
Do spectators and competitors accept the use of scoring technology in Taekwondo competitions?

Yong Jae Ko*, Kevin Cattani and
Yonghwan Chang

Department of Tourism, Recreation, and Sport Management,
University of Florida,
186 A Florida Gym,
P.O. Box 118208, Gainesville, FL 32611-8208, USA
Fax: (352)-392-7588
E-mail: yongko@hhp.ufl.edu
E-mail: kpcattani@hhp.ufl.edu
E-mail: yhchang@ufl.edu
*Corresponding author

Youngjin Hur

University of Central Missouri,
Morrow Building, Room 132, P.O. Box 800,
Warrensburg, MO 64093 USA
E-mail: youngjinhur@gmail.com

Abstract: The purposes of this study are

- a to examine consumers' perceptions about new technology (electronic scoring system) adapted in the US Open Taekwondo events
- b to identify factors that significantly influence their attitude and purchase decision.

Davis' (1989) and Davis et al.'s (1992) technology acceptance conception were applied. Multiple regression analyses and descriptive statistics were conducted using data from a survey of a convenience sample of spectators, athletes, and coaches participating in the 2010 US Open Taekwondo Championship. Person-to-person interviews were conducted to expand and enrich the quantitative findings. The results suggested that usefulness and enjoyability were found to be important predictors in developing positive attitude and purchase intention among target samples. The findings of the study are limited by the sample being restricted to a particular product in a very specific context in the USA.

Keywords: electronic scoring system; technology acceptance model; TAM; consumer attitude; event quality; Taekwondo.

Reference to this paper should be made as follows: Ko, Y.J., Cattani, K., Chang, Y. and Hur, Y. (2011) 'Do spectators and competitors accept the use of scoring technology in Taekwondo competitions?', *Int. J. Sport Management and Marketing*, Vol. 9, Nos. 3/4, pp.238-253.

Biographical notes: Yong Jae Ko is an Associate Professor in Sport Management Programme at the University of Florida, USA. His research interests include consumer behaviour, service marketing, and brand management.

Kevin Cattani is a Doctoral candidate in Sport Management Programme at the University of Florida, USA. His research interests include consumer behaviour and brand management.

Yonghwan Chang is a graduate student in Sport Management Programme at the University of Florida, USA. His research interests include brand management and endorsement studies.

Youngjin Hur is an Assistant Professor in Sport Management Programme at University of Central Missouri, USA. His research interests include consumer behaviour and information technology.

1 Introduction

Today, the development of technology has grown at an unprecedented rate (Meuter et al., 2005). The growth of technology in the sport industry is no exception. Taekwondo has become a popular cultural and sport product in the global community. Business success of Taekwondo (TKD) organisations in a highly-competitive environment depends on how well they adapt to rapid changes in the marketplace (Ko et al., 2010a; Ko and Yang, 2008). The need for an electronic scoring system has recently emerged as a means for fair judgment within a match and as a possible outlet to improve the quality of overall tournament operations. Fair judgment is one of the most important factors that determine consumer's event quality perceptions in a Taekwondo event (Ko et al., 2010b). International fencing and tennis organisations have also adapted technology to improve their events, through electronic scoring systems and television review processes, for similar reasons.

In response to the call for new technology, the electronic body protector (EBP) and scoring system was developed and recently adapted by the World Taekwondo Federation (Chi, 2005). This step was taken to further develop Taekwondo to be the highest-quality spectator sport available, while continuing to provide the best-possible on-field product and related customer services. This EBP scoring system will be adapted for the Taekwondo event at the 2012 London Olympics and at all subsequent Olympic games (Kim, 2010). It will be the only Olympic sport that requires electronic protective gear and equipment attached to the human body, other than fencing.

Conversely, the addition of an electronic scoring system has its faults, as well. Organisations may face resistance from their customers as a consequence of increasing prices, heightened expectations regarding product quality, and the lack of usefulness of technology products. Currently, few studies have been conducted to examine perceptions about and acceptance of this type of system among key stakeholders such as spectators, competitors, referees, and the media. The lack of systematic data can be a major barrier to Taekwondo organisations and events planners in formulating effective marketing strategies and achieving business goals. Accordingly, the main purposes of this research are twofold:

- a to examine consumers' perceptions about new technology (the electronic scoring system adapted in the US Open Taekwondo events)
- b to identify factors that significantly influence consumer attitudes and purchase decisions.

Specific research questions included: Are there any differences in consumers' perceptions across different groups (age, gender, income, status, and Taekwondo experience)? Which factors of the technology acceptance model (TAM; i.e., ease of use, usefulness, and enjoyability) are important in predicting consumers' attitude toward the product and respective purchase intention?

The results of this study will provide insight into the application of this technology for both managers of the organisations and academicians in the field of sport marketing. Ultimately, this information about consumers can be used for the development of effective marketing strategies.

2 Theoretical background

The nexus of sport and technology is evident in many areas: athletic performance, sport and media, sport equipment and apparel, electronic scoring systems, online gaming, and fantasy sport leagues. Even though many scholars have conducted research on the nexus, few studies have focused on a better understanding of how technology influences sport event quality by using a theoretically grounded model. The current study applies the TAM (Davis, 1989; Davis et al., 1989) to a sport setting (consumers' perception of the EBP in the Taekwondo event).

2.1 Technology acceptance model

The TAM, which was developed by Davis and Davis et al. in 1989, is one of the most influential models in information systems research to understand user acceptance of technology. The TAM is solidly grounded in the theory of reasoned action (TRA; Fishbein and Ajzen, 1975) and includes two primary beliefs (i.e., perceived usefulness and perceived ease of use) to explain users' intentions to use technology. As beliefs within the TRA are linked to attitudes about behaviours, the TAM proposes that perceived usefulness and perceived ease of use influence attitudes toward system use. Whereas under the TRA salient beliefs are explanatory only for a specific context, in the TAM, beliefs (i.e., perceived usefulness and perceived ease of use) can be generalised to user acceptance of technology. Additionally, under the TRA, a belief is considered a single construct which is then multiplied by all beliefs affecting attitude toward behaviour. In contrast, under the TAM, beliefs consist of two distinct constructs (Davis, 1989).

Perceived usefulness refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" [Davis, (1989), p.320]. Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis). Behavioural intention refers to "a person's intentions to perform various behaviours" [Fishbein and Ajzen, (1975), p.12]. The TAM proposes that perceived usefulness and perceived ease of use influence attitudes toward using computer-based technology, which in turn influences intentions to

use the technology. Scholars further supported these causal relations (e.g., Lai and Li, 2005; Lee et al., 2006; Page-Thomas, 2006; Shih, 2004)

Applying the TAM to the current study, the EBP would be perceived as useful and easy to use when it is utilised in Taekwondo events. For example, using an electronic scoring system would be perceived as useful equipment for fair match judgment and the quality of event operations. Similarly, Taekwondo players, referees, and spectators would easily find or judge the results of the match by utilising the EBP.

In addition to these two beliefs, Davis et al. (1992) introduced perceived enjoyment as another predictor of intention to use computers in the workplace. Perceived enjoyment is defined as “the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated” [Davis et al., (1992), p.1113]. Davis et al. (1992) found significant effects of perceived usefulness and perceived enjoyment on intentions. Van der Heijden (2004) focused on the fun-aspect of using information systems, and found that perceived enjoyment and perceived ease of use are more significant predictors of intention to use the systems than perceived usefulness. Scholars have further examined the TAM in various settings: the health-care context (Hu et al., 1999); the use of e-mail (Gefen and Straub, 1997); e-commerce (Pavlou, 2003); the World Wide Web (Lederer et al., 2000; Moon and Kim, 2001); and a cultural study (Straub et al., 1997).

In the sport management literature, however, few studies have applied the TAM to consumers’ perceptions of the use of technology in sport settings. Exploring the antecedents and consequences of winning expectancy in fantasy sports, Kwak et al. (2010) utilised perceived ease of use as an independent variable for winning expectancy, along with perceived football knowledge and enjoyment. They found a significant direct effect from perceived ease of use on winning expectancy and an indirect effect on time/money involvement. More recently, Hur et al. (in press) developed and proposed a sport website acceptance model (SWAM) to better understand the process of adopting a sport website by utilising the TAM as a fundamental framework. The SWAM includes six independent variables to examine sport fans’ intention to use a sport website (i.e., perceived ease of use, perceived usefulness, perceived enjoyment, perceived trustworthiness, sport involvement, and psychological commitment to a team).

3 Methodology

3.1 Measures

The selection of the measures utilised in the study was a three-step process. First, the extant scales of focal constructs were collected from the relevant literature. Second, the scales were assessed by a panel of scholars who have expertise in technology and sport marketing. Several items in the scales were dropped or revised based on the feedback from the panel of scholars. After the expert review, a total of 17 items were retained to measure the nine constructs. Each construct was measured using multiple items and a seven-point Likert-type scale (i.e., 1 – ‘strongly disagree’ to 7 – ‘strongly agree’).

Ease of use (four items) and usefulness (four items) were adapted from Davis’s (1989) study. Ease of use was measured using items including “I would find this product easy to use”, “Learning to operate this product would be easy for me”, and “I would find it easy to get this product to do what I want it to do”. Usefulness was measured by “Using

this product would improve my performance in a Taekwondo tournament”, “Using this product would enhance my effectiveness in a Taekwondo tournament”, and “I would find this product useful in a Taekwondo tournament”. Enjoyment (three items) was measured by such questions as “Using this product gives enjoyment to me”, “It is fun to use this product”, and “It is interesting to use this product” (Davis et al., 1992).

Customer brand attitude (three items) and purchase intention (three items) were measured by Bagozzi et al.’s (2004) multiple semantic-type scales including, “My attitude toward this product is; bad-good; unfavourable-favourable; unsatisfactory-satisfactory”, and “My future intention to purchase this product is; impossible-possible; very unlikely-very likely; improbable-probable”.

To expand and enrich the quantitative findings, the research team conducted a second study in which person-to-person interviews were used. A total of nine respondents participated in the interview process: three athletes, three spectators, and three referees. The researchers asked the following three general questions about electronic scoring systems:

- 1 What do you think are the most important elements of electronic protective gear?
- 2 What do you think are the main advantages and disadvantages of using electronic scoring systems in Taekwondo events?
- 3 Please describe your suggestions for future improvement of overall judging systems in Taekwondo.

Table 1 Factor loadings, Cronbach’s alpha (α), and AVEs

<i>Factor and items</i>	λ	<i>CR</i>	α	<i>AVE</i>
Ease of use (three items)			.829	.819
Learning to operate this product would be easy for me	.683	13.802		
I would find it easy to get this product to do what I want it to do	.844	17.783		
I would find this product easy to use	.800	-		
Usefulness (three items)			.920	.920
Using this product would improve my performance in a Taekwondo tournament	.888	24.237		
Using this product in the Taekwondo tournament would increase my productivity	.909	25.431		
Using this product would enhance my effectiveness in a Taekwondo tournament	.873	-		
Enjoyability (three items)			.875	.875
Using this product gives enjoyment to me	.858	19.972		
It is fun to use this product	.840	19.353		
It is interesting to use this product	.812	-		
Attitude (three items)			.975	.975
Bad/good	.963	47.218		
Unfavourable/favourable	.969	49.131		
Unsatisfactory/satisfactory	.961	-		
Intention (three items)			.983	.982
Impossible/possible	.964	54.891		
Very unlikely/very likely	.982	65.866		
Improbable/probable	.978	-		

Note: CR – critical ratio

3.2 *Sample and data collection*

The questionnaire was administered to athletes, spectators, and officials participating in the US Open Taekwondo Championship between June 29 and July 4, 2010 in Orlando, Florida. Data were collected at multiple areas of the orange county convention centre during the championship (six days). Questionnaires were distributed to an intercept sample of 800 spectators, who were intercepted individually as they entered the event through the two main gates. Members of the research team were also stationed at the booth assigned by the competition staff.

The research assistants told the potential participants that involvement in the study was voluntary and thereafter distributed the informed consent. This form was completed by all participants in compliance with the institutional review board's protocol. After the initial contact, the participants were given a brief explanation of the purpose of the research and instructions about how to properly fill out the survey. On average, it took approximately ten minutes for the participants to complete the questionnaire. No compensation was provided to the survey participants.

A total of 650 completed questionnaires were returned (81% response rate), of which 381 useful cases were included in data analysis. Overall, it is believed that the results contained in this report are reflective of the perceptions and attitudes of those attendees at the event. In terms of research sample characteristics, slightly more spectators were male ($n = 237$; 55%), while 42% were female ($n = 114$). The average age of the visitors was 32.7 years, ranging from 16 to 78 year olds. The largest age segment was over 40 years old (36.3%), followed by those between 16–23 years of age (34%) and between 24 to 39 years of age (29.5%). In terms of ethnicity, 47% of the respondents were self-identified as Caucasian. The largest visible minority group was Asian American (23.4%; $n = 87$), followed by Hispanic (16%; $n = 59$), African-American (8%; $n = 31$), and Native American (1.3%). In terms of status/affiliation, the largest group was spectators (44%; $n = 166$) followed by athletes (35%; $n = 132$), coaches (20%; $n = 76$) and officials (2%; $n = 7$).

3.3 *Data analysis*

Before analysing group differences and predictor variables, descriptive statistics and psychometric properties of the measurement scale were performed. Data were analysed using SPSS 17.0 and AMOS 17.0 (Bentler and Wu, 2002). The goodness-of-fit of the measurement model was tested using a maximum likelihood (ML) estimation method. Goodness of fit of the model to the data was assessed with the comparative fit index (CFI), standardised root mean square residual (SRMR), root mean square error of approximation (RMSEA), and χ^2/df . The convergent validity of the measures was assessed by factor loadings, AVE values, and reliability coefficients (Hair et al., 2005). Discriminant validity was established when the estimated correlations between the factors or dimensions were found to not be excessively high (Kline, 1998) and when the squared correlations between any two constructs were found to be less than the AVE for each construct (Fornell and Larcker, 1981).

For descriptive statistics, the researchers used a series of one-way, between-groups multivariate analysis of variance (MANOVA) procedures. Five dependent variables were examined: ease of use, usefulness, enjoyability, attitude, and purchase intention. In terms of gender differences, male respondents ($N = 204$) were compared against female

respondents (N = 109) across the selected research variables. For the age group difference test, the sample was divided into ages 16 to 23 (n = 105), ages 24–39 (n = 94), and ages 40-over (n = 113). In terms of respondent's education, education groups include high school degree (n = 85), college degree (n = 160), and advanced (graduate school and over) degree (n = 63). To examine the role of consumer income, income brackets include low (under \$50,000; n = 90), middle (\$50,000–\$99,999; n = 95), and high (over \$100,000; n = 92). Respondent's tournament involvement level was examined by dividing the groups into low (four tournaments and under; n = 74), middle (five to seven tournaments; n = 99), and high (eight or more tournaments; n = 98). Lastly, in terms of respondent's status, the perceptions of competitors (n = 132), spectators (n = 166), and coaches (n = 76) toward the technological product were examined. Only seven officials (including referees) participated in this survey, so they were not included in the analysis.

Multiple regression analyses were conducted to identify significant predictors of attitude toward the product and purchase intention.

4 Results

4.1 A measurement model test

Overall model fit of the measurement model was found to be good. Fit statistics showed that the chi-square/df ratio ($\chi^2 = 234.908$, $df = 80$, $\chi^2/df = 2.93$, $p < 0.01$) was below the suggested threshold of 3.0 (Kline, 1998). The chi-square was significant due to the RMSEA value of .071 was below the recommended threshold of 0.08 (Hu and Bentler, 1999). The incremental fit index (IFI) of .98 and the CFI of .98 were greater than the recommended threshold of .95 (Hu and Bentler, 1999).

4.2 Reliability and validity

Reliability was assessed using Cronbach's alpha and AVE values for each factor (see Table 1). The reliability coefficients ranged from .83_{Ease of use} to .98_{Purchase intention}. The AVE measures ranged from 0.819 (ease of use) to 0.982 (purchase intention); all were greater than the recommended standard of 0.50 (Hair et al., 2005). These results indicated that the items were highly reliable in measuring the constructs.

Convergent validity is established when each item has a significant factor loading on each construct (Anderson and Gerbing, 1988). As shown in Table 1, except for one item (.68; ease of use), all factor loadings were greater than the conservative threshold of 0.70 (Hair et al., 2005). In addition, the significant relationships between the three factors in the TAM provide further support for the convergent validity of the scale (Anderson and Gerbing, 1988). With regard to *discriminant validity*, results of a CFA revealed high factor correlations among the sub-dimensions. As shown in Table 2, these were .82 between 'ease of use' and 'enjoyability' and .88 between 'usefulness' and 'enjoyability'. Furthermore, these high factor correlations were greater than the shared variance between any two factors, thus evidencing strong discriminant validity.

Table 2 Mean, standard deviation, and squared intercorrelations for product characteristics predictor variables and consumer attitude and intention

Component	M	SD	Inter-factor correlations				
			EOU	USE	ENJ	ATT	INT
Ease of use	4.30	1.85	.819 ^a				
Usefulness	4.16	1.71	.709**	.920 ^a			
Enjoyability	4.05	1.60	.821**	.876**	.875 ^a		
Attitude	4.31	1.85	.514**	.555**	.638**	.975 ^a	
Intention	4.19	1.91	.410**	.434**	.476**	.663**	.982 ^a

Notes: EOU – ease of use, USE – usefulness, ENJ – enjoyability, ATT – attitude, INT – intention; ^aaverage variance extracted; ** $p < .01$

4.3 Result of regression analyses

With regard to the results of multiple regression analyses, Table 3 indicates that usefulness and enjoyability were found to be significantly related to consumer attitude toward the product. The total variance explained by the model was 57.9%, $F(3, 377) = 173.046$, $p < .001$. In particular, enjoyability ($\beta = .389$) was found to be the most significant factor for attitude followed by usefulness ($\beta = .327$). Ease of use was not a significant predictor of attitude.

Table 3 Regression analysis summary for product characteristics variables predicting consumer attitude

Variables	b	β	t	p
(Constant)	.540		2.820	.005
Ease of use	.166	.084	1.449	.148
Usefulness	.354	.327***	4.707	.000
Enjoyability	.449	.389***	5.430	.000
$R^2 = .579$				
$F = 173.046***$				

Notes: *** $p < .001$, ** $p < .01$, * $p < .05$

Table 4 Regression analysis summary for product characteristics variables predicting consumer purchase intention

Variables	b	β	t	p
(Constant)	.739		3.254	.001
Ease of use	.139	.107	1.602	.110
Usefulness	.377	.336***	4.224	.000
Enjoyability	.312	.262**	3.188	.002
$R^2 = .446$				
$F = 101.126***$				

Notes: *** $p < .001$, ** $p < .01$, * $p < .05$

Table 4 shows the results of regression analyses regarding the variables of product characteristics and future purchase intention. Two of the three independent variables contributed significantly to the prediction of purchase intention. This result, explained by the model as a whole, was 44.6%, $F(3,377) = 101.216$, $p < .001$. Usefulness ($\beta = .336$) was found to be the most significant contributor for purchase intention, followed by enjoyability ($\beta = .262$).

4.4 Descriptive statistics

- *Ease of use*: overall mean score was 4.3 (On a seven-point Likert-type scale). 47.3% of respondents agreed with the statement that the LaJUST brand was easy to use (5, 6, and 7 in Likert scale). 25.6% chose neutral (4) and 27.2% did not agree with the statement (1, 2, and 3).
- *Usefulness*: the overall mean score for usefulness was 4.16 (on a seven-point Likert-type scale). A majority of respondents positively perceived the products to be useful in Taekwondo events. 45% of respondents reported that the LaJUST brand is a useful product for their Taekwondo performance in a tournament. 23.3% chose neutral and 31.6% did not agree with the statement.
- *Enjoyment*: overall mean score was 4.1 (on a seven-point Likert-type scale). More than one-third of the respondents enjoyed using the products. 35.5% of respondents reported that the LaJUST product is enjoyable. 29.4% chose neutral and 35.1% did not agree with the statement.
- *Attitude*: participants showed a medium level of brand attitude ($M = 4.3$ on a seven-point Likert-type scale) toward LaJUST products. Specifically, 43.5% of respondents reported that they have a positive attitude toward the LaJUST brand. 26.8% chose neutral and 29.7% did not agree with the statement. It is positive that participants already developed positive attitudes about the product. Typically, when customers develop positive attitudes toward a promoted brand, they are likely to show purchase intention.
- *Purchase Intention*: Similarly, participants showed a medium level of purchase intention of LaJUST products in the future ($M = 4.2$ on a seven-point Likert-type scale). 40.3% of respondents showed intention to purchase the LaJUST brand in future. 24.9% chose neutral (4) and 34.8% did not agree with the statement.

4.5 Group difference tests

The researchers used a series of one-way between-groups MANOVA procedures to compare the variance (variability in scores of research variables) between the different groups. Table 5 summarises specific results of the analysis. In general, there was no statistically significant difference in consumer perception, attitude, and purchase intention among selected independent variables.

Table 5 A comparison of perceptions, attitude and intention: mean (standard deviation), *F*-statistics, *p*-value

<i>Factor</i>		<i>Male</i> (<i>n</i> = 204)	<i>Female</i> (<i>n</i> = 109)	<i>F</i>	<i>p</i>	
Gender	Ease of use	4.28 (1.44)	4.32 (1.53)	.076	.783	
	Usefulness	4.19 (1.73)	4.11 (1.68)	.184	.668	
	Enjoyability	4.08 (1.61)	4.00 (1.59)	.222	.638	
	Attitude	4.24 (1.79)	4.38 (1.94)	.493	.483	
	Purchase intention	4.10 (1.85)	4.29 (2.00)	.908	.341	
Wilks' Lambda = .988, <i>F</i> = .927 (5,375), <i>p</i> = .463						
<i>Factor</i>		<i>16–23 years</i> (<i>n</i> = 130)	<i>24–39 years</i> (<i>n</i> = 112)	<i>40 years <</i> (<i>n</i> = 138)		
Age	Ease of use	4.48 (1.50)	4.30 (1.34)	4.11 (1.54)	2.064	.128
	Usefulness	4.38 (1.67)	4.24 (1.64)	3.88 (1.77)	3.128	.045
	Enjoyability	4.30 (1.51)	4.14 (1.62)	3.74 (1.63)	4.473	.012
	Attitude	4.51 (1.74)	4.42 (1.86)	3.95 (1.90)	3.549	.030
	Purchase intention	4.34 (1.77)	4.21 (2.01)	3.96 (1.94)	1.374	.254
Wilks' Lambda = .970, <i>F</i> = 1.159 (10,746), <i>p</i> = .316						
<i>Factor</i>		<i>Competitor</i> (<i>n</i> = 132)	<i>Coach</i> (<i>n</i> = 76)	<i>Spectator</i> (<i>n</i> = 166)		
Status	Ease of use	4.33 (1.37)	4.25 (1.52)	4.35 (1.52)	.125	.883
	Usefulness	4.21 (1.59)	4.31 (1.84)	4.14 (1.71)	.264	.768
	Enjoyability	4.12 (1.44)	4.03 (1.81)	4.07 (1.62)	.080	.923
	Attitude	4.44 (1.55)	4.05 (1.97)	4.37 (1.96)	1.148	.319
	Purchase intention	4.19 (1.60)	4.94 (2.07)	4.35 (2.02)	1.202	.302
Wilks' Lambda = .965, <i>F</i> = 1.315 (10,734), <i>p</i> = .218						
<i>Factor</i>		<i>< US \$50,000</i> (<i>n</i> = 119)	<i>US \$50,000–99,999</i> (<i>n</i> = 115)	<i>US \$100,000 <</i> (<i>n</i> = 106)		
Income	Ease of use	4.37 (1.50)	4.17 (1.64)	4.27 (1.42)	.554	.575
	Usefulness	4.36 (1.65)	3.99 (1.73)	4.09 (1.78)	1.489	.227
	Enjoyability	4.16 (1.58)	3.90 (1.67)	4.01 (1.64)	.790	.455
	Attitude	4.36 (1.76)	4.26 (1.94)	4.22 (1.87)	.175	.840
	Purchase intention	4.14 (1.90)	4.21 (1.99)	4.21 (1.86)	.058	.944
Wilks' Lambda = .977, <i>F</i> = .772 (10, 664), <i>p</i> = .656						
<i>Factor</i>		<i>< 3 years</i> (<i>n</i> = 102)	<i>4–7 years</i> (<i>n</i> = 112)	<i>8 years <</i> (<i>n</i> = 139)		
TKD experience	Ease of use	4.53 (1.41)	4.09 (1.34)	4.17 (1.58)	2.850	.059
	Usefulness	4.26 (1.59)	3.89 (1.67)	4.12 (1.80)	1.314	.270
	Enjoyability	4.21 (1.56)	3.75 (1.52)	4.03 (1.45)	2.347	.097
	Attitude	4.51 (1.90)	4.05(1.84)	4.14 (1.84)	1.858	.158
	Purchase intention	4.47 (1.91)	4.00 (1.80)	4.01 (1.95)	2.199	.112
Wilks' Lambda = .963, <i>F</i> = 1.331 (10,692), <i>p</i> = .210						

Notes: ****p* < .001, ***p* < .01, **p* < .05

4.6 *Summary of interview data*

The following section includes general overviews of the responses to each question, along with selected quotations of note. Question one (1) asked respondents for their thoughts on the most important elements of electronic protective gear. It is clear from these responses that accuracy and protection are of utmost importance. One of the main benefits of the product in question is that it offers all of the conventional protection of non-electronic chest guards along with the acute scoring capabilities of electronic scoring. On a related note, LaJUST should continue stressing this point in their product literature, in an effort to differentiate themselves from the competition. One of the lesser points that continued to emerge was that of calibration. According to some of the respondents, pressure levels are sometimes set too high and fail to register clean strikes. Fine-tuning of the pressure sensors to the specific weight classes should be a priority of the research and development team.

“Well, definitely the accuracy of it, that it is sensitive enough when someone makes contact with it and that it protects the athlete.”

“I think they should definitely cover the basics of protection. The LaJUST chest guards now fit just like a normal chest guard would, but I think they need to be a little more sensitive as to the kicking.”

Question two (2) looked to explore some of the perceived advantages and disadvantages of electronic scoring in martial arts competition. Some of the more commonly listed advantages were the increased fairness provided by the product, consistency of point scoring and removal of complaints from coaches and parents. In each case where a respondent listed advantages (eight out of nine respondents), the word fair, or some derivation of it, was mentioned as the principal advantage of this scoring method. However, the researchers feel that there is more to learn from the disadvantages. Some of them include: dead spots on the vest that do not register points/not having sensors in traditionally (as per World Taekwondo Federation rules) scored areas, consistency of scoring, depletion of the human referee pool and if a strike hits and the sensor does not register it, can the judges overrule the point? The disadvantages are fixable through more consistent marketing messages and additional technological development. Being able to anticipate problems before they arise will go a long way towards improving electronic scoring in the future.

“The advantages include more accurate scoring, each competitor is judged equally and its pretty fair...they’re on the same basis. Disadvantages...does it work all the time?”

“I think the advantages...it seems a little bit more fair...you know, if the shot hits, it scores, its not a judges decision. I do think that the judges should be allowed to overrule the computer. If all three judges see a kick and it didn’t score on the computer, I think they should be able to [score it].”

“You know, of course I’ve been a referee for over 20 years, but it doesn’t lend itself to increasing the number of referees and judges, but that is a part of the deal. That’s just gonna happen, over time.”

Question three (3) inquired as to potential improvements of the overall judging system in Taekwondo competition. Many worthwhile suggestions were made in this section. Issues

that have already been touched on, such as referee training, the inclusion of scoring opportunities on the back of the body and product reliability were all mentioned here. A new point brought up by one of the referees was quite insightful, as well. The referee hinted at the fact that these new electronic scoring systems need to work in conjunction with the human referees and not against them. Product/user harmony must be a priority for LaJUST in an effort to make the scoring task more streamlined so that the judges can concentrate on the match.

“I would say to make the scoring capabilities wider and more punching capabilities. Also, the price is too high and they shouldn’t keep changing the pads and everything.”

“I say keep the judges. There is no perception like the human eye. A computer can’t take over that. I definitely think the technology is moving us forward, I just think we need to make some adjustments to it.”

5 Discussion

5.1 Research implications

This study examined consumers’ perceptions about new technology (electronic scoring system) adapted in the US Open Taekwondo events and identified factors that significantly influenced consumer attitudes and purchase decisions by using the TAM. In this research, both survey and interview data were collected to understand the consumer’s acceptance of emerging technology, particularly focused on electronic impact detection and scoring systems adapted in a Taekwondo event.

The consumers’ overall perceptions and attitude toward the new electronic scoring system were positive, which reflects a cue towards the long-term support from participants at future Taekwondo events (e.g., Olympics). In particular, the consumers of LaJUST products at the US Open Taekwondo Championship event responded positively to the key factors of the TAM, including ease of use, usefulness and enjoyment and positively responded to attitude and purchase intention statements.

The results of multiple regression analyses suggested that usefulness and enjoyment are positively related with customer’s attitude and purchase intention. These results are consistent with Davis et al.’s (1992) and Van der Heijden’s (2004) studies.

Analysis of group differences suggested that there is no statistically significant difference in perceptions, attitude, and purchase intention among different groups based on selected demographic (independent) variables. However, in general, highly experienced participants (four years or more) tended to show lower levels of perceptions about electronic scoring equipment when compared to less experienced participants (less than three years). The equipment is a new technology in Taekwondo tournaments. Experienced participants tend to be more comfortable with the classic scoring system and some of them still insist on keeping the traditional judging system.

The results of the interview data supported the survey data and helped in expanding our understanding of the perceptions and opinions of the consumers. This methodological triangulation provides confidence in the generalisability of our research findings.

5.2 *Managerial implications*

The research findings suggest that LaJUST consumers are highly diverse, affluent and educated. Results from the survey data were very encouraging for LaJUST because current customers hold positive perceptions and attitudes about the LaJUST brand.

Several implications come to mind when examining the results of the data. Firstly, almost half of the respondents (47.3%) agree with a statement that the LaJUST brand is easy to use. This is important because if consumers feel intimidated by the products, they will be hesitant to adopt the products into regular use. Those who had issues with this section were principally judges and referees, who had problems with the scoring controller (ambiguity of colouring and layout) and sensitivity calibration (lighter weight groups were set too high to record scoring hits, etc.). The results of this study suggest a more focused effort on product training as well as a 'helpful hints' type document that will assist the referees and judges with succinct troubleshooting answers. According to the TAM developed by Davis (1989), perceived ease of use is one of the main factors that influence consumers' adoption of a new product. Based on the survey data, it is believed that consumers' resistance to this technology will decrease while acceptance of this new technology will increase, over time.

Second, 45% of respondents reported that the LaJUST brand is a useful product for their Taekwondo performance in a tournament. Most agreed that electronic scoring provides a more consistent platform for scoring and helps to eliminate arguments and judgment questions on the part of the coaches and spectators. As with any technological product, continued monitoring and updating is necessary to achieving the best-possible accuracy of these products. The more uniform and simple you can make it, the more readily useable consumers will view the product to be. Along with ease of use, usefulness is another key factor of technology acceptance. Again, the results indicate that consumers' resistance to this technology will decrease while their acceptance will increase, over time. To improve consumer perceptions of ease of use and usefulness of the product, LaJUST needs to offer clinics and workshops for coaches and other key stakeholders (including athletes), whenever possible.

Third, 35.5% of respondents reported that the LaJUST product is enjoyable. This, in part, had to do with the product demonstration booth and the scoring display made available to those who were sampling the product. As a means to increase product enjoyment, the researchers suggest the creation of a kicking competition (separated into age groups), similar to throwing a baseball at a speed gun at a baseball game. Doing so will enable more individuals to experience the product and will serve to expose older members (parents, grandparents, tournament officials, referees, etc.) of the audience to the thrill of a competition setting. The most forceful kick in each age group could then win some prize (LaJUST branded merchandise, tournament merchandise, money off of future products, etc.). This kind of experiential marketing is a very popular approach in many sport industry segments, such as the auto racing business (e.g., NASCAR).

In terms of consumer's overall attitude toward the product, 43.5% of respondents reported that they have a positive attitude toward the LaJUST brand. Typically, when customers develop positive attitudes toward a promoted brand, they are likely to show purchase intention. Lastly, 40.3% of respondents showed intention to purchase the LaJUST brand in the future. This could be interpreted as a positive sign. This phenomenon suggests that the participants understand the usefulness and essentiality of the electronic equipment.

Based on the favourable responses to a number of the psychographic variables, it is clear that LaJUST is taking the necessary steps to ensure an effective and complete product. In combination with these positive responses, the areas needing improvement suggested in the qualitative data provide a great opportunity for further enrichment. Market research, like the type conducted in this study, is vital to products and service providers to understand where they stand in the market. The results of the multiple group comparisons show that users with varying levels of participation experience use and understand the product very differently. In this study, those participants who have been training in Taekwondo longer were more resistant to adopting the electronic scoring system. Resistance to change is a real and potentially detrimental hurdle that must be cleared by product-producing organisations. As mentioned earlier, product demonstration and education are the best ways to enlighten consumers who are used to older methods. Results from the qualitative data provided the researchers with additional insights on consumer concerns and perceptions for product improvement, system implementation and administrative regulation related to this emerging technology's usage in Taekwondo tournaments. Overall, the findings of this study serve to both enforce commonly held practices in use by today's product producers and provide some ways to improve their production and implementation services.

5.3 Limitations

Several limitations are acknowledged in the present study. First, the instrument was developed primarily for the evaluation of a particular product (electronic scoring system) in a very specific context (a martial arts competition). Although it is likely that the sub-dimensions contained within are reasonably generic, it is true that further studies would be required to ascertain whether the proposed instrument is equally applicable to other similar products and services.

Secondly, the sample used for data analysis was domestic in nature. Additional research should be done on foreign samples where other companies might be more prevalent in the electronic scoring industry. Even though the company under study is recognised as the official electronic scoring system of Taekwondo competition by the international governing body, other countries may not be used to such a system, or may have different product loyalties that could affect evaluation of a specific product.

Thirdly, while great strides were taken to collect qualitative data from respondents in different participation tiers, more interviews could be conducted in an attempt to capture more of the concerns and perceptions of electronic scoring system consumers. While common themes continued to emerge through the interviews, future results could be further strengthened by greater qualitative representation.

5.4 Conclusions and future research directions

This study is one of the first attempts to examine consumer's technology acceptance in a sport context. The findings presented in this paper serve as a fundamental first step to further studies on understanding sport-related technology acceptance. In addition to the matters raised in connection with the implications and limitations of the present study, future studies could consider adding other aspects of technology acceptance such as product quality, value perceptions and brand loyalty.

In summary, despite the acknowledged limitations of the present study, the combination of quantitative and qualitative data collection techniques provide a great framework to assist sports managers to establish and maintain a competitive edge within the sports marketplace by diagnosing organisational strengths and weaknesses, thus providing a solid basis for potential improvement.

Acknowledgements

This research is supported by a research grant from the LaJust Sports.

References

- Anderson, J.C. and Gerbing, D.W. (1988) 'Structural equation modelling in practice: a review and recommended two-step approach', *Psychological Bulletin*, Vol. 103, No. 3, pp.411–423.
- Bagozzi, R.P., Baumgartner, H. and Yi, Y. (2004) 'State versus action orientation and the theory of reasoned action: an application to coupon usage', *The Journal of Consumer Research*, Vol. 21 No. 5, pp.351–373.
- Bentler, P.M. and Wu, E.J. (2002) *EQS 6 for Windows: User's Guide, Multivariate Software*, Encino, CA.
- Chi, E.H. (2005) 'Introducing wearable force sensors in martial arts', *Pervasive Computing*, available at http://guzdial.cc.gatech.edu/hci-seminar/uploads/1/WearableForceSensors_MartialArts_PervasiveComp05.pdf (accessed on 5 April 2011).
- Davis, F.D. (1989) 'Perceived usefulness, perceived ease of use, and user acceptance of information technology', *MIS Quarterly*, Vol. 13, No. 3, pp.319–340.
- Davis, F.D., Bagozzi, R. and Warshaw, P.R. (1992) 'Extrinsic and intrinsic motivation to use computers in the workplace', *Journal of Applied Social Psychology*, Vol. 22, No. 14, pp.1111–1132.
- Davis, F.D., Bagozzi, R.P. and Warshaw, P.R. (1989) 'User acceptance of computer technology: a comparison of two theoretical models', *Management Science*, Vol. 35 No. 8, pp.982–1003.
- Fishbein, M. and Ajzen, I. (1975) *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*, Addison-Wesley, MA.
- Fornell, C. and Larcker, D. (1981) 'Evaluating structural equation models with unobservable variables and measurement error', *Journal of Marketing Research*, Vol. 18, No. 1, pp.39–50.
- Gefen, D. and Straub, D.W. (1997) 'Gender differences in the perception and use of e-mail: an extension to the technology acceptance model', *MIS Quarterly*, Vol. 21, No. 4, pp.389–400.
- Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. (Eds.) (2005) *Multivariate Data Analysis*, Upper Saddle River, NJ.
- Hu, L.T. and Bentler, P.M. (1999) 'Cut off criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives', *Structural Equation Modeling: A Multidisciplinary Journal*, Vol. 6, pp.1–55.
- Hu, P.J., Chau, P.Y.K., Sheng, O.R.L. and Tam, K.Y. (1999) 'Examining the technology acceptance model using physician acceptance of telemedicine technology', *Journal of Management Information Systems*, Vol. 16, No. 2, pp.91–112.
- Hur, Y., Ko, Y.J. and Claussen, C.L. (in press) 'Acceptance of sport websites: a conceptual model', *International Journal of Sports Marketing and Sponsorship*.

- Kim, J. (2010, June 3) 'Electronic Hogu, 'OK' for London Olympic Games', *MOOKAS*, available at http://www.mookas.us/media_view.asp?news_no=1655 (accessed on 5 April 2011).
- Kline, R.B. (1998) *Principles and Practice of Structural Equation Modelling*, Guilford, New York.
- Ko, Y.J. and Yang, J.B. (2008) 'Globalization of martial arts: the change of rules for new markets', *Journal of Asian Martial Arts*, Vol. 17, No. 4, pp.8–19.
- Ko, Y.J., Kim, M.K., Kim, Y.K., Lee, J. and Cattani, K. (2010a) 'Consumer satisfaction and event quality perception: a case of US Open Taekwondo Championship', *Event Management: An International Journal*, Vol. 14, No. 3, pp.205–214.
- Ko, Y.J., Kim, Y.K., Kim, M.K. and Lee, J. (2010b) 'The role of involvement and identification on quality perception and satisfaction', *Asia Pacific Journal of Marketing and Logistics*, Vol. 22, No. 1, pp.25–39.
- Kwak, D.H., Lim, C.H., Lee, W.Y. and Mahan, J., III (2010) 'How confident are you to win your fantasy league: exploring the antecedents and consequences of winning expectancy', *Journal of Sport Management*, Vol. 24, No. 4, pp.416–433.
- Lai, V.S. and Li, H. (2005) 'Technology acceptance model for internet banking: an invariance analysis', *Information & Management*, Vol. 42, No. 2, pp.373–386.
- Lederer, A.L., Maupin, D.J., Sena, M.P. and Zhuang, Y. (2000) 'The technology acceptance model and the World Wide Web', *Decision Support Systems*, Vol. 29, No. 3, pp.269–282.
- Lee, H., Fiore, A.M. and Kim, J. (2006) 'The role of the technology acceptance model in explaining effects of image interactive technology on consumer responses', *International Journal of Retail & Distribution Management*, Vol. 34, No. 8, pp.621–644.
- Meuter, M.L., Bitner, M.J., Ostrom, A.L. and Brown, S.W. (2005) 'Choosing among alternative service delivery modes: an investigation of customer trial of self-service technologies', *Journal of Marketing*, Vol. 69, No. 2, pp.61–83.
- Moon, J.W. and Kim, Y.G. (2001) 'Extending the TAM for a World-Wide-Web context', *Information & Management*, Vol. 38, No. 4, pp.217–230.
- Page-Thomas, K. (2006) 'Measuring task-specific perceptions of the world wide web', *Behavior & Information Technology*, Vol. 25, No. 6, pp.469–477.
- Pavlou, P.A. (2003) 'Consumer acceptance of electronic commerce: integrating trust and risk with the technology acceptance model', *International Journal of Electronic Commerce*, Vol. 7, No. 3, pp.101–134.
- Shih, H. (2004) 'Extended technology acceptance model of internet utilization behavior', *Information & Management*, Vol. 41, No. 6, pp.719–729.
- Straub, D., Keil, M. and Brenner, W. (1997) 'Testing the technology acceptance model across cultures: a three country study', *Information & Management*, Vol. 33, No. 1, pp.1–11.
- Van der Heijden, H. (2004) 'User acceptance of hedonic information systems', *MIS Quarterly*, Vol. 24, No. 4, pp.695–704.