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Application of the Extended Unified Theory of Acceptance and Use of Technology to a Robotic Golf Caddy: Health Consciousness as a Moderator

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Abstract: The COVID-19 pandemic not only accelerated the spread of contactless robot services but also revitalized the golf industry. These changes have expedited the adoption of robot caddies, making it necessary to conduct research on golfers' acceptance of robot caddies. This study, thus, intended to investigate the importance of the extended unified theory of acceptance and use of technology (UTAUT) in the framework of robotic golf caddies and examined health consciousness as a moderator. An online survey was conducted with South Korean golfers, and a total of 391 responses were analyzed. The data analysis results indicated that all five dimensions of the extended UTAUT have a positive impact on attitude. Also, attitude is a significant predictor of both intentions to use and word-of-mouth intentions. Lastly, this study discovered that the moderating effect of health consciousness on the correlation between performance expectancy and attitude was significant.

Keywords: robots; new technology-based services; attitude; technology acceptance behavior; behavioral intentions

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1. Introduction

The golf population has exploded in South Korea to the extent that it is difficult to book golf courses after COVID-19. For example, between 2018 and 2019, golf course users escalated from 37 million to 41.7 million, and by 2021, over 50 million South Koreans were using golf courses [1]. This surge in golf users has caused the problem of a lack of caddies in South Korea, which is a place where it is mandatory to hire caddies when playing golf. Caddies with insufficient qualifications are being put into the field, which is due to the lack of caddies [2]. What is worse is that caddy fees have risen by more than 20% since COVID-19, and golfers' dissatisfaction is rapidly increasing [3].

A robotic golf caddy is emerging as an alternative in order to solve these problems. Robotic golf caddies help golfers by carrying their equipment and bags during a round of golf and replace the role of human caddies. Robotic cadies are activated via a remote control that is Bluetooth-enabled, which can be attached to a golfer's pocket or belt. This allows the golfer to control the robotic golf caddy's speed and direction by using the buttons on the remote [4]. A lithium-ion battery is additionally integrated into the robotic golf caddy, which has the capacity to endure up to 36 holes of golf with a single charge [5]. The advantages of a robotic golf caddy can be derived from a golfer's perspective and from a golf course manager's perspective. First of all, robotic golf caddies make things very comfortable for golfers, because they carry their clubs and bags. Furthermore, robotic golf caddies play a major role in regard to improving golf scores, because they inform golfers about the distance of their golf balls to the pins and the course strategy. It is also possible to reduce the burden of hiring caddies from the perspective of a golf course manager, such as

employment insurance when using a robotic golf caddy. Furthermore, golf carts are not allowed to enter the fairway in South Korea, so golf games are often delayed if one caddy is handling four golfers [6]. However, it is one caddy per person in regard to robotic golf caddies, so a smooth golf game without interruptions can be played. Robotic golf caddies are attracting a lot of attention for these reasons.

This study tried to apply the extended unified theory of acceptance and use of technology (UTAUT) to the context of a robotic golf caddy. It is most important to identify the factor of consumers' adoption, which affects their behavioral intentions, for the success of a new technology-based product/service [7,8], so the UTAUT is commonly applied in order to predict users' behavioral intentions when a new technology-based product/service is released [9,10]. It has been verified that the original UTAUT is successful in regard to predicting the likelihood of consumers accepting and utilizing new technology-based products/services. The model consists of the following sub-dimensions, which include performance expectations, effort expectations, social influence, and facilitating conditions [11]. However, questions have continued to be raised that the UTAUT is insufficient in regard to fully explaining consumer behavior. Also, efforts have been made towards the extend UTAUT in regard to more clearly explaining consumer behavior in the field of new technology. This study adopted the original UTAUT for this reason, and it extended it by incorporating an additional construct, which is perceived risk, in order to increase the explanatory power of consumer behavioral intentions regarding robotic golf caddies for the first time.

In summary, this research analyzed the impact of the five dimensions of the extended UTAUT, which included performance expectancy, effort expectancy, social influence, facilitating conditions, and perceived risk, on attitude. This research additionally examined how attitude influences intentions to use and word-of-mouth intentions. Lastly, this study assessed the effect of health consciousness as a moderator on the extended UTAUT and attitude relationship. The results of this study can provide valuable insights in regard to developing a marketing plan in order to advance the commercialization of robotic golf caddies based on the extended UTAUT framework.

2. Literature Review

2.1. Extended Unified Theory of Acceptance and Use of Technology

Many scholars have researched the acceptance of new technology products and services by consumers [7–9]. The most frequently used theory in regard to explaining consumers' willingness to adopt new technology-based products/services is the technology acceptance model (TAM) [12]. The TAM has gained significant popularity in technology academia since its introduction, which is due to its simplicity and adaptability in regard to predicting the adoption of a new technology [13]. According to the TAM [12], the perceived usefulness and ease of use of a new technology are the main predictors of attitudes towards using a new technology, which positively affects the behavioral intention to use them. The TAM has been widely used in many fields, but the problem that has been raised is that it is somewhat insufficient in order to fully explain consumers' acceptance [14,15]. Numerous logics are associated with technology adoption behavior, such as the motivational model (MM) [16], the model combining the technology acceptance model and the theory of planned behavior (C-TAM-TPB) [17], and the model of personal computer utilization (MPCU) [18] have been employed to account for the TAM's inadequacies.

The most widely known theory among the various theories in the technology field is the UTAUT, which was proposed by Venkatesh et al. [11]. The UTAUT is considered to be one of the most extensive and significant theories in regard to explaining consumers' acceptance of new technology products/services, because it incorporates several of the previous theories [19,20]. According to Venkatesh et al. [11], the UTAUT proposes that four factors are crucial in regard to deciding how users behave and accept a product/service, and these factors include performance expectations, ease of use expectations, social influence, and facilitating conditions. First, performance expectancy refers to the level at which

individuals believe adopting a system will help achieve benefits in job performance [11]. This concept resembles perceived usefulness from the TAM and extrinsic motivation, which is presented in the MM, and it is the expected benefit of achieving a certain purpose. Second, effort expectancy can be defined as "the degree of ease associated with the use of the system" [11] (p. 450). This notion replicates perceived ease of use, a variable of the TAM, and complexity in the MPCU, which indicates how easy it is for consumers to learn. Third, social influence means "the degree to which an individual perceives that important others believe he or she should use the new system" [11] (p. 451). It is comparable to subjective norms in the C-TAM-TPB and social factors in the MPCU, which emphasize the way other people look at things. Fourth, facilitating conditions refer to "the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system" [11] (p. 453). They are similar to perceived behavioral control from the C-TAM-TPB and facilitating conditions in the MPCU, and they indicate the ability to perform a certain behavior.

The UTAUT has made important contributions to the study of new technology adoption, but it fails to consider that consumers may experience anxiety, which is due to unexpected consequences when using technology-based products/services [21]. This study extends the UTAUT for this critical reason by incorporating perceived risk. Perceived risk refers to "the nature and amount of risk perceived by a consumer in contemplating a particular purchase decision" [22] (p. 433). The concept is theoretically supported by the theory of perceived risk [23], which suggests that individuals tend to prioritize avoiding or reducing negative consequences over maximizing benefits when taking risks. Perceived risk arises when consumers are unsure of the potential consequences of a particular behavior and the potential dissatisfaction that may result from it [24]. Also, it negatively affects the adoption of a new technology [25]. The importance of perceiving risk has been continuously confirmed in the field of new technology products/services, and the reliability and validity of the extended UTAUT with perceived risk added to the original UTAUT has been demonstrated in many areas, which include eHealthcare, electric vehicles, internet banking, and mobile payments [26–29].

2.2. The Effect of Extended Unified Theory of Acceptance and Use of Technology on Attitude

The following theoretical and empirical evidence of the connection between the extended UTAUT and attitude serve as the basis for the proposed hypotheses of this study. Attitude has been consistently studied in the field of technology-based products, such as artificial intelligence, e-banking, fintech, and robotic restaurants [30–33]. Attitude refers to "the degree that a person has a favorable or unfavorable evaluation or appraisal of a behavior" [34] (p. 188). In other words, attitude indicates whether a person positively or negatively assesses a particular behavior, so it is an important factor regarding the establishment of his/her behavioral intentions [35,36].

First, this study proposed the effect of performance expectancy on attitude. According to the expectancy theory of motivation [37], an individual's attitude is determined by performance, which can give the most beneficial outcome to him/her. This means that if golfers are convinced that robotic caddies can perform well during their game, they would develop a favorable attitude regarding it. There are also empirical shreds of evidence supporting the argument. Sharma et al. [38] studied consumers' e-ticketing behavior by applying the extended UTAUT. Their findings indicate that consumers tend to adopt a positive attitude when they expect a high level of performance. Bu et al. [39] also found the positive impact of the performance expectancy of privacy by design on individuals' favorable attitudes. Based on the discussions above, the current study established the hypothesis as below.

Hypothesis 1 (H1). *Performance expectancy has a positive effect on attitude.*

Second, this study hypothesized the association between effort expectancy and attitude. The TAM theory suggests how easily consumers learn about a new technology influences their attitude [12]. Thus, it can be inferred that golfers will have a good attitude towards robotic caddies if using them seems to be easy. In addition, the prior research empirically found that effort expectancy significantly affects attitude. As an example, Dwivedi et al. [10] utilized the extended UTAUT in the context of information technology and information systems. Their findings indicated that effort expectancy has a significant effect on attitude. Patil et al. [40] also assessed the effect of effort expectancy in the context of mobile payments, and they showed that attitude is significantly affected by effort expectancy. Therefore, the following hypothesis of the current study was developed.

Hypothesis 2 (H2). *Effort expectancy has a positive effect on attitude.*

Third, the association between social influence and attitude was also examined in this study. According to the TPB [34], individuals tend to engage in a particular behavior under social pressure, which suggests that if people around them think they should use a robotic golf caddy, they will have a favorable attitude. The argument was also supported by empirical research. Shiferaw et al. [41] applied the extended UTAUT to the field of telemedicine, which is defined as the delivery of healthcare services remotely using telecommunication technologies. They disclosed that when people recognize a high level of social influence, they are more likely to have a good attitude. Alkhowaiter [42] more recently suggested that social influence significantly impacts attitude in the context of mobile payments. This study proposes a correlation between social influence and attitude, according to theoretical and empirical backgrounds.

Hypothesis 3 (H3). *Social influence has a positive effect on attitude.*

The fourth hypothesis of this study proposes a relationship between facilitating conditions and attitude. The TPB suggests that individuals have the confidence that they can take any action when their abilities are supported [34]. If golfers perceive that their situation, which includes money and time, cannot support the use a robotic golf caddy, they will have an unfavorable attitude towards a robotic golf caddy. This argument has also been supported by empirical studies. To illustrate, AlHadid et al. [43] investigated the role of facilitating conditions in the context of mobile applications, and they demonstrated a positive relationship between facilitating conditions and attitude. Huang [44] additionally employed the extended UTAUT in the context of virtual reality and found that the consumers' positive attitude towards virtual reality is influenced by their perception of high levels of facilitating conditions. The present study postulates the following hypothesis, which is based on this.

Hypothesis 4 (H4). *Facilitating conditions have a positive effect on attitude.*

Fifth, this study proposes a linkage between perceived risk and attitude. The perceived risk theory suggests that the negative outcomes of buying products can impact the decision-making process [23]. Cox [45] also showed the nexus between individuals' risk perceptions associated with a specific product or service and unfavorable attitudes. It implies that if a robotic golf caddy induces anxiety among golfers, they are likely to hold a negative attitude toward these devices. There are also empirical studies supporting this argument. Moryson and Moeser [46] investigated how perceived risks impact attitudes within cloud computing services using the extended UTAUT model, concluding that perceived risks negatively affect attitude. Likewise, Hwang, Kim, and Kim et al. [47] demonstrated the adverse effect of perceived risk on attitudes in the robotic restaurant sector. Building on these insights, the below hypothesis was established.

Hypothesis 5 (H5). *Perceived risk has a negative effect on attitude.*

2.3. Nexus Between Attitude and Behavioral Intentions

This research also explored the causal impact of attitude on behavioral intentions. Oliver [48] describes behavioral intentions as the likelihood that an individual will engage in a particular behavior. Numerous studies have identified intentions to use and word-of-mouth intentions as two major components of behavioral intentions [49–51]. Firstly, intentions to use represent the extent to which an individual plans to engage in a particular behavior in the future [52]. Prior works have examined factors that predict intentions to use, which directly influence consumers' actual engagement with technology-based products [53,54]. Secondly, according to Westbrook [55] (p. 261), word-of-mouth intentions can be defined as "informal communication that is directed at other consumers about the ownership, usage, or characteristics of particular goods and services and/or their sellers". The prevalent understanding is that the impact of word of mouth is more significant compared to that the impact of company-sponsored advertisements, because individuals obtain knowledge from individuals they know, such as relatives and friends [56].

Various theories have consistently reinforced the affiliation between attitude and behavioral intentions. For example, the TPB suggested by Ajzen [34] argued that people have a good attitude towards a behavior before engaging in it. In addition, Han and Ryu [57] theoretically established consumers' repurchase decision-making logic, suggesting that a positive attitude toward a product is essential before consumers decide to make a purchase. Prior works provide substantial evidence for the nexus between attitude and behavioral intentions. For instance, Ha [58] demonstrated that consumers' attitudes toward online shopping impact their behavioral intentions. Likewise, Hwang, Kim, and Lee et al. [31] highlighted this causal nexus in the context of drone-based food delivery services. Bano and Siddiqui [59] also found that consumers are more likely to exhibit strong behavioral intentions when they have favorable attitudes toward smart technologies in the hospitality and tourism industries. Grounded on these insights, the following hypotheses were proposed.

Hypothesis 6 (H6). *Attitude has a positive effect on intentions to use.*

Hypothesis 7 (H7). *Attitude has a positive effect on word-of-mouth intentions.*

2.4. The Moderating Role of Health Consciousness

Lastly, the current study proposes that health consciousness has a moderating effect in the extended UTAUT and attitude relationship. The concept of health consciousness has long been a topic of investigation across various fields, such as foods, sports, technology, and tourism [60–63]. This commonly suggests that health consciousness is a key determinant of healthy behaviors. Health consciousness can be defined as "a measure of an individual's readiness to take health actions" [64] (p. 31). Health consciousness is considered to be an indicator of an individuals' intrinsic motivation to stay healthy [65], so consumers with a high level of health consciousness are more likely to focus attention on their health [66]. These types of consumers also tend to focus more on their quality of life via healthy behaviors [67]. Individuals with a high level of health consciousness are more likely to engage in activities that are directly related to a healthy lifestyle for this reason [60,68].

The importance of health consciousness is no exception in the golf industry. Many golf courses in South Korea are located in mountainous terrain instead of flat areas, so golf courses require golfers to use carts in order to expedite the pace of the game. However, health-conscious golfers pay for using carts, but they do not ride in the carts in the middle of the game and walk on purpose [69]. Walking while playing golf can in particular help golfers improve their health, because they walk more than 7 km during a game [70]. Thus, it can be inferred that golfers with a high level of health consciousness would prefer to walk while playing golf instead of using a cart as opposed to golfers with a low level of health consciousness. Prior research provides empirical evidence of this effect. For

example, Chen [71] examined the significance of health consciousness and showed that high health consciousness makes customers more willing to use functional foods when they have a positive attitude towards them as opposed to customers with a low level of health consciousness. Lee et al. [64] examined how health consciousness moderates consumer perceptions in the restaurant industry, finding that highly health-conscious customers are more inclined to recognize corporate social responsibility in restaurants offering healthful food options compared to those with lower health consciousness. Similarly, Singhal [72] explored its moderating role in consumer behavior towards genetically modified foods, concluding that consumers with high health consciousness showed a stronger link between attitude and purchase behavior than those with lower health consciousness. Drawing from these discussions, the hypotheses below were established.

Hypothesis 8a (H8a). *The relationship between performance expectancy and attitude is moderated by health consciousness.*

Hypothesis 8b (H8b). *The relationship between effort expectancy and attitude is moderated by health consciousness.*

Hypothesis 8c (H8c). *The relationship between social influence and attitude is moderated by health consciousness.*

Hypothesis 8d (H8d). *The relationship between facilitating conditions and attitude is moderated by health consciousness.*

Hypothesis 8e (H8e). *The relationship between perceived risk and attitude is moderated by health consciousness.*

The conceptual model of the current study was formulated based on the aforementioned discussions, which is shown in Figure 1.

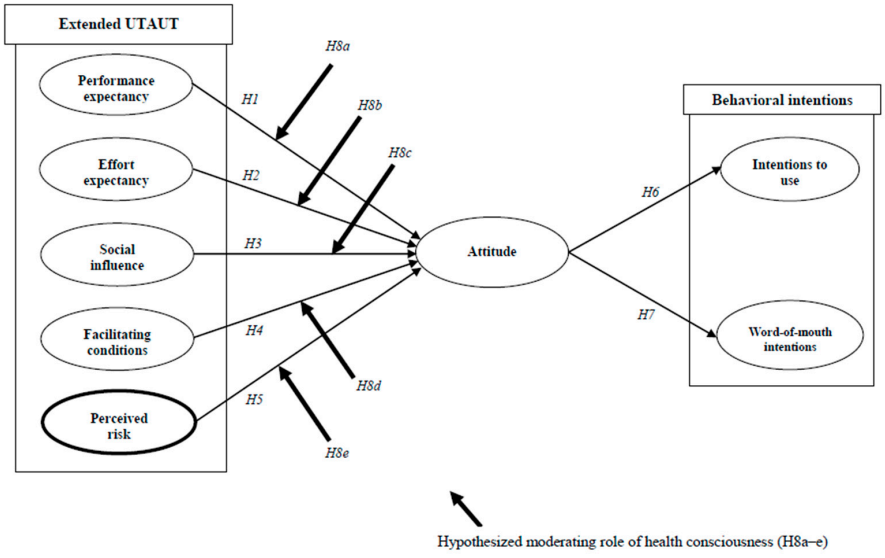


Figure 1. Proposed conceptual model. Notes: 1. H = Hypothesis. 2. The bolded construct is added in the original model of the unified theory of acceptance and use of technology.

3. Methodology

3.1. Study Design, Instruments, and Data Sampling

First of all, this study developed research hypotheses based on the literature review and collected data to test these hypotheses. The measurement items for the survey also were formulated after an in-depth literature review. Fifteen measures borrowed from

Khalilzadeh et al. [21] and Sobti [73] were used to measure the extended UTAUT. Three items to indicate attitude were derived from Ajzen [34] and Choe et al. [74]. Three items used to express intentions to use were taken from Zeithaml et al. [75] and Hwang and Kim [7]. Word-of-mouth intentions were manifested using three items that were cited from Hennig-Thurau et al. [76] and Hwang et al. [50]. Lastly, health consciousness was associated with three items that were adapted from Gould [77] and Hong [78]. A five-point Likert scale ranging from (1) strongly disagree to (5) strongly agree was used to assess the items.

In addition, this study investigated the acceptance intentions of potential users, because robotic caddies have not yet been widely commercialized. A pretest was conducted by administering questionnaires to 50 amateur golfers in South Korea by using an online survey before conducting the main survey. A brief video, which lasted about two minutes, was shown to them prior to the survey in efforts to assist the participants comprehend the concept of a robotic golf caddy better, and it is illustrated in Appendix A. The Cronbach's alpha values of the constructs were all greater than 0.70. This indicates a high level of reliability [79]. A total of 3912 individuals with experience playing golf within the last three months were invited to participate in the survey via email. Out of the 405 respondents who completed the survey, 14 were omitted due to multivariate outliers, and thus 391 respondents were statistically analyzed.

3.2. Data Analysis

First of all, this study conducted a pretest and instruments reliability test, as presented earlier. The data collected through the main survey, following the preliminary survey, were analyzed using the following procedure. To confirm respondents' demographic characteristics, frequency analysis was conducted via SPSS 22.0 software. The current study conducted a two-step statistical procedure using AMOS 22.0 software to analyze the data. Before the hypothesis tests, confirmatory factor analysis (CFA) was conducted to verify the unidimensionality of the constructs. Then, the hypotheses associated with causal links were tested by conducting structural equation modeling (SEM), and the hypotheses associated with moderating roles were tested by conducting multiple-group analysis.

4. Results

4.1. Profile of the Survey Respondents

The characteristics of the survey respondents are presented in Table 1. In summary, 57.3% (n = 224) of the respondents were male, and 42.7% (n = 167) of them were female. The majority of the respondents, which totaled 37.3%, belonged to the 20 s age group (n = 146). More than half of the respondents were bachelor's degree holders (n = 233 and 59.6%). This was followed by respondents with an associate's degree, which totaled 15.1% (n = 59). In terms of monthly income, 29.2% earned less than USD 1000 (n = 114). As for marital status, 218 respondents were single (55.8%).

Table 1. Sample characteristics (n = 391).

Demographics		*n*	Percentage
Gender	Male	224	57.3
	Female	167	42.7
Age	20s	146	37.3
	30s	125	32.0
	40s	81	20.7
	Over 50s	39	10.0
Education level	Less than a high school diploma	43	11.0
	Associate's degree	59	15.1
	Bachelor's degree	233	59.6
	Graduate degree	56	14.3

Table 1. *Cont.*

Demographics		*n*	Percentage
Monthly Household income	USD 5001 and over	14	3.6
	USD 4001–USD 5000	52	13.3
	USD 3001–USD 4000	87	22.3
	USD 2001–USD 3000	64	16.4
	USD 1001–USD 2000	60	15.3
	Under USD 1000	114	29.2
Marital status	Single	218	55.8
	Married	170	43.5
	Widowed/Divorced	3	0.8

4.2. Confirmatory Factor Analysis (CFA)

Table 2 presents the standardized factor loadings for the theoretical constructs. The model fit was deemed acceptable (χ^2 = 596.664, *df* = 224, χ^2/df = 2.664, $p < 0.001$, NFI = 0.939, IFI = 0.961, CFI = 0.961, TLI = 0.952, and RMSEA = 0.065), which was based on the results of the CFA [80], because all factor loadings were above 0.766 and statistically significant at the 0.001 level.

Table 2. Confirmatory factor analysis: items and loadings.

Constructs	Scale Items	λ [a]
Performance expectancy	A robotic golf caddy seems to improve the efficiency of a round of golf.	0.931
	A robotic golf caddy is likely to make a round of golf easier.	0.966
	A robotic golf caddy seems to enhance the convenience of a round of golf.	0.960
Effort expectancy	Using a robotic golf caddy seems to be easy for me.	0.887
	Learning how to use a robotic golf caddy seems to be easy for me.	0.936
	It seems to be simple for me to use a robotic golf caddy.	0.932
Social influence	People who influence my behavior would think that I should use a robotic golf caddy.	0.867
	People who are important to me would think that I should use a robotic golf caddy.	0.901
	I would use a robotic golf caddy during a round of golf because my friends are more likely to use a robotic golf caddy.	0.766
Facilitating conditions	I have a condition to use a robotic golf caddy.	0.863
	My current situation, such as money and time, can support to use a robotic golf caddy.	0.853
	I could have the knowledge necessary to use a robotic golf caddy.	0.872
Perceived risk	Using a robotic golf caddy makes me feel anxiety.	0.881
	Using a robotic golf caddy makes me feel nervous.	0.949
	The usage of a robotic golf caddy would lead me to a psychological loss.	0.911
Attitude	Unfavorable—Favorable	0.880
	Bad—Good	0.908
	Negative—Positive	0.922
Intentions to use	I will use a robotic golf caddy during a round of golf.	0.928
	I am willing to use a robotic golf caddy during a round of golf.	0.871
	I am likely to use a robotic golf caddy during a round of golf.	0.947
Word-of-mouth intentions	I am likely to say positive things about a robotic golf caddy to others.	0.839
	I am likely to recommend a robotic golf caddy to others.	0.967
	I am likely to encourage others to use a robotic golf caddy.	0.918
Goodness-of-fit statistics: χ^2 = 596.664, *df* = 224, $p < 0.001$, NFI = 0.939, IFI = 0.961, CFI = 0.961, TLI = 0.952, and RMSEA = 0.065		

Notes: [a] All factors loadings are significant at $p < 0.001$. NFI = Normed Fit Index, IFI = Incremental Fit Index, CFI = Comparative Fit Index, TLI = Tucker–Lewis Index, and RMSEA = Root Mean Square Error of Approximation.

The AVE values, shown in Table 3, for all constructs were higher than the standard of 0.5, and the R^2 values of the constructs were lower than their respective AVE values, which indicates both convergent and discriminant validity [81,82]. Furthermore, the com-

posite reliabilities for all constructs were greater than 0.7, which demonstrates internal consistency [83].

Table 3. Descriptive statistics and associated measures.

	Mean (SD)	AVE	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Performance expectancy	3.69 (0.79)	0.907	**0.967** [a]	0.211 [b]	0.005	0.070	0.012	0.440	0.381	0.302
(2) Effort expectancy	3.37 (0.93)	0.844	0.045 [c]	**0.942**	0.287	0.433	0.363	0.420	0.453	0.404
(3) Social influence	4.00 (0.65)	0.717	0.001	0.082	**0.883**	0.287	0.092	0.561	0.291	0.346
(4) Facilitating conditions	3.93 (0.64)	0.744	0.005	0.187	0.082	**0.897**	0.208	0.451	0.431	0.448
(5) Perceived risk	1.97 (0.90)	0.836	0.001	0.132	0.008	0.043	**0.938**	−0.039	0.109	0.101
(6) Attitude	3.56 (0.88)	0.816	0.194	0.176	0.315	0.203	0.002	**0.930**	0.749	0.698
(7) Intentions to use	3.39 (0.91)	0.839	0.145	0.205	0.085	0.186	0.012	0.561	**0.940**	0.761
(8) Word-of-mouth intentions	3.42 (0.89)	0.827	0.091	0.163	0.120	0.201	0.010	0.487	0.579	**0.935**

Notes: SD = Standard Deviation; AVE = Average Variance Extracted. [a] Composite reliabilities are along the diagonal. [b] Correlations are above the diagonal. [c] Squared correlations are below the diagonal.

4.3. Structural Equation Modeling (SEM)

The SEM was used in order to evaluate the proposed model, and it was found to have an acceptable fit to the data (χ^2 = 817.331, df = 235, χ^2/df = 3.478, $p < 0.001$, NFI = 0.917, IFI = 0.939, CFI = 0.939, TLI = 0.928, and RMSEA = 0.080) [80]. All seven hypotheses were statistically significant at a p-value of less than 0.05. The results indicated that performance expectancy (β = 0.370 and $p < 0.05$), effort expectancy (β = 0.268 and $p < 0.05$), social influence (β = 0.152 and $p < 0.05$), facilitating conditions (β = 0.288 and $p < 0.05$), and perceived risk (β = −0.183 and $p < 0.05$) have significant effects on attitude, which supports Hypotheses 1, 2, 3, 4, and 5. Moreover, attitude positively affected intentions to use (β = 0.797 and $p < 0.05$) and word-of-mouth intentions (β = 0.748 and $p < 0.05$), which supports Hypotheses 6 and 7. The hypothesis testing results are provided in Table 4.

Table 4. Standardized parameter estimates for the structural model.

	Path			β	t-Value	Hypothesis
H1	Performance expectancy	→	Attitude	0.370	8.669 *	Supported
H2	Effort expectancy	→	Attitude	0.268	4.928 *	Supported
H3	Social influence	→	Attitude	0.152	2.793 *	Supported
H4	Facilitating conditions	→	Attitude	0.288	5.300 *	Supported
H5	Perceived risk	→	Attitude	−0.183	−4.082 *	Supported
H6	Attitude	→	Intentions to use	0.797	18.252 *	Supported
H7	Attitude	→	Word-of-mouth intentions	0.748	16.092 *	Supported
Goodness-of-fit statistics: χ^2 = 817.331, df = 235, $p < 0.001$, NFI = 0.917, IFI = 0.939, CFI = 0.939, TLI = 0.928, and RMSEA = 0.080						

Notes: * $p < 0.05$, NFI = Normed Fit Index, IFI = Incremental Fit Index, CFI = Comparative Fit Index, TLI = Tucker–Lewis Index, and RMSEA = Root Mean Square Error of Approximation.

4.4. Multiple-Group Analysis

The hypothesis associated with the moderating role of health consciousness was tested by conducting a multiple-group analysis (see Table 5 and Figure 2). This study divided the data (n = 391) according to levels of health consciousness, i.e., high/low-health-consciousness groups, using the median value. The chi-square difference between the constrained and unconstrained models was assessed, taking into account the difference in degrees of freedom ($\Delta\chi^2 > 3.84$). Firstly, H8a was statistically supported ($\Delta\chi^2$ = 5.130). More specifically, the β value for the high-health-consciousness group (0.399) was higher than the low-health-consciousness group (0.287). On the other hand, 8b ($\Delta\chi^2$ = 0.002), H8c ($\Delta\chi^2$ = 1.057), H8d ($\Delta\chi^2$ = 0.485), and H8e ($\Delta\chi^2$ = 2.858) were statistically not supported.

Table 5. Moderating role of health consciousness.

Path	Unconstrained Model					Constrained Model	Tests of Moderator	
	Low			High				
	β	*t*-Value		β	*t*-Value	χ^2 (470) = 1210.258	χ^2 Differences	Hypotheses
H8a PE → A	0.287	2.939 *		0.399	5.363 *	χ^2 (471) = 1215.388	$\Delta\chi^2(1) = 5.130$	Supported
H8b EE → A	0.223	2.871 *	0.051	0.281	3.684 *	χ^2 (471) = 1210.260	$\Delta\chi^2(1) = 0.002$	Rejected
H8c SI → A	0.096	1.035 ^{ns}		0.171	2.427 *	χ^2 (471) = 1211.315	$\Delta\chi^2(1) = 1.057$	Rejected
H8d FC → A	0.221	2.790 *		0.359	4.933 *	χ^2 (471) = 1210.743	$\Delta\chi^2(1) = 0.485$	Rejected
H8e PR → A	−0.097	−1.123 ^{ns}		−0.266	−4.252 *	χ^2 (471) = 1213.116	$\Delta\chi^2(1) = 2.858$	Rejected

Notes: PE = performance expectancy, EE = effort expectancy, SI = social influence, FC = facilitating conditions, PR = perceived risk, A = attitude, ^{ns} = not significant, and * $p < 0.05$.

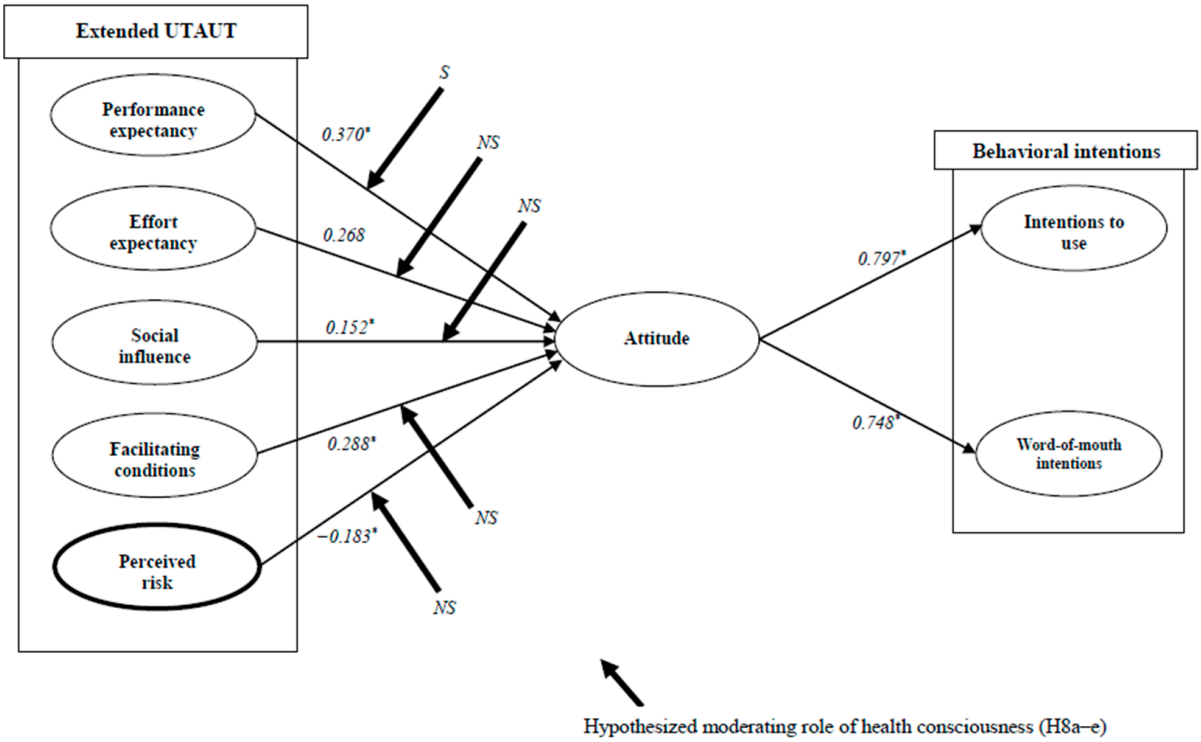


Figure 2. Standardized theoretical path coefficients. Notes: * $p < 0.05$, *S* = supported, *NS* = not supported, and the bolded construct is added in the original model of the unified theory of acceptance and use of technology.

4.5. Discussion of the Results

First of all, performance expectancy was the strongest predictor of attitude. This suggests that golfers place a high value on the efficiency and convenience of robotic caddies, which in turn leads to favorable evaluations of them. This nexus aligns with the role of perceived usefulness in the TAM [11]. More importantly, a significant moderating role of health consciousness was identified in the causal relationship between performance expectancy and attitude. Its path coefficient was higher in the group of golfers with greater health consciousness. It implies that the more golfers are conscious of health management, such as walking with a robotic caddie, the more favorable their attitude becomes toward the robotic caddie.

In addition, facilitating conditions also had a strong impact on attitude. This suggests that individuals are more likely to have a positive attitude toward robotic caddies when their abilities or the environmental conditions are adequate. It is consistent with the role of perceived behavioral control in the TPB [34]. Third, effort expectancy positively influenced attitude. In other words, the simpler and easier to use the robotic caddie appears to be, the

more favorable the attitude of golfers will be. This nexus aligns with the role of perceived ease of use in the TAM [11]. Fourth, social influence was also observed as a significant predictor of attitude. This result suggests that golfers are conscious of others' perceptions when using robotic caddies, aligning with the role of subjective norm in the TPB [34]. On the other hand, perceived risk was identified as an important technological barrier that negatively impacts attitude. It suggests that when the robotic caddie, as a new advanced technology, evokes concerns among golfers, it can hinder attitude formation.

This study consequently extended the UTAUT by adopting these five subdimensions and demonstrating their relationship with attitude. Lastly, attitude also played a crucial role in forming two behavioral intentions (i.e., intentions to use and word of mouth). The more favorable the golfers' attitude toward the robotic caddie, the more likely they are to use it and to spread word of mouth. Through these results, this study successfully demonstrated the sequential framework of the extended UTAUT, attitude, and behavioral intentions, along with the moderating role of health consciousness.

5. Implications

5.1. Theoretical Implications

First, this study applied the extended UTAUT to the field of a robotic golf caddy. The results showed that the five dimensions of the extended UTAUT, which include performance expectancy, effort expectancy, social influence, facilitating conditions, and perceived risk, significantly affect attitude, which confirms Hypotheses 1, 2, 3, 4 and 5. These results coincide with earlier studies that employed this model in the context of technology-based products/services [40,42,44,46,84]. They argued that the five dimensions of the extended UTAUT are crucial predictors of attitude. This study confirmed the high reliability and validity of the extended UTAUT. Furthermore, this study found that the five dimensions of the extended UTAUT significantly affect attitude. This study simulated and broadened the previous literature by being the first study to affirm the impact of the five dimensions of the extended UTAUT on attitude from the perspective of a robotic golf caddy.

An additional key finding of this study is its clear demonstration of the role of attitude within the context of robotic golf caddies. The SEM results showed that a positive attitude enhances both intentions to use and word-of-mouth intentions, supporting H6 and H7. It implies that golfers with a favorable attitude toward robotic golf caddies are more likely to use them on the course and recommend them to others. It also aligns with prior works on technology acceptance behavior [31,58,59], reinforcing that attitude is a predictor of behavioral intentions (i.e., intentions to use and word-of-mouth intentions). Thus, validating the predictive influence of attitude in the context of robotic golf caddies serves as a significant theoretical contribution of this research.

Lastly, health consciousness was found to moderate the relationship between performance expectancy and attitude. It can be interpreted that highly health-conscious golfers have a more positive attitude regarding robotic golf caddies when they perceive that using them improves the efficiency of a round of golf, compared to golfers with low health consciousness. The concept of health consciousness is a significant issue in diverse fields, and prior research consistently argued that people with a high level of health consciousness tend to care more about staying healthy [60,66]. The results of this study resemble prior studies. Golfers with a high level of health consciousness have a favorable attitude towards a robotic golf caddy if the performance aspect of a robotic golf caddy is satisfactory, because walking during golfing has a great effect on health [70]. This study confirmed and expanded the knowledge in this regard by analytically establishing health consciousness as a moderator in the framework of a robotic golf caddy.

5.2. Managerial Implications

The first finding of the study shows that the attitude towards a robotic golf caddy is affected by its performance expectancy, which suggests the need for golf course managers

to emphasize the advantages of using a robotic golf caddy over a human caddy. A golf caddy provides assistance to golfers for three or four golfers during a round of golf in South Korea. In South Korea, golf carts must stay on the cart path, which interferes with the round because the caddy is required to retrieve the golf clubs from the cart and bring them to the fairway. Nonetheless, using a robotic golf caddy increases the speed of the golf game, because one robotic golf caddy is in charge of one golfer. In addition, a robotic golf caddy would be highly convenient while playing golf, because a robotic golf caddy has a GPS chip installed in it in order to provide information on the distance to the pin [6]. Highlighting this kind of superior performance of a robotic golf caddy to potential consumers would result in a favorable attitude of the device.

Second, the current study identified that effort expectancy is an important predictor of attitude towards a robotic golf caddy, and it suggests that it should make it easy for golfers to learn how to use a robotic golf caddy. This study recommends creating a video that is easily understandable for all golfers who use a robotic golf caddy. It would additionally be beneficial to make it mandatory for golfers to watch the video before using a robotic golf caddy. This will ensure that there are no issues when using a robotic golf caddy. In addition, if a system is introduced that can quickly solve problems that may arise while using the robotic golf caddy during golf games, golfers will have no difficulty using a robotic golf caddy.

Third, our study found that attitude towards a robotic golf caddy is positively affected by social influence. This finding also has the following managerial implication. First of all, it is necessary to highlight that a robotic golf caddy represents cutting-edge technology, and people tend show off when they use new technology [85]. A robotic golf caddy also has a GPS tracker that operates in real time, which allows it to promptly locate the golfer should an accident occur while playing golf. Corporations that design and make robotic golf caddies additionally intend to incorporate AI technology into robotic golf caddies in order to provide golfers with swing recommendations and teach them course strategies [86]. This type of advanced technology with robotic golf caddies would make golfers feel that they are the pioneers of the trend.

The fourth finding is that facilitating conditions aid in enhancing attitude towards a robotic golf caddy, which suggests that it is important to ensure that golfers can use a robotic golf caddy without any burden or difficulty. It is mandatory to use a caddy in South Korea when playing golf, and each team of four players is required to pay approximately USD 150 for the caddy fee. Disney's Oak Trail golf courses in the United States, in contrast, only charge golfers USD 10 per person to use a robotic golf caddy. They are therefore more likely to be positive about using a robotic golf caddy by emphasizing that using a robotic golf caddy can greatly reduce the financial burden on golfers.

Fifth, perceived risk was found to have a negative effect on attitude, so it is necessary to stress that a robotic golf caddy is safe to use while playing golf. No incidents or accidents that are related to robotic golf caddies have, in fact, been reported. In addition, a robotic golf caddy is equipped with an aluminum battery, and there is no risk in game operation. There is enough power to finish 36 holes with a single charge [5]. Also, golfers would perceive a robotic golf caddy to have a low level of risk, because it can effectively navigate hilly terrain and rough patches with long grass. If golf course managers emphasize these points to golfers, they are likely to have a positive attitude towards a robotic golf caddy.

Sixth, this study found that health consciousness moderates the relationship between performance expectancy and attitude. The findings indicate the need to divide golfers based on their level of health consciousness. It was previously mentioned that it is widely known that playing golf while walking instead of using a cart can have a significant health effect, because it involves walking approximately 7000 m [70]. One approach that country club managers can take is to carry out surveys in order to determine the level of health consciousness among golfers and group them into subcategories based on their responses. The managers should also then emphasize the health benefits that can be

achieved while using a robotic golf caddy instead of a golf cart for golfers with a high level of health consciousness.

6. Limitations and Future Research

This study does include some limitations. First, all the respondents in this study are from South Korea, so the results of this study may not be generalizable to other geographical regions. It has been suggested that the characteristics of consumers in the East and West differ, particularly in technology-based product/service-related research [87,88], so it would be meaningful to apply the research model that is presented in this study to Western consumers in the future research. Second, this study was conducted based on a robotic golf caddy, so there may be some difficulties in regard to applying the results of this study to other industries. Third, this study did not identify whether the acceptance behavior of robotic caddies is applicable to multi-robot scenarios. Future research could examine this applicability based on theories, such as flocking dynamics for cooperation–antagonism multi-agent networks subject to limited communication resources [89] or Cucker–Smale flocking behavior for multi-agent networks with coopetition interactions and communication delays [90]. Lastly, robotic golf caddies have not yet been commercialized in South Korea, so the sample in this study does not include golfers who have actually used a robotic golf caddy. It would be a meaningful study if data were collected from golfers who actually used a robotic golf caddy in future studies in order to supplement this limitation.

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Appendix A



Figure A1. Screen Shot from Videos. Source from Hello Caddy. Notes: The Korean text in the blue box at the top left of the image means "Obstacle/Danger Zone Warning and Avoidance", emphasizing the robotic caddy's primary function. The Korean text written in white color in the middle right of the image means "Warning and Guidance for Avoiding Dangerous Areas, such as Bunkers and Hazards, in Tracking Mode", describing specific functions of the robotic caddy.

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