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Research Article

Continued use of wearable fitness technology: A value co-creation perspective

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ABSTRACT

Despite the widespread adoption of the wearable fitness tracker (WFT), the phenomenon of acceptance-discontinuance has limited their value. This phenomenon has called attention to the issue of continued WFT use, with emphasis on how the value of the WFT can be sustained. Using the concept of value co-creation, this research aims to understand the effects of actor-to-actor interactions on continued use of a WFT, with a specific focus on the interactions generated through two WFT services: choice and involvement of dietitians. Considering a WFT's service system as part of the greater healthcare ecosystem, this paper also considers the moderating role of self-efficacy in health management as an internal factor and healthcare system satisfaction as an external factor. A randomized experimentation using a scenario-based survey was conducted, and the data generated by 423 participants were analyzed. The results emphasize the significant positive effect of dietitian involvement on users' intentions to continue using their WFT. Dietitian involvement not only improves continued use intention, but also realizes the effect of choice. The positive effect of dietitian involvement is robust, regardless of user satisfaction with the healthcare service system. Self-efficacy in health management also plays a key role in positively moderating the effect of choice on continued use intention. This study expands information system literature by providing theoretical insights into continued use from the perspective of value-co-creation. Our findings also have implications for the development of service systems for fitness wearables.

1. Introduction

The wearable fitness tracker (WFT) has gained academic attention due to its ability to track physical activity in real time and engage individuals in tracking their performance to optimize long-term health behaviours. In recent years, the development of the WFT and related services has been afforded attention in both theory and practice, and the service delivery of wearable devices is an emerging topic in healthcare service research (Danaher & Gallan, 2016). WFT sales have increased in recent years and are expected to continue rising by 16.5 % annually until 2023 (Prescient & Strategic Intelligence, 2018).

However, despite large-scale adoption, the WFT has faced a critical challenge in sustainable usage; in response, research on the abandonment of personal quantification has increased (Attig & Franke, 2020). Users tend to discontinue using wearables in less than six months with an abandonment rate of approximately 30 % (Gartner, 2016). One possible explanation for this rate of abandonment is that the device is useful but fails to have a meaningful impact on users' behaviours and habits; in other words, the device is an object that provides data but does not inspire action. To ensure sustainable usage, a WFT needs more compelling value propositions. Determining an effective engagement process for WFT users that motivates them to continue using the device is essential in generating sustained value (Ledger, 2014). Therefore, rather than focusing on adoption alone, WFT designers need to take into consideration the value propositions that the device should provide in order to inspire users to continue using it.

Newer WFT devices may work with cloud services, third-party apps, and mobile devices to store data gathered from the device and simultaneously enable users to interact with other users and service providers integrated with the device. The provision of this additional value through the integration of several actors forms a service system. Service-Dominant Logic (S-DL) posits that a service system is a dynamic configuration of resources, including people, information, and technology, connected by value propositions (Vargo, Maglio, & Akaka, 2008).

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According to S-DL, value reconceptualization emphasizes multi-actor interactions and value co-creation (Chandler & Vargo, 2011) because each actor is connected to other actors, which provides a context for actors to experience value (Lusch & Nambisan, 2015). Perceived and co-created value offer additional benefits that influence users' evaluation of devices. It is beneficial to adopt the concept of a service system to understand how a user, WFT device, and associated services interact and affect continued use intention from the perspective of value co-creation.

In service systems, the S-DL posits that, rather than the physical form of the device, the value enclosed in the device is what determines service sustainability (Vargo & Lusch, 2008). Value is determined not only by the features that the device offers but also by the benefits acknowledged by the user (Vargo & Lusch, 2016). Under the system view, created values might undergo changes of form during the interaction process, which could also be different for each individual user (Figueiredo & Scaraboto, 2016). Hence, in this study, we focus on the value outcome resulting from the value co-creation between engaged actors - users' continued use intention.

Value co-creation is at the core of S-DL, which emphasizes actors' interactions and resource sharing. During interactions and resource sharing, users are enabled, activated, and more willing to co-create value with a device. The value of a WFT is defined by individuals based on their positive experiences in health enhancement (Joiner & Lusch, 2016). This concept is in line with the concepts of "patient engagement" and the "digitally engaged patient" in healthcare, which both encourage patients to be proactive in self-care by using technology-assisted health services (Lupton, 2013). Value co-creation emphasizes actors' volition to engage in resource sharing. Therefore, this study places the user as the focal actor.

This paper argues that WFT usage is an inseparable component of the service system. WFT usage is key to maintaining continuous actor-to-actor (A2A) interactions beyond the dyadic user-device relationship. WFT devices interact with the user and simultaneously connect with other actors in the service system to co-create value; the WFT thus serves as a mediating actor (actant), and the focal actor is the user.

To investigate A2A interactions in terms of users' centricity in value co-creation, this study highlights two interactions: user-health professional interactions (human-to-human) and user-device interactions (human-to-technology). Focusing on these two types of interactions helps to explain the interactions between actors playing different roles in social systems. User-to-user interactions, another type of human-to-human interaction, are not considered in this study since user-to-user interactions refer to interactions between actors playing the same role in social systems. Rather, actors with different roles are emphasized in this study since involvement of actors playing different roles can enrich value co-creation further due to the greater variety of resources available to the user (Pinho et al., 2014). Furthermore, the social structures and forces inherent in each role have implications for value co-creation and resource integration in service systems (Edvardsson, Tronvoll, & Gruber, 2011). User-device engagement can be encouraged by providing options that enable a user to act based on the recommendations given by the device. This study also investigates the role of expert actors within technology-assisted health management. For example, the study considers the role of healthcare professionals, whose feedback is considered by users in the resource exchange process to be more helpful than automated feedback.

This study also examines the roles of two services in value-co-creation in the WFT service system: choice and the involvement of healthcare professionals. Recent literature has found that one determinant of the success of a self-tracking device is whether the device treats users as people responsible for their own health decisions (Cosley, Churchill, Forlizzi, & Munson, 2017). Cosley et al. (2017) argue that internally triggered behaviour, which entails the user becoming self-reliant, can sustain motivation over time. Agency is part of what it means to be human; humans should be able to determine independently which course of action to take (Bandura, 1999). In user-device relationships, users, as the active agents, have the ability to assess their own needs and make choices based on the information offered by the device. For instance, users who read information on calories burnt can determine whether it is necessary for them to do additional exercise or change their diet; those opportunities to make choices are key to activating users' agency in the value co-creation process.

Enabling engagement with third-party actors is another important service. WFT devices provide value by either using their own resources (built-in algorithms) to generate feedback or involving other third-party actors such as doctors, physical trainers, or dietitians to offer greater value to the user. WFT users may be individuals who require additional support to maintain their physical condition. Although receiving automated reports from the WFT device is a form of support, users may perceive higher value when there is additional feedback from human actors rather than simple automated and generic feedback. A system that involves third-party actors may encourage profound resource sharing between actors and help users to determine follow-up actions. Furthermore, human feedback has been proven to encourage and motivate users to keep using a certain information system (Hassan, Dias, & Hamari, 2019).

To study interactions within the service system, this research examines the moderating factors of self-efficacy in health management and healthcare system satisfaction. In the assessment of service system performance, the study considers internal and external factors perceived by the user. On the one hand, users' internal perceptions in the form of self-efficacy in health management can be a proxy for evaluating users' internal capability to maintain self-health. On the other hand, users may also be affected by their perceptions of external support. The WFT service system is a subsystem of the broader health system which includes hospitals, insurance providers, and other health facilities. Value perceptions and the evaluations of the macro healthcare service system may affect users' self-reliance. This study examines how the effects of choice and the involvement of healthcare professionals are moderated by users' perceived values of the broader health system and self-efficacy in health management.

This study offers insights into WFT devices by adopting a service system perspective and treating its users as active agents that need to maintain their own agency with the device in the value co-creation process for managing their own health. This research uses a randomized experiment with scenario-based surveys to explore whether a WFT, from the perspective of human agency, can sustain usage by offering choices and the involvement of healthcare professionals. This research also aims to understand the mechanisms of the process of the WFT service system by examining the moderating roles of macro health systems, including the self-efficacy of health management (internal perceptions) and healthcare system satisfaction (external support).

This research contributes to existing literature on the continued use of wearable devices from both theoretical and practical perspectives. It has been acknowledged that an acceptance-discontinuance phenomenon exists in the WFT market. This study adopted the perspective of value co-creation in service systems in terms of the sustained use of technology-enabled services, which has not been the focus of previous empirical work. This focus allows the study to expand the view on user-device interactions in health technology beyond traditional dyadic relationships into a network of actors and beyond the user-device system to a broader health service system. This study also provides practical suggestions for service providers to offer effective features that encourage WFT users' prolonged usage.

2. Literature review

2.1. Continued use of wearable devices

In mainstream literature on IT/IS adoption, continuance refers to a form of post-adoption behaviour. Expectation-confirmation theory discusses an IS user's intention to continue using an IS based on post-

acceptance satisfaction (Storbacka, Brodie, Böhmann, Maglio, & Nenonen, 2016). This theory is also widely used to explain the continued use of technology applications. In more specific contexts, such as health technology, empirical research has used the Technology Acceptance Model (TAM) and its derivatives, which also consider continued use intentions to be a form of post-adoption effect (Akter, D'Ambra, Ray, & Hani, 2013; Bhattacherjee, 2001; Cho, 2016).

This paper argues that adoption and continuance behaviours are two theoretically distinct concepts affected by different sets of factors, and that the post-adoption stage is not an extension of initial adoption (Bölen, 2020). A review of the literature from the recent three years was conducted on continued use in the health technology domain to identify the gap regarding continued use. The results are shown in Table 1.

Based on this literature review, continued use has mainly been discussed as a post-adoption behaviour in the context of several specific health technology applications. However, there has been a growing trend of looking at the concept of continued use from different angles using different theories, such as using persuasive design, motivational affordance, and the net valence framework (Chuah, 2019; Hassan et al., 2019; Suh, 2018). Among these alternative perspectives, the most significant antecedents consider user-driven factors, such as motivation and perceived benefits, and device-related factors, such as features and motivational designs.

This study considers not only user- and device-related factors, but also larger service system factors and the interactions among these factors. This research aims to contribute to the literature by examining wearable devices as an inseparable component of the service system that co-creates value by enabling interactions with other actors and treating the user as a "proactive" agent rather than as a person who passively reacts to the device.

Continued use, in the field of health technology, has specific characteristics outside of general IT/IS applications. Health technology involves actors outside of the users themselves. The field has seen increasing interest in the interactions of people, practices, and technology (Kumar, Singh, Chandwani, & Gupta, 2019). Value co-creation may be a driver of continued use regardless of adoption. The success of wearable devices depends on the devices' ability to provide meaningful value to users in addition to satisfying utility needs. The performance of a service system is contingent on its ability to co-create value (Spohrer & Maglio, 2010). The wearable features that enable value co-creation and actors' interactions are value propositions. Users' continued use of the device reflects acceptance of its value proposition. This paper designs a compelling value proposition for a WFT aimed at persuading long-term use via service interactions and the stimulation of an active user-device relationship. This research aims to examine continued use from the perspective of value co-creation and service systems.

2.2. Value co-creation in technology-enabled health services

Value co-creation is defined as the "benefit realized from integration of resources through activities and interactions with collaborators in the customer service network" (McColl-Kennedy, Vargo, Dagger, Sweeney, & van Kasteren, 2012, p. 375). Value co-creation is enabled within complex service systems, which are a socio-technical system including human agents with knowledge and skills infused by technology within institutional arrangements (Peters et al., 2016).

Examining the value co-creation concept using a system view reflects the growing demand to examine healthcare services from the perspective of the digital health ecosystem and to identify the roles of and interactions between stakeholders which consist of patients, digital healthcare devices, healthcare institutions, and providers (Stephanie & Sharma, 2019). Digital health ecosystems emphasize the values afforded by increasing connectivity and interoperability among stakeholders (Stephanie & Sharma, 2019).

The focus of value co-creation has shifted from dyadic to many-to-

Table 1
Literature Review.

Theory / Model	Subject	Factors	Study examples
Persuasive design (i.e. gamification)	Social Fitness Tracker	Motivational design (gamification, social networking, and quantified self-features) Motivational feedback (Affective, Social, Informative feedback)	Hassan et al. (2019)
	m-Health	Service quality dimensions Satisfaction Perceived usefulness Trust Privacy concern Confirmation Habit Perceived usability Apps System Reliability Perceived Privacy Risk	Kim, Kim, Lee, and Kim (2019) Chen, Yang, Zhang, and Yang (2018) Huang, Chen, Tang, and Huang (2019)
Expectation-confirmation model (ECM)	Smartwatch	Satisfaction Satisfaction Perceived usefulness Confirmation Habit Perceived usability Perceived aesthetics Satisfaction Individual mobility Habit	Nascimento, Oliveira, and Tam (2018) Bölen (2020)
	Wearable Health	Habit	Stepanovic, Mettler, Schmidt-Kraepelin, Thiebes, and Sunyaev (2019)
	Social Fitness Tracker	Confirmation (internal forces)	Li, Liu, Ma, and Zhang (2019)
Technology adoption models (TAM, TPB, UTAUT	Mobile Apps	Social rank expectation Technological functions Perceived ease of use Perceived enjoyment Self-efficacy	Huang and Ren (2020)
	Wearable Health	Perceived behavioural control Satisfaction Regulation of motivation	Jain et al. (2018)
Net valence framework	Smartwatch tracker	Perceived benefits Previous lifestyle incongruence	Chuah (2019)
Motivational affordance theory	Quantified self-technology	Hedonic motivation Utilitarian motivation	Suh (2018)

(continued on next page)

Table 1 (*continued*)

Theory / Model	Subject	Factors	Study examples
		Eudaimonic motivation QST system feature	

many interactions (Gummesson, 2008) and expanded from user-device interaction to actor-to-actor (A2A) integration. The foundation of value co-creation is actor engagement, in which actors are defined as humans, collective humans (organizations), machines, and numerous combinations of humans and machines (Storbacka et al., 2016). In this research, engaged actors include users, healthcare professionals such as registered dietitians, and wearable health devices.

A2A interactions include human-to-human and human-to-technology interactions. High-tech and high-touch service experiences have emerged with advances in technology aimed at providing sustainable value. In other words, technology now allows for value co-creation to take place within and between service systems (Rantala & Karjaluoto, 2016). Human-to-human interactions in value co-creation empower the patient and allow patients to deliberate their preferences and opinions during service encounters (Osei-Frimpong & Owusu-Frimpong, 2017). Particularly when the human actor is a healthcare professional, there is a role clarity, trust-building process during the encounter that increases value perception. Human-to-technology interactions have emerged due to their ability to increase service effectiveness. This type of interaction emphasizes device reliability, features, and the ability to collect and process data as determinants of continued use of health wearables (Canhoto & Arp, 2017; Asimakopoulos, Asimakopoulos, & Spillers, 2017). Although both types of interaction have distinct characteristics, both can allow resource exchange and grant a user the autonomy to be involved in the value co-creation process.

Although the A2A interactions that may occur during value co-creation have been discussed on a conceptual level, empirical evidence for the mechanisms by which actors, including users, other human actors, and technologies, engage in value co-creation is limited. This lack of empirical evidence is especially pronounced regarding A2A interactions related to healthcare services. Value co-creation involves human-to-human interactions. These human-to-human interactions include interactions between customers and health service providers (doctors, physicians, service front liners) and/or caregivers (Anh & Thuy, 2017; Kim, 2019; McColl-Kennedy et al., 2012; Osei-Frimpong, Wilson, & Owusu-Frimpong, 2015). Human-to-human interactions also include interactions between users and other users (Beldad & Hegner, 2018; Kreitzberg, Dailey, Vogt, Robinson, & Zhu, 2016). However, the user-to-user interaction, which is between two entities with the same roles in the service system, has received substantial attention in existing literature as fitness wearables and apps commonly have social networking features that let users interact with other users (Cho & Tian, 2019; Whelan & Clohessy, 2020; Zhu, Dailey, Kreitzberg, & Bernhardt, 2017). User-to-user interaction is therefore not considered in this study. The present study's aim is to highlight instead the interactions between humans who bear different social roles, through which the technology-mediated value co-creation process can be enriched. On the other hand, we are not aware of empirical studies that address value co-creation of human-to-technology interactions rather than what has been discussed at the conceptual level. This study thus aims to provide empirical evidence of value co-creation practices that directly involve two under-studied types of A2A interactions: human-to-human and human-to-technology interactions.

2.3. Agency in value co-creation

Value co-creation has been applied to health literature to examine the relationship among patients, health practitioners, and support groups to investigate how patients contribute to their own value creation (Joiner & Lusch, 2016; McColl-Kennedy et al., 2012). Based on the concept of human agency, individuals are independent in determining which courses of action to take, primarily if they involve imperative circumstances such as health. Agency entails the capacity to act and the actions that generate outcomes by virtue of the engagement between users and technologies to reproduce and transform structural environments in an interactive response (Emirbayer & Mische, 1998).

Socio-materiality acknowledges that human and social dimensions are interwoven with the realm of the material, including technology (Cecez-Kecmanovic, Galliers, Henfridsson, Newell, & Vidgen, 2014). Technologies are human-created objectives that serve human purposes. Therefore, the human, as user, should exercise agency in using technology.

In the relationship between user and device, agency perspective does not treat technology as a determinant of social change. Conversely, the user changes his or her own behaviour with a trigger from the technology. This notion is in line with the concept of value co-creation in which users are the focal, active co-creators of value (Chou, Lin, & Huang, 2016). User engagement with technology is contextually provisional (Orlikowski, 2000). Therefore, a user can have greater freedom in acting on the technology's features in various ways (Boudreau & Robey, 2005) that satisfy their particular needs, either as service providers intended or through improvisation (Orlikowski, 1992).

3. Hypothesis development

Fig. 1 presents this paper's conceptual model. This research investigates two experimental factors embedded in WFT service: choice and the involvement of healthcare professionals. The WFT acts as a mediating value proposing actor that integrates different actors to form the WFT service system. This research also incorporates two moderators: self-efficacy of health management to reflect on how users enhance their ability to maintain their own health, and satisfaction with healthcare systems to reflect on how users perceive surrounding healthcare ecosystems.

3.1. The main effect of WFT service on continued use intention

This study's main hypotheses focus on employing WFT as a technology that provides a service to trigger human agency. Besides enacting individual will or agency, in the form of intrinsic motives, has also been proposed as a driver of value co-creation. Agency includes making choices and becoming involved in resource sharing and interactions with other actors in the system (Dominici, Yolles, & Caputo, 2017; Leclercq, Hammedi, & Poncin, 2016).

During interactions and resource exchange, WFT users are resource integrators and actors with agency (Aal, Di Pietro, Edvardsson, Renzi, & Guglielmetti Mugion, 2016). Agency is closely related to will, freedom, and choice (Benson, 2007). By being offered choice, users have the autonomy to decide the activities that they want to pursue based on personal assessments. In user-device interactions, the choice given by the device is generated from the user's record. Therefore, it is expected that the choice given helps users to make decisions by providing relevant and resourceful information.

Offering autonomy, such as giving users choices to do things or perform certain activities, significantly affects engagement (Deci et al., 2001). Users of wearable devices are more likely to be intrinsically motivated to engage in an activity if the device offers autonomous support choices (Roca & Gagné, 2008). As improved intrinsic motivation has been known to influence users' continued engagement (Kim, Kim, & Wachter, 2013), this study anticipates that users will continue using the WFT if granted options when operating the WFT.

H1a. A WFT user granted by options has higher continued use intention compared to those without options.

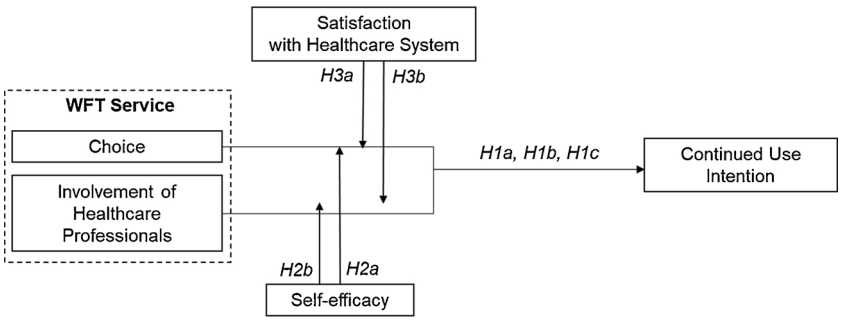

Fig. 1. Proposed conceptual model and hypotheses.

Agency in the form of proactive behaviour explains the reasons for which individuals engage in value co-creation (Füller, 2010; Payne, Storbacka, & Frow, 2008). When a WFT service is integrated with the support of a registered dietitian, resources in the service ecosystem are enhanced. A registered dietitian that appears on the wearable device may also play a clear role during the service encounter in increasing the user's trust of provided information. As resources such as skill and knowledge become richer and the actors become more diverse, users will become more proactive in co-creating value (Jaakkola & Alexander, 2014).

Resource integration in healthcare service extends beyond customer networks into a network of interrelated actors (Patrício, De Pinho, Teixeira, & Fisk, 2018). In networked systems such as that of the WFT service, a service is not only provided by the WFT, but also by other network actors such as healthcare professionals. For example, integrated health information technology (HIT) integrates physicians or specialists to improve the quality of care for patients (Pinsonneault, Addas, Qian, Dakshinamoorthy, & Tamblyn, 2017).

Previous studies have found that the decision to continue using mobile health apps is determined by the value of the service network, particularly the interactions among actors in a service system (Akter et al., 2013). Therefore, value is created with the interdependence on user-device-dietitian interactions over an extended period of time as the parties exchange information (Beirão, Patrício, & Fisk, 2017; Pinho, Beirão, Patrício, & Fisk, 2014). These interactions enhance intentions to keep using a device. This model has been proven feasible by adding health professional advice to the service, which potentially creates additional motivation to implement WFT (Franco, Fallaize, Lovegrove, & Hwang, 2016). This study proposes that continued use is higher when WFT services combined are combined with healthcare input. Hypothesis H1b is as follows:

H1b. A WFT service involved with healthcare professionals results in higher continued use intention compared with that of no involvement.

This paper also predicts an interaction effect between choice and the involvement of healthcare professionals. There is an idea in healthcare decision making that promotes patient autonomy as important in the context of the shared relationship with a trusted provider (Deber, Kraetschmer, Urowitz, & Sharpe, 2007). This idea implies a demand on the service provider to act as a partner when the user is autonomous. Offering choice enhances user autonomy. When a healthcare professional such as a dietitian is involved, users expect greater value to be exchanged if they are offered options to choose from instead of being forced to accept a single suggestion.

In contrast, an inappropriate combination of choice and the involvement of healthcare professionals can lead to value co-destruction, which ultimately reduces WFT usage. The value destruction processes can occur as the result of either incongruent resource application or misuse of resources when a dietitian is not present (Leo & Zainuddin, 2017). The customer can destroy the initial value proposed by the service provider by misusing or misunderstanding the integration of the operant resources (Farquhar & Robson, 2017). To avoid value co-destruction when there is no dietitian, it may be more effective to remove options and avoid user confusion to ensure usage intentions. Hypothesis H1c is as follows:

H1c. There is an interaction effect between choice and the involvement of healthcare professionals in shaping continued use intention. When a professional is present, a user is more likely to continue using the device along with the choice offered. However, when no professional is present, the intention to continue using the device is higher when choices are not offered.

3.2. *The moderating effect of the self-efficacy of health management*

Self-efficacy is a factor embedded in each individual and a constant predictor of both the short- and long-term success of health intervention (Rosenstock, Strecher, & Becker, 1988). Theoretically, self-efficacy is a relevant, well-established predictor of health technology adoption, though empirical findings have offered contradictory arguments in terms of general and context-specific self-efficacy such as computer self-efficacy (Balapour, Reychav, Sabherwal, & Azuri, 2019). Self-efficacy has been found to be a positive moderator in technological usage contexts, such as self-service technology (Chen & Wu, 2014) and online shopping (Yi & Gong, 2008). This paper focuses on the moderating effect of self-efficacy in the context of maintaining personal health. This research views users as the focal actors whose internal factors may drive their technology use. Thus, the presence of a strong internal factor such as self-efficacy is proposed to have critical moderating effects on human-to-technology and human-to-human interactions.

Efficacy beliefs are the foundation of human agency (Bandura, 2006). Even in relations between humans and technology, self-efficacy is congruent and emphasises self-reliance and the freedom to take the chosen course of action. The course of action cannot be fully driven by technology (Feldman, 2017). With a higher efficacy in maintaining their health, users are more likely to demand and possess autonomy to guide their lives and attain wellbeing. Decision-making self-efficacy is also positively associated with a preference for choice across a range of consumer decisions (Reed, Mikels, & Lockenhoff, 2012). Enabled by technology, efficacious individuals desire more choice and seek more information compared to people with lower self-efficacy. Thus, this research predicts that choice is preferred when self-efficacy is high.

H2a. The impact of choice on continued use intention is moderated by self-efficacy in maintaining personal health. Being provided with options (versus no options) will enhance continued use intention when self-efficacy is high.

In relation to technology use, self-efficacy is one of the strongest determinants of technology use (Venkatesh & Davis, 1996). Self-efficacy affects individuals' choices of activities, such as the goals they set for themselves, the amount of effort they mobilize, and their outcome expectations (Bandura, 1997). In our study, self-efficacy includes people's perceived ability to interact with healthcare professionals through their

personal health device. With higher self-efficacy, an individual feels more competent in implementing long-term behaviour changes using WFT (Stretcher & Rosenstock, 1997).

Social construction theories posit that humans have the potential to learn, adapt, and make their own choices, making the relationships between users' efficacy and the presence of healthcare professionals mutually reinforcing (Edvardsson et al., 2011). Health behaviour literature shows that involvement of dietitians enhances self-efficacy (Prestwich et al., 2013; Williams & French, 2011). On the other hand, high self-efficacy makes people feel competent, which is important when being observed and evaluated by healthcare professionals such as dietitians. Theories of social influence posit that people have a desire to be right and positively evaluated (Cialdini & Goldstein, 2004). This reinforcing relationship between self-efficacy and the presence of healthcare professionals leads us to believe that high self-efficacy enhances the effect of dietitian presence on users' intentions to continuously use WFT.

H2b. The impact of the involvement of healthcare professionals on continued use intention is moderated by self-efficacy. The involvement (versus no involvement) of healthcare professionals will enhance continued use intention when self-efficacy is high.

3.3. The moderating effect of satisfaction with healthcare ecosystems

There have been limited studies on Health Information Technology (HIT) that include the role of broader social and institutional issues. In addition to internal factors, external factors may also affect users' perceptions of whether they should rely on technology for personal health management. External factors, such as surrounding and situational factors, cannot be ignored as they may become a barrier to the adoption of health technology (Lee, Ramayah, & Zakaria, 2012). Therefore, users' perceptions of the performance of the healthcare ecosystem, essentially their satisfaction with the surrounding healthcare service system, is considered as a factor that may affect users' behaviour when engaging with health devices.

Satisfaction is considered to be a principal factor in determining post-usage behaviour. For example, the Expectation Confirmation Model (ECM) uses satisfaction to discuss why users of an IS decide to continue using a product or service (Bhattacherjee, 2001). Satisfaction as described by ECM is the satisfaction associated with the technology itself. However, the healthcare ecosystem is context-dependent (Kumar et al., 2019). In this research context, satisfaction regarding the surrounding environment is an important factor affecting how the user engages with and perceives WFT.

Study of choice in health-related contexts creates key implications, most notably in terms of financial consequences due to the financial burden of high healthcare costs (Reed et al., 2012). Life satisfaction is a marker of positive well-being. Individuals with higher life satisfaction engage in more prudent choices related to their health behaviours (Grant, Wardle, & Steptoe, 2009).

H3a. The impact of choice on continued use intention is moderated by healthcare system satisfaction. Giving options (versus no options) will enhance continued use intention when healthcare system satisfaction is high.

In a healthcare service ecosystem, a user is not only affected by the focal WFT service system. Because users use the wearable throughout the day, many actors are involved in macro healthcare ecosystems, including clinics and health facilities, infrastructures, and environments. Therefore, the intention to continue using WFT is not only a response to the satisfaction with the device, but also to the satisfaction with the entire health service ecosystem. If the value offered by the WFT is lower than that of the surrounding environment, users are likely to perceive a reduced value when using the WFT and decide to discontinue.

This study predicts that a user with higher satisfaction with surrounding service systems will have higher continued use intentions when given the opportunity to co-create value through interacting with dietitians. Moreover, satisfaction also serves as a driver of customer engagement which inevitably affects the value co-creation process (Franco et al., 2016). Therefore, this study predicts that a user with higher satisfaction with their surrounding service systems will have higher continued use intention when offered dietitian involvement.

H3b. The impact of involving healthcare professionals on continued use intention is moderated by service system satisfaction. The involvement (versus no involvement) of healthcare professionals will enhance continued use intention when healthcare system satisfaction is high.

4. Methodology

4.1. Research design

The hypotheses were tested by conducting a scenario-based randomised experiment with a 2 (options versus no options) x 2 (dietitian versus no dietitian) between-subject design (Table 2). Each of the groups was exposed to a scenario of WFT device use with options and dietitian involvement being turned on or off.

The experiment was conducted in an online environment. The procedure began with a pre-test survey that collected respondents' demographic information (age, gender, education, insurance coverage, and weight) and health habits (exercise habits and prior experience with a WFT). Following the pre-test survey, participants were assigned randomly to one of four scenarios. All four scenarios began with a short description summarising participants' demographics and conditions, such as insurance coverage and weight and piped from the pre-test survey to more effectively immerse participants into the scenario, followed by a narrative story. Participants were asked to imagine that they were given a WFT with certain functions. All scenarios shared the same background story, in which the user tracked steps, distance, and calories burned during physical activity. Following this stage, depending on the randomization, the participants were shown a picture of the assigned device interface with scenario-variant stories (Fig. 2). After the respondent read the scenario, s/he was asked to answer a series of attention and manipulation check questions to ensure the success of the manipulation. Participants who did not pass the attention and manipulation check were removed from the data analysis. The respondents who passed the attention and manipulation check completed a post-test survey that determined his/her continued use intention, self-efficacy, and satisfaction with the healthcare eco-system.

4.2. Scenarios

"Choice" is operationalized through the presence of meaningful options. A meaningful option allows one to determine which action endorses and facilitates self-determination (Ryan & Deci, 2006). Options were shown on the device as feature button to allow users to choose their next actions after reading their performance record, including options to modify goals as a response to generic automatic feedback or options to meet goals in response to the dietitian's feedback.

Table 2
Scenario Design.

		Choice	
		No options	With options
The involvement healthcare professionals	No dietitian involved	SCENARIO 1	SCENARIO 2
	With dietitian involved	SCENARIO 3	SCENARIO 4

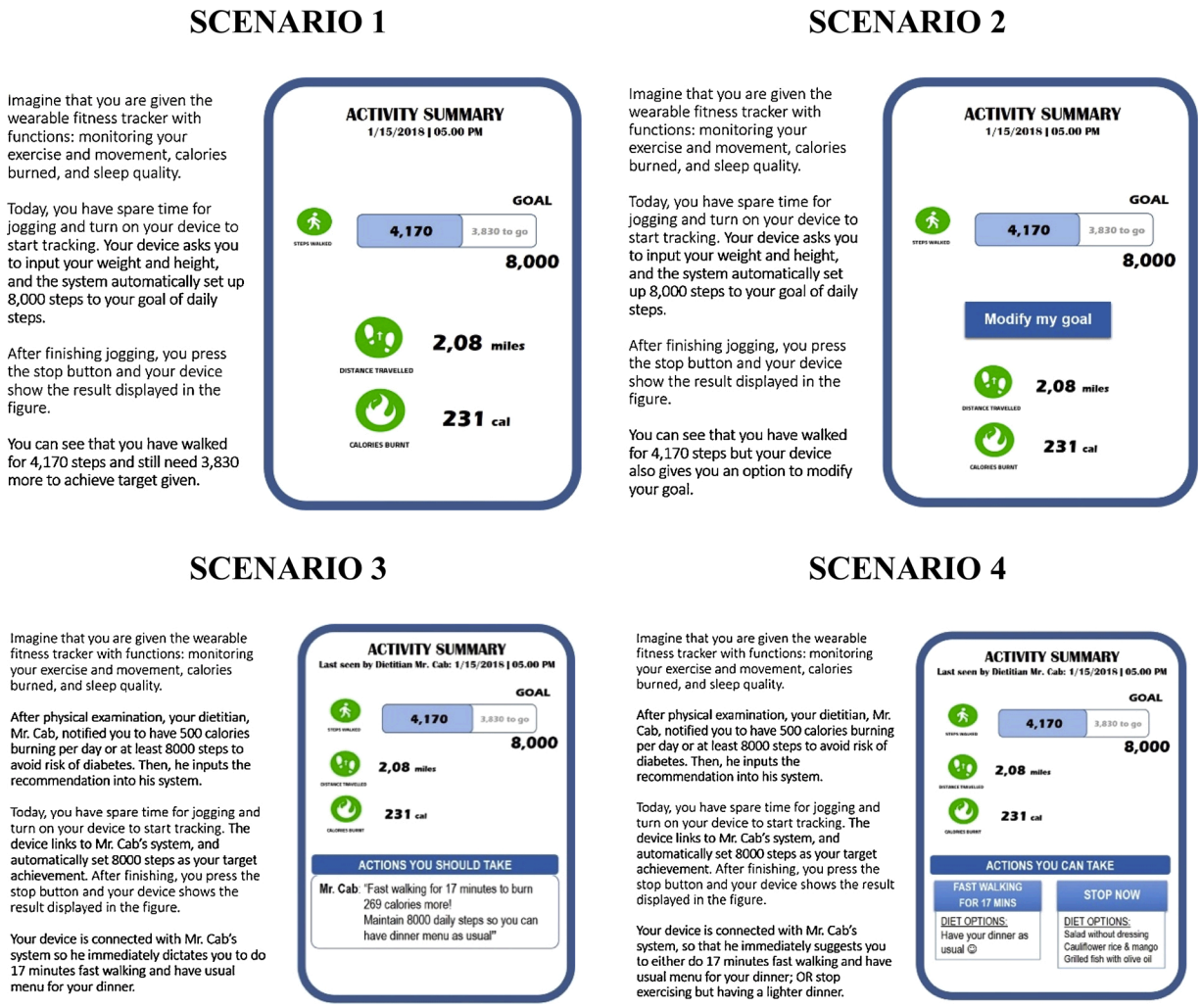

Fig. 2. Scenario narratives and screenshots.

4.3. Participants

To recruit participants, the authors used the Amazon Mechanical Turk (MTurk) and set the criteria of eligibility to US citizens to find participants under one national health service system. In total, 467 individuals clicked the survey link, 34 responses were excluded for not completing the entire experiment, and 10 others were removed for not passing the attention check.

The remaining 423 participants' demographic structure mirrored the demographic characteristics of WFT users in the US in terms of gender and age distributions (NPD, 2015). The complete participant profile is illustrated in Table 3. No significant differences were observed among participants assigned to these four scenarios, indicating that they were randomly assigned.

4.4. Measures

This study used validated scales for the three constructs, namely continued use intention, self-efficacy, and health system satisfaction, with minor wording changes to suit the context of the research. Five-point scales were used as it can ease respondents' cognitive burden and is considered as the best option from an information-processing perspective (Chen, Yu, & Yu, 2015; Weijters, Cabooter, & Schillewaert, 2010). Five-point scales are also commonly used in recent IT/IS literature (Marimon, Llach, Alonso-Almeida, & Mas-Machuca, 2019; Triantoro, Gopal, Benbunan-Fich, & Lang, 2019; Wilms, Stieglitz, Ross, & Meske, 2020). All measurement items are listed in Appendix A.

To measure continued use intentions, the research used four items adapted from Bhattacherjee (2001), such as "I intend to continue using the described wearable fitness tracker for the purpose of maintaining my personal health". Each of these questions was measured on a five-point scale, from "1 = strongly disagree" to "5 = strongly agree".

The self-efficacy of health management was measured with three items adapted from Schwarzer and Renner (2000), such as "I can keep myself healthy, even if I do not use any health device or apps". These questions were measured on a five-point scale from "1 = very uncertain" to "5 = very certain". The satisfaction with the healthcare system was inspired by the National Statistics Opinions and Lifestyle Survey (2012), which asked participants to rate satisfaction with their surrounding environment, including health facilities and overall living circumstances. This study used the four items on the five-point scale, from "1= not at all satisfied" to "5 = completely satisfied". The average score of each construct was used in the analysis.

4.5. Attention and manipulation checks

To ensure that participants were immersed in the scenarios, this research used attention and manipulation checks. The attention check aimed to ensure participants' ability to detect manipulating variables. After reading the scenario, participants were tested to determine whether they could identify the absence or presence of options and dietitian involvement with the following question: "In the scenario, I

Table 3
Participants' Profiles.

Characteristics		Scenario (Frequency (%))				Total	*p-value* *
		1	2	3	4		
Gender	Male	53 (46.9)	54 (46.5)	53 (50.5)	55 (53.9)	215 (50.8)	.768
	Female	60 (53.1)	47 (53.5)	54 (49.5)	47 (46.1)	208 (49.2)	
Age (years old)	Below 25	9 (8)	9 (8.9)	8 (7.5)	12 (11.8)	38 (9)	.099
	26 – 35	47 (41.6)	49 (48.5)	41 (38.3)	50 (49)	187 (44.2)	
	36 – 50	39 (34.5)	31(30.7)	41 (38.3)	31(30.4)	142 (33.6)	
	Above 51	18(15.9)	12 (11.9)	17 (15.9)	9 (8.8)	56 (13.2)	
Education	High school	25 (22.1)	28 (27.7)	24 (22.4)	23 (22.5)	100 (23.6)	.635
	College	51 (45.1)	47 (46.5)	54 (50.5)	52 (51)	204 (48.2)	
	Graduate	37 (32.7)	26 (25.7)	29 (27.1)	27 (26.5)	119 (28.1)	
Exercise Habit	Yes	101 (89.4)	86 (85.1)	89 (83.2)	90 (88.2)	366 (86.5)	.526
	No	12 (10.6))	15 (14.9)	18 (16.8)	12 (11.8)	57 (13.5)	
Experience using WFT	Yes	88 (77.9)	77 (76.2)	82 (76.6)	82 (80.4)	329 (77.8)	.892
	No	25 (22.1)	24 (23.8)	25 (23.4)	20 (19.6)	94 (22.2)	
Chronic Disease	Yes	16 (14.2)	19 (18.8)	26 (24.3)	19 (18.6)	339 (80.1)	.296
	No	96 (85)	81 (80.2)	80 (74.8)	82 (80.4)	80 (19.1)	
	N/A	1 (.9)	1 (1)	1 (.9)	1 (1)	4 (.9)	
Variables[a]		**Means (standard deviation)**					
Self-efficacy		3.69 (.91)	3.78 (.96)	3.51 (.93)	3.65 (.93)	3.66 (.93)	.227
Satisfaction of healthcare system		3.79 (.83)	3.70 (.78)	3.72 (.84)	3.67 (.79)	3.72 (.81)	.707

[a] Variables are measured on a 5-point Likert scale.
* *p*-values are obtained from ANOVA tests.

can see: 1) Options to choose my next immediate action, 2) My device is connected with Mr Cab's system" with yes/no options.

The manipulation check aimed to determine whether the manipulation was successful. Choice was assessed by a single item that reads "The feedback information allows me to choose what activities I want to do". For dietitians, the item, "The information presented by wearable device looks like a service integrated with human expertise", was used. Both questions were scored from "1 = strongly disagree" to "5 = strongly agree". The respondents who did not pass the attention and manipulation check were removed from the study.

4.6. Data analysis

An ANOVA test was conducted to verify for manipulation before data analysis. To assess the validity and reliability of the measurement items, this research conducted a confirmatory factor analysis (CFA) to obtain factor loadings (>0.7 for all constructs), discriminant validity (AVE > 0.5), composite reliability (CR > 0.7 for all constructs), and Cronbach's alpha (>0.7).

To test the main hypotheses, the study used a two-way ANOVA to examine the effect of choices and the involvement of healthcare professionals in continued use intentions. To test moderation, the research used the SPSS PROCESS Macro Model 1 (Hayes, 2017) with 5000 bootstrapped samples. PROCESS is a computational tool used for path analysis-based moderation and mediation analysis, as well as a combination as a "conditional process model". In a model that involves a moderated effect, PROCESS produces estimates of conditional effects (direct and/or indirect) for various values of the moderator (Hayes & Montoya, 2017).

Two separate regression analysis were conducted in PROCESS to discern whether the effect of moderation exists. To further analyze the effect of moderation, as moderators are continuous variables, the study uses the Johnson-Neymann Technique (J-N, floodlight analysis) to decompose interactions and identify regions in which the simple effect significantly differed. Floodlight analysis has been derived from the spotlight, which is chosen over mean/median splits due to its robustness in seeking turning points for where, in the absolute value of the moderator, the effect of the predictor changes from non-significance to significance.

5. Results

5.1. Constructs and manipulation checks

All items were included in the analysis because they had sufficiently high loadings (higher than 0.7). Continued use intention (CR = 0.939, AVE = 0.793, Cronbach's Alpha = 0.913), self-efficacy in maintaining health (CR = 0.916, AVE = 0.785, Cronbach's Alpha = 0.864), and healthcare system satisfaction (CR = 0.87, AVE = 0.626, Cronbach's Alpha = 0.805) were found to be above the threshold, which indicated high validity and reliability.

To conduct a manipulation check, respondents were able to discriminate between scenarios with and without options (M_{with_opt} = 4.00 (SD = .86) and M_{no_opt} = 3.56 (SD = 1.14, F (1,421) = 19.808, $p < .001$), as well as scenarios with and without human expertise integrated services (M_{with_diet} = 4.07 (SD = .85) and $M_{without\_diet}$ = 3.6 (SD = 1.06, F (1,421) = 25.188, $p < .001$). The analysis found that these manipulations were successful.

5.2. Main effect

The results demonstrate the significance of dietitian involvement; specifically that the presence of a dietitian leads to increased continued use intentions (M_{with_diet} = 3.97, SD = .88 vs. M_{no_diet} = 3.73, SD = .96, F (1, 421) = 7.28, $p < 0.01$). However, the presence of options does not

Table 4
Main effect on continued use intention.

Dependent Variable: Continued Use Intention			
	Means square	F	p-value
Choice	.010	0.012	.912
Dietition involvement	6.28	7.28	.007**

** $p < 0.01$.

have a significant effect on continued use intentions (F (1, 421) = 0.012, $p > 0.05$). The ANOVA table in Table 4 indicates that hypothesis H1a is rejected, whereas hypothesis H1b is supported.

This finding led the research to test the interaction between choices and dietitian involvement. The two-way ANOVA results reported in Table 5 show that there was a statistically significant interaction between choice and dietitian involvement in continued use intentions (F (1, 419) = 7.64, p = .006).

The simple main effect analysis demonstrates that a person granted options significantly increased continued use intentions when a dietitian was present (p = .000), but not when dietitian was absent (p = .963), as shown in Fig. 3. Therefore, granting options can be positive when a dietitian is present. However, giving choice to users without guidance from a dietitian can backfire. Therefore, hypothesis H1c is accepted.

5.3. Moderating effects of service system satisfaction and self-efficacy

The study tested moderating effects using a conditional process analysis of service system satisfaction and self-efficacy. The results in Table 6 show both of the statistics, as well as the pick-a-point approach to probing the interactions. The results of the regression analysis in PROCESS shows that the effect of dietitian involvement in continued use intention is significantly moderated by self-efficacy, as illustrated in Fig. 4 (b = .23, t = -2.36, $p < 0.05$).

The floodlight analysis shows that self-efficacy at the value of 3.34 is a turning point from the non-significant to significant effect of dietitian involvement, as shown in Fig. 4. In the no-dietitian scenario, higher self-efficacy leads to lower continued use intention, possibly because a device without dietitian involvement provides no additional value to a user with high self-efficacy. However, with a dietitian, a user with high self-efficacy may appreciate the value of the device and be more included to continue using it. Therefore, hypothesis H2b is accepted.

The study also found that the effect of choice on continued use intentions was moderated by user satisfaction with surrounding service systems (b=-.29, t =-2.70, $p < 0.01$), although the direction of the moderating effects differs from predictions. As shown in the red areas in Fig. 5, the floodlight analysis indicates that providing choices is helpful for user with average to low service system satisfaction (below 2.99). In contrast if the service system satisfaction is extremely high (above 4.71), no choice is preferred. Therefore, hypothesis H3a is partially accepted.

Finally, the study found that self-efficacy was not a significant moderator of choice (b = -.12, t = -1.19, $p = 0.23$), and that health system satisfaction was not a significant moderator of the effect of third-party involvement (b=-.13, t =-1.21, $p = 0.22$). The effect of choice does not change, regardless of how efficacious the user is, and the presence of a dietitian has a significant positive effect, regardless of how satisfied a user is when interacting with his/her existing healthcare system. Therefore, hypotheses H2a and H3b are rejected. The summary of hypothesis testing results is presented in Table 7.

6. Discussion

By adopting the perspective of the service system, this study designed a scenario-based experiment to study the effects of a WFT service that offers choice and dietitian involvement on continued use of WFT.

Table 5
Main Effect with Interactions on Continued Use Intention.

Dependent Variable: Continued Use Intention			
	Means square	F	p-value
Choice	.007	0.012	.935
Dietitian involvement	6.28	7.99	.005**
Choice * Health expert involvement	6.49	7.64	.006**

** $p < 0.01$.

The results prompt several important discussions. Firstly, the study found that dietitians had a strong, positive effect. The presence of a dietitian can directly improve continued use intentions and provide the effect of choice. The presence of the dietitian can overturn the negative effect of choice by making it positive. This finding shows that human-to-human interactions play a major role in value co-creation.

Factorial ANOVA shows that there is an interaction between choice and dietitian involvement on users' continued use intentions. This finding strengthens the notion of value co-creation from A2A interactions involving users, the device, and the dietitian. This finding also highlights the interplay of human-to-human and human-to-technology interactions to realise greater value co-creation and implies that value co-creation can promote the sustained use of technology.

A WFT service enables users to make choices that exercise their agency. Perceived agency is a key factor in enabling users to view their behaviour as a meaningful expression of choice (Bhattacherjee, Berger, & Menon, 2014). When potential dyadic interactions with other actors occur, actors expect resource exchanges, which may result in additional value. Feedback information on health devices or applications should also contain communication of resources that enlightens and addresses the pursuit of goals (Morrison, 2015).

The significant interaction effect between choice and the involvement of healthcare professionals indicates the importance of properly aligned feedback and choice. If a WFT service provides options for users to respond interactively, it should also provide dietitian feedback to enhance user agency. Options provide information on possible actions to take with corresponding consequences. Giving choices without directions from healthcare professionals may lead to confusion and lower users' intentions to keep using the device. Therefore, value co-creation via user-device-dietitian interactions is the most favourable system with the proximity of autonomy to choose because it enables and enhances users' agency. This finding is in line with the existence of the control/chaos and freedom/enslavement paradox, which posits that smart technology can be a key tool in facilitating regulation and independence or can lead to dependence (Wuenderlich et al., 2015). Therefore, WFT service providers should create value propositions with perceptible solutions that allow for informed decision making.

Our results also show the relationship between value perception and users' co-creation behaviour. When the value perceived from the feedback given by actors with certain expertise, such as by a dietitian after physical exercise, is higher, the user is more likely to continue co-creating value and possess more resources to exchange. However, when the perceived value is lower, for example, from resetting existing goals on a device or modifying goals without a suggested target, the user will perceive that the device is "not that smart", diminishing the device's value significantly. This low value perception could lead to value co-destruction and subsequently promote technology discontinuance. There are often incongruencies among actors, practices, and resources. If misused, these items may diminish value (Plé & Cáceres, 2010). Value co-destruction may occur through the elimination of opportunities for one party when the user is passive and value is not reciprocally created (Füller, 2010).

Secondly, this research examined healthcare system satisfaction and self-efficacy as potential moderators of the effects of choice and dietitian involvement on continued use intention. This study filled a gap in health technology literature by considering the role of broader social and institutional issues. The result strengthens the concept of a digital health ecosystem that interacts with patients, digital healthcare devices, and healthcare institutions (Stephanie & Sharma, 2019), thus providing conceptualization and empirical evidence.

Service system satisfaction is a subjective feeling perceived by a user, whereas choice can be embedded in the device by the service provider to enhance its value. These two factors may complement one another. When users are dissatisfied with the health system, their continued use intentions may be increased if offered a device with choice.

The effect of dietitian involvement is strong and persistent,

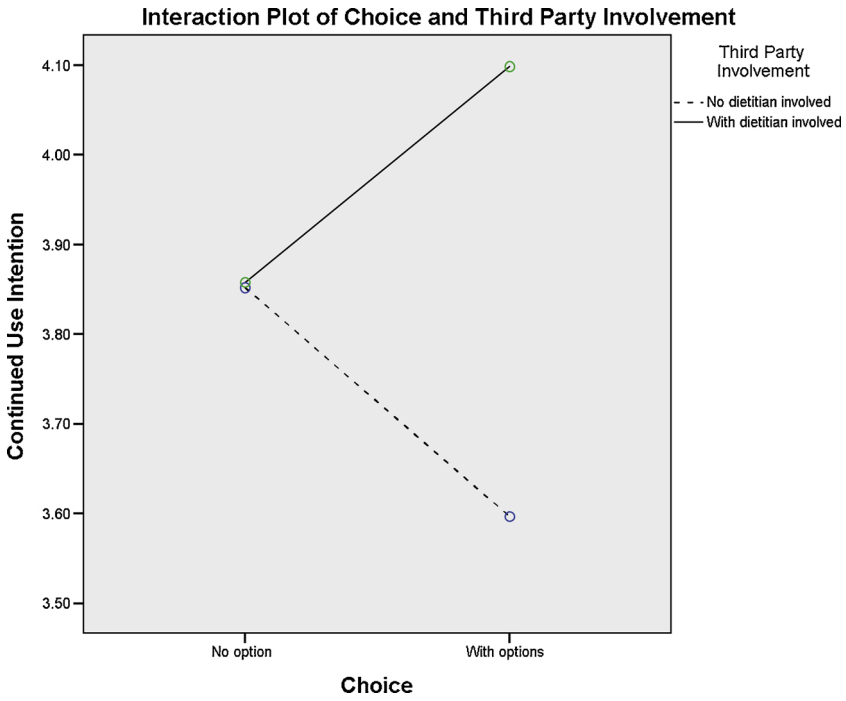

Fig. 3. Interaction plot of choice and third-party involvement.

Table 6
Significant conditional effects of the focal predictor at the value of moderators.

Predictors	Moderators	Value of Moderators	Effect	se	t	p	LLCI	ULCI	Value of JN region
Dietitian involvement	SEF	2.72 (-1SD)	.044	.127	.345	.729	−.206	.293	
		3.65 (SD)	.256	.089	2.86	.004**	.079	.434	>3.35
		4.59 (+1SD)	.469	.127	3.69	.001***	.219	.719	
Choice	SAT	2.91(-1SD)	.252	.122	2.06	.039*	.011	.493	
		3.72(SD)	.017	.086	.199	.842	−.153	.187	<2.99
		4.53 (+1SD)	−.218	.123	−1.77	.078	−.459	.024	
									> 4.72

(SEF: Self-efficacy; SAT: Service system satisfaction).
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

regardless of the user's healthcare system satisfaction. In addition, among users with high self-efficacy, dietitian feedback through a device can further motivate them to keep using the device. Higher self-efficacy boosts the user's confidence to perform polyadic interactions with actors such as dietitians. This finding supports the notion that interactions with other actors can enhance engagement and lead to sustained future co-creation (Füller, 2010).

Our findings show that giving users options is useful in encouraging them to keep using the device when their satisfaction with the surrounding service systems is low. Satisfaction is determined by consumers' perceptions and can be affected by initial expectations (Flavián, Guinalíu, & Gurrea, 2006). Expectations are difficult to satisfy and are influenced by internal factors, such as motives and socio-demographics, and external factors, such as prior experiences. Therefore, low satisfaction with a health service ecosystem indicates that a user expects more from the service system offered by the WFT. Giving users options may be perceived as a type of added value as it allows them to exercise agency in performing what is not offered by surrounding service systems. When a user is satisfied with surrounding service systems, the absence or presence of options does not have a significant effect.

6.1. Theoretical contributions

From a theoretical perspective, this study operationalizes the concept of value co-creation in a health service system. This research is among the first to deal with the role of users' agency in technology-assisted health behaviour. The study shows that value co-creation could be improved by wearable service providers by providing interactional features that enable users' agency, including dietitian involvement and the provision of choice.

This research also explores continued use from a value co-creation perspective. This perspective is different from that of recent literature which has mainly used post-adoption models, technology adoption, and their derivatives. Recent alternative views on continuing technology use emphasize behaviour and actions. Unlike reasoned action models that focus on the human cognitive process, the alternative view directs attention squarely to the characteristics or features of a technology that may restrict or guide users' actions in particular ways (De Guinea & Markus, 2009). Value co-creation addressing interactions between human actors and the characters of technology should be further explored.

This paper argues that what encourages long-term use of a technology are the acceptance of value and the involvement among engaged

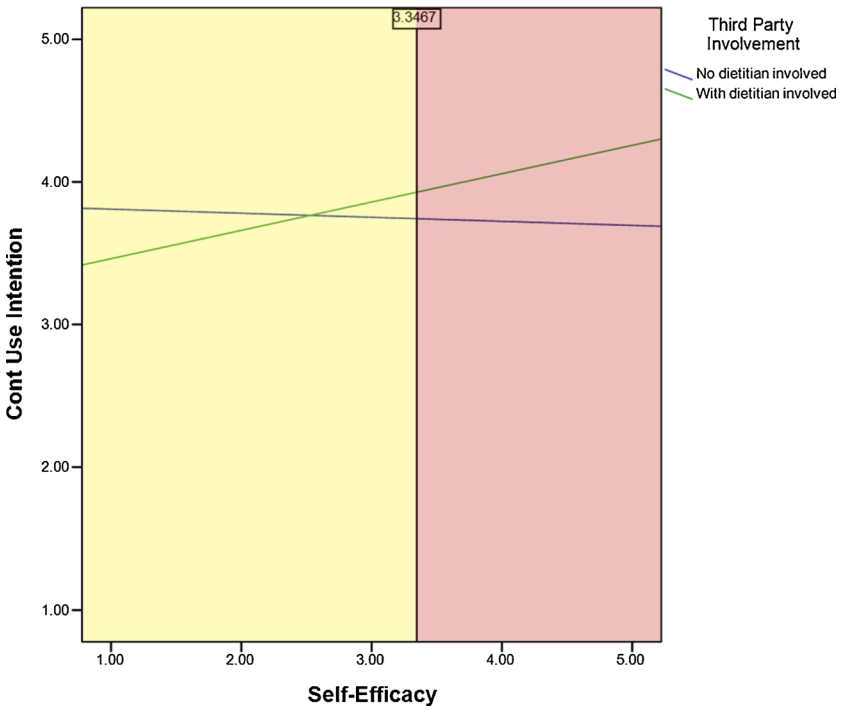

Fig. 4. Self-efficacy as a moderator of dietitian involvement effect.

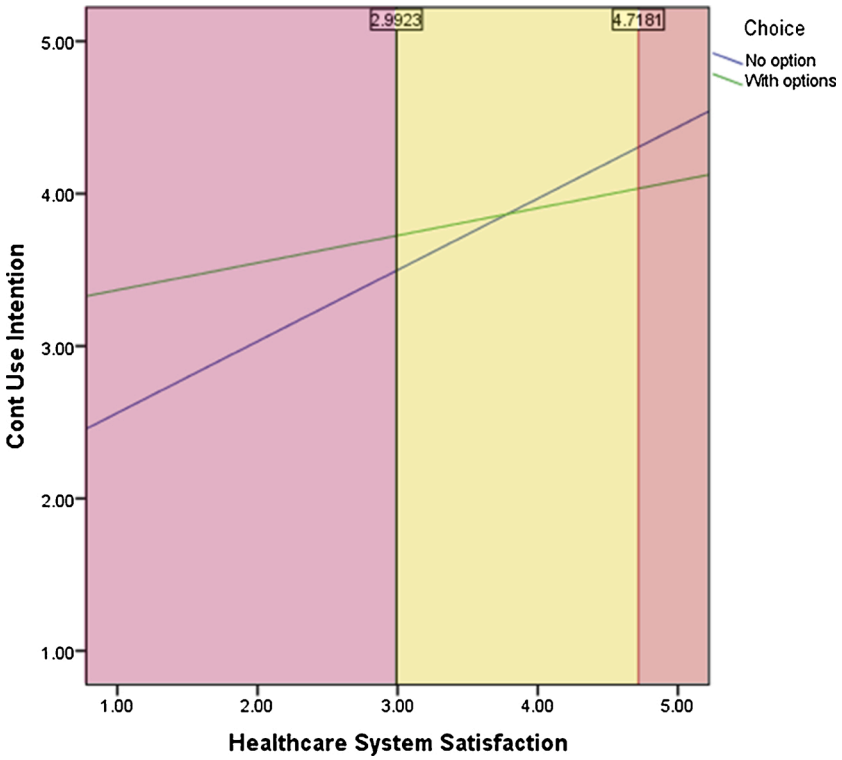

Fig. 5. Service system satisfaction as a moderator of the choice effect.

actors in co-creating value. The findings of this study show that the interactions between users and a dietitian enabled by the wearable device can generate increased intention to continue use. This view strengthens the S-D logic axiom on the actor-to-actor (A2A) view (Vargo & Lusch, 2016) that value creation is interactional and that the user is an active participant in integrating resources in the final determination of value (Botti, Grimaldi, & Vesci, 2018).

6.2. Implications for practice

The findings of this research have implications for practice, particularly for wearable health service providers. Providing more features does not necessarily lead to successful business cycles. For example, for users who aim to keep their bodies in good shape mostly by jogging, providing over twenty sport modes may even lead to the attrition of the

Table 7
Summary of hypothesis testing.

Hypotheses		Hypothesis Results
H1a	A WFT user granted by options has higher continued use intention compared to those without options.	Rejected
H1b	A WFT service involved with healthcare professionals results in higher continued use intention compared with that of no involvement.	Accepted
H1c	There is an interaction effect between choice and the involvement of healthcare professionals in shaping continued use intention. When a professional is present, a user is more likely to continue using the device along with the choice offered. However, when no professionals is present, the intention to continue using the device is higher when choices are not offered.	Accepted
H2a	The impact of choice on continued use intention is moderated by self-efficacy in maintaining personal health. Being provided with options (versus no options) will enhance continued use intention when self-efficacy is high.	Rejected
H2b	The impact of the involvement of healthcare professionals on continued use intention is moderated by self-efficacy. The involvement (versus no involvement) of healthcare professionals will enhance continued use intention when self-efficacy is high.	Accepted
H3a	The impact of choice on continued use intention is moderated by healthcare system satisfaction. Giving options (versus no options) will enhance continued use intention when healthcare system satisfaction is high.	Partially Accepted
H3b	The impact of involving healthcare professionals on continued use intention is moderated by service system satisfaction. The involvement (versus no involvement) of healthcare professionals will enhance continued use intention when healthcare system satisfaction is high.	Rejected

device due to overwhelming and irrelevant features. Wearable service providers should provide features that create value most effectively and efficiently, such as the involvement of healthcare professionals.

The important role of dietitians as value enablers is highlighted in the fitness wearable industry. The market provides several features that rely on automated feedback, such as asking users to run several kilometres to burn the targeted calories. However, this automated feedback may create aversions when it appears in inappropriate situations, such as when the user feels emotionally exhausted, is in a non-conducive environment for exercise, or has no spare time. Therefore, high-touch feedback, such as humanized advice from a dietitian, is more context-sensitive and effective. This professional advice can be linked to user activity records to provide meaningful feedback.

Our results suggest that is better not to offer choice unless there is dietitian feedback to avoid users' confusions in exercising their agency without appropriate reliable resources. The dietitian feature promotes users' autonomy to decide the most appropriate actions for their own physical health with the presence of choice. We suggest that service providers and designers can, based on the presence of healthcare professionals, provide action buttons or options to give a higher sense of stickiness to the device.

The presence of dietitians clearly has a positive impact on users' continued use intentions. Meanwhile, we acknowledge that remote health monitoring is still not universally covered by insurance plans (Ambrosino & Fracchia, 2017; Mann, Chen, Chunara, Testa, & Nov, 2020). We hope that with the growing evidence provided by other literature and our research, payments for healthcare professionals' services delivered via WFT may be on healthcare payers' agendas in the near future.

This study encourages wearable service providers and designers to consider the larger healthcare service ecosystem and assess whether the potential consumers have a certain level of efficacy and whether their surrounding health service systems are satisfactory. For a population that has high satisfaction with the healthcare service system, involvement of dietitians can be offered. However, for a population that has lower satisfaction with the healthcare service system, dietitian involvement should be offered together with choices presented to the user to maximize the positive value outcomes of WFT.

Privacy is an on-going concern in many third-party health applications, including WFT (Ambrosino & Fracchia, 2017; Atreja, Otobo, Ramireddy, & Deorocki, 2018; Powell, Henstenburg, Cooper, Hollander, & Rising, 2017). Data collected by WFT devices, such as individuals' diets and exercise routines, can be sensitive, such as individual's diet and exercise routine (e.g., context-sensitive information) and individuals' critical health data such as body weight, oxygen saturation, and blood pressure (e.g., health critical data). Privacy protection should be a joint effort and come from either service providers or national regulations to set up more strict policies on data protection. The healthcare industry is moving toward value-based population care, and technology continues to improve and will become a mainstream tool for healthcare delivery soon. As technology keeps penetrating our daily lives, witnessed by the prevalence of smart cities and smart homes, we believe that more mature policies and regulations will be in place. On the other hand, people may find a way to enjoy the benefits brought by technology while managing their privacy concerns (Kamphof, 2017).

6.3. Limitations and future research direction

This study has several limitations, partially related to data collection and analysis. First, this study uses a cross-sectional survey to obtain data and measure latent variables, such as continued use and healthcare service system satisfaction. This method may introduce bias to the findings. Secondly, this study is conducted in a single-country setting, which may generate homogeneous user perceptions on wearable services, as well as homogeneous perceptions of healthcare system satisfaction. Thirdly, this study only considers registered dietitians as the healthcare professionals and the results may not be applicable to WFT devices that provide services from other types of healthcare professionals.

Several promising research directions may arise from the findings of this study. Firstly, future studies could use longitudinal observational approaches to obtain objective data on continued usage. Collecting observational data may be more beneficial in measuring cumulative customer journeys and actual behavioural outcomes.

Secondly, future research could assess to what extent dietitians can be involved in the WFT service and what other types of healthcare professionals, such as cardiologists and physical therapists, may be included. This extension may provide additional insights into how customers perceive the value of different health services linked to their physical records. The feasibility of dietitian interactions with the user can be leveraged through the increase use of Artificial Intelligence for personalized feedback, continuous monitoring, and integration with the data that has been successfully implemented in similar health applications.

Thirdly, further research should replicate this study design to examine the effects of different types of choice, such as dichotomous choice vs. moderately sized sets of choices, and test the effectiveness of different types of choices on user empowerment. Lastly, cross-country comparisons that involves countries with various national healthcare scheme could be explored to determine the effect of the macro healthcare system.

7. Conclusion

This paper has highlighted the importance of examining actor-to-actor interactions in a service system and users' agency in shaping health behaviours when using WFT devices. This study contributes to the literature by providing empirical evidence in value co-creation practices that addresses squarely the A2A interactions, both human-to-human and human-to-technology interactions. The study found that

the involvement of healthcare professionals was an important value co-creation enabling feature that increase continued use intention. The presence of a dietitian makes the provision of choice effective and is essential in increasing continued use intention.

Individual factors, whether either internal or external, play a moderating role in A2A interactions. This research examined two individual factors: self-efficacy in health management and satisfaction with healthcare systems. With additional dietitian feedback on the device, individuals with higher self-efficacy are motivated to keep using the device. Additionally, when users' satisfaction with the broader healthcare systems is low, providing options as device features may deliver higher perceived value and increase continued use intentions. This research represents a significant advance in the general theoretical understanding of the effects of features that enable value co-creation in wearable continued use intention. The paper also contributes to existing IS literature by reinforcing the understanding of continued use intention rather than just adoption, taking the perspective of value-co-creation. These findings may help service providers identify strategies to create features that allow users to exercise their agency, prompting the sustained use of fitness wearables.

Authorship statement

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript.

List of Authors: N.A. Windasari, F.R. Lin, Y.C. Kato-Lin

N.A Windasari developed the conceptual framework, performed the data collection and analysis. F.R Lin and Y.C. Kato-Lin supervised the work and writing. All authors discussed the results and contributed to the final manuscript.

Appendix A

Variable/Items
Continued Use Intention (adapted from Bhattacherjee, 2001**)**
1 I intend to continue using the described wearable fitness tracker for the purpose of maintaining my personal health
2 I would like to recommend my friends and families to use the described wearable fitness tracker
3 I intend to increase my usage of the wearable fitness tracker in the future
4 (Assume that I have used the described wearable for six months) I want to keep using the wearable fitness tracker
Self-efficacy (adopted from Schwarzer & Renner, 2000**)**
I am certain that….
1 I can keep myself healthy, even if I do not use any health device or apps
2 I can manage to carry out my exercise, even when I do not use any health device or apps
3 I am aware of my own health conditions, even when I do not use any health device or apps
Service system satisfaction (adapted from the National Statistics Opinions and Lifestyle Survey, 2012**)**
Overall, how satisfied are you with …
1 the quality of your living environment (e.g., water quality, air quality, noise)
2 surrounding health facilities (e.g., jogging tracks, gym, etc)
3 the local health service (e.g., general practitioner, local clinics, hospitals)
4 the recreational (public spaces) or green areas in the place where you live

Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ijinfomgt.2020.102292.

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