Do smart connected objects improve consumer well-being over time?

Elodie ATTIÉ
Toulouse School of Management
Lars Meyer-Waarden
Toulouse School of Management Research -CNRS University Toulouse 1 Capitole

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Abstract:

Consumer well-being is increasingly becoming a discussion topic in the marketing literature (Arora et al., 2017). In this study, we aim to explain the consequences of smart connected objects (SCO) on consumer well-being. We study the direct influences of real use, perceived usefulness, ease of use, and social image on perceived well-being. Privacy concerns moderate this conceptual model. Also, we study differences in SCO perceptions according to adoption stages (early adopters, the early majority, and the late majority of users). 595 random respondents were surveyed over three years about the usage of SCO. Structural equation modeling shows that real use is the most important antecedent during all the adoption stages. Perceived usefulness and ease of use become less important whereas perceived social image gives more positive feelings to users with time. The experience of use decreases privacy concerns and increases the perceived well-being associated with SCO.

Keywords: Smart connected objects, IoT, Well-Being

Track: Innovation Management & New Product Development

1. Introduction

Smart connected objects (SCO) are active, digital, networked, controlling devices (Poslad, 2009) with artificial intelligence to adapt their features to environmental indicators. They connect to smartphones through wireless networks (e.g., smart watches, smart clothes, etc.). SCO aim to improve well-being (Atzori et al., 2010; Porter & Heppelmann, 2014). Little is known in marketing about the impact of SCO on well-being and its variation over time (Mogilner et al., 2012). Research is mitigated and has shown that using SCO can negatively influence well-being on the long term (Etkin, 2016). Indeed, users change their use and beliefs about technology over time (Rogers, 2003; Gilly et al., 2012). As the results are mitigated about the influence of using SCO on well-being and since there is a lack of research on the topic, we follow calls for research (Arora et al., 2017; Krebs & Duncan, 2015) and contribute to the literature in the following ways: first, we study the direct influences of real use of SCO, perceived usefulness, ease of use, privacy concerns and social image on users' perceived well-being. Second, we study differences according to adoption stages (early adopters, the early majority, and the late majority of users) and thus show the influence on the long term with the experience of use.

2. Literature review

Perceived well-being is a subjective state of fullness resulting from judgments, emotions and aspirations about the perception of a current situation, compared to a past or future situation of the person or entourage (Ayadi et al., 2019). It captures how consumers perceive experiences in positive ways, through cognitive judgments and affective reactions, without objective facts (Diener, 1984). Even if SCO aim at increasing well-being, over the long term, there might be a negative influence due to the consequences of dependence and stress (Etkin, 2016; Gonzales et al., 2017). Thus:

H1: Real use of SCO first influences positively well-being, which in turn decreases over time.

Moreover, better self-knowledge and self-management improve perceived usefulness (PU) (Katz et al., 1974), which is the degree that people believe that using a technology will help them to improve their performance (Davis, 1989). The PU of a SCO should increase well-being (Aurier et al., 2004; van Ittersum et al., 2013). Thus:

H2: PU of SCO has a positive influence on well-being, which increases over time.

Perceived ease of use (PEU) is the degree to which the use of a technology is perceived as easy and free of efforts (Davis, 1989). Easy-to-use SCO with low task

complexity increase perceived abilities of use. Subsequently, as SCO seem more reassuring, it positively enhances users' well-being (Sanzo-Perez et al., 2015; Gu et al., 2010). Therefore:

H3: PEU of SCO has a positive influence on well-being, which increases over time.

Perceived social image (PSI) is the degree to which the use of a product enhances a social status within a social group (Moore & Benbasat, 1991). Using SCO can give a positive PSI to users, bringing positive feelings toward the technology (Rogers, 1983; Kuisma et al., 2007). Subsequently, social values improve well-being since users feel that the SCO is consistent with their own-self (Aurier et al., 2004). Thus:

H4: PSI of SCO has a positive influence on well-being, which increases over time.

Moreover, PU and PEU are strong determinants of technology usage (Davis, 1989; Calantone et al., 2006; Taylor & Todd, 1995). Users have a more positive attitude toward a new technology when it is associated with PU and PEU, and tend to use it more often (King & He, 2006; Venkatesh & Davis, 2000). Therefore:

H5: PU of SCO has a positive influence on real use, which increases over time.

H6: PEU of SCO has a positive influence on real use, which increases over time.

Then, the role of perceived social image (PSI) is relevant in explaining technology usage (Bagozzi, 2007; Venkatesh & Davis, 2000). Innovations, like SCO, can give a positive social image, reinforcing use (Rogers, 1983; Hellström, 2004; Kuisma et al., 2007). Thus:

H7: PSI of SCO has a positive influence on real use, which increases over time.

Also, PEU is a direct determinant of PU (Davis, 1989). Indeed, easy-to-use technologies seem more accessible and useful than technologies, which seem difficult to learn and use (Davis et al., 1989; Taylor & Todd, 1995; Venkatesh, 1999). Therefore:

H8: PEU of SCO has a positive influence on PU, which increases over time.

Performing a specific behavior can be consistent with group norms to achieve group membership, social support, and group identification through social image (Kiesler & Kiesler, 1969; Pfeffer, 1981). Improving the PSI is useful for people eager to improve their social position within a social group (e.g., Hellström, 2004). Thus, we hypothesize:

H9: PSI of SCO has a positive influence on PU, which increases over time.

Situational factors and normative constraints moderate the links between the variables (Morwitz et al., 1993). The way SCO track and collect personal data can be seen as intrusive,

increasing privacy concerns (Awad & Krishnan, 2006; Hong & Thong, 2013). Privacy concerns represent the degree to which users are concerned about the flow of their information (Phelps et al., 2000). Privacy risks of SCO increases stress that decrease positive feelings toward the technology (Van der Heijden, 2004; Wüenderlich et al., 2015). Therefore:

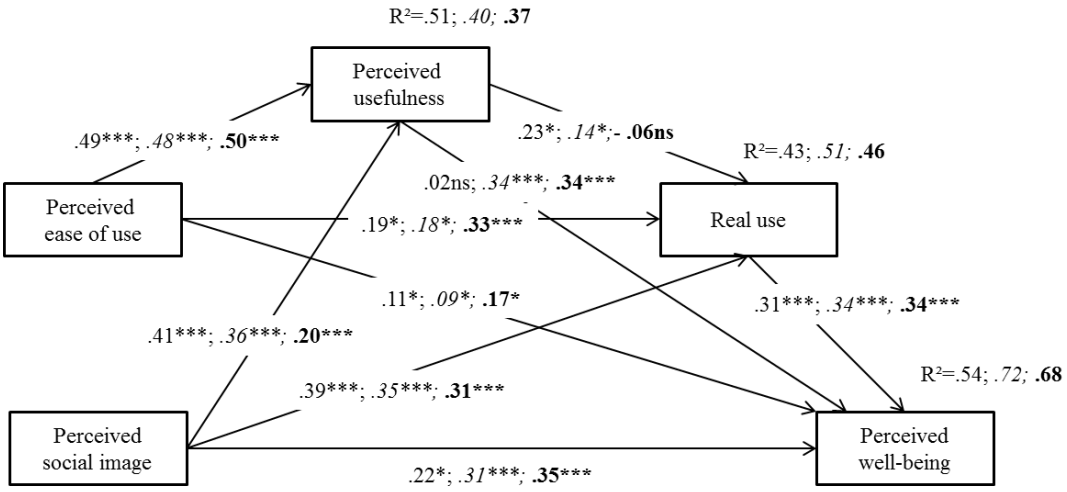
H10: The effects hypothesized in H5, H6, and H8 are weaker (stronger) when consumers have higher (lower) privacy concerns about SCO.

3. Methodology

The study was conducted from January 2015 to March 2018 with students who answered to surveys about all types of SCO (e.g., connected speakers, smart watches, connected lights, etc.). The samples comprised 100 late majority using SCO for less than one year (53% men, 47% women), 273 early majority users using SCO for less than two years (59% men, 41% women), and 222 early adopters of users using SCO for less than three years (64% men, 36% women). All concepts are measured with validated scales from prior research adapted to the context of study. Real use is measured with the scale from Chau (1996); PU and PEU are measured with Davis' (1989) scales; for well-being, we used a scale from Munzel et al. (2018), Brief and Aldag (1977), Howie et al. (1998), and Diener et al. (1985); for PSI, a scale developed by Sweeney and Soutar (2001); for privacy concerns, we used the scale from Hong and Thong (2013). Items are measured on five-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree). The reliability and validity of the scales are satisfactory assessed with the factor loadings and means by variable (Anderson & Gerbing, 1988), the Cronbach α (Nunnally, 1978), and the average variance extracted for construct reliability (Fornell & Larcker, 1981). Discriminant validity is satisfactory too, assessed with the square root of AVE for each variable (Fornell & Larcker, 1981).

4. Results

According to Levene's test, there are significant differences between early adopters, the early majority and the late majority of users with real use (M1=4.06; M2=3.86; M3= 3.97), PU (M1=3.69; M2=3.78; M3=3.89), PEU (M1=3.39; M2=4.12; M3=4.21), perceived well-being (M1=2.81; M2=3.09; M3=3.12), and privacy concerns (M1=4.02; M2=3.55; M3=3.42). Then, the data is analyzed via structural equation modeling with Amos 21. The model fit indicators are sufficient according to the guidelines ($Chi^2/DF<5$ (Byrne, 2006); CFI coefficients>.80 (Bentler, 1990); TLI coefficients>.80 (Bentler & Bonett, 1980); RMSEA<.08 (Browne & Cudeck, 1993)). Figure 1 shows the results with the model.



Late majority: Chi²/DF=5.12*; RMSEA=.11; CFI =.89 TLI = .79
Early majority: Chi²/DF=3.78; RMSEA=.07; CFI =.96; TLI = .82*
Early adopters: Chi²/DF=4.32*; RMSEA=.06; CFI =.98; TLI = .86
**** indicates p-value<.001; ** p-value<.01; * p-value<.1; ns = non-significant*

Figure 1. Conceptual model and results

The predictive power of perceived well-being is higher with the early majority (R^2=.72). Real use has an increasing positive influence on well-being for the late majority of users, the early majority and early adopters (β=.31***; β=.34***; β=.34***); H1 is supported. PU has a positive influence on well-being only for the early majority of users (β=.22***) but not for the late majority of users and early adopters (β=.02ns; β=.11ns); H2 is supported for the early majority of users. PEU has an increasing positive influence on well-being for the late majority of users, the early majority and early adopters (β=.11*; β=.09*; β=.17*); H3 is supported. PSI has an increasing positive influence on well-being for the late majority of users, the early majority and early adopters (β=.22*; β=.31***; β=.34***); H4 is supported. PU has a positive influence on real use for the early majority of users and the late majority of users (β=.23*; β=.14*) and not for early adopters (β=-.06ns); H5 is supported for the early majority of users and the late majority of users. PEU has an increasing positive influence on real use for the late majority of users, the early majority and early adopters (β=.19*; β=.18*; β=.33***); H6 is supported. PSI has a positive influence on real use for the late majority of users, the early majority and early adopters (β=.39***; β=.31***; β=.34***); H7 is supported. PEU has a positive influence on PU for the late majority of users, the early majority and early adopters (β=.49***; β=.48***; β=.50***); H8 is supported. PSI has a positive influence on PU for the late majority of users, the early majority and early adopters (β=.41***; β=.36***; β=.20***); H9 is supported. To test the effects of the moderator, Process model 1 from Hayes is used (Table 1). Table 1 shows that for the late majority of users, privacy concerns

negatively moderate the influence of PEU on real use and of PEU on PU (both $\Delta R^2 = 1\%$). For the early majority of users, privacy concerns do not moderate these links. For early adopters, privacy concerns negatively moderate the influence of PU and of PEU on real use (both $\Delta R^2 = 1\%$); H10 is partly supported.

H11 Moderator: Privacy concerns			
	H5: PU -> Real use	**H6: PEU -> Real use**	**H8: PEU -> PU**
Late majority	non-significant	negative effect $\Delta R^2=1\%$	negative effect $\Delta R^2=1\%$
Early majority	non-significant	non-significant	non-significant
Early adopters	negative effect $\Delta R^2=1\%$	negative effect $\Delta R^2=1\%$	non-significant

PU stands for perceived usefulness, PEU for perceived ease of use.

Table 1. Main moderating effects of privacy concerns

5. Discussion of the results and contributions

One of our main goals is to understand the consequences of SCO on perceived well-being. Our model shows a good fit according to the literature standards and one, which improves through adoption stages. Experience of use positively changes consumer perceptions (Reinhardt & Gurtner, 2004; Childers et al., 2001): in the early adoption stage, SCO are seen as useful technologies that become hedonic with time. Our investigation is in line with other research showing that SCO are linked to positive feelings (Atzori et al., 2010; Harkin et al., 2016; Porter & Heppelmann, 2014). Our research contributes to transformative marketing science literature to explain well-being (Arora et al., 2017; Krebs & Duncan, 2015). In line with literature only the early majority finds a useful reason to use SCO, which consequently improves their well-being (van Ittersum et al., 2013). Perceived utilities also increase over the time of use, showing that SCO help users to improve their performance (Davis, 1989). Moreover, the influence of PEU on well-being slightly increases over the time of use: the more a SCO seems easy to use, the more it increases perceived well-being (Sanzo-Perez et al., 2015; Ahmadpour et al., 2016). Following the literature, the influence of PSI on perceived well-being increases over the years of use, and experience enhances users' social status within social groups (Rogers, 1983; Kuisma et al., 2007). Privacy concerns decrease through experience, as users learn to control SCO and personalization benefits can compensate for privacy concerns (Dimitriadis & Kyrezis, 2010).

6. Limits and further research directions

This research is not without limitations. First, the study should be replicated with a more

representative sample to include other generations and cultures (Straub et al., 1997; Hofstede, 2001). We also have three different sets of data and it would be interesting to do a longitudinal study to follow up the same sample as perceptions can differ (e.g., Donaldson & Dunfee, 1994). Our study also considers all types of SCO (e.g., connected speakers, smart watches, connected lights, etc.) and does not focus on one type; future research should focus on only one type of SCO and differentiate the antecedents of perceived well-being according to particular SCO (Mani & Chouk, 2017). Finally, perceived well-being does not take into account objective facts (Diener, 1984), and we have no real-time behavior indicators of perceived well-being (Ahmadpour et al., 2016).

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