Beyond Hedonic Enjoyment: Conceptualizing Eudaimonic Motivation for Personal Informatics Technology Usage

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Abstract. Personal informatics technologies (PITs) have become popular tools that enable people to monitor and track themselves. By providing self-knowledge, PITs increase self-control, foster insight, and promote positive behavioral changes. The pursuit of knowledge about self, excellence, and self-growth is eudaimonic because it makes a person more capable and well informed. Considering the unique technological characteristics, research suggests that eudaimonic motivation should be considered in explaining PIT usage. However, despite increasing scholarly attention being paid to the eudaimonic nature of PITs, a systematic approach to developing a research construct that reflects a PIT user's eudaimonic motivation is lacking in computer-human interaction research. To fill this gap, drawing on the theory of aesthetic experience, we propose a multi-dimensional construct of aesthetic experience to conceptualize eudaimonic motivation for PIT usage. Based on its conceptual definition, we develop the measures to capture the extent of a PIT user's aesthetic experience and empirically examine the construct validity. Compared with widely examined antecedents of technology usage—perceived usefulness, perceived ease of use, and perceived enjoyment—this study shows that a PIT user's aesthetic experience is a key determinant for intention to use. Notably, perceived enjoyment loses its predictive value in favor of aesthetic experience. Our findings suggest that the eudaimonic nature of a PIT should be considered in understanding technology usage.

Keywords: Personal informatics technology · Eudaimonic motivation · Intrinsic motivation · Hedonic enjoyment · Aesthetic experience

1 Introduction

Along with the proliferation of wearable technologies and gamified applications designed for self-tracking and self-monitoring, personal informatics technologies (PITs) have become increasingly popular [15, 17, 25, 38]. People track and analyze data, including mood (MoodScope, https://www.moodscope.com), finances (Mint, http://mint.com),

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food (MyFitnessPal, https://www.myfitnesspal.com), weight (FitDay, http://www.fitday.com), and physical activity (Garmin, http://www.garmin.com) [13, 31, 36]. These emerging personal tools provide users with a means of exploring and reflecting on information about themselves, thus helping them experience self-improvement [12, 25]. The pursuit of knowledge about self, excellence, and self-growth is eudaimonic because it makes a person more capable and well informed [48, 49]. According to the positive psychology literature [2], self-fulfilling and goal-driven tasks, such as PIT usage, require users to perceive the eudaimonic value rather than the hedonic or instrumental value from technology use [10]. Thus, we argue that eudaimonic motivation should be incorporated into the human-computer interaction (HCI) literature. However, a long-standing tradition in HCI research is to understand information technology usage from two key perspectives: productivity-oriented (utilitarian) motivation and pleasure-oriented (hedonic) motivation. Utilitarian motivation leads users to believe that a given information technology offers external benefits to them, such as task performance, productivity enhancement, prestige, and positive evaluations from others [20, 47]. Hedonic motivation allows users to derive a sense of enjoyment from the use of technology, and it causes a user to become psychologically absorbed while using the technology [22], which leads to a kind of psychological "flow," a sense of merging with the interaction with an information technology [22, 28].

Motivated by the need to incorporate eudaimonic motivation with information technology usage, in this paper, we propose a construct labeled aesthetic experience. This construct derives its theoretical bases from the intrinsic motivation literature. Similar to other intrinsic motivation variables, we posit that aesthetic experience is a key determinant for PIT usage. Given that the construct of aesthetic experience remains new in the HCI literature, we begin by reviewing the concept of AE, highlighting its theoretical foundations in the intrinsic motivation literature. This is followed by arguments justifying the role of aesthetic experience in the technology use model. An operational definition of the multidimensional construct is developed, and the scale development process for the measures of aesthetic experience is presented as well. The role of a user's aesthetic experience is empirically examined by testing a model that explains PIT usage with data collected from around 194 PIT users. The results of this study show that aesthetic experience plays a critical role in explaining an individual's intention to use a PIT. This study contributes to research on information technology usage by introducing the concept of aesthetic experience, extending scholarly attention from pleasure-oriented hedonic motivation to eudaimonic motivation, which allows users to reflect better on their technology usage behaviors. This study also contributes to the industry by offering design guidelines for promoting users' intrinsic motivations for PIT usage.

2 Theoretical Background

PITs are defined as "those that help people collect personally relevant information for the purpose of self-reflection and gaining self-knowledge" [24, p. 558]. PITs afford technological functions for self-tracking and self-monitoring to enable users to observe and record their own actions, thoughts, and emotions [37]. Commercial apps and tools (e.g., Galaxy Gear, iWatch, Nike FuelBand, Garmin VvioFit, and Jawbone Up) are recent

examples of the PITs designed for gaining insights and understanding oneself [7, 38]. The primary purpose of PITs is to help users improve self-knowledge by providing a personal history and tools for its review or analysis [26]. Therefore, PITs require prolonged use to reap the benefits from technology usage [17]. However, evidence shows that around half of users stop using the PIT within six months after purchase [35]. Hence, the understanding of what motivates users to continue using PITs is important [41, 50].

2.1 Intrinsic Motivation

An individual experiences eudaimonia when his or her activities are most congruent with deeply held values and are fully engaged [10, 39]; Eudaimonia is characterized by the pursuit of excellence, virtue, and self-realization [3, 49]. Several concepts have been introduced to reflect eudaimonic motivation. Waterman [48] introduced the concept of personal expressiveness (PE) to reflect eudaimonia, arguing, "PE signifies self-realization and is expected to occur specifically in connection with activities affording opportunities for individuals to develop their full potentials, that is, further the development of their skills and talents, advance their life purposes, or both" (p. 680). Waterman [48] showed that measures of hedonic enjoyment and PE were strongly correlated, but were indicative nevertheless of distinct types of experiences. For example, although both PE and hedonic enjoyment measures were associated with positive emotions and self-fulfillment, it was found that PE was more closely related to activities that enabled personal growth and development. While Waterman [48] successfully distinguished hedonic enjoyment from eudaimonic happiness by proposing the concept of PE, his conceptualization of PE mainly focused on one's life outcomes rather than on motivation. Ryff and Keyes [40] identified six distinct aspects of human actualization (eudaimonia): autonomy, personal growth, self-acceptance, life purpose, mastery, and positive relatedness. However, Ryff and Keyes [40] focused on quality of life in terms of well-being rather than motivation. Although these researchers commonly showed when pursuing personal goals, feeling hedonic enjoyment may be disconnected from feeling a sense of self-growth, a concrete conceptualization of eudaimonic motivation has yet to be made.

2.2 Conceptualizing Eudaimonic Motivation

In this study, drawing on the theory of aesthetic experience [11], we propose the concept of aesthetic experience as a manifestation of one's eudaimonic motivation for PIT usage. Aesthetic experience is defined as a self-fulfilling state in which a person feels a sense of meaning and deeply understands the essence of the experienced events [4, 21]. Given that the concept of aesthetic experience reflects a user's sense of self-growth and self-fulfillment while interacting with a technology [5, 29, 33], we conceptualize an individual's aesthetic experience as eudaimonic motivation for PIT usage. Through an extensive literature review [4–6, 14, 21, 42], we identify three dimensions that characterize aesthetic experience: self-expansion, meaningfulness, and active discovery. These three dimensions reflect the overall extent to which a user feels he or she is having an aesthetic experience aesthetic while interacting with a PIT.

3 Modeling Aesthetic Experience as a Determinant for PIT Usage

We build on the technology usage model developed by Van der Heijden [46] that explains information technology usage with a focus on intrinsic motivation. The baseline model has been widely adopted to explain information technology usage for different types of information technologies, including utilitarian, hedonic, and hybrid information technologies [8, 44]. By adding the construct of aesthetic experience as an individual's eudaimonic motivation for PIT usage to the baseline model, we test the validity of the construct of aesthetic experience as another type of intrinsic motivation for information technology usage, as shown in Fig. 1. This model plays an important role in clarifying the nomological network of the construct, aesthetic experience. In this model, perceived enjoyment (PEN) was used to capture hedonic motivation, and aesthetic experience was used to capture an individual's eudaimonic motivation for PIT usage. Because the main objective of this research is to test the validity of the construct (aesthetic experience) and the relationships between variables used in the baseline model have been well established and extensively examined in the previous studies, we develop hypotheses in relation to the focal construct.

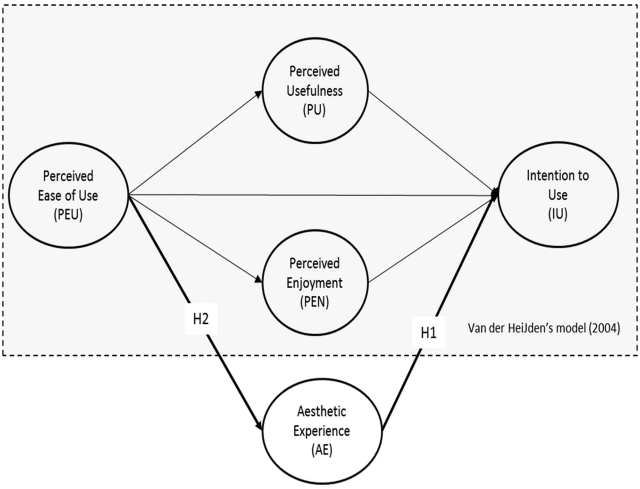

Fig. 1. Research model (the new relationships related to aesthetic experience are highlighted)

PITs enable users to receive immediate and granular feedback about their activities and to track their performance outcomes, which gives them a sense of accomplishment [30]. Previous PIT research has found that PIT users track their activities to determine what goals would be appropriate to pursue or what actions they should take to experience self-improvement [25]. The congruence of human activities with self-growth and deeply held values is a fundamental, first-order goal pursued for its own sake, which is called eudaimonic [39]. On this basis, we posit that eudaimonic motivation is a predictor of PIT usage. According to the theory of aesthetic experience [11], people are

more likely to engage continuously with an activity or object when they enter a state of an aesthetic experience—a state of mind in which a user's eudaimonic need for self-progress is fulfilled [21]. Therefore, we infer that aesthetic experience is a valid predictor of one's intention to use.

H1: Aesthetic experience is positively associated with intention to use.

Perceived ease of use is an assessment of the mental effort involved in the use of an information technology [46]. Research has found that perceived ease of use enables users to focus on the interaction with an information technology and not on objectives external to this interaction, regardless of whether the technology is designed for productivity, fun, or both [28]. This has important ramifications for the role of perceived ease of use in predicting the use of PITs. Given that the ultimate goal of a PIT is to make positive behavioral changes by allowing users to reflect upon and extract meaningful insights from the data they collect, user-system interaction is critical [25]. Accordingly, perceived ease of use is a prerequisite to incur AE in the context of PIT usage.

H2: Perceived ease of use is positively associated with aesthetic experience.

4 Scale Development

A systematic and rigorous approach to developing research constructs and validating their measurement instruments are prerequisites to advancing knowledge in relation to technology usage [30, 32]. In this study, we adopt Churchill's [9] approach to develop measures of aesthetic experience. According to Churchill [9], scale development and validation is a longitudinal process that begins with scale construction. The scale is then subjected to a systematic assessment of reliability, validity, and generalizability.

4.1 Domain Specification

As the first step in scale development, we specified the domain of the construct [34]. In this study, we defined aesthetic experience in the use of PITs as the extent to which a user feels his or her needs for a sense of self-expansion, meaningfulness, and active discovery are fulfilled in interactions with a particular PIT.

4.2 Item Generation

As the second step, we generated measurement items for aesthetic experience based on a review of the relevant literature, which resulted in an initial pool of nine items intended to capture the three dimensions of aesthetic experience. Five experienced researchers were invited to evaluate the content validity of each item with respect to our conceptual definitions of the three dimensions of aesthetic experience in the context of PIT usage. They were requested to classify the items into the corresponding dimensions of aesthetic experience. Cohen's kappa and the item placement ratio were assessed to test the validity of the scale. As shown in Table 1, the kappa index for all items was greater than 0.65 [45].

Table 1. Results of card sorting (Kappa coefficient)

		Degree of agreement
Judge	Judge	Kappa
1	2	.862
1	3	.732
1	4	.725
1	5	.100
2	3	.688
2	4	.688
3	4	.701
4	5	.872

4.3 Scale Evaluation

As the third step, we conducted a pilot study by distributing an online questionnaire to 60 PIT users; they were not involved in the previous stages of scale development for review and refinement. Cronbach's alpha was calculated for assessing the validity and reliability of the scale. As shown in Table 2, the scale reliability met conventional standards of internal consistency [19], with a Cronbach's alpha value greater than 0.70.

Table 2. Cronbach's alpha

	Number of items	Cronbach's alpha
Self-expansion	3	.778
Meaningfulness	3	.804
Active discovery	3	.810

5 Full-Scale Field Study

After we refined the scale items based on the participants' feedback in the pilot test, we conducted a full-scale field survey. An online survey company was commissioned for data collection, targeting PIT users with an email invitation soliciting participation in the survey. The PIT users were contacted in an online community in which members share their experiences in using PIT, such as iWatch, Galaxy gear, and Xiaomi smart bands, to track, monitor, and visualize their activity records. To minimize the effects of PIT types, we included users who have used PITs for healthcare and fitness in the survey. We asked participants to write down the name of the PIT they currently use most often and keep the particular PIT in mind while answering the survey questions. The survey ended after 235 valid responses were gathered. After removing 41 responses that contained unanswered items, 194 responses were used for the final analysis. Table 3 summarizes the demographic characteristics of the respondents.

Table 3. Demographic characteristics

Item	Category	Frequency	Ratio (%)
Gender	Male	127	65.5
	Female	67	34.5
	Total	194	100.0
Age	21–30	26	13.4
	31–39	72	37.1
	40–49	66	34.0
	>=50	30	15.5
	Total	194	100.0
Education	High school	17	8.8
	College (2 year)	10	5.2
	College (4 year)	149	76.8
	Graduate	5	2.6
	Above	13	6.7
	Total	194	100.0
Occupation	Student	11	5.7
	Office worker	147	75.8
	Self-employer	11	5.7
	Others	25	12.9
	Total	194	100.0
PIT device used	iWatch	41	44.3
	Galaxy Gear	86	21.1
	Mi Band	44	22.7
	Fitbit	14	7.2
	Others	9	4.6
	Total	194	100.0

5.1 Model Testing

We used the partial least squares (PLS) approach for validating the measurement model and the structural model. Following the two-step analytical approach, we first performed a psychometric assessment of the measurement model, followed by an evaluation of the structural model. This approach allows for more confidence in concluding that the structural relationships are drawn from a set of measurement instruments with desirable psychometric properties [19].

5.1.1 Measurement Model

We tested he measurement model by examining convergent and discriminant validity. Convergent validity refers to the extent to which the items on a scale are theoretically related. We assessed convergent validity using three criteria: (1) composite reliability (CR) should be at least 0.70, (2) the average variance extracted (AVE) should be at least 0.50, and (3) all item loadings should be greater than 0.70 [16]. As shown in Table 4, all the criteria for convergent validity were met, with CR values ranging from 0.710 to 0.921

and AVE values ranging from 0.678 to 0.797. As shown in Table 5, all item loadings are higher than 0.70, except three items for perceived enjoyment (PEN 3, 4, 6) used as reversed items with loading values of less than 0.7. The results imply that the reversed items do not properly reflect the perceived enjoyment construct in the context of PIT usage. Accordingly, we have removed the three reversed items from the final analysis. Because previous studies, such as Lee et al. [23], have used the items (PEN 1, 2, 5) as perceived enjoyment, we do not believe that the exclusion of the three reversed items from perceived enjoyment threatens the validity of the measurement model.

Table 4. The psychometric properties

	AVE	CR	AE	IU	EOU	PEN	PU
AE	0.797	0.921	**0.893**				
IU	0.753	0.902	0.758	**0.868**			
EOU	0.743	0.710	0.317	0.257	**0.862**		
PEN	0.723	0.887	0.770	0.643	0.327	**0.850**	
PU	0.678	0.894	0.756	0.699	0.305	0.698	**0.823**

Note:
(a) The square root of the AVE of each latent construct is given in diagonals
(b) CR: Composite Reliability; AVE: Average Variance Extracted; AE: Aesthetic Experience; IU: Intention to Use; EOU: Perceived Ease of Use; PEN: Perceived Enjoyment; PU: Perceived Usefulness.

Discriminant validity is the degree to which a scale measures the variable it intends to measure. It is indicated by low correlations between the measure of interest and the measures of other constructs [16]. Discriminant validity is demonstrated when the squared root of the average variance extracted for each construct is greater than the correlations among it and all other constructs. In Table 4, the square root of the AVE for each construct is located in the diagonals of the table. The value for each construct was higher than the correlations between it and all other constructs, suggesting sufficient discriminant validity.

5.1.2 Structural Model

Following the confirmation of good psychometric properties in the measurement model, we examined the structural model to assess the explanatory power of the constructs and the significance of the posited paths. By modeling aesthetic experience as a PIT user's eudaimonic motivation, we expected a positive influence on intention to use. We first tested the base-line model, as shown in Fig. 2. The two main factors associated with the model—perceived usefulness (utilitarian motivation) and perceived enjoyment (hedonic motivation)—explained 54% of the variance in intention to use. The results are consistent with those of Van der Heijden [46], except for the path between perceived ease of use and intention to use.

Table 5. Item loadings and reliability

Construct	Item	Loading	t	Cronbach's α
Aesthetic experience	AD	0.938	115.154	0.790
	MEA	0.899	52.763	
	SE	0.838	29.375	
Perceived enjoyment	PEN1	0.885	40.943	0.89
	PEN2	0.854	43.479	
	PEN5	0.810	19.815	
Intention to use	IU1	0.864	45.063	0.836
	IU2	0.875	44.860	
	IU3	0.865	46.519	
Perceived usefulness	PU1	0.849	40.194	0.842
	PU2	0.823	28.753	
	PU3	0.795	26.586	
	PU4	0.826	28.979	
Perceived ease of use	EOU1	0.831	48.613	0.706
	EOU2	0.864	35.432	
	EOU3	0.893	27.568	

To test further the proposed model, we subjected the validated measures for AE to PLS. The results showed that perceived ease of use was positively associated with AE ($b = 0.327$, $p < 0.001$), which in turn positively influenced intention to use ($b = 0.466$, $p < 0.001$), supporting H1 and H2. Figure 3 presents the results of the PLS analysis for the hypothesis test. The results also show that the positive effect of perceived enjoyment on intention to use was crowded out by AE. Compared to perceived usefulness, AE has a stronger predictive value to explain intention to use (approximately 1.7 times as much).

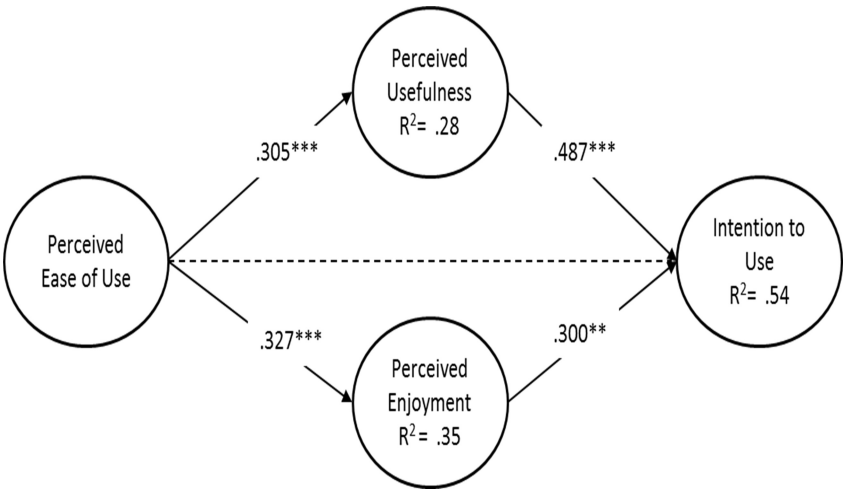

Fig. 2. The baseline model

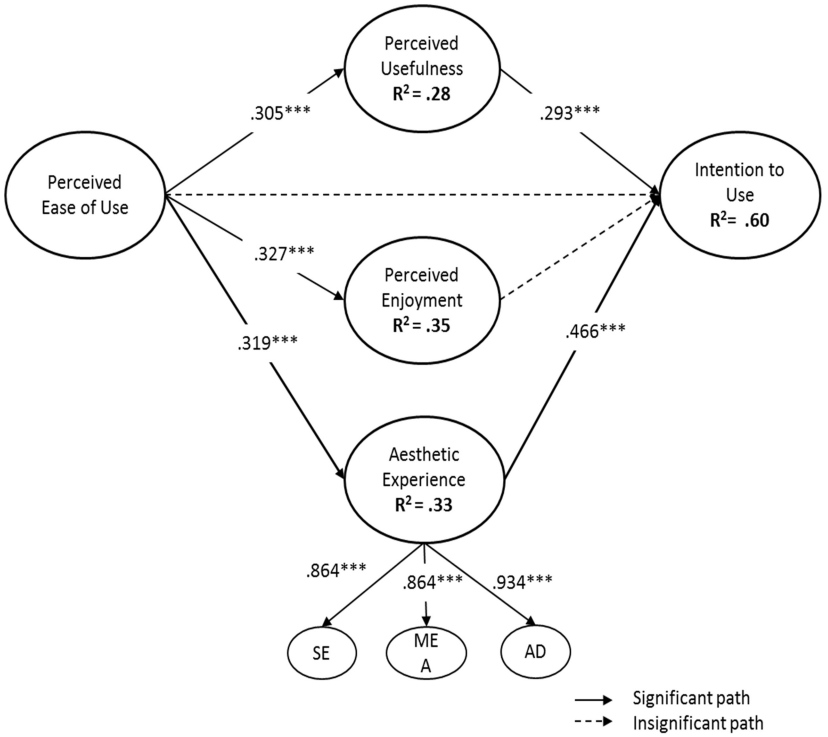

Fig. 3. The structural model

6 Discussion

Motivated by the need to understand how eudaimonic motivation plays a role in explaining PIT usage, this study proposes a multidimensional construct, aesthetic experience, to capture a user's sense of self-growth and self-fulfillment while interacting with technologies. The newly developed nine-item scale of aesthetic experience was empirically validated, with sufficient psychometric properties. The construct was also tested in a nomological network in which the aesthetic experience when using a PIT was found to be a critical determinant of intention to use. In other words, the result of this study demonstrates that the eudaimonic motivation for PIT usage is a significant boundary condition for the technology usage model. It is noteworthy that perceived enjoyment lost its predictive value in favor of aesthetic experience.

The implication for further research is that attention should be paid to the important role of eudaimonic motivation. This research demonstrates that if a technology affords users the opportunities to track, monitor, and reflect on their activities and thus help them to experience self-improvement, eudaimonic motivation should be considered an important determinant for intention to use. This finding suggests that progress in technology usage models can be made by focusing on the emerging nature of technology (eudaimonic) in addition to utilitarian and hedonic motivations.

6.1 Implications for Research

This study has advanced our theoretical understanding of information technology usage. In this study, we demonstrated that the eudaimonic motivation is an appropriate extension of current IT usage research. Although there has been a call for an exami-nation of the different types of intrinsic motivation in relation to technology acceptance and use [18, 22], past studies have focused primarily on utilitarian and hedonic motivation [e.g., 1, 46, 51]. The role of eudaimonia motivation has not received much scholarly attention in the field of HCI. This study contributes to the development of motivation theory by conceptualizing eudaimonic motivation and validating its predictive power for PIT usage. Furthermore, by empirically showing that the construct of aesthetic experience can serve as a reliable theoretical concept to explain PIT usage intention, this study complements existing concepts aimed at facilitating technology usage.

6.2 Implications for Practices

As technological developments provide new affordances that facilitate individuals' intrinsic motivation for self-growth and development, the importance of experiences that are intrinsically motivating, i.e., self-fulfilling and self-improving in and of themselves, might dominate as predictors of technology usage. Although the scope of the present study was limited to PITs for personal healthcare and fitness, our model can apply to diverse contexts in which people use technology for self-improvement by tracking, monitoring, and reflecting on their cognitive and physical activities. This study provides insight into work environments because many organizations have incorporated PIT components into their existing information systems to facilitate employees' intrinsic motivation for enterprise technology usage [42, 43]. Information systems developers and managers who wish to implement successfully a new enterprise system need to be cognizant of users' eudaimonic motivation and strive to provide technological functions to support users' needs for self-improvement.

6.3 Limitations and Future Research

Although this study contributes to the HCI literature by proposing the concept of aesthetic experience to conceptualize one's eudaimonic motivation for PIT usage, its predictive power for intention to use may vary depending on the purposes of PITs. We call on researchers to examine our model in different PIT usage contexts to ensure the generalizability of the proposed model. Second, our data were collected from a single source, and all research constructs were measured by respondent perceptions. To alleviate concern of regarding the common method bias (CMB), objective data on PIT users' actual usage behaviors would provide insight into how intrinsic motivations affect actual technology usage. Finally, we surveyed active members of a PIT community; they may have had a relatively positive experience compared to those not attracted to PITs. Future research could widen the applicability of this study by including data obtained from people who ended their PIT usage due to negative experiences.

7 Conclusion

This study empirically demonstrates that eudaimonic motivation differs from hedonic motivation, as captured by perceived enjoyment, and it has a stronger predictive power than utilitarian motivation for technology usage. Based on the findings of this study, we argue that although utilitarian and hedonic motivations appear meaningful forces for technology usage, people are more likely to use a PIT because of eudaimonic motivation. Hence, we suggest that technological functions that can facilitate one's eudaimonic motivation should be designed and implemented to ensure PIT usage.

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Appendix A. Measurement Items

Construct	Items	Sources
Self-expansion	1. The PIT increases my ability to accomplish new things 2. The PIT enables me to have a larger perspective on what I am doing 3. The use of PIT results in learning new things	Self-developed
Meaningfulness	1. The PIT makes my activities very important 2. The PIT makes my activities personally meaningful 3. My interaction with the PIT is meaningful	Self-developed
Active discovery	1. The PIT enables me to exercise powers of mind to address challenges 2. The PIT enables me to discover new paths to seek answers or resolution 3. The PIT enables me to be aware of how to proceed to fulfil my purposes	Self-developed
Perceived usefulness	1. The PIT is helpful for my health 2. The PIT helps me better track my health activities 3. The PIT provides useful information for my health 4. The PIT helped me change my health behavior	Adapted from Lowery et al. [28] and Van der Heijden [46]
Perceived ease of use	1. The use of PIT is easy 2. It is easy to learn how to use the PIT 3. It is easy to operate the PIT	Adapted from Lee et al. [23]

(*continued*)

(*continued*)

Construct	Items	Sources
Perceived enjoyment	1. The use of the PIT is enjoyable 2. I had fun using the PIT 3. Using the PIT was boring.* 4. The PIT really annoyed me* 5. The PIT experience was pleasurable 6. The PIT left me unsatisfied.*	Adopted from Lowery et al. [28]
Intention to use	1. I would plan on using the PIT in the future 2. I would intend to continue using the PIT in the future 3. I expect my use of it to continue the PIT in the future	Adopted from Lowery et al. [28] and Van der Heijden [46]

* Reversed items

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