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# **Affective Responses and IS Continuance**

*Completed Research Paper*

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## **Abstract**

*IS research increasingly recognizes that affective responses play an important role in explaining continuance intention. However, most research disregards the variety and complexity of affective responses. Encountering models with multiple affective responses included is scarce, and possible relationships among different affective responses are neglected. This paper develops a model measuring continuance intention in the context of fitness applications using three fundamentally different, but complementary affective responses: IS satisfaction, deep engagement, and meaningful engagement. An empirical investigation using an online survey is conducted. The findings demonstrate that different affective responses influence continuance intention in distinct ways, and that there are interrelations between affective responses. Deep engagement and IS satisfaction have a direct influence on continuance intention, and there is an indirect relationship between meaningful engagement and continuance intention mediated by IS satisfaction. Contributions to theory and practice are discussed.*

**Keywords:** continuance intention, affective response, fitness applications, user engagement

# **Affective Responses and IS Continuance**

*Completed Research Paper*

## **Introduction**

Continued use of an information system (IS) is crucial to its long-term viability (Venkatesh et al. 2011). The financial success of most IS, such as Netflix or Spotify, is not generated by user trial (Maier et al. 2022), but by continuing the use (Bhattacharjee 2001; Chiu et al. 2021). Many efforts have been put into developing a theory on what may influence IS continuance intentions to ensure this continued use (Bhattacharjee 2001; Bhattacharjee and Lin 2015). Research agrees that there are cognitive, affective and habitual factors relevant for IS continuance intentions (Bhattacharjee and Lin 2015). Recently, there has been growing interest in affective responses, which represent emotion driven influences associated with evocation of feelings and moods (Guinea and Markus 2009; Zhang 2013). For example, affective responses constitute for the extent to which users derive fun from an activity (Hsieh et al. 2008), or the overall pleasing experience of the IS (Bhattacharjee and Lin 2015). Affective responses are relevant for understanding IS continuance intentions, since they play role in human motivation (Reeve 2009), and thus are important for generating enough motivation for a user to continue using an IS (Guinea and Markus 2009; Suh et al. 2017). While cognitive responses – factors based on rational, reason-based thought processes such as the perceived usefulness of a system – are also established to play a crucial role in explaining continuance intentions (Guinea and Markus 2009), under some circumstances, affect can even have more explanatory power than cognitions, as people may exhibit greater similarity in their affective reaction than in cognition-based assessments (Pham et al. 2001; Zhang 2013).

However, most studies in that stream focus on only one affective response at the same time (Lee and Cho 2017; Martins et al. 2014; Venkatesh et al. 2012; Zhang 2013). Above that, certain types of affective responses, such as experiencing meaning and self-expansion, are underrepresented (Suh et al. 2017) and individual affective responses are different from each other (Russell 2003). This implies that they might have a different impact on IS continuance intention and ignores their unique underlying processes (Zhang 2013). Subsequently, studying one specific type of affective response does not represent the complexity of affective responses and may lead to inconclusive findings (Suh et al. 2017; Zhang 2013). We therefore focus on affective responses and study multiple different affective responses as antecedents of IS continuance. Hence, we aim to answer the following research question:

*How do different affective responses influence IS continuance intention?*

To answer this research questions, we investigate mobile fitness applications. In this context, IS continuance is crucial to see any progress in health related goals, since the human body needs repeated behavior to develop muscle mass and improve stamina (Chiu et al. 2021). Fitness applications are particularly suitable for this research because the motivations to adopt and continue using fitness applications are often affective in nature - like the desire to feel better mentally or regaining “feeling fit” (Molina and Myrick 2021). We construct a model based on the unified model of IS continuance (Bhattacharjee and Lin 2015) and research examining user engagement in the context of continuance intention (Suh et al. 2017). We split affective responses into three different types as to consider different dimensions (Zhang 2013) – IS satisfaction, deep engagement and meaningful engagement. We collect data via MTurk (N=180) and results show that the three affective responses have direct and indirect effects of continuance intention. This lets us contribute to IS continuance research by extending existing theories on IS continuance intention.

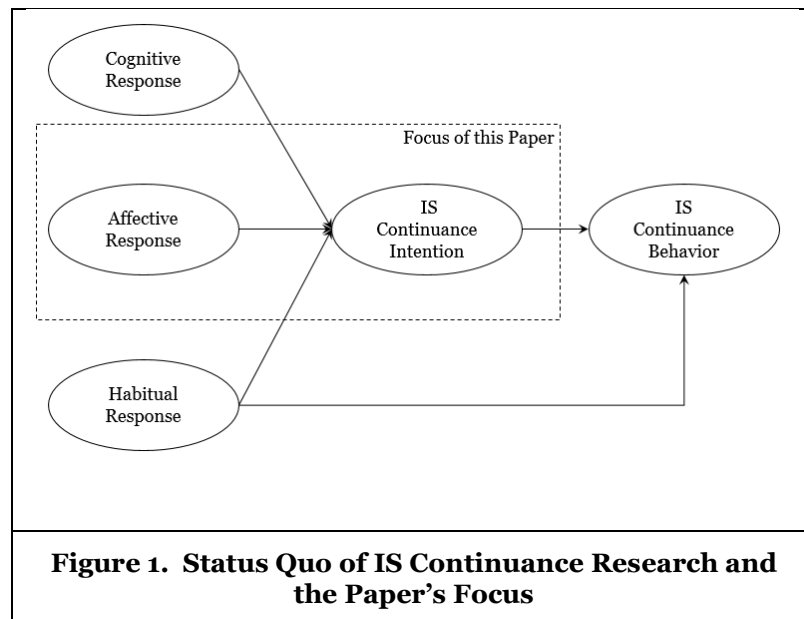
The remainder of this research paper is structured as follows. In section two, we present the relevant theoretical background. In section three, we propose a conceptual model featuring the three different types of affective responses to examine the effect affective responses have on continuance intention of fitness applications. In section four, we verify the model’s validity through an empirical analysis. Lastly, in section five, our contributions and venues for future research are discussed.

## Theoretical Background

### *Continuance and its' Explanations*

IS continuance – why users continue to use an IS for a prolonged period of time – has seen a steady growth of research interest in the last two decades (Bhattacharjee and Lin 2015; Guinea and Markus 2009; Söllner et al. 2022). Research in that stream agrees on three alternative influences to IS continuance: cognitive response, affective response, and habitual response. Together, they are summarized in the unified model of IS continuance (Bhattacharjee and Lin 2015). The *cognitive response* represents the very established research related to reasoned action, arguing that continuance intention originates from cognitive and planned actions (Ajzen 1991; Fishbein and Ajzen 1975). Accordingly, perceived usefulness and subjective norm have been identified as antecedents of continuance intention. Satisfaction with an IS is an *affective response*, resulting from the evaluation of prior experiences with the IS. Based on the comparison of expectations and their confirmation, a relation between IS satisfaction and disconfirmation is established (Bhattacharjee 2001). Disconfirmation, the extent to which the initial expectations are met, has a positive influence on both IS satisfaction and perceived usefulness (Bhattacharjee and Lin 2015). The unified model of IS continuance posits a distinction between continuance intention and actual continuance behavior. Continuance behavior is influenced by continuance intention and IS satisfaction. The *habitual response* originates from specific environmental cues that can trigger use. Habit moderates the relationship between continuance intention and continuance behavior, and additionally has a direct positive influence on continuance behavior.

The three interdependent and complementary influences of cognitive, affective and habitual responses identified in the unified model of IS continuance have proven to form a robust model for explaining IS continuance behavior and continuance intention. Figure 1 provides a simplified representation of the three perspectives. Although various research builds on the idea of affective responses and emphasizes that IS continuance may be influenced by behaviors not fundamentally cognitive (Bhattacharjee and Lin 2015; Guinea and Markus 2009; Zhang 2013), the relationship between cognitive responses and continuance intention still receives far more attention than the effect of affective responses on continuance intention (Venkatesh et al. 2011; Yuan et al. 2015). Bhattacharjee and Lin (2015) include IS satisfaction as the only affective response in their model, neglecting other potentially relevant affective explanations of continuance intention. In the next section, we elaborate on the definition of affective responses and the different types of affective responses we chose to augment this restricted view with.



## Affective Responses

Affect is an umbrella term for various concepts including emotions, moods and feelings (Zhang 2013), as well as evaluations and dispositions such as attitude and satisfaction (Guinea and Markus 2009; Zhang 2013). We focus on three affective responses: IS satisfaction, deep engagement, and meaningful engagement. These three affective responses are useful, as deep engagement and meaningful engagement are complementary and both deal with the interaction between an IS and an IS user (Suh et al. 2017). We complement this with IS satisfaction (Bhattacharjee and Lin 2015). Affective responses can be categorized along different dimensions, for instance whether they are temporarily constraint (Zhang 2013). While deep engagement is an affective state that is restricted to a particular moment in time, IS satisfaction and meaningful engagement describe an outcome-based evaluation of a system interaction. This combination of affective responses thus offers a unique perspective on different aspects of affect.

*IS satisfaction* is defined as “*affect, based on [...] [the user’s] confirmation level and expectation on which that confirmation was based*” (Bhattacharjee 2001, p. 353). If expectations are fulfilled or exceeded, users will be satisfied with the IS, evaluating the interaction with the IS as pleasing (Bhattacharjee and Lin 2015). IS satisfaction has been proven to be a salient predictor of IS continuance intention (Deng et al. 2010; Venkatesh et al. 2011). As such, IS satisfaction is an element of many established theories on IS continuance, including the unified model of IS continuance (Bhattacharjee and Lin 2015), the expectation-disconfirmation model (Bhattacharjee 2001), and the information systems success model (DeLone and McLean 1992). IS satisfaction focusses on the evaluation of affective quality of an IS (Zhang 2013).

*Deep engagement* represents states that describe how users feel in a particular moment. They are only temporarily present and gone after the environment or conditions related to the affective response change (Suh et al. 2017; Zhang 2013). Deep engagement captivates the users attention, drawing them in and engaging the user to further interact with the system (O’Brien and Toms 2008). It is an aspect of user engagement, which is an expression of the interaction between the user and the IS (O’Brien and Toms 2008). Deep engagement describes a user being totally involved with an IS (Suh et al. 2017). It is characterized by four dimensions. First, immersion, the extent to which the user becomes engaged to the point where the user stops being aware of themselves as separate from the actions performed. Second, time distortion, the extent of not being aware of past or future due to extreme focus. Third, control, the extent the user feels they are in control over the interaction with an object. Forth, enjoyment, the extent of pleasure associated with actions related to the interaction (Suh et al. 2017). To enhance enjoyment, the use of gamification elements in fitness applications has become increasingly popular (Huang and Ren 2020). Some fitness applications rely on haptic feedback to increase immersion (Martin-Niedecken and Mekler 2018).

*Meaningful engagement* goes beyond the specific context of the use itself and encompasses a bigger perspective on the activities performed (Suh et al. 2017). Based on the theory of aesthetic experience (Dewey 1934), meaningful engagement is defined by three dimensions. First, self-expansion, the extent to which users experience personal growth by accumulation of new knowledge and broadening the users’ perspective. Second, meaning, the extent to which the IS facilitates personal connections between the IS and the user which the user thus perceives as meaningful (Nicholson 2015; Suh et al. 2017). Third, active discovery, the “*extent to which an individual feels he or she is actively seeking answers or resolutions to cognitive challenges to achieve his or her personal goals*” (Suh et al. 2017, pp. 272 - 273). The core idea is that personal connections between the IS and the user are established. By doing so, meaning can be transferred into a real world context (Nicholson 2015). Framing activities as meaningful is key to an engaging IS interaction (McGonigal 2011; Mekler et al. 2013). This can be for instance achieved by embedding activities within a narrative by utilizing story-telling, or supporting users’ personal goals and interests (Mekler et al. 2013). In the context of mobile fitness applications, customization is a feature that can foster a personal connection between the application and the user (Bol et al. 2019). Data about an individual’s activity behavior can be tracked and used for the purpose of understanding oneself better through personally relevant data and thus self-expansion (Li et al. 2011). However, in the IS continuance context, meaningful engagement is not widely established, although results of existing research on meaningful engagement indicate that the affective response may be a key determinant of IS continuance (Chen et al. 2015; Suh et al. 2017). Meaningful engagement underlies less temporary constraints than deep engagement, and expands beyond a particular moment in time (Suh et al. 2017). For instance by facilitating self-growth, it possess capabilities to impact users even after the experience itself has passed.

## ***Fitness Applications and IS Continuance Intentions***

To investigate these different affective responses, we focus on the context of fitness applications. Meaningful engagement is applicable to contexts where the use of the IS is voluntary and seeks to increase self-awareness and behavioral change (Suh et al. 2017). Fitness applications like workout, exercise, or activity tracking apps are particularly suited to be examined under this theoretical lens. User motivations for the use of fitness applications are often related to changing aspects about themselves, such as improving appearance or well-being (Molina and Myrick 2021). Additionally, affective responses may also play a critical role especially in a fitness context, as previous research indicates that affective influences are important both as a mediator between cognitive decision making and physical activity, as well as an independent predictor of physical activity (Kiviniemi et al. 2007).

To achieve a better overview of the current state of research in the area, we conducted a literature review of research specifically dealing with fitness applications and continuance intention. While most research deals with adoption of fitness applications, there are some papers with a focus on continuance intention. Table 1 summarizes the direct antecedents of continuance intention used within the literature. Literature conducted in this area is fairly recent. For instance, some examinations apply the extended unified theory of acceptance and use of technology (UTAUT2) to the context of mobile fitness applications, which is the only case in which all three categories - cognitive responses, affective response, and habitual response - can be found (Damberg 2022; Soontornwat et al. 2016; Yuan et al. 2015). Social influence (Soontornwat et al. 2016), performance expectancy, price value, hedonic motivation, and habit are identified as significant predictors of continuance intention (Yuan et al. 2015). Health consciousness is identified as an additional driver extending the UTAUT2 in this context (Damberg 2022). The role of affective responses is limited to the singular construct of hedonic motivation, which constitutes for enjoyment and playfulness. In other cases, a gratification approach based on motivations to use fitness apps is utilized (Chen et al. 2020; Lee and Cho 2017). Tracking activities, user interaction, and acquiring information on fitness are named as motivations from which various antecedents of continuance intention can be derived: recordability, networkability, credibility, comprehensibility, and trendiness, none of which are affective responses (Lee and Cho 2017). Multiple studies (Chiu et al. 2021; Cho et al. 2020) base their research on the investment model, introducing the commitment, the “stickiness” to a relationship, in this case between user and IS (Chiu et al. 2021). Drawing on the technology acceptance model (TAM), another paper (Huang and Ren 2020) examines the direct and moderating role of exercise self-efficacy. A study particularly targeting young people shows that self-efficacy, outcome expectations, innovative propensity and engagement had a statistically significant positive effect on intention to continue using fitness apps (Park et al. 2018). A particularly recent publication integrates the expectation-confirmation model (ECM), TAM, and the Post-Acceptance Model of Information Systems Continuance (PAM-ISC) to explain fitness app continuance behavior in China (Cai et al. 2022). In the entire model, multiple affective responses such as self-development motivation, emotional motivation, trust and IS satisfaction among many cognitive responses can be found, although the only direct antecedent of continuance behavior identified is IS satisfaction. ECM is also used as the theoretical lens in other publications to conduct research on fitness applications (Gupta et al. 2021; Yousaf et al. 2021). Gupta et al. (2021) specifically focus on fitness wearables, combining ECM with social comparison theory, and finding that continuance intention is influenced by IS satisfaction and perceived usefulness. Yousaf et al.'s (2021) research involves a two-stage data collection process in pre- and post-adoption phases. The results show that continuance intention is influenced by IS satisfaction, perceived usefulness and technology self-efficacy. Lastly, research uses the idea of value co-creation to understand the effects of actor-to-actor interactions on continued use of wearable fitness technologies (WFT) (Windasari et al. 2021). Findings indicate a significant positive effect of dietitian involvement on users' intentions to continue using their WFT.

While some research considers affective responses - mostly IS satisfaction and enjoyment - to a certain degree, this literature analysis reveals that previously conducted research in this area does not have a focus on affective responses. When it comes to direct antecedents of continuance intention and often entire models, only one - if any - affective responses is considered, and there is seldom consideration of the relationships these responses may have among themselves. Most antecedents used in literature can be categorized as cognitive responses and the influence of different affective responses and their interplay is currently unknown. The present paper aims to close this research gap by concentrating especially on three different affective responses and their effect on IS continuance intentions.

Direct Antecedents of IS Continuance Intention	Type of Response	References
Enjoyment (Entertainment; hedonic motivation)	Affective	Damberg (2022), Huang and Ren (2020), Lee and Cho (2017), Yuan et al. (2015)
IS satisfaction	Affective	Cai et al. (2022), Chen et al. (2015), Chiu et al. (2021), Cho (2016), Cho et al. (2020), Gupta et al. (2021), Yousaf et al. (2021)
Commitment	Affective	Chiu et al. (2021), Cho et al. (2020)
Accuracy of information	Cognitive	Lee and Cho (2017)
Choice	Cognitive	Windasari et al. (2021)
Comprehensibility of information	Cognitive	Lee and Cho (2017)
Credibility of information	Cognitive	Lee and Cho (2017)
Effort expectancy	Cognitive	Damberg (2022), Yuan et al. (2015)
Exercise self-efficacy	Cognitive	Huang and Ren (2020), Park et al. (2018)
Facilitating conditions	Cognitive	Damberg (2022), Yuan et al. (2015)
Health concerns	Cognitive	Park et al. (2018)
Innovative propensity	Cognitive	Park et al. (2018)
Involvement of health care professionals	Cognitive	Windasari et al. (2021)
Networkability	Cognitive	Lee and Cho (2017)
Perceived ease of use	Cognitive	Cho et al. (2020), Huang and Ren (2020), Yuan et al. (2015)
Perceived health outcomes/ health consciousness	Cognitive	Damberg (2022), Gupta et al. (2021)
Perceived usefulness	Cognitive	Chiu et al. (2021), Cho (2016), Cho et al. (2020), Gupta et al. (2021), Huang and Ren (2020), Yousaf et al. (2021)
Performance expectancy/Outcome expectation	Cognitive	Damberg (2022), Park et al. (2018), Yuan et al. (2015)
Price value	Cognitive	Damberg (2022), Yuan et al. (2015)
Quality-related app characteristics	Cognitive	Park et al. (2018)
Recordability	Cognitive	Lee and Cho (2017)
Social influence (Trendiness)	Cognitive	Damberg (2022), Lee and Cho (2017), Park et al. (2018), Soontornwat et al. (2016), Yuan et al. (2015)
Technology self-efficacy	Cognitive	Yousaf et al. (2021)
Habit	Habitual	Chen et al. (2020), Damberg (2022), Soontornwat et al. (2016), Yuan et al. (2015)
<b>Table 1. Direct Antecedents of IS Continuance in Fitness Application Literature</b>		

## Research Model

To understand the influences of affective responses on IS continuance intention, we develop a research model which focuses on IS satisfaction, deep engagement, and meaningful engagement. Moreover, we hypothesize dependencies between the different affective responses.

Because deep engagement constitutes the optimal experience (Csikszentmihalyi and Bar 1990; Suh et al. 2017), users want to experience this state again and continue their use. Many fitness applications include elements and features specifically designed for more emotive concepts such as entertainment purposes (Yuan et al. 2015). When users are emotionally involved in an IS interaction, the user is motivated to use the IS more (Wu and Holsapple 2014). Even though one might use the application for the purpose of fulfilling a particular fitness goal, experiencing fun and enjoyment along the way makes the use more appealing (Yuan et al. 2015). Deep engagement has been shown to be an indirect and direct antecedent of IS continuance intention in a variety of contexts. This includes e-learning (Guo et al. 2016; Rodríguez-Ardura and Meseguer-Artola 2016), mobile games (Yang and Lin 2019), and mobile payment services (Zhou 2013). Based on empirical evidence both in other contexts as well as the fitness application context (Lee and Cho 2017; Yuan et al. 2015), we hypothesize the following:

*H1: The higher deep engagement, the higher continuance intention.*

When using fitness applications, users have the need to collect personally relevant data and reflect on themselves, which they then can leverage to identify and achieve personally relevant goals (Li et al. 2011). These needs directly correspond to elements of meaningful engagement. Establishing a personal connection between the user and the IS by providing the means to facilitate self-growth and progress on personal goals should make the user more interested in engaging with the IS for a prolonged period of time (Nicholson 2015; Suh et al. 2017). While there is empirical evidence of meaningful engagement influencing continuance intention in a gamification context (Suh et al. 2017), other theories also imply that experiencing meaning is relevant for IS continuance. Based on transformative learning theory, Nicholson (2015) argues that creating a meaningful experience for users is important to achieve long-term change in a users' behavior. For personal fitness in particular, meaningful interaction with the IS may be necessary to support long-term health goals (Niess and Woźniak 2018), which also implies a need for continued use of the IS. We hypothesize the following:

*H2: The higher meaningful engagement, the higher continuance intention.*

It has been established in IS research that if users evaluate the interaction with the IS as positive, they are more likely to continue using an IS (Bhattacharjee and Lin 2015). IS satisfaction has been identified as one of an important determinant of continuance intention (Bhattacharjee 2001). The assumption that satisfied users have a higher use level and are more likely to continue this use into the future also holds for the fitness applications context (Chiu et al. 2021). Supported by empirical evidence in fitness applications (Cho et al. 2020; Yousaf et al. 2021), as well as a variety of other contexts (Hong et al. 2011; Hu et al. 2015; Lankton et al. 2015), we propose the following hypothesis:

*H3: The higher IS satisfaction, the higher continuance intention.*

There are also many relationships between affective responses (Zhang 2013). For instance, the affect-as-information hypothesis, posits that judgements about one's life, which include satisfaction, can be influenced by momentary feelings and moods (Schwarz and Clore 1983). As deep engagement is a state restricted to a particular moment in time characterized by affects such as enjoyment, this implies for the IS context that deep engagement may influence IS satisfaction in the same way. Empirical evidence has shown that affective responses closely related to deep engagement – i.e. enjoyment, flow and cognitive absorption – influence IS satisfaction (Deng et al. 2010; Lee et al. 2007; Zhou 2013), as these affective responses constitute for the optimal experience which is highly satisfying (Csikszentmihalyi and Csikszentmihalyi 1988). IS satisfaction is characterized by being a pleasurable outcome of IS use, so deriving immediate pleasure from deep engagement may promote the formation of IS satisfaction (Deng et al. 2010). We thus hypothesize:

*H4: The higher deep engagement, the higher IS satisfaction.*

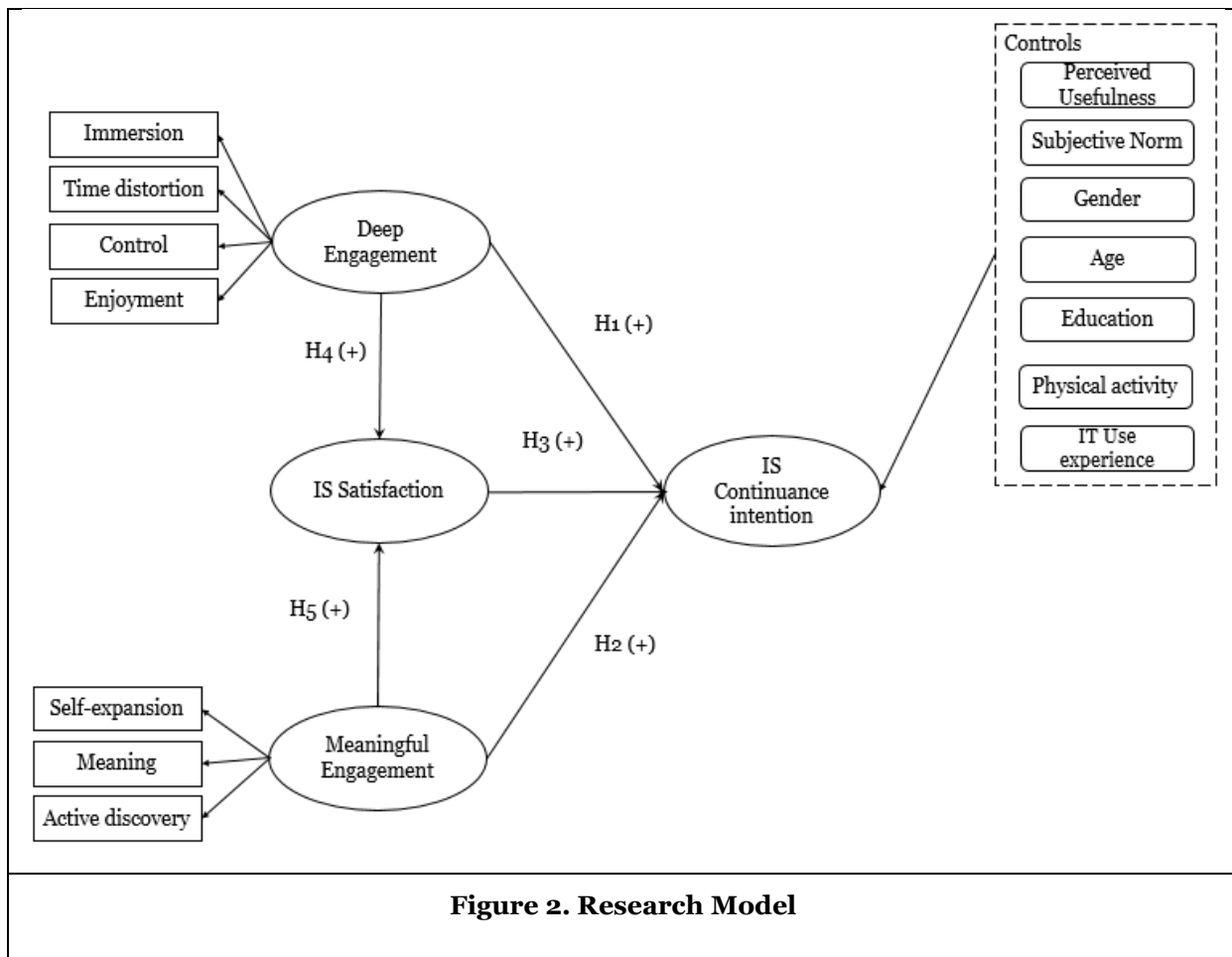
We assume an analogous relationship between meaningful engagement and IS satisfaction. Experiencing a sense of meaning, understanding oneself, and actively overcoming personal challenges are all fundamental



psychological needs (Mekler and Hornbæk 2019; Sheldon et al. 2001). If these needs are fulfilled, a person will feel more satisfied (Sheldon et al. 2001). On a fundamental level, general well-being and life satisfaction is linked with the presence of meaning and a sense of purpose in an individual’s life (Park et al. 2010). Accordingly, if a user can achieve these needs through meaningful engagement with the IS, the user should feel more satisfied with both the IS and themselves. Gamification research indicates that internalized motivations associated with meaningfulness may positively impact attitude, an affective response categorized similarly to IS satisfaction (Nicholson 2015). Based on these considerations, we hypothesize that:

*H5: The higher meaningful engagement, the higher IS satisfaction.*

We included the control variables of perceived usefulness and subjective norm as they are part of the unified model of IS continuance (Bhattacharjee and Lin 2015), as well as gender, age, and education as demographic controls. Physical activity, the extent to which users are physically active in their daily lives and place importance on physical activity, as well as information technology (IT) use experience, the extent to which users interact with IT and mobile applications, were included in the model as to reflect the context of mobile fitness applications (Klopping and McKinney 2004; Wilson and Rodgers 2004). Figure 2 shows our research model.



## Methodology

To test our hypotheses, a quantitative research approach was applied. The methodology chapter explains the sampling of participants, the measurement of constructs, as well as the methods utilized to ensure the validity and reliability of the model.

### Sample

We collected data through an online survey using the online data panel Amazon Mechanical Turk (MTurk). MTurk has proven itself to be a viable sampling alternative to more traditional sampling methods, given that researchers follow certain guidelines for the collection of data such as including attention trap questions (Lowry et al. 2016). Data collection with MTurk has already been employed in numerous high quality publications in IS research (Lowry et al. 2016; Steelman et al. 2014), and provides accessing and filtering possibilities that were previously impossible (Lowry et al. 2016). Through Mturk, we specifically recruited participants that were currently users of fitness applications. We collected data from participants that had been using fitness applications such as activity tracking, workout or exercise apps, within the last two weeks. We limited participation to suitable respondents. We also performed multiple screening questions (e.g., comprehension questions on the topic of fitness applications such as “Mobile fitness applications are commonly used to track vehicle speed.”) and attention tests (e.g., “Please select Disagree”), which eliminated 221 respondents. The data was filtered according to these control variables. This filtering process resulted in a sample size of N=180. Regarding the data sample, 47 % of participants were male, 53 % female; the average participant was 33.5 years old. Demographics of the participants are shown in Table 2.

<b>Age (Mean 33.5; STD 10.5)</b>	20 and below	1.2 %	<b>Education</b>	High School Degree or lower	9.7 %
	21-30	47.5 %		Qualification from trade and technical schools	5.0 %
	31-40	21.3 %		Bachelor	52.4 %
	41 and above	30.0 %		Master	29.7 %
<b>Gender</b>	male	47.0 %		Doctorate	3.2 %
	female	53.0 %			
Note: No participant selected “other” or “prefer not to say” for gender.					
<b>Table 2. Demographics of the Participants (N=180)</b>					

### Measurements

The survey items were adapted from previous research to the context of mobile fitness applications. We assessed continuance intention (three items) and IS satisfaction (six items) using items derived from Bhattacharjee and Lin (2015). Deep engagement and meaningful engagement were conceptualized using the dimensions of immersion (four items), control (three items), time distortion (four items) and enjoyment (three items), as well as active discovery (three items), meaning (three items) and self-expansion (three items) respectively. The dimensions and their respective items were adapted from Suh et al. (2017). All measures used a 7-point Likert scale, ranging from “strongly disagree” to “strongly agree”. Control variables included in the survey were perceived usefulness, subjective norm, gender, age, education level, level of physical activity, and IT use experience. The survey was conducted using the original English items to avoid translation inconsistencies. All items are shown in the Appendix Table 1.

In order to accurately represent multidimensional variables of deep engagement and meaningful engagement in our model, we closely followed the two step approach using second order formative constructs described by Wright et al. (2012). This approach includes running a first-order measurement model, evaluating its validity and reliability, and subsequently constructing a model where the second-order

factors are modeled with the latent variable scores as indicators. Accordingly, we measured all constructs in the first-order measurement model with reflective indicators adapted from literature to ensure content validity. The measurement model was then validated by ensuring indicator reliability, construct reliability, and discriminant validity (Bagozzi 1979).

### **Validity, and Reliability**

*Common Method Bias (CMB).* As CMB may be an issue with self-reported data (Podsakoff et al. 2003), we controlled for CMB by following the procedure suggested by Williams (2003). We determined the extent of CMB by introducing a CMB factor into the model, which contains each indicator of the original model. All remaining factors were transformed into several single-item constructs. We then compared the average R<sup>2</sup> without a CMB factor and the delta R<sup>2</sup> that could be explained with the CMB factor, resulting in a ratio of 1:198, i.e., no observable signs of CMB influence (Liang et al. 2007).

*Indicator reliability.* How much of an item's variance is explained by the construct can be determined by assessing indicator reliability (Hair et al. 2017). To ensure the indicators explain 50% or more of the variance, the factor loadings should exceed a threshold of 0.707 (Carmines and Zeller 1979). We investigated our factor loadings to fulfill this requirement (Appendix, Table 1).

*Internal consistency reliability.* Cronbach's alpha (CA) and composite reliability (CR) should be higher than 0.7 (Hair et al. 2017). When investigating our model, this requirement held in all cases (see Table 3). It can thus be concluded that the internal consistency of all constructs is given.

*Convergent validity.* We examine average variance extracted (AVE) to assess the convergent validity of the reflective constructs. All items exceed the threshold of 0.5 (Fornell and Larcker 1981). Accordingly, convergent validity is also given (see Table 3).

*Discriminant validity.* Lastly, we checked for discriminant validity, which indicates the extent to which constructs differ from other constructs in the model (Henseler et al. 2015). Discriminant validity was deemed not an issue for the research, as the heterotraitmonotrait (HTMT) relation of correlations criterion was fulfilled (Fornell and Larcker 1981) (Appendix, Table 2).

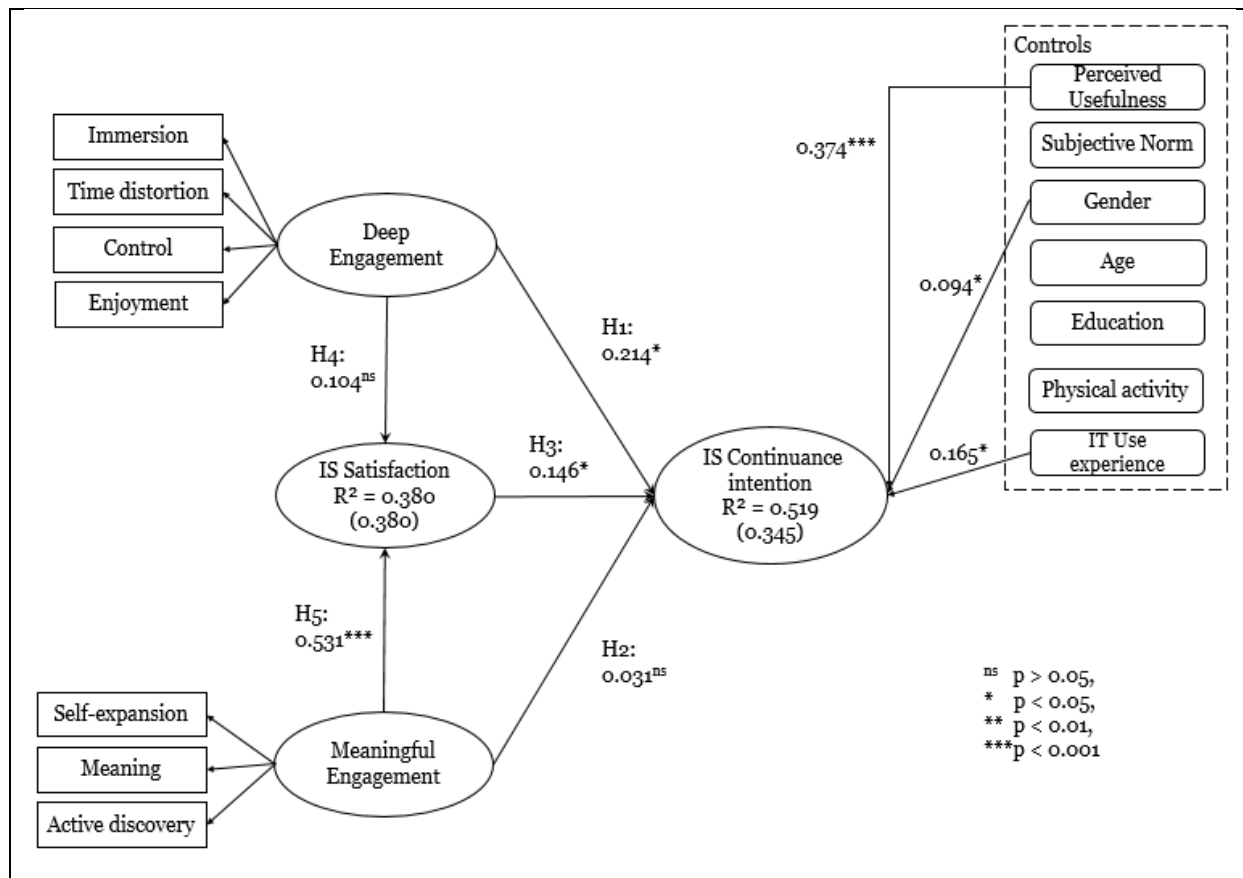
<b>Construct</b>	<b>M</b>	<b>SD</b>	<b>AVE</b>	<b>CR</b>
Active Discovery	5.29	1.08	0.772	0.910
Continuance Intention	5.78	0.79	0.690	0.870
Control	5.76	0.86	0.801	0.890
Enjoyment	5.67	0.85	0.823	0.903
Immersion	5.53	0.94	0.798	0.888
Meaning	5.76	0.86	0.805	0.892
IS Satisfaction	5.71	0.87	0.691	0.899
Self-Expansion	5.42	0.95	0.668	0.858
Time Distortion	4.44	1.42	0.729	0.915
<b>Controls</b>				
Age	33.45	10.44	NA	NA
Education	3.16	0.95	NA	NA
IT Use Experience	6.33	0.85	0.849	0.919
Gender	1.58	0.53	NA	NA
Perceived usefulness	5.75	0.87	0.838	0.912
Physical activity	5.87	0.91	0.779	0.914
Subjective Norm	4.99	1.19	0.807	0.926
Note: M = Mean; SD = Standard deviation; AVE = average variance extracted; CR = composite reliability; NA = not applicable				
<b>Table 3. The Measurement Model of the Overall Sample.</b>				

## Results

*Structural model.* The empirical analysis adopts the partial least squares path modeling (PLS) (Hair et al. 2017) approach and SmartPLS 3.3.5 (Ringle et al. 2014). In accordance with the two step approach (Wright et al. (2012), we construct a model where the second-order factors are modeled with the latent variable scores as indicators to obtain the final loadings.

The coefficient of determination indicates that 51.9 % of the variance of continuance intention and 38 % of the variance of IS satisfaction was explained by the model. As indicated by significance tests and path coefficients, two paths were nonsignificant (Figure 3). Our results reveal that deep engagement and significantly influences continuance intention, which supports H1. However, H2 is not supported, as there is no significant direct relationship between meaningful engagement and continuance intention. The positive influence of IS satisfaction on continuance intention supports H3. Moreover, H4 is not supported, as deep engagement does not influence IS satisfaction. Although the path from meaningful engagement to continuance intention was not significant, our results show that there is a strong, significant relationship between meaningful engagement and IS satisfaction, supporting H5.  $F^2$  for all significant paths was above the threshold of 0.15 (Hair et al. 2017), with an  $F^2$  of 0.176 for meaningful engagement on IS satisfaction being the highest (see Figure 3).

Three control variables were significant: Perceived usefulness (0.374,  $p < 0.001$ ), gender (0.094,  $p = 0.032$ ), and IT use experience (0.165,  $p = 0.013$ ).



**Figure 3. Research Results of PLS-SEM Analysis**

Note: Values in brackets are  $R^2$  values when excluding controls; Encoding for gender: male = 0, female = 1;

$F^2$  values of significant paths: Deep engagement  $\rightarrow$  continuance intention: 0.032, IS satisfaction  $\rightarrow$  continuance intention: 0.025, IT use experience  $\rightarrow$  continuance intention: 0.041, Perceived usefulness  $\rightarrow$  continuance intention: 0.142, Meaningful engagement  $\rightarrow$  IS satisfaction: 0.176

We conduct a posthoc analysis in which we investigate indirect effects of meaningful engagement and deep engagement on continuance intention using a bootstrapping method (Preacher and Hayes 2004). Hair et al. (2017) suggest calculating the 95 percent-bias-corrected confidence intervals (5,000 bootstraps resamples) of each independent variable. The independent variable has an indirect effect through the mediator on the dependent variable, if zero does not lie within the bias-corrected interval. After following this approach, our results show that there the effect of meaningful engagement on continuance intention is mediated by IS satisfaction (see Table 4).

IV	DV	Mediator	Indirect Effects	Bias Corrected 95% Confidence Interval
Meaningful engagement	Continuance intention	IS satisfaction	<b>0.077*</b>	[0.021; 0.163]
Deep engagement	Continuance intention	IS satisfaction	0.015 <sup>ns</sup>	[-0.006; 0.069]

Note: NS  $p > .05$ ; \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .005$

**Table 4. Indirect Effects of Meaningful Engagement and Deep Engagement on Continuance Intention**

## Discussion, Implications, Limitations, and Future Research

There is awareness that the formation of continuance intention does not have to be fundamentally cognitive (Guinea and Markus 2009; Zhang 2013). Affective responses are relevant for understanding how continuance intentions are formed and, as such, affective responses should be taken into consideration in this context (Bhattacharjee and Lin 2015; Zhang 2013).

Bhattacharjee and Lin (2015) consider that the formation of continuance intention and continuance behaviors has cognitive, affective and habitual causes. This is already an improvement from previous well-established theories (e.g., the technology acceptance model), which are extremely cognition centered. However, the definition of affective responses in the unified model of IS continuance is restricted by a focus on IS satisfaction. This is not exclusive to the unified model of IS continuance, but can be found as a recurring pattern in most research, as for instance, research on fitness application continuance often only considers IS satisfaction and enjoyment as the only forms of affective responses (Cai et al. 2022; Lee and Cho 2017; Yuan et al. 2015). Since affective response is an umbrella term for a multitude of fundamentally different factors which may influence continuance intention in different ways, this approach does not sufficiently represent the complexity of the topic (Zhang 2013). Additionally, there is a need for investigating the relationships between affective responses, because the complex interrelations are not yet understood (Zhang 2013).

This paper explicitly focusses on affective responses by investigating fitness application continuance and introducing additional constructs for affective responses by combining IS satisfaction with deep engagement and meaningful engagement (Suh et al. 2017). We validate this model empirically and find that fundamentally different affective responses such as IS satisfaction, deep engagement and meaningful engagement impact continuance intention in different ways. There is a direct positive influence of deep engagement on continuance intention, no direct relationship between IS satisfaction and continuance intention, and a strong influence of meaningful engagement on IS satisfaction. Contrary to our expectations, there was no direct correlation observed between meaningful engagement and continuance intention. Suh et al. (2017) find that meaningful engagement can have a strong, direct influence on continuance intention in the context of gamification. These discrepant results highlight that there should be more research incorporating meaningful engagement, because its nature and interrelations with other variables is not yet fully understood. Our posthoc examination indicates that the relationship between meaningful engagement and continuance intention is mediated by IS satisfaction.

These results do not only emphasize that affective responses have an effect on continuance intention and should be considered, they show that this effect varies depending on the particular affective response considered. This shows that there is no singular affective response that can aggregate the complexity of affective responses thus underlining the need to examine different types of affective responses and their relationships among each other. Nonetheless, in accordance with the unified model of IT continuance, the significant relationship between perceived usefulness and continuance intention in our results shows that affective responses should be used in combination with cognitive and possibly habitual responses to explain the formation of continuance intentions.

### ***Theoretical Contributions***

The results of our study contribute to IS literature in the following ways.

In the context of fitness applications, we show that affective responses other than IS satisfaction, enjoyment and commitment are relevant for continuance intention. Although fitness application literature mostly agrees that fun and entertainment value is important for continuance (Yuan et al. 2015), that is generally the extent to which the relevancy of affective responses is examined (Huang and Ren 2020; Lee and Cho 2017; Yuan et al. 2015). As our results indicate, research should consider more affective responses as potentially relevant for fitness application continuance. Generally, previous IS literature focuses strongly on cognitive and habitual antecedents of IS continuance (Bhattacharjee and Lin 2015; Guinea and Markus 2009; Venkatesh et al. 2012). Some examinations consider affective response in addition to cognitive response but research does not have a focus on affective responses (Bhattacharjee and Lin 2015; Guinea and Markus 2009). Our study contributes to this literature stream by validating that affective responses have direct and indirect relationships with continuance intention and should be considered when constructing a model to investigate continuance intention.

We also contributed to the IS literature (Bhattacharjee and Lin 2015; Suh et al. 2017) which considered some affective responses by especially focusing on the role of affective responses and splitting them into three different types – IS satisfaction, deep engagement and meaningful engagement. Considering that these three affective responses all had different effects on the dependent variable, - deep engagement and IS satisfaction have a direct effect of IS continuance intention and meaningful engagement shows an indirect positive effect - we extend prior work (Bhattacharjee and Lin 2015; Venkatesh et al. 2011; Yuan et al. 2015) by revealing that multiple affective responses should be considered. We show that besides common affective responses such as IS satisfaction others also play a significant role in explaining and understanding why users develop the willingness to use the IS over a longer time.

Past literature often considers none or only one affective responses such that the interplay among different affective responses is uncertain. We contribute to literature (Suh et al. 2017; Zhang 2013) by showing that relationships between different affective responses exist and should be taken into account when investigating the effect of affective responses on dependent variables. The influence of meaningful engagement on IS satisfaction is particularly interesting, as the relationship between meaningful engagement and IS satisfaction had not been explicitly tested previously and the results indicate that there is a strong correlation. The significant relation between the two constructs reinforces the idea that different types of affective responses are strongly correlated with each other in numerous ways (Zhang 2013). Meaningful engagement and IS satisfaction had the strongest path coefficient as well as  $F^2$  value in our model. If the notion of “meaningfulness” is strongly associated with IS satisfaction in IS contexts, theories should incorporate this relationship, considering that IS satisfaction is a particularly salient predictor of continuance intention in a multitude of contexts (Deng et al. 2010; Venkatesh et al. 2011).

### ***Contributions to Practice***

In general, especially when it comes to systems used purely on a voluntary basis such as fitness applications, thinking about the emotional aspect - how the system *feels* - can deliver considerable value added. The results suggest that the implementations of fitness applications could benefit from features associated with different affective responses. The high correlation between meaningful engagement and IS satisfaction is a promising result, indicating that including features associated with meaningful engagement such as customization, story-telling, or educational elements in fitness applications may improve both IS satisfaction and system continuance. This extends beyond the fitness application context and can even be

applied to utilitarian contexts. Gerow et al. (2013) argue that experiencing fun and enjoyment is relevant for the use of both hedonic and utilitarian systems.

Likewise, users can also derive implications from our results. Contrary to many mobile applications in the entertainment and social media area (Leung and Lee 2012; Lukoff et al. 2018), many users want to continue the use of fitness applications, because they help them maintain a healthier lifestyle (Molina and Myrick 2021). Putting a focus on affective responses when choosing a fitness application may be key to facilitate continuance and help in achieving long-term personal fitness goals. In fact, there is a growing trend of research supporting that serious matters, such as health and education, may benefit from being handled less sternly: serious games (Bellotti et al. 2013; Hofmann and Göbel 2018). Our results suggest that the core idea of serious games - making these issues a little more fun - is very much reasonable as a practical recommendation for organization, as adding enjoyment and a personal connection through deep engagement and meaningful engagement contributed to a higher continuance intention.

### ***Limitations and Future Research***

Our research is limited by the fact that we chose to only investigate continuance intention and not continuance behavior. It is well established in both IS research and adjacent disciplines that there is a gap between intention and actual behaviors (Sheeran and Webb 2016). Relatedly, the unified model of IS continuance also includes this distinction between intention and behavior and argues that habit plays a role in influencing both continuance intention and continuance behavior. Due to our focus on continuance intention, our results are limited because habit was not taken into account in our model. What role habit plays and if deep engagement and meaningful engagement may lead to actual continuance behavior is subject to future research. It is also worth noting that especially fitness applications have particularly high attrition rates (Molina and Myrick 2021), which suggests that future research should examine the situation from a discontinuance perspective. The presence of meaningful engagement may not have a direct influence on continuance intention, but its absence may directly contribute to discontinuance, if users are less satisfied when meaningful engagement is absent.

While we argue that the three affective responses used in the model complement each other well, we recognize that this particular combination may not be the only sensible possibility. For instance, meaning may also be expressed by different dimensions such as connectedness, purpose, coherence, resonance, and significance (Mekler and Hornbæk 2019). There is the possibility of adding new affective responses such as commitment, which has been utilized in the fitness application context before (Chiu et al. 2021; Cho 2016; Cho et al. 2020). In the specific context of fitness applications, there are also opportunities for future research to be found in differentiating between different types of fitness applications and adding additional variables that are only relevant in this specific context such as health consciousness (Damberg 2022).

Additionally, an important direction for future research also lies in investigating the relationships between different affective responses. Looking at the influence of meaningful engagement on IS satisfaction, there may be similar relationships between other affective responses that we did not consider in this research.

### **Conclusion**

To ensure the long-term viability of systems, users must continue to use a system for an extended period. Affective responses are a crucial part of explaining the formation of a user's continuance intention. Therefore, this paper introduces a model focused on three different affective responses to investigate fitness application continuance: IS satisfaction, deep engagement and meaningful engagement. Our results show that while deep engagement and IS satisfaction directly influence continuance intention, meaningful engagement does not. However, there is a strong connection between meaningful engagement and IS satisfaction, mediating the relationship between meaningful engagement and continuance intention. The paper contributes by investigating the effect of different affective responses on influencing continuance intention, as well as highlighting connections among affective responses.

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## Appendix

Table 1: Items, Measures, and Loadings

Construct	Item	Loading
	Please evaluate the following statements. When using the fitness application...	
Immersion (Suh et al. 2017)	...I am able to block out most other distractions.	n.s.
	...I am absorbed in what I am doing.	0.903
	...I am immersed in the task I am performing.	0.884
	...I get distracted by other attentions very easily.	n.s.
	Please evaluate the following statements.	
Time distortion (Suh et al. 2017)	Sometimes I lose track of time when I am using the fitness application.	0.798
	Time flies when I am using the fitness application.	0.901
	I end up spending more time that I had planned.	0.828
	I often spend more time on the fitness application than I had intended.	0.884
Control (Suh et al. 2017)	When using the fitness application I feel in control.	0.890
	I feel that I have control over my interaction with the fitness application.	0.901
	The fitness application allows me to control my computer interaction.	n.s.
Enjoyment (Suh et al. 2017)	I have fun interacting with the fitness application.	n.s.
	Using the fitness application provides me with a lot of enjoyment.	0.896
	I enjoy using the fitness application.	0.918
	Please evaluate the following statements. When I am using the fitness application...	
Self-expansion (Suh et al. 2017)	...I feel an increased ability to accomplish new things.	0.843
	...I feel that I have a larger perspective on what I am doing.	0.811
	...I feel that my activities result in learning new things.	0.798
Meaning (Suh et al. 2017)	...I feel that my activities are very important to me.	0.883
	...I feel that my activities are personally meaningful.	0.911
	...I feel that my interaction with the system is meaningful.	n.s.
Active discovery (Suh et al. 2017)	...I feel I exercise powers to deal with challenges I face.	0.837
	...I feel I discover new paths to seek answers or resolution.	0.908
	...I feel I am aware of how to proceed to fulfil my purposes.	0.889
	How do you feel about your overall experience with your fitness application usage?	
Satisfaction (Bhattacharjee and Lin 2015)	Very dissatisfied   Very satisfied	0.767
	Very displeased   Very pleased	0.876
	Very frustrated   Very contented	0.832
	Absolutely terrible   Absolutely delighted	0.847
	Please indicate the extent to which you disagree or agree with the following statements about your satisfaction with the fitness application.	

(Additional IS satisfaction items, Lee and Chung (2009))	I think that I made the correct decision to use the fitness application.	n.s.
	Overall, the experience that I have had with the fitness application has been satisfactory.	n.s.
	Please evaluate the following statements.	
Continuance intention (Bhattacharjee and Lin 2015)	I intend to continue using the fitness application rather than discontinue its use.	0.849
	My intentions are to continue using the fitness application rather than any alternative systems.	0.819
	My intentions are to continue using the fitness application in the future, at least as actively as I use it today.	0.824
Perceived usefulness (Bhattacharjee and Lin 2015)	Using the fitness application improves my performance when it comes to the fitness goals I am trying to achieve.	0.926
	Using the fitness application increases my productivity when it comes to the fitness goals I am trying to achieve.	0.905
	Using the fitness application enhances my effectiveness when it comes to the fitness goals I am trying to achieve.	dropped
	I find the fitness application to be useful for achieving my goals.	dropped
Subjective Norm (Bhattacharjee and Lin 2015)	People who influence my behavior (e.g., family, friends, coworkers) think that I should use the fitness application.	0.907
	People who are important to me (e.g., family, friends, coworkers) think that I should use the fitness application.	0.909
	People who influence my behavior (e.g. family, friends, coworkers) would welcome my use of the fitness application.	0.878
IT Use experience (adapted from Klopping and McKinney (2004))	On average, how often do you use a computer?	0.913
	On average, how frequently do you use mobile devices such as smartphones, smartwatches, etc.?	0.930
Physical activity (adapted from Wilson and Rodgers (2004))	I am physically active in my daily life.	0.902
	It's important to me to exercise regularly.	0.894
	I enjoy physical activity a lot.	0.851
Note: Seven items marked n.s. were removed while analyzing the data because loadings were < 0.707, indicating nonsignificance.		

Table 2: Cross-correlations

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Active Discovery	0.879															
2	Age	0.018	1.000														
3	Continuance Intention	0.279	0.071	0.831													
4	Control	0.327	-0.036	0.533	0.895												
5	Education	-0.102	0.239	0.020	-0.048	1.000											
6	Enjoyment	0.572	0.018	0.451	0.428	-0.003	0.907										
7	Experience	-0.133	-0.049	0.408	0.317	-0.026	0.059	0.922									
8	Gender	-0.121	-0.138	0.049	-0.114	-0.023	-0.017	0.116	1.000								
9	Immersion	0.444	0.076	0.233	0.323	-0.070	0.379	0.109	-0.120	0.893							
10	Meaning	0.434	0.095	0.542	0.534	-0.111	0.576	0.310	-0.067	0.516	0.897						
11	Perceived usefulness	0.277	-0.039	0.627	0.486	-0.130	0.404	0.412	-0.075	0.372	0.644	0.915					
12	Physical activity	0.220	-0.105	0.358	0.341	-0.060	0.355	0.281	-0.099	0.375	0.440	0.436	0.883				
13	Satisfaction	0.495	0.001	0.469	0.413	-0.147	0.459	0.225	0.061	0.295	0.464	0.440	0.242	0.831			
14	Self Expansion	0.642	0.068	0.439	0.455	-0.118	0.608	0.037	-0.104	0.455	0.628	0.523	0.303	0.589	0.818		
15	Subjective Norm	0.516	0.027	0.174	0.254	-0.065	0.400	-0.090	-0.091	0.315	0.297	0.153	0.220	0.333	0.444	0.898	
16	Time Distortion	0.526	-0.022	0.030	0.173	-0.033	0.438	-0.280	-0.210	0.370	0.248	0.126	0.194	0.231	0.431	0.529	0.854

Note: Square root of AVE is listed on the diagonal of bivariate correlations