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Consumers' intentions to purchase smart home objects: Do environmental issues matter?

Abstract

The literature that investigates consumers' motivations to adopt smart home objects has focused on the ego-centric, utilitarian, and functional benefits that smart home objects may provide to consumers. Although smart home objects have also been acknowledged to promote environmental sustainability, investigation of the influence of altruistic and ecological motivational variables on consumers' willingness to purchase these products has been limited. This study presents a conceptual model that considers three relevant altruistic, ecological antecedents of eco-friendly product adoption (environmental beliefs, environmental concern, and smart home objects' perceived usefulness for the environment) and assesses their influence on the intention to purchase smart home objects. Furthermore, it uncovers the moderating role of the two dimensions of materialism (success and happiness) and hypothesizes that they moderate the relationship between environmental concern and intentions to purchase smart home objects. Structural equation modeling is applied to data from a sample of 641 French respondents. The results confirm that altruistic, ecological variables do matter in developing intentions to purchase smart home objects. Environmental concern and perceived usefulness positively affect consumers' intentions to purchase smart home objects. Furthermore, both happiness and success negatively moderate the effect of environmental concern on consumers' intentions to purchase smart home objects.

Keywords: smart home objects; eco-friendly products, environmental concern; materialism; purchase intentions

1. Introduction

Smart homes can be defined as residences equipped with a high-tech network linking sensors and domestic devices, appliances, and features that can be remotely monitored, accessed or controlled and that provide services responding to the needs of the inhabitants (De Silva et al., 2012; Balta-Ozkan et al., 2014). Smart home objects can replace existing products (e.g., connected windows or taps) or come in addition to existing ones (e.g., sensors). Self-learning thermostats (e.g., Nest Learning Thermostat) and security systems (e.g., Arlo Pro by Netgear Security System), smart water controllers (e.g., Eve Aqua), connected body fat bathroom scales (e.g., Fitbit Aria 2), and smart speakers (e.g., Amazon Echo) are all examples of smart home objects.

The market for smart home objects is growing significantly (Khedekar et al., 2017). Forecasts indicate the global smart home market to grow to approximately 40.90 billion U.S. dollars by 2020; revenue in the smart home market amounted to 48.71 million U.S. dollars in 2018. Revenue is expected to show an annual growth rate (CAGR 2018-2022) of 25.8%, resulting in a market volume of 121.96 million U.S. dollars by 2022. Household penetration is 7.5% in 2018 and is expected to hit 19.5% by 2022 (Statista, 2017).

Along with companies' increasing investments into the smart home sector, the academic community has intensified its efforts in examining the concept of smart home objects, the perceptions of consumers about smart home objects, and the motives for adopting these solutions (for a review, see De Silva et al. 2012 and Marikyan et al., 2018). As for the latter, scholars have focused on the ego-centric, utilitarian, and functional benefits that smart home objects may offer to users, such as the financial benefits (i.e., cost savings) and well-being benefits (e.g., security, surveillance, and comfort) (Rijsdijk and Hultink, 2009; Balta-Ozkan et al., 2014; Park and Lee, 2014). Similarly, companies launching smart home objects have mainly advertised these items with ego-centric and functional appeals and showed how

smart home objects may satisfy consumers' needs for comfort, assistance, well-being, convenience, security, surveillance, and entertainment (Liobikienė et al., 2016; De Silva et al. 2012; Marikyan et al., 2018).

However, and importantly, numerous smart home objects do not only offer ego-centric, utilitarian, and functional benefits to users; they also promote environmental sustainability (Dangelico and Pontrandolfo, 2010; Marikyan et al., 2018). Connected lighting and heating and smart windows can reduce consumers' energy consumption. Plant, sensors, and sprinkler sensors can minimize water usage. By helping consumers track and control their resource consumption, smart home objects enable users to achieve an effective use of resources; they are therefore facilitators in reducing environmental harm (Technavio, 2016). This reduced environmental harm leads to environmentally friendly smart home objects and to the designation of these products as "eco-friendly smart home objects" (ESHO).

ESHO environmental benefits have relevant implications for consumers, policy makers, and companies. As for consumers and policy makers, recent data from the European Commission (2017) suggest that 94% of Europeans believe that protecting the environment is important, with climate change (51%), air pollution (46%), and shortage of drinking water (30%) as some of the most important environmental issues. Eighty-seven percent of Europeans believe that individual consumption plays a significant role in protecting the environment, and 35% believe that investing in research and development to find technological solutions is one of the most effective measures in addressing environmental problems. Along these lines, ESHO may represent one of the technological and innovative measures helping consumers to easily reduce their individual environmental impact, especially for their energy and water household usage.

As for companies, gaining more insights on whether consumers perceive smart home objects to be eco-friendly products and, if so, developing more knowledge on consumers'

perceptions about ESHO makes it possible to better understand the factors underpinning the promotion of ESHO in the mainstream market (Dangelico and Pontrandolfo, 2010). Moreover, studying the effectiveness of pro-environmental motivations that may stimulate consumers to purchase ESHO provides opportunities for companies to change (or enrich) ESHO's bundle of attributes to positioning these products more effectively (e.g., by using both ego-centric and altruistic/pro-environmental motivational leverages) (Dawid et al., 2017; Faucheux and Nicolaï 2011).

Despite this relevance, only a limited number of studies (e.g., Reinisch et al., 2011; Paetz et al., 2012) have conceptualized smart home objects as eco-friendly products (ESHO), and the investigation of consumers' willingness to purchase ESHO has been pursued to a very limited extent. Furthermore, none of the previous studies investigating consumer willingness to purchase ESHO has explicitly assessed whether, and to what extent, altruistic and pro-environmental motives – which are typical, relevant antecedents of eco-friendly product adoption (Bamberg, 2003; Bamberg and Möser, 2007; Jansson et al., 2011; Stern, 2000) – may also motivate consumers to purchase ESHO.

The current study addresses these issues. It aims to provide a better understanding of consumers' purchase intentions of ESHO. Specifically, this study aims to understand whether, and to what extent, altruistic, pro-environmental motives of environmental beliefs, environmental concern, and smart home objects' perceived usefulness for the environment may significantly motivate consumers to purchase ESHO. Furthermore, it aims to understand whether the altruistic and ecological motives that may influence consumers' ESHO purchase intentions may also vary across different consumers with diverse degrees of materialistic orientations. Therefore, the current study aims to respond to the following unanswered research questions: How do environmental concern and the perceived usefulness of the ESHO for the environment affect consumers' purchase intentions of ESHO? How does materialism

moderate the relation between consumers' environmental concern and their ESHO purchase intentions?

To answer the research questions mentioned above, the remainder of this paper is structured as follows. The next section offers a theoretical foundation for the altruistic, pro-environmental motives of ESHO purchase intentions and discusses the conceptual development of the proposed model and the hypotheses for the study. The third section presents the methodology, and the fourth section presents the results. In the last section, the results of the empirical study are discussed, practical implications are developed, and guidelines for future research are provided.

2. Literature review, theoretical framework and hypotheses development

Previous studies have identified a number of important altruistic and pro-environmental motivational drivers to purchase and adopt eco-friendly products (for a review see Bamberg and Möser, 2007) or green technologies (Jansson, 2011; Jansson et al., 2011). Among other factors, altruistic and biospheric values and beliefs (Barbarossa et al., 2017), environmental concern and knowledge (Wicker and Becken, 2013; Newton et al., 2015; Nauges and Wheeler, 2017), and perceived consumer effectiveness (Yadav and Pathak, 2017) have received particular attention for well-established eco-friendly products. However, ESHO are material, technological objects. As such, questions about materialism and technology acceptance are raised. To the best of our knowledge, no study has simultaneously examined the influence of altruistic and pro-environmental motivational variables alongside the influence of materialism on consumers' purchase intentions of ESHO. Our conceptual model is therefore the first to combine these two paths.

The current study presents a conceptual model that considers three relevant altruistic antecedents of eco-friendly products' purchase intentions (i.e., environmental beliefs, environmental concern, perceived usefulness of the ESHO for the environment), and assesses how these factors affect the purchase intentions of a under-researched product category, i.e., ESHO. Furthermore, this study also uncovers the nuanced moderating role of the two dimensions of materialism, success and happiness, and it hypothesizes that both main facets of materialism moderate the relationship between environmental concern and ESHO purchase intentions. The proposed conceptual model is reported in Figure 1.

2.1. Environmental beliefs and environmental concern

The Value-Belief-Norm Theory (Stern, 2000) suggests that environmental beliefs influence environmental concern. Environmental beliefs refer to "the existence of environmental problems such as water shortages, ozone depletion, and global warming" (Kilbourne and Pickett, 2008, p. 887). They have been analyzed in the New Ecological Paradigm (Dunlap et al., 2000). This paradigm argues that the rise of environmentally responsible behaviors is linked to the growing acceptance that human actions have substantial adverse effects on a fragile biosphere. Environmental beliefs create a general predisposition toward environmental considerations (i.e., environmental concern). Environmental concern may refer to both a specific attitude directly determining intentions or more broadly to a general attitude or value orientation (Bamberg, 2003). Despite the existence of some attempts to measure environmental concern as an attitude toward a specific consumption action or object (e.g., concern over the negative environmental consequences of driving cars – Barbarossa et al., 2017), most research has conceptualized environmental concern as overall care for the preservation of the natural world and concern for the depletion of its resources (Bamberg, 2003; Moons et al., 2018).

Empirical evidence has widely corroborated the positive influence of environmental beliefs on environmental concern across a number of studies that investigated different pro-environmental behaviors, such as purchasing eco-friendly and organic products, joining or contributing money to environmental organizations, subscribing to environmental magazines, contacting a legislative policy maker (e.g., Kilbourne and Pickett, 2008; Stern, 2000; Stern et al., 1993), and saving energy for pro-environmental reasons (Gadenne et al., 2011). Along these lines, we hypothesize the following:

H1. Environmental beliefs have a positive effect on environmental concern

2.2. Environmental concern, perceived usefulness of the ESHO for the environment, and intentions to purchase ESHO

The Theory of Planned Behavior (Ajzen, 1991), when it is applied to environmentally responsible behaviors, assumes that consumers' intention to perform an environmentally responsible behavior (e.g., purchasing eco-friendly products) is determined, among other factors such as subjective norms and perceived behavioral control, by consumers' attitude toward an object (e.g., the degree to which protecting the environment is positively or negatively valued). In line with this theory, environmental concern is one of the most relevant predictors of green purchasing behavior (Bamberg, 2003; Wicker and Becken, 2013; Nauges and Wheeler, 2017) and purchase intentions (e.g. Koenig-Lewis et al., 2015; Newton et al., 2015). Consumers may purchase products based on the extent to which they care about the impact of current consumption lifestyles on the natural environment (Bamberg and Möser, 2007; Barbarossa et al., 2017). In line with the Theory of Planned Behavior, environmental psychology research has widely demonstrated the impact of environmental concern on the intention to adopt eco-friendly alternatives across different empirical contexts, such as purchasing green electricity or green-labeled energy brands (Hartmann and Apaolaza-Ibáñez,

2012), adopting eco-friendly energy policies, and accepting future changes in energy consumption (Wicker and Becken, 2013). With specific reference to green technologies and innovations, previous research has argued that environmental concern, among other factors, may determine consumers' willingness to adopt alternative fuel vehicles (Jansson, 2011; Jansson et al., 2011). This literature leads to hypothesize a direct, positive effect of environmental concern on consumers' intentions to purchase ESHO.

Furthermore, the plethora of technology adoption models (technology acceptance model [TAM] Davis et al., 1989; model of acceptance of technology in households, Brown and Venkatesh, 2005; unified theory of acceptance and use of technology, Venkatesh et al., 2012) predicts technology adoption and purchase intentions, mainly according to product characteristics. Such models have been applied successfully in various contexts, such as online consumption (Bruner and Kumar, 2005), advertising (Muk and Chung, 2015) or electronic commerce (Ko et al., 2009; Leppel and McCloskey, 2011). Overall, the Technology Acceptance model considers perceived usefulness as a key antecedent of usage intention. Perceived usefulness relates to the degree to which the consumer believes that the technology will facilitate a task completion. Environmental concern may also influence the intentions to purchase ESHO through the perceived usefulness of the ESHO for the environment, i.e., the extent to which consumers perceive that the adoption of ESHO may lead them to reduce their large footprint on the natural environment. When environmental concern increases, consumers may place more attention on, and value to a greater extent, the way in which ESHO contribute to saving natural resources. Similar to the concept of perceived consumer effectiveness for environmental issues (i.e., the extent to which individuals believe that their actions make a difference in solving an environmental problem – Ellen et al., 1991), perceived usefulness of ESHO for the environment is defined as the evaluation of smart home objects in the context of reducing one's ecological footprint, which differs from a general attitude

toward the environment (i.e., environmental concern). Individuals with a strong belief that smart home object usage will result in a positive outcome for the environment will be more likely to purchase these objects in support of their ecological concerns. Along these lines, we hypothesize that environmental concern influences consumers' willingness to purchase ESHO both directly and indirectly via the perceived usefulness of the ESHO for the environment. Hence, we hypothesize the following:

H2. Environmental concern has a positive effect on the intentions to purchase ESHO

H3. Environmental concern has a positive effect on the perceived usefulness of the ESHO for the environment

H4. Perceived usefulness of the ESHO for the environment has a positive effect on intentions to purchase ESHO

2.3. Moderating effect of materialism (happiness and success)

Previous research has extensively argued that materialism and environmentalism are in conflict (e.g., Hurst et al., 2013; Kilbourne and Pickett, 2008; Richins and Dawson, 1992). Richins and Dawson (1992) argue that materialists are unconcerned about the environment. Further, Hurst et al. (2013) in their meta-analysis show evidence of the negative association between materialism and pro-environmental behaviors. Therefore and in accordance with previous research, the present study addresses relevant question about the impact of materialism on purchasing ESHO.

Materialism "guides people's choices and conduct in a variety of situations, including but not limited to, consumption areas" (Richins and Dawson, 1992, p. 307). It generally comprises three dimensions (Rokeach, 1973): success (i.e., acquiring new objects grants people social success), centrality (i.e., importance of acquiring new objects), and happiness (i.e., acquiring new objects leads to happiness). However, Richins and Chaplin (2015) found

that centrality items correlate with the success and happiness subscales. They thus argue that centrality actually is an outcome of the success and happiness dimensions. Griffin, Babin, and Christensen (2004) have also indicated the lack of relevance of centrality in a French context.

Increased consumption by materialistic consumers has effects for climate change, natural resource scarcity, and environmental contamination. People who exhibit greater materialism tend to demonstrate lower levels of environmental concern (Kilbourne and Pickett, 2008; Segev et al., 2015), because the latter positively relates to altruistic values including biospherism but negatively relates to ego-centric values including materialism. Materialists express more concern for pleasure and a comfortable life than for the natural environment. As materialism prevails in Western societies, conflicts between materialism and environmentalism are often resolved in favor of materialism (Kilbourne and Pickett, 2008). For consumers exhibiting high levels of materialism, the relationship between environmental concern and purchase intentions may thus be weakened.

First, happiness is a dimension of materialism. Richins and Chaplin (2015) show that materialistic parents tend to purchase and offer more material objects when they believe that acquisition is important for happiness, despite any environmental harm. People who believe that the acquisition of material objects is important for their happiness will thus value material objects other than ESHO that are not directly related to environment preservation. Thus, for individuals scoring high in happiness, the effect of environmental concern on ESHO purchase intentions should be weaker.

Second, materialism guides the selection of possessions and behaviors. Highly materialistic consumers tend to judge success by the kinds of things they own (Richins and Chaplin, 2015) regardless of whether they relate to environmental issues. Success in life expressed through material objects is negatively associated with environmental concern (Segev et al., 2015). If people believe their success must be signaled through material,

conspicuous consumption, they might privilege the purchase of expensive, contaminating products, which likely lowers their ESHO purchase intentions. Thus, for individuals prioritizing success in life, the effect of environmental concern on ESHO purchase intentions should be weaker. Along these lines, we hypothesize the following:

H5. The happiness dimension of materialism negatively moderates the effect of environmental concern on ESHO purchase intentions

H6. The success dimension of materialism negatively moderates the effect of environmental concern on ESHO purchase intentions

The conceptual framework also includes several control variables related to consumer characteristics and perceived complexity. Despite the fact that sociodemographic variables have been found to have weak links with environmental concern (Diamantopoulos et al., 2003), demographic characteristics, including age, gender, and profession, tend to affect purchase intentions. Specifically, Choi and Johnson (2019) found that income, age, sex and education significantly affect customer purchase intention to purchase green products. However, Qureshi et al. (2009) found that income significantly influences customer purchase intentions in New Zealand, but not in North Ireland. Gender and education do not significantly affect purchase intentions in either countries. These conflicting results underline the importance to control for socio-demographic factors' effects in each context of investigation. Furthermore, the perceived complexity of ESHO may also influence related purchase intentions. In fact, prior studies showed that more complex environmental tools are less efficient in comparisons to tools with lower complexity (Dargin et al., 2019). Therefore, it is important to control the effects of technology perceived complexity on the outcome variable.

[Figure 1 about here]

3. Methodology

3.1. Context and data collection

The empirical study has been conducted in France, where the smart objects market is rapidly expanding, with sales increases of 230% reaching 500 million euros in 2016 (Xerfi, 2018). French consumers generally recognize the cost-savings (e.g., energy savings) associated with smart objects (LSA, 2016), and note the appeal of connected homes that feature, for example, smart thermostats (i.e., 68% of French consumers find smart thermostats very or quite appealing – DELTA, 2015). Furthermore, 95% of French citizens say that the protection of the environment is important to them. Seventy-six percent think that environmental issues directly affect their daily life, with climate change and air pollution being the most important environmental issues (53%). Additionally, French consumers state that they have recently made efforts to reduce their own energy consumption (56%) and water consumption (48%). For 39% of French consumers, reducing home energy consumption to protect the environment (i.e., lightening, heating, household appliances) represents a priority in their daily life (European Commission, 2014). French public policies also encourage environmentally friendly behaviors via monetary incentives, trainings and awareness campaigns (Tuot, 2007; European Commission, 2012). Thus, eco-friendly smart object producers encounter appealing opportunities in the French market.

This study uses an intercept survey. To ensure diversity in our sample, we ensured that interview respondents came from different backgrounds (e.g., city of residence, social class and occupation). We interviewed respondents in distinct French cities, varying from large cities such as Paris (2,200,000 inhabitants), medium cities such as Reims (200,000 inhabitants) to smaller cities such as Mons-en-Baroeul (21,000 inhabitants). We also

administered the questionnaire in diverse public places (e.g., malls, streets, street markets) to target real customers. The data collection took place in France during October 2016. The participants had to be at least 18 years of age to participate. Trained interviewers (the first author and twenty postgraduate students) administered the questionnaires face-to-face. Some informants were relatives or acquaintances of interviewers. However, a vast majority of participants were unknown passers-by during the data collection phase.

Ten minutes on average were required to complete the questionnaire. Most questionnaires were completed on site. Several participants did not want to answer the questionnaire in public places, which led to 10% of the questionnaires being collected at informants' homes or offices. Of the 641 respondents, 319 were men (49.8%) and 322 were women (50.2%). Their ages ranged between 18 and 86 years (M = 39 years, SD = 16), which reflects the French population. Furthermore, interviewers took special care to ensure sociodemographic diversity among informants. The sample comprised employees (30%), students (26.8%), executives (16%), retirees (12.2%), liberal professions (7.2%), and others (7.8%). The informants provided sufficient diversity. All relevant categories were represented in the sample.

3.2. Measurement instruments

The questionnaire relies on standard item scales in English. In line with Lertwannawit and Mandhachitara (2012), two professional translators first translated the item scales into French, then back-translated them into English. In any cases of mismatch, the researchers selected the item that best matched the original version. The questionnaire included latent constructs measured on five-point Likert scales (1 = "strongly disagree" to 5 = "strongly agree").

We took all the necessary steps to ensure a clear understanding and adaptability of the measurement tools. First, we paid particular attention to the influence of response styles on solid conclusions in research (Baumgartner and Steenkamp, 2001). Finally, we pretested the questionnaire with 15 French adult respondents to ensure questionnaire's understandability and fluency. No particular issue was raised.

Environmental beliefs were measured with seven items from Kilbourne and Pickett (2008). The measure of environmental concern employed eight items from Bamberg (2003), which were designed for a European context. This scale has the advantage of overcoming disappointing relationships between environmental concern and environmental behaviors. It has also been successfully used in prior research in the French context (Elgaaïed, 2012). For perceived usefulness of the ESHO for the environment, this study adapted three items from Van Ittersum and Feinberg (2010), which are well suited for innovations with functional benefits, instead of social or hedonic benefits. To measure ESHO purchase intentions, we used three items from Rodgers (2003) adapted to the specific context of eco-friendly smart objects. Materialism consisted of six items to measure happiness and success, derived from Kilbourne and Pickett (2008) and translated to the French context by Ladwein (2005). Finally, the questionnaire included conventional sociodemographic variables (gender, age, profession, complexity of technology use) as control variables. Table 1 contains all the measurement scales.

[Table 1 about here]

4. Analyses and results

4.1. Assessment of measurement model

Most of the constructs came from different contexts, so exploratory factor analyses (FA) with Varimax rotation (when needed) in SPSS 24 helped establish the initial structure of each scale. We ran an FA to confirm unidimensionality because the scales were not originally

created or tested in the local context. Different cultural contexts may affect scale stability (Steenkamp and Baumgartner, 1998). Thus, caution should be exercised in each cultural context through the use of FA. Because the concepts do not belong to the same domain, we ran separate FAs for each main construct (e.g., environmental beliefs, environmental concern, and purchase intention). Only materialism was an exception. As it comprises two dimensions (happiness and success) belonging to the same domain (multidimensional construct), we included them in one factor analysis in accordance with Gerbing and Anderson (1988).

All KMO values were greater than .70, the variance explained was greater than 50%, and all item loadings were greater than .70. Furthermore, the acceptable Cronbach's alpha values were as follows: environmental beliefs ($\alpha = .80$), environmental concern ($\alpha = .74$), perceived usefulness of the ESHO for the environment ($\alpha = .90$), ESHO purchase intentions ($\alpha = .69$), and materialism ($\alpha = .79$). Thus, the exploratory stage indicates sound scale properties.

A confirmatory factor analysis (maximum likelihood estimation) in AMOS 24 reveals the final structure of the measurement models, prior to the structural model testing (Gerbing and Anderson, 1988). The overall measurement model indices indicate satisfactory model fit ($\chi^2 = 219.9$, df = 104, $p < .01$; root mean square error of approximation [RMSEA] = .042; confirmatory fit index [CFI] = .97; Tucker-Lewis index [TLI] = .965; χ^2/df = 2.114). The constructs' internal consistency is adequate; the composite reliability (ρ) values are greater than the recommended cutoff (.70) (Hair et al., 2010). Table 2 also reveals the convergent validity of the constructs in that all loadings are significant at $p < .01$, and the average variance extracted (AVE) values (ρvc) exceed .50 (Fornell and Larcker, 1981). Because the AVE for each construct is also greater than the square of the interconstruct correlations, all constructs and dimensions fulfill the requirements for discriminant validity (Fornell and Larcker, 1981), as documented in detail in table 3.

[Table 2 about here]

[Table 3 about here]

The survey responses came from single key respondents, which requires a check for common method bias (Podsakoff et al., 2003). First, post hoc tests showed no evidence that a single factor accounted for all or most of the covariance among the variables. Second, in applying the marker variable technique (Malhotra et al., 2006), this study includes profession as a marker variable; it is unlikely to relate to any of the main constructs in the model (Diamantopoulos et al., 2003; Grunert and Kristensen, 1992). The differences between the original and corrected correlations are small and not significant ($\Delta r < .05$). Thus, common method bias does not appear to influence the parameter estimates.

4.2. Structural model and hypotheses test

To test the research hypotheses, we relied on AMOS 24, which supports assessments of one focal model (M1) and two alternative models (M2 and M3) as in Bajaj et al. (2016): the hypothesized partial mediation model (Model 1), a direct model (Model 2), and a full mediation model (Model 3). The hypothesized structural model (Model 1) shows a good fit to the data overall: $\chi^2 = 138.34$, df = 50, $p < .001$; RMSEA = .053; CFI = .97; TLI = .96; χ^2/df = 2.77. As recommended by Chin (1998), the predictors explain acceptable (moderate) amounts of variance in the dependent variable (purchase intentions) ($R^2 = .31$). A chi-square difference test with the no mediation model (Model 2) indicates the better fit of Model 1 ($\Delta\chi^2$(df) = 228.68 (1), $p < .01$). Furthermore, the comparison of the hypothesized Model 1 with the full mediation Model 3 indicates the superiority of the former (χ^2(df) = 19.53 (1), $p < .01$).

Table 4 summarizes the findings for the main effect relationships (H1–H4). The analyses establish the positive, strong effect of environmental beliefs on environmental

concern ($\gamma = .69$, $p < .01$), in support of H1. Furthermore, environmental concern enhances ESHO purchase intentions ($\gamma = .21$, $p < .01$), in line with the prediction in H2. However, no direct effect of environmental concern emerges for the perceived usefulness of the ESHO for the environment ($\gamma = .04$, $p > .05$), in contrast with H3. Finally, the perceived usefulness of the ESHO for the environment positively influences ESHO purchase intentions ($\gamma = .50$, $p < .01$), in support of H4.

[Table 4 about here]

To assess the moderating effects of materialism (happiness and success), we created latent moderators (interactions), following well-established approaches (Frazier et al., 2004). The moderator is continuous, so it is preferable to create latent moderation variables and retain their nature (MacCallum et al., 2002). Mean centering helped overcome potential multicollinearity issues that might arise from creating the interactions (West et al., 1996). Specifically, subtracting the sample means of the variables produced revised sample means of 0. The product terms multiply together the predictor and moderator variables, using the centered continuous variables (West et al., 1996).

The results summarized in Table 5 reveal that the moderation term between environmental concern and happiness is significant and negative ($\gamma = -.127$, $p < .05$), in support of H5. The moderation term between environmental concern and success is also significant and negative ($\gamma = -.164$, $p < .05$), as H6 predicted.

[Table 5 about here]

4.3. Robustness check and further analyses

To confirm the robustness of the results, a final check added each consumer characteristic (age, gender, profession) as control variables. As covariates in the model, these variables did not change the main results. A chi-square difference test indicates the better fit of Model 1: $\Delta\chi^2(df) = 484.04$ (73), $p < .01$. Age ($\gamma = -.078$; $p > .05$), gender ($\gamma = .038$; $p > .05$), and profession ($\gamma = -.036$; $p > .05$) did not affect ESHO purchase intentions, though perceived complexity had a negative effect ($\gamma = -.163$; $p < .05$).

5. Discussion and implications

5.1 General discussion and implications for theory

This study sought to understand how consumer environmental beliefs, environmental concern and the perceived usefulness of the ESHO for the environment may impact ESHO purchase intentions. Furthermore, this study shows how two dimensions of materialism, happiness and success, moderate the relationship between environmental concern and ESHO purchase intention. The results on a sample of 641 French adult consumers reveal that the hypothesized relationships are mainly supported.

First, environmental beliefs influence environmental concern. These results are in line with the Value-Belief-Norm Theory, and with well-established environmental psychology studies that found that the more people recognize environmental issues, the more they are concerned about the environment (Stern, 2000; Kilbourne and Pickett, 2008). They extend prior studies on environmental services and objects (Sauer and Fischer, 2010; Barbarossa et al., 2017), and specifically shed light on ESHO.

Second, and most importantly, consumer environmental concern has a significant direct effect on ESHO purchase intentions. This finding shows that consumers do recognize

smart home objects as eco-friendly solutions, although smart home objects have mainly been advertised for the ego-centric, utilitarian benefits that these innovative products may offer to consumers (e.g., money and time savings). Additionally, in line with the Theory of Planned Behavior, our results clearly show a positive and significant effect of consumers' environmental concern on their intention to purchase ESHO. The more consumers care for the natural environment, the more they will be willing to purchase ESHO. This is a relevant finding, especially considering the current theoretical debate – and the rather inconsistent empirical evidence – on whether measures of ecological concern, attitude, or care might be good predictors of pro-environmental behavioral intentions and actual pro-environmental behaviors. One the one hand, a number of studies have supported the notion of a significant and positive correlation between consumers' environmental attitudes, their pro-environmental purchase intentions and behaviors (e.g., Gadenne et al., 2011; Jansson et al., 2011; Kilbourne and Pickett, 2008; Wicker and Becken, 2013). On the other hand, other studies have pointed toward the existence of an environmental value-action gap, i.e., the notion that environmental values, beliefs, and attitudes do not automatically yield the respective pro-environmental behavior due to the presence of consumer-related variables (e.g., personal traits and orientations, consumers' justifications for not behaving pro-environmentally – Eckhardt et al., 2010) and company-related variables (e.g., skepticism toward a company's eco-friendly claims – Bray et al., 2011); this may make it less likely for consumers to translate their biospheric and altruistic values into pro-environmental behavioral intentions and behaviors (Yates, 2008; Wicker, 2018). Despite measuring self-reported purchase intentions rather than actual purchase behavior, the results of our study seem to support the first stream of research in the context of purchasing ESHO. Our results show that environmental concern is a rather strong predictor of pro-environmental behavioral intentions (i.e., ESHO purchase intentions),

especially for consumers who have lower materialistic orientations (see below for a detailed discussion of this point).

Third, in line with the Technology Acceptance Model and its derivatives, the results of the current study confirm the effect of perceived usefulness of the ESHO for the environment on ESHO purchase intention. However, environmental concern has no effect on perceived usefulness. Consumers perceive the usefulness of ESHO to reduce their footprint (e.g., energy and water use) regardless of their ecological concern. A possible explanation for this result is that the influence of environmental concern on perceived usefulness of the ESHO for the environment may be moderated by variables such as consumer familiarity with smart home objects or ESHO previous purchase experience, which have not been included in the current study. Consumer awareness about the specific environmental effects of using ESHO is highly situation- or issue-specific and could be indeed influenced by respondents' knowledge about a specific smart home object. This result warrants further investigation.

Finally, the results of the current study indicate a significant negative moderating effect of materialism in both of its dimensions on the relationship of environmental concern with ESHO purchase intention. The more consumers are driven by happiness and success in their everyday consumption choices, the weaker the path is from environmental concern to ESHO purchase intentions. As long as materialism is valued in Western societies, consumers appear likely to consume objects that embed materialistic, rather than altruistic or biospheric values, and to value high status objects unrelated to environmental preservation (Segev et al., 2015). For highly materialistic consumers, purchasing smart home objects that are associated with positive emotional benefits or high-status value seems more crucial than purchasing smart home objects for pro-environmental reasons. To the best of our knowledge, this is the first study to explore the moderation of materialism in its both relevant dimensions, i.e., success and happiness, in the context of ESHO.

5.2. Implications for practice

The current study offers key insights for companies aiming to position ESHO effectively and spread the diffusion of ESHO in the market. The results also provide policy makers with useful insights to communicate about the benefits of ESHO, and thus help in sustaining the economy of ecology. The results emphasize the positive direct impact of both environmental concern and perceived usefulness of the ESHO for the environment on consumers' ESHO purchase intentions. They also show that the environmental concern effect is greater for consumers who have lower materialistic orientations. Smart home objects have been widely advertised for the utilitarian benefits they offer to consumers. Companies should also consider clearly positioning smart home objects as eco-friendly products as well as communicating and emphasizing the specific positive impact on the natural environment that derives from using these goods. These objects' reduced impact on the natural environment may be one of the key attributes to communicate, especially when targeting consumers who score low in materialism, such as members of pro-environmental organizations. Similarly, companies should develop recycling facilities to increase consumer perceptions about the reduced environmental impact of these products. In particular, companies should be able to inform consumers about the complete life cycles of ESHO and their impacts on the environment. To help consumers overcome the inconsistency between environmental concern and the perceived usefulness of the ESHO for the environment, companies may consider improving the perceived environmental usefulness of ESHO. For instance, Nest's learning thermostat claims it saves money on energy bills by controlling its own use. The regular messages of the device tell a consumer how much energy he/she saved the current month compared to the previous one. Smart Water Controller with Apple HomeKit technology monitors the amount of water used when gardening, providing consumers with cost-saving

information. Companies should consider emphasizing more how these smart home solutions (and the technology behind smart home objects) contribute to save natural resources and the specific amount of natural resources saved monthly.

A number of policies and instruments concerning ESHO may be further developed to help reduce domestic energy and water consumption. As for energy, current EU policies aim to reduce energy consumption by 20% by 2020. As for water, EU policies mainly focus on improving water quality, but the need to address efficient water usage is increasingly recognized (European Commission, 2012). Our results show that both environmental concern and the perceived usefulness of the ESHO for the environment are significant and positive antecedents of consumers' intentions to purchase ESHO. Policy makers should consider funding awareness-raising programs targeting adult and younger consumers (e.g., the Eco-schools), which educate on issues such as energy and water efficient consumption. Specifically, these programs may emphasize how ESHO may help consumers engage in pro-environmental behavior change, and how ESHO may contribute to increase energy and water efficiency in order to save both financial resources and natural resources (e.g., highlighting high financial and environmental costs associated with inefficient appliances usage and develop consumer support mechanisms via ESHO). In reaching these goals, policy makers may also consider increasing consumers' awareness about certification schemes that rate the sustainability of housing and other buildings.

Finally, our study only investigates measures of environmental concerns and ESHO purchase intentions rather than actual purchase behavior. Value-action gaps or intention-behavior gaps may occur in the market due to the existence of potential barriers (e.g., high capital costs). To avoid potential value-action gaps or intention-behavior gaps, and increase the actual dissemination of ESHO in the market, policy makers should support the ESHO market dissemination with awareness campaigns, labeling measures, fiscal measures (e.g.,

lower VAT rates or VAT free or bonuses, or grants, for efficient appliances, to overcome the potential affordability issue) or they may consider encouraging retailers to provide product trials or money back guarantees to increase consumer ESHO purchase intentions.

Finally, the results highlight that both dimensions of materialism, happiness and success, negatively moderate the effect of environmental concern on ESHO purchase intentions. That is, the effect of environmental concern on ESHO purchase intention is stronger (vs. weaker) for consumers who have lower (vs. higher) materialistic orientation. These results suggest that companies and/or public policy makers' communication contents that are based on the altruistic and biospheric value of helping the environment may be particularly effective when targeting consumers that exhibit lower degrees of materialism. Conversely, when targeting high materialistic consumer segments, companies and public policy makers should consider downplaying the environmental and altruistic aspects of owing ESHO, since these claims would be less persuasive for these targets. When targeting highly materialistic consumer segments, companies and policy makers should consider positioning ESHO as assets and foster their conspicuous consumption. Positioning ESHO as higher status goods would suggest that the adoption of these items would grant consumers social status, self-esteem and social-esteem (Richins and Dawson, 1992).

5.3 Limitations and further research

This study has limitations that constitute avenues for future research. First, it is limited to the French market, and caution is required before generalizing the results. Future research is recommended to test the model proposed in this study across different countries to assess whether cultural variables (specifically, masculinity and femininity) may impact individual traits and orientations toward the environment and alter the effects of these variables on subsequent ESHO purchase intentions.

Second, the data collection procedure (face-to-face) used in this study might have introduced a social desirability bias due to the presence of the interviewer. Future research should include a measure of social desirability in the hypothesized model. Similarly, this study involves measures of ESHO purchase intentions rather than actual purchase behavior. Findings of self-reported behavioral measures may not reflect actual purchase behavior. Like the value-action gap discussed above (Yates, 2008; Bray et al., 2011; Wicker, 2018), recent research has explored the existence of an intention-behavior gap (Diekmann, and Preisendörfer, 2003; Gleim et al., 2013), which is a gap between consumers' stated intentions and their actual behavior (Barbarossa and Pastore, 2015; Carrington et al., 2010; 2014). In light of these considerations, future research is recommended to replicate the model proposed in this study by including measures of actual purchase behavior rather than self-reported purchase intentions and to explore the occurrence of factors that may be responsible for a value-action gap or an intention-behavior gap in the context of purchasing ESHO.

Third, the results of the current study interestingly indicate that environmental concern does not affect significantly the perceived ESHO usefulness for the environment. As mentioned before, this result may be explained by including additional moderating variables, such as familiarity with the product or past experience with the product category, which may moderate the effect of environmental concern on perceived ESHO usefulness for the environment. A significant path between environmental concern and ESHO usefulness for the environment may therefore emerge for consumers who are familiar with these objects, know these objects well, and are therefore more aware of the specific reduced negative effects that using smart objects has on the natural environment.

Finally, further experimental research may consider testing the effects of different communication contents for ESHO across different consumer segments (e.g., low vs. high materialistic consumers, or consumers with low vs. highly familiarity with ESHO). Different

consumer segments may be sensitive to different purchasing motivations, and the motivational variables included in the hypothesized model may exert different effects across diverse target consumer groups. Future research is invited to explore the most effective communication strategies (e.g., positioning ESHO as higher status goods instead of highlighting their biospheric aspects or relying on positive emotional benefits instead of priming negative emotions, such as guilt or fear) for different consumer segments.

In conclusion, the current study contributes to a better understanding of the altruistic and ecological factors that may motivate consumers to adopt smart home objects, thus representing one of the few attempts to investigate the promotion of smart home objects by adopting a "green" consumer perspective.

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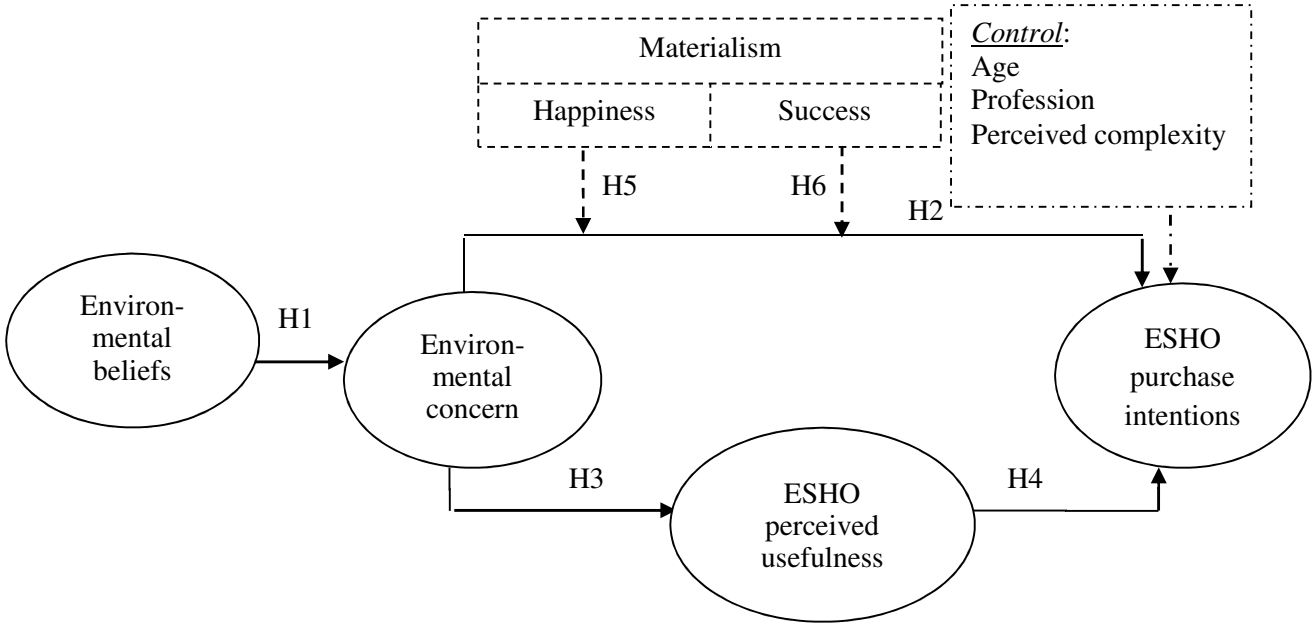

Figure 1. Conceptual model with hypotheses

Constructs	Measurement Items	Sources
Environmental concern	EC1. I am concerned about the environmental conditions our children have to live under.	Bamberg (2003)
	EC2. Newspaper articles or TV reports concerning environmental problems make me angry.	
	EC3. If we continue as before, we are approaching an environmental catastrophe.	
Environmental beliefs	EB1. Some living things are being threatened with extinction.	Kilbourne and Pickett (2008)
	EB2. Global warming is becoming a problem.	
	EB3.Ozone depletion is an environmental problem.	
	EB4. The availability of clean water will become a problem in the future.	
Perceived usefulness of the ESHO for the environment	USE1. Using eco-friendly smart home objects in my life would increase environmental benefits.	Van Ittersum and Feinberg (2010)
	USE2.If I use eco-friendly smart home objects, I will increase the quality of the environment.	
	USE3. Using eco-friendly smart home objects increases environmental benefits.	
ESHO purchase intentions	PINT1. I would like to have more information about eco-friendly smart home objects within a purchase intention context.	Rodgers (2003)
	PINT2. I'm interested in purchasing eco-friendly smart home objects.	
Success	SUC1. I admire people who own expensive homes, cars, and clothes.	Kilbourne and Pickett (2008)
	SUC2. Some of the most important achievements in life include acquiring possessions.	
Happiness	HAP1. I have all the things I really need to enjoy life (R)	
	HAP2. My life would be better if I owned certain things I don't have.	
	HAP3. I'd be happier if I could afford to buy more things.	

Note: (R) reversed item

Table 1. Measurement items and sources

Constructs	Item codes	Means [1 to 5] (SD)	Item loadings	Reliability	Convergent validity (AVE)
1. Environmental concern	EC1 EC2 EC3	4.11 (1.07) 3.67 (1.17) 4.04 (1.02)	λ = .69 λ = .71 λ = .72	Rhô = .74	.50
2. Environmental beliefs	EB1 EB2 EB3 EB4	4.48 (.87) 4.29 (.93) 4.23 (1.03) 4.19 (1.05)	λ = .64 λ = .82 λ = .82 λ = .62	Rhô = .81	.53
3. Perceived ESHO usefulness for the environment	USE1 USE2 USE3	2.65 (1.21) 2.68 (1.23) 2.55 (1.18)	λ = .83 λ = .89 λ = .88	Rhô = .90	.75
4. ESHO purchase intentions	PINT1 PINT2	3.09 (1.38) 2.75 (1.24)	λ = .69 λ = .78	Rhô = .70	.54
5. Happiness	HAP1 HAP2 HAP3	2.64 (1.28) 2.91 (1.42) 3.06 (1.38)	λ = .60 λ = .81 λ = .84	Rhô = .80	.58
6. Success	SUC1 SUC2	2.33 (1.31) 2.93 (1.25)	λ = .86 λ = .64	Rhô = .73	.58

Table 2. Psychometric properties of the scales

Constructs	Means (SD)	AVE and correlations between constructs					
		1.	2.	3.	4.	5.	6.
1. Environmental concern	3.94 (.89)	**.50**					
2. Environmental beliefs	4.29 (.77)	.689	**.53**				
3. Perceived ESHO usefulness on the environment	2.62 (1.10)	.050	-.017	**.75**			
4. ESHO purchase intentions	2.92 (1.15)	.237	.155	.512	**.54**		
5. Happiness	2.87 (1.14)	-.204	-.161	.183	.137	**.58**	
6. Success	2.63 (1.12)	-.271	-.248	.157	.079	.623	**.58**
Control variables	---	---	---	---	---	---	---
Age	---	-.253	-.188	.208	.08	.298	.166
Profession	---	-.081	-.005	.022	-.058	.041	.035
Complexity of technology use	2.44 (1.15)	.189	.081	-.152	-.151	-.319	-.176

Notes: For construct discriminant validity, the average variance extracted (AVE) values, which appear in bold on the diagonal, must be greater than the squared correlations between constructs, which was the case for all constructs.

Table 3. Means, correlations, and discriminant validity

	Model M1: Partial mediation model (focal model)	**Model M2**: Direct model	**Model M3**: Full mediation model	Confirmed?
H1: Environmental beliefs → Environmental concern	$\gamma = .69$ **	---	$\gamma = .69$ **	Yes
H2: Environmental concern → ESHO purchase intentions	$\gamma = .21$ **	$\gamma = .18$ **	---	Yes
H3: Environmental concern → Perceived ESHO usefulness for the environment	$\gamma = .04$ ns	---	$\gamma = .05$ ns	No
H4: Perceived ESHO usefulness for the environment → ESHO purchase intentions	$\gamma = .50$ **	$\gamma = .51$ **	$\gamma = .51$ **	Yes
Predictive power	$R^2 = .31$	$R^2 = .30$	$R^2 = .26$	
Model fit indices	$\chi^2 = 138.34$, df = 50, $p = .000$; RMSEA = .053; CFI = .97; TLI = .96; χ^2/df = 2.77	$\chi^2 = 367.02$, df = 51, $p = .000$; RMSEA = .098; CFI = .90; TLI = .87; χ^2/df = 7.19	$\chi^2 = 157.87$, df = 51, $p = .000$; RMSEA = .057; CFI = .96; TLI = .95; χ^2/df = 3.09	

Note: ns = not significant. ** $p < .01$.

Table 4. Summary of the findings

Test of H5			Test of H6		
		Coefficient			Coefficient
Main effects	Environmental concern → Happiness	γ = .205 **	*Main effects*	Environmental concern → Success	γ = -.285 **
	Environmental concern → ESHO purchase intentions	γ = .288 **		Environmental concern → ESHO purchase intentions	γ = .329 **
	Happiness → ESHO purchase intentions	γ = -.192 **		Success → ESHO purchase intentions	γ = .170 *
Moderation effect (H5)	Environmental concern × Happiness → ESHO purchase intentions	**γ = -.127** *	*Moderation effect* (H6)	Environmental concern × Success → ESHO purchase intentions	**γ = -.164** *
Model fit indices : χ^2 = 166.698, df = 96, *p* = .000; RMSEA = .034; CFI = .985; TLI = .976; χ^2/df = 1.736			*Model fit indices* : χ^2 = 86.784, df = 51, *p* = .001; RMSEA = .033; CFI = .986; TLI = .979; χ^2/df = 1.702		

Table 5. Moderation effect of materialism factors