Continued usage of smart wearable devices (SWDs): cross-level analysis of gamification and network externality

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Abstract
With the increasing maturity of mobile networks and big data technology, smart wearable devices (SWDs) are regarded as a new technology trend following smartphones. Especially during the COVID-19 pandemic, the increase in telework and the growing interest in self-health monitoring have greatly promoted the market growth of SWDs. This study aimed to investigate the factors affecting the continued use of SWDs. A cross-level analysis model that integrates technical characteristics, gamification theory, perceived value theory, and network externality was constructed. A hierarchical linear model was employed to evaluate the data and test it against the hypotheses. The empirical results showed that, at the individual level, gamification enhances users’ value perceptions. Users pay more attention to rewards in gamification than to competition. Rewards were also found to effectively promote the users’ value perception and increase the intention to continue using the device. At the group level, the effect of network externality significantly influences the intention to continue using SWDs. Moreover, SWDs are associated with the phenomenon by which consumers conspicuously display and highlight their own characteristics, and this attribute is also a crucial factor enticing consumers to continue using SWDs. Developers should therefore establish clear product positioning and strengthen interactivity as early as possible to build a loyal customer base.

Keywords Smart wearable devices · Gamification · Perceived value · Network externality · Hierarchical linear modelling · Self-health monitoring

JEL Classification M10 · O330

Introduction
Smart wearable devices (SWDs) are considered a new technological trend following closely behind smartphones. The most common SWDs are smart bands, bracelets and smartwatches, all of which enable consumers to monitor and transfer information; these devices also offer functions such as measurement of heart rate and calories burned. Because of the continuous growth in the global market for wearable devices, the research institution Gartner (2021) forecasts that in 2021 end-user spending on wearable devices will total US$81.5 billion worldwide, an 18.1% increase from the value of US$69 billion in 2020. However, a study by Ledger and McCaffrey (2014) reveals that continued use of SWDs after six months drops to 70% and to 55% after one year of use. Other researchers report a roughly 33%–50% discontinuation-of-use rate of wearable devices after six months of use (Chen et al., 2017).

SWDs are electronic devices worn on, or attached to, the bodies of users; they feature data continuity that facilitates an accurate analysis of the user’s condition. These devices are closely related to personal health and must be worn for extended periods to achieve the maximum benefit (Esmailzadeh, 2021; Wu et al., 2016). Studies of SWD typically investigate functional factors, such as reliability and

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Because network externalities restrict common standards and result in the formation of a common group culture (Heinrich, 2014; Zhou et al., 2015), the group-level effect on user intention to continue using SWDs should not be overlooked.

This study is particularly valuable amid the challenging situation created by COVID-19, especially in terms of the increase in self-health management that has emerged because of the pandemic. To date, there is no stratified analysis of the relationship between factors involved in the implementation of gamification. Thus, gamification studies that adopt more rigorous methods to further examine these gamification factors are very desirable. Therefore, the following questions guide our research:

1. Why do some users use SWDs for brief periods only, while others continue using SWDs?
2. What are the factors that lead consumers to continue to use an SWD?

To answer the questions above and to address the need for a stratified analysis, this study focused on relationships at the individual perceptual level and employed technical characteristics, gamification and perceived value to model the intention to continue using SWDs. Additionally, this study incorporated network externalities at the group level to explore the potential effects of group external factors, such as the bandwagon and conspicuous behaviour effects, on consumers. A cross-level analysis model that integrates technical characteristics, gamification theory, perceived value theory, and network externality was constructed. A hierarchical linear model was employed to evaluate the data and test it against the hypotheses. Therefore, this study contributes to the emerging literature regarding SWDs as well as the literature on customer behaviour in several ways. First, this study is among the earliest to provide an integrated theoretical insight into consumers’ continued use of SWDs, incorporating antecedent and intervening factors that are critical to the SWD context from technical, gamification, and perceived-value perspectives. The method of hierarchical linear modelling was employed to analyse the empirical data. Furthermore, this study verifies the importance of gamification theory and clarifies critical factors that are of concern to users. Finally, this study constructs a cross-level analysis model, expanding on the effects that network externalities have on users’ intentions to continue using SWDs.

The paper is organized as follows. The first chapter is the introduction. This is followed by the literature review and hypotheses development. Subsequently, we present our research methods and empirical results. Finally, there is a discussion of the findings, the implications of the work, and a conclusion.
Literature review and hypotheses development

Perceived value and intention to continue using SWDs

Zeithaml (1988) defined perceived value as a consumer’s assessment and comparison of the overall value of the product or service they received. Scholars have generally used both utilitarian and hedonic values as the measurement criteria for perceived value (Anderson et al., 2014; Ozturk et al., 2016). Utilitarian value stems from a consumer’s pursuit of results, emphasises goal orientation and rationality and requires a thorough consideration of the need for a product; the consumer’s relevant behaviour is viewed as work or a task (Hirschman & Holbrook, 1982). Venkatesh et al. (2003) proposed that a user’s performance expectancy affects the intention and behaviour of using technology products. Technological advancements have constantly improved the functionality and scope of the application for SWDs, creating utilitarian experiences for users from various dimensions, such as sports, health and smart living management. Utilitarian value is generated when SWDs help users achieve their workout goals (e.g., to lose weight or continue to exercise) (Babin et al., 1994). When users perceive a high utilitarian value, they tend to engage in repetitive behaviour and continued usage behaviour (Hsiao et al., 2019; Kandampully et al., 2015).

Hedonic value is defined as the experience of pleasure and happiness during a consumption process (Holbrook & Hirschman, 1982). Hedonic value is generated as long as playful and fun emotions are perceived during the process (Nalepa et al., 2019; Naghmeh et al., 2020). The current SWDs are largely designed with gamified elements to make sports and self-health management more fun for users (Burbach et al., 2019). Thus, users can experience hedonic value while using SWDs. When users perceive hedonic value, they tend to spend more time with the device and continue using it (Lin & Lu, 2015; Nan et al., 2020). Kim et al. (2013) proposed that utilitarian value and hedonic value positively influence the continued use of smartphones. Utilitarian value and hedonic value can also influence loyalty (Bilgihan & Bujisic, 2015). Therefore, we proposed the following hypotheses:

H1a. Utilitarian value exerts a positive influence on the intention to continue using SWDs.
H1b. Hedonic value exerts a positive influence on the intention to continue using SWDs.

Effect of gamification on perceived value

Gamification refers to the incorporation of game design elements, such as presentation, user achievements, teamwork and feedback (Alsawaier, 2018; Zichermann & Cunningham, 2011), in a non-game environment (Deterding et al., 2011). Each element can produce distinct effects in different games (Seaborn & Fels, 2015; Xu et al., 2013; Kleiman, 2021). The addition of gamified mechanisms can lead to increased consumer engagement and loyalty (Huotari & Hamari, 2012; Woźniak, 2020). Johnson et al. (2016) indicated that rewards are the most commonly used gamification element in health and welfare settings. In digital game designs, consumer engagement is enhanced through competition (e.g., providing challenges and interaction) (Demetrovics et al., 2011; Liu et al., 2013; Yee, 2006). Kleiman (2021) evaluated the effects of gaming on public servants’ attitudes towards open government data and showed that civil servants’ attitudes towards the release of government data were affected by the game.

Rewards and competition are the two factors most commonly discussed in gamification theory (Hamari et al., 2014; Santhanam et al., 2016). Elias et al. (2013) attempted to improve the self-management of asthma in adolescents by developing a personalized asthma care instant reporting system called InSpire, which includes a portable spirometer, mobile phone and virtual-community gaming. García-Jurado et al. (2019) found that fun is a key factor influencing the intention to continue using a product. Therefore, SWDs and the user scenarios of gamification will influence continued usage intention through users’ perceived value (Cho et al., 2018; Delghani et al., 2018).

Rewards are given in the form of points, badges and levels. Whenever users complete a task or goal during gamification, they are rewarded with points or badges (Miller et al., 2016; Mora et al., 2015). Rewards prompt users to become increasingly immersed in an activity because of the sense of achievement and resulting feedback they get from the reward (Deterding et al., 2011; Nelson et al., 2019). When users engage in a target activity that includes rewards, they find the process more appealing and experience increased hedonic value (Guo & Poole, 2009; Hamari & Koivisto, 2015). Designs incorporating rewards provide incentives relative to the difficulty of the task or goal involved (Hacker & Ahn, 2009). To complete more difficult tasks or goals, users need to use the SWDs more frequently and spend more time on the task (Cafazzo et al., 2012; Chen et al., 2014). Hence, users engage with SWDs more frequently, which increases the probability of achieving the desired goal. As a result, they more strongly believe that SWDs can help them to achieve a specific goal and, in turn, experience the satisfaction generated from utilitarian value (Adapa et al., 2018;
Based on these arguments, we proposed the following hypotheses:

**H2a.** Rewards exert a positive influence on utilitarian value.

**H2b.** Rewards exert a positive influence on hedonic value.

Individuals in a competitive environment are motivated by others, and their abilities are recognized in the process, prompting them to enhance their performance (Chen, 2019; Liu et al., 2013; Thiebes et al., 2014). Gamification generally uses scoreboards and ranking to encourage users to compete with others (Thiebes et al., 2014). When the result exceeds the expectation, users gain satisfaction from the utilitarian value generated by the interaction (Deterding et al., 2011). Group challenges in gamified SWDs prompt friends to compete with one another and work toward a common goal. As participants compete against each other, they perceive the increased interaction and exchange with others, which makes activities more fun and enjoyable, thereby improving the participation rate of the activity (Chen, 2019; Venkatesh et al., 2012). In a competitive environment, individuals are more involved (Lee et al., 2019), more willing to enjoy the activity and tend to feel satisfied from the hedonic value created by the engagement. Therefore, we proposed the following hypotheses:

**H3a.** Competition exerts a positive influence on utilitarian value.

**H3b.** Competition exerts a positive influence on hedonic value.

### Effect of technical characteristics on gamification

SWDs are defined as electronic devices that can be worn on or attached to the bodies of users. These devices feature app functions, core processors, sensors for data collection, and internet connectivity (Kortuem et al., 2009; Privat, 2000). Studies on SWDs have largely been conducted at the technical level. Rhodes (1997) proposed three major criteria defining the technical characteristics of SWDs: portability, autonomy and interactivity. Feiner (1999) pointed out that the coordination of autonomous operations is a key characteristic of smart devices. Specifically, an autonomous product can operate without human involvement, switch itself on and initiate actions, all of which can assist users in making decisions (Rijsdijk & Hultink, 2009). Favourable autonomous functions can also reduce the cognitive load on users and the operational requirements of using such devices (Callaghan et al., 2009; Nelson et al., 2019). The primary objective of SWD users is to continuously measure their physiological parameters, such as daily steps, heart rate, sleep quality, or workout performance (Wieneke et al., 2016). However, SWDs can independently track and record users’ physical data and take the initiative to provide feedback or recommendations. Therefore, users can access the data easily (Asadi et al., 2019; Stiglbauer et al., 2019).

In addition, Nenonen et al. (2007) observed that interactivity can be used in gamification designs for SWDs. For example, a heart rate-based game scores players according to their heart rates as they compete with other players; it also notifies users of irregular heart rates and provides relevant feedback. Three characteristics of interactivity—the direction of communication, duration of communication, and degree of control—are used to describe the interaction with a product. These three elements are also involved in the interaction between SWDs and users (Lyons et al., 2014). Other related studies have investigated topics related to the correctness and reliability of wearable devices, design applications, the Internet of Things, and big data (Byun et al., 2016; Cho et al., 2019; Diaz et al., 2015; Huang et al., 2016; Markovic et al., 2013; Wu et al., 2017). According to the preceding discussion, both the managerial and industrial perspectives indicated that SWDs must be equipped with autonomous operation and user interaction functions (Silverio-Fernández et al., 2018). Therefore, we use autonomy and interactivity as the crucial technical characteristics of SWD in this study.

Games may be expected to change the attitude of players in general, as experiential learning can be more effective than other approaches to reach this objective (Kleiman, 2021). Through the experiential learning cycle, attitudes can be influenced by experiences that result in different behaviours (Kleiman et al., 2020). However, rewards and competition designed for gamification are the most effective in generating specific behaviours (Liu et al., 2013). Autonomy enables an SWD to operate without interference in a goal-oriented and independent manner (Rijsdijk & Hultink, 2009). An autonomous product can operate without human involvement, switch itself on, and take the initiative, all of which can assist users in making decisions (Patel et al., 2017). Autonomous products with more competent autonomous functions can further reduce the cognitive load on users and the operational requirements for using the product (Callaghan et al., 2009). This in turn assists users in continuously measuring their physiological parameters, such as daily steps, heart rate, sleep quality or workout performance, and take the initiative to provide feedback and recommendations as well as encouraging the user with rewards and incentives (e.g., celebratory fireworks, virtual badges). Users can easily access data that encourages them to continue working toward their goals (Patel et al., 2017; Stiglbauer et al., 2019). The autonomy of an SWD can thus promote users’ perceptions.
of reward and competition. Hence, we proposed the following hypotheses:

**H4a.** Autonomy in the SWD exerts a positive influence on rewards.

**H4b.** Autonomy in the SWD exerts a positive influence on competition.

Interactivity refers to the extent to which human-like exchange is achieved through technology, i.e., the interaction between a product and its user (Heeter, 1989). Current SWDs feature push notification functions, which represent a method of interaction between SWDs and users (Lyons et al., 2014; Silverio-Fernández et al., 2018). In general, users and SWDs interact through message notifications, such as reminders to move after maintaining a single position for prolonged periods or reminders to take medication, which are a form of humanized interaction (Cho et al., 2019). Zichermann and Cunningham (2011) reported that interactivity affects users’ attitudes toward perceived fun and playfulness. Positive interactivity is the key factor influencing rewards and competition in gamification (Shadiev et al., 2018). When users complete the workout goal for the day, the SWD provides incentive rewards by sending users a message that they have reached the day’s goal and encouraging them to continue with the hard work. Additionally, the device creates a competitive atmosphere by informing users of the performance of others during the training process (Shadiev et al., 2018). Therefore, SWDs can adopt interactivity designs to engender a gamification experience in users. Thus, we propose the following hypotheses:

**H5a.** Interactivity exerts a positive influence on rewards.

**H5b.** Interactivity exerts a positive influence on competition.

**Effect of network externality on intention to continue using SWDs**

Network externality refers to the increase in the value of a product or service because other users use the same product or service (Katz & Shapiro, 1985; Wu et al., 2017). Since network externalities reinforce common standards and result in the formation of a common group culture (Heinrich, 2014; Zhou et al., 2015), sports-based SWDs are typically featured with social media functions (Chen et al., 2017). The effect of social media on the adoption of SWDs should, therefore, not be neglected.

The bandwagon effect is used to describe the benefit a person enjoys because others are doing the same thing (Rohlf, 2003). Interactive benefits increase as more people use the same technology (Lin & Bhattacherjee, 2008). Individuals comprising the general public imitate the consumption methods of other people, and this effect boosts market demands (Naghmeh et al., 2020; Rohlf, 2003). Most SWDs feature social interaction functions (Venkatesh et al., 2012). As more people use SWDs, an increasing number of social media users can receive benefits. Individuals are likely to engage in imitative behaviour to reduce search costs or uncertainties in decision-making (Gimeno et al., 2005; Wu et al., 2017). Therefore, when people notice that their friends are using SWDs, these individuals are more likely to start using similar products and services (Sun, 2013; Wu et al., 2017). As the number of users increases, more benefits are generated, and the switching cost increases as well. When the cost of switching is high, users tend to continue using their current SWDs (Zhou et al., 2015). Hence, the bandwagon effect enhances the intention to continue using SWDs. We propose the following hypothesis:

**H6.** The bandwagon effect exerts a positive influence on the intention to continue using SWDs.

Consumers use SWDs not only to meet functional needs but also to satisfy the need to flaunt their wealth. The conspicuous display effect refers to consumption behaviour that focuses on spending on products or services for the purpose of demonstrating wealth or income (Bagwell & Bernheim, 1996). The conspicuous display effect regarding product prices influences purchase intentions (Piron, 2000). Conspicuous consumption is common in society (Cleveland et al., 2009), particularly for fashionable products where the consumption is more easily perceived. Consumers may purchase branded accessories to demonstrate their lifestyle (Adapa et al., 2018; Silina & Haddadi, 2015). The demonstration of personal taste, professionalism, or status through these products or accessories prompts other consumers to follow suit and use specific brands (O’cass & McEwen, 2004; Ting et al., 2018). For example, most fans of Apple products probably prefer the Apple Watch, while runners likely opt for Garmin running watches to record their sports data (Apple, 2022; Garmin, 2022). SWDs are often considered a type of wearable accessory, and SWD users may, therefore, exhibit conspicuous consumption behaviour (Silina & Haddadi, 2015). The more consumers care about the opinions of others, the more frequently they are likely to engage in conspicuous behaviour to demonstrate their status (Rucker & Galinsky, 2009; Souiden et al., 2011). Hence, we proposed the following hypothesis:

**H7.** The conspicuous behaviour effect exerts a positive influence on the intention to continue using SWDs.

In this study, we examined the relationships among users’ perceived value, gamification, intention to continue using
SWDs and the technical characteristics of SWDs. Moreover, we investigated the effect of network externality at the group level. The research model is depicted in Fig. 1.

Research design

Data collection and sampling

The goal of this study was to explore the continued usage intention of individuals who use SWDs. Therefore, the research subjects were users of SWDs. We designed an online survey questionnaire for the analysis; both the individual and group factors were considered. Participants in the most popular sports activities as indicated by the Sports Administration of the Ministry of Education, Taiwan (SAME, 2019), including a total of 30 sports categories, such as jogging, walking, ball games, yoga, aerobic dance, fitness, etc., were selected for the survey. Different sports groups exhibit distinct characteristics, and sports groups of the same category are likely to have a similar culture and to share related knowledge (Kozlowski & Klein, 2000). We first contacted the board masters of the sports communities in the most widely visited websites in Taiwan (Dcard and PTT) to ask them to post and distribute the questionnaire to their members. To ensure logical consistency and ease of understanding, the questionnaire was pre-tested with 20 graduate students who had experience in using SWDs. The comments gathered from these people offered a basis from which to revise the construct measures and modify the wording and item sequence. The survey was conducted from March to May 2020, and a 7-point Likert scale was employed to categorize the responses, where 7 denotes strongly agree and 1 denotes strongly disagree. A total of 500 samples was collected. After excluding incomplete questionnaires (such as incomplete answers, abnormal ticks in the answers—all ticked "strongly agree" or "strongly disagree"—and inconsistent responses to the questionnaire), 253 samples that cover 18 types of sports were obtained for analysis.

Definition of variables

The design of the questionnaire and the conceptual definition of variables were based on related literature. Table 1 presents each construct, the definitions of decomposed factors and the literature resources.

Statistical method

Hierarchical Linear Modelling (HLM) is a complex format of ordinary least squares (OLS) regression that is employed to evaluate variance in result variables when the predictor variables are at altering hierarchical levels (Woltman et al., 2012). Before the formulation of HLM, hierarchical data was generally investigated employing fixed-parameter simple linear regression methods. These techniques were not sufficient, nevertheless, for such analyses owing to their negligence of the shared variance. HLM is a regression model that is devised to explain the hierarchical or nested structure of the data. It is also known as multi-level modelling, linear
mixed-effects model or covariance components model. The model simultaneously explores the relations within and between hierarchical levels of grouped data, therefore rendering it more efficient than other existing analyses at accounting for variance among variables at different levels. Users in the same category of sports groups are likely to have similar experiences and may also share common culture and knowledge. We, therefore, considered the individual factors and group factors at the same time. Our study data are nested and embedded within groups and require analysis through HLM, which adopts statistical regression to model parameters that alter at more than one level (Raudenbush & Bryk, 2002). While the model can be seen as linear, in a particular linear regression, it can also expand to nonlinear models. Variables in different levels are evaluated separately. The current study adopted two software packages, SPSS and HLM, to complete the statistical analysis.

### Data analysis and results

#### Data analysis

In this study, 253 valid responses were gathered, 111 of which were accomplished by men (43.9%) and 142 by women (56.1%). The largest age group was 21–30 years old (48.6%), followed by 31–40 years old (36%). Table 2 lists the statistics of the sampling distribution. The reliability of the questionnaire items ranged from 0.60 to 0.93, exceeding the acceptable value of 0.50 (Hair et al., 2019). All composite reliabilities exceeded the threshold value of 0.6 (0.74–0.91). The average variance extracted (AVE; 0.50–0.77) for all constructs exceeded the benchmark of 0.5 recommended by Tabachnick and Fidell (2013). Since the three values for reliability all exceeded the recommended values, the scales for measuring these constructs were deemed to exhibit satisfactory convergence reliability. Table 3 provides relevant details.

#### Hierarchical linear model analysis

The average Rwg of the bandwagon effect (average Rwg = 0.92) and conspicuous effect (average Rwg = 0.96) were all above the decision value of 0.7; the intraclass correlation coefficient (ICC)1 values of the bandwagon effect (ICC1 = 0.06) and conspicuous behaviour effect (ICC1 = 0.08) indicated moderate correlations, and that of an intent to continue (ICC1 = 0.16) revealed a high correlation. The results indicated that the data are suitable for HLM analysis.

At the individual level, the results of the random coefficient model reveal that utilitarian value was positively related to intent to continue ($\beta_1 = 0.39$, $p < 0.001$), and hedonic value was positively related to intent to continue ($\beta_2 = 0.42$, $p < 0.001$). H1a and H1b are thus supported. This result is consistent with previous findings that higher

### Table 1 Operational definitions of variables

| Variables            | Operational definition                                                                 | References                              |
|----------------------|----------------------------------------------------------------------------------------|-----------------------------------------|
| Autonomy             | Users perceive that their SWD can operate in an independent and goal-oriented manner   | Rijsdijk and Hultink (2009)             |
| Interactivity        | The SWD can engage in two-way exchange with users and provide an instant response users can also engage in exchanges with other users | Wu (2005); McMillan and Hwang (2002) |
| Reward               | The reward that users obtain when completing a specific task it can be physical rewards or intrinsic motivation | Csikszentmihalyi (2014); Suh et al. (2018); Kleiman (2021) |
| Competition          | A group of at least two people competing for an advantage or victory                   | Liu et al. (2013); Kleiman (2021)       |
| Utilitarian value    | The value that users perceive from using the function of a product                     | Voss et al. (2003)                      |
| Hedonic value        | The emotional experience that users gain from using a product                         |                                         |
| Bandwagon effect     | A person that uses a product because other consumers are using it                      | Sun (2013)                              |
| Conspicuous effect   | The consumption behavior that involves spending on products or services for the purpose of demonstrating wealth or income | Leibenstein (1950); Vigneron & Johnson (1999) |
| Intention to Continue| The subjective probability of a user continuing to use a wearable device               | Hong et al. (2017)                      |
utilitarian and hedonic values result in a reinforcement of the intention to continue use of the product (Chen, 2008; Chen & Chen, 2010; Ryu et al., 2008). In this study, we discovered that the effect of hedonic value is stronger than that of utilitarian value. This finding mirrors the research results of Krey et al. (2019) but is inconsistent with the results of Hong et al. (2017), who report that the effect of utilitarian value is stronger than that of hedonic value. This discrepancy may be caused by the different study samples used. Compared with studies involving younger sample groups, such as that of our study and of Krey et al. (2019), which recruited Malaysian students, Hong et al. (2017) included 31 to 40-year-old participants in the samples and focused more on whether the functions of SWDs can improve health. This might explain why they observed a higher utilitarian value than a hedonic value.

In support of H2a and H3a, our results revealed that reward is positively related to utilitarian value ($\gamma_{10} = 0.43$, $p < 0.001$), and competition is positively related to utilitarian value ($\gamma_{20} = 0.06$, $p < 0.05$). This result is consistent with the related finding that reward increases utilitarian value for users (Kettunen et al., 2017). Moreover, gamification generally uses scoreboards and ranking to encourage users to compete with others. When the result exceeds the expectation, satisfaction is experienced from the utilitarian value generated (Chen, 2019; Deterding et al., 2011; Thiebes et al., 2014). In support of H2b, our results indicated that reward is positively related to hedonic value ($\gamma_{10} = 0.35$, $p < 0.001$). In addition, the empirical results did not support H3b. Thus, competition was not associated with hedonic value ($\gamma_{20} = 0.05$, $p > 0.05$). Previous studies indicated that competition can increase the opportunity to interact with others and, therefore, competitive activities should be made more fun (Chen, 2019; Venkatesh et al., 2012). In contrast, we found that the competition designs in SWDs cannot effectively evoke the competitiveness of users, which might explain why users cannot perceive the fun in obtaining a higher ranking (Cheng et al., 2009; Hanus & Fox, 2015). Our study indicated that users perceive the utilitarian value and hedonic value of rewards more strongly, echoing previous studies that reward designs are the most effective method of influencing behaviours in sports and health settings (Johnson et al., 2016; Nelson et al., 2019).

In support of H4a and H5a, our results indicated that autonomy is positively related to reward ($\gamma_{10} = 0.30$, $p < 0.05$), and interactivity is positively related to reward ($\gamma_{20} = 0.41$, $p < 0.001$). This finding is consistent with previous study results, which indicate that SWDs autonomously collect all types of user information and provide feedback to encourage users to continue working toward a goal (Hofacker et al., 2016; Patel et al., 2017; Zheng & Motti, 2017). Similarly, the interaction between users and their SWDs (e.g., reminders to move after sitting for prolonged periods or reminders to take medication) or with other users also provides a form of feedback that further influences users’ intention to continue using SWDs (Moroo, 2003; Cho et al., 2019; Liu & Peng, 2013; Patel et al., 2017). In support of H4b, our results revealed that autonomy is positively related to competition ($\gamma_{10} = 0.26$, $p < 0.05$). The results did not support H5b. Thus, interactivity was not associated with competition ($\gamma_{20} = 0.16$, $p > 0.05$), which is consistent with previous research findings that certain apps for SWDs automatically record and upload data to their respective database so that users can engage in exchanges with other users and become more competitive (Kortuem et al., 2009; Privat, 2000). However, our finding is not consistent with previous study assertions that competition can be generated by

| Table 2  | The statistics of the sampling distribution |
|---------|-------------------------------------------|
| **Type** | **Frequency** | **Percentage** | **Type** | **Frequency** | **Percentage** |
| Gender  | Male         | 111          | 43.9     | Monthly income | Under 15000 | 87          | 34.4     |
|         | Female       | 142          | 56.1     |                | 15001 to 5000 | 118         | 46.6     |
| Age     | Under 20     | 28           | 11.1     |                | Over 50001  | 48          | 19.0     |
|         | 21 ~ 30      | 123          | 48.6     | Education      | Under       | 7           | 2.8      |
|         | 31 ~ 40      | 91           | 36.0     |                | High school |             |          |
|         | 41 ~ 55      | 11           | 4.3      |                | College     | 160         | 63.2     |
| Occupation | Student       | 70           | 27.7     |                | Master/Doctoral degree | 86 | 34.0 |
|         | Tech & Manufacturing | 64 | 25.4   |                |             |             |          |
|         | Service & Financial | 53 | 20.9   |                |             |             |          |
|         | Civil servant | 29           | 11.5     |                |             |             |          |
|         | Others       | 37           | 14.6     |                |             |             |          |
| Experience | Under 6 months | 78 | 30.8   |                |             |             |          |
|         | 6 ~ 12 months | 47           | 18.6     |                |             |             |          |
|         | Over 1 year  | 128          | 50.6     |                |             |             |          |
Table 3  Reliability statistics

| Variables                  | Loading | variables                               | Loading |
|----------------------------|---------|-----------------------------------------|---------|
| Autonomy (CR = 0.76 AVE = 0.51) |         | The smartwatch or smart bracelet can record my physiological parameters anytime and anywhere 0.68 | The smartwatch or smart bracelet features measuring functions 0.73 |
|                            |         | The smartwatch or smart bracelet is very convenient to use and requires minimal settings or operation 0.73 |                                                      |
| Interactivity (CR = 0.74 AVE = 0.50) |         | I can access my physiological data immediately on my smartwatch or smart bracelet 0.68 | The smartwatch or smart bracelet is appealing to me 0.72 |
|                            |         | To more accurately measure my physiological parameters, the smartwatch or smart bracelet will ask me to enter my basic information (e.g., height and weight) 0.70 |                                                      |
| Reward (CR = 0.87 AVE = 0.63) |         | I can see my workout records by using the smartwatch or smart bracelet app, and this makes me feel more motivated 0.74 | When my smartwatch or smart bracelet reminds me that I have surpassed my previous performance, this reminder is a form of reward and affirmation for me 0.79 |
|                            |         | Reaching more achievement goals (e.g., continue to exercise for 10 weeks) on the smartwatch or smart bracelet app is what motivates me to commit to exercising 0.86 | The special badge given to me by the smartwatch or smart bracelet is a type of reward for my activity performance 0.78 |
| Competition (CR = 0.90 AVE = 0.75) |         | Numerous users can compete with me through the apps (e.g., Nike run club) installed on the smartwatch or smart bracelet 0.73 | I will use the apps (e.g., Nike run club) installed on the smartwatch or smart bracelet to compare my performance with that of others 0.93 |
|                            |         | The rankings shown on the apps (e.g., Nike run club) installed on the smartwatch or smart bracelet motivate me to work harder 0.93 |                                                      |
| Utilitarian values (CR = 0.77 AVE = 0.53) |         | The smartwatch or smart bracelet can more accurately record my workouts 0.77 | I feel physically healthier after using the smartwatch or smart bracelet 0.60 |
|                            |         | The functions of the smartwatch or smart bracelet are useful 0.79 |                                                      |
| Hedonic values (CR = 0.85 AVE = 0.58) |         | Using the smartwatch or smart bracelet does not make me feel annoyed 0.68 | Using the smartwatch or smart bracelet to assist with my workout makes me feel happier during my workout 0.79 |
|                            |         | Using the smartwatch or smart bracelet to support my workouts makes exercise more fun 0.76 | I like the experience that the smartwatch or smart bracelet provides 0.82 |
| Bandwagon effect (CR = 0.84 AVE = 0.63) |         | I will use the smartwatch or smart bracelet because it’s popular 0.76 | I choose to use the smartwatch or smart bracelet because lots of people around me are already using it 0.73 |
|                            |         | I use the smartwatch or smart bracelet because it’s a technological trend 0.89 |                                                      |
| Conspicuous effect (CR = 0.78 AVE = 0.54) |         | Using a branded smartwatch or smart bracelet helps reflect my social status 0.75 | If I have enough money, I would use higher-end smartwatches or smart bracelets 0.78 |
|                            |         | I want to own a smartwatch or smart bracelet that demonstrates my personal characteristics 0.67 |                                                      |
| Intention to continue (CR = 0.91 AVE = 0.77) |         | I would like to continue using a smartwatch or smart bracelet 0.88 | I will use a smartwatch or smart bracelet more frequently in the future 0.84 |
|                            |         | I am willing to continue using smartwatch or smart bracelet in the future 0.91 |                                                      |

CR composite reliability; AVE average variance extracted
a gamification design in which users are notified of the status of the competition (e.g., current rankings) (Liu & Peng, 2013). We assert that the notification function of SWDs cannot lead to competition among users in a gamification experience. Notification functions serve only as a reminder of a situation and cannot induce feelings regarding a competition. Therefore, interactivity and competition are not correlated. Moreover, we added the bandwagon and conspicuous effects at the group level to investigate the connection between them and continued usage intention. The results of the intercepts-as-outcomes model reveal that the bandwagon effect was not related to intent to continue using ($\gamma_{01} = -0.13, p > 0.05$); thus, H6 is not supported. The conspicuous display effect had a direct effect on continued usage intention ($\gamma_{02} = 0.48, p < 0.05$); thus, H7 is supported. Although SWDs were initially used for sports and health management, previous studies show that wearing these devices for long periods serves as a demonstration of individual style and taste (Adapa et al., 2018), or, more specifically, a mentality to conspicuously display one’s wealth, which is consistent with our study results. Researchers indicated that individuals can imitate other consumers’ behaviour to reduce search costs or uncertainties in decision-making (Naghmeh et al., 2020; Wu et al., 2017). However, according to our results, most users choose to use SWDs for a specific purpose. For example, most joggers use a smart running watch specifically to record the distance and duration of their run, instead of using it simply because everyone else is using it (i.e., the bandwagon effect). The hypothesis test results are summarized in Table 5.

### Table 4 Measurements of discriminant validity

|               | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   |
|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1 Autonomy    | 0.75|     |     |     |     |     |     |     |     |
| 2 Interactivity| 0.67| 0.74|     |     |     |     |     |     |     |
| 3 Reward      | 0.47| 0.48| 0.87|     |     |     |     |     |     |
| 4 Competition | 0.18| 0.18| 0.38| 0.90|     |     |     |     |     |
| 5 Utilitarian values | 0.61| 0.70| 0.61| 0.30| 0.74|     |     |     |     |
| 6 Hedonic values | 0.54| 0.62| 0.48| 0.21| 0.65| 0.84|     |     |     |
| 7 Bandwagon effect | 0.14| 0.13| 0.16| 0.44| 0.21| 0.15| 0.84|     |     |
| 8 Conspicuous effect | 0.09| 0.16| 0.12| 0.30| 0.16| 0.22| 0.60| 0.77|     |
| 9 Intention to continue | 0.59| 0.63| 0.45| 0.16| 0.67| 0.70| 0.20| 0.23| 0.91|

### Conclusion

Using gamification theory as the foundation, we integrated technical characteristics and perceived value theory to verify the intention to continue using SWDs. Our results indicate that gamification designs can increase consumers’ continued use of SWDs and maximize the functionality (e.g., sports and health management) of wearing SWDs for extended periods. The results also reveal that the relationship between technical characteristics, interactivity and rewards in gamification is the most significant factor. However, if a competition gamification element is integrated into the SWD, users cannot effectively perceive the hedonic value generated by this element. At the group level, the conspicuous display effect exerted the most significant effect on the intention to continue using SWDs, which suggests that SWDs have conspicuous display features that highlight individual tastes or characteristics. In contrast to studies that assert that the bandwagon effect exerts an influence on consumers’ continued usage intention (Gao & Bai, 2014; Hsu & Lin, 2016; Zhou et al., 2015), we report that the bandwagon effect is not significant, indicating that consumers’ continued use of SWDs is not affected by others. That is, consumers pay more attention to the individual characteristics of the devices and the image they can convey when using them than to what others are doing.

### Implications and limitations

#### Theoretical implications

Gamification has been employed in a range of fields, such as learning (Alsawaier, 2018), health management (Hamari et al., 2014; Santhanam et al., 2016) and sports management (Kim et al., 2018). Even though gamification is perceived positively by users, its effects on the continuous use of devices have not been examined. In light of the criticism of gamification and a lack of rigorous studies evaluating its effectiveness, this study focuses on a systematic assessment of factors influencing consumers’ continuing use of SWDs and constructs a cross-level model, incorporating antecedent and intervening factors that are critical to the SWD context from technical, gamification, and perceived value perspectives. This study has several implications and makes several contributions.
First, we expand the relationship between gamification and perceived value and ascertain the factors that are crucial to gamification. Our results revealed that users pay more attention to rewards in gamification than to competition. However, Venkatesh et al. (2012) and Chen (2019) indicate that competition can increase the opportunity to interact with others and competitive activities should be made more fun. Numerous studies assert that competition produces positive outcomes, such as specific behaviours and intrinsic incentive effects (Koivisto & Hamari, 2019; Thiebes et al., 2014). By contrast, we find that the competition designs cannot effectively evoke the competitiveness of users, which is probably why users cannot perceive the fun in obtaining a higher ranking. However, in this study, we determined that rewards generate both utilitarian and hedonic values for consumers, which increases the intention to continue using the SWDs. Furthermore, this study reports that gamification in SWDs has a hybrid nature, being neither purely functional software nor a full-fledged game. Gamification can potentially lessen intrinsic motivation because external rewards are known to decrease intrinsic motivation (Deci et al., 2001). Therefore, this study makes a crucial contribution to the expansion of gamification theory.

Second, we verify that the technical characteristics of SWDs are crucial to gamification theory. Previous studies largely focus on how gamification should be applied to increase benefits for users, such as increasing engagement, incentives and positive behaviours (Hamari & Koivisto, 2015; Kim et al., 2018). Few studies investigate either the gamification designs for SWDs or which technical characteristics can be used in gamification theory. Our finding is not consistent with Rughiniş (2013) assertions that competition can be generated by a gamification design in which users are notified of the status of the competition. Notification functions serve only as a reminder of a situation and cannot induce feelings regarding a competition. Therefore, interactivity and competition are not correlated. We elucidated the technical characteristics, namely autonomy and interactivity, that can effectively evoke a gamification experience. Interactivity can drive reward designs, and autonomy simultaneously promotes gamified perception of rewards and competition.

Third, the bandwagon effect of network externalities is found to be insignificant. Previous studies typically discussed the usage of SWDs from the individual behaviour perspective (Dehghani, 2018; Dehghani et al., 2018; Park et al., 2015). This study adopts the HLM analysis to clarify the difference between individual and group factors. Gimeno et al. (2005) assert that individuals can imitate other people to reduce decision uncertainties and increase their continued usage intention. By contrast, our results show that the bandwagon effect does not influence the intention to continue using SWDs, nor does the bandwagon effect across different groups influence the intention to continue using SWDs. Finally, SWDs are characterized by conspicuous behaviours and the need to display one’s wealth or social status. This study shows that the conspicuous display effect exerts the strongest influence on the intention to continue using SWDs. The empirical results also suggest that users view SWDs as a symbol of their wealth or personal characteristics, thus echoing the related finding that wearing devices for an extended period is a demonstration of individual style or taste (Adapa et al., 2018). Users do not wear an SWD simply because other people are wearing it. They focus more on the value perception generated by smart devices and the notion of displaying their unique characteristics.
Therefore, this study’s expansion of the application of the network externality theory to wearable devices is a crucial contribution.

**Practical implications**

Based on the current results, we present the following practical implications: First, the effectiveness of reward elements in gamification can be enhanced to foster customer loyalty. This study verifies that users pay more attention to rewards in gamification than to competition. Rewards generate both utilitarian value and hedonic value for consumers. An increase in consumers’ perceived value enhances their continued usage intention. Developers of SWDs should integrate gamification rewards into their products, which are effective in encouraging users to make exercising a habit or engage in self-health management behaviour. Second, the interactive functions of wearable devices should be enhanced to build a loyal group of online users. SWDs autonomously collect users’ information to help them achieve self-health management goals (Hofacker et al., 2016; Patel et al., 2017; Zheng & Motti, 2017). However, we find that interactive functions are more effective than autonomous functions in terms of incentive effect. The global spread of COVID-19 has forced the suspension of numerous physical activities, helping online communities move into the mainstream. However, it remains a major challenge for community administrators to figure out how to make online communities as active and real as physical communities. We recommend that developers strengthen the interactivity between users and their SWDs by increasing users’ reliance on these products, through informing users of their workout performance or enabling them to interact with other users. Furthermore, online live streaming or other digital media methods can be integrated to forge a stronger parasocial relationship among users, build sustainable community relationships and cultivate self-health management habits in consumers.

Third, the brand characteristics of SWDs should be clearly established and linked to the consumers’ self-image. This study reveals the absence of a bandwagon effect in this context, indicating that consumers value their self-worth more than the need to jump on the bandwagon. SWD developers should therefore create signature brand images that prompt certain consumer needs. Additionally, the developers of wearable devices should establish their product positioning as early as possible and build a loyal base of customers.

**Limitations and future research**

Because of the vigorous development of information and communications technologies, SWDs have numerous technical characteristics. For example, the technical characteristics of SWDs can be measured from the perspective of chronic disease detection and consumer financing technologies. We adopted autonomy and interactivity as the technical characteristics of SWDs, because almost all users employ these technical characteristics. We evaluated the technical characteristics of SWDs by using the device’s technical applications (i.e., notification and recording functions). Future studies may further investigate SWDs from the technical aspects of other applications. Moreover, SWD brands offer distinct functions as part of their product positioning; for instance, some smart bracelets provide EasyCard (a smart card payment tool) functionality and reminders to move after sitting for extended periods. Therefore, future studies should classify SWDs by either the same functions or the same brand.

In this study, we used smart bracelets and smartwatches as samples. Future works may expand the sample scope to include other types of SWDs.

**References**

Adapa, A., Nah, F. F., Hall, R. H., Siau, K., & Smith, S. N. (2018). Factors influencing the adoption of smart wearable devices. *International Journal of Human - Computer Interaction*, 34(5), 399–409. https://doi.org/10.1080/10447318.2017.1357902

Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. *The International Journal of Information and Learning Technology*, 35(1), 56–79. https://doi.org/10.1108/IJILT-02-2017-0009

Anderson, K. C., Knight, D. K., Pookulangara, S., & Josiam, B. (2014). Influence of hedonic and utilitarian motivations on retailer loyalty and purchase intention: A facebook perspective. *Journal of Retailing and Consumer Services*, 21(5), 773–779. https://doi.org/10.1016/j.jretconser.2014.05.007

Apple. (2022). *Apple Watch Series*. Retrieved May 8, 2022, from https://www.apple.com/watch/

Asadi, S., Abdullah, R., Safaei, M., & Shah, N. (2019). An integrated SEM-neural network approach for predicting determinants of adoption of wearable healthcare devices. *Mobile Information Systems*, 2019, 1–9. https://doi.org/10.1155/2019/8026042

Babin, B. J., Darden, W. R., & Griffin, M. (1994). Work and/or fun: measuring hedonic and utilitarian shopping value. *Journal of Consumer research*, 20(4), 644–656. https://doi.org/10.1086/209376

Bagwell, L. S., & Bernheim, B. D. (1996). Veblen effects in a theory of conspicuous consumption. *The American Economic Review*, 86(3), 349–373.

Balog, A., Băjenaru, L., & Cristescu, I. (2019). Analyzing the factors affecting the quality of IoT-based smart wearable devices using the DANP method. *Studies in Informatics and Control*, 28(4), 431–442. https://doi.org/10.24846/v28i4y2019007

Bilgihan, A., & Bujisic, M. (2015). The effect of website features in online relationship marketing: A case of online hotel booking. *Electronic Commerce Research and Applications*, 14(4), 222–232. https://doi.org/10.1016/j.electrap.2014.09.001

Burbach, L., Lidynia, C., Brauner, P., & Ziefle, M. (2019). Data protectors, benefit maximizers, or facts enthusiasts: Identifying user profiles for life-logging technologies. *Computers in Human Behavior*, 99, 9–21. https://doi.org/10.1016/j.chb.2019.05.004

Byun, W., Barry, A., & Lee, J. M. (2016). Accuracy of the Fitbit for measuring prescchoolers’ physical activity: 2768 Board# 291 June
Continued usage of smart wearable devices (SWDs): cross-level analysis of gamification and...
International Conference on Human Factors in Computing Systems, 1207–1216. https://doi.org/10.1145/1518701.1518882

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate data analysis. Cengage.

Hamari, J., & Koivisto, J. (2015). Why do people use gamification services? International Journal of Information Management, 35(4), 419–431. https://doi.org/10.1016/j.ijinfomgt.2015.04.006

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work?-a literature review of empirical studies on gamification. 47th Hawaii international conference on system sciences, 3025–3034. https://doi.org/10.1109/HICSS.2014.377

Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. Computers & Education, 80, 152–161. https://doi.org/10.1016/j.compedu.2018.09.019

Heeter, C. (1989). Implications of new interactive technologies for conceptualizing communication. In J. Savaggio & J. Bryant (Eds.), Media use in the information age: Emerging patterns of adoption and consumer use, 217–235. Routledge.

Heinrich, T. (2014). Standard wars, tied standards, and network externality induced path dependence in the ICT sector. Technological Forecasting and Social Change, 81, 309–320. https://doi.org/10.1016/j.techfore.2013.04.015

Hirschman, E. C., & Holbrook, M. B. (1982). Hedonic consumption: Emerging concepts, methods and propositions. Journal of Marketing, 46(3), 92–101. https://doi.org/10.2307/1251707

Hofacker, C. F., De Ruyter, K., Lurie, N. H., Manchanda, P., & Donaldson, J. (2016). Gamification and mobile marketing effectiveness. Journal of Interactive Marketing, 34, 25–36. https://doi.org/10.1016/j.intmar.2016.03.001

Hong, J. C., Lin, P. H., & Hsieh, P. C. (2017). The effect of consumer innovativeness on perceived value and continuance intention to use smartwatch. Computers in Human Behavior, 67, 264–272. https://doi.org/10.1016/j.chb.2016.11.001

Hsiao, K. L., Lin, K. Y., Wang, Y. T., Lee, C. H., & Zhang, Z. M. (2019). Continued use intention of lifestyle mobile applications: The starbucks app in Taiwan. The Electronic Library, 37(5), 893–913. https://doi.org/10.1108/EL-03-2019-0085

Hsu, C. L., & Lin, J. C. C. (2016). An empirical examination of consumer adoption of Internet of Things services: Network externalities and concern for information privacy perspectives. Computers in Human Behavior, 62, 516–527. https://doi.org/10.1016/j.chb.2016.04.023

Huang, Y., Xu, J., Yu, B., & Shull, P. B. (2016). Validity of FitBit, Jawbone UP, Nike+ and other wearable devices for level and stair walking. Gait & Posture, 48, 36–41. https://doi.org/10.1016/j.gaitpost.2016.04.025

Huotari, K., & Hamari, J. (2012). Defining gamification: a service marketing perspective. Proceeding of the 16th international academic MindTrek conference, 17–22. https://doi.org/10.1145/2393132.2393137

Johnson, D., Deterding, S., Kuhn, K. A., Staneva, A., Stoyanov, S., & Hides, L. (2016). Gamification for health and wellbeing: A systematic review of the literature. Internet Interventions, 6, 89–106. https://doi.org/10.1016/j.invent.2016.10.002

Kandampully, J., Zhang, T. C., & Bilgihan, A. (2015). Customer loyalty: A review and future directions with a special focus on the hospitality industry. International Journal of Contemporary Hospitality Management, 27(3), 379–414. https://doi.org/10.1108/IJCHM-03-2014-0151

Katz, M. L., & Shapiro, C. (1985). Network externalities, competition, and compatibility. The American Economic Review, 75(3), 424–440.

Kettunen, E., Kari, T., Chasandra, M., Critchley, W., & Doğan, U. (2017). Activity trackers influencing motivation and awareness: Study among fitness centre members. University of Maribor Press.

Kim, S., Lee, S., & Han, J. (2018). StretchArms: Promoting stretching exercise with a smartwatch. International Journal of Human-Computer Interaction, 34(3), 218–225. https://doi.org/10.1080/10447318.2017.1342408

Kim, Y. H., Kim, D. J., & Wachter, K. (2013). A study of mobile user engagement (MoEn): Engagement motivations, perceived value, satisfaction, and continued engagement intention. Decision Support Systems, 56, 361–370. https://doi.org/10.1016/j.dss.2013.07.002

Kleiman, F. (2021). Winning Data: Designing and testing a game to change civil servants’ attitudes towards open governmental data provision. [Doctoral thesis, Delft University of Technology]. https://doi.org/10.4233/uuid:01bc5442-00a4-45ca-ae48-1440ef16f833

Kleiman, F., Meijer, S., & Janssen, M. (2020). A systematic literature review on the use of games for attitude change. International Journal of Electronic Government Research, 16(4), 1–20. https://doi.org/10.4018/ijegr.2020100101

Koivisto, J., & Hamari, J. (2019). The rise of motivational information systems: A review of gamification research. International Journal of Information Management, 45, 191–210. https://doi.org/10.1016/j.ijinfomgt.2018.10.013

Kortuem, G., Kawsar, F., Sundramoorothy, V., & Fitton, D. (2009). Smart objects as building blocks for the internet of things. IEEE Internet Computing, 13(1), 44–51. https://doi.org/10.1109/MIC.2009.143

Kozlowski, S. W. J., & Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K. J. Klein & S. W. J. Kozlowski (Eds.), Multilevel theory, research and methods in organizations: Foundations, extensions, and new directions. San Francisco, CA: Jossey-Bass.

Krey, N., Chuah, S.-H.-W., Ramayah, T., & Rauschnabel, P. A. (2019). How functional and emotional ads drive smartwatch adoption. Internet Research, 29(3), 578–602. https://doi.org/10.1108/IntR-12-2017-0534

Leder, D., & McCaffrey, D. (2014). Inside wearables: How the science of human behavior change offers the secret to long-term engagement. Interactions, 21(6), 1621–1643. https://doi.org/10.1177/107514971660048

Lee, J. H. Y., Hsu, C., & Silva, L. (2020). What lies beneath: Unraveling the generative mechanisms of smart technology and service design. Journal of the Association for Information Systems, 21(6), 1621–1643. https://doi.org/10.17705/1aiss.00648

Lee, P. T. Y., Lui, R. W. C., & Chau, M. (2019). How does competition help future learning in serious games? an exploratory study in learning search engine optimization. Journal of Information Systems Education, 30(3), 167–177.

Leibenstein, H. (1950). Bandwagon, snob, and Veblen effects in the theory of consumers’ demand. The Quarterly Journal of Economics, 64(2), 183–207. https://doi.org/10.2307/1882692

Lin, C. P., & Bhattacharjee, A. (2008). Elucidating individual intention to use interactive information technologies: The role of network externalities. International Journal of Electronic Commerce, 13(1), 85–108. https://doi.org/10.2753/JEC1086-4415130103

Lin, Y. Y., & Lu, H. P. (2015). Predicting mobile social network acceptance based on mobile value and social influence. Internet Research, 25, 107–130. https://doi.org/10.1108/IntR-01-2014-0018

Liu, D., Li, X., & Santhanam, R. (2013). Digital games and beyond: What happens when players compete? MIS Quarterly, 37, 111–124. https://doi.org/10.25300/MISQ/2013/37.1.05
of Digital Convergence, 13(7), 137–145. https://doi.org/10. 14400/JDC.2015.13.7.137
Park, E. (2020). User acceptance of smart wearable devices: An expectation-confirmation model approach. Telematics and Informatics, 47, 101318. https://doi.org/10.1016/j.tele.2019.101318
Patel, M., Hartswood, M., Webb, H., Gobbi, M., Monger, E., & Jirota, M. (2017). Authority as an interactional achievement: Exploring deference to smart devices in hospital-based resuscitation. Computer Supported Cooperative Work, 26(4–6), 489–525. https://doi.org/10.1007/s10606-017-9274-0
Piron, F. (2000). Consumers’ perceptions of the country-of-origin effect on purchasing intentions of (in) conspicuous products. Journal of Consumer Marketing, 17, 308–321. https://doi.org/10.1108/0736376001033530
Privat, G. (2000). A system-architecture viewpoint on smart networked devices. Microelectronic Engineering, 54(1–2), 193–197. https://doi.org/10.1016/S0167-9317(00)80070-2
Raudenbush, S. W., & Bryk, A. S. (2002). Hierarchical linear models: Applications and data analysis methods (Vol. 1). Sage Publications, Inc.
Rhodes, B. J. (1997). The wearable remembrance agent: A system for augmented memory. Personal Technologies, 1(4), 218–224. https://doi.org/10.1007/BF01682024
Rijndijk, S. A., & Hultink, E. J. (2009). How today’s consumers perceive tomorrow’s smart products. Journal of Product Innovation Management, 26(1), 24–42. https://doi.org/10.1111/j.1540-5885.2009.00332.x
Rohlfis, J. H. (2003). Bandwagon effects in high-technology industries. MIT press.
Rucker, D. D., & Galinsky, A. D. (2009). Conspicuous consumption versus utilitarian ideals: How different levels of power shape consumer behavior. Journal of Experimental Social Psychology, 45(3), 549–555. https://doi.org/10.1016/j.jesp.2009.01.005
Rughiniş, R. (2013). Gamification for productive interaction: Reading and working with the gamification debate in education. 8th Iberian Conference on Information Systems and Technologies (CISTI), 1–5.
Ryu, K., Han, H., & Kim, T. H. (2008). The relationships among overall quick-casual restaurant image, perceived value, customer satisfaction, and behavioral intentions. International Journal of Hospitality Management, 27(3), 459–469. https://doi.org/10.1016/j.ijhm.2007.11.001
SAME. (2019). Sports Statistics. Retrieved May 7, 2021, from https://www.sa.gov.tw/eBook/List?id=126
Santhanam, R., Liu, D., & Shen, W. C. M. (2016). Research Note—Gamification of technology-mediated training: Not all competitions are the same. Information Systems Research, 27(2), 453–465. https://doi.org/10.1287/isre.2016.0630
Seaborn, K., & Fels, D. I. (2015). Gamification in theory and action: A literature review of gamification design frameworks. ITEJ, 9, 127–137. https://doi.org/10.1107/S1540756315002118
Shadiev, R., Hwang, W. Y., & Liu, T. (2018). A study of the use of health apps efficacy, satisfaction and continued use intention on wearable device adoption: a convergence perspective. Journal of Digital Convergence, 13(7), 137–145. https://doi.org/10.14400/JDC.2015.13.7.137
Shadiev, R., Hwang, W. Y., & Liu, T. (2018). A study of the use of wearable devices for healthy and enjoyable English as a foreign language learning in authentic contexts. Journal of Educational Technology & Society, 21(4), 217–231.
Silina, Y., & Haddadi, H. (2015). New directions in jewellery: A close look at emerging trends & developments in jewelry-like wearable devices. Proceedings of the 2015 ACM International Symposium on Wearable Computers, 49–56. https://doi.org/10.1145/280202.83280410
Silverio-Fernández, M., Renukappa, S., & Suresh, S. (2018). What is a smart device? - a conceptualisation within the paradigm of the internet of things. Visualization in Engineering, 6(1), 1–10. https://doi.org/10.1186/s40327-018-0063-8
Souiden, N., M’Saad, B., & Pons, F. (2011). A cross-cultural analysis of consumers’ conspicuous consumption of branded fashion
accessories. Journal of International Consumer Marketing, 23(5), 329–343. https://doi.org/10.1080/08961530.2011.602951

Spil, T., Sunyaev, A., Thiebes, S., & Van Baalen, R. (2017). The adoption of wearables for a healthy lifestyle: can gamification help? 50th Annual Hawaii International Conference on System Sciences, HIACC 2017 - Hilton Waikoloa Village, Waikoloa, Hawaii. https://doi.org/10.24251/HICSS.2017.437

Stiglbauer, B., Weber, S., & Batinic, B. (2019). Does your health really help? Evidence from a longitudinal randomized control trial. Computers in Human Behavior, 94, 131–139. https://doi.org/10.1016/j.chb.2019.01.018

Suh, A., Wagner, C., & Liu, L. (2018). Enhancing user engagement through gamification. Journal of Computer Information Systems, 58(3), 204–213. https://doi.org/10.1080/08874417.2016.1229143

Sun, H. (2013). A longitudinal study of herd behavior in the adoption and continued use of technology. MIS Quarterly, 37, 1013–1041. https://doi.org/10.25300/MISQ/2013/37.4.02

Tabachnick, B. G., & Fidell, L. S. (2013). Using Multivariate Statistics (6th ed.). Boston, MA: Pearson.

Thiebes, S., Lins, S., & Basten, D. (2014). Gamifying information systems—a synthesis of gamification mechanics and dynamics. ECIS 2014 Proceedings - 22nd European Conference on Information Systems, June 9-11, at Tel Aviv, Israel.

Ting, M. S., Goh, Y. N., & Isa, S. M. (2018). Inconspicuous consumption of luxury fashion goods among malaysian adults: An investigation. Global Business and Management Research, 10(1), 313–330.

Tudor-Locke, C., & Lutes, L. (2009). Why do pedometers work? Sports Medicine (Auckland, N.Z.), 39, 981–993. https://doi.org/10.2165/11319600-000000000-00000

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425–478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Quarterly, 36, 157–178. https://doi.org/10.2307/41410412

Vigneron, F., & Johnson, L. W. (1999). A review and a conceptual framework of prestige-seeking consumer behavior. Academy of marketing science review, 1(1), 1–15.

Voss, K. E., Spangenberg, E. R., & Grohmann, B. (2003). Measuring the hedonic and utilitarian dimensions of consumer attitude. Journal of Marketing Research, 40(3), 310–320. https://doi.org/10.1509/jmkr.40.3.310.19238

Wang, C. H. (2015). A market-oriented approach to accomplish product positioning and product recommendation for smart phones and wearable devices. International Journal of Production Research, 53(8), 2542–2553. https://doi.org/10.1080/00207543.2014.991046

Wieneke, A., Lehrer, C., Zeder, R., & Jung, R. (2016). Privacy-Related Decision-Making in the Context of Wearable Use. Proceedings of the 20th Pacific Asia Conference on Information Systems (PACIS), 67.

Woltman, H., Feldstain, A., Mackay, J. C., & Rocchi, M. (2012). An introduction to hierarchical linear modeling. Tutorials in Quantitative Methods for Psychology, 8(1), 52–69. https://doi.org/10.20982/tqmp.08.1.p052

Woźniak, J. (2020). Gamification for sales incentives. Contemporary Economics, 14(2), 144–161.

Wu, G. (2005). The mediating role of perceived interactivity in the effect of actual interactivity on attitude toward the website. Journal of Interactive Advertising, 5(2), 29–39. https://doi.org/10.1080/15252019.2005.10722099

Wu, J., Li, H., Lin, Z., & Zheng, H. (2017). Competition in wearable device market: The effect of network externality and product compatibility. Electronic Commerce Research, 17(3), 335–359. https://doi.org/10.1007/s10660-016-9227-6

Wu, L. H., Wu, L. C., & Chang, S. C. (2016). Exploring consumers’ intention to accept smartwatch. Computers in Human Behavior, 64, 383–392. https://doi.org/10.1016/j.chb.2016.07.005

Xu, F., Weber, J., & Buhalis, D. (2013). Gamification in tourism. Information and Communication Technologies in Tourism, 2014, 525–537. https://doi.org/10.1007/978-3-319-03973-2_38

Yee, N. (2006). Motivations for play in online games. CyberPsychology & Behavior, 9(6), 772–775. https://doi.org/10.1089/cpb.2006.9.772

Zeithaml, V. A. (1988). Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. Journal of Marketing, 52(3), 2–22. https://doi.org/10.2307/1251446

Zheng, H., & Motti, V.G. (2017). WeLi: a smartwatch application to assist students with intellectual and developmental disabilities. Proceedings of the 19th International ACM SIGACCESS Conference on Computers and Accessibility, 355–356. https://doi.org/10.1145/3132525.3134770

Zhou, T., Li, H., & Liu, Y. (2015). Understanding mobile IM continuance usage from the perspectives of network externality and switching costs. International Journal of Mobile Communications, 13(2), 188–203. https://doi.org/10.1504/IJMC.2015.067963

Zichermann, G., & Cunningham, C. (2011). Gamification by design: Implementing game mechanics in web and mobile apps. O’Reilly Media, Newton.

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