrapping analysis was conducted in SmartPLS 3, and the results are shown in Table 7. Except for the path from compatibility with offline practice to loyalty through satisfaction, all other indirect effects were statistically significant, thus H7 is generally supported. Notably, although compatibility with offline practice may not affect loyalty through enhancing user satisfaction, its effect can be transmitted through compatibility with value, as the path "compatibility with offline practice→compatibility with value→satisfaction→loyalty" was significant (Indirect effect = 0.068, t = 2.843, p < 0.01).

Table 7. Results of mediating effects.

Paths	Indirect Effect	*t*-Statistics	*p*-Values	Results
COF→SAT→LOY	0.036	0.769	0.442	Not significant
COL→SAT→LOY	0.193	3.572	0.000	Significant
COF→CVA→SAT	0.093	2.943	0.003	Significant
COL→CVA→SAT	0.223	6.479	0.000	Significant
CVA→SAT→LOY	0.333	7.874	0.000	Significant
COF→CVA→SAT→LOY	0.068	2.843	0.005	Significant
COL→CVA→SAT→LOY	0.162	5.707	0.000	Significant

Notes: COF-Compatibility with offline practice; COL-Compatibility with online practice; CVA-Compatibility with value; SAT-Satisfaction; LOY-Loyalty.

6. Discussion

This study proposes a theoretical model to help understand the formation of smart health device users' loyalty, and the empirical analysis using data from 375 online surveys supports most of our hypotheses. The results indicate the following key findings. First, we find that compatibility is an important factor in the formation of user loyalty. In this study, all three compatibilities, i.e., compatibility with offline health practice, compatibility with online health practice, and compatibility with value, were found to affect user loyalty directly or indirectly. Second, this study finds that the mediation of satisfaction is the key mechanism for compatibilities engendering loyalty, as the results indicate significant indirect effects of them on loyalty through satisfaction. Third, the empirical results show that compatibility with offline health practice and online health practice positively influence compatibility with value, thus indicating significant interactions among three compatibilities.

6.1. Theoretical Implications

The theoretical implications of this study can be understood in the following three ways. First, this study enriches the literature on smart health devices by investigating the role of compatibility. Specifically, although many scholars have paid great attention to users' acceptance and adoption [85,86], rather limited literature has addressed users' post-adoption behavior, such as their loyalty [10,13]. From the perspective of compatibility, this study identified three types of compatibilities (compatibility with offline practice, compatibility with online practice, and compatibility with value) and examined how these compatibilities engender user loyalty, thus narrowing the above research gap.

Second, this study proposes and verifies the underlying mechanism that links compatibility engendering loyalty. The results of this study suggest that satisfaction significantly mediates the relationships between the three compatibilities with user loyalty. More specifically, compatibility with online practice and compatibility with value contribute to loyalty by improving users' satisfaction, while compatibility with offline practice affects loyalty through the double mediations of compatibility with value and satisfaction. In this sense, this finding is expected to offer a valuable reference for future research.

Third, this study advances the knowledge on compatibility by examining the interactions among three compatibilities. Although several previous studies have found significant impacts of different compatibilities on user' behaviors [15,87,88], the internal relationships among different compatibilities have rarely been tested. In this study, our results indicate that compatibility with offline health practice and compatibility with online health practice can significantly improve compatibility with value. In this sense, this study provides new knowledge on compatibility, thus contributing to the existing literature.

6.2. Practical Implications

This study also provides several practical implications. First, enterprises should pay attention to the offline health management status of users. Specifically, enterprises should optimize offline health management guidance for their users by recording and learning users' personalization patterns. For example, based on the quantification and visualization characteristics, enterprises can find users' preferred exercise methods and remind them to carry out the habitual exercises at the right time rather than recommending exercises that users do not like at an inappropriate time. Meanwhile, enterprises can regularly organize offline fitness competitions or social activities, in which users with the same sports hobbies in certain regions are encouraged to participate and communicate with each other face to face. In these ways, enterprises can effectively improve users' compatibility with offline practice and eventually contribute to their loyalty to smart health devices.

Second, user loyalty is realized mainly through compatibility with offline and online health management, compatibility with value, and satisfaction. Smart health devices should enhance the data to identify risk factors, early preventive intervention, and treatment. Enterprises must strive to design products with user values as the focus, accurately

understand the overall consumption values of users using smart health devices, ensure that the design of products is consistent with the concept of users' pursuit of pleasant consumption experience and the goal of pursuing good consumption benefits, and thus improve users' satisfaction with products.

Third, enterprises should develop more extended functions while improving the measurement accuracy of smart health devices, creating a multi-dimensional development pattern of physical intervention, psychological debugging, nutritional diet, and scientific exercise. Meanwhile, practitioners should create a specific communication community and encourage users to interact with others, share progress with joy, and ensure smart health device capabilities more stability. It is conducive to the long-term compatibility with health management mode and value between products and users.

6.3. Limitations and Future Research

This research has several limitations that can be improved in the future. First, due to limited research time and energy, this study did not continue observing and collecting the actual behavior data using smart health devices. In this regard, future scholars can use field data to carry out longitudinal research and build a theoretical model to study the actual behavior of smart health device users to expand the research model further. Second, the national culture may significantly affect users' behavior, therefore it is necessary to explore the relationships proposed in this study in other cultural backgrounds. Third, accompanied by the popularity of smart health devices, the group difference of users becomes more and more apparent. Future research is suggested to investigate the moderating role of personality traits in their theoretical models. Finally, we call on scholars to develop research models from offline health management, which has been ignored in previous literature aiming to understand users' loyalty.

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Appendix A

Table A1. Recent studies on loyalty to smart health devices.

Research	Research Context	Behavior	Theoretical Basis	Antecedents
Hong et al. [8]	Smartwatch	Continuation	Diffusion of innovation theory Technology acceptance model Expectation confirmation theory Flow theory	Consumer innovativeness Utilitarian value Hedonic value
Dehghani et al. [15]	Smartwatch	Continuation	Technology acceptance model	Aesthetic appeal Operational imperfection Hedonic motivation

Table A1. *Cont.*

Research	Research Context	Behavior	Theoretical Basis	Antecedents
Nascimento et al. [10]	Smartwatch	Continuation	Expectation confirmation theory	Perceived enjoyment Satisfaction Habit Perceived usefulness
Song et al. [7]	Smart-connected sports product	Continuation	Theory of planned behavior	Attitude Social comparison Perceived behavioral control
Cho et al. [18]	Healthcare and fitness wearable device	Continuation	Privacy calculus theory	Benefit Privacy risk
Pal et al. [36]	IoT-based smart wearable product	Continuation	Trust perspective	Mobility Usability Security concerns Privacy concernsTrust
Chuah [11]	Smartwatch	Continuation	Net valence framework	Perceived benefits Perceived risk Previous lifestyle incongruence
Ogundele and Cilliers [89]	Healthcare wearable device	Continuation	Expectation confirmation theory Technology acceptance model	Perceived usefulness Confirmation Satisfaction
Rekha and Timothy [14]	Smartwatch	Continuation	Technology acceptance model	Social influence Satisfaction Attitude
Cho and Lee [20]	Smart device	Continuation	Expectation confirmation theory Technology acceptance model	Confirmation Perceived usefulness Satisfaction
Park [9]	Smart wearable device	Continuation	Expectation confirmation theory Technology acceptance model	Service & System quality Perceived ease of use Perceived usefulness Perceived enjoyment
Bölen [72]	Smartwatch	Continuation	Expectation confirmation theory	Satisfaction Perceived aesthetics Individual mobility Habit
Siepmann and Kowalczuk [42]	Smartwatch	Continuation	Expectation confirmation theory Self-determination theory	Goal pursuit motivation Self-quantification behavior Perceived usefulness Confirmation Device annoyance Enjoyment
Windasari et al. [90]	Wearable fitness technology	Continuation	Value co-creation perspective	Dietitian involvement Choice
Talukder et al. [6]	Fitness wearable technology	Recommendation	Diffusion of innovation theory Theory of planned behavior	Compatibility Innovativeness Social influence Performance expectancy Effort expectancy

Table A1. *Cont.*

Research	Research Context	Behavior	Theoretical Basis	Antecedents
Rahman et al. [12]	Wearable technologies	Recommendation	Expectation confirmation theory Theory of planned behavior	Performance expectancy Social influence Facilitating conditions Attitude
Gupta et al. [38]	Smart fitness wearable device	Recommendation	Expectation confirmation theory Social comparison theory	Perceived usefulness Confirmation Perceived health outcomes Social comparison tendency

Appendix B

Table A2. Measurement items.

Construct	Items
Compatibility with offline practice (COF)	COF1: Using this smart health device is very similar to how I used to conduct my offline personal health management. COF2: Using this smart health device does not require changing my current offline personal health management. COF3: Using this smart health device is in line with my yearning offline personal health management mode.
Compatibility with online practice (COL)	COL1: Using this smart health device is very similar to how I used to conduct my online personal health management. COL2: Using this smart health device does not require changing my current online personal health management. COF3: Using this smart health device is in line with my yearning online personal health management mode.
Compatibility with value (CVA)	CVA1: Using this smart health device is consistent with my concept of pursuing a pleasant consumption experience. CVA2: Using this smart health device is consistent with my goal of pursuing good consumption efficiency. CVA3: Using this smart health device is consistent with my overall consumption values.
Satisfaction (SAT)	SAT1: I feel satisfied with the services provided by this smart health device. SAT2: I feel contented with the services provided by this smart health device. SAT3: I like the services provided by this smart health device.
Recommendation (REC)	REC1: I will introduce this smart health device to my friends. REC2: I will commend this smart health device to my friends. REC3: I will tell others about the benefits of this smart health device.
Continuation(CON)	CON1: I will continue to use this smart health device in the future. CON2: I will probably continue to use this smart health devices in the future. CON3: I plan to continue using this smart health device in the future.
Cross-buy (CRO)	CRO1: I will purchase value-added services related to this smart health device in the future. CRO2: I will buy the peripheral products of this smart health device in the future. CRO3: I will buy other products of this smart health device brand in the future.

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