The Determinants of Quantified-Self Adoption: Towards the development of a Risk/Benefit Model

Emergent Research Forum Paper

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Abstract

Self-quantification technologies offer an unlimited number of opportunities for improving human life, especially in terms of health and well-being. Despite the growing adoption of these technologies worldwide and the increasing scholarly interest, the factors that influence the adoption of quantified self (QS) have only been slightly examined by past research. To close this gap, this research in-progress presents a literature review on the benefits and risks of QS practices and it develops a multidisciplinary research model based on the Extended Valence Framework. This model offers five hypotheses that highlight the importance of considering technological, social and health factors when measuring QS adoption. Data collection with QS users is ongoing. The paper concludes with the design of the research and the expected contributions.

Keywords

Quantified-Self, Self-Tracking Technology, Adoption, Health, Valence Framework.

Introduction

The worldwide market for wearable technology will reach over $27 billion by 2022 with 233 million unit sales. These technologies have given rise to Quantified Self (QS). "The philosophy behind the QS movement is that by using quantifiable data, which can be collected relatively easily through readily available technology, one can significantly improve the understanding of one's health and gain deeper insights into different approaches to improving health" (Kim 2014). Understanding this phenomenon requires a multidisciplinary approach. Indeed, QS practices involve health dimensions, human and social dimensions (De Moya and Pallud 2017) especially concerning privacy, human integrity, normalization of the society, and technical dimensions (regarding measurement reliability, user-friendly interface design, and the methods used to analyze the data collected). However, research has not paid enough attention to the multiple facets of QS adoption. Actually, most of the research models in Information Systems (IS) looking at QS are based on the Technology Acceptance Model and thus acknowledge only technical factors (del Río Carral et al. 2017). In their literature review, del Río Carral et al. (2017) also point out that a purely technical approach does not reflect the complexity of QS practices. They identify two trends in their review: 1) a set of enthusiastic articles that promote QS as a new hope for health management and 2) more nuanced and critical articles that discuss this practice in light of a neoliberal surveillance society. In order to fill in this research gap, this paper focuses on the following research questions:

What are the technological, social and health determinants that explain QS adoption?

Could a more nuanced model based on Risk/Benefit explain properly QS adoption?

To answer that question, we follow Becker et al. **(Becker et al. 2017)**'s research in which they identified the main factors that influence the continuity of fitness trackers usage in relation to the perceived benefits/costs, and the work of Gribel et al. **(Gribel et al. 2016)** on the acceptance factors of wearables.

The structure of the paper proceeds as follows. The second section presents a literature review on the risks and benefits of QS and it introduces the Extended Valence Framework. The third section presents the development of our comprehensive research model. The fourth section details the methodology. The final section provides a discussion of the expected outcome and concluding remarks, as well as suggestions for future research and the next steps.

Literature Review

The risks and benefits of Quantified Self

We performed a literature search using several databases (namely, Business Source Premiere, Science Direct, Web of Science, IEEExplore and Google Scholar) on the adoption of QS. As QS is a generic term, we also used several adjacent keywords for the query, such as: "activity tracking device", "fitness tracker", "physical activity tracking", "healthcare device", "mhealth", "wristband", "wearable". These key words were used in conjunction with the terms "adoption", "appropriation", "acceptance", "perception", "continuity", "commitment", "attitude", and "motivation". This request allowed us to identify 50 research articles that address the benefits and the risks of QS practices. These findings are discussed in more details on Section 3 when we develop our research model. The main factors will be combined with the Extended Valence Framework introduced in the next section.

The Extended Valence Framework

This theory has been extended by Kim et al. (Kim et al. 2009) in the marketing context to account for the role of trust in risk/benefit evaluation and also to measure the impact on customer intentions (see Figure 1). Mou et al. (Mou et al. 2016) tested this model in conjunction with the Health Belief Model (HBM) (Rosenstock 1974) to theorize the adoption of online health services. Their study defined risk as the sum of performance-related risks, psychological risks and perceptions of time needed to search for health information. This sum of risks is counterbalanced by consumer belief that online health information could improve one's health condition (perceived benefits). Their results confirm that the benefits positively influence intention to use and the risks negatively impact the adoption of digital health services. In addition, their results confirm the role of trust that positively influences intentions, reduces risk perception and increases perceived benefits

Developing the theoretical model

Drawing on the Valence Theory and our literature review on the risks and benefits of QS adoption, we develop a comprehensive research model of QS adoption. Figure 1 depicts our research model.

Perceived Benefits

Two technological factors are retained to measure perceived benefits, namely perceived ease of use and ubiquity. Perceived ease of use refers to "the extent to which the potential user expects the target system to be free of any user effort" (Davis 1989). Several studies have verified the positive effect of ease of use in intention to use QS (Pfeiffer et al. 2016). A qualitative study has also highlighted the need for simple and easy to use QS devices (Canhoto and Arp 2017).

Since QS devices belong to the category of mobile technologies, users will generally expect mobile features or the possibility to have a ubiquitous experience. Ubiquity is characterized by time and space flexibility and defined as the opportunity "to monitor user conditions anytime and anywhere" (Hirose and Tabe 2016, p. 48). Past research demonstrated that ubiquity positively influenced user perceptions during QS usage (Hirose & Tabe, 2016) and contributed to perceived usefulness of the wearable device (Gribel et al. 2016).

The various health-related benefits can be combined into a variable called "health support", defined as: "the perception of portable self-care devices to support the treatment of health problems" (Pfeiffer et al., 2016, p.6). Indeed, the intrinsic objective of QS, as given by its definition, is to improve health.

Last, perceived benefits include a social benefit, namely social norms, defined as "the extent to which consumers believe that other important people (e. g. close friends and family) believe they should use a particular technology." (Venkatesh et al. 2012). This factor has been extensively tested in the research stream of technology adoption. Past research indicates that the practice of QS is a response to social pressure (Becker et al., 2017) and this social pressure positively influences intention to use QS (Pfeiffer et al., 2016). These three different benefits combined together constitute an overall perception of the perceived benefits, which in accordance with the Extended Valence Framework (Kim et al., 2009 ; Mou et al., 2016) influence positively the intention to use QS.

H1: Perceived benefits positively influence the intention to use QS.

Perceived Risks

Performance risk is defined as "the possibility that the product will malfunction and not function as designed and advertised and, therefore, fail to provide the desired benefit" (Grewal et al. 1994, p. 145). Thus, when the QS technology is not representative of one's own activity, s/he will stop using it (Buchwald et al. 2015). The different health risks can be combined into a single variable named physical risk and defined as "the possibility that products may be harmful to the health of individuals or that products may not look as good as individuals expect" (Lim 2003). It can be operationalized in terms of wearable discomfort (Becker et al., 2017) or in terms of techno-stress (Spagnolli et al. 2014). The third risk frequently mentioned in the literature is privacy risk, which is defined as "potential loss of control over personal information, for example when information about you is used without your knowledge or permission." (Featherman and Pavlou 2003, p. 155). This risk is amplified by the fact that QS data tends to be hosted in the cloud, making it vulnerable and reusable by third parties. These three risks taken together reflect an overall perception of the perceived risks. In accordance with the Extended Valence Framework (Kim et al., 2009 ; Mou et al., 2016), we posit the following:

H2: Perceived risks negatively influence the intention to use QS.

Trust

Trust is defined as: "the belief that the other party will behave in a socially responsible manner, and, by so doing, will fulfil the trusting party's expectations without taking advantage of its vulnerabilities". (Pavlou 2003). Trust has been questioned several times when examining QS (Pfeiffer et al., 2016). This is mainly due to a certain opacity of manufacturers who rarely explain their methodology to detect and measure physical activities. In the Extended Valence Framework (Kim 2009) and in studies on monitoring tools (Gao et al. 2016) trust is a variable that directly affects the intention to adopt. Consequently, we hypothesize the following:

H3: Trust positively influences the intention to use QS.
The valence model also points out the effects of trust on perceived benefits and perceived risks:
H4: Trust reduces perceived risks.
H5: Trust increases the perceived benefits of using QS.

Expected Contributions

To empirically test our research model and collect data, we have chosen the survey methodology. First, the research model was operationalized by using existing Likert-scales adapted to fit the context of QS. We used two different scales to measure trust : 1) trust in the provider (Pavlou, 2003) and 2) trust in the QS technology (Mcknight et al. 2011). Support for health was taken from Pfeiffer et al. (2016), ubiquity comes from Okazaki et al.(Okazaki et al. 2009), ease of use from Pfeiffer et al. (2016) based on Venkatesh et al. (Venkatesh et al. 2003). Social norm is measured with Pfeiffer et al.'s (2016) scale coming from Venkatesh et al. (2003). Physical risk comes from Gurtner (Gurtner 2014), performance risk comes from Yang et al. (Yang et al. 2016), private risk from Li et al. (Li et al. 2016). Finally, intention to use QS was adapted by relying on two studies (Venkatesh et al., 2003 ; Venkatesh et al., 2012).

Our expected results will detail and extend the findings of existing research regarding QS adoption (Baumgart and Wiewiorra 2016; Maltseva and Lutz 2018). Our model shows the ambivalence of self-tracking and in particular the weight of risk in relation to benefit. Given the importance of some tracking data, it is also crucial to assess the contribution of trust in the manufacturer on intention to adopt QS. Since trust can play a significant role, it seems also important for manufacturers or service providers to detail their privacy policy and to improve the technology performance in order to reduce perceived risks.

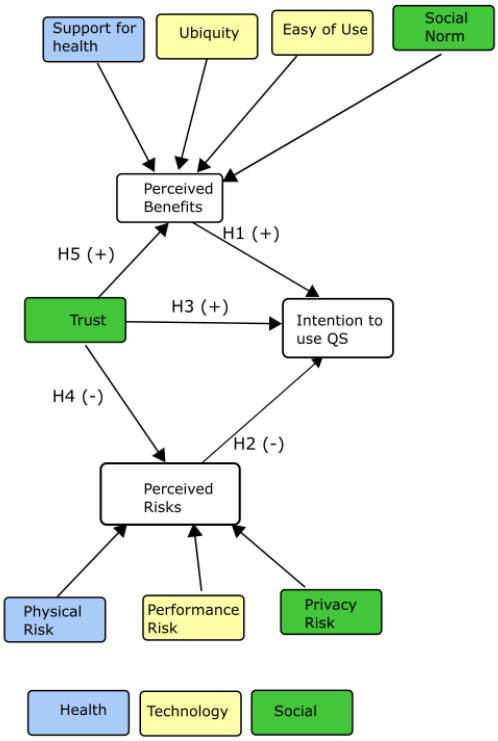

Figure 1: Our model

References

Baumgart, R., and Wiewiorra, L. 2016. "The Role of Self-Control in Self-Tracking," *ICIS 2016 Proceedings*.

Becker, M., Kolbeck, A., Matt, C., and Hess, T. 2017. *Understanding the Continuous Use of Fitness Trackers: A Thematic Analysis*.

Buchwald, A., Letner, A., Urbach, N., and von Entress-Fuersteneck, M. 2015. "Towards Explaining the Use of Self-Tracking Devices: Conceptual Development of a Continuance and Discontinuance Model," in *Proceedings of the 36th International Conference on Information Systems*.

Canhoto, A. I., and Arp, S. 2017. "Exploring the Factors That Support Adoption and Sustained Use of Health and Fitness Wearables.," *Journal of Marketing Management* (33:1/2), pp. 32–60.

Davis, F. D. 1989. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly*, pp. 319–340.

De Moya, J.-F., and Pallud, J. 2017. "Quantified-Self: A Literature Review Based on the Funnel Paradigm," in *ECIS* 2017 Proceedings.

Featherman, M. S., and Pavlou, P. A. 2003. "Predicting E-Services Adoption: A Perceived Risk Facets Perspective," *International Journal of Human-Computer Studies* (59:4), pp. 451–474.

Gao, S., Zhang, X., and Peng, S. 2016. "Understanding the Adoption of Smart Wearable Devices to Assist Healthcare in China," in *Social Media: The Good, the Bad, and the Ugly* (Vol. 9844), Y. K. Dwivedi, M. Mantymaki, M. N. Ravishankar, M. Janssen, M. Clement, E. L. Slade, N. P. Rana, S. Alsharhan, and A. C. Simintiras (eds.), pp. 280–291.

Grewal, D., Gotlieb, J., and Marmorstein, H. 1994. "The Moderating Effects of Message Framing and Source Credibility on the Price-Perceived Risk Relationship," *Journal of Consumer Research* (21:1), pp. 145–153.

Gribel, L., Regier, S., and Stengel, I. 2016. "Acceptance Factors of Wearable Computing: An Empirical Investigation," in *Proceedings of the Eleventh International Network Conference (INC 2016)*.

Gurtner, S. 2014. "*Modelling Consumer Resistance to Mobile Health Applications," ICIS 2014 Proceedings*.

Hirose, M., and Tabe, K. 2016. "Responses to Mhealth Application on Health Behavior: A Theoretical Extension of the Technology Acceptance Model," in *Looking Forward, Looking Back: Drawing on the Past to Shape the Future*, C. Campbell and J. J. Ma (eds.), pp. 46–55.

Kim, D. J., Ferrin, D. L., and Rao, H. R. 2009. "Trust and Satisfaction, Two Stepping Stones for Successful E-Commerce Relationships: A Longitudinal Exploration," *Information Systems Research* (20:2), pp. 237–257.

Kim, J. 2014. "A Qualitative Analysis of User Experiences With a Self-Tracker for Activity, Sleep, and Diet," *Journal of Medical Internet Research* (16:3), pp. 1–1.

Li, H., Wu, J., Gao, Y., and Shi, Y. 2016. "Examining Individuals' Adoption of Healthcare Wearable Devices: An Empirical Study from Privacy Calculus Perspective," *International Journal of Medical Informatics* (88), pp. 8–17.

Lim, N. 2003. "Consumers' Perceived Risk: Sources versus Consequences," *Electronic Commerce Research and Applications* (2:3), Selected Papers from the Pacific Asia Conference on Information Systems, pp. 216–228.

Maltseva, K., and Lutz, C. 2018. "A Quantum of Self: A Study of Self-Quantification and Self-Disclosure," *Computers in Human Behavior* (81), pp. 102–114.

Mcknight, D. H., Carter, M., Thatcher, J. B., and Clay, P. F. 2011. "Trust in a Specific Technology: An Investigation of Its Components and Measures," *ACM Transactions on Management Information Systems (TMIS)* (2:2), p. 12.

Mou, J., Shin, D.-H., and Cohen, J. 2016. "Health Beliefs and the Valence Framework in Health Information Seeking Behaviors," *Information Technology & People* (29:4), pp. 876–900.

Okazaki, S., Li, H., and Hirose, M. 2009. "Consumer Privacy Concerns and Preference for Degree of Regulatory Control," *Journal of Advertising* (38:4), pp. 63–77.

Pavlou, P. A. 2003. "Consumer Acceptance of Electronic Commerce: Integrating Trust and Risk with the Technology Acceptance Model," *International Journal of Electronic Commerce* (7:3), pp. 101–134.

Pfeiffer, J., von Entress-Fuersteneck, M., Urbach, N., and Buchwald, A. 2016. "Quantify-Me: Consumer Acceptance of Wearable Self-Tracking Devices.," in *ECIS 2016 Proceedings*.

del Río Carral, M., Roux, P., Bruchez, C., and Santiago-Delefosse, M. 2017. "Santé Digitale : Promesses, Défis et Craintes. Une Revue de La Littérature," *Pratiques Psychologiques* (23:1), pp. 61–77.

Rosenstock. 1974. "The Health Belief Model and Preventive Health Behavior," *Health Education Monographs* (2:4), pp. 354–386.

Spagnolli, A., Guardigli, E., Orso, V., Varotto, A., and Gamberini, L. 2014. "Measuring User Acceptance of Wearable Symbiotic Devices: Validation Study Across Application Scenarios," in *Symbiotic Interaction* (Vol. 8820), G. Jacucci, L. Gamberini, J. Freeman, and A. Spagnolli (eds.), pp. 87–98.

Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. 2003. "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly*, pp. 425–478.

Venkatesh, V., Thong, J. Y., and Xu, X. 2012. "Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology," *MIS Quarterly*, pp. 157–178.

Yang, H., Yu, J., Zo, H., and Choi, M. 2016. "User Acceptance of Wearable Devices: An Extended Perspective of Perceived Value," *Telematics and Informatics* (33:2), pp. 256–269.