Whether to adopt or not? A cross-country comparison of consumer resistance towards the Internet of Things in households

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ABSTRACT

The uptake of IoTs in households worldwide is lower than predicted and comparatively slower in developing countries than in developed countries due to inadequate digital infrastructure. This study aims to understand why the Internet of Things in households (specifically smart household appliances) have been resisted and have not been adopted to predicted levels by comparing Germany as a developed country to South Africa as a developing country. The specific focus was on innovation and consumer characteristics, perceived risk of adoption, and personality considerations, using a smart refrigerator. Through regression analysis of data generated from a quantitative survey of 1665 consumers from Germany and South Africa, it was found that both resistance and adoption are influenced by how intrusive the smart appliance is, how the consumer perceives its usefulness and whether it is considered novel or new. The perceived price of the smart appliance also played a role in adoption. Only South Africans' perception of their capability to use a technologically innovative product influences their resistance to the smart appliance. Adoption is not the inverse of resistance when considering the constructs in their totality. Consumer innovativeness, influenced by uncertainty avoidance, played a significant role among the German and South African participants both resisting and adopting smart products. However, the cultural dimension of uncertainty avoidance also influenced consumer innovativeness. On the other hand, South Africans' spirit of innovation influenced their resistance to and adoption of smart appliances more strongly than their German counterparts.

Keywords: Resistance; adoption; smart products; IoT; consumer characteristics, innovation characteristics, perceived risk, nostalgia, spirit of innovation

INTRODUCTION

The recent emergence of the Internet of Things (IoT), as a pillar of Industry 4.0 (Ancarani, Di Mauro, Legenvre & Cardella 2020), is changing how we live, work and relate to one another (Balaji & Roy 2017). New technologies, such as smart home appliances, as one of the types of IoTs available, have continued to drive change at a personal and organisational level. IoTs are network-connected devices and systems, allowing for the collection and exchange of data (Hsu & Lin 2016; Meola 2016) and are growing into a substantial industry with the opportunity to transform society. Information technology analysts have predicted that by 2020, 50 billion IoT devices would be deployed worldwide. However, only around nine billion are connected to date, including approximately eight billion mobile phones and home devices (Eseye 2020), indicating a slower than expected adoption (Hong, Nam & Kim 2020; Van Hung, Thao, Kieu & Hien 2021).

Various authors have studied the possible reasons why IoTs have been resisted and not adopted to the predicted levels (Balta-Ozkan, Davidson, Bicket & Whitmarsh 2013; Coughlin, D'Ambrosia, Reimer & Pratt 2007; Hong, et al. 2020; Hsu & Lin 2016; Kim, Park & Choi 2017; Leong, Ping & Mutheveloo 2017; Mani & Chouk 2017; Mayer, Volland, Thiesse & Fleisch 2011; Paetz, Dütschke & Fichtner 2011; Pillai & Sivathanu 2020; Roy, Balaji, Quazi & Quaddus 2018). Studies conducted before 2015 focussed on the user acceptance of smart home technologies since the technology itself was not readily available. After 2015 however, consumer adoption and resistance as explicit constructs emerged as significant research areas, along with testing the dimensions that influence consumer adoption and resistance in various settings. Some studies have considered the adoption of or resistance to IoT services in homes (Hsu & Lin 2016; Hong, et al. 2020), smart devices available in the retail space (Roy et al. 2018), smart cities (Leong et al. 2017), or IoT adoption in agriculture (Pillai & Sivathanu 2020). However, very few have concentrated on smart household appliances specifically (Mani & Chouk 2017) or considered both adoption and resistance in the same study.

Adopting innovation constitutes a 'positive' decision to acquire and use innovation, while resistance is regarded as tantamount to non-adoption (Nabih, Bloem & Poiesz 1997). However, it is unclear whether consumer resistance is simply the obverse of adoption (Ram & Seth 1989), as resistance is overcome after during an innovation's lifecycle (Mani & Chouk 2017). Adoption occurs after the consumers' resistance to innovation has been overcome (Ram 1987) and is evident during the first phase of the innovation lifecycle. However, resistance and adoption can coexist during the lifecycle of an innovation lifecycle (Ram 1987), which necessitates exploring whether consumer resistance can be regarded as the obverse of adoption.

Purpose

By comparing a developed country (Germany) and a developing country (South Africa), this study aims to understand why smart household appliances have been resisted and have not been adopted to predicted levels. As most previous studies have focused on the adoption of IoTs, this study includes exploring both adoption of and resistance to IoTs to gain insight into whether adoption is indeed the opposite of resistance. Innovation and consumer characteristics are typically studied to understand why IoTs are resisted and not adopted. Other variables, such as the perceived risk of adoption and personality considerations, also play a role in this research. This study focuses on smart household appliances, considering the example of the smart refrigerator particularly.

Problem

There is a concern that the uptake of IoTs in households in developing countries such as South Africa has been comparatively slow due to inadequate digital infrastructure (Ghosh 2020) and the lower living standards in South Africa compared to those in Germany (Franceso & Gold 2005). Additionally, factors such as consumer and innovativeness characteristics (Mani & Chouk 2017), perceived risk (Hirunyawipada & Paswan 2006), and certain cultural conditions (Herbi & Dunphy 1998) also influence whether these innovations are adopted. These cultural conditions include uncertainty avoidance (Snelgar, Shelton & Giesser 2017) and the effect of collective nostalgia as a personality construct on cultural elements (Creighton 2015). Therefore, it is necessary to consider both consumer and innovativeness characteristics and the possible influence of particular cultural conditions when comparing a developing country to a developed one.

The research objectives that guide this paper are:

- To determine whether the innovation characteristics of perceived uselessness, perceived novelty, perceived price and intrusiveness influence consumer resistance to or adoption of smart household appliances.
- To establish whether the consumer characteristics of privacy concerns, dependence, and self-efficacy influence consumer resistance to or adoption of smart household appliances.
- To ascertain whether perceived risk, such as social and security risk, influence consumer resistance to or adoption of smart household appliances.
- To reveal whether the personality constructs of consumer innovativeness and nostalgia influence consumer resistance to or adoption of smart household appliances.

THEORETICAL FRAMEWORK

The theoretical framework of this study is based on the work of Ram and Sheth (1989) and Mani and Chouk (2017). They categorised the resistance to IoT adoption according to functional barriers caused by product (innovation) characteristics and psychological barriers resulting from consumer characteristics. To understand these barriers in a country-specific context, it is essential to consider the various constructs of consumer personality, such as consumer innovativeness (spirit of innovation) and nostalgia. These serve as indicators of buyer behaviour in the IoT context (Aldás-Manzano et al. 2008). Perceived risk is not only multidimensional but is also a potential deterrent to innovation adoption. The two risk dimensions most applicable to an IoT context are security risk (Leong et al. 2017) and social risk (Hirunyawipada & Paswan 2006).

A brief discussion of IoT, smart homes, and appliances follows, after which the resistance to and adoption of innovation are unpacked. There are various types of resistance to innovation and various types of resistance to innovation, and barriers to adoption. These are reviewed with specific reference to the dimensions of innovation resistance. The dimensions include innovation characteristics such as perceived uselessness, novelty, price and intrusiveness, and consumer characteristics such as privacy concerns, dependence and self-efficacy. However, some authors argue that specific types of perceived risks also influence resistance to innovation (Hirunyawipada & Paswan 2006; Leong et al. 2017; Ooi & Tan 2016). These are specifically social and security risks. While consumer resistance to innovation is influenced by innovation and consumer characteristics and perceived risks, there are two personality considerations or traits that may also affect resistance and adoption. Although consumer personality is not the only focus in this study, these two traits, namely innovativeness and nostalgia, could provide insight into consumer resistance to innovation when comparing a developed country with a developing country and taking cultural considerations into account. The first trait is domain-specific innovativeness which refers to the inclination to buy new products in a particular product category (such as smart appliances). The second trait is nostalgia, linked to a nation's identity and affects consumers' preference patterns. These are deliberated in the next sections.

IoT, smart homes and appliances

The Internet of Things is "the next evolution of the Internet that (1) incorporates billions of internet-connected sensors, cameras, wearables, smartphones and other smart IoT devices and (2) are capable of communicating and consulting with one another without human intervention" (Georgakopoulos & Jayaraman 2016:1043). It is considered a system in which objects, humans and other living things are connected through 'smart' technologies (Lupton 2020). The IoT consists of devices in healthcare, security and surveillance, infrastructure, transportation, retail and smart consumer and household devices (Yu, Bang, Lee & Lee 2016), the latter being the focus in this study. Smart homes consist of intelligent things, such as appliances, that are generally heterogeneous, resource-constrained and connected over low power networks (Yu et al. 2016). These smart homes are considered as a place of security and control; a site of activity.

A smart appliance is a material piece of equipment with the ability to communicate. It has a distinctive identifier, basic computing proficiencies and the ability to discover other pieces of equipment connected to the same network. The objects co-operate with humans and other objects or devices over the internet, allowing smart appliances to mix with the internet forming a vast network of related objects. This affords the consumer better suitability in bonding to and interacting with the system (Hsu & Lin 2016). Thus, smart household appliances are equipped with sensors that collect data about the environment and take action based on communication received from other entities through network connectivity, including Wi-Fi, Bluetooth, or Radio-frequency identification (RFID). The smart appliance market is diverse with several sectors such as health, mobility, lifestyle, wearables and smart household appliances, among others (Mani & Chouk 2017).

Smart appliances present a radical change from the original appliances that were available and are thus regarded as an innovation. According to Rogers (1995:1), an innovation is "an idea, practice or object that is perceived as new by an individual or other unit of adoption." The characteristics of smart appliances include connectivity, intelligence and ubiquity. Connectivity means that smart appliances have communication protocols enabling the exchange of

information. Intelligence is evident in the ability of smart appliances to be autonomous and undertake actions based on captured data. They are ubiquitous as they may be used anywhere, anytime and from any device (Porter & Heppelmann 2014).

Various smart home product categories exist (Griffith & Colon 2019). These include smart household centres and controllers such as the Amazon Echo Family, smart household surveillance equipment, locks and home security systems, air conditioning, lighting, kitchen appliances, vacuums, smart health and fitness devices, and outdoor gadgets such as robotic lawnmowers. In South Africa, the smart appliance market is the second largest after security, while in Germany, it is the largest (Statista Smart Home Market Outlook: Germany & South Africa 2020). Germany's revenue in 2020 for smart home devices is 4th in the world being US$4.344m, compared to South Africa, which is in 25th position being US$366m. In Germany and South Africa, smart appliances are characterised by incremental innovations, adding new features to existing products. Relatively high product prices generate a high revenue, and those who already own smart appliances are more likely to purchase large, higher-priced appliances like refrigerators (Statista Smart Home Market Outlook: Germany & South Africa 2020). For this reason, the focus of this study is on smart household appliances, specifically smart refrigerators as consumers using a smart refrigerator already have some insight into how a smart appliance works.

Resistance to and adoption of smart household appliances

Consumers resist all kinds of innovations (Laukkanen 2016, Talwar, Talwar, Kaur & Khir 2020). Innovation resistance is "the resistance offered by consumers to innovation either because it poses potential changes from a satisfactory status quo or because it conflicts with their belief structure" (Ram & Seth 1989:1). Resistance to innovation is a behaviour that can block innovations from being successful, thus impacting the adoption rate (Mani & Chouk 2018; Talwar et al. 2020). It is, therefore, necessary to gain insight into the barriers leading to innovation resistance and limited adoption. Innovation and consumer characteristics are among those barriers (Mani & Chouk 2017), as well as the perceived risk (Hirunyawipada & Paswan 2006) and personality (Fauscette 2010) associated with the adoption of an innovation. These are discussed in the sections that follow.

Consumer resistance to and adoption of innovation

Resistance exists on a continuum and can either be passive, active or very active (Ram & Seth 1989). In passive resistance, the consumer, who is aware of the innovation, is reluctant or disinclined to adopt the innovation. If the resistance is active, the consumer may postpone the adoption decision as it is considered too risky. Very active resistance is demonstrated when the consumer engages in attacks against the adoption of the innovation, when the consumer is convinced that the innovation is unsuitable (Ram & Seth 1989; Mani & Chouk 2017). A consumer's predisposition to resist innovation results in passive resistance, whereas an unfavourable new product evaluation results in an attitudinal outcome and is considered active resistance (Talke & Heidenrieich 2014). Active resistance will be the focus of this study.

Three forms of innovation resistance exist (Szmigin & Foxall 1998), namely rejection, postponement and opposition, the descriptions of which echo the explanations provided by Ram & Sheth (1989) and Mani & Chouk (2017). These provide for a more detailed description of innovation resistance. Rejection, similar to passive resistance, refers to the reluctance of consumers to adopt an innovation, which is not merely driven by a lack of awareness or ignorance but involves an ongoing evaluation by the consumer. This constant evaluation includes consumers being suspicious of new and untested innovations. Hirschheim & Newman (1988) found that rejection is often entangled with traditionalism (a reluctance to change; conservativism). When consumers postpone adopting an innovation, it is an active form of resistance in which adoption is delayed due to situational factors. Kleijnen, Lee & Wetzels (2009) describe postponement or active resistance as a state in which consumers find the innovation acceptable in principle but will wait until the circumstances (situation) are more suitable before they decide to adopt. Like very active resistance, opposition refers to a process in which a consumer may try an innovation before rejecting it, followed by

an attack through negative word-of-mouth (Szmigin & Foxall 1998; Kleijnen et al. 2009). This form of resistance to innovation can also be considered innovation sabotage, with consumers actively employing strategies to prevent the innovation from taking off. Due to the slower than expected uptake of smart household appliances (Eseye 2020), it may be argued that consumers display active resistance or postponement of the adoption of these appliances.

Dimensions of consumer resistance to and adoption of innovation

Several authors concur that active innovation resistance is created by product-specific barriers (Heidenriech & Handrich 2015; Laukkanen, Sinkkonen & Laukkanen 2008; Molesworth & Suortfi 2002; Wiedmann, Hennigs, Pankalla, Kassubek & Seegebarth 2011). In addition, the typologies for the barriers to adoption differentiate between functional barriers and psychological barriers (Ram & Seth 1989; Talwar et al. 2020). Functional barriers include consumers observing a fundamental change when adopting a new appliance. These barriers encompass usage, value and risk. The usage barrier is evident when adopting a new appliance goes in opposition to consumer customs and habits. The value barrier emerges when a consumer believes that the innovation (smart appliance) does not provide a significant economic benefit compared to appliances currently available. The risk barrier relates to the potential risk of adopting an innovation, such as financial, physical, performance or social risks. Functional barriers are caused by smart appliance (innovation) characteristics such as perceived uselessness, perceived novelty, perceived price, and intrusiveness. These formed the constructs of the innovation characteristics dimension of this study.

Psychological barriers relate to a consumer's daily routines and the image associated with adopting an appliance, resulting from consumer characteristics such as self-efficacy, dependence, and privacy concerns (Ram 1987; Mani & Chouk 2017). These formed the constructs of the consumer characteristics dimension.

Innovation characteristics

Perceived usefulness is the "degree of improvement in a persons' performance when using a new technology" (Mani & Chouk 2017:83). This perception means that the more useful a smart appliance is to a consumer, the more likely they are to adopt it (Chang & Chen 2021). Perceived usefulness is how the consumer thinks they will benefit from using the smart appliance in the future (Tsourela & Nerantzaki 2020). Perceived novelty refers to how any innovation is considered unique or different, i.e. novel (Venkatraman & Price 1990). The novelty may be a significant change in the product idea or merely a change to the product's attributes. Previous research has found novelty to positively influence a consumer's attitude towards an IT innovation (Mani & Chouk 2017). Perceived price relates to how a consumer feels about the price of a product. It must be noted that the value of the new product influences how the price is perceived (Mani & Chouk 2017). The price value is a mental compromise between the smart appliance's perceived benefits and the cost of using them. When the benefits of using the smart appliance outweigh the monetary cost, the value derived from using the smart appliance positively influences how the monetary cost (price) is perceived (Leong et al. 2017). Intrusiveness typically has an adverse influence on consumers' behaviour as it causes unfavourable emotive responses such as irritation. Intrusion refers to the process whereby a product enters a consumer's life without permission. Smart appliances may be seen as intrusive as they can perform actions without the user's consent (Hoffman & Novak 2015). This ultimately leads to the question of whether the innovation characteristics of perceived uselessness, perceived novelty, perceived price and intrusiveness influence consumer resistance to or adoption of smart household appliances comparing Germany and South Africa. We posit that innovation characteristics negatively influence consumer resistance and positively influence consumer adoption of smart household appliances.

H_1: Innovation characteristics being, (a) perceived uselessness, (b) perceived novelty, (c) perceived price, and (d) intrusiveness, negatively influence consumer resistance to smart household appliances in Germany and South Africa.

H_2: Innovation characteristics being, (a) perceived uselessness, (b) perceived novelty, (c) perceived price, and (d) intrusiveness, positively influence consumer adoption of smart household appliances in Germany and South Africa.

Consumer characteristics

Consumer data privacy is a challenge (Mani & Chouk 2017) which is particularly evident in online transactions and which, in turn, will increase with the development of smart appliances. The characteristics of smart appliances include ubiquity, invisibility, pervasiveness and invasiveness. This is because they collect and manage private data and sensitive information (Sicari, Rizzardi, Grieco & Coen-Prisini 2015; Slettemeås 2009). There is a link between privacy concerns and intrusiveness. The more consumers feel sensitive about their privacy, the more they perceive the smart appliance to be intrusive (Mani & Chouk 2017). Consumers develop a dependence on the internet and computer-related technology (Hoffman, Novak & Venkatesh 2004), leading to 'technostress'. Technostress occurs when a person experiences direct or indirect negative attitudes or thoughts towards new technology or when technology influences their behaviour or how they feel physically. In the context of this study, dependence refers to consumers' reliance on technology to reach their goals. There is still the risk of causing seclusion as interaction with humans is substituted with interaction with devices (Mani & Chouk 2017). Self-efficacy refers to the perception a person has of their capability to use a technologically innovative product (Compeau & Higgins 1995), affecting resistance to technological innovation.

Interestingly, consumer resistance is negatively affected by self-efficacy (Ellen, Bearden & Sharma 1991) and positively impacts the adoption of innovation (Yangil & Chen 2007). If consumers feel more comfortable using a smart appliance, they will behave less oppositionally towards it (Mani & Chouk 2017). This then supports the question of whether the consumer characteristics of privacy concerns, dependence, and self-efficacy influence consumer resistance to or adoption of smart household appliances, comparing Germany and South Africa. We posit that consumer characteristics negatively influence consumer resistance and positively influence consumer adoption of smart household appliances.

H_3: Consumer characteristics being, (a) privacy concerns, (b) dependence, and (c) self-efficacy, negatively influence consumer resistance to smart household appliances in Germany and South Africa.

H_4: Consumer characteristics being, (a) privacy concerns, (b) dependence, and (c) self-efficacy, positively influence consumer adoption of smart household appliances in Germany and South Africa.

Perceived risk

Perceived risk may be detrimental to the adoption of innovation (Conchar, Zinkham, Peters & Olavarrieta 2004; Hirunyawipada & Paswan 2006). It is a function of the unexpected adoption results, followed by an outcome different from what was expected. The perceived risk may negatively influence the adoption of smart appliances as consumers may seek more information to alleviate the sensitivity towards risk or manage the perceived risk. Perceived risk is multidimensional, consisting of various categories of risks, such as financial, performance, privacy, psychological (Hong et al. 2020), and social (Hirunyawipada & Paswan 2006). For consumer electronics, such as smart appliances, social risk for example, may be very salient. This is because high-tech consumer electronics are used with friends and colleagues, and having the right appliance may be crucial for some consumers (Hirunyawipada & Paswan 2006).

Similarly, security risk may be prevalent in the smart environment (Leong et al. 2017). Security risk 'refers to the perception of protection against risk' (Ooi & Tan 2016:37) 'associated with IoT applications in a smart environment' (Leong et al. 2017: 445). This then supports the question of whether perceived risk such as social and security risk, influences consumer resistance to or adoption of smart household appliances, comparing Germany and South Africa. We posit that perceived risk negatively influence consumer resistance and positively influence consumer adoption of smart household appliances.

H_5: Perceived risk consisting of, (a) social and (b) security risk, negatively influence consumer resistance to smart household appliances in Germany and South Africa.

H_6: Perceived risk consisting of, (a) social and (b) security risk, positively influence consumer adoption of smart household appliances in Germany and South Africa.

Cultural and personality indicators influencing resistance to and adoption of innovation

Culture is human-made and thus communicated from one generation to another (Albaum, Strandskov & Duerr 2002). Hofstede (2001:9) stated that culture is "the collective programming of the mind that distinguishes the members of one group or category of people from another". This means "that a national culture is a set of collective beliefs and values that distinguish people of one nation from those of another" (Schnalke & Mason 2014:172), which is also considered the personality of a region (Worthley, Macnab, Brislin & Rose 2009).

Geert Hofstede conceptualised six dimensions of culture: individualism, power distance, masculinity, uncertainty avoidance, long-term orientation, and indulgence (Hofstede n.d.). Snelgar et al. (2017) state that, based on Hofstede's six dimensions of culture, Germany and South Africa do not seem to have many differences. However, Francesco and Gold (2005) found that Germany demonstrated a higher uncertainty avoidance level than South Africa. Uncertainty avoidance refers to the degree to which members of a culture feel comfortable in unstructured situations. This means that Germans experience more anxiety and distrust when facing something unknown or new than South Africans.

Uncertainty avoidance does not imply risk avoidance but rather a desire to have fixed habits and rituals. This can influence consumer innovativeness, which is the "tendency to willingly embrace change and try new things and buy new products more often and more quickly than others" (Hirunyawipada & Paswan 2006:182). Consumer innovativeness increases innovation adoption (Foxall 1995; Aldás-Manzano et al. 2008; Seyed Esfahani & Reynolds 2021), and is a personality trait, also referred to as the spirit of innovation (Ailawadi, Neslin & Gedenk 2001). This is a personality trait whereby a person's behaviour towards a product is predicted by understanding the extent to which they are willing to try new things (Mowen 1999). In other words, their propensity to be among the first to try a new and novel product. The relationship between innovation and adoption can be categorised into different levels, namely global (personal trait), domain-specific innovativeness (narrowly defined trait towards product categories) and innovative behaviour. Adoption in the context of this study is a function of domain-specific consumer innovativeness (Hirunyawipada & Paswan 2006).

Innovativeness is associated with independence, extraversion, impulsivity, risk-taking, tolerance of ambiguity and flexibility. It is an individual's predisposition towards experimenting with new technologies (Ali, Khalid, Javed & Islam 2021). However, a person's behaviour is affected by these personality elements (their own makeup) and the norms and beliefs of the cultural environment. Consumers are members of a particular national culture that affects their attitudes and behaviours (Triandis 1989). These attitudes and behaviours are also affected by central and consumer-context-specific dispositions. Central dispositions apply to various situations, contexts, and behaviours, such as personal values.

In contrast, consumer-context-specific dispositions include consumer ethnocentrism and their attitude towards the past (nostalgia). This means that consumers in some countries may display a stronger disposition towards innovation than consumers in other countries, due to systematic differences in the national environment. A country's culture is a key environmental characteristic underlying these differences (Jan-Benedict, Steenkamp, Hofstede & Wedel 1999). In this study, consumer-context-specific dispositions are most relevant compared to the resistance to and adoption of Germany and South Africa's innovation. Consumer-context-specific dispositions have relevance in explaining consumer innovativeness and include a consumer's attitude toward the past in the form of nostalgia (Holbrook 2013).

Nostalgia is typically a longing for the past, a desire for former times, and a love for belongings and activities connected with earlier years. Collective nostalgia may involve a melancholic longing for the past and represents attempts for some aspects within cultures to inscribe or reinscribe forms of culture that were more desirable (Creighton 2015). As such, it is an important phenomenon that affects the preference patterns of consumers (Holbrook 1993). Holbrook & Schindler (1991:330) defined it as "a preference (general liking, positive attitude or favourable effect) toward objects (people, places, or things) that were more common (popular, fashionable, or widely circulated) when one was younger (in early adulthood adolescence, in childhood, or even before birth)." Seifried & Meyer (2010) found harmony between IT innovations and nostalgia. Nostalgia is linked to a nation's identity, in that an intangible display of the nation's identity is promoted by nostalgia (Pajoutan & Seifried 2014). This then leads to the question of whether the personality constructs of consumer innovativeness and nostalgia, influence consumer resistance to or adoption of smart household appliances, comparing Germany and South Africa. We posit that the personality constructs of

consumer innovativeness and nostalgia negatively influence consumer resistance and positively influence consumer adoption of smart household appliances.

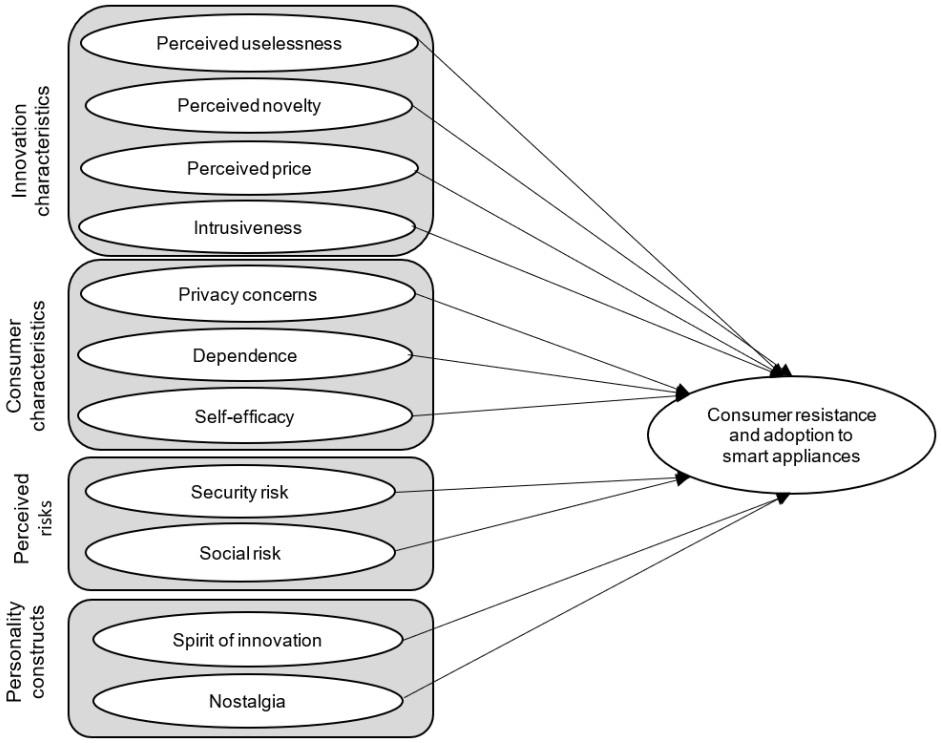
H_7: Personality constructs being, (a) consumer innovativeness and (b) nostalgia, negatively influence consumer resistance of smart household appliances in Germany and South Africa.

H_8: Personality constructs being, (a) consumer innovativeness and (b) nostalgia, positively influence consumer adoption of smart household appliances in Germany and South Africa.

The dimensions and constructs associated with this research are presented in Figure 1.

Place Figure 1 approximately here

FIGURE 1
THEORETICAL FRAMEWORK ASSOCIATED WITH CONSUMER RESISTANCE AND ADOPTION



RESEARCH STRATEGY

Data collection and sample characteristics

A quantitative research approach was adopted for this study. Non-probability sampling was applied using purposive sampling to reach a total of 1665 respondents. Of this, 974 respondents were from Germany and 691 were from South Africa. The research aimed to compare a developed country (Germany) with a developing country (South Africa) regarding consumers' resistance to and resultant adoption of smart household appliances.

Data were collected through an online questionnaire consisting of four parts. The first was a screening question to ensure that respondents were older than 18 and resided in the country in question. The second section was a welcome statement and description of smart refrigerators. Smart refrigerators were selected as the study's main smart household product as consumers in Germany and South Africa are familiar with them. The smart fridge can assist in food management and provide family connection and entertainment via push messages to smartphones or tablets through Amazon Alexa, Google Assistant, or Apple Siri. The third section consisted of the scale items using a 7-point Likert-type scale with anchors 1 (do not agree) to 7 (totally agree). The last section of the questionnaire included

demographic information and questions related to IoT usage. In Germany, a non-probability sample of respondents was recruited using purposive sampling to collect data. In South Africa, the services of Qualtrics XM were employed to assist with the recruitment of suitable respondents from South Africa. The result was a mixed sample consisting of different age and income classes.

Scale development

This study adapted the scale of resistance to smart appliances developed and tested by Mani & Chouk (2017). The constructs measured include the seven variables based on the conceptual framework developed by Mani & Chouk. The constructs are privacy concerns, perceived uselessness, self-efficacy, perceived price, intrusiveness, dependence, perceived novelty and resistance, and measuring consumer resistance as a construct (scale items adopted from the Mani & Chouk study). From their research, each of the constructs provided an acceptable or high Cronbach's Alpha score. The scale developed by Aldás-Manzano et al. (2008) was adopted for perceived risk, and only the variables of social and security risk were included. The scales for the personality constructs, consumer innovativeness and nostalgia, were adapted from Ailawadi, Neslin & Gedenk, (2001) and Holbrook (1993), respectively. Adoption was measured by asking respondents to provide the number of smart connected products they owned. According to this method, the actual adoption behaviour is reflected and has high reliability (Lastovicka & Joachimsthaler 1988; Hirunyawipada & Paswan 2006).

Results

Demographic description

All respondents were over 18 years of age, mostly female (58%) living with a partner in a shared apartment (59%) with access to the internet. The majority owned at least one smart connected product (90%), with little difference between Germans (85%) and South Africans (95%). In Germany, most responses were from 18 to 28-year-old consumers, while in South Africa, they were from 18 to 38-year-old consumers. In Germany, the majority of the respondents had a high school qualification or higher. In contrast, in South Africa, all but one of the respondents had a high school qualification or higher. Notably, the household income of respondents from Germany was lower than that of respondents in South Africa. The reason for this may be that a younger population participated in the study in Germany, while in South Africa, a panel was recruited to participate.

Descriptive statistics, Cronbach's Alphas and CFA

Considering the mean scores in Table 1, most of the respondents saw the smart refrigerator as useful, novel, priced high, and not intrusive. They had concerns regarding privacy and security but remained confident that they were self-efficient in using the appliance and were not concerned that they would depend on the technology. These respondents demonstrated a spirit of innovation, were somewhat nostalgic and had some resistance to the smart refrigerator, although they are likely to consider adopting it. When comparing Germany and South Africa, most Germans are more likely to resist smart refrigerators, while most South Africans are more likely to adopt them. The majority of German consumers perceived the smart refrigerator as more useful than their South African counterparts, while most South African consumers saw it as more novel. Most Germans viewed the price as higher than South Africans and found it more intrusive. They had more privacy concerns, while most South Africans were more confident in using the technology, although they were concerned that they might develop dependency. The majority of both Germans and South Africans had security concerns but were not worried that it might impact their social status. Most South Africans had a higher spirit of innovation, while the majority of both Germans and South Africans were mildly nostalgic about the past.

The Cronbach's Alphas, means and standard deviations of all constructs and items are reported in Table 1. Although the generally accepted value for a Cronbach's Alpha is 0.70 or above (Cortina 1993), a study by Taber (2018) on the use of Cronbach's Alpha reported Cronbach's Alphas of .45 and above as sufficient. With the exception

of the constructs of 'perceived novelty' and 'nostalgia', all scores were above 0.57, considered acceptable, moderate, adequate, reasonable and good.

TABLE 1
CRONBACH'S ALPHA, MEAN SCORES AND STANDARD DEVIATIONS

		N	A	Mean	Mean (Germany)	Mean (SA)	Std. Dev
Adoption	Suppose you need a new refrigerator how likely is it that you choose a smart fridge?	1662	.729	4.07	3.42	4.99	1.81
	I think smart refrigerators are generally good						
	Willing to spend more on smart fridge compared to another fridge						
Resistance	I'm likely to be opposed to the purchase of a smart fridge.	1659	.775	3.99	4.36	3.46	1.58
	I'm more critical of the promises of a smart refrigerator.						
	The smart fridge is not for me.						
Perceived uselessness	The features of a smart refrigerator offer few advantages.	1658	.573	3.99	3.96	4.05	1.47
	The functions of a smart refrigerator provide little added value.						
Perceived Novelty	This smart fridge is unique	1657	.465	5.12	4.60	5.85	1.35
	The smart fridge is different compared to other fridges.						
Perceived Price	The price of the smart fridge is high	1152	.667	5.39	5,45	5.34	1.31
	The price of the smart fridge is low (Recoded)						
Intrusiveness	A smart fridge is intrusive i.e it is annoying.	1656	.867	3.43	3.61	3.17	1.48
	A smart fridge irritates me.						
	The smart fridge is indiscreet i.e revealing things that should remain private.						
	I'm not comfortable with the smart fridge.						
	The smart fridge is disturbing i.e. causing anxiety.						
Privacy Concerns	I am worried that my privacy will be affected.	1664	.767	4.45	4.66	4.15	1.72
	I am worried that my personal data will be collected from a smart fridge without my permission.						
Dependence	I'm afraid of becoming dependent on the smart fridge.	1657	.706	3.00	2.72	3.39	1.30
	A smart fridge will limit my autonomy i.e. being independent.						
	A smart fridge will limit my addiction to technology.						
	I think my social life will suffer from the use of a smart refrigerator.						
Self-Efficacy	I know how to use a smart fridge.	1658	.689	5.13	4.82	5.57	1.20
	I am confident that I can understand the use of the smart refrigerator.						
	I think I am able to operate the smart fridge, although I've never used it before.						
Security Risk	I worry about giving my personal data or login to smart connected product companies.	1660	.789	5.04	5.21	4.80	1.60
	When I send data to smart products companies, I am concerned that my data may also reach unauthorised third parties or hackers.						
Social Risk	Using smart, internet-connected products degrades the picture my friends or relatives have of me.	1658	.601	3.26	3.22	3.31	1.15
	I'm afraid smart products do not offer the benefits promised on the website or by the manufacturer.						
	It is very likely that smart products will not meet my expectations.						
Innovativeness	If I see a product that differs from the conventional products, I try this out.	1659	.810	4.51	4.00	5.24	1.12
	I am often among the people who test a new product first.						
	I like to try things that are new and different.						
Nostalgia	Things used to be better in the good old days.	1657	.590	3.58	3.56	3.60	1.14
	Technological change will not secure a better future.						
	Internet-connected products do not improve your daily life.						
	The reliability of products used to be generally better.						

A two-step approach was adopted to examine the reliability and validity of the constructs. First, a Confirmatory Factor Analysis (CFA) was performed, followed by multiple regression analysis. The CFA was run on a 32-question questionnaire that measured the influence of eleven variables on the resistance to and adoption of a smart household appliance among 1665 consumers. The suitability of CFA was assessed prior to analysis. The inspection of the correlation matrix showed nine variables that had at least one correlation coefficient greater than 0.3 (see Table 2). The two variables that could not be measured were privacy concerns and dependency and were therefore not included. For this reason the hypotheses associated with these consumer characteristics (H3a, H3b, H4a, H4b) are not reported on. Removing those variables from the CFA resulted in nine clear components with the overall Kaiser-Meyer-Olkin (KMO) measure of 0.93. According to Kaiser (1974), this measure is considered 'marvellous'. Bartlett's test of sphericity was statistically significant ($p < .0005$), indicating that the data was likely factorisable.

TABLE 2
ITEM LOADINGS

		Factor								
		1	2	3	4	5	6	7	8	9
Intrusiveness	A smart fridge is intrusive i.e it is annoying.	.663								
	A smart fridge irritates me.	.699								
	The smart fridge is indiscreet i.e revealing things that should remain private.	.749								
	I'm not comfortable with the smart fridge.	.752								
	The smart fridge is disturbing i.e. causing anxiety.	.648								
Innovativeness	If I see a product that differs from the conventional products, I try this out.		.802							
	I am often among the people who test a new product first.		.831							
	I like to try things that are new and different.		.706							
Self- Efficacy	I know how to use a smart fridge.			.623						
	I am confident that I can understand the use of the smart refrigerator.			.710						
	I think I am able to operate the smart fridge, although I've never used it before.			.808						
Social Risk	Using smart, internet-connected products degrades the picture my friends or relatives have of me.				.616					
	I'm afraid smart products do not offer the benefits promised on the website or by the manufacturer.				.484					
	It is very likely that smart products will not meet my expectations.				.499					
Nostalgia	Things used to be better in the good old days.					.785				
	Technological change will not secure a better future.					.538				
	Internet-connected products do not improve your daily life.					*				
	The reliability of products used to be generally better.					.739				
Security Risk	I worry about giving my personal data or login to smart connected product companies.						.783			
	When I send data to smart products companies, I am concerned that my data may also reach unauthorised third parties or hackers.						.850			
Perceived Price	The price of a smart refrigerator is high							.831		
	The price of a smart refrigerator is low.							-.861		
Perceived uselessness	The features of an intelligent refrigerator offer few advantages.								.803	
	The functions of a smart refrigerator offer little added value.								.749	
Perceived Novelty	This smart fridge is unique.									.467
	A smart refrigerator is different from other refrigerators.									.881

*Loading below 0.3

The CFA was followed by multiple regression analysis to measure the extent to which resistance to and adoption of smart appliances are explained by the independent variables applicable to this study. First, the analysis was conducted with a combined data set for both Germany and South Africa. This was followed by another analysis for each of the dependent variables for Germany and South Africa respectively.

Multiple regression

Resistance to smart household appliances

With an adjusted r² of 64,7%, the statistics for resistance are robust (see Table 3). With the exception of the dimension of social risk (0,093), the total regression and the predictors are highly significant. Similar to adoption, the most substantial influence can be found for intrusiveness (+0,392**) and perceived uselessness (0,207**), whereas social risk (0,114**), price (+0,066**) and nostalgia (+0,037**) show much lower β-values. As an analogue of adoption, the personal spirit of innovation (-0,160**) and perceived novelty (-0,101**) also have the most substantial adverse influence on resistance. All premises of the regressions are fulfilled. The plot of the standardised residuals against the standardised predicted values shows only a very slight indicator of heteroscedasticity, and the Durbin-Watson value is 1,90. Therefore, autocorrelation and tolerance values are all above 0,49 with no multicollinearity, and the plot of the standardised residuum shows a nearly normal distribution.

TABLE 3
MULTIPLE REGRESSION RESULTS FOR RESISTANCE (COMBINED DATA SET)

Resistance	*B*	95% CI for B		SE *B*	β	t	Sig.	R^2	ΔR^2
		LB	UB						
Model								.649	.647
Constant	1.949	1.507	2.392	.226		8.641	.000		
Perceived uselessness	.212	.175	.249	.019	.207	11.237	.000		
Perceived novelty	-.161	-.160	-.072	.022	-.101	-5.177	.000		
Perceived price	.076	-.037	.115	.020	.066	3.817	.000		
Intrusiveness	-.419	.368	.471	.026	.392	16.006	.000		
Self-efficacy	-.069	-.121	-.018	.026	-.054	3.653	.000		
Security risk	.069	.032	.106	.019	.073	4.845	.000		
Social risk	.147	.087	.206	.030	.114	1.683	.093		
Spirit of innovation	-.175	-.222	-.128	.024	-.160	-7.345	.000		
Nostalgia	.048	-.008	.104	.029	.037	-2.636	.008		

Note. Model – “Enter” methods in SPSS Statistics; B – unstandardized regression coefficient; CI = confidence interval; LB = Lower Bound; UB = Upper Bound; SE B = standard error of the coefficient; = standardized coefficient; R^2 = coefficient of determination; ΔR^2 = adjusted R^2.

Resistance to smart household appliances: Germany vs South Africa

The analysis of the resistance to smart household appliances differentiated by country shows similar results as the integrated analysis (see Table 4). As it is with adoption, Germany (69,7%) shows a higher adjusted r² than South Africa (59,6%) for resistance. Once again, the dimension with the most critical positive factor is the same for both Germany and South Africa, namely intrusiveness, with Germany at +0,402**, and South Africa at +0,314**. The second most crucial dimension is perceived uselessness for Germany (+0,313**), and social risk (+0,225**) for South Africa respectively. As in the country integrated regression, the spirit of innovation shows the most significant negative influence in the separated regression (Germany -0,132** / South Africa -0,134**). In Germany, this is followed by perceived novelty (-0,047**) as the overall regression, whereas in South Africa, self-efficacy (-0,073*) ranks at number two.

All premises of the regressions for resistance in Germany are fulfilled. The plot of the standardised residuals against the standardised predicted values shows no serious indicator of heteroscedasticity, and the Durbin-Watson value is 2,01. Therefore, autocorrelation and tolerance values are all above 0,47, indicating no multicollinearity, and the plot of the standardised residuum shows a nearly normal distribution. All premises of the regressions for resistance in South Africa are fulfilled. The plot of the standardised residuals against the standardised predicted values shows only very slight indicators of heteroscedasticity, and the Durbin-Watson value is 1,89. Autocorrelation and tolerance values are all above 0,41, indicating no multicollinearity, and the plot of the standardised residuum shows a nearly normal distribution.

TABLE 4
MULTIPLE REGRESSION RESULTS FOR RESISTANCE (GERMANY VS. SA)

Germany

Resistance	*B*	95% CI for B		SE *B*	β	t	Sig.	R^2	ΔR^2
		LB	UB						
Model								.701	.697
Constant	.976	.234	1.718	.387		2.583	.010		
Perceived uselessness	.369	.302	.437	.032	-.313	10.758	.000		
Perceived novelty	-.060	-.125	.005	.033	-.047	-1.806	.071		
Perceived price	-.121	.060	.181	.031	.096	3.928	.000		
Intrusiveness	.443	.372	.514	.036	.402	12.256	.000		
Self-efficacy	-.049	-.120	.021	.036	-.037	2.674	.008		
Security risk	.075	.020	.130	.028	.071	2.228	.26		
Social risk	.105	.012	.198	.047	.070	.300	.764		
Spirit of innovation	-.169	-.238	-.101	.035	-.132	-4.860	.000		
Nostalgia	.013	-.073	.100	.044	.009	-1.374	.170		

South Africa

Resistance	*B*	95% CI for B		SE *B*	β	t	Sig.	R^2	ΔR^2
		LB	UB						
Model								.601	.596
Constant	1.803	1.165	2.440	.325		5.551	.000		
Perceived uselessness	.133	.090	.185	.022	.157	6.143	.000		
Perceived novelty	-.034	-.102	.034	.035	-.028	-.994	.320		
Perceived price	.020	-.029	.069	.025	.020	.805	.421		
Intrusiveness	.309	.236	.382	.037	.314	8.306	.000		
Self-efficacy	-.092	-.167	-.017	.038	-.073	2.330	.020		
Security risk	.057	.009	.105	.024	.071	6.267	.000		
Social risk	.239	.164	.314	.038	.225	3.148	.002		
Spirit of innovation	-.138	-.202	-.074	.033	-.134	-4.239	.000		
Nostalgia	.114	.043	.185	.036	.104	-2.421	.016		

Note. Model – “Enter” methods in SPSS Statistics; B – unstandardized regression coefficient; CI = confidence interval; LB = Lower Bound; UB = Upper Bound; *SE B* = standard error of the coefficient; = standardized coefficient; R^2 = coefficient of determination; ΔR^2 = adjusted R^2.

Adoption of smart household appliances

The regression of the integrated data for both Germany and South Africa, with all seven dimensions as independent variables and adoption as dependent variable, shows a satisfying adjusted r² of 48,6% (see Table 5). The complete

regression and all Beta values show significant or highly significant results, apart from security risk, which is slightly insignificant (0,056). All Beta values show plausible results with a standardised β of -0,348**. Intrusiveness has the most significant negative influence on adoption, followed by perceived price (-0,123**) and perceived uselessness (-0,107**). The most substantial positive impact is identified in the personal spirit of innovation (+0,252**), followed by perceived novelty (+0,197**). All premises of the regressions are fulfilled. The plot of the standardised residuals plot the standardised predicted values shows no indicator of heteroscedasticity, and the Durbin-Watson value is 1,83. Autocorrelation and tolerance values are therefore all above 0,46, with no multicollinearity. The plot of the standardised residuals shows a nearly normal distribution.

TABLE 5
MULTIPLE REGRESSION RESULTS FOR ADOPTION (COMBINED DATA SET)

Adoption	*B*	95% CI for B		SE *B*	β	t	Sig.	R^2	ΔR^2
		LB	UB						
Model								.489	.486
Constant	3.312	2.684	3.941	.320		10.339	.000		
Perceived uselessness	-.128	-.181	-.076	.027	-.107	-4.801	.000		
Perceived novelty	.267	.205	.329	.032	.197	8.411	.000		
Perceived price	-.166	-.222	-.110	.028	-.123	-5.851	.000		
Intrusiveness	-.438	-.511	-.365	.037	-.348	-11.774	.000		
Self-efficacy	.116	.042	.189	.037	.077	01.909	.056		
Security risk	-.051	-.104	.001	.027	-.046	2.021	.044		
Social risk	.087	.003	.171	.043	.057	2.227	.026		
Spirit of innovation	.323	.257	.390	.034	.252	9.557	.000		
Nostalgia	.090	.011	.170	.041	.059	3.090	.002		

Note. Model – "Enter" methods in SPSS Statistics; B – unstandardized regression coefficient; CI = confidence interval; LB = Lower Bound; UB = Upper Bound; SE B = standard error of the coefficient; = standardized coefficient; R^2 = coefficient of determination; ΔR^2 = adjusted R^2.

Adoption of smart household appliances: Germany vs South Africa

If the regression on adoption is considered separately for Germany and South Africa, Germany shows a higher adjusted r² of 55,6% than South Africa at 38,8% (see Table 6). The influence of the most important variables remains the same, although intrusiveness has the most significant negative influence on adoption in both Germany and South Africa (Germany -0,370** / RSA -0,291**). The second most crucial factor is different for Germany and South Africa. In Germany it is perceived uselessness (-0,297**), and in South Africa it is perceived price (-0,150**), so the price of the smart appliance has a much stronger influence in South Africa than in Germany. All premises of the regressions for adoption in Germany are fulfilled. The plot of the standardised residuals against the standardised predicted values shows no serious indicator of heteroscedasticity, and the Durbin-Watson value is 2,01. Autocorrelation and tolerance values are all above 0,47. Therefore, no multicollinearity is present, and the standardised residuum plot shows a nearly normal distribution. All premises of the regressions for adoption in South Africa are fulfilled. The plot of the standardised residuals against the standardised predicted values shows no serious indicator of heteroscedasticity, and the Durbin-Watson value is 1,87. Autocorrelation and tolerance values are all above 0,41. Therefore, there is no multicollinearity present, and the plot of the standardised residuum shows a nearly normal distribution.

The ranking of the dimension with the biggest positive influence shows no difference between the two countries. They are the same as in the country integrated regression, with personal spirit of innovation (Germany +0,158** / RSA 0,240**), followed by the perceived novelty (Germany +0,073** / RSA +0,114**).

TABLE 6
MULTIPLE REGRESSION RESULTS FOR ADOPTION (GERMANY VS. SA)

Germany

Adoption	B	95% CI for B		SE B	β	t	Sig.	R^2	ΔR^2
		LB	UB						
Model								.519	.556
Constant	5.631	4.725	6.537	.461		12.208	.000		
Perceived uselessness	-.355	-.437	-.272	.042	-.297	-8.562	.000		
Perceived novelty	.094	.015	.174	.041	.073	2.324	.020		
Perceived price	-.116	-.189	-.042	.038	-.091	-3.073	.002		
Intrusiveness	-.412	-.499	-.326	.044	-.370	-9.333	.000		
Self-efficacy	.059	-.027	.145	.044	.043	-1.861	.063		
Security risk	-.064	-.131	.001	.034	-.060	.209	.834		
Social risk	.012	-.101	.125	.058	.008	.689	.491		
Spirit of innovation	.204	.121	.288	.043	.158	4.801	.000		
Nostalgia	.037	-.069	.143	.054	.025	1.342	.180		

South Africa

Adoption	B	95% CI for B		SE B	β	t	Sig.	R^2	ΔR^2
		LB	UB						
Model								.347	.338
Constant	3.844	2.824	4.864	.519		7.401	.000		
Perceived uselessness	-.063	-.131	.004	.035	-.060	-1834	.067		
Perceived novelty	.178	.069	.286	.055	.114	3.216	.001		
Perceived price	-.185	-.264	-.107	.040	-.150	-4656	.000		
Intrusiveness	-.358	-.475	-.241	.059	-.291	-6.016	.000		
Self-efficacy	.132	.012	.252	.061	.083	-.772	.440		
Security risk	-.030	-.107	.046	.039	-.030	.691	.490		
Social risk	.042	-.078	.162	.061	.032	.667	.449		
Spirit of innovation	.310	.207	.412	.052	.240	5.928	.000		
Nostalgia	.039	-.074	.152	.058	.029	2.168	.030		

Note. Model – "Enter" methods in SPSS Statistics; B – unstandardized regression coefficient; CI = confidence interval; LB = Lower Bound; UB = Upper Bound; *SE B* = standard error of the coefficient; = standardized coefficient; R^2 = coefficient of determination; ΔR^2 = adjusted R^2.

Hypothesis

The hypothesis and results are outlined as follows:

H_1: Innovation characteristics being, (a) perceived uselessness, (b) perceived novelty, (c) perceived price, and (d) intrusiveness, negatively influence consumer resistance to smart household appliances in Germany and South Africa.

H_2: Innovation characteristics being, (a) perceived uselessness, (b) perceived novelty, (c) perceived price, and (d) intrusiveness, positively influence consumer adoption of smart household appliances in Germany and South Africa.

From Table 3 and 5 it is evident that H1b (-0.161), H1d (-0.419) and H2c (0.267) are supported and addresses research objective 1.

H_3: Consumer characteristics being, (a) privacy concerns, (b) dependence, and (c) self-efficacy, negatively influence consumer resistance of smart household appliances in Germany and South Africa.

H_4: Consumer characteristics being, (a) privacy concerns, (b) dependence, and (c) self-efficacy, positively influence consumer adoption of smart household appliances in Germany and South Africa.

Tables 3 and 5 show that H3c (-0.069) and H4c (0.116) are supported. H3a and H3b as well as H4a and B could not be tested. This addresses research objective 2.

H_5: Perceived risk consisting of, (a) social and (b) security risk, negatively influence consumer resistance of smart household appliances in Germany and South Africa.

H_6: Perceived risk consisting of, (a) social and (b) security risk, positively influence consumer adoption of smart household appliances in Germany and South Africa.

Tables 3 and 5 show that H6b (0.087) is supported and addresses research objective 3.

H_7: Personality constructs being, (a) consumer innovativeness and (b) nostalgia, negatively influence consumer resistance of smart household appliances in Germany and South Africa.

H_8: Personality constructs being, (a) consumer innovativeness and (b) nostalgia, positively influence consumer adoption of smart household appliances in Germany and South Africa.

From Table 3 and 5 it is evident that H7a (-0.175) and H8a (0.323) and H8b (0.090) are supported and addresses research objective 4.

DISCUSSION

Product-specific barriers create resistance caused by innovation (represented by smart appliances) and consumer characteristics. Although it was expected that consumer characteristics (namely privacy concerns, dependence and self-efficacy) might influence the resistance to and adoption of smart appliances, privacy concerns and dependence did not yield satisfactory results, indicating that they are more complex than initially thought. Self-efficacy did yield satisfactory results, but the regression analysis did not significantly influence either the resistance to or adoption of smart appliances in the combined analysis. It did, however, have a negative influence on resistance in South Africa.

Consumers from both Germany and South Africa found intrusiveness to be the most significant influence on both their resistance to the smart household appliance and their resultant adoption. When the data from Germany and South Africa are combined, intrusiveness still has the most significant influence. Hoffman & Novak (2015) found that intrusiveness typically negatively impacts the behaviour of consumers and makes them feel irritated. In South Africa, social risk also influences the resistance to smart household appliances, while in Germany, the perceived uselessness and novelty were evident. South African consumers' adoption is affected by perceived price, while perceived uselessness still played a role for their German counterparts. It is, therefore interesting that for German consumers, intrusiveness and perceived uselessness influenced both the resistance to and adoption of smart appliances, in addition to novelty, which only influenced resistance. This indicates that resistance is not merely the obverse of adoption (Ram & Seth 1989).

For South African consumers, intrusiveness, social risk, and self-efficacy affect their resistance to smart appliances, while intrusiveness and perceived price influence adoption. It is clear from the results that there is a difference between a developed and developing country regarding why smart appliances are resisted and not adopted to the predicted levels. For a developing country, perceived price affects the adoption of IoTs in the home, reflecting the lower living standards in South Africa, compared to Germany (Franceso & Gold 2005). Interestingly, social risk influences resistance to smart appliances in a developing country. Hirunyawipada & Paswan (2006) found that high-tech consumer electronics are used with friends and colleagues. South African consumers seem to feel that their social standing is at risk for not having the latest smart appliance, causing them to resist it altogether. In South Africa, resistance is affected by intrusiveness and social risk, while adoption is influenced by intrusiveness and perceived price. Resistance is the behaviour that precedes adoption, and during active resistance, the adoption decision is postponed (Mani & Chouk 2017) due to situational factors. These factors are possibly affordability (price) (Hirschheim & Newman 1988) or the intrusiveness of the product.

When the data for both countries are combined, intrusiveness, perceived uselessness, and perceived price influence resistance. All constructs of innovation characteristics, namely intrusiveness, perceived uselessness, perceived price and perceived novelty, influence the resistance to smart appliances. This means that although there are slight differences between the two countries, intrusiveness, perceived uselessness, and perceived novelty, as innovation characteristics, are overall the most important reasons for the resistance to and the adoption of smart household appliances.

An individual's personality toward specific buying behaviour is portrayed through a combination of personality characteristics (Mowen 1999). For this reason, personality characteristics need to be explored to understand the barriers caused by innovation and consumer characteristics in a country-specific context. These characteristics are measured through a consumer's personality constructs. The personality constructs applicable to this research are consumer innovativeness (spirit of innovation) and nostalgia. Persons with a strong spirit of innovation are risk-takers who increase innovation adoption (Aldás-Manzano et al. 2008). The spirit of innovation negatively influenced consumer resistance and positively influenced adoption for the country-specific and combined data. This means that consumers from both developed and developing countries have a strong spirit of innovation (consumer innovativeness) and are likely to adopt smart appliances based on this personality construct. For South Africans, however, the spirit of innovation influenced resistance (negatively) and adoption (positively) slightly more than for Germans. The spirit of innovation (consumer innovativeness) is influenced by the cultural dimension of uncertainty avoidance, where Germans have a higher level of uncertainty avoidance than their South African counterparts. This thus supports the notion that South Africans have a stronger spirit of innovation in line with their lower levels of uncertainty avoidance.

CONCLUSION

The emergence of smart appliances as part of the growing IoT industry is changing how we interact with the world. However, the uptake of these IoT devices is slower than expected, especially in developing countries, where there is little emphasis placed on smart household appliances. Some of the reasons for this resistance to and adoption of smart appliances are located in the characteristics of both the smart appliance and the consumers. For the consumers, these include those characteristics related to personality. Insights from consumers from Germany and South Africa revealed that the features of the smart appliance influence both the resistance to and adoption of the smart appliance. Resistance is influenced by how intrusive the smart appliance is, how the consumer perceives its usefulness and whether it is considered novel or new. Adoption is influenced by how intrusive the smart appliance is, how it is perceived in terms of usefulness, whether it is deemed novel, and how the consumer perceives the price. Only South African consumers' perception of their capability to use a technologically innovative product influences their resistance to the smart appliance. The reasons for the resistance to and adopting smart appliances differ when comparing a developed and developing country. Overall, it was found that adoption is not the inverse of resistance. Although the influence of consumer characteristics on the resistance to and adoption of smart appliances is inconclusive, the personality construct of consumer innovativeness (spirit of innovation) plays a significant role in both Germany and South Africa. The cultural dimension of uncertainty avoidance influenced the spirit of innovation. South Africans' spirit of innovation influences their resistance to and adoption of smart appliances more strongly than their German counterparts.

The importance of the research is fourfold: Firstly, the comparison of a developed country to a developing country to understand the reasons why IoTs have been resisted and not adopted to the expected levels provides the basis for further research to be conducted among more developed and developing countries. This will ascertain whether this phenomenon extends beyond the two countries included in this study and provide a basis for more generalizable results. Understanding the nuances of resistance and adopting smart appliances comparing a greater sample of developed and developing countries has implications for technology developers and marketers. Secondly, although all of the innovation characteristics were found to influence the resistance to and adoption of IoTs, intrusiveness was found to be more significant all around. Further research is needed to understand this particular construct, thereby providing insight to IoT organisations in finding ways to overcome this. Thirdly, uncovering that IoT adoption is not merely the inverse of resistance, and especially discovering the particular reasons for each of these, is significant. As some of the results for consumer characteristics were inconclusive, further research is needed to understand the

complexities of privacy concerns and dependence. Fourthly, discovering that the personality construct of the spirit of innovation significantly influences resistance negatively and adoption positively recognises that personality may influence consumer characteristics and warrants further exploration.

It is recommended that the industries associated with IoTs, more specifically smart appliances, take cognisance of their innovations' characteristics to curb the resistance to these innovations and encourage adoption. The intrusiveness of technological innovations needs to be limited, allowing consumers to feel more comfortable using and adopting smart appliances. The seamless integration of these appliances with a consumer's life is necessary for increased adoption. Similarly, the uselessness, price and novelty need to be balanced with limiting the smart appliance's intrusiveness. Understanding consumers remain pivotal in encouraging the adoption of smart appliances. Apart from the needs of consumers such as protecting their privacy, ensuring they remain independent from the technology and their ability to handle the technology, their propensity to take risks and try new things are likely to play a significant role in acquiring smart appliances.

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