Extending reality

Uses, processes, and persuasive effects of augmented reality apps

Smink, A.R.

Publication date
2020
Document Version
Other version
License
Other

Link to publication

Citation for published version (APA):
Smink, A. R. (2020). *Extending reality: Uses, processes, and persuasive effects of augmented reality apps*.

Disentangling the Persuasive Effects of Self-Augmentation in AR and its Underlying Processes

ABSTRACT

Augmented Reality (AR) enables consumers to virtually try products on their own face or surroundings in real time (e.g., make-up, furniture), which could help providing consumers a 'try before you buy' experience when shopping online. In an online experiment, we examined the potential positive and negative effects of online product presentation with AR, compared to two non-AR product presentations on a picture of the self or a model. Results suggest that AR enhances perceived informativeness and enjoyment of the shopping experience, as opposed to both non-AR product presentations. Consequently, perceived informativeness leads to a cognitive process which enhances purchase intention and willingness to share personal data with the brand, while perceived enjoyment leads to an affective process which enhances attitude towards the brand. At the same time, AR is perceived as more intrusive, but against expectations, this does not lead to any negative effects.

While online purchases via (mobile) e-commerce continue to grow worldwide, retailers face issues such as high return rates, *online shopping card abandonment*, and *webrooming* (browse products online, then shop product offline; Dacko, 2016; Hilken et al., 2018). These issues may partly be attributed to the lack of direct product experiences when shopping online, as online product presentations lack the sensory information one would have when shopping in a physical store (Fang et al., 2014; Hilken et al., 2017; Overmars & Poels, 2015; Verhagen et al., 2014). One way to bridge the gap between offline and online shopping is through Augmented Reality (AR) technology (Baek et al., 2018). AR enables consumers to virtually try products on their own face or surroundings in real time (e.g., make-up, furniture, sunglasses), and as such deliver a more direct product experience (Hilken et al., 2017; Verhagen et al., 2014). Because this technology offers a 'try before you buy' experience, AR shows great potential for marketers and retailers to improve online conversion rates and reduce return rates (Dacko, 2016; Morgan, 2017).

Due to its increasing popularity, academics have started comparing AR experiences to non-AR experiences to assess the value of AR during online shopping. These studies mostly showed that an AR experience was more persuasive compared to a non-AR experience (Baek et al., 2018; Javornik, 2016; Verhagen et al., 2014). This enhancing effect of AR was found via several underlying mechanisms, such as increased local presence (Verhagen et al., 2014), stronger self-brand connections (Baek et al., 2018), and increased utilitarian and hedonic value of the shopping experience (Hilken et al., 2017). With this study, we aim to extend the existing literature in three ways.

First, most studies have compared AR experiences involving augmenting a virtual product on the face, to non-AR experiences which show the product on a model, or solely show the product (Baek et al., 2018; Javornik, 2016; Verhagen et al., 2014; Yim & Park, 2019). Therefore, it remains unclear which part of these effects can be attributed to AR technology, and which part to merely seeing one's own face. In this study, we aim to filter out this possible confound by comparing an online product presentation with AR, to a non-AR product presentation featuring a picture of one's own face, and a non-AR product presentation featuring a picture of a model. We expect that AR has a strengthening effect on persuasive outcomes (as opposed to both non-AR conditions), due to its interactive and real-time features. And, we also expect that showing one's own face in the non-AR condition (as opposed to a model) causes stronger effects because of consumers' preference and attention for self-relevant cues (*self-referencing theory*; Kuiper & Rogers, 1979).

Second, previous studies have mostly focused on effects of AR on brand related affective and behavioral responses (Baek et al., 2018; Javornik, 2016; Verhagen et al.,

2014). However, the effectiveness and adoption of AR apps might partly be dependent on consumers' willingness to share personal data. In order to use AR apps, retailers ask users for permission to use their camera and collect other personal data. Research showed this is considered a drawback of using AR apps and consumers might be reluctant to share personal data with AR apps (Dacko, 2016). However, it has not been studied whether usage of AR apps actually affects consumers' personal data disclosure. Therefore, this study considered willingness to share personal data as a dependent variable, besides brand attitude and purchase intention as brand responses.

Third, while previous research has mostly shown positive effects of AR through several underlying mechanisms (Baek et al., 2018; Javornik, 2016; Verhagen et al., 2014; Yim & Park, 2019), its potential negative effects are often overlooked. Although recent research has shown that AR can have potentially negative effects for consumers with specific characteristics (e.g., strong privacy concerns; Hilken et al., 2017), it is not clear through which process AR yields negative persuasive effects and whether these negative effects are stronger or weaker than the positive persuasive effects (Suh & Prophet, 2018). Therefore, we examine whether differences in online product presentations will either translate into more positive or negative persuasive effects.

Following Hilken et al. (2017) we focused on both hedonic (perceived enjoyment) and utilitarian processes (perceived informativeness), as these are important indicators of intended adoption of new technologies and positive consumer reactions. Moreover, by differentiating between hedonic and utilitarian processes, we can separate affective versus cognitive effects of AR. At the same time, the real-time and interactive nature of this relatively new and unfamiliar technology could potentially raise the perceived intrusiveness and therefore negatively affect consumer reactions. We expect, based on *equity theory* (Adams, 1963) and *privacy calculus theory* (Culnan & Armstrong, 1999), that consumers make a cost-benefit analysis, which determines whether the positive persuasive effects outweigh the potential negative effects and to decide whether they want to disclose personal information (Dinev & Hart, 2006; Wottrich et al., 2018).

In sum, this study examines the positive and negative effects of online product presentation through AR (compared to a picture of the self or a model), on brand attitude, purchase intention, and willingness to share personal data share through three underlying processes: perceived informativeness, enjoyment, and intrusiveness.

THEORETICAL FRAMEWORK

Online Product Presentation with AR

AR has three unique characteristics that distinguish an online product presentation with AR from other forms of online product presentation. First, AR *combines the real and virtual world* by overlaying virtual products onto the consumer or their surroundings, which enables them to try a product 'as if' it is really there (Scholz & Smith, 2015). Second, the virtual objects in AR are *interactive* and are shown in *real time* (Azuma, 1997), which means that users are exposed to a real-time view of themselves or their surroundings through a webcam or smartphone camera, overlaid with virtual products. Third, the virtual object is registered in 3D and therefore has a fixed position in the 3D space (Azuma, 1997). In this sense, a virtual product can be fixed on the user's head through facial recognition (e.g., makeup or sunglasses), or in a fixed position in the user's surroundings (e.g., furniture), meaning that users can inspect the product from different angles while moving around. Because the virtual objects are registered and fixed in physical space, it enables interaction between the virtual objects and the real world (Azuma, 1997). These unique characteristics of AR result in online product presentations that resemble a more direct product experience (Verhagen et al., 2014). We expect that due to this, online product presentations with AR (compared to the two non-AR conditions) will enhance or diminish consumer reactions via three underlying mechanisms: perceived informativeness, perceived enjoyment, and perceived intrusiveness. The conceptual model corresponding to this is outlined in Figure 4.1.

Figure 4.1 Conceptual Model
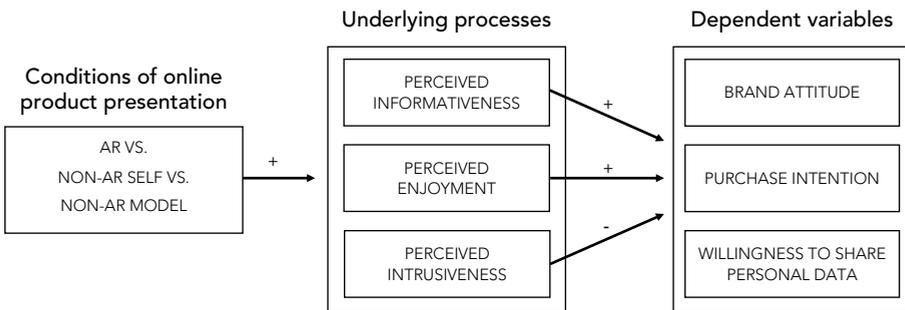
Perceived Informativeness

With perceived informativeness, we address the subjective evaluation of how much information the online product presentation offers. While online stores can provide factual information about the search attributes of a product (attributes that can be assessed before using a product, such as measurements or price), they are less capable of providing information about the experience attributes of a product (attributes that can be verified by actual use of the product, such as fit, shape, texture, and feel; Overmars & Poels, 2015). Research has shown that direct product experiences (as opposed to indirect experiences) provide more vivid mental images of the product, more sensory engagement, and enable consumers to better judge the quality of the experience attributes of a product (Hamilton & Thompson, 2007; Klein, 2003; Li et al., 2001; Overmars & Poels, 2015; Schlosser, 2003). Therefore, these direct product experiences provide more subjective information than indirect product experiences. To illustrate, previous research showed that more direct product experiences (videos or 360 view of the product) led to a higher perceived informedness than more indirect product experiences (a static picture of the product; Li & Meshkova, 2013). Thus, from the above, it can be argued that online product presentations that offer the most direct product experience, will likely be perceived as the most informative.

Due to its previously described interactive and real-time features, AR resembles the most direct product experience (Verhagen et al., 2014) and is therefore also expected to be perceived as most informative. A consumer survey also showed that the 'more complete information on products' is considered the biggest benefit of using AR shopping applications (Dacko, 2016). AR provides a multisensory and vivid experience, which enables consumers to visually examine specific experience characteristics of the product (Klein, 2003; Li et al., 2001; Yim et al., 2017). In comparison, a non-AR experience, providing a picture of the consumers' own face or a model, lacks these interactive and real-time features and as such provides a more indirect experience. As we argue that more direct product experiences will be perceived as more informative, we expect that online product presentation with AR will be perceived as more informative than both non-AR conditions.

Additionally, both non-AR conditions are compared in order to filter out whether the effect is (partly) caused by the presence of one's own face rather than AR. We also expected an enhancing effect of seeing one's own face (as opposed to a model), through a process called self-referencing (Kuiper & Rogers, 1979). Self-referencing means that, when consumers are exposed to self-relevant information (in this case, a picture of their own face), they tend to pay more attention and process the information more easily and deeply (Tam & Ho, 2005). We anticipate that this cognitive process will

increase the perceived informativeness of the online product presentation. Moreover, showing the virtual product on the consumers' face (as opposed to a model) enables them to better judge the fit of the product and as such provides more subjective information (Baek et al., 2018).

In sum, we hypothesize that both online product presentation with AR (compared to the non-AR conditions) and online product presentation on one's own face (compared to a model) enhance the perceived informativeness. By posing two hypotheses for each process, we distinguish between the relative effect of AR (H1a) and the effect of seeing one's own face (H1b).

Hypothesis 1a (The Perceived Informativeness of AR Hypothesis): Online product presentation with AR elicits a higher perceived informativeness than online product presentation without AR (on a picture of the consumer's own face or a model).

Hypothesis 1b (The Perceived Informativeness of the Consumer's Own Face Hypothesis): Online product presentation on a picture of the consumer's own face elicits a higher perceived informativeness than online product presentation on a picture of a model.

The product information obtained through online product presentations can consequently lead to positive brand responses. Providing enriching product information can help consumers to reduce uncertainty about product choices, make more informed decisions when shopping online, and, as such, can lead to a higher purchase intention (Chen & Yen, 2004; Hilken et al., 2017; Overmars & Poels, 2015). For example, research showed that greater informedness through interactive product presentations positively enhanced purchase intention (Li & Meshkova, 2013). Additionally, because product information obtained through AR is considered more reliable and reduces the risk associated with buying the product, we expect that consumers will experience more positive affect, which will be transferred to their attitude towards the brand. Similarly, we expect that perceived informativeness will positively mediate the effect of online product presentation on brand attitude and purchase intention.

Lastly, we expect that the enhanced informativeness will have a positive effect on the willingness to disclose personal data with the brand. Research on AR applications showed that when users feel they have control over the access to personal information in AR apps, this has a positive effect on user satisfaction (Poushneh, 2018). In has not been studied however, whether users are actually more willing to disclose their

personal information with AR apps (as opposed to non-AR apps). Research has shown that product information gathered through a more direct experience on online shopping sites (induced by image interactivity) is considered as more reliable and trustworthy (Overmars & Poels, 2015), which can make users less reluctant to disclose personal information (Schoenbachler & Gordon, 2002). Moreover, research showed that websites which were considered as more informative, induced trust in the user, reduced the users' privacy concerns, and consequently made them more willing to share personal data with the website (Kaushik et al., 2018; Pavlou et al., 2007). In relation to AR, we expect that the enhanced informativeness through online product presentations, makes users more willing to share their personal data.

Hypothesis 2 (The Perceived Informativeness Mediation Hypothesis): Perceived informativeness positively mediates the effect of online product presentation on a) brand attitude, b) purchase intention, and c) willingness to share personal data.

Perceived Enjoyment

Besides proving utilitarian value through enhancing the perceived informativeness, online product presentations can also provide hedonic value through increasing perceived enjoyment (Hilken et al., 2017; Huang & Liao, 2015; Li & Meshkova, 2013). Research showed that enjoyment during online shopping can be induced through increased interactivity and vividness of the experience (Li & Meshkova, 2013; Yim et al., 2017; Yim & Park, 2019). Interactive and vivid experiences (on websites, shopping sites, or through mobile apps) have been shown to lead to flow, involvement, and immersion, creating a more positive emotional experience, and as such induce a more fun and enjoyable experience (Kim & Forsythe, 2008; Shih, 1998; Van Noort et al., 2012; Yim et al., 2017). For example, research showed that online product presentations with more interactive and vivid features (i.e., a video of the product) led to more enjoyment (operationalized as excitement or hedonic value) as opposed to static online product presentations without these features (Hilken et al., 2017; Li & Meshkova, 2013; Yim & Park, 2019). As discussed, an online product presentation with AR provides sensory cues to induce a vivid experience and enables real-time interaction with virtual products (Azuma, 1997; Javornik, 2016). Based on this, we expect that online product presentation with AR will be perceived as more enjoyable than online product presentation without AR.

Second, research on self-referencing shows that consumers prefer and attach positive affect to information or advertising that addresses the self (Ahn et al., 2017; Holland et al., 2009; Tam & Ho, 2005; Maslowska et al., 2016). Therefore, we expect that

besides AR, there will also be an enhancing effect on perceived enjoyment through showing the product on the self (as opposed to a model). Thus, we argue that both the presence of one's own face (compared to a model) and AR (versus non-AR) will have an ameliorating effect on perceived enjoyment.

Hypothesis 3a (The Perceived Enjoyment of AR Hypothesis): Online product presentation with AR elicits a higher perceived enjoyment than online product presentation without AR (on a picture of the consumer's own face or a model).

Hypothesis 3b (The Perceived Enjoyment of the Consumer's Own Face Hypothesis): Online product presentation on a picture of the consumer's own face elicits a higher perceived enjoyment than online product presentation on a picture of a model.

Enjoyment while shopping online can lead to positive affect (Mathwick et al., 2001), which, in turn, can be carried over to the brand through affect transfer (Baek et al., 2018). Research indeed showed that increasing enjoyment while shopping online consequently enhances brand attitude and purchase intention (Javornik, 2016; Li & Meshkova, 2013; Pantano et al., 2017; Yim et al., 2017). At the same time, enjoyment while shopping online is characterized by feeling immersed and involved, which makes consumers less critical towards the content and more likely to be persuaded (Huang & Liao, 2017; Javornik, 2016; Yim et al., 2017). This can also translate into a higher willingness to disclose personal data. Within this study, we expect that enjoyment will reduce the natural resistance to share personal information. Consequently, we expect that perceived enjoyment will positively mediate the effect on willingness to share personal data.

Hypothesis 4 (The Perceived Enjoyment Mediation Hypothesis): Perceived enjoyment positively mediates the effect of online product presentation on a) brand attitude, b) purchase intention, and c) willingness to share personal data.

Perceived Intrusiveness

In order to use AR applications, consumers need to provide personal information to enable the technology, such as camera access, an e-mail address, or location. Consumers can be reluctant to share this information, because they do not know how their information will be used (Poushneh, 2018). When consumers do not feel in control over the information they are sharing, it can lead to an uncomfortable feeling and raise feelings of intrusiveness (Baek & Morimoto, 2012; Poushneh, 2018; Van

Doorn & Hoekstra, 2013; White et al., 2008). Especially because AR is a relatively new technology, consumers are unaware of the benefits of using AR for online shopping and could perceive AR apps asking for camera access as intrusive (Dacko, 2016; Hopp & Gangadharbatla, 2016; Tokunaga, 2013).

First of all, we expect that perceived intrusiveness will be highest for online product presentation with AR, because consumers need to give access to their live camera to use the application. This will lead to a higher perceived intrusiveness than using online product presentation without AR (showing a picture of the self or a model). Additionally, we expect that online product presentation using a picture of the consumer's own face, will also raise feelings of intrusiveness, as consumers still need to provide more personal information (a picture), which is not needed for the model condition. Therefore, we hypothesize:

Hypothesis 5a (The Perceived Intrusiveness of AR Hypothesis): Online product presentation with AR elicits a higher perceived intrusiveness than online product presentation without AR (on a picture of the consumer's own face or a model).

Hypothesis 5b (The Perceived Intrusiveness of the Consumer's Own Face Hypothesis): Online product presentation on a picture of the consumer's own face elicits a higher perceived intrusiveness than online product presentation on a picture of a model.

When consumers perceive information as too intrusive, it can lead to reactance and avoidance (Baek & Morimoto, 2012; Li, Edwards, et al., 2002). According to reactance theory, consumers try to resist persuasion and respond negatively when they experience a lack of control or freedom (Brehm, 1966). This negative effect can spill over to brand attitude and purchase intention. For example, research showed that intrusiveness induced by personalized or location-based advertising can cause negative evaluations and behavioral intentions (Gazley et al., 2015; Huhn et al., 2011; McCoy et al., 2008; Van Doorn & Hoekstra, 2013). Intrusiveness could also negatively affect willingness to share personal data. For example, intrusiveness of mobile apps (operationalized as how much personal data the app was collecting), has been found to negatively affect personal data disclosure (Wottrich et al., 2018). Moreover, 'having to give too much personal information' is considered one of the biggest drawbacks of using AR apps, according to a consumer survey (Dacko, 2016). Therefore, we expect that the perceived intrusiveness will also decrease the willingness to share personal data. We hypothesize:

Hypothesis 6 (The Perceived Intrusiveness Mediation Hypothesis): Perceived intrusiveness negatively mediates the effect of online product presentation on a) brand attitude, b) purchase intention, and c) willingness to share personal data.

Positive versus Negative Effects

Lastly, we will explore whether the hypothesized positive mediating effects (H2 and H4) are stronger than the hypothesized negative effects (H6). *Equity theory* (Adams, 1963) states that consumers make a decision to use a technology by comparing what they receive (input or benefits) to what they sacrifice (output or costs). When the benefits of the technology outweigh the costs, user satisfaction will be positive. At the same time, user satisfaction will be negative when the costs outweigh the benefits (Adams, 1963). For example, a study from Poushneh (2018) showed that the quality of the AR experience (the benefits) and the perceived user control over personal information (potential cost) affected user satisfaction. When both the quality of the AR experience and the control over personal information was low (as opposed to high), it led to a lower (higher) user satisfaction. Research based on *privacy calculus theory* also showed that consumers make a cost-benefit analysis to decide whether or not they want to disclose personal information (Culnan & Armstrong, 1999; Dinev & Hart, 2006; Wottrich et al., 2018). For example, a study on branded apps showed that when the relative benefits (app value) where stronger than the costs (intrusiveness and privacy concerns), consumers were more willing to disclosure personal information (Wottrich et al., 2018). In this study, the potential benefits of using AR for online shopping (perceived informativeness and enjoyment), are compared to the potential cost (perceived intrusiveness). This cost-benefit analysis would then either yield more positive or more negative effects on brand responses and willingness to share data depending on which mediating effect is stronger. To examine this, we pose a research question:

Research Question 1: Is the (hypothesized) positive mediating effect through perceived informativeness and perceived enjoyment on brand responses and willingness to share data stronger than the (hypothesized) negative mediating effect through perceived intrusiveness?

METHOD

Design and Participants

An online experiment was conducted, using a one-way factorial design with three conditions differing in online product presentation: Augmented Reality (AR), a picture of the self (non-AR self) or a picture of a model (non-AR model). Participants were recruited using a snowball sampling procedure and were contacted through e-mail and social media over a period of three weeks in May 2018 in The Netherlands.

Because the online application concerned a make-up app, only women could participate in the experiment. We selected participants aged between 18 and 30 years old, as this age group is in general more open to innovative technologies, and form the main target group for online shopping (Blake et al., 2003). Moreover, women are more responsive to direct product experiences than men and perceive a higher risk of shopping online compared to men (which provide more indirect product experiences; Garbarino & Strahilevitz, 2004; Hasan, 2010). Therefore, AR might be especially useful for women to help visualize products. We expect that this group of young women could be potential users of new technologies used in e-commerce, and therefore, their reactions to AR will provide valuable, relevant insights for practice and an appropriate study sample. Additional requirements were that all participants had a laptop/computer with built in camera or a webcam, because this was needed in the AR and non-AR self-condition.

From the full responses (N = 183), 50 participants had to be removed from the data because they failed the manipulation check, which means they applied the makeup in a different online product presentation than they were instructed[5]. Additionally, one participant was excluded because of extreme values on more than three variables and was considered an outlier. Finally, 132 participants qualified for testing the hypotheses. All participants were women and aged between 18 and 30 years old (M = 23.57, SD = 2.15). The participants were overall highly educated, familiar with the Sephora brand, experienced online shoppers, and positive about Sephora. All sample characteristics are summarized in Table 4.1.

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[5] We excluded participants that used a different online product presentation condition then they were assigned to, as this leads to self-selection and does not assure random assignment to conditions. Moreover, participants could have had several reasons for not using the assigned condition: 1) because participants did not read the instructions carefully, 2) because they did not fulfill the requirements to have a camera which made them unable to use the AR condition or non-AR self condition, or 3) because they were not willing to use their camera in the AR condition or non-AR self condition, possible due to privacy concerns, and instead used the non-AR model condition. As this could have influenced reliability and validity of the results we excluded these participants.

Table 4.1 Sample Characteristics

Variables	Sample (N = 132)
Age	23.57 (2.15)
Gender	
Female	100%
Education	
Pre-university	6.8%
Higher professional	25.8%
University	67.4%
Cosmetics use	
Sometimes	9.1%
Daily	90.9%
Brand familiarity	
Unfamiliar	7.6%
Moderately familiar	38.6%
Familiar	53.8%
Online shopping experience	5.44 (1.63)
Brand attitude (pre-measure)	5.04 (.98)

Note. Mean with standard deviation between brackets
(for age, online shopping experience, and brand attitude).

Stimulus Material

For the experimental task, we used an existing online application from cosmetics brand Sephora (Sephora Virtual Artist; https://sephoravirtualartist.com), which enabled participants to use one of the three online product presentations: apply make-up products on a model, on a picture of themselves or by using AR. The lay-out and features of the application were exactly the same and only differed in the way the products were presented. For the online product presentation on a model (non-AR model), participants could choose between four models and apply make-up on a picture of the chosen model. For the online product presentation on a picture of the self (non-AR self), participants could take or upload a picture of their own face in the application and apply make-up on their picture. For the online product presentation with AR, participants could virtually apply the make-up in real time on their own face by using their live webcam or camera.

Procedure

An invitation with an URL to a Qualtrics questionnaire was distributed via e-mail and social media. The invitation instructed participants to only perform the study on a laptop or computer with a webcam, which was required for both the AR and the non-AR self-condition. In the questionnaire, participants first read a factsheet about the study and had to agree with the informed consent to start the study. Then, participants were randomly assigned to one of the three conditions: online product presentation on a model (n = 52), on a picture (n = 42), or AR (n = 38). They first had to read the instructions to perform the experimental task using the Sephora application. Participants were instructed to use the assigned online product presentation from a menu. The experimental task was the same for each condition: participants had to try several lipsticks using the Sephora application and choose the lipstick that they liked best. After performing the experimental task, participants had to fill in which lipstick they chose and were asked whether they had any problems with the application. Participants that reported problems with the app (being unable to perform the experimental task) were excluded from further participation. Then, participants filled in questions to measure the dependent variables, mediators, and control variables. Lastly, they filled in a manipulation check asking how they had applied the make-up to check whether they had used the assigned condition. After filling out the questionnaire participants were thanked for their participation and debriefed about the purpose of the study.

Measures

The variables from the conceptual model; *perceived informativeness* (Ahn et al., 2004), *perceived enjoyment* (Hassanein & Head, 2005), *perceived intrusiveness* (Li, Edwards, et al., 2002), *brand attitude* (Li, Daugherty, et al., 2002), *purchase intention* (Bearden et al., 1984), and *willingness to share personal data* (Rifon et al., 2005); were all measured with multiple items from existing, validated scales and can be found in Table 4.2. The items were adjusted to fit the context of this experiment. All variables formed reliable scales.

Additionally, several control variables were taken into account: use of cosmetics (daily/sometimes/no), online shopping experience, measured on a scale from 1 (*very unexperienced*) to 7 (*very experienced*), brand familiarity with Sephora (familiar/moderately familiar/unfamiliar), and a pre-measure of brand attitude, measured on a scale from 1 (*very negative*) to 7 (*very positive*). Background variables age, gender, and education were also measured. The sample characteristics are presented in Table 4.1.

Table 4.2 Measurement Items with Factor Loadings and Descriptives per Variable

Items	INF	ENJ	INT	BA	PI	WSPD
The information about the lipstick colors I tried was…						
complete*	.91					
detailed*	.90					
credible*	.83					
understandable*	.90					
helped me find answers on questions about the different colors of lipstick*	.91					
helped me make decisions on the color of lipstick*	.89					
Trying the colors of lipstick on the website was…						
enjoyable*		.95				
fun*		.97				
pleasant*		.97				
interesting*		.93				
Trying the colors of lipstick on the website was…						
interfering*			.95			
invasive*			.95			
intrusive*			.97			
unpleasant*			.97			
disturbing*			.97			
I think the brand Sephora is…						
bad – good				.92		
unattractive - attractive				.94		
negative - positive				.92		
After trying the lipstick on the website, the chance that I will buy the lipstick is…						
improbable – probable					.98	
unlikely - likely					.99	
small - big					.99	
To be able to use this website to try cosmetics in the future, I am willing to give the following information:						
My name*						.69
My address*						.75
My date of birth*						.81
My e-mail*						.67
My phone number*						.78
My hobbies*						.78
My income*						.78
My media use*						.79
My purchase history of last month*						.70
EV	4.75	3,63	4.62	2.57	2.91	5.08
R²	.79	.91	.92	.86	.97	.56
α	.95	.97	.98	.92	.99	.90
M	4.66	5.15	2.85	5.13	4.00	3.09
SD	1.26	1.35	1.46	.89	1.67	1.29

Note. INF = Perceived Informativeness, ENJ = Perceived Enjoyment, INT = Perceived Intrusiveness, BA = Brand Attitude, PI = Purchase Intention, WSPD = Willingness to Share Personal Data; *Measured on 7-point Likert Scale.

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Lastly, to check whether the experimental task was performed correctly, we performed a check to make sure participants used the correct assigned online product presentation. Participants were asked how they tried the lipstick in the Sephora application, (1) on a model, (2) using a picture of myself, or (3) through a live connection with my webcam. As mentioned, participants that failed this check were excluded from further analysis (n = 50).

RESULTS

Control Variables

First, we checked whether the three experimental conditions differed on any of the control variables. As can be seen in Table 4.3, cosmetics use, brand familiarity, education, online shopping experience, and brand attitude (pre-measure) did not differ between the experimental conditions. However, there was a significant difference with respect to age, with the AR condition (M = 24.42, SD = 1.98) scoring significantly higher than the picture condition (M = 23.00, SD = 2.04) and the model condition (M = 23.40, SD = 2.20). A correlation analysis showed that age did not correlate with the dependent variables or mediators. Therefore, we decided not to include age as a covariate when testing the hypotheses.

Table 4.3 Control Variables

Variables	χ² (df)	F(df)	p
Cosmetics use	2.17 (2)		.338
Brand familiarity	7.74 (4)		.102
Education	4.17 (4)		.384
Online shopping experience		.59 (2, 129)	.557
Brand attitude (pre-measure)**		2.56 (2, 119)	.082
Age		4.98 (2, 129)	.009*

Note. * Significant p < 0.05; ** The brand attitude pre-measure has missing values and therefore a lower df is reported.

Hypotheses

To test the hypotheses, we used the PROCESS macro for SPSS (version 3.2) from Hayes (2018) to calculate the direct and indirect effects of the conceptual model (model 4). For each dependent variable (brand attitude, purchase intention, and willingness to share personal data), we calculated a parallel mediation model, with online product presentation as independent variable and perceived informativeness, enjoyment, and intrusiveness as mediators. Bootstrapping with 5000 samples was used to calculate 95% bias-corrected bootstrap confidence intervals (BCBCI) for the indirect effects (Hayes, 2018). The means per condition can be found in Table 4.4 and all indirect effects from the mediation models can be found in Table 4.5.

Perceived Informativeness Hypotheses

First of all, we expected that online product presentation in AR would enhance perceived informativeness as opposed to both non-AR online product presentations (H1a). The data showed that the AR condition scored higher on perceived informativeness compared to both the non-AR self-condition ($b = 1.00$, SE = .27, $p = .000$) and the non-AR model condition ($b = 1.00$, SE = .25, $p = .000$). Hence, *the perceived informativeness of AR hypothesis* (H1a) was confirmed by the data. Additionally, we expected that the non-AR self condition would score higher than the non-AR model condition (H1b). However, there was no difference between the non-AR self and the non-AR model condition ($b = .00$, SE = .25, $p = .994$).

Table 4.4 Means and Standard Deviations per Condition

Variables	Non-AR model (n = 52)	Non-AR self (n = 42)	AR (n = 38)
Perceived informativeness	4.38 (1.40)[a]	4.37 (1.09)[a]	5.37 (.95)[b]
Perceived enjoyment	4.84 (1.45)[a]	4.88 (1.25)[a]	5.88 (1.04)[b]
Perceived intrusiveness	1.90 (.97)[a]	2.90 (1.35)[b]	4.08 (1.21)[c]
Brand attitude	5.11 (1.03)[a]	5.02 (.89)[a]	5.29 (.68)[a]
Purchase intention	3.48 (1.48)[a]	3.87 (1.26)[a]	4.87 (1.99)[b]
Willingness to share personal data	2.52 (1.05)[a]	3.15 (1.16)[b]	3.81 (1.39) [c]

Note. Table presents means per condition and standard deviation between brackets; [abc]Means with different superscripts in the same row differ significantly in a post hoc Bonferroni tests at $p < .05$. Means with the same superscripts in the same row do not differ significantly.

Table 4.5 Indirect Effects of Online Product Presentation on Brand Attitude, Purchase Intention and Willingness to Share Personal Data

	B	SE	BC 95% CI	
			Lower	Upper
Hypothesis 2 (The Perceived Informativeness Mediation Hypothesis)				
H2a: Online product presentation→Perceived Informativeness→Brand attitude				
Non-AR Model vs. Non-AR Self	.00	.05	-.108	.115
Non-AR Model vs. AR	.18	.11	-.012	.428
Non-AR Picture vs. AR	.18	.11	-.009	.408
H2b: Online product presentation→Perceived Informativeness→Purchase intention				
Non-AR Model vs. Non-AR Self	.00	.16	-.341	.317
Non-AR Model vs. AR	**.61**	**.20**	**.263**	**1.056**
Non-AR Picture vs. AR	**.61**	**.20**	**.278**	**1.048**
H2c: Online product presentation→Perceived Informativeness→Willingness to share personal data				
Non-AR Model vs. Non-AR Self	.00	.10	-.192	.215
Non-AR Model vs. AR	**.38**	**.16**	**.110**	**.730**
Non-AR Picture vs. AR	**.39**	**.15**	**.133**	**.713**
Hypothesis 4 (The Perceived Enjoyment Mediation Hypothesis)				
H4a: Online product presentation→Perceived Enjoyment→Brand attitude				
Non-AR Model vs. Non-AR Self	.01	.08	-.158	.182
Non-AR Model vs. AR	**.28**	**.12**	**.087**	**.556**
Non-AR Picture vs. AR	**.27**	**.11**	**.085**	**.530**
H4b: Online product presentation→Perceived Enjoyment→Purchase intention				
Non-AR Model vs. Non-AR Self	.00	.06	-.125	.154
Non-AR Model vs. AR	.19	.16	-.116	.523
Non-AR Picture vs. AR	.18	.15	-.108	.488
H4c: Online product presentation→Perceived Enjoyment→Willingness to share personal data				
Non-AR Model vs. Non-AR Self	.00	.03	-.063	.082
Non-AR Model vs. AR	.07	.11	-.153	.286
Non-AR Picture vs. AR	.06	.10	-.151	.278
Hypothesis 6 (The Perceived Intrusiveness Mediation Hypothesis)				
H6a: Online product presentation→Perceived Intrusiveness→Brand attitude				
Non-AR Model vs. Non-AR Self	-.05	.06	-.166	.074
Non-AR Model vs. AR	-.10	.13	-.373	.151
Non-AR Picture vs. AR	-.06	.08	-.226	.072
H6b: Online product presentation→Perceived Intrusiveness→Purchase intention				
Non-AR Model vs. Non-AR Self	.18	.12	-.023	.455
Non-AR Model vs. AR	.40	.24	-.054	.882
Non-AR Picture vs. AR	.22	.14	-.037	.514
H6c: Online product presentation→Perceived Intrusiveness→Willingness to share personal data				
Non-AR Model vs. Non-AR Self	**.20**	**.10**	**.029**	**.435**
Non-AR Model vs. AR	**.54**	**.20**	**.073**	**.846**
Non-AR Picture vs. AR	**.24**	**.12**	**.036**	**.499**

Note. Unstandardized b-coefficients; BC 95% CI = 95% Bias corrected bootstrap confidence interval using 5.000 bootstrap samples; bold means the indirect effect is significant; $N = 132$.

Thus, *the perceived informativeness of the consumer's own face hypothesis* (H1b) was not supported by the data.

Consequently, we expected that perceived informativeness would positively mediate the effect of online product presentation on brand attitude (H2a), purchase intention (H2b), and willingness to share personal data (H2c). The indirect effects that relate to these mediation hypotheses can be found in Table 4.5. Each indirect effect is shown per dependent variable and for each of the three comparisons between the conditions (AR vs non-AR model, AR vs non-AR self, and non-AR model vs non-AR self).

The results show that perceived informativeness had a positive direct effect on brand attitude (b = .18, SE = .08, p = .029). However, perceived informativeness did not mediate the effect of online product presentation on brand attitude, as shown by the non-significant indirect effects in Table 4.5. *The perceived informativeness mediation hypothesis* was therefore rejected for brand attitude (H2a). However, the effect of online product presentation on purchase intention and willingness to share personal data was positively mediated by perceived informativeness, but only when comparing the AR condition to both non-AR conditions (self and model). The direct effects of perceived informativeness on purchase intention (b = .61, SE = .15, p = .000) and willingness to share personal data (b = .39, SE = .12, p = .002) were also significant. The indirect effects for comparing the two non-AR conditions were not significant. Thus, *the perceived informativeness mediation hypothesis* was confirmed for purchase intention (H2b) and willingness to share personal information (H2c), for the AR condition (as opposed to the two non-AR conditions). In other words, the AR online product presentation led to a higher perceived informativeness as opposed to the two non-AR online product presentations, which consequently enhanced purchase intention and willingness to share personal data.

Perceived Enjoyment Hypotheses

With regard to perceived enjoyment, we expected that AR would enhance perceived enjoyment, as opposed to the non-AR conditions (H3a), and again a difference between the non-AR self and non-AR model condition (H3b). We found that the AR condition scored higher on perceived enjoyment than the non-AR self-condition (b = 1.00, SE = .29, p = .001), and the non-AR model condition (b = 1.03, SE = .27, p = .000). *The perceived enjoyment of AR hypothesis* (H3a) was accepted. There was no difference on perceived enjoyment between the two non-AR conditions (self and model; b = .03, SE = .27, p = .899). Therefore, *the perceived enjoyment of the consumer's own face hypothesis* (H3b) was rejected.

Consequently, we expected that perceived enjoyment would also positively mediate the effect of online product presentation on brand attitude (H4a), purchase intention (H4b), and willingness to share personal data (H4c). First of all, perceived enjoyment had a positive direct effect on brand attitude (b = .27, SE = .08, p = .001). Significant indirect effects showed that perceived enjoyment positively mediated the effect of online product presentation on brand attitude, but only for the difference between the AR condition versus both non-AR conditions. There was no difference between the non-AR self and non-AR model condition. As such, *the perceived enjoyment mediation hypothesis* was accepted for brand attitude (H4a), but only for the AR condition (as opposed to both non-AR conditions). The indirect effects on purchase intention and willingness to share personal data, via perceived enjoyment, were not significant. Thus, *the perceived enjoyment mediation hypothesis* is rejected for purchase intention (H4b) and willingness to share personal data (H4c). In sum, online product presentation in AR enhanced the perceived enjoyment as opposed to the online product presentations without AR, which consequently enhanced brand attitude.

Perceived Intrusiveness Hypotheses

With regard to perceived intrusiveness, we expected that perceived intrusiveness would be higher in the AR condition as opposed to the non-AR conditions (H5a) and we also expected a difference between the non-AR conditions (with the self condition scoring higher than the model condition; H5b). The results showed that the AR condition scored higher than the non-AR self-condition (b = 1.17, SE = .26, p = .000), and the non-AR model condition (b = 2.18, SE = .25, p = .000). *The perceived intrusiveness of AR hypothesis* (H5a) was accepted. We also found a significant difference between the non-AR picture and non-AR model condition (b = 1.00, SE = .24, p = .000). As such, *the perceived intrusiveness of the consumer's own face hypothesis* (H5b) is also accepted.

We expected that perceived intrusiveness would negatively mediate the effect of online product presentation on brand attitude (H6a), purchase intention (H6b), and willingness to share personal data (H6c). As can be seen in Table 4.5, the indirect effects on brand attitude and purchase intention, via perceived intrusiveness, were not significant. *The perceived intrusiveness mediation hypothesis* is rejected for brand attitude (H6a) and purchase intention (H6b). Against expectations, perceived intrusiveness had a positive effect on willingness to share personal data (b = .20, SE = .08, p = .013). Moreover, we also found a significant and positive indirect effect of online product presentation on willingness to share personal data, via perceived intrusiveness. These indirect effects were significant for the difference between the AR condition and both non-AR conditions, as well as the difference between the non-AR self and

non-AR model condition. Thus, while the perceived intrusiveness increased for the non-AR self condition (as opposed to non-AR model condition) and the AR condition (as opposed to both non-AR conditions), this actually led to a higher willingness to share personal data. Since the mediation effect was positive instead of negative, *the perceived intrusiveness mediation hypothesis* is also rejected for willingness to share personal data (H6c).

Lastly, we posed a research question (*Research Question 1*) on whether the positive hypothesized mediating effects (via perceived informativeness and perceived enjoyment) would either be stronger or weaker compared to the negative hypothesized mediating effect (via perceived intrusiveness). However, in this study, we only found positive mediating effects and no negative mediating effects through perceived intrusiveness. Therefore, the positive effects of AR outweighed the potential negative effects in this study, because the latter were absent. Implications are discussed.

DISCUSSION

Conclusions

This study adds to the literature on AR by 1) comparing the relative effect of online product presentation through AR versus two non-AR conditions (a picture of the self or a model), 2) considering three underlying mechanisms that could yield both positive (perceived informativeness and perceived enjoyment) and negative (perceived intrusiveness) consumer reactions, 3) considering the effect on brand responses (brand attitude and purchase intention) and willingness to disclose personal information, and 4) exploring whether the positive effects of AR outweigh the potential negative effects. Four main conclusions emerge from the research.

First, this study advanced the literature on AR by filtering out the effect of seeing the self (compared to a model), versus the effect caused by AR (compared to the two non-AR conditions). In previous studies that compared effects of online product presentation using AR to non-AR conditions, the conditions differed on both the technology (AR or non-AR) and the presence of one's own face or not (Baek et al., 2018; Verhagen et al., 2014). Results from this study showed that the effects on perceived informativeness and enjoyment were solely caused by AR (as opposed to both non-AR conditions). Online product presentation on a picture of the consumer's own face did not have an ameliorating effect compared to online product presentation on a picture of a model. We expected that seeing the self in the non-AR condition would serve as a self-reference cue which would increase processing of the content and the attribution

of positive affect towards this self-relevant information, as is posed in self-referencing theory (Kuiper & Rogers, 1979; Maslowska et al., 2016). However, in this study context, it seems that self-referencing theory cannot be applied to a picture of the self as a self-reference cue in order to enhance informativeness and enjoyment. Rather, because AR enables an interactive and real-time view of the product on the consumer's own face (Azuma, 1997), it led to a more informative and enjoyable shopping experience, and these effects were not confounded by the presence of ones' own face.

Second, both perceived informativeness and enjoyment positively mediated the effects of online product presentation on brand responses and willingness to share personal data, but the underlying mechanisms seem to induce either behavioral or affective consumer reactions. More specifically, informativeness affected behavioral responses (purchase intention and willingness to share personal data), while enjoyment enhanced affective responses (brand attitude). Thus, enhanced informativeness seems to lead to a cognitive process, in which the enriching information offered through AR led to a decision-making process in whether or not to buy the product and disclose personal information. At the same time, enhanced enjoyment seems to lead to an affective process, in which the positive affect is transferred to the attitude towards the brand. This is in line with research on branded apps, which showed that consumers' use of information focused branded apps enhanced cognitive responses, while use of entertainment focused branded apps enhanced affective responses (Van Noort & Van Reijmersdal, 2019). Possibly, AR apps have more affective versus behavioral effects depending on the specific goal to use AR apps, which could be a more hedonic and/or utilitarian goal. For example, qualitative research from Scholz and Duffy (2018) in which users of an AR makeup app were interviewed, illustrated that for some users, shopping with AR was a purely hedonic, fun, and playful experience, without the intention of actually buying something. However, other users reported more on the use of AR for a more functional purpose (usefulness) to actually buy a product. This could be an interesting angle to explore in a quantitative fashion in future research.

Third, with regard to intrusiveness, both AR and the presence of one's own face increased the perceived level of intrusiveness of online product presentations. Thus, online product presentation on a picture of one's own face enhanced intrusiveness (compared to online product presentation on a model), and online product presentation in AR had an additional enhancing effect on intrusiveness (compared to both non-AR product presentations). While we expected that intrusiveness would lead to reactance and therefore would negatively affect consumer reactions, we did not find any indirect effects on brand responses. Contrary to our expectations, a higher perceived intrusiveness actually led to a higher willingness to disclose personal

information. Although the conditions that involved the presence of one's own face raised intrusiveness, this did not seem to lead to reactance, as has been found in studies on personalized advertising (Gazley et al., 2015; McCoy et al., 2008; Van Doorn & Hoekstra, 2013) and did not negatively affect consumer reactions as a consequence. Possibly, the positive effects of online product presentation with AR on willingness to share personal data can partly be attributed to the sample used, since young people are more used to share personal data to enable use of mobile applications (Rice & Pearce, 2015) and could have lower level of privacy concerns in general (Hilken et al., 2017; Poushneh, 2018). Thus, while online product presentation involving the self (a picture or AR) can potentially raise the intrusiveness level, it seems from these results that these costs are considered acceptable by users and are therefore willing to disclose personal information to use the technology.

This brings us to our fourth conclusion, which is that within this study, the benefits of using AR for online shopping seem to outweigh the potential costs. As stated by *equity theory* (Adam, 1963) and privacy calculus theory (Culnan & Armstrong, 1999), consumers make a cost-benefit analysis when using, in this case, AR technology. As we only found positive mediating effects on consumer reactions, the benefits (perceived enjoyment and perceived informativeness) of using online product presentation with AR outweighed the potential negative effect of intrusiveness (which was absent).

Limitations and Future Research

There are some limitations which should be kept in mind when interpreting these results. This study focused on an existing make-up application, examined in a potential user group of AR applications (18 to 30 years old women). This limits the generalizability over a more diverse user population, including older people and men, which could have differently affected the results. Regarding age, research has shown that young people are especially tech savvy and tend to have less technology anxiety compared to older people (Rice & Pearce, 2015; Vishwanath & Goldhaber, 2003). As a consequence, older people generally have more difficulties in using and adopting new technologies. Therefore, it is likely that they perceive AR applications as less useful and enjoyable than younger people and at the same time as more intrusive. Regarding gender, research has shown that women find direct product experiences more important than men, and as such perceive a higher risk of shopping online (which provides a more indirect product experience; Garbarino & Strahilevitz, 2004; Hasan, 2010). Therefore, AR might be especially beneficial during online shopping for women (as opposed to men) as it could reduce the risk of shopping online and provide a more realistic experience (Hilken et al., 2017). Thus, it could be that the positive

effects found in this study would be weaker, or even negative when considering a more diverse population of both older people and men. Studies focusing on AR have mostly used young, student samples, and differences with regard to sociodemographics have been largely neglected (Suh & Prophet, 2018). Therefore, future research should consider more diverse populations and examine whether gender and age influence the effectiveness and use of (different) AR applications.

In relation to this, our study only showed positive effects of AR and no potential negative effects. However, this cost-benefit analysis could have different outcomes for people with different characteristics. Whether benefits of AR outweigh costs or otherwise, could partly be dependent upon the level of privacy concerns (Dinev & Hart, 2006; Wottrich et al., 2018), technology-related characteristics such as technology innovativeness (Huang & Liao, 2015), and demographics that influence technology adoption as outlined in the previous paragraph (i.e., age; Rice & Pearce, 2015). Therefore, future studies could consider these personal characteristics as potential moderators to assess for whom AR has more positive, weaker, or even negative effects.

Part of our sample had to be excluded because they used a different product presentation mode than they were assigned to. While this online experimental set-up provided a more natural setting that enabled participants to try the application in their own time and in their own environment, this also enabled participants to choose a different online product presentation mode then they were assigned to. Most of these participants used the online product presentation with a picture of a model instead of the AR condition or the condition in which participants needed to upload or take a picture of their own face. While participating in this study required all participants to have a webcam or build-in camera, it could have been the case that participants turned out to not fulfill these requirements and therefore were only able to use the online product presentation with the model. Future studies could account for this by choosing a more controlled experimental setting. Additionally, it could be that some participants were not willing to use their camera and therefore chose to use another online product presentation. A reason for this could be that these participants had higher privacy concerns and were therefore not willing to give access to their camera or a picture of their face. Therefore, it is important that future studies take into account variables that could influence whether people are willing (or not) to use AR apps.

Lastly, this study considered intentions to buy products or disclosure personal information. While this gives an indication of users' responses towards AR apps and intended adoption, future studies could take into account actual behavioral measures, such as real-time buying behavior, actual personal data disclosure, and providing numbers on whether AR helps to reduce return rates. Moreover, actual user data could also inform AR literature on the type of people that use and adopt AR apps.

Implications

This study provides relevant insights to retailers and marketers wishing to invest in AR apps. The results indicate that for the potential user group of AR applications, AR helps providing an online 'try before you buy' experience, delivering an informative and enjoyable product experience which can positively affect brand attitude and purchase intentions. Since AR specifically led to beneficial effects during the online shopping experience (and not merely showing a picture of the consumers' face), it is recommended to invest in AR applications to induce positive affective and behavioral responses. Additionally, the results show that app builders should focus on both hedonic and utilitarian aspects in the AR shopping experience, as these seem to induce either affective or behavioral effects. Lastly, as shopping with AR increases users' willingness to disclose personal data, AR could not only be beneficial for brand responses, but could also help marketers to use this information and provide more personalized solutions to consumers.

In sum, the results of this study add to the AR literature by showing that the positive effects on consumer reactions were caused by AR and not merely by the presence of one's own face. Moreover, by considering potential positive and negative mediating mechanisms, this study showed that AR mainly had positive effects on brand responses and willingness to share data, through increasing perceived informativeness and enjoyment. At the same time, no negative effects were found through perceived intrusiveness. Thereby, it demonstrates that in this context, the benefits of using the technology, seemed to outweigh the potential costs in a potential user group of AR apps.

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