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Author(s): Lavoye, Virginie; Tarkiainen, Anssi; Sipilä, Jenni; Mero, Joel

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More than skin-deep: The influence of presence dimensions on purchase intentions in augmented reality shopping

Virginie Lavoye [a,*], Anssi Tarkiainen [a], Jenni Sipilä [b], Joel Mero [c]

[a] LUT Business School, PO Box 20, FIN-53851 Lappeenranta, Finland
[b] LUT Business School, Mukkulankatu 19, FIN-15120 Lahti, Finland
[c] University of Jyväskylä, School of Business and Economics, PO Box 35, FIN-40014 Jyväskylä, Finland

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ABSTRACT

Virtual try-on applications use augmented reality to virtually display products on consumers' faces or bodies. That is, they simulate a believable try-on experience by means of psychological presence, whereby the virtual experience feels real to the consumer. Grounded in social cognitive theory, this study is the first to investigate spatial presence, social presence, and self-presence to clarify the impact of virtual try-ons on consumers' purchase intentions. We demonstrate that the three dimensions of presence have varying effects on purchase intentions. Furthermore, the different outcomes of the presence dimensions are attributed to the symbolic significance ascribed to body modification consumption. We confirm this effect for two contexts that represent low and high levels of body modification. The findings reveal the roles of (1) spatial presence in the low-level body modification context, (2) self-presence in the high-level body modification context, and (3) social presence across different body modification contexts.

1. Introduction

The fashion industry currently represents the largest business-to-consumer e-commerce segment worldwide; its global market size is forecasted to reach $871.2 billion in 2023, with an annual growth rate of 11.5% (Statista, 2023). However, one of the main impediments to this segment's expansion is consumers' inability to see how products look on them (Briedis et al., 2020), which may not only hinder future growth but also harm fashion retailers' profitability owing to product returns. Virtual try-on (VTO) applications offer a promising solution to this shortcoming. VTO experiences are based on augmented reality (AR) technology and feature interactive mirrors that facilitate realistic product try-on experiences by allowing consumers to fit products virtually onto their bodies or faces prior to purchasing them (Hilken et al., 2017). For example, Ray-Ban allows consumers to model virtual sunglasses by simulating the glasses' appearance and fit (Ray-Ban, n.d.); MAC Cosmetics enables consumers to virtually apply makeup to their faces (MAC Cosmetics, n.d.); and Kohl's has collaborated with Snapchat to create Kohl's AR Virtual Closet to let users picture themselves in the new Levi's Trucker Jacket (Kohl's, 2020).

VTO tools' capacity to improve consumers' decision-making may be explained through the concept of presence, which constitutes "a psychological state in which the virtuality of experience is unnoticed" (Lee, 2004, p. 32) and leads to consumers' increased sense that they are really experiencing a given product (Hilken et al., 2017). According to Lee (2004), presence is a three-dimensional construct comprising *spatial presence*, *self-presence*, and *social presence*. The first dimension—spatial presence—refers to the psychological state in which virtual objects are experienced as actual objects (Hilken et al., 2017). The second dimension—self-presence—refers to the psychological state in which the virtual self is experienced as the actual self (Seo et al., 2017). Finally, the third dimension—social presence—refers to the psychological state in which virtual social actors are experienced as actual social actors (Gefen & Straub, 2003).

According to studies conducted two decades ago, the persuasiveness of virtual technologies was based on presence (Grigorovici, 2003; Kim & Biocca, 1997). Along similar lines, recent studies have emphasized presence as the core element driving consumer responses when using AR apps in business-related contexts, such as tourism (Fan et al., 2022), education (Cheng & Tsai, 2013), and retail (Kumar, 2022; Lavoye et al., 2021). Prior research in retail has additionally verified the pivotal role of spatial presence in delivering business-relevant outcomes, such as decision comfort (Hilken et al., 2017), positive brand attitudes (Smink et al., 2020), and purchase intentions (Kumar & Srivastava, 2022;

* Corresponding author.
E-mail addresses: virginie.lavoye@lut.fi (V. Lavoye), anssi.tarkiainen@lut.fi (A. Tarkiainen), jenni.sipila@lut.fi (J. Sipilä), joel.j.mero@jyu.fi (J. Mero).

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Whang et al., 2021). However, although research has acknowledged the importance of presence, significant gaps remain in our understanding of the mechanisms by which it operates.

First, research on VTOs has largely investigated the individual dimensions of presence separately (Hilken et al., 2017; Smink et al., 2020), thereby undermining the concept's multidimensional nature. In particular, the research has focused on spatial presence and its impact on product-related outcomes, such as purchase intentions (Hilken et al., 2017; Vonkeman et al., 2017), while the roles of self-presence and social presence remain largely unexplored. Meanwhile, research on online shopping technologies has systematically investigated a single optimal dimension, such as spatial presence, which permits the experience of products in the contexts of AR shopping (Hilken et al., 2017; Smink et al., 2020; Verhagen et al., 2014), self-presence in video games (Behm-Morawitz, 2013; Li & Lwin, 2016; Teng, 2017), and social presence in the context of 3D virtual models (Algharabat & Shatnawi, 2014). Therefore, we suggest that a three-dimensional conceptualization of the presence experience is lacking and that filling this gap can provide a more refined understanding of the psychological processes involved in consumers' e-commerce experiences. Thus, we tested a holistic view of presence to crystallize the findings in the VTO literature and to develop more precise recommendations for managers.

Second, most studies have investigated the role of presence within a single VTO context (Hilken et al., 2017; Verhagen et al., 2014; Whang et al., 2021). Research investigating the impact of VTOs on consumer outcomes has revealed conflicting findings, implying that further research is required. For example, spatial presence was found to have a significant effect on purchase intentions in the context of VTO for sunglasses (Verhagen et al., 2014) but not in the context of VTO for makeup (Smink et al., 2020). Therefore, we tested two different contexts to augment the theoretical explanations underlying the outcomes of presence.

In summary, the present study makes two major contributions to the literature. First, this is the first study in the AR field to adopt a three-dimensional conceptualization of presence and demonstrate its relevance by elucidating the psychological mechanisms that drive consumers' purchase intentions in the VTO context. Second, we demonstrate that the importance of the three presence dimensions depends on the symbolic meaning of consumption, which varies across contexts. Therefore, we suggest that researchers and practitioners should understand a specific behavior and the context in which it will occur, particularly in terms of the level of body modification involved.

2. Literature review and theoretical background

2.1. Social cognitive theory in the context of augmented reality

Social cognitive theory (SCT) explains how people learn behaviors in various contexts, including computer-mediated communication (Bandura, 2001; Schunk, 2012). Behavioral intentions result from the links between internal cognitive and affective states (i.e., an individual's personal attributes), actions undertaken in a particular situation (i.e., behavioral factors), and external influences (i.e., environmental factors) (Bandura, 2001). According to SCT, changes in behavior may occur within a social environment through the observation and emulation of behaviors performed by a model, which may be oneself or another person (Schunk, 2012). For instance, virtually seeing oneself wearing fashionable sunglasses that one likes may increase one's willingness to wear the item in real life (an effect captured by purchase intentions). However, this learning experience translates into behavior only if the individual believes in the realistic nature of the actions leading to the given outcomes (Bandura, 2001). Thus, SCT applies to virtual environments through the concept of presence (Fox & Bailenson, 2009; Li & Lwin, 2016). The realistic experience that VTO facilitates is likely to influence behavioral intentions as follows: the inspection of a virtual product (i.e., the behavioral factor) is rendered believable by spatial presence; the personally relevant virtual self as a model (i.e., the personal factor) is rendered believable by self-presence; and the VTO app is perceived as the social context (i.e., the social environment) by virtue of social presence.

2.2. Influence of presence dimensions on product-related responses

We build on existing knowledge of online shopping technologies to discuss the three dimensions of presence typically delivered by AR. Thus, based on a systematic literature review of the influence of spatial, social, and self-presence dimensions on product attitude, cognition, and behavioral intentions (Appendix A), we found that these dimensions have a positive impact on consumers' intentions to purchase in immersive shopping contexts.

Spatial presence is particularly important in terms of experiencing how a product might look and feel—for example, if one wishes to realistically place sunglasses on one's face and physically manipulate the product in the real world (Heller et al., 2019; Hilken et al., 2017). Therefore, spatial presence increases consumers' intentions to purchase a product (Verhagen et al., 2014; Vonkeman et al., 2017).

Self-presence entails that an individual resembles and identifies with the virtual self (Seo et al., 2017). It influences consumers' future behaviors through a self-modeling mechanism whereby people see themselves performing the action and learning about the outcomes of the behavior (Li et al., 2021; Li & Lwin, 2016). Prior studies have demonstrated that self-presence enhances purchase intentions in virtual environments (Behm-Morawitz, 2013; Lau & Ki, 2021; Wang et al., 2022).

Finally, social presence entails developing a sense of human connection with companies and products (Gefen & Straub, 2003). Furthermore, social presence enhances purchase intentions (Weisberg et al., 2011).

Overall, each dimension of presence can influence shoppers; however, in the discussion that follows, we shall argue that the predictive capacity of each dimension varies depending on the level of body modification that a product entails.

2.3. Role of body modification in the impact of presence on behavior change

Human symbolizing capability determines what meanings are ascribed to events and the motivating impact they exert (Bandura, 2001). Following SCT, we suggest that the conflicting findings in previous VTO presence research (Verhagen et al., 2014; Smink et al., 2020) may be explained by the symbolic meaning of consumption objects which places varying weights on the importance of the three presence dimensions (Schunk, 2012). Consumption objects placed upon the body carry a symbolic meaning that helps define and express one's identity (Belk, 1988). We propose that the level of body modification that a consumption object entails (in terms of permanence and invasiveness) affects one's purchase decisions. For example, tattoos are more permanent than mere accessories and are, therefore, used to build a coherent narrative of one's identity (Sweetman, 1999). The permanence of body modification refers to its effects, which are enduring and not easily reversible, while invasiveness refers to the level of modification on the skin or what lies beneath it (Ghigi & Sassatelli, 2018). Fig. 1 presents AR VTO apps for products that entail different levels of body modification.

Herein, we examine the wearing of sunglasses as the least permanent and invasive means of modifying one's appearance (Ghigi & Sassatelli, 2018). Sunglasses barely touch the skin and can be easily removed at any point. By contrast, tattoos are applied below the skin (i.e., most invasive), last for many years, and cannot be removed without professional treatment (i.e., most permanent). Therefore, we treat sunglasses as a low-level body modification context and tattoos as a high-level body modification context.

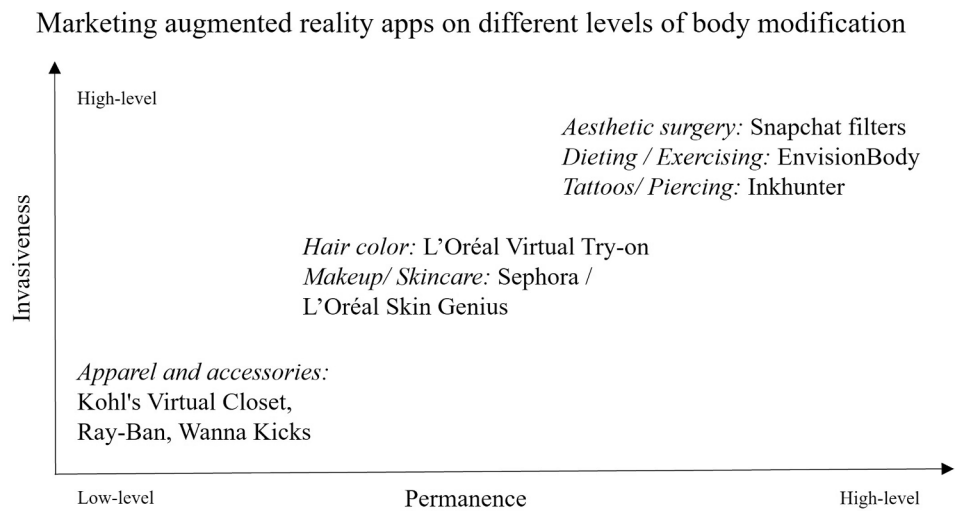

Fig. 1. Marketing augmented reality apps on different levels of body modification.

3. Conceptual model and hypothesis development

3.1. Influence of spatial presence on purchase intentions

Based on the literature review and SCT, we assert that a realistic product experience induced by spatial presence enables trying on products with realistic movements and reflects the consequences of wearing the product, which leads to higher purchase intentions. However, we suggest that the importance of spatial presence as a predictor of purchase intentions will vary depending on the level of body modification. In particular, trying on sunglasses or tattoos involves different behaviors in the offline context; thus, we expect that consumers may not always rely on spatial presence when making decisions in AR contexts.

In consumers' offline decision-making, people who try-on sunglasses may examine their style in a mirror and manipulate the product more when evaluating it; for instance they might inspect the product more precisely from every angle. An optimal sense of spatial presence involves the perception that the product is located on the consumer's body and that they can control the product in the real world (Wirth et al., 2007). As such, approximation of the real service experience in AR requires the sense that one is able to move the product in the real world to support consumers' decision-making. For example, in the context of AR apps for sunglasses retail, spatial presence improves purchase intentions (Verhagen et al., 2014).

While sunglasses (i.e., low-level body modification context) may be detached from the body and moved around as distinct objects, tattoos are inextricable from the body (i.e., high-level body modification context). This limits the ability to move the tattoo around because one cannot see behind the tattoo. Moreover, it emphasizes the need to move one's body rather than the tattoo when inspecting it, thus emphasizing the modified body rather than the product itself, making it less important to move the tattoo around when making a purchase decision. Accordingly, we propose that consumers experience spatial presence in tattoo AR apps but that it does not improve purchase intentions. On this basis, we formulated the following hypothesis:

H1. The extent of body modification moderates the effect of spatial presence on purchase intentions, such that:

(a) For low-level body modification consumption, spatial presence positively influences purchase intentions.
(b) For high-level body modification consumption, spatial presence does not influence purchase intentions.

3.2. Influence of self-presence on purchase intentions

Consumers' use of AR-based VTO applications to view photorealistic representations of themselves enhances their self–brand connection and purchase intentions (Baek et al., 2018). Behm-Morawitz (2013) demonstrated that the greater the level of self-presence, the more likely one is to use the virtual self as a source for making judgments about

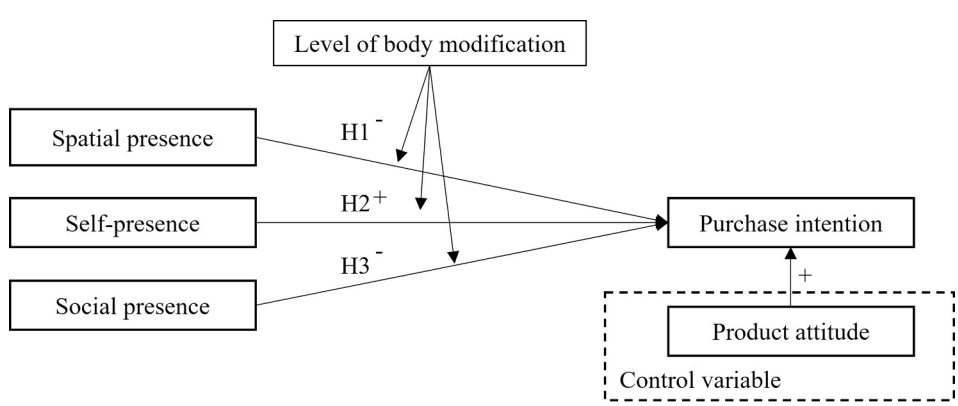

Fig. 2. Conceptual model and hypotheses.

oneself and as a factor in one's decision-making. According to SCT, self-presence can persuade consumers because it makes the consequences of their decision-making personally relevant (Schunk, 2012).

However, as in the case of spatial presence, the importance of self-presence may differ across contexts entailing varying levels of body modification studied in the present paper—namely, sunglasses and tattoos. Given that tattoos are located under the skin and are an integral part of one's physical appearance, customers might have a more intimate relationship with them than with sunglasses.

Tattoos are permanent and irreversible; thus, they permit affirming one's self-identity (Ghigi & Sassatelli, 2018). They also influence physical attractiveness and help construct a complex visual narrative of the self (Roux & Belk, 2019). As body art, tattoos represent a complex process of redefining and expressing one's identity (Roux & Belk, 2019). The wearer's more intimate relationship with tattoos might explain why consumers focus more on self-relevant cues and, consequently, why self-presence dominates their decision-making to the extent that it diverts their attention from spatial presence. Therefore, we assert that AR-induced self-presence leads to greater purchase intentions for high-level body modification consumption, as follows:

H2: The extent of body modification moderates the effect of self-presence on purchase intentions, such that:

(a) For low-level body modification consumption, self-presence does not influence purchase intentions.
(b) For high-level body modification consumption, self-presence positively influences purchase intentions.

3.3. Influence of social presence on purchase intentions

Social presence is an important topic in e-commerce (Kumar & Benbasat, 2006). Bandura (2001) noted that learning invariably occurs in a social setting. In addition, shopping is typically a social activity, and online shopping requires social presence (Weisberg et al., 2011). VTO technology reduces the user's effort by virtually displaying the try-on situation without necessitating that the consumer imagines what it would look like (Heller et al., 2019). Thus, when it helps to try on several products similar to what a salesperson does in a physical store, a VTO provides social presence (Gefen & Straub, 2003). In online shopping, therefore, social cues associated with social presence increase purchase intentions (Gao et al., 2018; Yen & Chiang, 2021). Based on this stream of literature and SCT, we propose that AR-based VTO can provide a social environment in which self-modeling experiences occur and lead to behavioral changes. Thus, we assert:

H3: Social presence positively influences purchase intentions.

Fig. 2 presents the conceptual model.

4. Methodology

4.1. Procedure

Presence dimensions are rarely studied altogether; therefore, before conducting the main data collection, we conducted a pretest that aimed to ensure the appropriateness of our survey instrument. We used a sample of university students (n = 70) from two business school courses. Among the participants, 63 were between 18 and 25 years old, 5 between 25 and 34 years old, and 2 between 35 and 44 years old. In addition, 42 were women, 26 were men, and 2 preferred not to say. We applied confirmatory factor analysis (CFA)– structural equation modeling (SEM) and confirmed convergent reliability: the lowest composite reliability (CR) was 0.79 with a threshold of 0.60, while the lowest average variance extracted (AVE) was 0.54 with a threshold of 0.50 (Hair et al., 2010). When using a VTO for sunglasses, spatial ($\beta = 0.31$, $p < .05$) and social presence ($\beta = 0.45$, $p < .05$) positively impacted attitude certainty, while self-presence did not ($\beta = 0.11$, n.s.). This pretest provided evidence for the contextual importance of presence dimensions and served as a foundation for the multidimensional main study.

In the main study, we compared two samples from two conditions representing low and high levels of body modification: one VTO for sunglasses and one for tattoos. Upon accessing the questionnaire, the participants were asked to indicate their ages to ensure a representative sample. The participants could only access the VTO and questionnaire using a mobile device. In the sunglasses group, the participants accessed the VTO app on the brand's website. In the tattoo group, the participants needed to download an app similar to that in previous studies (Daassi & Debbabi, 2021; Park & Yoo, 2020). In both instances, the participants were first presented with a welcome page that instructed them to try on selected products (sunglasses or tattoos). Next, they received detailed instructions on how to use the VTO applications. The participants were then directed to the VTO app, where they viewed virtual products superimposed directly onto their own bodies. Web Appendix A presents the stimuli. We asked the participants to confirm that they had used the VTO apps, and we implemented an attention check ("Does this statement correspond to the task you completed: 'I fitted products on fashion models," to which the correct answer was "No") at the beginning of the questionnaire. If the participants did not use the VTO or failed the attention check, they could not access the rest of the questionnaire. The participants could spend as much time as they wanted inspecting the products and, subsequently, responding to the questionnaire ($M_{\text{response time}} = 5$ min including interaction with the VTO and responding to the questionnaire). We excluded respondents whose answering time was less than two minutes and whose answers were straight-liners. Of the original 458 participants, 58 were rejected. We conducted an additional round of data collection (n = 66), from which we excluded 8 more participants based on the exclusion criteria detailed above. In the final sample (n = 458), 254 participants tried on the sunglasses and 204 participants tried on tattoos. The detailed characteristics of the participants are reported in Web Appendix B.

Finally, we ran an additional post-hoc test with 32 participants and confirmed the extent of body modification in our contexts. We asked the participants to rank six items, from 1 = the most invasive to 6 = the least invasive. The participants reported a significantly greater level of invasiveness for tattoos (M = 2.44, SD = 1.24) than for sunglasses (M = 4.50, SD = 1.39), $t(31) = -4.79$, $p < .05$, $r = 0.65$ (Web Appendix C).

4.2. Measures

We used established measures from the literature to capture the constructs in our study (Appendix B). We controlled for the effects of product attitudes on purchase intentions to determine the extent to which the presence dimensions explained the dependent variable beyond product attitudes, given that a large body of research has confirmed the relationship between attitudes and behavioral intentions (e.g., Ajzen, 1991; Ajzen & Cote, 2008; Zhu & Chang, 2014).

We used CFA-SEM because it is theory-driven (Schreiber et al., 2006) and tested the model in LISREL 12. Similar to McLean and Wilson's (2019) study, measurement invariance was tested under the two VTO

Table 1
Multigroup confirmatory factor analysis for invariance testing.

Model	χ^2 (d.f.)	Delta: χ^2 (d.f.)	RMSEA	NNFI	CFI
Configural invariance	481.27 (218)		0.07	0.98	0.98
Metric invariance	498.95 (230)	17.68 (12)	0.07	0.98	0.98
Factor invariance	503.95 (235)	5 (5)	0.07	0.98	0.98

Note. χ^2 = Chi-square; d.f. = Degrees of freedom; RMSEA = Root mean square error of approximation; NNFI = Non-normed fit index; CFI = Comparative fit index.

Table 2
Measure properties.

	1	2	3	4	5	Square root AVE
Low-level body modification (sunglasses)						
1. Spatial presence	1					0.82
2. Self-presence	0.84	1				0.86
3. Social presence	0.82	0.85	1			0.88
4. Product attitude	0.60	0.62	0.54	1		0.91
5. Purchase intention	0.75	0.74	0.74	0.68	1	0.89
CR	0.92	0.92	0.91	0.93	0.92	
AVE	0.68	0.73	0.78	0.82	0.92	
High-level body modification (tattoos)						
	1	2	3	4	5	Square root AVE
1. Spatial presence	1					0.82
2. Self-presence	0.83	1				0.86
3. Social presence	0.81	0.74	1			0.88
4. Product attitude	0.63	0.53	0.52	1		0.91
5. Purchase intention	0.69	0.65	0.64	0.71	1	0.89
CR	0.89	0.92	0.91	0.93	0.92	
AVE	0.68	0.73	0.78	0.82	0.78	

Note. CR = Composite reliability; AVE = Average variance extracted.

Table 3
Results of hypothesis testing.

Relationships / Level of body modification	Low	High	Result
Spatial presence → PI			
Standardized effects	**0.20***	$0.08^{n.s.}$	H1: Accepted
Standard error	0.12	0.14	
t-value	1.84	0.63	
Self-presence → PI			
Standardized effects	$0.08^{n.s.}$	**0.23***	H2: Accepted
Standard error	0.11	0.13	
t-value	0.82	2.00	
Social presence → PI			
Standardized effects	**0.27****	**0.20***	H3: Accepted
Standard error	0.11	0.12	
t-value	2.88	1.93	
Product attitude → PI			
Standardized effects	**0.40*****	**0.47*****	
Standard error	0.06	0.06	
t-value	6.92	7.22	

Note. Critical t-value (one-tailed) = 1.645; Significance level: *** p <.001, ** p <.01, * p <.05. Bolded values were significant. PI = purchase intentions.

conditions (sunglasses and tattoos). Factor invariance entails that the factor loadings are attributes of the tests and, therefore, should be independent of the population sampled, whereas the distribution of the factors themselves may differ across populations (Jöreskog & Sörbom, 1993). Factor invariance confirmed equivalence between groups and enabled the comparison of relationships across them; therefore, it served as a test of moderation hypotheses (Hair et al., 2010). Testing the invariance of the path parameters with our two-group multigroup analysis involved three steps: configural, metric, and factor invariance. In each step, we compared an unconstrained measurement model with a constrained one and used changes in chi-square (χ^2) and degrees of freedom (d.f.) to determine whether invariance existed between the measurement models. We confirmed factor invariance by constraining the factor loadings to be equals and reported insignificant degradation of the model fit compared to the base model (Table 1). Table 1 further shows that the model displayed a good fit.

The multigroup CFA confirmed convergent validity, as all loadings were above 0.70 and statistically significant (Web Appendix D). CR was above the threshold value of 0.60 for all items under all conditions (Bagozzi & Yi, 1988), and the AVE values for each construct exceeded the threshold value of 0.50 (Hair et al., 2010). Discriminant validity was confirmed using the Fornell–Larcker criterion (Fornell & Larcker, 1981) by comparing correlations with the square root of AVE values for the corresponding constructs (Table 2). We also ruled out common method bias (Web Appendix E) in the study design following Mackenzie and Podsakoff's (2012) recommendations and conducted Harman's single-factor test, here in line with Korsgaard and Roberson's (1995) and Mossholder et al.'s (1998) studies.

Table 4
Moderating effects of the extent of body modification on purchase intentions.

Model	χ^2 (d.f.)	Delta: χ^2 (d.f.)	Hypothesis
Unconstrained model	503.95 (235)		
Constrained1	502.02 (242)	16.07 (7)	H1: Moderation of spatial presence
Constrained2	520.42 (242)	16.47 (7)	H2: Moderation of self-presence
Constrained3	519.76 (242)	15.82 (7)	H3: Moderation of social presence

4.3. Results

The hypotheses were tested using SEM, which was estimated based on the hypothesized model in Fig. 2. The model presented a good fit (χ^2 = 219.52, d.f. = 241, p <.005, RMSEA = 0.07, CFI = 0.99, NNFI = 0.98) and supported all hypothesized relationships (Table 3).

Hypothesis 1 was confirmed because the results showed that spatial presence was significantly related to purchase intentions only in the low-level body modification condition (H1: β_{low} = 0.20, p <.05), not in the high-level body modification condition (H1: β_{high} = 0.08, n.s.). The second hypothesis was supported as self-presence positively impacted purchase intentions for consumption with a high level of body modification (H2: β_{high} = 0.23, p <.01) but not in the low-level body modification condition (H2: β_{low} = 0.08, n.s.). Finally, hypothesis 3 stated that social presence is significantly related to purchase intentions, which was confirmed in both conditions (H3: β_{low} = 0.27, p <.001; β_{high} = 0.20, p <.01).

As expected, product attitudes influenced purchase intentions in both conditions (β_{low} = 0.40, p <.001; β_{high} = 0.47, p <.001). Thus, the hypotheses were tested through SEM in two steps. First, we estimated a model with only the control variable (i.e., product attitudes) and recorded the squared multiple correlation (R^2). Second, we estimated the full model presented in Fig. 2. Product attitudes alone explained 52% of the variance, and the full model explained 70% of the variance in purchase intentions. Therefore, we confirmed that the presence dimensions explained the impact of the VTO on purchase intentions beyond product attitude.

4.4. Moderating effects of the extent of body modification

To further estimate moderator effects in SEM, we additionally run three constrained versions of the unconstrained model by fixing the path from each presence dimension. First, constrained model version 1 fixed the path from spatial presence to purchase intentions to be equal in both samples. Second, constrained model version 2 fixed the path from self-presence to purchase intentions to be equal in both samples. Third, constrained model version 3 fixed the path from social presence to purchase intentions to be equal in both samples.

Table 4 reports the chi-square values and degrees of freedom of these constrained models and the model comparison tests. If there is moderation, the constrained model ($\gamma_{sunglasses} = \gamma_{tattoo}$) will have a significantly worse fit (i.e., increase in the chi-square). Without moderation, the constrained model ($\gamma_{sunglasses} = \gamma_{tattoo}$), will not deteriorate the model fit. Thus, we gain further support for our hypotheses suggesting that the extent of body modification moderates the impact of spatial presence (i.e., H1) and self-presence (i.e., H2) on purchase intentions.

However, this analysis further revealed a moderating effect for social presence, which we did not originally hypothesize. This result is attributable to the fact that consumers often use clothes and accessories

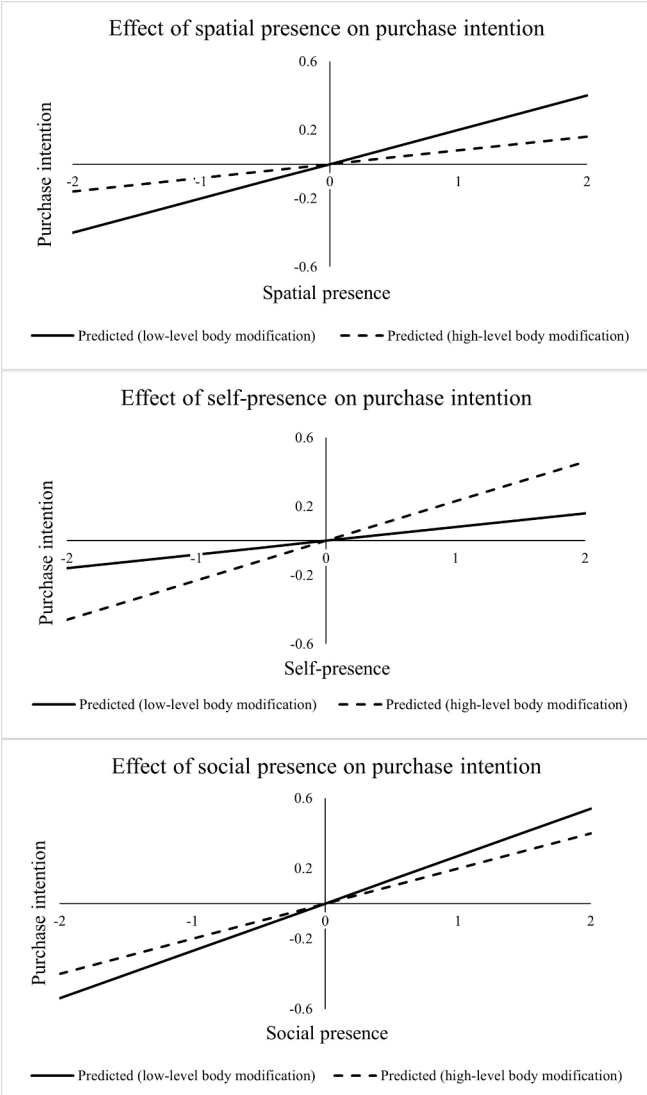

Fig. 3. Plots of the moderating effects of body modification on the relationship between presence and purchase intention.

(i.e., low-level body modification) to manage how other people perceive them (Peluchette et al., 2006), whereas high-level body modification consumption is a more personal expression of one's identity (Roux & Belk, 2019). Thus, the influence of social presence may not be as strong in the high-level body modification context, as consumers may not use social cues in their purchase decisions to the same extent as in the low-level body modification context. In conclusion, the analyses provide further detail on social presence; although social presence positively influences purchase intentions in both conditions, as expected in H3 (Table 3), the result is more emphasized in the low-level body modification condition.

Fig. 3 shows the moderating effects of the extent of body modification on the relationship between presence and purchase intention.

4.5. Robustness check

We previously controlled for the impact of product attitude; however, it is necessary to rule out the influence of additional factors (Appendix B) pertaining to app features that might influence consumers while using the VTO (Web Appendix F).

First, we observed no difference between the two modes of using VTO tools (i.e., app and website) with respect to the experience of presence, product attitude, and purchase intentions, with the exception of spatial presence. Given that we used a commercially available AR-based VTO app, we confirmed that there were no difference in prior attitudes between the conditions. For sunglasses, we adopted brand attitude because we used an app affiliated with a well-known sunglasses brand. For the tattoo app, we ruled out the influence of app attitudes rather than brand attitudes given that tattoos are typically unbranded products. We then confirmed that the technological features themselves did not change the AR experience. Thereafter, we observed no significant difference between genders or devices used in terms of the experience of presence, product attitude, and purchase intention (Web Appendix G). Finally, we reported our model with demographic variables as control variables and confirmed that demographics do not confound our model (Web Appendix H).

5. Discussion

5.1. Theoretical contributions

To the best of the authors' knowledge, this is the first study to adopt a multidimensional conceptualization of presence in investigating its impacts on decision making in an AR environment. Thus, we extend the research on presence in the context of AR (e.g., Hilken et al., 2017) by showing that all three presence dimensions have the potential to affect purchase intentions, which demonstrates the relevance of our multidimensional approach. Furthermore, the current study is one of the first to compare the impacts of presence in different AR contexts. Our multidimensional and multi-contextual approach helps address previous conflicting research results on the impact of presence on purchasing behavior in the AR environment (Verhagen et al., 2014; Smink et al., 2020).

First, based on the three dimensions of SCT, we have shown the importance of the three dimensions of presence. SCT states that behavior change occurs when people trial new behaviors and derive benefits therefrom (Bandura, 2001). Therefore, an effective VTO experience requires presence (Smink et al., 2020). SCT also states that three dimensions (i.e., behavioral, personal, and social determinants) explain behavior change; however, the symbolic meaning associated with an action determines how the information is observed and organized for future use (Bandura, 2001). Therefore, we show that AR presence can influence purchase intentions when it delivers information that consumers use in their decision making, here depending on the symbolic meaning of the consumption associated with different levels of body modification. Concretely, spatial presence informs decision-making, depending on the contextual importance of evaluating an object (the behavioral determinant). Self-presence is used in decision making to consider consumption closely tied to identity (the personal determinant). Finally, learning about products invariably occurs in a social context; therefore, social presence is consistently influential (the social determinant).

Second, our results also contribute to research on individual presence dimensions. We reaffirm the importance of spatial presence for consumer decision-making (Hilken et al., 2017; Verhagen et al., 2014) and further clarify its key role in leading to purchase intentions in the low-level body modification context. Consistent with our findings, Smink et al. (2020) found that spatial presence was salient in the use of a furniture app but not in a makeup app, suggesting that personalization cues are more important when consumers see their own faces. We extend this explanation by conceptualizing the role of self-presence in selling products that involve high levels of body modification. This has been confirmed by research on high-level body modification practices which found that self-presence influences exercising behavior (Behm-Morawitz, 2013; Li & Lwin, 2016), while social and self-presence mediate healthy eating intentions (Jin, 2011). Exercise and healthy eating behavior result in self-enhancement and bodily transformation (Ghigi & Sassatelli, 2018) and are more permanent and invasive

practices than wearing sunglasses.

Third, in the case of social presence, we find that AR-based VTO tools facilitate believable consumer–firm interaction because social presence is a crucial predictor of purchase intention in both conditions. Social presence theory notes that although AR does not permit large-scale human communication, the level of social presence in AR is sufficient for it to serve as the most consistent predictor of purchase intention. Therefore, while a VTO may not provide the highest possible level of presence; it may nonetheless be optimal in the retail context. This result extends the knowledge of social presence in the computers-as-social-actors literature (Nass et al., 1994). In particular, AR-based social presence is sufficient for consumers to perceive that AR-VTO technology is a social actor and to influence purchase intention.

5.2. Practical implications

AR provides greater presence than traditional technologies, such as websites (Vonkeman et al., 2017) and brands use AR-based VTO tools to sell directly to consumers and increase their margins. Therefore, VTO tools help brands create a competitive advantage and offers a means of acquiring and engaging consumers. It is thus important to provide a framework that shows the different tactics that may be used to influence purchase intention within the context of VTOs. The present study indicates that no single route to behavior change works best across all contexts. Rather, we suggest that practitioners should aim to understand a specific behavior and the context in which it will occur. Social presence theory (Short et al., 1976), SCT (Bandura, 2001), and our empirical findings collectively suggest that the optimal level and type of presence vary depending on the situation. Therefore, the present study used SCT as a foundation for recommending features that improve consumer decision-making, as tailored to different product contexts.

We examined VTO apps pertaining to different levels of body modification to help managers predict the presence dimensions necessary to enhance consumer decision making. When consumers shop for low-level body modification products, such as apparel and accessories, these products are more free-floating by nature. Therefore, when participating in a try-on experience, spatial presence is likely to influence purchase intentions. Spatial presence is the most widely investigated dimension of presence because it helps evaluate experiential products, such as a car or a sofa.

However, for higher-level body modification practices, such as makeup, tattoos, and plastic surgery, consumers may value self-presence more in their decision-making. Beyond the existing knowledge that one's virtual self influences consumers to change their diets or exercise more (Behm-Morawitz, 2013), marketers may exploit the ability to portray the individual's virtual self to promote products as a means of acquiring associated health rewards. For public institutions, the use of a virtual self to associate the use of nicotine patches with positive health rewards might promote their use. Furthermore, because consumers rely both on self-relevant and social cues in high-level body modification conditions, brands can create long-lasting relationships through self–brand connections. The salience of social and self-presence may influence consumers to view the brand as they view themselves and in a relationship with themselves (MacInnis & Folkes, 2017).

Social presence was confirmed to be the most consistent predictor of purchase intentions across product categories, which implies that companies should invest in social cues to enhance social presence in the VTO environment. Virtual e-commerce benefits from enhanced trust; therefore, social cues are highly important in virtual shopping (White Baker et al., 2019). We propose that the addition of recommendation tools to VTO tools will enhance social presence, as suggested by Kumar and Benbasat (2006), who demonstrated that recommendations and consumer reviews lead to a higher level of social presence. Some firms have already provided recommendation tools in addition to VTO technology. For example, L'Oréal's (n.d.) Skin Genius analyzes five key skin attributes and provides consumers with a recommendation agent to offer personalized skincare advice based on artificial intelligence and image recognition. Ray-Ban (n.d.) offers a recommendation agent that helps consumers find the perfect sunglasses based on their face shape. These recommendation tools can also enhance convenience by providing consumers with personalized advice from experts. Such features therefore would help retailers impress their consumers (Grewal et al., 2017).

5.3. Limitations and future research

The present study has several limitations that can serve as avenues for future research. First, the data presented herein were largely based on first-time users' experiences because most participants (83%) had no prior experience with VTO technology. Given the novelty of AR-based VTO technology, our data are likely to be representative of the current state of consumers' usage of AR shopping tools. However, in the future, as similar technologies become more widely used, it will be necessary to study samples of consumers who have more experience with the technology. Future research should also consider including other variables in our model, such as price, the amount of product information, and online reviews. Second, we used existing apps from different designers, which may explain why spatial presence differed so significantly across the distinct use cases. We found that the tattoo app had the strongest spatial presence: people may have moved their arms around more than their faces, since head movements are constrained by neck mobility. However, these differences do not appear to transfer to purchase intentions in the same manner, because spatial presence in the tattoo app does not impact purchase intentions. Therefore, future research should investigate the precise use cases that lead to increased spatial presence. For example, product realism, which is composed of visual appeal features—such as the color of the sunglasses and the quality/realism of the tattoo—may influence spatial presence. Our study included two product categories, highlighting the differences between them in terms of the three dimensions of presence. Thus, it is likely that future studies based on additional product categories will identify further differences between the presence dimensions in terms of their influence on consumer decision-making.

Third, although the present study offers a moderation analysis that provides empirical verification for our model, we recommend that future studies provide additional tests of moderation for the impact of the level of body modification on purchases. Finally, the present paper is among the first to point out the importance of presence in AR-related literature and highlight the need for further research on this topic. Notably, our literature review suggests that presence facilitates the evaluation of products, ties the experience to one's identity, and enables trust that leads to purchase intentions. Therefore, additional processes that explain the outcomes of presence remain to be investigated. In addition, future research with a multidimensional conceptualization of presence may clarify the unique contributions of other online shopping technologies. Thus, we hope that the present study will inspire future research that focuses on the performance of online businesses.

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CRediT authorship contribution statement

Virginie Lavoye: Writing – original draft, Data curation, Conceptualization, Writing – review & editing, Visualization, Formal analysis, Methodology, Project administration. **Anssi Tarkiainen:** Writing – review & editing, Conceptualization, Visualization, Supervision, Methodology. **Jenni Sipilä:** Writing – review & editing, Conceptualization, Visualization, Supervision. **Joel Mero:** Writing – review & editing, Conceptualization, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A

Table A1

Table A1
The impact of psychological presence dimensions on product-relevant attitude, cognition, and behavioral intention.

References	Data (sample)	Condition	Process variable(s)	Outcome variable(s)	Selected key findings
Presence[1]					
(Li et al., 2001)	Qualitative (30)	3D images	Product type	Product knowledge, physical presence, and affordances	Strong sense of physical presence enhances consumer learning.
(Li et al., 2002)	Experiment (153)	3D images vs. 2D images on website	Physical presence	Product knowledge, brand attitude, and purchase intentions	3D images enhance presence for both material and geometric products and result in higher product knowledge, brand attitudes, and purchase intentions than 2D images.
(Klein, 2003)	Experiment (240)	Image on website	User control and media richness, Telepresence	Belief strength about product attributes and attitude intensity toward the product.	Telepresence enhances belief strength and attitude intensity toward the product. User control and media richness increase telepresence.
(Li et al., 2003)	Mixed methods (124)	3D images vs. 2D images on website	Product type	Product knowledge, brand attitudes, and purchase intentions	3D images enhance brand attitude and purchase intentions for both material and geometric products.
(Hopkins et al., 2004)	Experiment (320)	Online advertisement	Media richness and telepresence	Involvement, attitude toward the ad, brand attitude, and purchase intention	Telepresence increases involvement and leads to increased consumer attitudes and intentions.
(Ahn & Bailenson, 2011)	Experiment (231)	Self-endorsed advertisement on website	Spatial and self-presence	Self-referencing, brand attitude, purchase intention, and self–brand association	Self-endorsement enhances brand attitude and the self–brand association. Self-referencing is proposed as the underlying mechanism.
(Verhagen et al., 2014)	Experiment (366)	AR VTO vs. product presentation	Local presence, product tangibility, and product likability	Online purchase intentions	Local presence enhances product tangibility and likability and, in turn, improves online purchase intentions.
(Hilken et al., 2017)	Experiment (832)	AR VTO vs pictures, 360-spin rotation, or non-AR VTO	Environmental embedding (EE), simulated physical control (SPC), spatial presence, utilitarian and hedonic value, decision comfort/ style of information processing and awareness of privacy practices	Patronage and purchase intentions	AR features enhance spatial presence and decision comfort—which, in turn, increase purchase intentions. The impact of spatial presence on decision comfort is decreased when consumers have a high level of concern about privacy issues.
(Vonkeman et al., 2017)	Experiment (212)	Pictures, 360-spin rotation, and AR VTO	Interactivity, vividness, local presence, product risk, and product affect	Urge to buy impulsively	Interactivity and vividness improve local presence and impulse buying.
(White Baker et al., 2019)	Survey (237)	Online shopping in a virtual world and on the website	Telepresence and social presence	Attitudes toward site, and purchase intentions	Telepresence and perceived social presence enhance trust and enjoyment (and perceived usefulness for social presence only) and influence site attitudes.
(Martínez-Navarro et al., 2019)	Survey (236)	VR (vs 360° images) commerce	Emotions, discomfort, affective appraisal, and presence	Brand recall and purchase intentions	In VR, emotions and presence improve purchase intentions while affective appraisal leads to brand recall.
(Daassi & Debbabi, 2021)	Survey (224)	AR	Perceived augmentation, immersion, product presence, perceived realism,	Attitude toward AR, intention to reuse app	Immersion, product presence, and perceived realism mediate the impact of augmentation on consumers' attitudes and intentions.
Self-presence					
(Shim & Lee, 2011)	Survey (390)	3D virtual model	Similar body shape	Perceived risk about apparel fit	3D virtual model (vs. 2D) reduces consumers' perceived product risk. Particularly when the body shape of the virtual model matches the participants' real bodies.
(Suh et al., 2011)	Experiment	VR virtual store with body scanning	Face similarity, body similarity, avatar identification, self-satisfaction, attachment	Perceived diagnosticity of apparel, intention to use avatar for try-on	Physical similarity and avatar identification enhance apparel product diagnosticity and increase intentions to use avatar for try-on.
(Kim et al., 2012)	Survey (183)	Virtual world	Attractiveness of the avatar and variety of items, avatar identification	Self-efficacy, trust, continue to use	Decorating and beautifying avatars helps users identify with avatars; thus, it increases self-efficacy about one's skills

(*continued on next page*)

Table A1 (*continued*)

References	Data (sample)	Condition	Process variable(s)	Outcome variable(s)	Selected key findings
					and trust toward other members and results in purchase intentions of virtual world services.
(Behm-Morawitz, 2013)	Survey (279)	Virtual world	Self-presence, physical similarity	Motivation to change style, body appearance and exercise	Self-presence enhances users' motivation to change their style and body appearance and to exercise offline.
(Wu & Hsu, 2018)	Survey (411)	Virtual world	Aesthetic design, avatar identification, cocreation, authenticity	Play intention, virtual items purchase intentions	Avatar identification enhances the sense that the game is authentic and results in higher intentions to play and to purchase in-game items.
(Wang et al., 2022)	Longitudinal survey (1515)	Virtual world purchases	Game affordances, gamer orientation, avatar identification	Hedonic and utilitarian in-game purchases	An attractive game aesthetic helps consumers identify with avatars. Identification with the avatar motivates players to purchase hedonic and utilitarian in-game items.
Social presence					
(Gefen & Straub, 2003)	Experiment (161)	E-commerce website	Social presence, perceived ease of use, and perceived usefulness	Trust and purchase intentions	Social presence (closely related to information richness) improves trust and purchase intentions.
(Fortin & Dholakia, 2005)	Experiment (360)	Website advertisement	Interactivity, vividness	Social presence involvement and arousal	Interactivity and the vividness of a message enhance social presence and involvement, in turn leading to positive attitudes toward brand and purchase intentions.
(Hassanein & Head, 2005)	Experiment (168)	E-commerce website (apparel vs. headphones)	Perceived ease of use, social presence, perceived usefulness, trust, enjoyment	Product attitudes	Social presence influences trust, enjoyment, and perceived usefulness of the website and improves attitudes toward products. The key role of product type is that the effect of social presence on trust is higher for apparel than for headphones.
(Hassanein & Head, 2007)	Experiment (78)	E-commerce website social cues	Social presence and perceived ease of use	Usefulness, trust, enjoyment of shopping websites, and consumer attitudes	Enhanced social presence improves usefulness, trust, and enjoyment and leads to positive purchase-related attitudes.
(Pavlou et al., 2007)	Survey (521)	Website	Social presence, trust, product diagnosticity, website informativeness	Perceived uncertainty, purchase intentions, actual purchase	Social presence decreases information privacy and security concerns because it increases consumers' feeling of proximity to seller.
(Dash & Saji, 2008)	Survey (486)	E-commerce website	Self-efficacy, social presence, perceived usefulness	Perceived risk, trust, purchase intentions	Social presence increases trust and reduces risk and leads to higher purchase intention online.
(Weisberg et al., 2011)	Survey (115)	E-commerce website	Purchase experience, social presence, trust	Purchase intention	Purchase experience and social presence promote purchase intention online. Trust mediates this effect.
(Shen & Khalifa, 2012)	Experiment (151)	E-commerce website	Telepresence, Social presence, pleasure, arousal	Impulse purchase	Telepresence and social presence provide a compelling experience and increase impulse purchase.
(Algharabat & Shatnawi, 2014)	Survey (330)	3D virtual model VTO	Perceived usefulness, enjoyment and social presence, 3D quality	Perceived risk and purchase intention	Social presence increases purchase intentions and decreases perceived risk through the mediating effect of 3D quality.
(Lee & Park, 2014)	Experiment (407)	E-commerce website	Cue multiplicity, telepresence, social presence, trust, enjoyment, social approval	Product choice confidence	Telepresence and social presence increase decision confidence through website trust.
(Gao et al., 2018)	Survey (259)	E-commerce website	Telepresence, social presence, autonomy, relatedness, stickiness	Purchase intention	Presence dimensions deliver a positive online experience and increase purchase intentions.
(Bleier et al., 2019)	Experiment (1.470)	E-commerce website	Informativeness, entertainment, social presence, and sensory appeal	Purchase	Linguistic style and lifestyle pictures are key features for enhancing social presence. Social presence and sensory appeal are more important for experiential products (vs. search). The impact of social presence on purchases is equally as important as the impact of informativeness.
(Sohn et al., 2020)	Experiment (647)	E-commerce website	Social cues, social presence, trust	Organic wine purchase intention	Social cues enhance purchase intentions via social presence and trust. This relationship is not moderated by familiarity with wine or goal-directed shopping.
This study	Survey (458)	AR VTO (low vs high-level body modification conditions)	Spatial, social, and self-presence	Purchase intention	Spatial and social presence influence purchase intentions in the low-level body modification condition, while social and self-presence enhance purchase intentions in the high-level body modification condition. The extent of body modification moderates the impact of presence dimensions on purchase intention.

Note: [1]Presence, also called telepresence, encompasses physical and spatial presence and any other concept related to a sense of presence in a virtual environment. AR: augmented reality; VTO: virtual try-on; 3D: three-dimensional; 2D: two-dimensional.

Appendix B

Table B1

Table B1
Overview of constructs and measurement

Construct	Item wording
Respondents answered on a seven-point Likert scale ranging from 1 = "strongly disagree" to 7 = "strongly agree."	
Spatial presence adapted from Hilken et al. (2017).	SP1: It was as if the true location of the product had shifted into the real-world environment.
	SP2: I felt like the product meshed with the real-world surroundings.
	SP3: I felt like I could move the product around in the real world.
	SPP4: The product gave me the feeling I could do things with it.
Self-presence adapted from Seo et al. (2017).	SEP1: I felt like this character looked like me.
	SEP2: I felt like I identified with this character.
	SEP3: I felt like this character represented something in me.
	SEP4: I felt like this character had meaning for me.
Social presence adapted from Gefen and Straub (2003).	SO1: I felt like there was a sense of sociability in the try-on service.
	SO2: I felt like there was a sense of human warmth in the try-on service.
	SO3: I felt like there was a sense of human sensitivity in the try-on service.
Purchase intention adapted from Verhagen et al. (2014).	PI1: It is likely that I will soon buy products via this app.
	PI2: It is likely that I will purchase products from an app offering this try-on service in the future.
	PI3: It is likely that I will return to this try-on service.
AR experience composed of environmental embedding and simulated physical control adapted from Hilken et al. (2017).	AR1: I was able to see how the product looked on my face.
	AR2: I could visualize how the product fit on my face.
	AR3: I felt like I was wearing this product on my face.
	AR4: The try-on experience was easy to control.
	AR5: I had physical control over the try-on experience.
	AR6: I was able to move the product.
Attitude toward app (Porter & Donthu, 2006)	AT1: I am positive about the app.
	AT2: The app is so interesting that you just want to learn more about it.
	AT3: It just makes sense to use the app.
Respondents answered on a seven-point semantic differential scale—for instance, from 1 = "Bad" to 7 = "Good."	
Brand attitude adapted from Li et al. (2002).	BA1: Bad/good
	BA2: Unappealing/appealing
	BA3: I don't like the brand/ I like the brand
Introduced by the following statement: "Which of the following adjectives best describes your attitude toward the products displayed in the try-on service?"	
Attitude toward products adapted from Briñol et al. (2004)	PA1: Unfavorable/favorable
	PA2: Negative/positive
	PA3: Bad/good

Web Appendices. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbusres.2023.114247.

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Virginie Lavoye is a Junior Researcher in Digital Marketing and a doctoral candidate at LUT Business School. Her research focuses on consumer behavior with immersive technology and sustainability. Her work has been published in the *Journal of Services Marketing* and the *International Review of Retail, Distribution and Consumer Research*.

Anssi Tarkiainen is Professor of Digital Marketing at LUT Business School. The overarching theme of his research is human behavior and the decision-making of individuals and groups, which he has studied in the contexts of digital marketing, consumer behavior, sales management, and strategy.

Jenni Sipilä is an Academy of Finland Postdoctoral Researcher at LUT Business School and holds a Title of Docent at the University of Turku. She received the degree of D.Sc. (Economics and Business Administration) from LUT University in 2018. Her research focuses on consumer behavior, sustainable consumption, and sustainability communication and has been published in esteemed journals, including the *Journal of Consumer Psychology*, the *Journal of the Academy of Marketing Science*, and the *Journal of Business Research*. She has extensive international experience (University of Mannheim, Stanford University) and has received several awards for her academic activities.

Joel (Järvinen) Mero is an Associate Professor (tenure track) of Marketing at the University of Jyväskylä (School of Business and Economics). He received the degree of D.Sc. (Economics and Business Administration) from the University of Jyväskylä in 2016. His research focuses on the use of data and new technologies in marketing management. His previous research has been published in *Industrial Marketing Management*, the *Journal of Business Research*, the *Journal of Services Marketing*, and *Electronic Markets*, among others. Mero has received the Best Paper award in *Industrial Marketing Management* twice (2017 & 2019) as a corresponding author.