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Drivers of consumers' resistance to smart products

Zied Mani[a*] and Inès Chouk[b,c*]

[a]LEMNA Research Center, Nantes University, IUT Saint Nazaire, Saint Nazaire, France; [b]THEMA Research Center, UMR CNRS 8184, Cergy-Pontoise University, Cergy-Pontoise, France; [c]Research Chair of Digital Economy, Paris-Dauphine University, Paris, France

ABSTRACT

The Internet of Things (IoT) market is set to grow rapidly. Although IoT offers new opportunities, it nevertheless raises challenges. The objective of this research is to develop a better understanding of the reasons underlying consumer resistance to smart and connected products. To this end, a quantitative survey was carried out to understand resistance to smartwatch. Structural equation modelling was used to test the conceptual model. The findings show that perceived uselessness, perceived price, intrusiveness, perceived novelty and self-efficacy have an impact on consumer resistance to smart products. Moreover, privacy concerns have an effect on intrusiveness and dependence impacts privacy concerns. To our best knowledge, this is the first research studying smart products through a resistance approach.

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Resistance; innovation; Internet of Things; smart and connected products; smartwatch

Introduction

The Internet of Things (IoT) is beginning to grow significantly, with market estimates predicting 26 billion IoT devices by 2020 (Gartner, 2013). The amount invested in this new technology and the rapid spread of connected devices highlight the great potential of the sector (Porter & Heppelmann, 2014). These new connected and smart products are revolutionising consumers' lives and can be considered as disruptive innovations (Christensen, 1997). Indeed, the IoT '*is a thrilling next phase in the Internet revolution because it brings the intelligence of the Internet to physical products with the potential for something new to emerge*' (Hoffman & Novak, 2015, p.126).

Nevertheless, the continued growth of the IoT raises significant challenges (security, privacy, trust, . . .) (Sicari, Rizzardi, Grieco, & Coen-Porisini, 2015) and ethical issues (Nguyen & De Cremer, 2016). Thus, several authors and specialists have raised concerns about information privacy (Hsu & Lin, 2016) and identified potential problems '*related to data protection, lack of human control, and enslavement to devices*' (Slettemeås, 2009, p. 226). Furthermore, increasing numbers of gadgets are being added to the IoT ecosystem, which raises questions about the utility and added value of these innovations. The success of any innovation in smart services depends on the value perceived by consumers in having it (Wuenderlich et al., 2015).

CONTACT Zied Mani zied.mani@univ-nantes.fr LEMNA Research Center, Nantes University, IUT Saint Nazaire, 58 rue Michel Ange 44606, Saint Nazaire cedex, France

*These authors contributed equally to this work.

Several studies and surveys have confirmed the existence of these threats and barriers. The '2016 Accenture[1] Digital Consumer Survey for communications, media and technology companies (which polled 28,000 consumers in 28 countries on their use of consumer technology) found that price, security and ease of use stand as barriers to the adoption of IoT devices and services: 62% of consumers believed that these devices are too expensive, 47% of consumers cited 'privacy risk/ security concerns' and 64% of consumers experienced a challenge when using a new IoT device. In relation to the smartwatch market in particular, a recent study conducted by Wristly[2] of 330 Apple Watch owners who were dissatisfied with the device, found that 86% found no value in the product, 80% thought the device's functionalities were too limited, and 53% did not plan to purchase the next version.

Hence, the slow pace of consumer adoption of new technologies is a major disappointment for the IoT industry. The risk for companies is that they will encounter consumer resistance to these new products. According to Kleijnen, Lee, and Wetzels (2009) and Szmigin and Foxall (1998), resistance manifests itself in three forms of consumer response; rejection (consumers may not accept the smart product); postponement (consumers may not adopt smart products because the circumstances are not suitable); or opposition (consumers may consider smart products to be a threat and act to resist their adoption). Hence, understanding why consumers resist these innovations is an important issue for the success of smart products.

From a managerial perspective, studying innovation using a resistance approach helps firms to reduce the probability of an innovation failure (Ram, 1989). Moreover, it provides opportunities for companies to change the attributes of the new product in order to reduce oppositional reactions (Ram, 1987) and to boost the rate of adoption (Talke & Heidenreich, 2014). Adoption and resistance are related and '*can coexist during the life of an innovation*' (Ram, 1987, p. 208). In this context, several authors have attempted to conceptualise resistance and adoption factors theoretically (e.g. Bagozzi & Lee, 1999) and to identify consumer groups resistant to technological innovation (Wiedmann, Hennigs, Pankalla, Kassubek, & Seegebarth, 2011).

From a theoretical perspective, the current literature regarding resistance to innovation arguably falls short in at least three aspects. First, the majority of existing research takes an adoption or a diffusion perspective on the study of technological innovations. These approaches have the advantage of providing an assessment of the market potential (Page & Rosenbaum, 1992) and predicting the success of a new product. However, they remain insufficient (Gatignon & Robertson, 1985) because they do not take into account the oppositional reactions of consumers (Ram, 1987; Ram & Sheth, 1989). Indeed, it is essential to consider the drivers of consumer resistance when introducing new innovations to the market (Wiedmann et al., 2011) because these drivers may present obstacles to the diffusion and acceptance of an innovation.

In addition, relatively few empirical studies (e.g. Heidenreich, Kraemer, & Handrich, 2016; Heidenreich & Spieth, 2013; Laukkanen, 2016; Wiedmann et al., 2011) have been conducted on consumer resistance to innovations. According to previous research (e.g. Heidenreich & Spieth, 2013; Ram & Sheth, 1989), resistance can be driven by product-specific barriers (functional barriers) and by consumer-specific factors (psychological barriers). In line with these studies, we consider resistance to be motivated by two categories of factors: product characteristics and consumer characteristics. We extend these works by examining the original variables of privacy and intrusiveness concerns, which are also important in any understanding of consumer resistance to smart and connected products.

Third, very few studies have been undertaken regarding smart products specifically, and the few studies that exist have focused on the role of variables that influence purchase intention (Chang, Dong, & Sun, 2014) or adoption (Kim & Shin, 2015; Hsu & Lin, 2016). However, '*adoption begins only after the initial resistance offered by the consumers is overcome*' (Ram, 1987, p. 208). Hence, understanding consumer resistance in the first stage of the innovation lifecycle is a key factor.

To address these research gaps, the aim of the present paper is to provide a better understanding of consumer resistance to smart products. More precisely, through this research we intend to answer the following research question: What are the factors that influence consumer resistance to smart products?

The remainder of the paper is divided into three sections. The first section offers a literature overview of resistance to innovation in marketing. Then, it provides the conceptual development and the hypothesis for the study. The second section depicts the methodology and presents the results. In the last section, the results of the research are discussed and some managerial implications are developed.

Literature review and hypothesis development

Innovation resistance

Although the concept of resistance has been the subject of several marketing studies, the term encompasses several meanings. According to Roux (2007), consumer resistance is situational and is displayed through opposition to a situation perceived as dissonant. This kind of resistance can be directed against the products, discourses, practices and partnerships associated with a structure of dominance (Lee, Roux, Cherrier, & Cova, 2011).

Ram and Sheth (1989, p. 6) define innovation resistance as '*the resistance offered by consumers to an innovation, either because it poses potential changes from a satisfactory status quo or because it conflicts with their belief structure*'. The literature identifies this kind of resistance as one of the major causes of the market failure of innovations (Bagozzi & Lee, 1999; Ellen, Bearden, & Sharma, 1991) and of their rejection by consumers (Ram, 1987). In that sense, some authors consider resistance to innovation as an intention or behaviour (Kleijnen et al., 2009), others as an attitude (Ellen et al., 1991) and yet others as a combination of attitude and behaviour (e.g. Bagozzi & Lee, 1999; Ram & Sheth, 1989). Thus, resistance can be orientated against (1) a new product (Ram, 1989); (2) a new service based on technological innovation (Kuisma, Laukkanen, & Hiltunen, 2007) or (3) a new market (Close & Zinkhan, 2007).

For Ram (1987), three sets of factors can lead consumers to reject innovation: innovation characteristics (relative advantage, compatibility, perceived risk, complexity, reversibility, communicability, . . .); consumer characteristics (personality, attitudes, value orientation, previous experience, innovation perceptions, motivations, beliefs and demographic variables) and characteristics of propagation mechanisms (credibility, clarity, source similarity and informativeness).

Ram and Sheth (1989) explain that innovation resistance is caused by two types of barriers. First, functional barriers occur when the consumer perceives a radical change during a new product adoption. Functional barriers include usage, value and risk. The usage barrier arises when consumers refuse innovation because it goes against their habits and routines of use. The value barrier results from the idea that the innovation should have a significant economic benefit in comparison to existing products. The risk barrier relates to the level of potential risk entailed in an innovation (there are four types of risk related to innovation: economic, physical, performance and social). The second set of barriers are psychological, and comprise barriers related to tradition (daily routines, …) and image (country of origin, brand and product category).

Whatever the categorisation of factors, innovation resistance can take three forms (Ram & Sheth, 1989). Resistance can be *passive* if the consumer feels reluctant to adopt the innovation or it can be *active* if the consumer postpones an adoption decision because the innovation is too risky. Finally, resistance can be *very active* if the consumer decides to engage in actions or attacks against the adoption of the innovation. For Heidenreich and Spieth (2013) and Talke and Heidenreich (2014), active resistance to innovation is an attitudinal outcome that results from an unfavourable new product evaluation; however, passive resistance to innovation results from a consumer's predisposition to resist to innovations. The present study focuses on active consumer resistance to innovation. Heidenreich and Handrich (2015) developed a scale to measure this factor of personality and showed that an individual's general tendency to resist can explain and predict adoption-related behaviours. Finally, Claudy, Garcia and O'Driscoll (2015) suggest that the reasons that consumers do not adopt innovations (and hence resistance drivers) are context-specific and depend on the type of innovation in question.

Smart products as technological innovations

Innovation is defined by Rogers (1995) as '*an idea, practice or object that is perceived as new by an individual or other unit of adoption*' (Rogers, 1995, p. 11). Smart products may be perceived to be a radical change in the concept of the original product (Ram, 1987) due to three main characteristics: intelligence, ubiquity and autonomy (Porter & Heppelmann, 2014). Hoffman and Novak (2015, p. 14) define smart products as products that 'interact and communicate with themselves and each other – and with humans – on an ongoing basis by sending and receiving data through the Internet that is stored and organised in a database'. Adopting a technical approach, Hsu and Lin (2016, p. 516) suggest the following definition: *'Smart objects are regarded as a physical embodiment with communication functionality, possessing a unique identifier, some basic computing capabilities and a way to detect physical phenomena and to activate actions having an effect on physical reality'*

In summary, smart products have: (1) 'sensors' that collect data about the environment; (2) 'actuators' that activate an action and are controlled by some other entity and (3) 'network connectivity' that can take several forms, including WiFi, Bluetooth or RFID.

The smart products market is heterogeneous and has many segments (health, smart home, mobility, lifestyle, etc.) and several economic actors (multinationals

Table 1. Examples of smart products.

Examples of smart products	Segment	Description/ Examples of applications		
		Sensors	Actuators	Connectivity
Smartwatch (apple.com)	Wearables	Monitoring physical activity: track steps, running, calories burned, elevation and distance, detect inactivity of the body.	- Smartwatch senses when user stands and moves. - If user has been sitting for almost an hour, smartwatch reminds him to get up with notifications.	- It connects to the internet with WiFi and 3G networks. - It automatically syncs to IPhone and Mac with Bluetooth (read mails, sms, . . .)
Advanced Health Tracker (withings.com)	Health	- Measure heart rate and blood oxygen level with a single touch. - Analyse a night and sleep cycles.	The mobile application 'Health Mate' turns data into graphs showcasing the day-to-day progress to better understand how user habits impact their health.	It automatically syncs to smartphone all throughout the day thanks to its embedded Bluetooth Low Energy technology.
Ikettle (smarter.am)	Smart Home	- Automatic start when the user wakes up. - It senses the presence of the user;	It sends invitations on Facebook and twitter.	It can connect to the home WiFi network.
Driver tracking tool '*Pay how you drive*' (Youdrive.fr)	Mobility	GPS data collected from the vehicle, including speed and time-of-day information, historic riskiness of the road.	Information on the score of driving is displayed on the car dashboard	The data is sent to the server of the company via cellphone or RF technology.

such as Google and Apple or new start-ups offering innovative products). Table 1 provides some examples of smart products (according to the definition by Hoffman & Novak, 2015). In our research, we focus particularly on consumer resistance to smartwatch.

Smart product characteristics (connectivity, intelligence and ubiquity) can be sources of consumer resistance. We have developed a number of potential sources of resistance in Table 2.

Table 2. Potential sources of resistance to smart products.

Smart products characteristics	Description	Potential sources of resistance
Connectivity	Smart products include communication protocols enabling the exchange of information with their environment (other objects, servers, . . .).	- The consumer does not control the information collected by smart devices. - Sensitive data can be communicated without the permission of the consumer. - Consumers lack of information on the nature of the data collected and its use.
Intelligence	Smart products can be autonomous and undertake actions based on previously captured data.	- The consumer may lose control of the functioning of the product. Reliability problems of objects can endanger the consumer (in case of hacking for example).
Ubiquity	Smart products are predicted to be used anywhere, anytime and from any device.	- '*Big brother is watching you*': these devices raise privacy issues since that can put consumers under constant surveillance. - The consumer could be exposed to a health risk because of the radiations and the harmful waves (especially when using wearables).

Formulation of hypotheses regarding resistance to smart products

Smart products are new products equipped with technical options that differentiate them from other existing products. Consumers perceive these products as technological innovations and may be inclined to resist them. They may resist smart objects both as new products and as new services. To identify the drivers of resistance, we first conducted a netnographic study (Kozinets, 2010), followed by a quantitative study to examine the impact of the identified factors on resistance.

Preliminary netnographic study

Netnography is a form of ethnography that is applied online and adapted to the study of phenomena present among a community who interact online. The Internet allows consumers to provide their opinions readily on products and brands, meaning that users can express their opposition to new products. Thus, netnography is an interesting method for studying these reactions.

Our study can be considered an 'observational netnography' (Kozinets, 2010) or non-participant netnography (Hamilton & Hewer, 2010), because we did not intervene in interactions between members. We did not reveal our presence to the community members following the approach of Langer and Beckman (2005). These authors affirm that disclosing a researcher's presence can inhibit members' participation in discussions and bias outcomes.

We focused on French online virtual communities debating smartwatch (Table 3). We chose smartwatch because they are becoming increasingly popular (Kim & Shin, 2015). According to a Gartner report, smartwatch comprise about 40% of consumer wrist worn devices by 2016.[3] It is also easier for participants to answer questions on their perceptions of smartwatch than other less popular smart products such as smart insurance services.

Table 3. Threads studied.

Community	Description of community	Topics	Number of participants	Number of replies
Frandroid.com	Website news on Android (mobile operating system from Google) created in 2006	Functional overview of the smartwatch	90	167
Mac4ever.com	Forum on Apple news created in 2001.	Release date by Apple watch	62	97
Numerama.com	Digital news website created in 2006.	- Functional overview of the smartwatch	47	118
		- Failure of the smartwatch by Samsung launched in 2013	17	29
Lesnumerique.com	Online magazine dedicated to digital product tests created in 2004	- Polar smartwatch test	25	33
		- A user experience narrative of the smartwatch	67	133
Developpez.com	Forum on Microsoft news created in 1999	Presentation of the Microsoft smartwatch	11	20
Jeuxvideo.com	Video game news website created in 1997	The price of the Apple watch	45	169
		Total	**364**	**766**

We followed four steps:

(1) Familiarisation with the topic and ethnographic immersion via analyses of press articles, forums, blogs and specialist websites, and discussions with specialists and experts in the field.
(2) Keyword research on www.google.fr, producing an initial list of discussions connected with our object of study (communities debating smartwatch).
(3) We moved through the Google search results in the order of their appearance and selected only those discussions that were characterised by rich and informational content (Kozinets, 2010).
(4) We removed virtual communities with few posts and poor interactions. One of the main conditions for carrying out netnography is the existence of communities characterised by regular narratives and communicative exchanges, and by behaviours that can be observed in a virtual context (Kozinets, 2010).

In total, six virtual communities were selected (Table 3) and eight threads were studied until we arrived at the point of theoretical saturation, meaning that no new themes were emerging from the data (Strauss & Corbin, 1990). Data analysis is based on a thematic analysis with inductive coding (Ryan & Bernard, 2003).

Based on this first qualitative study, we identified eight resistance factors (Table 4):

We removed 'visual aesthetics' from the eight factors that emerged from the data. This factor is closely related to brand image and brand name (Goode, Dahl, & Moreau, 2013). Brand label strongly influences consumers' perceptions of the features of smartwatch and visual aesthetics are very specific to the smartwatch brand. We chose, in this research, to study the resistance to smart products from a general perspective without specifying the brand. Consequently, we focus on the seven remaining factors for the quantitative research.

Table 4. Findings of the preliminary study.

Categories	Factors	Examples of verbatim
Product characteristics	Usefulness and price	*'The smartwatch is a useless and very expensive gadget'. (mac4ever)*
	Perceived novelty	*'Objectively, the smartwatch brings nothing new in terms of features. If we ask the question "what can I do with this watch that I cannot do with my smartphone?". We do not find an answer'. (Frandroid)*
	Visual aesthetics	*'Looks like the plastic digital watches that we buy for the kids to play the role of adults.' (jeuvideo).*
Consumer characteristics	Privacy concern and intrusiveness	*'it's ugly!' (jeuvideo).* *'Smartwatch were developed to be more tracked and spied' (Frandoid)* *'A new way to spend advertising: the smartwatch!'(developpez.com)*
	Dependence	*'The real issue is rather the permanent connection to the technology (social networks, internet, etc.), some people are unable to disconnect. It is pathological (just like alcoholics and drug addicts)'.(mac4ever)*
	Self-efficacy	*'I received this "thing" (smartwatch) for Christmas. I am extremely disappointed and I do not see the value compared to a Runkeeper application (free).The interface is complex to use, Android synchronisation is impossible as confirmed by the technical support on the Polar website' (lesnumeriques)*

Furthermore, our findings are consistent with the categorisation of resistance drivers developed by Ram and Sheth (1989). Indeed, we identified two types of factors: functional barriers caused by product characteristics (usefulness, novelty, price, device intrusiveness); and psychological barriers due to consumer characteristics (self-efficacy, dependence, privacy concerns). In the following, we present each factor and formulate a related research hypothesis (see Figure 1).

Hypothesis

Perceived uselessness. Perceived usefulness is one of the key variables of the technology acceptance model put forward by Davis (1989), based on the theory of reasoned action (Ajzen & Fishbein, 1980). Perceived usefulness can be defined as the degree of improvement in a person performance when using a new technology. Hence, the higher the added value of the smart product, the more the consumer will be inclined to adopt it. Indeed, Bruner and Kumar (2005) found that perceived usefulness contributes to the consumer adoption of Internet devices. Applied to smart products, perceived usefulness relates to the benefits the consumer thinks (s)he will take from the future use of a new

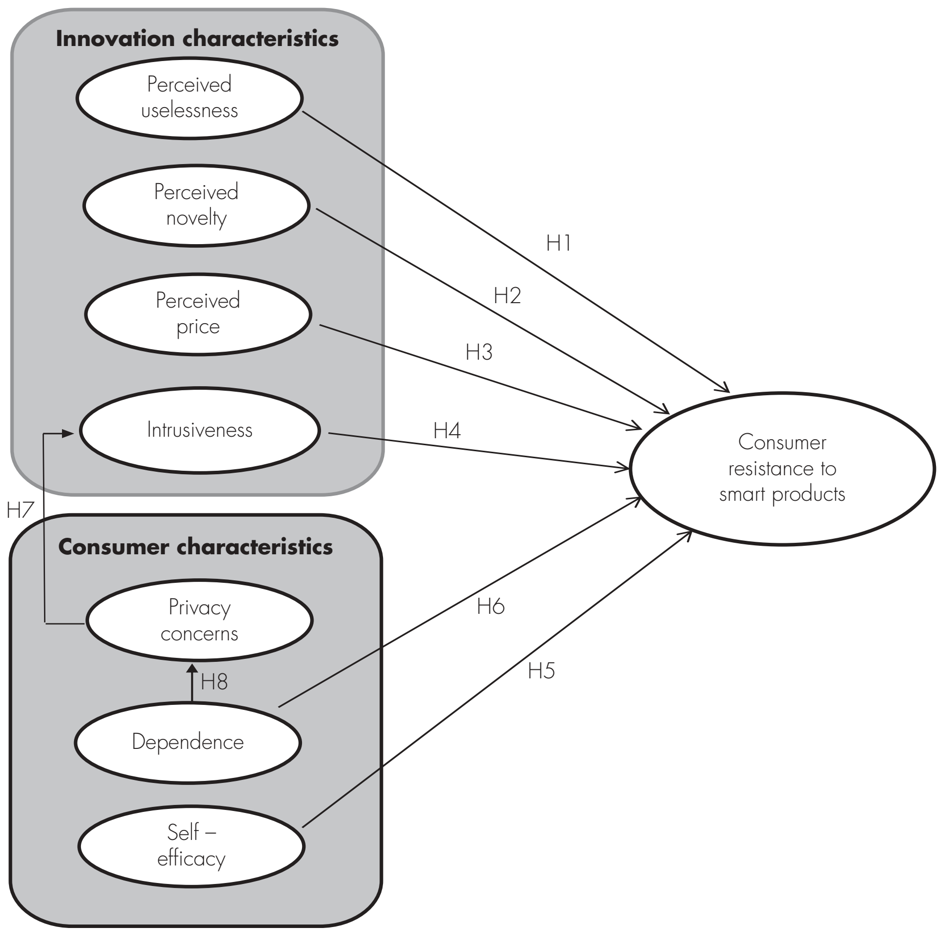

Figure 1. Theoretical framework and hypotheses.

product. These benefits can involve saving time, convenience, access to additional information and new uses. If the consumer considers the smart product to have no advantages (or not enough advantages), resistance to its adoption will be more pronounced.

H.1: Perceived uselessness positively influences consumer resistance to smart products.

Perceived novelty. A fundamental characteristic of any innovation is its novelty, according to the definition of innovation by Rogers (1995) cited earlier. An innovation is perceived to be novel if it is perceived to be unique or different and/or recent or new (Venkatraman & Price, 1990). Consumers may perceive novelty when there is a radical change in the product concept or simply change(s) in one attribute of the product (Ram, 1987). Rogers (1995) stressed that '*the perceived newness of the idea for the individual determines his or her reaction to it*' (p. 11). Thus, perceptions of novelty differ widely across individuals and types of innovation. Previous research has often considered novelty as a factor that positively influences an individual's attitude towards using an innovation, especially IT innovation (Wells, Campbell, Joseph, Valacich, & Featherman, 2010). Thus, we assume the following hypothesis:

H.2: Perceived novelty negatively influences consumer resistance to smart products.

Perceived Price. In the marketing literature, perceived price is related to the feeling that consumers have about the price of a product (Zeithaml, 1988) and refers to the price the consumer considers to be an appropriate monetary sacrifice for the product in question. In the context of innovation resistance, the perceived price is related to the value of the new product. Thus, the consumer might show resistance when the innovation does not offer a strong performance-to-price ratio (Ram & Sheth, 1989) and consumers may not adopt an innovation if the price is seen as too high (Lian & Yen, 2013). Thus, we postulate that perceived price will have a positive impact on consumer resistance to smart products.

H.3: Perceived price positively influences consumer resistance to smart products.

Intrusiveness. Intrusiveness in marketing is considered to have a negative impact on consumer behaviour. It triggers individual negative emotional reactions (Edwards, Li, & Lee, 2002). In the case of advertising, the magnitude of the perceived intrusiveness can result in feelings of irritation (Li, Edwards, & Lee, 2002). Some research has found intrusiveness to have a negative effect on consumers' adoption of RFID (Boeck, Roy, Durif, & Grégoire, 2011) or of mobile location-based services (Hérault & Belvaux, 2014). In our research, we are interested in the intrusion of technology, where intrusion refers to entering into the consumer's life without permission. Based on the definition of Hoffman and Novak (2015), smart products could be seen as intrusive because they have the ability to perform actions autonomously and without the permission of the user. Therefore, we suggest the following hypothesis:

H.4: Intrusiveness positively influences consumer resistance to smart products.

Self-efficacy. According to the literature, self-efficacy is defined as '*an individual's perception of his or her ability to use a technological innovative product*' (Compeau & Higgins, 1995, p. 193). Several researchers have identified a positive link between self-efficacy and the willingness to adopt technology (Davis, Bagozzi, & Warshaw, 1989; Hill, Nancy, & Millard, 1985). Ellen et al. (1991, p. 305) showed empirically that self-efficacy affects resistance to technological innovation. According to these authors '*persons who felt high self-efficacy were less resistant to changing to the allocated program and the telephone registration system than those persons low in self-efficacy*'. Self-efficacy has been found to have a negative effect on consumer resistance (Ellen et al., 1991) and a positive effect on consumers' adoption of innovations (Yangil & Chen, 2007). In line with prior research, we postulate that self-efficacy will have a negative impact on consumer resistance. Indeed, when consumers feel confident about their ability to understand the use of a smart product, they tend to show less oppositional reactions.

H.5: Self-efficacy negatively influences consumer resistance to smart products.

Dependence. Internet and computer-related technology has become necessary in different contexts including work, family and school (Hoffman, Novak, & Venkatesh, 2004). Several technologies increase this dependency such as mobile phones (Licoppe & Heurtin, 2001), online video games (Lo, Wang, & Fang, 2005) and the Internet (Hadlington, 2015). Shu, Tu, and Wang (2011) indicate that technology dependence is linked to 'technostress'. This term refers to the direct or indirect negative impact of technology on attitudes, thoughts, behaviour and physiology of the human (Weil & Rosen, 1997).

In our research, we use dependence to mean that individuals are reliant upon technology (e.g. IT devices, Internet, machines) to reach their goals (Park, Kim, Shon, & Shim, 2013). Such technological dependence also carries the risk of creating isolation because it substitutes communication with humans with communication with devices. Moreover, dependence can also lead to addiction (Charlton, 2002). Addiction can be defined as a more severe form of dependence and can be represented as a pathological state that occurs due to technology abuse and overuse (Dhir, Chen, & Nieminen, 2015). Thus, we believe that technology dependence can be seen as a variable that negatively influences consumer perception towards technology.

We postulate that this variable will increase consumer resistance to smart products.

H.6: Dependence positively influences consumer resistance to smart products.

Privacy concerns. The rapid proliferation of Internet, information and communication technologies has had a significant impact on interactions between users, between users and machines and finally between users and organisations. Many people use technologies (e.g. mobile devices, Internet) to communicate and share private information. Users experience difficulty knowing where and how their information is stored and who is authorised to access and use it. Thus, protecting users' data and data privacy has become a real challenge. In marketing, several studies have highlighted the importance of privacy concerns related to online transactions (Ashworth & Free, 2006). Other researchers believe that these concerns will increase with the development of smart products (Slettemeås, 2009) and smart services (Hsu & Lin, 2016; Wuenderlich et al., 2015). These products and services interact daily with the user and are characterised by ubiquity, invisibility, pervasiveness, and invasiveness (Slettemeås, 2009). They collect and manage private data or sensitive information (Sicari et al., 2015) such as activities (e.g. geographical location), business operations (e.g. financial information), and personal information (e.g. health, habits). Under these conditions, research shows that privacy concerns have a negative effect on attitudes to the use of smart products (Müller-Seitz, Dautzenberg, Creusen, & Stromereder, 2009) and the continued intention to use IoT services (Hsu & Lin, 2016).

First, we assume that privacy concerns have an impact on resistance through perceived intrusiveness. Indeed, the more consumers feel sensitive about their privacy, the higher the level of perceived intrusiveness of the smart device will be.

H.7: Privacy concerns will have a positive effect on the perception of intrusiveness.

Second, dependence is synonymous with the substantial use of technology by the consumer, which increases the quantity of private data exchanged. Smart products can be used in several areas (health, sports, home, shopping, …) to assist and help the consumer in his/her everyday life. The proliferation of these products increases the risks associated with attempts to keep data private, which in turn increases concerns about privacy.

H.8: Dependence will have a positive effect on privacy concerns about smart products.

Methodology and results

The research model was tested using structural equation modelling (AMOS). Before performing the analysis, we carried out preliminary checks. Outliers were identified and removed. To ensure the normality of the distributions of variables, we verified that the kurtosis and asymmetry coefficients are below the critical thresholds ([−1.5, 1.5]]). The Kolmogorov–Smirnov test was also significant for all the variables. To examine the reliability and validity of the constructs, the study performs an assessment of structural equation modelling using a two-step approach: a CFA measurement model and a structural model (Anderson & Gerbing, 1988).

Measurements

Consumer resistance to smart products was measured through items adapted from works of Kleijnen et al. (2009) and Szmigin and Foxall (1998). To measure perceived usefulness, we used the Mukherjee and Hoyer (2001) scale. For perceived novelty, we

Table 5. Scale measurement.

Scale	Code	Item	Mean	SD
Privacy concerns	PC1	I'm concerned about threats to my personal privacy	3.8	1.15
	PC2	I'm concerned about data collected by smartwatch without my permission		
Perceived usefulness	PU1	The functions of the smartwatch offer little advantages (reversed)	2.7	1.05
	PU2	The functions of the smartwatch provide little added value (reversed)		
Self-efficacy	SE1	I know how to use the smartwatch	3.91	.86
	SE2	I am confident in my ability to understand the use the smartwatch		
	SE3	I think I am able to operate the smartwatch although I've never used it before		
Perceived price	PP1	The price of the smartwatch is high	4.19	.84
	PP2	The price of the smartwatch is low (reversed)		
	PP3	The smartwatch is expensive		
Intrusiveness	INT1	The smartwatch is intrusive	2.73	.99
	INT2	The smartwatch is irritating		
	INT3	The smartwatch is indiscreet		
	INT4	I'm not comfortable with the smartwatch		
	INT5	The smartwatch is disturbing		
Dependence	DEP1	I'm afraid of becoming dependent on the smartwatch	2.47	1.04
	DEP2	The smartwatch will reduce my autonomy		
	DEP3	The smartwatch will strengthen my addiction to technology		
	DEP4	I think my social life will suffer from my use of the smartwatch		
Perceived novelty	PN1	This smartwatch is unique	2.37	1.01
	PN2	This smartwatch is different compared to the other watches		
Resistance	RES1	I'm likely to be opposed to the purchase of smartwatch	3.04	1.17
	RES2	I'm likely to be opposed to the discourses extolling the benefits of smartwatch		
	RES3	The smartwatch is not for me		

adapted items from Venkatraman and Price (1990) scale. Regarding the perceived price, we used the scale of Yoo, Donthu, and Lee (2000). Intrusiveness was measured using the scale of Hérault and Belvaux (2014). Self-efficacy was measured by adapting Compeau and Higgins (1995) scale. Dependence items were adapted from the Charlton (2002) scale. Finally, to measure privacy concerns, we were inspired by scales of Malhotra, Kim, and Agarwal (2004) and Smith, Milberg, and Burke (1996). We opted for five-point Likert scales ranging from 1 (strongly agree) to 5 (strongly disagree) to measure our constructs. To verify reliability of the scales, Cronbach's alpha and composed reliability values were calculated for each variable. Results show that reliability coefficients are satisfactory (α ranges from .68 to .86, and CR from .69 to.89). Details on the scales are set out in the table below (Table 5):

Data collection and sample characteristics

The questionnaire was administrated both offline (paper copy) and online (using google-forms). On the one hand, a self-administered, cross-sectional survey was given to first-year and second-year undergraduate students from two French universities. Researchers went to classes (with prior permission from instructors) and students were kindly asked to fill in the paper copy of the questionnaire (all students agreed to participate to the study). On the other hand, researchers kindly asked their students to spread the online questionnaire on their online social networks (Facebook, forums, …). We received a total of 416 survey forms (184 online/218 offline). At the end, 402 questionnaires were used for the data analysis (we excluded invalid and incomplete forms).

The questionnaire was divided into three sections. In the first section participants were instructed to read carefully a presentation of a smartwatch (no brand was specified to avoid introducing a bias). In the second section, we included questions about their perceptions of the smartwatch features (usefulness, price, …). The final section was focusing on personal variables (self-efficacy, dependence, demographic questions, …).

We used a convenience sampling method to recruit respondents. Our sample included 66% of women and 34% of men. 1.2% of the sample has already a smartwatch. Furthermore, the questionnaire included a single item question to measure scepticism '*I'm skeptical about smartwatch*', 10% of people surveyed reported that are 'very skeptical' and 23% that they are 'rather skeptical'. The latter result points out the relevance of the resistance approach of the research.

Psychometric quality of constructs

First, we performed an exploratory factorial analysis with oblique rotation on the independent variables of the model. The Kaiser–Meyer–Olkin index is greater than .5 (.78) and the Bartlett sphericity test is significant (p = .000). The representation quality of each item was verified. As expected, the results show seven factorial axes corresponding to our variables. The final factorial solution explains 71% of the total variance. Second, we ran a confirmatory factor analysis (CFA) to examine the measurement model and assess the convergent and discriminant validity of all the latent variables.

Regarding the convergent validity, we verified two conditions:

- The link between the latent variable and each of its indicators must be significant. Student's t-test shows that all the factorial contributions are significant at the level p = .001. This condition is confirmed.
- The AVE must be greater than .5 (approach recommended by Fornell & Larcker, 1981). This means that the mean variance shared between the latent variable and its indicators is greater than 50%. When the AVE is greater than this threshold, the variance explained by the items is greater than the variance due to measurement error. As indicated in the table below, this condition is confirmed (Table 6).

The discriminant validity of the latent variables can be tested by demonstrating that the variance that each construct shares with its items is greater than the variance it shares with the other constructs. To this aim, we compared the correlation between the latent variables and the square root of the average variance extracted (AVE). Results show that this condition is verified, thus discriminant validity is confirmed (Table 7).

Test of the research model

As indicated earlier, the research hypotheses were examined using a structural equation modelling (Figure 2). Results show that the theoretical model has acceptable indicators

Table 6. Convergent validity.

Latent variables	Average Mean Extracted (AVE)	Cronbach'salpha (α)	Composed reliability	Items code	Loadings	p-value
Perceived usefulness	.52	.68	.69	PU1	.75	.000
				PU2	.70	
Privacy concerns	.71	.83	.83	PC1	.85	.000
				PC2	.83	
Self-efficacy	.60	.80	.82	SE1	.66	000
				SE2	.85	.000
				SE3	.81	
Perceived price	.72	.80	.89	PP1	.85	.000
				PP2	.83	.000
				PP3	.79	
Intrusiveness	.55	.86	.85	INT1	.65	.000
				INT2	.75	.000
				INT3	.74	.000
				INT4	.75	.000
				INT5	.81	
Dependence	.52	.81	.81	DEP1	.74	.000
				DEP2	.76	.000
				DEP3	.72	.000
				DEP4	.65	
Perceived novelty	.63	.69	.75	PN1	1	.000
				PN2	.51	
Resistance	.60	.79	.82	RES1	.85	.000
				RES2	.80	.000
				RES3	.67	

Table 7. Discriminant validity.

Construct	PU	PN	PP	INT	SEF	DEP	PC	RES	Square root of AVE
PU	1								.71
PN	−.11	1							.79
PP	.13	−.01	1						.85
INT	.27	−.02	.22	1					.74
SEF	.03	−.04	.39	−.20	1				.77
DEP	−.11	.18	.11	.39	−.10	1			.71
PC	.03	.03	.34	.28	.13	.30	1		.84
RES	.39	−.20	.28	.71	−.11	.11	.11	1	.77

Perceived uselessness (PU), Perceived novelty (PN), Perceived Price (PP), Intrusiveness (INT), Dependence (DEP), Privacy concerns (PC), Self-efficacy (SEF), Resistance (RES)

of fit. The RMSEA is .07 which could be considered as a reasonable error of approximation (Browne & Cudeck, 1993; Steiger, 1990). CFI and IFI show an acceptable overall fit quality (CFI = .87, IFI = .87) and the chi-square value is 778.93 ($p < .001$). The results show that the perceived uselessness has a significant positive impact on consumer resistance to smart products (β = .53 CR = 5.59, $p < .001$). Hypothesis H1 is therefore supported. Moreover, perceived novelty has a significant negative impact on consumer resistance (β = −.25, CR = −3.69, $p < .001$). This result supports H2. Perceived price has a significant positive impact on consumer resistance to smart products (β = .18; CR = 3.54, $p < .001$). Our results confirm hence the hypothesis H3. Intrusiveness has a significant positive effect on consumer resistance (β = .73; CR = 9.29, $p < .001$). Hypothesis H4 is then supported. Moreover, self-efficacy has a significant negative impact on consumer resistance (β = −.12, CR = −2.04, $p = .04$). Hence, H5 is confirmed. Hypothesis H6 is not supported since the effect of dependence on consumer resistance is not statistically significant ($p > .05$). Privacy concerns have a

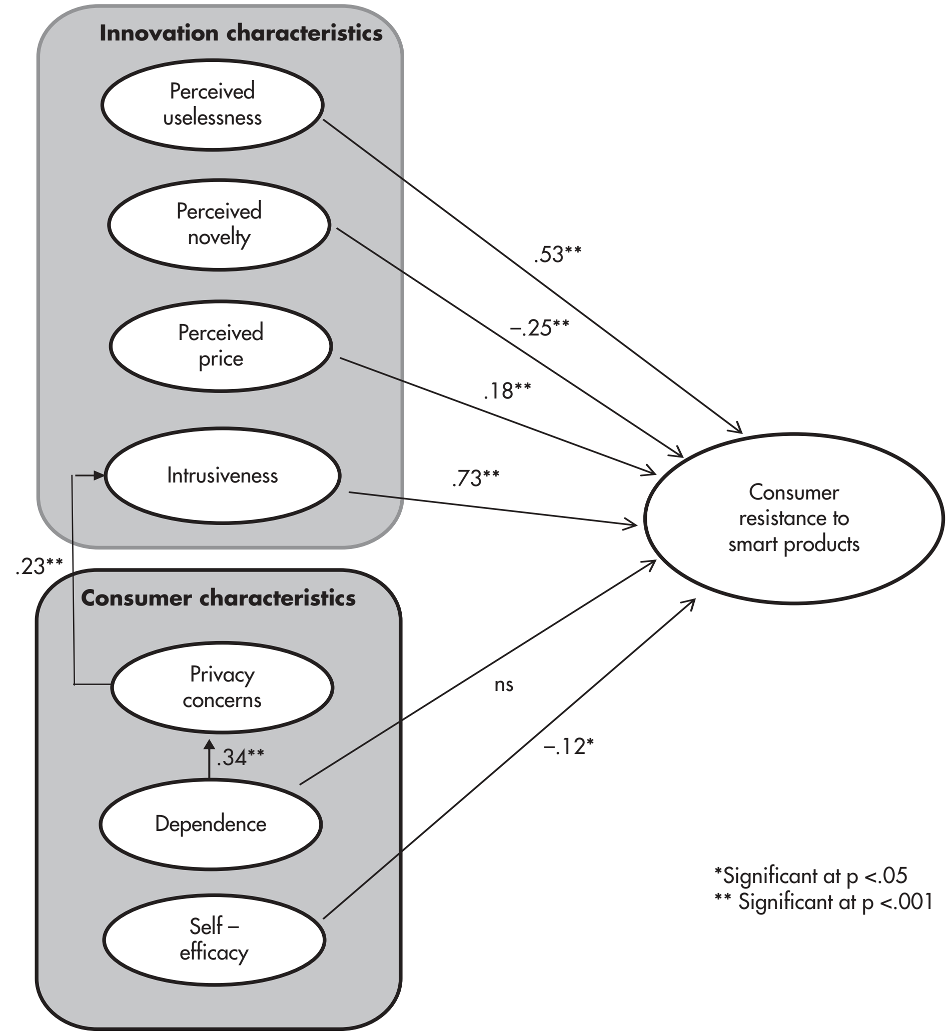

Figure 2. Structural model.

positive significant effect on intrusiveness (intrusiveness: β = .23, CR = 4.5, $p < .001$). This result supports H7. Finally, dependence is found to be a predictor of privacy concerns (β = .34, CR = 5.07, $p < .001$). Thus, H8 is confirmed.

Discussion and managerial implications

As predicted, our results show a significant negative effect of perceived usefulness on consumer resistance. The impact of perceived usefulness on technology adoption has been widely studied in TAM research (Davis, 1989). Our findings demonstrate that this variable is an important factor of resistance to smart products, this result is consistent with previous studies. Indeed, according to Laukkanen (2016), functional barriers are drivers of consumer resistance to innovation. Consumers surveyed in this research may have considered that smartwatch do not have a significant added value compared to smartphones. Moreover, the image of 'gadget' often associated with smart products decreases their perceived usefulness.

Moreover, our findings enrich the resistance literature by showing that perceived novelty has a negative effect on consumer resistance to smart products. When consumers perceive smart products as different and unique, they are less reluctant to adopt these innovations. This result is consistent with previous findings showing that perceived novelty alleviates the perceived risk associated with technological innovation (Wells et al., 2010).

Furthermore, the present research examined the effect of perceived price. In the current stage of the product life cycle of smart products, perceived price seems to be one of the core reasons why consumers resist these products. Technological innovations are generally expensive and some consumers are reluctant to spend substantial amounts of money. The qualitative study of Kleijnen et al. (2009) identifies economic risk as one of the drivers of consumer resistance. Our research provides empirical evidence of the positive effect of price on consumer resistance.

Moreover, we found a negative relationship between self-efficacy and consumer resistance, this result is consistent with previous studies (Ellen et al., 1991). Indeed, consumers may think that understanding how smartwatch work requires specific abilities.

Our research predicted a positive effect of dependence on consumer resistance (H6). Even though dependence has been studied widely within a technology context (Licoppe & Heurtin, 2001; Park et al., 2013), its impact on consumer resistance has not previously been examined. However, our results did not support H6. This can be explained by the difficulty that 'digital natives' (our sample) might have in perceiving their dependence on technology. Conversely, 'digital immigrants' are more likely to perceive this dependence because they can compare their lives before and after the adoption of digital innovations. Moreover, it is difficult to assess dependence without owning the innovation (smartwatch).

Lastly, one of the contributions of the present research is to show that privacy concerns influence perceptions of intrusiveness, which in turn effect consumer resistance. A qualitative study conducted by Reppel and Szmigin (2010) underlined the fact that consumers need to control access to and management of their personal data. For Sill, Fisher and Wasserman (2008), the perceived intrusion of the RFID technology is a predictor of trust in RFID. In our research, these two factors were found to be salient in consumer resistance. Concerns related to privacy and intrusiveness increase when companies are able to access personal information that the consumer does not wish to disclose. Smart products have the ability to collect information automatically. The 'Big Brother' effect can increase consumers' skepticism and lead to their resistance to the use of smart products.

Our study also contributes a number of managerial insights. First, it is important for companies to improve the perceived usefulness of connected and smart products. This can be achieved strategically through the promotion of a combination of smart products with appropriate support services. Hence, firms can offer a complete 'package' with personalised services, suggestions and helpful reminders. For instance, to convince consumers of the benefits associated with smartwatch, manufacturers could go further by offering the users check-ups, sports programs and nutritional advice. Second, we recommend that companies adopt a co-creation strategy (Hoyer, Chandy, Dorotic, Krafft, & Singh, 2010). Co-creation is based on collaboration between firms and consumers. Customers could be involved at an early stage of the smart product conception, with the aim of taking into account their wishes and needs. Consequently, product usefulness could be enhanced. Third, firms need to be careful about perceived novelty because it is one of the major barriers for consumer resistance. Companies selling smartwatch need to be very clear in their communication campaigns about the advantages of these smart devices compared to smartphones (this problem was reported many times in the netnographic study).

Fourth, our findings show that perceived price is one of the factors underlying consumer resistance. The market for connected and smart products is an early stage of development; costs are substantial for companies. If firms improve the perceived usefulness of their smart products, consumers will be more likely to accept the financial risk.

Finally, to reduce the perception of intrusiveness and privacy concerns, companies can 'rethink' the design of smart products. Cavoukian (2012) introduced the concept of 'privacy by design,' defined as '*an engineering and strategic management approach that commits to selectively and sustainably minimize information systems' privacy risks through technical and governance controls*' (p. 8). For example, IoT firms can incorporate features that allow the user to erase easily any data captured by a smart device.

Concerns about intrusion and privacy can be addressed if efforts are made to improve transparency in relation to smart products. Indeed, currently consumers are not sufficiently informed about how collected data are used and how to control disclosure. Firms can conduct awareness campaigns and in this way demonstrate their benevolence towards the consumer. In addition, companies can provide technical support to consumers to help them when they face difficulties in understanding security and privacy issues (web sites, forums, blogs, …).

Conclusion, limitations and future research

This study contributes to a better understanding of the factors that explain consumer resistance to smart products. A conceptual framework was introduced and tested by integrating seven key variables. Findings show that perceived usefulness, perceived novelty, perceived price, intrusiveness, privacy concerns and self-efficacy have an impact on consumer resistance to smart products. The contributions of this paper are twofold. On the one hand, to the best of our knowledge, this is the first study to examine consumer resistance within the context of the IoT. To date, most research studies on the IoT are focused on adoption (Hsu & Lin, 2016; Kim & Shin, 2015) or purchase intention of smart products (Chang et al.). Second, previous empirical studies on innovation resistance have examined the effect of different types of risk (Wiedmann et al., 2011), usage and value barriers (Laukkanen, 2016) and self-efficacy (Ellen et al., 1991). Our research enriches these works by examining original variables that have not been studied previously in the resistance literature, such as privacy, intrusiveness, perceived novelty and dependence.

However, the present research has a number of limitations, which in turn open up new areas of research. First, the study was conducted within a French context. Future research should verify whether the results can be generalised to other countries. Specifically, a comparative study could enhance our understanding of the differences in consumer resistance to smart products across different countries. Second, the use of a student sample (digital natives) limits the generalisability of our results. However, understanding this consumer segment is crucial for technology-related industries. Indeed, digital natives are heavy users of technological devices and services. Third, in this research, we did not take into account different types of resistance; however, it will be interesting for future works to examine the role of the identified factors in determining passive, active and very active resistance. Fourth, future work could replicate this study in relation to other smart products or services (insurance, banking, etc.) and identify additional factors. Finally, perceived complexity, technical reliability and security aspects were not included in the current model because this would have required too much knowledge on the respondent's part about smartwatch. However, these factors will likely be important in explaining consumer resistance. Future research is needed to investigate the impact of these factors.

Notes

1. Accenture 'Igniting Growth in Consumer Technology' (2016) https://www.accenture.com/_acnmedia/PDF-3/Accenture-Igniting-Growth-in-Consumer-Technology.pdf.
2. https://medium.com/wristly-thoughts/dissatisfaction-learnings-48c26d564bc1#.z9ldmhvu3.
3. http://www.patentlyapple.com/patently-apple/2014/09/gartner-thinks-the-apple-watch-will-trigger-more-consumer-interest-in-the-wearables-space-in-2015.html.

Notes on contributors

Zied Mani is an associate professor of marketing at Nantes University, IUT Saint Nazaire (France). His research interests include consumer behaviour, relationship marketing, green marketing, Internet marketing and Consumer Culture Theory. He has published in top French marketing journals.

Inès Chouk holds a PhD degree in marketing from Paris-Dauphine University (France). Her research interests include consumer behaviour, relationship marketing, Internet marketing and social marketing. She is an associate professor of marketing at Cergy-Pontoise University (France). In 2013, she joined the chair of 'Digital Economy' of Paris-Dauphine University as an associate researcher. She teaches Internet marketing and has published in *Advances in Consumer Research* and in top French marketing journals.

Disclosure statement

No potential conflict of interest was reported by the authors.

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