IAES International Journal of Robotics and Automation (IJRA)
Vol. 14, No. 2, June 2025, pp. 173~180
ISSN: 2722-2586, DOI: 10.11591/ijra.v14i2.pp173-180

Understanding golfers' acceptance behavior toward robotic golf caddies by merging the task technology fits theory and the perceived risk theory

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Article Info

Article history:

Received Apr 8, 2024
Revised Feb 17, 2025
Accepted Mar 5, 2025

Keywords:

Behavioral intentions
Perceived risk theory
Performance risk
Privacy risk
Robotic golf caddy
Task technology fit theory
Time risk

ABSTRACT

The current paper was designed to understand how to form the acceptance behavior of golfers toward robotic golf caddies, which conducted a hypothetico-deductive approach. The study focused on two questions: i) Can the TTF theory explain the acceptance behavior of golfers toward robotic golf caddies? ii) Do perceived risks negatively affect the acceptance behavior of golfers toward robotic golf caddies? Thus, the study postulated the impacts of task/technology characteristics and the five perceived risks (i.e. financial, time, privacy, performance, and psychological) on task technology fit, and the link between task technology fit and behavioral intentions. The data was collected from 387 golfers in South Korea, and the hypotheses tests were conducted by structural equation modeling. The results of the data analysis indicate that both task and technology characteristics increase task technology fit, and the four dimensions of perceived risks, which include time, privacy, performance, and psychology, have a negative influence on task technology fit. In addition, task technology fit also increases behavioral intentions. The study provides theoretical contributions by filling the acknowledged research gaps, and it also presents managerial implications in regard to commercializing robotic caddies in the golf industry.

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1. INTRODUCTION

Outbound tourism was suppressed due to COVID-19, which caused people to engage more with domestic leisure activities, such as golf in particular compared to the pre-pandemic period [1]. The other tourism, hospitality, and leisure industries faced stagnation, but the number of golf rounds that were played increased by 13.9% in June 2020 [2]. However, the supply of caddy personnel did not keep up with the growth of the golf industry, which resulted in the average caddy fees far exceeding $100 in South Korea, and they are continuing to rise [3]. Efforts were made in order to train new caddies and employ them on-site, which was in response to the shortage of caddy personnel, but it just caused customer dissatisfaction due to their low level of expertise [4].

Robotic golf caddies (RGC) are regarded as an innovative solution for these issues. Their fees are lower than the fees for human caddies, which reduces the burden of golfers in regards to the fees and contributes to popularizing golf [5]. The existing studies focused on the technological aspect, such as the

driving functions and algorithm modeling [5], [6]. However, empirical studies on the usage behavior of golfers are still insufficient. The current study focused on the task-technology fit (TTF) theory and the perceived risk theory (PRT) in order to predict the usage behavior of golfers toward RGC.

The current study addressed the following research questions, which include i) can the TTF theory explain the acceptance behavior of golfers toward RGC? and ii) do perceived risks negatively affect the acceptance behavior of golfers toward RGC? The study presents managerial implications for commercializing robotic caddies in the golf industry.

2. METHOD

This study addresses the acknowledged research problem via a hypothetico-deductive method. It conducted a systematic theoretical review for each construct and formulated hypotheses among the constructs that are grounded on theoretical foundations. The data collecting and quantitative approach were then conducted, and the details of them are delineated in the following sections.

2.1. Literature review

2.2.1. Task technology fit (TTF) theory

TTF is the degree that a specific technology aids individuals in regards to performing their tasks/behaviors [7]. The TTF theory explains that there is a strong likelihood of its adoption when a particular technology aligns with the anticipated performance of a user [7]. The theory suggests the two antecedent factors of the TTF, which are task characteristics (TaC) and technology characteristics (TeC). First, TaC refer to the unique features of a task that can affect an individual's experience and engagement with the task [8]. Goodhue and Thompson [7, p. 216] viewed tasks as "the actions carried out by individuals in regards to turning inputs into outputs". TaC, in other words, refers to the course of actions that an individual should perform in order to link input with the desired outputs. For instance, RGC functions, which include distance-to-pin yardage exacting systems, correspond to their TaC. Second, the concept of TeC is the abilities of a certain technology as tools, which are used by individuals in regards to tasking [7]. It explains the attributes of technologies that customers should use in order to conduct their tasks, which commonly include their usefulness [9]. For example, the performance of RGC, which includes the exactness of the distance measurements, corresponds to their technological characteristics. The TTF theory by Goodhue and Thompson [7] explains that these two characteristics lead to the TTF, which forms usage intentions.

2.2.2. Perceived risk theory (PRT)

Perceived risk refers to "the nature and amount of risk perceived by a consumer in regards to contemplating a particular purchase decision" [10, p. 33]. The PRT describes perceived risk as the subjective evaluation of consumers in regards to potential negative consequences [11]. The PRT by Bauer was developed as a multidimensional concept by Mitchell [12]. The multidimensions of the PRT have been partly adopted and extended in regards to the research background, such as robot services [13]. The current study focuses on the following five dimensions of the PRT in the context of new technology-based services [12, p. 27]. First, financial risk (FinR) is defined as "the risk that the service purchased will not attain the best possible monetary gain for the consumer". Second, time risk (TimR) refers to "the risk that the consumer will waste time, be inconvenienced, or waste effort in regards to getting a service redone" [12, p. 27]. Third, privacy risk (PriR) is the potential threat or harm that individuals might face in regards to the protection and confidentiality of their personal information in various contexts especially in digital environments [14]. Fourth, performance risk (PerR) is defined as "the risk that the service purchased will not be completed in the manner that will result in customer satisfaction" [12, p. 27]. Fifth, psychological risk (PsyR) is "the risk that the selection or performance of the producer will have a negative effect on the consumer's peace of mind or self-perception" [12, p. 27].

2.2. Hypothesis development

The current study proposes eight hypotheses for causal relationships among the adopted factors. According to the person-environment fit theory by Dawis [15], humans have an inherent tendency to seek out environments that align with their needs and characteristics. If individuals desire a specific technological function, they may perceive the technology as being suitable for their task. The users favor a certain technology when they perceive the usefulness of that technology as a tool that is used in tasking, which is in accordance with the theory of technology acceptance behavior by Davis [9]. Individuals can perceive a certain robot as being suitable for them when they believe that the robot can sufficiently perform the functions they desire. The effect of TaC on the TTF and the effect of TeC on the TTF are sufficiently explained by these two theories as well as the TTF theory by Goodhue and Thompson [11].

Hypothesis 1 (H1). TaC positively affect TTF.
Hypothesis 2 (H2). TeC positively affect TTF.

According to the prospect theory by Kahneman and Tversky [16], the negative perceptions of individuals can lead to avoidance behavior. Goodhue [17] also mentioned that if a certain technology becomes more difficult or if individuals worry about its functionality, the TTF can be reduced. It is also related to the concept of technostress. Technostress refers to an individual's state being unable to adapt to the introduction of new technology [18]. People can experience stress due to concerns about encountering unfamiliar aspects when facing the introduction of new technology, and this phenomenon is also evident in modern society during the digital transformation [19]. That is, if consumers are concerned about unexpected negative outcomes of a specific technology, they would perceive that the technology is unsuitable for them.

Hypothesis 3 (H3). FinR negatively affects TTF.
Hypothesis 4 (H4). TimR negatively affects TTF.
Hypothesis 5 (H5). PriR negatively affects TTF.
Hypothesis 6 (H6). PerR negatively affects TTF.
Hypothesis 7 (H7). PsyR negatively affects TTF.

The schema theory by Stalans and Lurigio [20] stated that people have mental structures. The concept of schema is a type of psychological framework in regards to helping people understand how things work, and it is also adopted in the previous literature in regards to examining consumer behavior [21], [22]. This means that consumers develop a specific schema based on the characteristics of a product, and the schema leads to their behavioral intentions. TTF can correspond to a schema fostered by TaC and TeC in the TTF theory context. The following hypothesis is proposed, which is based on the discussions above:

Hypothesis 8 (H8). TTF positively affects behavioral intentions (BI).

2.3. Measurement

Multi-item scales, which were validated in prior research, were used in order to measure the nine constructs in the proposed model. Twelve-item scales from Lin and Huang [23] and Zhou *et al.* [24] were borrowed to measure the TTF, which included TaC, TeC, TTF, and BI. Furthermore, 15 measurement items, which were adapted from Hwang and Choe [25], were used in order to assess perceived risks, which included FinR, TimR, PriR, PerR, and PsyR. A five-point Likert's scale was utilized in order to access all the constructs, which ranged from (1) strongly disagree to (5) strongly agree.

2.4. Data collection and analysis

A pretest was performed by administering questionnaires to 50 amateur golfers in South Korea via an online survey in order to prepare for the main survey. A brief two-minute video about RGC was shown to the respondents before the survey in order to assist with their comprehension of RGC. The reliability of all the constructions was determined by using Cronbach's alpha values, which exceeded .70. This indicates a high level of reliability. The main survey was conducted in a similar manner to the pretest, which included 3,912 participants who had played golf within the previous three months and were contacted by email. A total of 405 respondents completed the survey, but 18 of them were removed due to multivariate outliers, which resulted in 387 respondents being available for further analyses. The collected responses underwent data coding and frequency analysis using SPSS 22.0 in order to understand the characteristics of the respondents. After that, a confirmatory factor analysis (CFA) was first conducted using AMOS 22.0 in order to validate reliability and validity. A structural equation modeling (SEM) analysis was then performed in order to test the hypotheses regarding causality.

3. RESULTS AND DISCUSSION

The results of the research are explained in this section. A comprehensive discussion is also supplied. The results are presented in tables, which make it easier for the reader to understand them.

3.1. Confirmatory factor analysis (CFA)

The standardized factor loadings for the theoretical constructions are displayed in Table 1. The model fit, which includes chi-squared (χ^2), Degree of Freedom (*df*), *p*-value, normed fit index (NFI), incremental fit index (IFI), comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square error of

approximation (RMSEA), was determined to be acceptable after conducting a CFA. All factor loadings were additionally greater than .720, and they were statistically significant at the .001 level.

Table 1. Confirmatory factor analysis: Items and loadings

(Constructs) Scale items	Standardized loading[a]
(TaC 1) I want to know the exact distance to the pin.	.827
(TaC 2) I want to know about golf course strategies during round of golf.	.928
(TaC 3) I want to comfortably carry my golf bag during rounds.	.920
(TeC 1) RGC seems to be equipped with technology for precise distance.	.720
(TeC 2) RGC seems to offer reliable course information.	.912
(TeC 3) RGC seems to ensure secure services.	.895
(FinR 1) There's a chance I could be overcharged if I use RGC.	.868
(FinR 2) Using RGC is probably going to be expensive.	.916
(FinR 3) RGC is likely to be pricier than I expected.	.837
(TimR 1) Learning how to use RGC will take some time.	.896
(TimR 2) Switching to RGC may cause me to lose more time.	.882
(TimR 3) The potential time loss from getting acquainted with it is significant.	.913
(PryR 1) Personal information might be exposed when using RGC.	.923
(PryR 2) RGC may not safeguard my personal information.	.965
(PryR 3) Personal information could be at risk of theft when using RGC.	.893
(PerR 1) RGC doesn't appear to perform well.	.941
(PerR 2) There is a high likelihood of performance issues with RGC.	.974
(PerR 3) Using RGC seems risky given its expected performance level.	.935
(PsyR 1) Using RGC makes me feel anxious.	.838
(PsyR 2) I feel nervous when using RGC.	.891
(PsyR 3) Utilizing RGC would result in psychological discomfort for me.	.895
(TTF 1) RGC appears to play a sufficient role during a round of golf.	.912
(TTF 2) RGC is likely to be generally helpful during a round of golf.	.901
(TTF 3) The role of RGC seems suitable during a round of golf.	.892
(BI 1) I will use RGC during a round of golf.	.933
(BI 2) I am willing to use RGC during a round of golf.	.884
(BI 3) I am likely to use RGC during a round of golf.	.955
Goodness-of-fit statistics: $\chi^2 = 520.917$, $df = 90$, $\chi^2/df = 1.809$, $p < .001$, NFI = .950, IFI = .977, CFI = .977, TLI = .972, and RMSEA = .046.	

Note : a=All factors loadings are significant at $p < .001$.

The descriptive statistics and the related measures are presented in Table 2. The average variance extracted (AVE) values for all constructs exceeded the standard threshold of .50, and the R^2 values for each construct were less than their respective AVE values, which indicates that the proposed concepts had a high level of convergent and discriminant validity. Moreover, the composite reliabilities for all constructions were above .7, which indicates a high level of internal consistency.

Table 2. Descriptive statistics and associated measures

	Mean (SD)	AVE	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	3.56 (.81)	.797	**.922[a]**	.460[b]	-.251	-.300	-.226	-.127	-.304	.407	.462
(2)	3.45 (.87)	.717	.212[c]	**.883**	-.435	-.280	-.283	-.286	-.358	.430	.559
(3)	3.36 (.88)	.764	.063	.189	**.907**	.294	.366	.501	.662	-.408	-.403
(4)	3.21 (1.02)	.805	.090	.078	.086	**.925**	.308	.388	.421	-.427	-.376
(5)	2.87 (1.04)	.860	.051	.080	.134	.095	**.949**	.382	.555	-.407	-.334
(6)	3.40 (1.07)	.903	.016	.082	.251	.151	.146	**.965**	.514	-.421	-.403
(7)	3.39 (.91)	.766	.092	.128	.438	.177	.308	.264	**.907**	-.478	-.545
(8)	3.92 (.88)	.813	.166	.185	.166	.182	.166	.177	.228	**.929**	.675
(9)	3.36 (95)	.855	.213	.312	.162	.141	.112	.162	.297	.456	**.946**

Notes 1: (1) TaC, (2) TeC, (3) FinR, (4) TimR, (5) PriR, (6) PerR, (7) PsyR, (8) TTF, and (9) BI
Notes 2: SD = Standard Deviation
a=composite reliabilities are along the diagonal
b=correlations are above the diagonal
c=squared correlations are below the diagonal

3.3. Structural equation modeling

Structural equation modeling was employed in order to test the proposed hypotheses, which was found to have an acceptable fit to the data. All eight hypotheses were statistically significant at a p-value that was less than .05. The results indicated that TaC and TeC positively affect TTF. Hence, Hypothesis 1 and Hypothesis 2 were supported. However, there is no relationship between FinR and TTF, which was

against our expectations, so Hypothesis 3 was not supported. TimR, PriR, PerR, and PsyR negatively affect the TTF, so Hypothesis 4, Hypothesis 5, Hypothesis 6, and Hypothesis 7 were statistically supported. Lastly, the TTF positively affects BI, so Hypothesis 8 was not supported. A summary of the hypotheses testing results is provided in Table 3.

Table 3. Structural equation modeling

				β	*t*	Hypothesis
H1	TaC	→	TTF	.199	3.896*	Accepted
H2	TeC	→	TTF	.175	3.201*	Accepted
H3	FinR	→	TTF	-.029	-.443	Rejected
H4	TimR	→	TTF	-.159	-3.128*	Accepted
H5	PriR	→	TTF	-.119	-2.252*	Accepted
H6	PerR	→	TTF	-.164	-3.060*	Accepted
H7	PsyR	→	TTF	-.139	-1.900*	Accepted
H8	TTF	→	BI	.696	14.719*	Accepted

Note: $^{*}p < .05$

3.4. Discussions

The results of the SEM indicated that TaC and TeC positively affect TTF, which leads to BI. RGC's TaC/TeC, in other words, make golfers think that it plays a sufficient role during a round of golf, so they are willing to use RGC. The results also revealed that TimR, PriR, PerR, and PsyR are negatively related to TTF, which is also in line with the prospect theory and the concept of technostress. However, the impact of FinR on TTF was not statistically supported. This means that time, privacy, performance, and PsyR can cause people to perceive that RGC do not seem to play a sufficient role during a round of golf, and a FinR is not related to this perception. However, the existing literature discovered that the FinR of a specific emerging new service is related to the attitudes toward it [13]. It can be interpreted that the FinR of new technology-based services is related to how individuals evaluate the technology positively or negatively as opposed to whether they perceive that the technology is suitable for them or not, which is based on the results of the current study and the existing literature. The current paper consequently also implies the role of FinR in the context of new technology-based services.

3.4.1. Theoretical contributions

Firstly, this research focuses on user acceptance behavior in the context of RGC for the first time. There are only studies on the technological aspects of RGC, such as driving functions and algorithm modeling. This study focused on the TTF theory in order to predict the golfers' usage behavior of RGC. This study also postulated and proved the sequential relationship among these four constructs, which is grounded on the theory of technology acceptance behavior, the schema theory, and the person-environment fit theory, in addition to the TTF theory. This study consequently presents a theoretical extension by applying the TTF theory in the context of RGC for the first time.

The present study also pioneeringly investigated the perceived risks of RGC. The PRT was also widely adopted in existing literature in regard to technology acceptance behavior. There are not many studies about the effects of perceived risks on TTF despite the crucial role of perceived risks in the context of new technology-based services. Considering both positive and negative factors is highly meaningful in order to understand the technology acceptance behavior from the perspective of consumers beyond the users. The current study thus adopted the PRT in order to integrate it with the TTF theory. The five dimensions of the PRT, which include FinR, TimR, PriR, PerR, and PsyR, in the context of RGC were more specifically applied based on the literature review. This research consequently identified the effects of perceived risks on TTF for the first time.

3.4.2. Managerial implications

The TaC and TeC of RGC should be promoted in order to enhance the TTF of golfers as well as the TTF of caddies. Golf club managers should specifically inform the consumers of the useful tasks (functions) of robotic caddies via pamphlets or online advertisements. Another vital recommendation is reducing the risks, which include TimR, PriR, PerR, and PsyR. First, customers can be concerned about time-loss due to learning how to use RGC. Managers can inform customers that learning how to use RGC is very simple via short-form videos that last less than 30 seconds. Second, customers may have concerns about privacy due to cameras being equipped on RGC. General motion tracking cameras record specific faces with infrared cameras as opposed to high-definition cameras, and this type of video information is not stored after a round of golf is completed. The customers should be informed of this fact in order to alleviate their worries. Concerns about the robot's performance also can be addressed via influencer marketing, which is suggested above, by showcasing videos

in order to test and verify the robot's performance. Lastly, managers can offer complimentary beverages to the first-time customers of RGC and encourage them to try the mini fridges that are equipped on the robot golf caddies in order to alleviate PsyR.

4. CONCLUSION

This paper employed a hypothetico-deductive approach in order to derive the following empirical findings as the first study that addresses how to form acceptance behavior of golfers toward robotic caddies. This study was designed in order to understand how to form BI by merging the TTF theory and the PRT theory. The data was collected from 387 golfers in South Korea in order to test eight hypotheses in the proposed model. The major results revealed that i) the TaC have the most positive effect on the TTF, ii) the TeC also positively affect the TTF, iii) TimR decreases the TTF, iv) PriR also negatively affects the TTF, v) PerR has the most negative effect on the TTF, vi) PsyR decreases the TTF, and vii) the TTF leads to the behavior intentions of golfers, so H1, H2, H4, H5, H6, and H7 were statistically supported. Only the link between FinR and TTF was not statistically supported, so H3 was rejected. These results present theoretical contributions by filling the acknowledged research gaps, and they also provide practical suggestions in regard to commercializing robotic caddies in the golf industry, which was previously discussed in the theoretical implications and managerial implications sections.

The study does have some limitations despite its originality and contributions. Firstly, the data was solely collected in South Korea, which makes it challenging to extend the results to other areas. Future research should aim to apply the research model that is introduced in this study to other cultures. Secondly, more studies on the FinR of RGC are needed. It was previously discussed that FinR can be related to other factors, such as attitudes and not TTF. It is suggested that an experimental study on price sensitivity in the context of RGC be conducted in order to better understand the monetary barriers. Lastly, RGC have not been commercialized in South Korea yet, so the sample for this study did not include golfers who have prior experience using RGC. It would be valuable to collect data from golfers who have actually used RGC in future research in order to address this limitation.

FUNDING INFORMATION

This research was supported by the Culture, Sports and Tourism R&D Program through the Korea Creative Content Agency (KOCCA) grant funded by the Ministry of Culture, Sports and Tourism (MCST) in 2024 (Project Name: Cultivating masters and doctoral experts to lead digital-tech tourism, Project Number: RS- 2024-00442006, Contribution Rate: 100%).

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY

The author(s) has(have) no permission to share the data.

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