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Determinants of users' continuance intention toward digital innovations: Are late adopters different?

Sara F. Jahanmir[a,*], Graça Miranda Silva[b,1], Paulo J. Gomes[c], Helena Martins Gonçalves[b,1]

[a] Neoma Business School, Mont-Saint-Aignan, France
[b] ADVANCE/CSG, ISEG, University of Lisbon, Portugal
[c] College of Business, Florida International University, Miami, USA

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ABSTRACT

This study examines the users of digital innovations with covariance-based structural equation modeling (CBSEM) and a fuzzy-set qualitative comparative analysis (fsQCA) to understand the factors that drive their continuance intention. We examine the interplay between the perceptual factors related to the user experience with a digital product and personal factors that characterize late adoption. The findings highlight that perceived radicalness is a core condition to achieve the users' continuance intention in a digital context. The findings contribute to theory by providing a better understanding of how personal factors in adoption interact with other determinants of the continuance intention. The study also presents practical implications. The results show that in the case of late adopters, firms should invest in both the radicalness and high system quality of their digital innovations.

1. Introduction

The proliferation of digital technologies has created significant opportunities to launch new products, but it has also challenged firms to rethink their strategies to advance digital transformation. In particular, the diffusion and adoption of digital innovations have received significant attention from both scholars and practitioners (e.g., Chen & Granitz, 2012; Jahanmir & Cavadas, 2018), and there is a growing research interest in continued use after initial adoption. In competitive markets of digital innovations, repeat usage is a key goal for firms to ensure profitability and growth in addition to the adoption by new customers (Bhattacherjee, 2001b). In fact, the continuance intention has a greater impact on the long-term viability of digital innovations than attracting new customers (Bhattacherjee, 2001a; Ding, 2019) because it helps firms to achieve a competitive advantage and long-term sustainable success (Wang, Ou, & Chen, 2019).

Continuance intention is a complex phenomenon influenced by many factors (Chiu & Wang, 2008; Liébana-Cabanillas, Molinillo, & Ruiz-Montañez, 2019; Venkatesh, Thong, & Xu, 2012). Previous studies have analyzed the effect of various antecedents on the continuance intention (e.g., Hong, Kim, & Lee, 2008; Hsiao, Chang, & Tang, 2016; Li et al., 2018; Wang et al., 2019). Some studies have emphasized the important role of personal factors to explain the adoption and the continuance intention to use digital innovations (e.g., Ding, 2019; Lu, 2014; Parasuraman & Colby, 2015). However, few studies investigate the effect of personal factors on the continuance intention (Lu, 2014). For example, Jahanmir and Cavadas (2018) study both personal and perceptual factors related to the user experience that affect the late adoption of digital innovations. Two key personal factors that characterize late adoption are the slowness of adoption and skepticism (Jahanmir & Lages, 2016). Digital innovations play a central role in the disruption of businesses, and late adopters represent a significant portion of the total number of adopters. Therefore, an understanding of how to ensure late adopters' continuance intention is essential for firms. To the best of our knowledge, no study has explored how the personal factors that drive adoption combine with the perceptual factors drawn from the users' experience with the digital product to affect the continuance intention. Furthermore, studies that explore late adoption are scarce. This study attempts to fill this gap. In particular, we address the following research questions: Which perceptual and personal factors are associated with the continuance intention? How do these factors combine to achieve it?

* Corresponding author.
E-mail addresses: sara.jahanmir@neoma-bs.fr (S.F. Jahanmir), gracamsilva@iseg.ulisboa.pt (G.M. Silva), pgomes@fiu.edu (P.J. Gomes), helenamg@iseg.ulisboa.pt (H.M. Gonçalves).

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To answer these research questions, we apply both a CBSEM and a fuzzy-set qualitative comparative analysis (fsQCA). Since our study involves some antecedent factors not analyzed in the literature, it starts by analyzing the net effects of each antecedent factor on the continuance intention with conventional correlational techniques. FsQCA can provide a more accurate understanding of the complex reality associated with the continuance intention. First, this approach explores how the antecedent factors combine to produce multiple alternative paths that can successfully lead to this intention. Second, fsQCA assumes causal asymmetry to identify the paths that explain the negation of the continuance intention, which are likely to be different from the ones that explain it (Ragin, 2008). Third, fsQCA can explore how an individual factor in a configuration can contribute positively or negatively to the continuance intention due to the presence or absence of the other antecedent factors in the configuration. In sum, this study analyzes the data using fsQCA to expose patterns between the antecedent factors and the continuance intention that the CBSEM does not capture. The use of fsQCA to explain the continuance intention also answers the call of Liu, Mezei, Kostakos, and Li (2017) for the application of this technique to information systems (IS) behavior research since it can offer new insights into understanding the IS phenomena.

The contribution of this study is threefold. First, despite extensive research on technology acceptance and users' behavioral intention toward using digital innovations, few studies focus on the key determinants of the continuance intention that incorporate personal and perceptual factors related to the user experience. Our study is unique because it combines perceptual factors related to the user experience with personal factors that characterize late adoption. Second, to the best of our knowledge, no study has considered radicalness from a perceptual perspective. The technology readiness index (TRI), proposed by Parasuraman (2000), posits that an individual's technology acceptance is "an interplay between drivers (optimism, innovativeness) and inhibitors (discomfort, insecurity) of technology readiness" (p. 317). However, this index only considers personal factors. Our study adds to the body of knowledge because it explores the role of perceived radicalness as a perceptual factor that ensures users' continuance intention. Third, we use fsQCA as a complementary method to a traditional SEM approach that offers a deeper understanding of how perceptual and personal factors combine to influence the continuance intention. We identify the interplay among the aforementioned factors that can help managers and practitioners to specify detailed patterns of factors that stimulate the continuance intention to use digital innovations. This specificity allows product managers to develop new digital innovations with higher continuance intention.

The study proceeds as follows: The next section reviews the literature on the continuance intention to use digital innovations and several antecedents. The following two sections describe the methodology and present the empirical results. We then present a discussion of the results and their implications for theory and practice. The study concludes with limitations and directions for future research.

2. Theoretical background and hypotheses development

2.1. Continuance intention in a digital context

Digital innovations have fundamentally changed the way firms conduct business and interact with consumers. Because of the radical change, the amount of digital innovations that enter markets has grown at an increasing pace (Huang & Rust, 2013). However, up to 90% of digital innovations fail (Marmer, Herrmann, Dogrultan, & Berman, 2011). To stand out in this highly competitive and dynamic environment, firms need to consider not only strategies to boost adoption but also to better understand users' continuance intention.

Scholars have applied a variety of adoption theories and models to examine the factors that affect the users' acceptance of technology innovations, such as the diffusion of innovation theory (Rogers, 2010), technology acceptance model (Davis, 1989), theory of planned behavior (Ajzen, 1991), technology readiness index (Parasuraman, 2000; Parasuraman & Colby, 2015), or the technology adoption propensity index (Ratchford & Barnhart, 2012). Such studies focus on the initial adoption and rarely provide insights into post-adoption behavior (Cheung & Limayem, 2005). Recent models consider both adoption and usage, such as the unified theory of acceptance and use of technology (Venkatesh et al., 2012) or the expectation-confirmation model (Bhattacherjee, 2001b). Not surprisingly most studies research continuance intention by extending the framework for initial adoption. Still, these models highlight that adoption is not the defining success factor for an innovation. Specifically, in the case of certain digital or IS innovations, such as websites or web browsers, users' loyalty and continuance intention at an individual level play critical roles in service providers' survival (Hong et al., 2008).

This study refers to the continuance intention as users' long-term intention to use an innovation on a regular basis (Kim & Kang, 2016; Limayem, Hirt, & Cheung, 2007) and, consistent with the research, equates the continuance intention with customer loyalty (e.g., Tseng, Pham, Cheng, & Teng, 2018). The continuance intention provides an indication of consumers' overall assessment of the use of a particular technology (Hong et al., 2008). While adoption of a digital innovation is a significant success for firms, the continuance intention is a determinant of the firms' high market share and significant revenues that result in long-term survival and success of that innovation (Bhattacherjee, 2001a; Bhattacherjee, Perols, & Sanford, 2008).

2.2. Perceptual factors related to user experience

The continuance intention indicates a repeated behavioral pattern that results from certain contextual cues (Wang et al., 2019) and is directly related to the satisfaction or perceived value the consumer derives from using the product (Hsiao et al., 2016; Li et al., 2018). This study considers three factors that are associated with users' satisfaction with the digital innovations: perceived radicalness, perceived system quality, and expectation fulfillment.

2.2.1. Perceived radicalness

Radical digital innovations create new solutions and new market values through innovative concepts. Chandy and Tellis (1998) refer to radical innovations as a clear advance in the state-of-the-art technology that offers better functionality and/or performance as well as higher customer benefit per dollar.

The research argues that the creation of radical innovations offers firms a higher payoff (Lilien, Morrison, Searls, Sonnack, & Hippel, 2002; Kleinschmidt & Cooper, 1991). In a digital environment with rapid technological changes, firms' long-term survival and competitiveness depend on their ability to generate radical innovations (Lettl, 2007). Scholars have illustrated how digitization provides vast potential for unpredictable product and service innovations (Nylén & Holmström, 2015) with shorter product life cycles (Herrmann, Gassmann, & Eisert, 2007). In this high tech context, firms cannot afford slow adoption of their innovations but must have the ability to develop and launch innovations faster than competitors as a key success factor (Allocca & Kessler, 2006). Radical innovations increase the possibility of unexpected positive outcomes for the user, which the research has shown to positively influence continuance intention (Hsu, Hsu, Wang, & Chang, 2016). Still, few studies have directly associated radicalness with users' continuance intention. In the context of online game technology, Jung, Kim, and Lee (2014) find a positive effect of perceived product innovation on the attitude toward playing that in turn positively influences the behavioral intention to play. Chen, Lee, and Windasari (2015) study the success factors of e-learning systems and find that the level of service innovation moderates the impact of perceived usefulness on the continuance intention.

Thus, this study presents the following hypothesis:

Hypothesis 1. Perceived radicalness is positively related to the continuance intention.

2.2.2. Perceived system quality

System quality refers to the excellence or superiority of a product from a technical point of view (Delone & McLean, 2003). Golder, Mitra, and Moorman (2012, p. 9) state that "the core feature of the quality evaluation process is the conversion of perceived attributes into an aggregated evaluation of quality, which is a summary judgment of the customer's experience of the firm's offering." Building on Golder et al. (2012), this study considers perceived system quality as a result of the continuous assessment of the experience with a digital system. We follow the IS literature (e.g., Kim, Kim, Lee, & Kim, 2019; Wang & Lin, 2017) and consider reliability and functionality as the two major components of perceived system quality.

The delivery of high quality is among the first strategies that firms follow to fulfil customers' needs and to ensure the competitiveness, survival, and success of their businesses (Parasuraman, Zeithaml, & Berry, 1988). Fornell, Johnson, Anderson, Cha, and Bryant (1996) argue that customer satisfaction is more quality-driven than value- or price-driven. In the context of digital innovations, the perceived system quality is the main factor that affects satisfaction (Zhou, 2013). The studies of IS have analyzed perceived quality as the first determinant of overall consumer satisfaction with an innovation that in turn positively influences users' continuance intention (e.g., Kim, Chang, Park, & Lee, 2015; Kim et al., 2019; Lin, Fan, & Chau, 2014).

When consumers perceive a digital innovation to be of high quality, they are less likely to consider alternatives (Wang et al., 2019). The research has explored the direct effect of perceived quality on the continuance intention in a digital context (e.g., Hu, Brown, Thong, Chan, & Tam, 2009; Liébana-Cabanillas et al., 2019; Kim et al., 2015). For instance, in the context of Near Field Communication for mobile payment systems in public transportation, Liébana-Cabanillas et al. (2019) find a positive effect of perceived quality on the continuance intention. Following this stream of research, this study intends to explore the perceived system quality as an antecedent of the continuance intention. Therefore, this study proposes the following:

Hypothesis 2. Perceived system quality is positively related to the continuance intention.

2.2.3. Expectation fulfillment

The confirmation of the users' expectation is among the most influential factors to ensure their continuance intention as suggested by expectation-confirmation models (Bhattacherjee, 2001b). Users evaluate the fit between quality related characteristics of a digital innovation and their needs and expectations to determine satisfaction with a digital product (Wang et al., 2019). When exploring the continuance intention, the literature indicates that satisfaction is a key antecedent of inertia; a force that encourages users to keep their behavior unchanged and to continue to use a current technology (Amoroso & Lim, 2017; Limayem et al., 2007).

Expectations consist of predictions customers make about their experience with a technology (Parasuraman, Zeithaml, & Berry, 1988). The expectation-confirmation theory offers an explanation about users' repurchase intention as a result of satisfaction with their pre-purchase expectations (Nascimento, Oliveira, & Tam, 2018; Oliver, 1980). Similarly, scholars argue that fulfilling customers' expectations can create customer loyalty (Parasuraman, Berry, & Zeithaml, 1991) that can increase the continuance intention. Bagozzi (1992) presents the idea of an "outcome-desire unit." He argues that individuals engage in a certain behavior, such as the purchase or use of an innovation because of their expectations about achieving a certain outcome. If a "desire-outcome fulfillment" exists, that is, if the expectation is fulfilled, an affective response such as satisfaction will follow. An affective response is then followed by a coping response that can be in the form of a positive behavioral intention, such as the continuance intention. On the other hand, failure to meet expectations may reduce the involvement of users, or make them feel cognitive dissonance and anxiety, which represents a major challenge to continued usage (Bhattacherjee et al., 2008; Meuter, Ostrom, Bitner, & Roundtree, 2003).

Extensive research has applied the expectation-confirmation theory to a variety of digital innovations, such as e-commerce (Bhattacherjee, 2001a, 2001b), mobile internet (Hong, Thong, & Tam, 2006), e-learning services (Roca, Chiu, & Martínez, 2006), and smartwatches (Nascimento et al., 2018). This study predicts that expectation fulfillment is as an antecedent of the continuance intention of users. The next hypothesis then is:

Hypothesis 3. Expectation fulfillment is positively related to the continuance intention.

2.3. Personal factors that characterize late adoption

Previous studies have shown that personal factors such as personal innovativeness, technology anxiety, and skill capacity affect both the adoption of technological innovations and their continued use (Chiu & Wang, 2008; Ding, 2019; Meuter et al., 2003). Resistance to adoption and skepticism are among other possible reactions to novel technologies (Moore, 2014). Resistant customers adopt an innovation later than their peers do. On the diffusion of innovation curve, late adopters represent about half of the total number of adopters (Jahanmir & Lages, 2016). Further, late adopters are characterized by their skepticism toward novel products (Jahanmir & Lages, 2016; Rogers, 2010). The literature on late adoption explores personal elements that characterize late adopters (Jahanmir & Lages, 2016) or personal factors that drive the late adoption of innovations (Jahanmir & Cavadas, 2018; Parasuraman & Colby, 2015). Following this stream of research, this study presents two key elements of late adoption as personal factors that affect the continuance intention, namely, the slowness of adoption and skepticism.

2.3.1. Slowness of adoption

Slowness of adoption refers to how slowly users adopt an innovation (Jahanmir & Lages, 2016; Rogers, 2010). The addition of slow adopters as users of a digital innovation is key to long-term market dominance (Moore, 2014). Slow users believe more in tradition than in progress, wait until products are mature and prices are low (Moore, 2014), and tend to be more loyal customers (Moore, 2014). In other words, they have a higher level of continuance intention. Hence, the next hypothesis is:

Hypothesis 4. The slowness of adoption is positively related to the continuance intention.

2.3.2. Skepticism

The research defines skeptical users as those who have a cautious approach toward innovations and resist changing old habits or using new technologies (Jahanmir & Lages, 2016). Skeptical users are more sensitive to uncertainties such as those associated with radical digital innovations (Moore, 2014). Parasuraman and Colby (2015) refer to late adopters as avoiders who are consumers with a high degree of resistance and a low degree of motivation. Nevertheless, late adopters are more loyal customers than other user categories (Jahanmir & Lages, 2015; Uhl, Andrus, & Poulsen, 1970). Therefore, they offer firms higher potential for the continued use of digital innovations. To understand this relationship, this study explores the effect of late adopters' skepticism on the continuance intention toward digital innovations.

Hypothesis 5. Skepticism is positively related to the continuance intention.

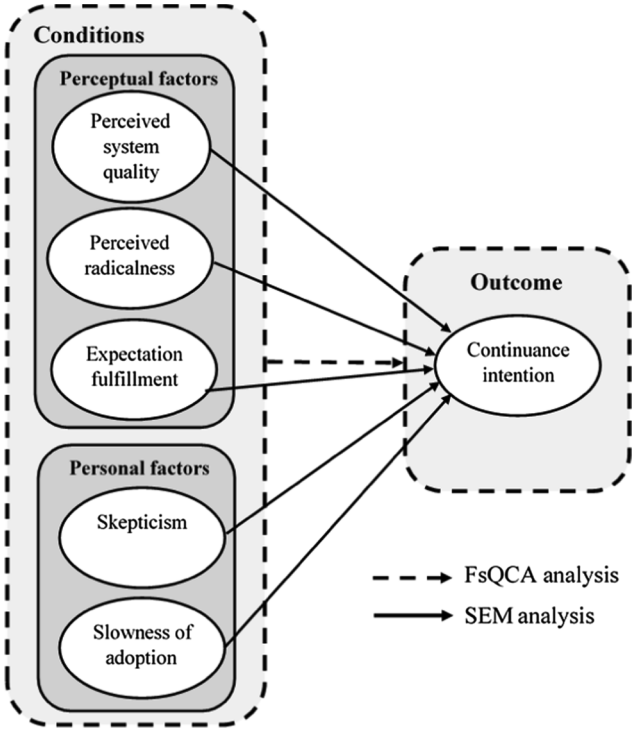

Fig. 1. Research model.

Fig. 1 illustrates the research model this study proposes. This model includes the hypothesized relations for each predictor that the CBSEM tests. These predictors can combine in multiple ways to achieve the continuance intention. We use an exploratory approach to analyze possible combinations between the predictors (conditions) and the outcome of interest (continuance intention) by applying fsQCA.

3. Methodology

3.1. Data collection

The target population are users of web browsers. Browsers are complex digital products that interpret multiple sets of core technologies such as Javascript and Geolocation. They have to keep up-to-date with changes in these core technologies. This study uses a non-probability sampling, that is, a purposive sampling procedure. One of the researchers recruited respondents that were active users of web browsers. An online survey provided 141 completed questionnaires. In the final sample, 56.7% of the respondents were male, and 88.7% were 25 years old or younger. Windows was the operating system that most respondents (60.9%) used, and Google Chrome was the browser most respondents (32.8%) used, followed by Internet Explorer (23.9%) and Firefox (17.9%).

3.2. Measures

This study applied scales from the literature. All items were measured using Likert scales anchored by one (strongly disagree) and five (strongly agree). Slowness of adoption and skepticism were measured with two items and three items, respectively, that were adapted from Jahanmir and Lages (2016). Perceived radicalness was measured through a six-item scale adapted from Chandy and Tellis (1998) and Carlo, Gaskin, Lyytinen, and Rose (2014). The five items used to measure perceived system quality were adapted from Dodds, Monroe, Grewal, (1991) and Lin et al. (2014). The continuance intention and expectation fulfillment were measured using three-item scales adapted from Bhattacherjee (2001b).

3.3. Common method bias

To control for common method bias (CMB), the study used both ex ante and ex post approaches (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The ex ante approaches used concise and simple items in which respondents were assured of their anonymity and that no right or wrong answers existed. The respondents were not aware of our research model. The ex post methods used three approaches. The first was a confirmatory factor analysis with Harman's single-factor model (Harman, 1967). The model presented a poor fit (χ^2 = 1458.988; df = 190; χ^2/df = 7.679, CFI = 0.413, TLI = 0.351, IFI = 0.418, RMSEA = 0.218, p-close = 0.00, and standardized RMR = 0.148). The second was the latent factor test (Podsakoff et al., 2003). The results showed no loss in significance in the factor loading when the latent factor was introduced to the original measurement model. The third approach used a full collinearity test by calculating the variance inflation factor (VIF) for all variables (dependent and independent variables) in the research model (Kock & Lynn, 2012). This test is considered an effective and conservative alternative to identify CMB (Kock, 2015). The highest VIF value obtained was 3.85 for the variable continuance intention, which was below the VIF threshold of five recommended for covariance-based SEM algorithms (Kock & Lynn, 2012). Taken together, these results indicated that CMB was minimal in this study.

4. Analysis and results

The empirical analysis in this study used a conventional CBSEM and a fsQCA. CBSEM is a variable-oriented technique that focuses on the net effects of the independent variables on the dependent variable. FsQCA is a case-oriented technique that focuses on exploring how the causal conditions can jointly configure to link to the outcome (Fiss, 2011) to create a fine-grained empirical investigation of causal complexity through the logic of set theory (Misangyi et al., 2017; p.1).

4.1. Measurement model

A confirmatory factor analysis (CFA) with the maximum likelihood (ML) estimation were performed using AMOS 22 to check the fit of the measurement model and its reliability and validity. The measurement model showed a good fit with the data: χ^2 = 156.888 (df = 119; $p < 0.001$); χ^2/df = 1.318; CFI = 0.978; TLI = 0.971; IFI = 0.978; RMSEA = 0.048, *p*-close = 0.559; SRMR = 0.051). The χ^2/df ratio was below 2.0 (Hair, Black, Babin, & Anderson, 2010); and the IFI, TLI, and CFI exceeded the recommended minimum threshold of 0.90 (Kline, 2005). The RMSEA of 0.048 did not exceed the cutoff of 0.08 (Kline, 2005) nor did the standardized RMR of 0.050 exceed its cutoff of 0.10 (Kline, 2005).

The standardized factor loadings, the average variance extracted (AVE), the Cronbach's coefficient alpha (α), and the composite reliability (CR) values for all constructs are presented in Appendix A. The results show that the standardized factor loadings are above 0.7 (with the exception of one item at 0.68) and are all significant at $p < 0.001$ (Bagozzi & Yi, 2012; Hair et al., 2010). The α, CR, and AVE values surpass the recommended cutoffs (Fornell & Larcker, 1981). Furthermore, the square root of the AVE values (shown on the diagonal of Table 1) for each construct are higher than the correlations between all constructs (Fornell & Larcker, 1981), which supports discriminant validity. Table 1 presents the correlations and statistics for all constructs.

4.2. Structural model results

Table 2 summarizes the results of the structural model. The goodness-of-fit statistics show that the proposed structural model satisfactorily fits the data: χ^2 = 170.388 (df = 126; $p < 0.01$), χ^2/df = 1.352, CFI = 0.974, TLI = 0.968, IFI = 0.974, RMSEA = 0.050,

Table 1
Correlation Matrix (discriminant validity check).

Latent Variables	Mean	S.D	(1)	(2)	(3)	(4)	(5)	(6)
(1) Slowness of adoption	2.45	0.91	**0.84**					
(2) Skepticism	2.74	0.77	0.28*	**0.74**				
(3) Perceived system quality	3.57	0.80	−0.14	−0.16	**0.83**			
(4) Perceived radicalness	3.11	0.78	−0.15	−0.01	0.49**	**0.86**		
(5) Expectation fulfillment	3.40	0.85	−0.19	−0.07	0.20*	0.56**	**0.76**	
(6) Continuance intention	3.28	1.10	−0.20*	0.11	0.31**	0.68***	0.72***	**0.92**

Note: Diagonal elements in bold are the square roots of AVE.
* Significant at $p < 0.05$ (2-tailed).
** Significant at $p < 0.01$ (2-tailed).
*** Significant at $p < 0.001$.

p-close = 0.479, SRMR = 0.073). For the perceptual factors, both perceived radicalness and expectation fulfillment have positive and significant effects on the continuance intention with ($\beta = 0.37$; $p < 0.001$) and with ($\beta = 0.50$; $p < 0.001$), respectively. These findings support H1 and H3. The effect of the perceived system quality (H2) is not significant. The effects of the slowness of adoption and skepticism on the continuance intention are also not significant. Thus, the results do not support H4 and H5. The structural model explains 66% of the variance ($R^2 = 0.66$) in users' continuance intention.

4.3. Calibration

As fsQCA springs from the concept of set membership, the calibration of the measures is the first step for the fuzzy-set analyses. For all variables, to express the degree of membership we use the direct method of calibration (see Ragin, 2008). This process requires specifying three qualitative anchors: full non-membership, full membership, and a crossover point. The endpoints and the midpoint of the five-point Likert scales used to measure the variables are used as the three qualitative anchors for the calibration of full membership (value 5), full non-membership (value 1), and the crossover point (value 3). (cf. Frambach, Fiss, & Ingenbleek, 2016). The fsQCA 2.5 program (www.fsqca.com) provides the calibrated scores.

FsQCA cannot analyze cases with scores of exactly 0.5 because it represents the point of indifference. Thus, to ensure that no cases are dropped from the analysis, a constant of 0.001 is added to all scores lower than one.

4.4. Analysis of necessary conditions

The analysis of sufficient conditions should always be preceded by the analysis of necessity (Schneider & Wagemann, 2010, p. 404). Thus, that analysis examines whether any of the five antecedent factors can be regarded as necessary for users' high continuance intention. Conventionally, a condition is necessary if the consistency score exceeds the threshold of 0.9 (Ragin, 2008). Table 3 depicts the results of the analysis of necessity. The results show that the perceived system quality is a necessary condition for users' high continuance intention.

Table 3
Overview of necessary conditions.

	Users' high continuance intention	
Condition	Consistency	Coverage
Slowness of adoption	0.48	0.79
~Slowness of adoption	0.83	0.76
Skepticism	0.59	0.81
~Skepticism	0.73	0.74
Perceived system quality	0.91	0.79
~Perceived system quality	0.41	0.74
Perceived radicalness	0.84	0.89
~Perceived radicalness	0.53	0.68
Expectation fulfillment	0.87	0.83
~Expectation fulfillment	0.44	0.67

Note: "~" represents the absence of a condition.
Calculations with the fsQCA 2.5 Software (www.fsqca.com).

4.5. Analysis of sufficient conditions for users' continuance intention

To explore which conditions (or combination of conditions) might consistently lead to users' continuance intention, we use the truth table algorithm described by Ragin (2008). To reduce the truth table to meaningful configurations the frequency threshold was set at four observations to ensure at least 80% of the cases in the sample were part of the analyses as suggested by Ragin (2008). With respect to consistency, the analysis first identified all configurations (with four or more cases) that had a minimum raw consistency of 0.8 (Ragin, 2008). Second, from those configurations it eliminated any that had a PRI consistency lower than or equal to 0.70 to avoid simultaneous subset relations of factor combinations in both users' high continuance intention and their negation (Schneider & Wagemann, 2012). Further, when applying these threshold values, the truth table was reduced to a simplified configuration that used Boolean algebra. Based on the differences in counterfactual analysis (see Fiss, 2011), the truth table algorithm produced three different solutions, namely, complex, intermediate, and parsimonious solutions. This study analyzes the intermediate solution that is generally considered the best solution (Ragin, 2008). Table 4 provides this solution for the outcome users' high continuance intention that distinguishes between "core" and "peripheral" conditions (see Fiss, 2011).

Table 2
Structural model results.

Path	Path coefficient estimate	Standard error	*t*-value	*p*-value
Perceived radicalness → Continuance intention	0.37***	0.14	4.20	0.00
Perceived system quality → Continuance intention	0.05	0.11	0.72	0.48
Expectation fulfillment → Continuance intention	0.50***	0.18	5.28	0.00
Slowness of adoption → Continuance intention	−0.09	0.08	−1.38	0.17
Skepticism → Continuance intention	0.16	0.12	1.54	0.13

*** Significant at $p < 0.001$.

Table 4
Sufficient configurations for users' high continuance intention.

Condition	1	2	3
Slowness of adoption			●
Skepticism		●	
Perceived system quality	●	●	●
Perceived radicalness	●	●	●
Expectation fulfillment	●		
Consistency	0.94	0.93	0.91
Raw coverage	0.76	0.54	0.44
Unique coverage	0.18	0.01	0.01
Solution coverage	0.79		
Solution consistency	0.92		

Note: Black circles indicate the presence of a condition; circles with "x" indicate its absence. Large circles indicate core conditions; small circles, peripheral conditions. Blank cells indicate "don't care."

Table 5
Sufficient configurations for the negation of users' high continuance intention.

Condition	1	2
Slowness of adoption	⊗	
Skepticism	⊗	●
Perceived system quality		⊗
Perceived radicalness	⊗	⊗
Expectation fulfillment	⊗	⊗
Consistency	0.90	0.90
Raw coverage	0.58	0.45
Unique coverage	0.18	0.05
Solution coverage	0.63	
Solution consistency	0.89	

Note: Black circles indicate the presence of a condition; circles with "x" indicate its absence. Large circles indicate core conditions; small circles, peripheral conditions. Blank cells indicate "don't care."

The solution presented in Table 4 shows that three equifinal configurations exist. As all of the consistency scores exceed the cutoff value of 0.8 (Ragin, 2008), then all configurations are sufficient. Moreover, the unique coverage is larger than zero for all configurations. Thus, all configurations are empirically relevant (Ragin, 2008). According to the solution coverage, the overall solution accounts for 79% of the cases associated to users' high continuance intention.

Perceived radicalness is the single core condition for all the configurations. This result means that it represents the condition that is most essential to achieve users' high continuance intention. Additionally, the results show that perceived radicalness and perceived system quality are present in all configurations. The first configuration is the most empirically relevant in absolute terms (raw coverage = 0.760) as well as in relative terms (unique coverage = 0.184). It shows that the combination of these two perceptual factors with high expectation fulfillment are sufficient to achieve users' high continuance intention. The second and third configurations show that skeptical consumers and slow adopters achieve high continuance intention if their perceived system quality and perceived radicalness are high. Skepticism and the slowness of adoption substitute for high expectation fulfillment.

4.6. Analysis of sufficient conditions for the negation of users' high continuance intention

Contrary to most traditional techniques (e.g., SEM, regression), fsQCA accounts for causal asymmetry, that is, configurations that lead to the outcome might be quite different from those that lead to the negation of the outcome (Fiss, 2011; Frambach et al., 2016; Ragin, 2008). To check this asymmetry, fsQCA conducts another set of analyses in which the negation of users' high continuance intention represents the outcome and is coded as the inverse. To explore which conditions consistently lead to this outcome, the same frequency, consistency, and the PRI thresholds are applied. The intermediate solution for the negation of the high continuance intention comprises two equifinal configurations presented in Table 5.

The two identified configurations comply with the recommended consistency and coverage thresholds (Ragin, 2008). The first configuration shows that a non-skeptical user who quickly adopts innovations combined with low perceived radicalness and high unfulfilled expectations leads to the absence of users' high continuance intention. The second configuration shows that a skeptical user, regardless of slowness of adoption, combined with the system's low perceived quality, low perceived radicalness, and low expectation fulfillment also lead to the absence of users' high continuance intention. These findings indicate the presence of causal asymmetry. This asymmetry means configurations that lead to the negation of users' high continuance intention are not the mirror opposites of the configurations that were found for the users' continuance intention.

5. Discussion and implications

This study uses the CBSEM and fsQCA to explore the effect of perceived radicalness, perceived system quality, and expectation fulfillment as well as the slowness of adoption and skepticism on users' continuance intention toward digital innovations.

The results highlight perceived radicalness as a strong factor that influences the continuance intention. The CBSEM results show that perceived radicalness and expectation fulfillment have a strong positive effect on users' continuance intention. The findings from fsQCA confirm that perceived radicalness is indeed a core condition for all configurations, while expectation fulfillment is present in just one configuration. The relevance of fulfilling users' expectations is consistent with the studies in the IS research that highlight the importance of the congruence of users' perception of the expectation performance to achieve satisfaction and consequently the continuance intention (e.g., Bhattacherjee, 2001b; Ding, 2019; Hong et al., 2006; Nascimento et al., 2018; Roca et al., 2006).

The net effect of the perceived system quality on users' continuance intention was not significant in the CBSEM model. This result is aligned with the study of Kim et al. (2019) who find a non-significant direct effect of reliability on the continuance intention. However, fsQCA shows that this perceptual factor is a necessary condition for users' continuance intention, which corroborates previous studies that observe a positive direct effect of perceived system quality on the continuance intention (e.g., Hu et al., 2009; Kim et al., 2015; Liébana-Cabanillas et al., 2019).

FsQCA offers additional novel insights that indicate a combination of the perceptual factors needs to be taken into account to explain the continuance intention. High perceived radicalness and high perceived quality complement each other in all three combinations. This synergetic effect could not be captured by CBSEM since it examines the perceived system quality in isolation from the other perceptual and personal factors. These two perceptual factors are not sufficient to achieve users' high continuance intention because they require expectation fulfillment or the presence of personal factors related to late adoption.

While the SEM results show that both the slowness of adoption and skepticism have a non-significant effect on the continuance intention, fsQCA findings show that for skeptical users or slow adopters, high perceived system quality combined with high perceived radicalness is sufficient to ensure the continuance intention. This finding is supported by Jahanmir and Lages (2015) who confirm the preference of late adopters for radical simple products. Finally, the results show that

perceived system quality and radicalness are complements, whereas personal factors associated with late adoption substitute for high expectation fulfillment.

This study provides several theoretical contributions. First, while other studies present models for the adoption of innovations, this study contributes to theory by exploring post-adoption conditions through the determinants of the continued usage of digital innovations. To the best of our knowledge, no previous study has combined perceptual factors that are related to user experience with personal factors that characterize late adoption in order to ensure the continuance intention.

Second, this study analyzes both the net effects and configurations of causal conditions that drive the continuance intention to extend the contingency perspective on the continuance intention to use digital innovations. Personal factors combine with perceptions drawn from usage experience to drive the continuance intention. The study also finds that the perceived system quality is a necessary condition and yet complements the perceived radicalness to drive the continuance intention.

Third, our findings demonstrate the importance of perceived radicalness that extends the IS continuance models. Previous studies have highlighted the role of perceived usefulness, the utilitarian evaluation, and the confirmation of the expectations that determine the intention to use (Kim, Malhotra, & Narasimhan, 2005; Bhattacherjee & Lin, 2015), yet limited empirical studies had demonstrated the importance of perceived radicalness.

Fourth, our study provides novel insights about late adopters and their continuance intention to use a digital innovation that contributes to the literature of the diffusion and adoption of innovations. Late adopters represent half of the total number of users. Therefore, an understanding of the factors that facilitate their continuance intention to use digital innovations is of primary importance. They adopt more slowly and are skeptical of innovations. These users are resistant and do not seek deep knowledge of innovations (Jahanmir & Lages, 2015). The research finds that for consumers with little product knowledge, firms should improve and update existing products rather than invest their resources on the research and development (R&D) of radical products (Nam, Wang, & Lee, 2012). However, the results of this study show that in the case of late adopters, firms should invest in the development of radical innovations and in the promotion of both the radicalness and high system quality of their digital innovations.

This study's findings provide several implications for managerial practice. Our results show that to ensure continuance intention, firms should invest in R&D for high quality radical digital innovations. To fuel the innovativeness of R&D teams, firms should integrate customers into the development process (Schweitzer et al., 2019). Radicalness can be achieved through the presentation of new core components and the incorporation of a new core technology. Additionally, customers perceive innovations as radical when the innovation is radically better than the available options and presents a significant improvement over current practices. Firms can also show that the innovation creates new efficiencies and provides substantially higher benefits for customers as other options through which they can signal radicalness (Carlo et al., 2014; Chandy & Tellis, 1998). Radicalness needs to be complemented by high system quality to drive the continuance intention. Negative unexpected outcomes due to poor quality could turn the user away from a digital product (Hsu et al., 2016). To promote the high quality in digital innovations, product managers should focus R&D on functionality and reliability (Dodds, Monroe, & Grewal, 1991; Lin et al., 2014).

Users of digital innovations can often switch from one to another easily and at no cost. They can also simultaneously use multiple digital innovations. In this context, ensuring the continuance intention is critical for innovations' success. To achieve this goal, this study suggests that firms signal the radicalness of their digital innovations both at the product launch and during the diffusion process and post-adoption period.

In order to ensure the continuance intention of all customers, whether late adopters or not, firms must focus on the fulfillment of their customers' needs and expectations and must avoid differences between sales claims and the delivered product. Given the unlimited potential of digital innovations, many studies recommend the use of a dynamic problem-solution design that pairs rather than focuses on innovation processes (Nambisan, Lyytinen, Majchrzak, & Song, 2017). Firms should also conduct market research to analyze and better understand problems of potential customers so that they can fulfil customers' expectations and so increase the possibility of users' continuance intention to use their digital innovations. This finding supports the studies that emphasize the importance of the voice of customers (Griffin & Hauser, 1993).

6. Limitations and conclusion

This study attempts to enrich the current understanding of customers' continuance intention to use digital innovations. However, like any other study, it suffers from a couple of limitations that could be addressed in future research. The first limitation is related to the external validity of our results. This study uses data collected through a purposive sample in a single country. Thus, we assume selection bias as a limitation in our study. Additionally, 88.7% of our respondents are 25 years old or younger. Responses might vary in different geographical and cultural settings. Additionally, this study focuses on a single technology that may have specific patterns of adoption and usage. Studies have shown that in the case of IS applications used on a daily basis, such as web browsers, habitual use overshadows the effect of perceptual factors on the continuance intention (Kim, Malhotra, & Narasimhan, 2005). Future research is encouraged to build on this study and to test the presented models in other countries and/or on other digital innovations.

The second limitation concerns the absence of users' satisfaction, and additional personal or perceptual factors that affect users' continuance intention to use digital innovations, while considering key elements of late adoption. In this context, future research could extend our model by considering combinations with other relevant personal factors such as personal innovativeness and technology anxiety (Ding, 2019; Jung et al., 2014; Li et al., 2018; Lu, 2014) or other perceptual factors, such as perceived usefulness or perceived usability (Bhattacherjee, 2001a; Nascimento et al., 2018). Moreover, users' satisfaction should also be included as an antecedent condition since it has been recognized as a strong predictor of users' continuance intention (e.g., Bhattacherjee, 2001a, 2001b; Nascimento et al., 2018) as well as a mediator of the relationship between perceptual factors and personal factors and users' continuance intention (e.g., Akter, Wamba, & D'Ambra, 2019; Kim et al., 2019).

To conclude, this study empirically tested the net and combinatorial effects of three perceptual factors related to the user experience, namely, the perceived radicalness, perceived system quality, and the expectation fulfillment together with two personal factors, the slowness of adoption and skepticism on users' continuance intention. The findings show that perceived radicalness and perceived system quality are the two most critical perceptual factors for early and late adopters' continuance intention. While both early and late adopters tend to discontinue usage based on low expectation fulfillment, a segment of late adopters is less sensitive to confirmation of their expectations for the continuance intention. Specifically, for skeptical users or those who adopt more slowly, high perceived radicalness and high perceived system quality are sufficient to ensure the continuance intention.

Appendix A

Operationalization of constructs

Construct and items description	Standardized factor loadings	*t-value*
Slowness of Adoption (Jahanmir & Lages, 2016)		
Cronbach's α = 0.83; CR = 0.83; AVE = 0.71		
I was a very late adopter of this browser.	0.80	11.13
I was one of the last to adopt this browser.	0.89	_a
Skepticism (Jahanmir & Lages, 2016)		
Cronbach's α = 0.70; CR = 0.70; AVE = 0.54		
I can be stubborn in resistance to buying new products.*	*	*
I approach innovations with a skeptical and cautious air.	0.79	_a
I often fear high-tech a little bit.	0.68	3.41
Perceived system quality (Dodds et al., 1991; Lin et al., 2014)		
Cronbach's α = 0.91; CR = 0.90; AVE = 0.69		
The quality of the browser I use is high.	0.78	_a
The browser I use is very functional.	0.81	15.15
The browser I use is very reliable.	0.90	10.69
The browser I use must be of very good quality.	0.81	9.92
The browser I use appears to be of very bad quality (R)*	*	*
Perceived radicalness (Carlo et al., 2014; Chandy & Tellis, 1998)		
Cronbach's α = 0.93; CR = 0.92; AVE = 0.74		
I believe that the selected browser:		
Incorporates substantially new core technology	0.88	_a
Provides substantially higher customer benefits	0.88	13.98
Has the ability to create new efficiencies in the market	0.84	12.69
Includes substantially new core components	0.86	13.26
Is radically better than the current browsers*	*	*
Presents a significant improvement of features over current* browsers	*	*
Expectation fulfillment (Bhattacherjee, 2001b)		
Cronbach's α = 0.74; CR = 0.80; AVE = 0.58		
The services of this firm fulfil the expectations I have at the time of purchase	0.64	_a
After buying this browser, I found out that it was what I expected it to be.	0.74	7.09
I continuously find differences between sales claims and the delivered service. (R)	0.88	7.70
Continuance intention (Bhattacherjee, 2001b)		
Cronbach's α = 0.94; CR = 0.94; AVE = 0.84		
I will continue to use this browser in the future.	0.97	_a
It is very likely that I will use this browser in the future.	0.91	20.65
The next time I use a browser, I will use this browser.	0.87	17.54

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