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Are households ready to engage with smart home technology?

Rory Mulcahy[a]*, Kate Letheren[b], Ryan McAndrew[b], Charmaine Glavas[b], Rebekah Russell-Bennett[b]

[a]*USC Business School, University of the Sunshine Coast, Sunshine Coast, Australia*

[b]*School of Advertising, Marketing and Public Relations, Queensland University of Technology, Brisbane, Australia*

***Corresponding author: Rory Mulcahy, USC Business School, University of the Sunshine Coast, Locked Bag 4, Maroochydore DC Qld 4558, rmulcahy@usc.edu.au**

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This paper contributes new knowledge regarding consumers' preparedness for smart home technology adoption. This research bridges together three important frameworks – the technology readiness index (TRI) 2.0, consumer engagement, and perceived risk and trust – to understand consumers' intentions to adopt smart home technology. We examine both direct and indirect effects, with results demonstrating the model explains 77% variance of consumers' imagined engagement with smart home technology and 74% variance of intentions to adopt; hence, our model has greater predictive power than others proposed in the literature. Theoretically and managerially, we demonstrate a new pathway to consumers' adoption of smart home technology in two ways. First, we depict the impact of consumers' general perceptions of technology (TRI) on opinions and imagined engagement experiences with smart home technology. Second, we show how opinions and imagined experiences with smart home technology impact their intentions to adopt.

Keywords: Smart home technology, technology readiness index, consumer engagement, perceived risk, trust

Introduction

Recent forecasts suggest the market size for smart homes – modern homes which have appliances or electronic devices that can be controlled remotely by the owner to provide services that address householder needs – will reach an estimated US$153 billion and a household penetration rate of 18.1% worldwide by 2023 (Statista, 2018a, 2018b). Smart homes offer unprecedented opportunities to households but also bring with them a number of concerns; hence, making smart homes a popular discussion point for industry (Goulden, 2017) and scholars (Caccavale, 2018). For example, the literature suggests smart home technologies will assist households in controlling their demand and use of energy, which benefits household financial well-being and subsequently the environment by reducing energy production pressures (Di Giorgio & Pimpinella, 2012). Other potential benefits for society include the support of vulnerable consumers, such as the elderly (Deen, 2015; Liu, Stroulia, Nikolaidis, Miguel-Cruz, & Rincon, 2016) and chronically ill (Chiang & Wang, 2016). However, there is also the potential for smart home technologies to bring about 'dark-side' issues, such as technology-facilitated domestic abuse (Burdon & Douglas, 2017), or privacy and information misuse (De Cremer, Ngyuen, & Simkin, 2017). With the current conflicted state of the literature, it is important to understand if households are also conflicted; that is, we need to examine household readiness and willingness to engage with smart home technologies so that marketers can have a greater understanding as to why encouraging consumers to purchase such technology may or may not be successful. The present study contributes to understanding this area by developing and empirically testing a comprehensive model of consumer smart home adoption, drawing from major frameworks and concepts in the literature, namely: the technology readiness index (TRI) (Parasuraman, 2000; Parasuraman & Colby, 2015), to examine *whether* consumers wish to engage; consumer engagement (Brodie, Ilić, Jurić, & Hollebeek, 2013; Hollebeek, Glynn, & Brodie, 2014), to show *how* consumers see themselves engaging; and trust and risk (Pavlou, 2003), to examine factors that may be motivating or demotivating for adoption and engagement.

First, we need to understand whether consumers wish to adopt smart home technology. Technology has radically changed – and continues to change – daily life for consumer households. For example, in the past, microwaves and washing machines changed cooking and washing practices. However, compared with previous forms of household technology, smart home technologies are more proactive and responsive to users (Wu, Chen, & Dou, 2017). At first glance, this means that households are posed with an important internal question: are they ready to provide control to smart home technologies that can autonomously make decisions or undertake actions on their behalf? This question and the subsequent decisions can be confronting for consumers – popular media does not necessarily help consumers, instead ensuring that doomsday technology scenarios (e.g. Terminator) are top of mind, leaving consumers to wonder if these examples are science fiction or science prophecy. We therefore need to understand if consumers in the current climate are actually ready to engage. One framework that provides insight into households' general psychological traits and beliefs relating to technology is the TRI. The TRI has been utilised to understand consumer acceptance of a number of technologies, such as mobile services and self-service technology (Chen, Lui, & Lin, 2013; Lee, Castellanos, & Choi, 2012), and we extend this thinking to investigate how general perceptions of technology motivate or inhibit consumers' acceptance of smart home technology.

Secondly, it is important to understand the factors that may drive consumer adoption of and engagement with smart home technology. In this context, trust and risk prove especially pertinent (Balta-Ozkan, Davidson, Bicket, & Whitmarsh, 2013; Letheren, Russell-Bennett, Mulcahy, & McAndrew, 2019; Ponce, Polasko, & Molina, 2016). Trust is regarded as a catalyst for consumer–technology interaction that can also provide consumers with high expectations (Marriot & Williams, 2018). The importance of trust is heightened due to the high degree of uncertainty and unfamiliarity surrounding smart home technology (Pavlou, 2003). Indeed, trust in automation has long been a key concern of the literature – including ensuring that 'errors in trust' (dis/trusting the automation when not earned) are avoided (Muir, 1994). This also suggests risk is an important consideration to understand perceptions of smart home technology. Given the current reports of smart home technology, it is plausible that households perceive there are a number of risks of using this technology. For example, recent reports of smart home technologies eavesdropping and recording conversations could lead to households perceiving security and monetary risks due to the unintentional sharing of sensitive information. Thus, since trust and perceived risk are crucial constructs for scenarios where consumers are uncertain or unfamiliar with technology, these concepts are also integrated into our model.

Third, we need to understand how consumers imagine themselves engaging with smart home technology. A framework that can provide insight into household technology adoption is consumer engagement (Brodie, Hollebeek, Jurić, & Ilić, 2011). As this study focuses on adoption, our perspective of consumer engagement is based upon consumers futurising (imagining) how their household would engage with the technology. Undertaking such an approach is not unusual for developing technologies and is important to ensure theoretical frameworks can be at the forefront of new phenomena. Further, it is appropriate to examine consumers' imagined experiences (Jaakkola, Helkkula, & Aarikka-Stenroos, 2015) as smart home technology is still in the adoption phase (Hubert, Blut, Brock, Backhaus, & Eberhardt, 2017). Therefore, we seek to enhance understanding of how consumers will imagine their engagement with smart home technology and how this influences their readiness to adopt.

While the three aforementioned frameworks and concepts (the TRI, consumer engagement, and trust and risk) are noted for providing rich insight into consumer technology adoption and engagement, there is scarce research that draws these together into a singular model to understand intentions to adopt smart home technology. Bringing together these frameworks and concepts provides an understanding of how a household's current characteristics and beliefs (sourced from the TRI) influence how they evaluate (perceived trust and risk) and anticipate engaging with (consumer engagement) and, finally, adopting (adoption intentions) smart home technologies. Synthesising these models and concepts into the model enhances their explanatory value for smart home technology above that which would be possible for the existing models alone. For instance, the TRI predicts whether consumers are *ready* for new technology but not how they will evaluate it or engage with it. The other elements of the proposed model similarly benefit from inclusion in a larger model, in that the interaction between different antecedents and outcomes is visible; hence, providing greater illumination of consumer responses to smart home technology than the previous stand-alone models could have provided.

We draw these together to depict a new pathway consumers may use to adopt smart home technology via two phases. The initial phase demonstrates how general perceptions of technology transfer and affect opinions and imagined experiences with smart home technology via TRI's interrelationships with trust, risk and consumer engagement. Such an approach to understanding the initial formation of consumers' opinions and imagined consumer engagement with smart home technology is important because consumers often use heuristics or experiences with similar products and product categories when purchasing or adopting unfamiliar products (Strebel, Erdem, & Swait, 2004). The next phase of unpacking the consumer pathway to adoption of smart home technology demonstrates how intentions to adopt are fostered through consumers' perceptions of trust and risk, and their imagined engagement with the technology. The approach of mapping the pathway with general perceptions of technology evolving to specific opinions and imaginations has yet to be explored, with previous studies focusing solely on consumers' perceptions of smart home technology (e.g. Hubert et al., 2018; Yang, Lee, & Zo, 2017). Further, in examining imagined consumer engagement within our model we address the need to 'examine the directionality and strength of relevant constructs' theoretical link to consumer engagement, thus identifying and empirically validating particular consumer engagement antecedents [in our case TRI, trust and risk] and consequences [in this study intentions to adopt smart home technology]' (Islam, Rahman, & Hollebeek, 2018, p. 24).

The TRI serves an important foundation for the model in the current study as it allows us to measure consumers' general perceptions of technology and how this affects factors relating to smart home technology adoption (trust, risk and consumer engagement). As suggested by Parasuraman and Colby (2015), the TRI is a key framework that can be used as a diagnostic and ‘valuable psychographic variable in applied, decision-oriented research in contexts where technology-based innovations play an important role’ (p. 72). Yet, current technology adoption research focuses predominately on the antecedent roles of utilitarian attributes of technology, such as ease of use and usefulness, through models such as the technology acceptance model (TAM; e.g. Hubert et al., 2018).

Further, trust and risk are included as key components in our proposed model. The importance of these two concepts for technology use and adoption has been noted by other researchers (e.g. Wuenderlich et al., 2015), and so their inclusion in our model – which attempts to combine relevant theoretical frameworks and concepts to derive a greater understanding of consumer adoption of smart home technology – is appropriate. The importance of these two concepts is also reinforced by incidents with smart technology that have impacted consumers' trust and perceptions of risk. For example, Samsung Smart TVs were reported for listening to all home conversations and sending the data over the internet to a third-party cloud service (Cowling, 2015). Thus, from both a scholarly and practitioner perspective, trust and risk are important inclusions to understand consumers’ intentions to adopt smart home technology.

Finally, regarding consumer engagement, scholars point out there is a need to examine the directionality and strength of its impact on outcomes (Islam et al., 2018), and thus we map its impact onto intentions to adopt to complete our understanding of the consumer pathway to adopting smart home technology. This is important managerially as practitioners often undertake efforts to assist consumers in imagining how they would interact with future products such as smart home technologies. For example, consumers may undertake a virtual walkthrough of their future home before it is built. Yet, little research takes such a theoretical approach to explore consumers’ imagined engagement with smart home technology; instead, past research tends to take a retrospective approach, investigating only after consumers have engaged with a good or service.

The remainder of this article is organised as follows. First, we provide a brief overview of the literature and present our conceptual model and hypotheses. Then, we describe the study's methodology. This is followed by a presentation of the results. The implications of the results and findings for theory and practice are then discussed. Finally, we outline directions for future research.

Literature review

Smart home technology and smart home services

A smart home can be defined as a 'residence equipped with a communication network, high-tech household devices, appliances, and sensors that can be remotely accessed, monitored, and controlled, and that provide services responding to the residents' needs' (Yang et al., 2017, p. 69). Due to the capabilities of smart technology, households can access an array of services that benefit both the consumer and the provider (e.g. the ability to manage supply and demand), facilitated by the network of technological components used (Balta-Ozkan et al., 2013). These services can include security, assisted living, health, entertainment and energy efficiency. For example, smart home energy meters connected to energy grids allow for 'set and forget' (automated) features, whereby energy is used by household appliances at the most economical times of the day, enabling households to access a technological service which provides 'effortless energy saving' and making homes more sustainable (Paetz, Dütschke & Fichtner, 2012; Sintov & Schultz, 2017; Strengers & Nicholls, 2017). However, these benefits of smart technology can at times be overestimated and are limited by consumers' preferences for comfort and control (Darby, 2017; Ford, Pritoni, Sanguinetti, & Karlin, 2017; Gram-Hanssen & Darby, 2018).

Much of the research on smart home technology has been concerned with technical features, or on the role of smart home technology within the Internet of Things (Marikyan, Papagiannidis, & Alamanos, 2019; Stojkoska & Trivodaliev, 2017), and so a substantial amount of the literature evidence has been reported by technology developers (Wilson, Hargreaves, & Hauxwell-Baldwin, 2015; Yang et al., 2017). Therefore, while smart home technology offers great promise from a technical perspective when considering the smart home services that can be offered, how best to market and encourage households' adoption and acceptance of smart home technology remains to be thoroughly understood. In Marikyan et al.'s (2019) systematic review of smart home technology studies, the authors identify that there is little evidence relating to issues of acceptance or adoption of smart home technology. Further, they state: 'future research may contribute to theory, which would tackle both the psychological and technological factors that could drive the adoption of smart home technology' (p. 150). Indeed, scholars such as Sanguinetti, Karlin and Ford (2018) acknowledge that 'despite hundreds of smart HEM [Home Energy Management] products on the market and many invested stakeholders, consumer adoption is lagging behind expectations' (p. 274). Studies that have investigated consumer adoption or intentions to adopt smart technology have often replicated established frameworks such as the theory of planned behaviour (TPB; Yang et al., 2017) or the TAM (Hubert et al., 2018). This could potentially be limiting, as other approaches could provide alternative and greater explanations of consumers' intentions to adopt smart home technology.

Further, of the limited literature on smart home adoption and acceptance, there appears to be agreement that trust and risk are major motivators/detractors from the technology's use, which can be attributed to privacy and security concerns, as well as consumers' ability to adjust the level of autonomy and control of the technology (Balta-Ozkan et al., 2013; Paetz et al., 2012). Yang et al.'s (2017) study showed how trust and risk can have a significant influence on consumers' perceptions of smart home services. This is consistent with Demiris, Hensel, Skubic and Rantz's (2008) study, which shows privacy, access to data and issues of trust to be key issues for the adoption and use of smart home technology. Similarly, Mani and Chouk's (2017) study found usefulness and intrusiveness to be the two strongest predictors of consumers' resistance to smart products.

In sum, while published research on smart homes and smart services is growing exponentially, a clear and thorough understanding of the factors which encourage adoption and use of smart technologies is currently missing from the literature. To contribute to this emerging literature base, we use the TRI and consumer engagement frameworks as well as the concepts of trust and risk, which we review next.

Technology readiness index

Technology readiness can be defined as 'people's propensity to embrace and use new technologies for accomplishing goals in home life and at work' (Parasuraman, 2000, p. 308). The literature has consistently conceptualised the TRI as having four dimensions: optimism, innovativeness, discomfort and insecurity. This includes recent studies that have streamlined and updated the original version of the TRI scale for recent digital disruption and social media technologies (Parasuraman & Colby, 2015; Lin & Hsieh, 2012). Of the four dimensions, *optimism* (a positive view of technology and a belief that it offers people increased control, flexibility and efficiency in their lives) and *innovativeness* (a tendency to be a technology pioneer and thought leader) are motivators which contribute to consumers' technology readiness. Conversely, *discomfort* (a perceived lack of control over technology and a feeling of being overwhelmed by it) and *insecurity* (a distrust of technology, stemming from scepticism about its ability to work properly and concerns about its potentially harmful consequences) are inhibitors which detract from consumers' technology readiness.

Numerous scholars in the fields of services and marketing have studied consumers' technology readiness for new and developing technologies (as shown in Table 1). Of these studies, there appears to be two approaches to measuring and testing the TRI. The first set of studies find it useful to distinguish the differing effects of the TRI dimensions by examining their individual impact on outcomes (e.g. Lee et al., 2012; Wang, So, & Sparks, 2017). The other approach focuses on the TRI as a multidimensional omnibus indicator or hierarchical construct (see Roy, Balaji, Quazi, & Quaddas, 2018; Ferreira, da Rocha, & da Silva, 2014). For this study, we take the lower-order approach as we seek to gain nuanced and diagnostic insights into how the motivators and inhibiting factors affect consumer perceptions of engaging with smart home technology.

As demonstrated in Table 1, the TRI has shown to be a significant predictor of a number of outcomes that are of interest to technology adoption, such as perceived ease of use, usefulness and satisfaction, both when examined by dimension and cumulatively. However, what is currently under-researched is how consumers' general technology readiness impacts upon outcomes such as perceptions of engagement with, trust in and risk of smart home technology – concepts which are noted for being integral to technology adoption and use (discussed shortly). This study therefore aims to contribute new insight into the TRI literature (shown in Table 1) by examining its impact on important under-researched concepts in the technology use and adoption literature.

Table 1. Chronological overview of exemplar technology readiness studies.

Author(s)/Year	Technology	Single Order	Higher Order	Motivators		Inhibitors		TRI	Outcomes
				Optimism	*Innovativeness*	*Discomfort*	*Insecurity*	*Cumulative effect*	
Mady (2011)	Sentiment towards marketing	Y		Pos (sig)	Neg (non-sig)	Neg (sig)	Neg (sig)		Consumer sentiment towards marketing
Son and Han (2011)	Internet protocol Television	Y		Pos (sig)	Pos/Neg (sig)	Neg (sig)	Neg (non-sig)		Usage patterns, satisfaction, Retention
Elliot, Meng and Hall (2012)	Self-service technology		Y					Pos (sig)	Ease of use, usefulness, reliability, fun
Lee et al. (2012)	Airline self-service check-in		Y					Pos (sig)	Attitudes toward technology, Attitudes to service provider, intentions to use technology
Lu, Wang and Hayes (2012)	Customer-to-customer platforms	Y		Pos (sig)	Pos (non-sig)	Neg (non-sig)	Neg (sig)		Trust, functionality, satisfaction
Chen et al. (2013)	Mobile services		Y					Pos (sig)	Usefulness, confirmation of expectations
Jin (2013)	Facebook		Y					Pos/Neg (sig)	Ease of use, usefulness, Playfulness
Vize, Coughlan, Kennedy, & Ellis-Chadwick (2013)	Business-to-Business online retail		Y					Pos (sig)	Satisfaction, service quality
Ferreira et al. (2014)	E-book readers		Y					Pos (sig)	Ease of use, usefulness, relative advantage, pleasure, arousal, dominance
Wang et al. (2017)	Airline technology-enabled services	Y		Pos (sig)	Pos (sig)	Neg (non-sig)	Neg (non-sig)		Satisfaction, future behaviour
Mishra, Maheswarappa and Colby (2018)	General technology use		Y						TRI is outcome*
Roy et al. (2018)	Smart retail technology		Y					Pos (sig)	Ease of use, usefulness, functionality, adaptiveness
Current Study	Smart home technology	Y		Pos (sig**)	Pos (sig**)	Neg (sig**)	Neg (sig**)		Trust, risk, consumer engagement

Note: sig=significant, non-sig=non-significant, Pos/Neg=both positive and negative effect evident, *Study examined antecedents of TRI **anticipated effect for current study; cumulative effect=observing the impact of all TRI dimensions collectively on an outcome.

Trust and risk

Trust and risk have been examined in numerous technological settings, such as online retailing (Martin, Mortimer, & Andrews, 2015), internet banking (Kesharwani & Singh Bisht, 2012) and mobile payments (Slade, Dwivedi, Piercy, & Williams, 2015). Trust is key for consumers' social interactions (Thielmann & Hilbig, 2015) and, as consumers start to see their interactions with smart technology take on social roles such as servants, friends and masters (Schweitzer, Belk, Jordan, & Ortner, 2019), it is an important inclusion in the current study. Trust can be defined as the extent to which one believes that new technology usage will be reliable and credible (McKnight & Chervany, 2001). Furthermore, trust has been shown to be a strong predictor of task performance for consumers using technology (Colquitt, Scott, & LePine, 2007; Kivijärvi, Leppänen, & Hallikainen, 2013). Risk, however, refers to an attribute of an alternative decision, reflecting the variance of possible outcomes (Gefen, Karahanna, & Straub, 2003); that is, risk is weighed when making decisions, allowing consumers to consider likely costs and benefits. In the literature, it is widely agreed that risk should be measured as a multidimensional rather than uni-dimensional construct (Kim, Ferrin, & Rao, 2008; Luo, Li, Zhang, & Shim, 2010; Park & Tussyadiah, 2017). This is because many characteristics of a decision or interaction with a product such as smart technology can interplay in creating consumers' perceptions of risk (Park & Tussyadiah, 2017). This therefore necessitates the need to capture the richness of these different aspects of risk through a multidimensional conceptualisation, which cumulates into an overall perception of risk. Trust and risk are significant factors in determining the adoption of smart home technology because the technology is often automated, which requires a higher investment of trust to countervail the perceived risk due to the responsibility of tasks being given from the consumer to the automated technology. Automation occurs when a task or function which was previously carried out by a human is executed via a machine or artificial intelligence (AI; Yang et al., 2017). It is this handing over of task performance and control to AI and automated smart home technology that can make trusting technology and reducing perceptions of risk important for adoption. This is particularly the case given reports of smart home technologies performing unethical behaviours, such as eavesdropping on personal communications, as well as smart home technologies being left open to unwanted purchases and vulnerability to identity theft. It is reasons such as these and others that demonstrate the importance of perceived risks and trust in the marketplace for smart home technology.

Consumer engagement

Consumer engagement is defined as 'a psychological state that occurs by virtue of interactive, co-creative customer experiences with a focal agent/object in focal service relationships' (Brodie et al., 2011, p. 260). The concept of consumer engagement has attracted significant and growing interest in the scholarly and practitioner literature (Hollebeek & Andreassen, 2018). Despite the rapid advancement of consumer engagement, both conceptually and empirically, understanding and agreement regarding its structure and measurement remain only partial. Further, while consumer engagement measures consumers' interactions with objects, the majority of studies focus on online consumer–brand engagement (e.g. Dessart, Veloutsou, & Morgan-Thomas, 2016; Hollebeek et al., 2014).

In the literature, several multidimensional conceptualisations of consumer engagement have been proposed (see Table 2). However, while many are proposed, the majority recommend three dimensions which broadly capture cognitive, affective and behavioural aspects (Brodie et al., 2011). This study specifically adopts the conceptualisation proposed by Hollebeek et al. (2014) and explores it as a higher-order construct as per Islam et al. (2018). This approach is supported by the work of Letheren et al. (2019), in which they adopted Hollebeek et al.'s (2014) framework to explore households' imagined engagement with smart home technology. We also undertake a hierarchical approach to modelling Hollebeek et al.'s (2014) consumer engagement framework which has been shown to be highly reliable and valid, as well as having strong predictive power for outcomes such as brand loyalty (Islam et al., 2018). When applying Hollebeek et al.'s (2014) conceptualisation of engagement to smart home technology, cognitive engagement refers to consumers' thoughts and knowledge relating to the product. The affective aspects of engagement capture the positive or negative emotional states related to using smart technology, and behavioural engagement examines consumers' perceptions of how and when they would use smart home technology.

As this study is focused on adoption, we seek to understand consumers' imagined engagement with smart home technology. As suggested by Wuenderlich et al. (2015), understanding consumers' imagined experiences is important for technological innovations such as smart home technology as this allows for theories and frameworks to be built ahead of the widespread use of these technologies. This research therefore sets out to extend understanding of consumer engagement beyond that of interactions with online brand communities by examining how consumers' perceived (imagined) engagement with smart home technology encourages adoption.

As shown in Table 2, antecedents of consumer engagement are another area deserving of more research focus. Of the studies that have examined antecedents, many have focused on those associated with brands or involvement. This leaves little understanding of specific antecedents related to technology which may influence consumers' engagement with smart home technology. As suggested by Islam et al. (2018), 'a need exists to examine the directionality and strength of relevant constructs' theoretical link to consumer engagement, and thus identifying and empirically validating particular consumer engagement antecedents and consequences' (p. 24). This research therefore sets out to contribute greater understanding in this area by examining how TRI influences consumer engagement, and how this relationship in turn affects smart home technology adoption.

Conceptual model and hypotheses

In this section, we propose our conceptual model and its relationships. The model and network of construct relationships are presented in Figure 1. Justifications for each relationship presented in our model follow.

Table 2. Chronological overview of engagement study conceptualisations and measurement.

Author(s)/Year	Object	Antecedents	Dimensions	High/Low Order	Outcomes
Calder, Malthouse and Schaedel (2009)	Advertising/Website	N/A	Personal engagement Social-interactive engagement	High	Click intention Attitude towards ad
Brodie et al. (2011)	Brand/Virtual Communities	N/A	Cognitive Emotional Behavioural	Low	No outcomes
Hollebeek et al. (2014)	Brands/Online Communities	Consumer involvement	Affective Cognitive processing Activation	Low	Self–brand connection Brand usage intention
So, King, Sparks and Wang (2016)	Brand/Retail Services	N/A	Identification Enthusiasm Attention Absorption Interaction	High	Brand trust Service quality Brand loyalty
Dessart, Veloutsou and Morgan-Thomas (2015)	Brands/Online Communities	Brand identification Brand satisfaction Brand trust Value Identification	Affective (enjoyment, enthusiasm) Cognitive (attention, absorption) Behavioural (learning, endorsing, sharing)	High	Brand loyalty
Verhagen, Swen, Feldberg and Merikivi (2015)	Virtual Customer Environments	N/A	Access to knowledge Feedback Social identification Social ties Peer recognition Company recognition Self-expression Altruism	Low	Cognitive benefits Social integrative benefits Personal integrative benefits Hedonic benefits

Author(s)/Year	Object	Antecedents	Dimensions	High/Low Order	Outcomes
Dessart et al. (2016)	Brands/Online Communities	N/A	Affective (enjoyment, enthusiasm) Cognitive (attention, absorption) Behavioural (learning, endorsing, sharing)	High	No outcomes
Leckie, Nyadzayo and Johnson (2016)	Brand/Mobile Phone Service Providers	Involvement Participation Self-expression	Cognitive Affection Activation	Low	Brand loyalty
Marbach, Lages and Nunan (2016)	Brand/Social Media Communities	Personality traits	Cognitive Affective Behavioural	Low	Perceived Value
Islam et al. (2018)	Brands/Online Communities	Self–brand image congruity Value congruity	Affective Cognitive processing Activation	High	Brand loyalty

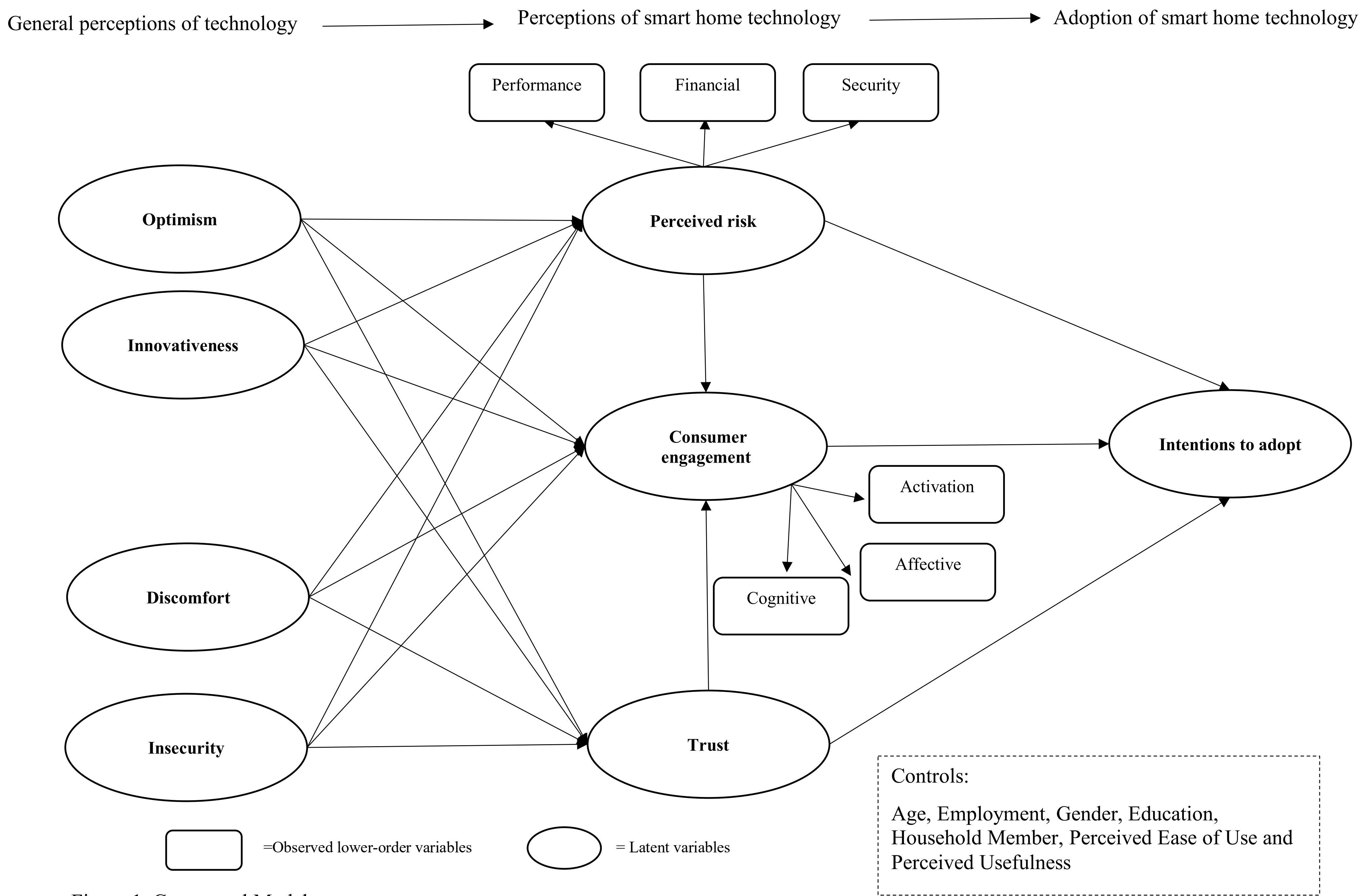


Figure 1. Conceptual Model

TRI relationships

Most scholars posit the TRI dimensions as important predictors of attitudes and perceptions; we also predict this effect. However, studies are yet to empirically link TRI to the concepts of consumer engagement, trust and risk. For example, Elliot et al.'s (2012) study suggests the TRI has a direct effect on perceived usefulness, ease of use, fun and reliability of self-service technology. These findings were confirmed and extended upon by Roy et al. (2018), who found technology readiness to affect perceived ease of use, functionality and store reputation for smart retail technology. Thus, these two studies provide evidence that TRI is an important antecedent in influencing consumer perceptions of technology. When extending and applying this to the current study, it is proposed that TRI will influence consumers' imagined engagement with smart home technology as well as perceived trust and risk. This notion is supported by Marbach et al.'s (2016) study that shows personality and psychological traits of the consumer (introversion/extroversion, (dis)agreeableness, conscientiousness, openness to experience, need for activity, need for learning and altruism) can function as motivators or inhibitors when influencing consumer engagement. This is particularly relevant for our linkage of TRI to consumer engagement, as Parasuraman and Colby (2015) point out that TRI is an important psychological concept which explains consumer motivators or inhibitors for using technology. We therefore extend the findings of these prior studies to suggest new relationships yet to be thoroughly explored in the literature: that of TRI motivators having positive direct effects on consumer engagement and trust (except for risk, which will be negative), and the opposite for inhibitor dimensions (except for trust which, will be positive).

Thus, the following set of relationships is proposed:

H1: Optimism will have a positive direct effect on (a) consumer engagement and (b) trust, a negative effect on (c) risk, and an indirect effect on (d) intentions (when mediated by consumer engagement).

H2: Innovativeness will have a positive direct effect on (a) consumer engagement and (b) trust, and a negative effect on (c) risk, and an indirect effect on (d) intentions (when mediated by consumer engagement).

H3: Discomfort will have a negative effect on (a) consumer engagement and (b) trust, and a positive effect on (c) risk, and an indirect effect on (d) intentions (when mediated by consumer engagement).

H4: Insecurity will have a negative effect on (a) consumer engagement and (b) trust, and a positive effect on (c) risk, and (d) an indirect effect on intentions (when mediated by consumer engagement).

Trust and risk relationships

Research indicates that trust and risk can be significant predictors of desired outcomes. Examining the influence of product consumer trust and web-vendor consumer trust, Pappas (2016) concludes that trust can have a positive impact upon consumers' intentions to purchase. This is also supported by Gross (2016), who found trust to influence continued usage of mobile shopping via smartphones, whereas studies have found the opposite relationship for risk, whereby risk detracts from consumers' likelihood to purchase or use products and services (e.g. Martin et al., 2015). Links between trust and consumer engagement, and risk and consumer engagement, have also been reported in the literature. For instance, Dessart et al.'s (2015) study finds that brand trust can lead to significant increases in consumer engagement, whereas Letheren et al. (2019) suggest that both trust and risk are important considerations for households to engage with technology. Consistent with past findings, our conceptual framework also contends trust and risk will influence outcomes. Specifically, we predict trust will have a positive direct relationship with consumer engagement, as well as a positive direct and indirect relationship with intentions to adopt smart home technology (mediated by consumer engagement). We also predict the opposite for risk. In sum, we propose:

H5: Trust will have a positive direct effect on (a) consumer engagement and (b) intentions to adopt.

H6: Risk will have a negative direct effect on (a) consumer engagement and (b) intentions to adopt.

Consumer engagement and intentions to adopt

It is expected that consumer engagement will predict intentions to adopt smart home technology. Consumers often imagine their experiences with products and services prior to their purchase or use. As a result, when consumers imagine positive consumer engagement experiences with smart home technology this should increase their likelihood to adopt the technology. Most scholars posit a causal direction of consumer engagement on desired marketing outcomes (recall Table 2). For example, the findings of Brodie et al. (2013) demonstrate that consumer engagement sub-processes can lead to improving outcomes, such as satisfaction, loyalty, empowerment and connection/emotional bonds. Further, Hollebeek et al.'s (2014) study demonstrates that consumer–brand engagement dimensions (cognitive, affective/affection and behavioural/activation aspects) can have a positive influence on self–brand connection and brand usage intention. Islam et al.'s (2018) findings lend additional support, showing consumer engagement to be a significant predictor of brand loyalty in online brand communities. Other studies also provide strong evidence of the ability for consumer engagement to predict loyalty or behavioural intentions (Dessart et al., 2015; Leckie et al., 2016; So, King, & Sparks, 2014). In the setting of our study, we therefore predict that when consumers' imagined engagement with smart home technology positively increases, this will lead to a rise in their intentions to adopt the technology. Hence, based upon the prior evidence in the literature, we expect consumers' imagined engagement with smart home technology will have a positive impact on their intentions to adopt, stated formally as:

H7: Consumer engagement will have a positive direct effect on intentions to adopt smart home technology.

Method

Data collection and sample

An online survey was chosen as the data collection instrument, which was hosted on Qualtrics (a software for collecting data). The data were collected in January 2019 from Australian consumers. A market research company was employed to collect data from its panel, along with guidelines to ensure the sample was kept as representative as possible. Prior to filling out the survey, participants were provided a description of smart home technologies and examples of common products in the marketplace, such as Google Home and Amazon Echo (see Appendix A for the full description). Based upon the smart home technology description provided, participants were provided a smart home technology check question ('which statement below best describes smart home technologies?'). This required participants to select the correct response: 'Electronic appliances connected and wired to a central computer system that allows automation'. If participants did not correctly answer this question, they were screened out of the survey as they were not deemed to have a thorough enough understanding and/or have an alternative personal definition of smart technology that differed from the smart technologies under investigation in this study. The final sample consisted of data from 445 consumers who did not currently own smart home technology. The sample profiles are shown in Table 3. The sample shows reasonably good representation for gender, age and education. For age, 24.5% identified as being aged 21–29 (compared to the national average of 17.8%) and 22% as 30–39 (compared to the national average of 18.9%) (Australian Bureau of Statistics [ABS], 2017). Regarding gender, 45.6% of the sample identified as male, which is comparable to the national average of 49.62% (ABS, 2017). In the sample, 52.4% identified as having finished a university degree, which closely resembles the national average of 50%. A total of 35.3% identified as being full-time employed (compared to the national average of 41%) and 18.4% identified as working part-time (compared to the national average of 18%) (ABS, 2017).

Table 3. Respondent characteristics (%).

Sample Characteristic	%
Gender	
Male	45.6
Female	54.4
Employment	
Full-time	35.3
Part-time	18.4
Casual	5.8
Student	5.2
Retired	16.0
Other	19.3
Age	
18–20	7.0
21–29	24.5
30–39	22.0
40–49	13.7
50–59	14.2
60+	18.7
Education	
Primary school	1.3
High school	34.6
University/Technical college	52.4
Postgraduate	11.7
Household role	
Mum	21.1
Dad	16.9
Housemate	7.6
Grandparent	2.2
Partner	24.5
Adult child	16.2
Other	11.5

Instrument development

All scale items were based on previous studies and measured via five-point scales (strongly agree–strongly disagree). For the TRI, we used the shortened version of the scale (TRI 2.0; Parasuraman & Colby, 2015) to measure general perceptions of technology, which has been validated in previous studies (Hallikainen, Alamäki, & Laukkanen, 2018). For consumer engagement we slightly modified Hollebeek and colleagues' (2014) scale to match the context of this study. We measured trust through three items adopted from Lacey's (2007) study, which have been shown to be reliable, valid and useful when applied to recent advancements in technological innovations (Ramadan, Farah, & Kassab, 2019). Risk was measured using three factors – security (six items), financial (three items) and performance (three items) from Hubert et al.'s (2017) scale – which were originally adapted from Kleijnen, de Ruyter and Wetzel's (2007) study. Intentions to adopt smart home technology was adapted from Balaji and Roy's (2017) three-item scale, which has also been shown to be a reliable measure. We used five-point Likert scales for TRI, trust, risk and intentions to adopt (1=strongly disagree, 5=strongly agree) and five-point slider scales for consumer engagement (1=strongly disagree, 5=strongly agree).

Control variables

To reduce the potential for other variables and theoretical explanations to impact upon our results, we controlled for variables pertaining to participants' characteristics, such as age, sex, education and income, as well as other theoretical constructs (ease of use and perceived usefulness) which could have a confounding effect on the relationships in our model. As a result, our sample becomes more homogenous, meaning any relationships which would differ based upon these different sample characteristics (e.g. age) have been controlled for, subsequently improving the estimation of our hypothesised relationships and ability to provide more generalised findings. The decision to include these variables, particularly those of ease of use and perceived usefulness, was based upon prior technology adoption literature (for a comprehensive overview see Blut, Wang, & Schoefer, 2016) and our research aim of focusing on psychological traits rather than utilitarian attributes (ease of use and perceived usefulness) focused on the technology itself. For instance, as suggested in prior studies, we controlled for perceived ease of use (Gray & Durcikova, 2005; Sun, Wang, Shen, & Zhang, 2015) and perceived usefulness (Chang & Cheng, 2014; Maruping & Mangi, 2012). We measured perceived of use and perceived usefulness with four items, each adapted from Pavlou (2003). Additionally, scholars have argued that characteristics such as age and income can affect technology adoption (see Porter & Donthu, 2006). Therefore, we deemed it important to control for these variables in our model (see Appendix B). We controlled for these factors by regressing them onto risk, trust, consumer engagement and intentions to adopt.

Common method bias

To assess the potential for common method bias to influence the results, we applied two tests as per prior studies (Hubert et al., 2018). First, we applied Harman's single-factor test. The results revealed that a single factor only explains 29% of the overall variance, which is well below the recommended threshold of 50%. We also conducted the marker variable test (Lindell & Whitney, 2001). As the marker variable did not significantly relate to any of the variables, this indicates common method bias did not have a substantial impact. Further, as suggested by Podsakoff, MacKenzie, Lee and Podsakoff (2003), we tried to minimise potential common method bias when designing the study, for instance, by varying scale endpoints and response formats, and reassuring respondents of their anonymity. Therefore, the tests conducted provide some evidence that common method bias has no influence on the results.

Results

Instrument validation

Prior to hypotheses testing, the constructs were assessed for convergent and discriminant validity via confirmatory factor analysis (CFA) using AMOS 24.0 software. We first checked the measurement model, with the results indicating a reasonably good fit (CMIN/DF=2.04; CFI=.93; RMSEA=.04; SRMR=.06) according to the recommended thresholds in the literature. For example, the RMSEA of .04 is below the threshold of .06 (Iaccobucci, 2009).

Following Fornell and Larcker's (1981) recommended procedures, convergent validity was examined by confirming the significance of the t-values associated with the items' parameter estimates. Table 4 confirms the reliability of the measures, with the composite reliability index scores for each construct being above the recommended threshold of .60 (Bagozzi & Yi, 1988) and the average variance explained (AVE) scores being higher than the recommended level of .50 for all constructs (Bagozzi & Yi, 1988). Discriminant validity was verified by comparing the AVE of each construct to the shared variance between the construct and all other variables, as shown in Table 5 (Fornell & Larcker, 1981). For example, the highest shared variance which was between consumer engagement and behavioural intentions (.59), was well below the associated AVE scores being .84 and .86 respectively. Thus, from the results it can be confirmed that all constructs were measuring different constructs.

Table 4. Construct measurement summary.

Construct	Factor	AVE	CR
Innovativeness		.67	.86
Other people come to my household for advice on new technologies	.74		
In general, my household is among the first in our circle of friends to acquire new technology when it appears	.90		
My household keeps up with the latest technological developments in my household's areas of interest	.81		
Optimism		.66	.88
New technologies contribute to a better quality of life	.77		
Technology gives my household more freedom and mobility	.84		
Technology gives people more control over their daily lives	.82		
Technology makes my household more productive in our personal lives	.81		
Insecurity		.60	.82
People are too dependent on technology to do things for themselves	.68		
Too much technology distracts people to a point that is harmful	.84		
Technology lowers the quality of relationships by reducing personal interaction	.79		
Discomfort		.54	.83
When my household gets technical support from a provider, we sometimes feel that we are being taken advantage of by someone who knows more than we do	.67		
Technological support lines are not helpful because they don't explain things in terms my household understands	.79		
Sometimes, my household thinks that technology systems are not designed for use by ordinary people	.77		
There is no such thing as a manual for a high-tech product or service that's written in plain language	.71		
Risk (Second Order)		.65	.85
Financial risk	.78		
Performance risk	.86		
Security risk	.78		
Financial Risk (First Order)		.63	.85
If my household used smart home technology we would become concerned that the financial investment we would make would not be wise	.83		
If my household used smart home technology we would become concerned that we really would not get our money's worth	.85		
If my household used smart home technology we would become concerned that this could involve important financial losses	.73		
Performance Risk (First Order)		.65	.85
If my household used smart home technology we would become concerned about whether the smart home technology will really perform as well as it is supposed to	.78		
If my household used smart home technology we would become concerned about how really reliable the smart home technology will be for the level of benefits we were expecting	.81		
That the application will not provide the level of benefits we were expecting	.83		
Security Risk		.51	.86
If my household used smart home technology we would become concerned about the security of using the smart home technology not being adequate	.76		

Construct	Factor	AVE	CR
If my household used smart home technology we would become concerned that the private information my household provided using smart home technology will only reach the relevant persons and nobody else	.69		
If my household used smart home technology we would become concerned the information my household provided would not be manipulated by inappropriate parties	.66		
If my household used smart home technology we would become concerned that inappropriate parties may store the information my household provided	.77		
If my household used smart home technology we would become concerned that the information my household provided would not be exposed to inappropriate parties	.63		
If my household used smart home technology we would become concerned that the transmission of data over the smart home technology was unsafe	.77		
Trust		.74	.90
Smart home technology can be counted on to do what is right	.89		
Smart home technology has high integrity	.88.		
Smart home technology can be trusted completely	.82		
Consumer engagement (Second Order)		.84	.90
Activation	.90		
Affective	.95		
Cognitive	.90		
Activation (Single Order)		.65	.79
My household would spend a lot of time using smart home technology compared to other activities	.79		
Smart home technology would be one of the objects my household uses when attempting to complete a task	.82		
Affective (Single Order)		.74	.90
My household would feel very positive when using smart home technology	.87		
Using smart home technology would make my household happy	.84		
My household would feel proud to use smart home technology	.87		
Cognitive (Single Order)		.60	.82
Using new smart home technology would get my household to think about new technologies	.79		
We would think a lot about smart home technology when we are using it	.68		
Using smart home technology would stimulate our interest to learn more about new technologies	.84		
Intentions to Adopt		.86	.95
Given the chance, my household would use smart home technology in the future	.91		
My household's intentions are to use smart home technology in the near future	.93		
If my household could, we would like to continue using smart home technology in the future	.94		

AVE=average variance explained; CR=composite reliability

Table 5. Construct correlations, means, AVEs.

Construct	M	AVE	1	2	3	4	5	6	7	8
Optimism	3.71	.66	1	.22	.00	.01	.00	.22	.26	.22
Innovativeness	2.85	.67	.46**	1	.04	.00	.00	.22	.32	.33
Discomfort	3.02	.54	-.01	.21**	1	.22	.18	.01	.00	.00
Insecurity	3.54	.60	-.11*	.04	.48**	1	.26	.00	.00	.00
Risk	3.51	.65	-.00	.04	.43**	.52**	1	.00	.01	.00
Trust	3.13	.74	.47**	.47**	.14**	-.04	-.07	1	.36	.35
Engagement	3.23	.84	.51**	.57**	.05	-.08	-.11*	.60**	1	.59
Intent to adopt	3.56	.86	.47**	.58**	.05	-.07	-.09	.59**	.77**	1

**p<.01, *p<.05, AVE=Average variance explained; Scores shown in the top half of the matrix are squared correlation scores.

Hypotheses testing

After confirming the validity and reliability of our constructs, we then proceeded to test the structural model and hypotheses using 2000 bootstrapping samples. The fit statistics for the structural model all fell within acceptable ranges, as recommended by the literature (CMIN/DF=1.93, CFI=.93, RMSEA=.04, SRMR=.06). The model produced medium explanations (R^2) of trust, .53, and risk, .52, and substantial explanations of consumer engagement, .74, and intentions to adopt, .79. The hypotheses testing results are detailed in Table 6 and Figure 2.

Technology readiness motivators (optimism and innovativeness) H1–H2

The results show optimism did not have a direct effect on consumer engagement nor an indirect effect on intentions to adopt smart home technology, rejecting H1a and H1b. The results show optimism has a positive direct effect on trust (β=.18, p<.01) as predicted, supporting H1c. Optimism had an indirect effect on intentions to adopt via consumer engagement (β=.18, p<.01). Interestingly, the direction of the relationship was counter to what was proposed for the optimism and risk relationship (β=.17, p<.05), rejecting H1d. Innovativeness was found to positively impact engagement (β=.18, p<.01) and indirectly influence intentions to adopt (β=.06, p<.01), supporting H2a and H2b. Innovativeness was found to not significantly influence trust or risk, rejecting H2c and H2d.

Technology readiness detractors (discomfort and insecurity) H3–H4

The results show discomfort did not significantly directly influence consumer engagement or indirectly influence intentions to adopt, resulting in the rejection of H2a and H2b. The results show discomfort significantly influenced trust (β=.16, p<.01) but in the opposite direction to that proposed in H3b. Discomfort also significantly influenced risk (β=.40, p<.0001) as predicted, supporting H3c. H4a and H4b were not supported by the data. Insecurity significantly influenced trust (β-.13, $p<.01$) and risk (β=.43, $p<.0001$) in the directions predicted, hence supporting H4b and H4c.

Trust, risk and consumer engagement H5–H7

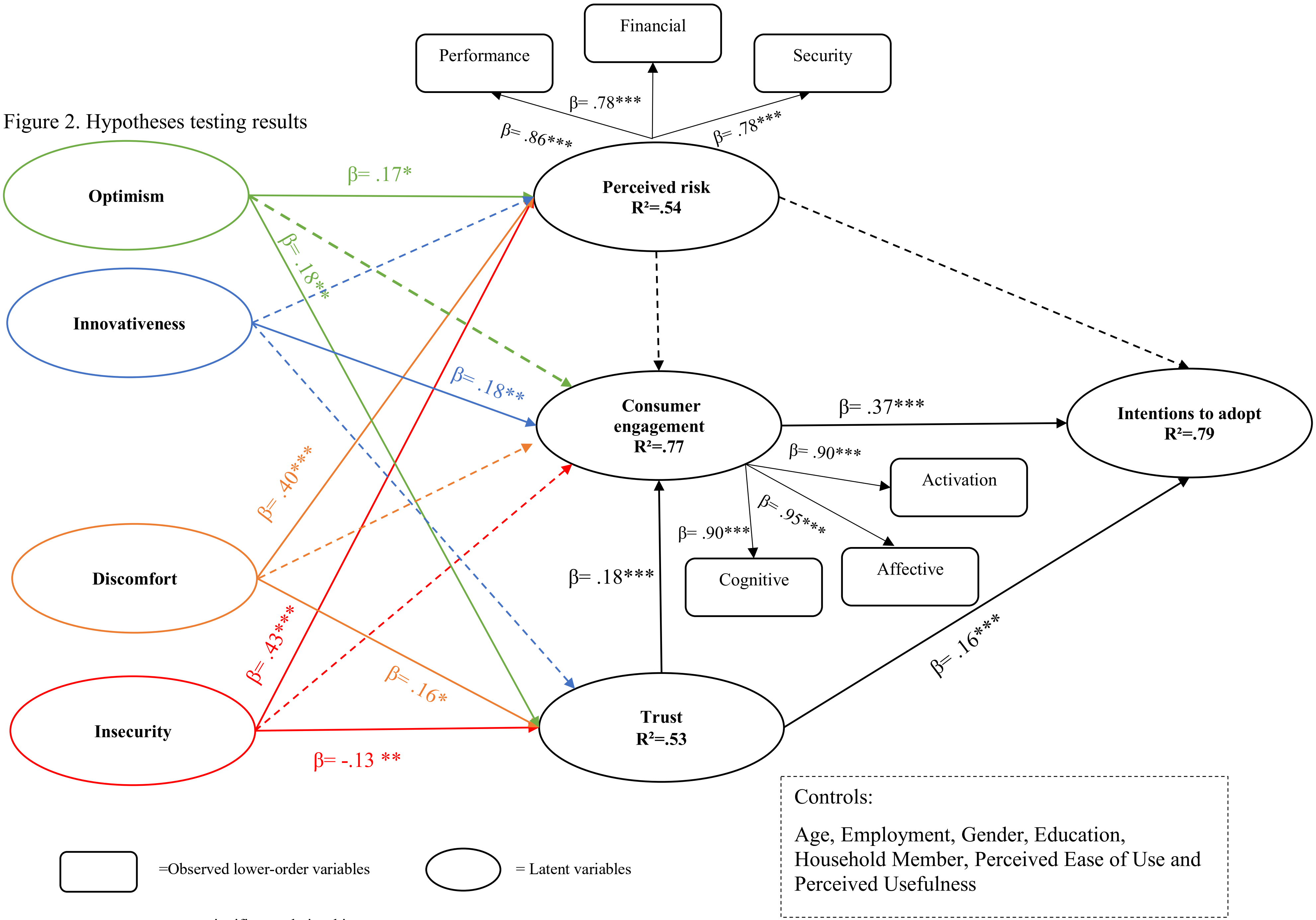
Trust was found to significantly impact consumer engagement (β=.18, $p<.0001$) and intentions to adopt (β=.16, $p<.0001$), supporting H5a and H5b. Risk did not influence consumer engagement or intentions to adopt, rejecting H6a and H6b. Consumer engagement (β=.37, $p<.0001$) significantly influenced intentions to adopt smart home technology, supporting H7.

Table 6. Hypotheses testing results

Relationships	β	Hyp No.
Technology Readiness Motivators		
Optimism→Engagement	.03ns	H1a
Optimism→Engagement→Intentions to Adopt	.01ns	H1b
Optimism→Trust	.18**	H1c
Optimism→Risk	.17*	H1d
Innovativeness→Engagement	.18**	H2a
Innovativeness→Engagement→Intentions to Adopt	.06**	H2b
Innovativeness→Trust	.05ns	H2c
Innovativeness→Risk	-.10ns	H2d
Technology Readiness Inhibitors		
Discomfort→Engagement	-.07ns	H3a
Discomfort→Engagement→Intentions to Adopt	-.02ns	H3b
Discomfort→Trust	.16**	H3c
Discomfort→Risk	.40***	H3d
Insecurity→Engagement	-.07ns	H4a
Insecurity →Engagement→Intentions to Adopt	-.02ns	H4b
Insecurity→Trust	-.13**	H4c
Insecurity→Risk	.43***	H4d
Trust, Risk and Engagement		
Trust→Engagement	.18***	H5a
Trust→Intentions to Adopt	.16***	H5b
Risk→Engagement	.02ns	H6a
Risk→Intentions to Adopt	.01ns	H6b
Engagement→Intentions to Adopt	.37***	H7
R^2 (Variance explained)		
Trust	.53	
Risk	.54	
Engagement	.77	
Intentions to Adopt	.79	

***p<.0001 **p<.01 *p<.05

Figure 2. Hypotheses testing results



Rival models

For thoroughness in our model testing we tested two competing models. First, we tested a model which deconstructed consumer engagement into its individual dimensions, as it could be argued that this is more theoretically appropriate (recall Table 2). The resulting fit statistics were inferior to that of the hypothesised model (see Table 7). For example, the chi-square was higher for the competing model, which indicates a superior fit for the originally hypothesised and tested model. Further, we also examined if there were significant differences between the two models by performing a chi-square difference test. The result was significant (χ^2=216.74 (*df*=21), *p*<.000), demonstrating that introducing the additional paths from the individual consumer engagement dimensions led to a significant decrement in model fit (Iacobucci, 2009).

These results offer strong support in favour of our theorising and testing of consumer engagement and provide support for a hierarchical approach. We additionally sought to test the TRI as a higher-order construct as per prior studies (recall Table 1). However, reliability and validity of the TRI as a higher-order construct did not meet the recommended thresholds in our study. Further, the model fit indices were slightly inferior than those of our originally theorised model. In short, we believe that our model serves well for the current study in comparison to other potential models.

Table 7. Model comparison.

	Hypothesised Model	Lower-order Engagement	Higher-order TRI
Chi-square (*df*)	1745.47(901)	1954.21(878)	1998.85 (928)
CMIN/DF	1.93	2.23	2.28
CFI	.93	.91	.90
RMSEA	.06	.05	.05
SRMR	.06	.06	.06
R^2 Intentions to Adopt	.74	.72	.74
Model Chi-square difference	N/A	216.74***(21)	253.38***(27)

As perceived ease of use and perceived usefulness are known to be significant predictors that explain large amounts of variance in technology adoption models, we also tested a model which excluded these factors to understand the level of impact these two constructs were having on the high R^2 scores in our model. When not controlling for perceived ease of use and usefulness, the model produced an R^2 of .64 (in comparison to .74) for consumer engagement (an increase of .10) and .77 (in comparison to .79) for intentions to adopt smart home technology (an increase of .02). It can therefore be determined that while these factors do improve the predictability of constructs within the model, the hypothesised relationships explain the largest amount of variance within the model. This testing further demonstrates the strength of our theorisation in the model and that the constructs of TRI, trust, risk and consumer engagement explain the majority of variance for intentions to adopt rather than alternative controls of ease of use and perceived usefulness.

Discussion

Marketing scholars have contributed to the literature on technology readiness (e.g. Roy et al., 2018), consumer engagement (e.g. Hollebeek et al., 2014), and trust and risk (e.g. Pappas, 2016), yet little work combines these areas to explain how consumers think, feel and act when it comes to their intended adoption of smart home technologies, nor how motivators and detractors may influence this relationship – allowing marketing practitioners to ease consumer concerns and encourage smart home technology adoption. Prior studies have attempted to provide an understanding of consumers' perceptions of smart home technology. For example, Yang et al.'s (2017) model explained 64% of the variance in intentions to use smart home services using the TPB. In another study by Hubert et al. (2018), the proposed model explained 65% of the variance using a combination of the TAM and innovation diffusion theory. This research takes a significant step forward, with the model in the current study explaining 74% of the variance for intentions for smart home technology adoption, which begins to address calls for research in this area (Marikyan et al., 2019). Further, the model explained 77% of the variance for consumer engagement, which is above prior studies such as that by Islam et al. (2018), which explained only 51%. The strong R^2 measurements suggest that our model is excellent at assessing the variance of intentions to adopt and consumers' perceptions of their future engagement with smart home technology, which lends considerable support for our theorisation.

The non-significant influence of risk in our model is somewhat consistent with prior research. For example, Sanguinetti et al.'s (2017) findings suggest that consumers are less concerned with risk and more focused on benefits such as bill/energy savings, security and comfort, which is in line with the results of the current study. There were also two interesting results which were counter to what we hypothesised. Specifically, the optimism–risk relationship and the discomfort–trust relationship were both significantly positive rather than negative. A deeper investigation of the TRI literature uncovers that such results are not necessarily unusual, with studies such as Son and Han (2011) and Mady (2011) also reporting dimensions having impacts on outcomes in the opposite direction to what would be expected. One potential explanation for these results can be drawn from the comparison between consumers' perceptions of general technology, which were measured by the TRI in the current study, and opinions of smart technology, which were captured by risk and trust. The finding of the optimism–risk negative relationship may suggest that consumers who feel a sense of optimism about the use of more generalised, commonly accepted technologies around the home, perceive a greater risk with smart technologies due to the transfer of control to the technology. Whereas, for the discomfort–trust negative relationship, it could be suggested that a potential explanation for this relationship is that consumers who dislike (feel discomfort) using technology due to complex interactions are more willing to trust smart technology to undertake these tasks and the burden.

Theoretical implications

Our model contributes to the smart home technology literature in several ways. First, to the best of our knowledge, this study is one of the first to theorise and provide empirical evidence for propositions about the role of consumers' perceptions of general technology (TRI) and the pathways by which these perceptions impact on smart home technology perceptions (trust, risk, and consumer engagement) and adoption. Several studies have explored smart home technology adoption (Yang et al., 2017; Hubert et al., 2018), yet few have theorised or explored how perceptions of general technology affect adoption of new types of technology, such as smart home technology. By theorising a model which incorporates both consumers' broader perceptions of technology and specific perceptions of smart home technology, we are able to delineate how perceptions are related to adoption intentions in this context. Our findings specifically show that the TRI of general technology directly influences trust in and risk of smart home technology, directly and indirectly influences consumer engagement and indirectly influences intentions to adopt smart home technology, and this pattern of relationships depends upon the TRI dimension of focus. The theorised and empirically supported approach of our model's use of general perceptions of technology and its impact on specific thoughts and feelings relating to smart home technology provides potentially important direction and considerations for scholars creating models or frameworks to understand technology adoption, as it contrasts with prior approaches which often consider only one form of technology and not consumers' past or general perceptions of that product category.

Another contribution of this study lies in supporting the validity, generalisability and applicability of the refined TRI 2.0 (Parasuraman & Colby, 2015). Further, we contribute by identifying nuances regarding the TRI dimensions and smart home technology perceptions, which we will now detail. Our findings provide understanding of how feelings of trust manifest via consumers' optimism regarding how technology can enhance their lives. We also demonstrate that a key motivation for consumers imagining their future engagement with smart home technology is their levels of innovativeness. In regard to the technology readiness inhibitors, we show that both insecurity and discomfort are key to driving perceptions of risk with smart home technology. These nuanced insights provide new understanding of the influence of motivating (optimism and innovativeness) and inhibiting (discomfort and insecurity) factors of the TRI beyond their impact on technology acceptance factors, such as perceived ease of use and perceived usefulness, as per prior studies (e.g. Roy et al., 2018; Walczuch, Lemmink, & Streukens, 2007). These insights have important implications for marketing scholars, suggesting an alternative approach using psychological traits relating to general technology to understand smart home technology adoption beyond those that have predominately focused on the utilitarian attributes such as in the TAM.

Another key contribution of this study is the rigorous testing of consumer engagement in a setting beyond online brand communities (Dessart et al., 2016; Hollebeek et al., 2014). Through the lens of the imagined service experience (Jaakkola et al., 2015; Letheren et al., 2019) we suggested and confirmed that consumers could envision their future engagement with smart home technology and that this would be able to predict intentions to adopt. This finding lends support to recent theoretical discussions linking consumer engagement and co-creation (Hollebeek, Srivastava, & Chen, 2019). It is within this space between consumer engagement and co-creation that imagined experiences can fall (Jaakkola et al., 2015). We also find new antecedents to engagement and adoption: perceived risk and the innovativeness dimension of TRI, as suggested by Islam et al. (2018). Our findings also reinforce the theoretical importance of consumer engagement, not only as a framework for explaining current marketplace behaviours but also for attempting to capture and predict future phenomena from the consumer's perspective.

A third contribution is our conceptual model and results, which integrate two schools of thought relating to the measurement and modelling of TRI and consumer engagement. Some studies have shown that TRI and consumer engagement can be measured and modelled as a multidimensional hierarchical construct (i.e., measuring their cumulative effect), whereas other studies have argued they should be modelled as a single-order multidimensional construct (i.e., examining the individual effects of each dimension) (recall Tables 1 and 2). This lack of agreement, identified in the technology readiness and consumer engagement literature, led us to investigate these frameworks' structures, as well as rival models, in our study. Our research does not support modelling the TRI as a multidimensional hierarchical construct. Instead, our findings suggest caution with the generalisability of this approach. With regards to consumer engagement, our results in comparing the models shown in Table 7 suggest there is some flexibility regarding its modelling in conceptual frameworks. Our results provide evidence that consumer engagement can be tested as a hierarchical construct (as shown in Table 4 and Figure 2), with all the paths of all the consumer engagement dimensions (cognitive, affective and activation) confirmed, and the cumulative second-order construct shown to predict outcomes, namely intentions to adopt smart home technology. Our study therefore begins to consolidate thinking and provides direction to discussions surrounding technology readiness and consumer engagement regarding how they are modelled in future conceptual frameworks examining emerging technologies.

Managerial implications

Industry reports expect that close to 20% of households will adopt smart home technology by 2023 (Statista, 2018a, 2018b). In view of these small but growing numbers, this research has several important implications which will assist practitioners and marketers in encouraging greater adoption of smart home technology.

From our findings, we suggest that marketers of smart home technology should focus on consumers' technology readiness and customise their strategies based upon their dominant traits. For the technology readiness inhibitors, our results suggest that smart home technology developers should think of ways to design and market their technologies to minimise feelings of discomfort and insecurity. We suggest that potentially anthropomorphising smart home technology could be used to minimise discomfort and insecurity, as giving the technology more humanistic characteristics has been shown to increase trust (Touré-Tillery & McGill, 2015). Smart technology companies are beginning to incorporate such practices to combat consumers' insecurity and discomfort with technology through branding of products; for instance, Alexa (personal AI assistant for Amazon smart technology) and Siri (personal AI assistant for Apple smart technology) both have humanistic names and voices. Further steps could also be taken to anthropomorphise through product design of smart technologies. This could be undertaken by designing smart home technology to emulate human or even animal shapes or figures such as hands, faces or humanised characters, in a similar approach to those undertaken in baby monitors which adopt baby animal features to soften their hard design and reassure.

Our results also have important implications for how marketers frame messaging relating to trust and risk of smart home technology. The results demonstrate that trust is a more significant factor for consumers. While it could be argued that these are two sides (trust vs risk) of the same coin, this does suggest practitioners should match their marketing messaging more so around a framing of trust rather than perceived risk minimisation. This could include messages leveraging aspects such as guarantees (e.g. the product/brand guarantees satisfaction), the product having demonstrated reliability, and meeting expectations of users – all characteristics which are noted for building and improving trust (Delgado-Ballester, 2004).

Managerial benefits may accrue from the perspective taken in regard to consumer engagement from this study. In today's marketplace of rapidly increasing innovations of smart technology, marketers are challenged to communicate and express the complex and new benefits of the goods and services they are offering, and consumers to imagine the benefits they provide. Companies such as IKEA demonstrate an understanding of this complexity in their marketing, using phrases such as '*imagine sitting back in your sofa, dimming on the lights and turning on your favourite music…When you're creating the home you dream of, smart products put possibilities at your fingertips*' (IKEA, 2019), and our results provide support for designing marketing communications that encourage consumers to imagine their engagement with new technologies. Simulated scenarios and sequences in advertising which allow consumers to imagine their use of smart home technology are also strategies supported by our data. As evidenced in advertisements such as those by Google for their Google Home smart technology ('Hey Google! Call that sandwich shop on Pearce street!', see https://www.youtube.com/watch?v=psr8tUqqCC0), smart home technology should be marketed in such a way that consumers can imagine specific tasks which can be accomplished. Other innovative ways marketers could allow consumers to imagine the possibilities of engaging with smart home technology could be using augmented and virtual reality technology. For instance, consumers could undertake an augmented or virtual reality tour through a home (or version of their current home) which has been set up with a range of smart home technologies to facilitate this imagination.

Limitations and future directions

While this research has some strengths, such as the model's strong predictive power and testing for rival model structures, there are also limitations which should be acknowledged. First, this study was cross-sectional in nature, only measuring consumers' perceptions of smart technology at one point in time. As shown in previous studies (e.g. Sanguinetti, Karlin, Ford, Salmon, & Drombrovski, 2018; Karlin, Sanguinetti, & Ford, 2018), consumers often go through stages of adoption. It would therefore be a useful extension of the current findings to understand how the relationships examined in this study may change, for example strengthen or weaken, based on different stages of the consumer adoption process.

Second, while the measurement of consumer engagement which was adapted from Hollebeek et al. (2014) demonstrated high reliability and validity in this study, there is a need for future research to develop consumer engagement scales which specifically focus on technology and technology use. As identified in the literature review, most scales and empirical investigations of consumer engagement are situated in brands and online community settings. It is therefore important that future research develop measures specifically for consumer engagement with technology use to ensure that each aspect of consumers' interactions with technology are adequately captured. This is important given the increasing interest in smart technologies, augmented reality and virtual reality.

Overall, this study contributes new insight into the growing area of smart home technology, providing an important foundation for practice as well as for future research into this fruitful area.

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Appendix A

Participant smart home technology description

Smart home technologies are electronic appliances which are connected and wired to a central computer control system that allows them to be automatically switched on and off at certain times (e.g. air conditioning or cooling set automatically for 3.00pm or lights to come on at 6.00pm).

Examples of current smart home technologies include Google Home, Apple HomePod, Amazon Echo, mobile home apps, smart lights, smart TVs and fridges, and home automation. We are interested in your attitudes towards these types of smart home technologies.

Appendix B

Table A.1 Impact of controls.

Controls	β
Gender→Trust	-.02ns
Gender→Risk	-.05ns
Gender→Engagement	.04ns
Gender→Intentions to Adopt	-.05ns
Employment→Trust	.01ns
Employment→Risk	.05ns
Employment→Engagement	-.02ns
Employment→Intentions to Adopt	.04ns
Age→Trust	.01ns
Age→Risk	-.07ns
Age→Engagement	-.01ns
Age→Intentions to Adopt	-.06ns
Education→Trust	-.05ns
Education→Risk	.07ns
Education→Engagement	.03ns
Education→Intentions to Adopt	.02ns
Household member→Trust	.07ns
Household member→Risk	.01ns
Household member→Engagement	.00
Household member→Intentions to Adopt	-.04ns
Perceived Usefulness→Trust	.42***
Perceived Usefulness→Risk	-.22**
Perceived Usefulness→Engagement	.65***
Perceived Usefulness→Intentions to Adopt	.42***
Ease of Use→Trust	.16*
Ease of Use→Risk	.10ns
Ease of Use→Intentions to Adopt	.07*
Ease of Use→Engagement	-.13*

***p<.0001 **p<.01 *p<.05 ns=non-significant