Young Customer Responses to Service Robots vs. Humans in Luxury Retail: A Multidisciplinary Approach

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Luxury retailers are increasingly considering the introduction of service robots in their stores to enhance the value proposition and reshape the dynamics of both the service encounter and the customer experience. Although the literature recognizes the social presence of robots in service encounters, little empirical research compares humans and service robots related to luxury. In addition, further research is needed to investigate the emotional responses of young customers, like Generation Z, to a technology-infused servicescape and to explore the value of service robots as a social presence in luxury stores. A 2×2 mixed methods experimental design was developed to test the research hypotheses. The study was conducted in a laboratory with 116 participants randomly assigned to one of four experimental conditions: approaching vs. non-approaching behavior with a service robot or a human sales assistant. Self-reports and neurophysiological responses (skin conductance) were collected to measure their responses during the service encounter. The results show that a human or a service robot approaching the customer can lead to greater positive affective states and emotional responses than a human or a service robot not approaching. In addition, we found that young customers do not differentiate between human sales assistants and ser-

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vice robots. However, the customers' level of immersion in the flow, understanding of the message, and happiness are higher with a human sales assistant. Finally, the absence of any interaction (non-approaching) during the service encounter leads to a negative reaction to a human sales assistant compared to a service robot, showing the importance of personalized and deep connections in luxury service.

1. Introduction

Luxury retail is a dynamic and fast-growing sector in the overall retail market (Back et al. 2021). Recent reports suggest that the market size of the luxury segment will increase from USD 93.4 billion in 2022 to USD 238.5 billion by 2028 (Fortune Business Insights 2024), with strong consumer interest in luxury experiences (D'Arpizio et al. 2021; Bell 2022). Luxury firms tend to expand their customer base and target a younger market segment, Generation Z (Mckinsey 2023), which represents 35 % of luxury consumption (Baudier et al. 2023).

Driven by the need to enhance the value proposition and offer personalized services, luxury brands are increasingly integrating advanced technologies such as AI and robotics (Larivière et al. 2017; Marinova et al. 2017; Wirtz et al. 2021; Ali et al. 2023) to meet the unique demands of these digital-native customers (Priporas et al. 2017). The rise of robotics in the luxury industry is not only improving the customer experience (McKinsey 2022) but also leading to profound changes in the service encounter (BenMark and Venkatachari 2016; Čaić et al. 2019; Mende et al. 2019) although empirical research on new technologies in luxury retail is increasing (Holmqvist et al. 2020), additional research on Generation Z is needed to understand their responses to a technology-infused servicescape (Lu et al. 2020) and how this development impacts the customer experience (Priporas et al. 2017).

A high level of anthropomorphism of service robots (robots with human-like appearance features) is a critical factor that could influence customer experience as this increases the likelihood of perceiving the service robot as an independent social entity with an automated social presence (van Doorn et al. 2017; Ameen et al. 2021). Research suggests that verbal and nonverbal means, including behavioral approaching cues, like body language (Lee et al. 2006), proximity (Brown 2001), and affective expressions (Fiore et al. 2013) can facilitate the perception of social presence in human-robot interactions. However, empirical research on the comparison between human social presence and anthropomorphic automated social presence is notably limited (Holthöwer and van Doorn 2023), particularly in retail and service contexts (Onnash and Roesler 2021; Perifanis and Kitsios 2023; Rancati and Maggioni 2023), and further research may unveil novel methods to leverage these advancements for emotional engagement with customers.

Luxury stores are places where the brand is communicated and legitimized (Moore and Doherty 2007) through a prestigious image, premium prices, exclusivity, elegance, excellent service quality, unique and personalized customer experiences, and deep and intimate relationships during customer-sales assistant interactions (Berry and Bendapudi 2003; Ko et al. 2019). In particular, luxury services and social relationships are at the core of the luxury offering and key to competitive advantage (Dion and Borraz 2017; Wirtz and Fritze 2020). Therefore, the service encounter in luxury stores has received considerable attention in the literature (Dion and Arnould 2011; Cervellon and Coudriet 2013; Smith and Milligan 2015), with frontline service employees critical to the success of customer experience (Frei and Morris 2012; Pernice 2016). Sales assistants are expected to exhibit a specific sequence of verbal and nonverbal behaviors as part of a service script (Solomon et al. 1985; Victorino et al. 2013; Pernice 2016) to immerse the customer in a unique shopping experience (Dion and Arnould 2011; Smith and Milligan 2015). Previous research has confirmed that immersion in a flow conveys positive emotions (Vanhamme and Snelders 2001), influences customer arousal (Moses et al. 2018), and ultimately makes shopping more enjoyable (Lent and Tour 2009; Rancati and Maggioni 2023). However, further research is needed to investigate the value of service robots as interaction partners for Generation Z in luxury stores (Iwamura et al. 2011; Rancati and Maggioni 2023). Also, given the recent use of service scripts for new technologies, research needs to investigate the influence of such service scripts on customers (Sands et al. 2021).

Previous research on service robots has also relied primarily on either qualitative or quantitative surveys and self-reports, while scholars have recently highlighted the importance of using a multidisciplinary approach and new measurement protocols that combine traditional and neuromarketing techniques (Nguyen et al. 2014; Benoit et al. 2017). Some recent studies have already begun to include neuro-tools in measuring customer behavior (Plassman et al. 2015; Verhulst et al. 2020; Rancati et al. 2023). Following this line of research, we combine self-reports and neuromarketing techniques in the present study to empirically answer the call to inspect further human-robot interactions (Lajante et al. 2023; Rancati and Maggioni 2023). Given this background, the present study first aims to assess the preferences of Generation Z in service encounters by analyzing the emotional reactions of young customers when offered a luxury product without distinguishing between humans and service robots. Subsequently, the study focuses on a technology-infused servicescape and investigates the value of the social presence of service robots during service encounters while offering a luxury product. In doing so, we address the following research questions (RQs)

RQ1: *What is the difference in the responses of young customers between approaching and non-approaching behavior during service encounters while a luxury product is offered?*

RQ2: *How do the reactions of young customers vary in different forms of service, namely in human-human interactions (HHI) and human-robot (HRI) interactions during service encounters when offered a luxury product?*

Through a laboratory experiment, we investigated these research questions. We analyzed how customers' responses change as a function of approaching or non-approaching behavior by a service robot or human sales assistant. By applying a multidisciplinary approach to the analysis of HHIs and HRIs, we answer the call to combine traditional and neuroscientific methods to generate insights in service research (De Keyser et al. 2019; Verhulst et al. 2019), which is specifically suited for the aim of this study, i.e., analyzing the dynamic nature and responses elicited by HRIs. To investigate responses to interaction with a service robot versus a sales assistant, we combine self-report techniques consisting of the Positive Affect and Negative Affect Schedule (PANAS), the Social Presence Inventory, and the Short Flow State Scale (short-FSS) with the neuromarketing technique of Galvanic Skin Response (GSR).

Through this research, we contribute to knowledge by better understanding how human-robot interactions inside a store influence the service encounter and elicit customer responses, with a particular focus on Generation Z. We also extend research in luxury retail by examining how customers' emotional responses vary between approaching and non-approaching behaviors during a luxury product presentation. Further, we provide managerial implications for companies and retail managers considering the introduction of service robots in their stores, highlighting both the benefits and limitations of such technology in terms of customer behavior and responses.

2. Theoretical background

2.1. Service robots in the frontline

As research on HRI progresses, the definition of service robots varies from country to country and diverges in content (Chen et al. 2023). A more widely accepted definition comes from Wirtz et al. (2018, p. 909), who define service robots as "system-based autonomous and adaptable interfaces that interact, communicate, and deliver service to an organization's customers."

Service robots can either be humanoid, namely humanoid service robots, or "robots with a human-like anthropomorphism such as a face, arms, and legs" (Mende et al. 2019, p.1) as well as non-humanoid (i.e., a non-anthropomorphic robot without human-like features). Anthropomorphism, the tendency to attribute human characteristics to inanimate objects or animals to rationalize their actions (Waytz et al. 2010), has been applied in social robotics to support meaningful social interactions and human acceptance of service robots (Duffy 2003; Appel et al. *20*20). This phenomenon can be induced by the characteristics of a robot's appearance, behavior, and communication and by framing the robot anthropomorphically via names (Darling 2015). A high degree of anthropomorphism (humanoid features) of service robots is a critical factor that could positively influence the customer experience (Mende et al. 2019, p.5; Chuah and Yu 2021; Baudier et al. 2023), as it increases the likelihood of perceiving the service robot as a distinct social entity with an "automated social presence" (ASP) (van Doorn et al. 2017).

As highlighted by Biocca et al. (2001), the sense of social presence is most pronounced when two individuals are in close physical proximity, actively participating in a shared endeavor. The perception of "being together with another" is intricately tied to the aptitude for perceiving and forming mental representations of another individual's cognitive capabilities (Biocca et al. 2001). Both verbal and nonverbal means, including behavioral approaching cues like body language (Lee et al. 2006), proximity (Brown 2001), and affective expressions (Fiore et al. 2013), can facilitate the perception of social presence. Previous studies provide evidence of the impact of social cues on participants' perceptions, behavioral dynamics, and emotional states in human-robot interactions (Fiore et al. 2013). For example, Fiore et al. (2013) demonstrated that cues related to a robot's approaching behavior significantly influence participant perceptions of the robot's social presence and emotional state. It also has been found that physical co-location and visibility positively predicted social presence (Oh et al. 2018). Following social presence theory (Heerink et al. 2010), ASP defines "the extent to which machines (e.g., robots) give consumers the sense that they are in the company of another social entity" (van Doorn et al. 2017, p. 44). ASP has changed people's perception of robots from emotionless machines to collaborators, partners, and companions (Leite et al. 2014; McLean et al. 2021). Furthermore, previous researchers have shown that users' behavior is influenced by their perception of communicators' credibility (Ohanian 1990), which is reinforced by ASP (Baudier et al. 2023).

Previous research has extensively conceptualized human-robot interaction (HRI) (Wirtz et al. 2018; Lu et al. 2020) and explored the effects of robots' social presence (van Doorn et al. 2017) to transpose social and cognitive abilities in service robots. However, understanding the emotional responses during human-robot interactions requires additional empirical research (Chuah and Yu 2021; Rancati and Maggioni 2023). Further, existing studies have discussed the technological features of service robots, particularly their anthropomorphic appearance (Onnash and Roesler 2021). However, anthropomorphism is a multidimensional concept linked to behavioral characteristics analyzed separately or focused primarily on physical features. Therefore, further research is needed to combine human-like features (e.g., facial expressions, arms) with anthropomorphic behaviors (e.g., proximity, movements), which are necessary to immerse the customer in the shopping experience (Chen et al. 2023).

2.2. Service encounter in luxury

In recent decades, the luxury industry has experienced various shifts in consumer behavior (Giachino et al. 2021). The perception of the younger generations, the so-called Generation Z (Mckinsey 2023), regarding the concept of luxury has changed due to the increase in communication on social media (Mosca and Casalegno 2016), the adoption of multi-channel strategies (Lee 2020) and the introduction of new technologies supported by artificial intelligence such as service robots (Wirtz et al. 2018; Holmqvist et al. 2020). As a result, luxury brands have started to adapt their strategies to these changes. Luxury retail differs from other retail strategies (Kapferer and Bastien 2009; Dion and Arnould 2011). According to Chevalier and Mazzalovo, "a luxury brand is selective and exclusive, and which has an additional creative and emotional value for the consumer" (Chevalier and Mazzalovo 2008, p.2). Its specificity is shaped by the cultural and historical heritage of the brand, where the store does not meet the criteria of pure functionality (Kapferer and Bastien 2009). Instead, luxury stores serve as places where the brand's prestige is both conveyed and affirmed through a superior image, high-end pricing, exclusivity, sophistication, outstanding service quality, bespoke and tailored sales assistant-customer interactions (Berry and Bendapudi 2003; Moore and Doherty 2007; Ko et al. 2019. The essence of luxury offerings and the competitive advantages lies in the superior customer services and social connections at the heart of the luxury experience (Dion and Borraz 2017; Wirtz et al. 2020), with frontline service employees critical to the success of the customer experience (Frei and Morris 2012). In retail, sales assistants must adopt a customer-oriented communication style (Pernice 2016), whose specific verbal and nonverbal behaviors are anchored in a service script (Solomon et al. 1985). This procedural schema outlines the sequence of communications and behaviors expected of employees during the service encounter (Victorino et al. 2013). The service script guides sales assistants when interacting with customers (Walsh et al. 2012). In luxury stores, the service script becomes a selling ceremony (Cervellon and Coudriet 2013) whose ultimate goal is to immerse the customer in a unique shopping experience (Dion and Arnould 2011; Smith and Milligan 2015).

The concept of immersion as one of the critical elements of an unforgettable consumer experience has gained visibility due to the growth of the experience economy (Pine and Gilmore 1999). Immersion has been studied under several perspectives in psychology (Mainemelis 2001), consumer behavior (CaruÌ and Cova 2006), computer games (Brown and Cairns 2004; Calleja 2011), and virtual reality literature (Jennett et al. 2008). Immersion can be defined as "a form of spatiotemporal belonging in the world that is characterized by deep involvement in the present moment" (Hansen and Mossberg 2013, p. 212) and as a neurological and psychological process occurring when a person experiences a deep attentional and emotional involvement with the environment (Zak and Barraza 2018). Immersion has been compared to the concept of flow as a state of concentration or absorption in an activity in which individuals are so involved in a situation that nothing else seems to matter and irrelevant thoughts and perceptions are screened out (Csikszentmihalyi 1997). During the flow state, people experience time distortion and a deep attentional and emotional involvement with the external environment (Brown and Cairns 2004). The immersion in a flow during the service encounter conveys positive emotions (Vanhamme and Snelders 2001), influences customer arousal (Moses et al. 2018), and ultimately improves the customer experience by making shopping more enjoyable (Heilman et al. 2002; Lent and Tour 2009).

Previous research has acknowledged the critical role of hedonic motivation in young customers' willingness to engage with new technologies (Longoni and Cian 2020; Vitezić and Perić 2021). However, further research on Generation Z is needed to better understand their preferences during service encounters and their responses to a technology-infused servicescape (Lu et al. 2020). Further, service scripts have been widely investigated in retail (Walsh et al. 2012). However, further research is needed to understand how traditional service scripts designed for human sales assistants translate to interactions involving new technologies (Sands et al. 2021). In particular, how the presence of service robots affects Generation Z's experience of flow and immersion during luxury shopping.

2.3. Service robots in luxury retailing

In the evolving landscape of luxury retail, the integration of new technologies empowered by AI, such as robotics (Larivière et al. 2017; Marinova et al. 2017; Wirtz et al. 2021; Ali et al. 2022), to improve the customer experience represents a pivotal shift toward catering the demands of Generation Z (McKinsey 2022). Further, as luxury brands strive to blend tradition with innovation, the deployment of service robots along with robots underscores a strategic move towards immersive, unique customer experiences (Wirtz et al. 2018) that resonate with the values and expectations of young and digital-native customers (Priporas et al. 2017).

The rise of service robots in luxury retail is leading to profound changes altering the dynamics between frontline service employees and customers (BenMark and Venkatachari 2016; Čaić et al. 2019; Mende et al. 2019). When employed in the service frontline, service robots are also referred to as social robots due to their tangible presence in the servicescape and their ability to engage with customers on a social level during the service encounter (Wirtz et al. 2018; Čaić et al. 2019). Previous studies show that robots are successful as conversational partners because they can engage with their counterparts (Breazeal 2009), helping to create a social and emotional connection (Cabibihan et al. 2014; Leite et al. 2014) and generate an increased level of attention and engagement (Iwamura et al. 2011). Customers' emotional and psychological responses to this technology are influenced by ASP and the feeling that the robot cares about their needs, which increases the adoption of service robots (Wirtz et al. 2018; Belanche et al. 2020). In the luxury retail context, the development of rapport and emotional connection with customers is critical (Wirtz et al. 2018; Shank et al. 2019) as it facilitates engagement and co-creation of experiences (Rincon et al. 2019), and developers are working to create service robots that can express emotions and approach customers through both verbal and non-verbal communication, such as facial expressions and body language (Baudier et al. 2023). Previous research in this area has found that such robots are perceived as more pleasant than those that cannot show emotions (Tielman et al. 2014; Appel et al. 2020), and a robot that shows an expression of surprise and happiness has a positive effect on users (Chuah and Yu 2021). Recently, Rancati and Maggioni (2023) studied the immersion in a flow during human-robot interaction in luxury stores, showing increased customer attention and engagement and highlighting that immersion is greater when the customer interacts with a service robot than with a human sales assistant.

Most studies related to the luxury sector are related to the tourism and hospitality sector (Chan and Tung 2019; Shin and Jeog 2020; Nozawa et al. 2022), however empirical research on human-robot interactions in the luxury sector is scarce (Giachino et al. 2021). Further, while service robots are noted for their ability to engage customers on a social level (Čaić et al. 2019), further research is needed to understand how robots can be optimized to deliver personalized and unique shopping experiences that are critical in luxury retail.

3. Research hypothesis and model

In luxury stores, sales assistants are critical for creating a unique customer experience through superior and personalized customer service (Dion and Borraz 2017; Ko et al. 2019; Wirtz et al. 2020). In these service-intensive stores, the interaction between sales assistants and customers follows a service script that creates a unique and immersive customer experience, increasing customer attention and engagement (Smith and Milligan 2015; Pernice 2016). By examining how approaching vs. non-approaching behavior affects the customer experience, we focus on the role of the sales assistant during the service encounter. Also, the present study draws on the theoretical frameworks of automated social presence (Heerink et al. 2010; van Doorn et al. 2017) and anthropomorphism (Waytz et al. 2010) to investigate whether and to what extent customers perceive social presence in the approaching or non-approaching behaviors. The study of proxemics highlights how expectations regarding personal space shape social interactions, as identified by Dosey and Meisels (1969). Cultural norms and personal comfort shape distance preferences in social settings, as Hall (1966) observed. Factors like spatial proximity, body language, and emotional expression intensify the perception of social presence (Lee et al. 2006). In interactions with anthropomorphic service robots, people often ascribe human traits to these machines, thus merging human-human and human-robot interaction dynamics (Waytz et al. 2010; van Doorn et al. 2017). For example, Fiore et al. (2013) demonstrated that a robot's proximity and approach behaviors positively influence the perceived social presence and emotional reactions. Therefore, we propose that young customers respond to the approaching behavior of a human or a service robot with more positive affective states, enhanced emotional responses, and a different perception of social presence during a luxury product presentation. As a result, we propose the following hypothesis:

H1: In young customers, the approaching condition will positively impact (a) affective states (measured through PANAS and Flow scale), (b) emotional responses (measured through GSR), and (c) the perception of social presence (measured through Social Presence Inventory) compared to the non-approaching condition.

In retail, several authors propose different conceptual frameworks regarding the potential benefits of robot-based service delivery, where service robots could positively contribute to the customer experience by facilitating and enhancing interactions in servicescapes (i.e., BenMark and Venkatachari 2016; Čaić et al. 2019). For example, the service robot deployment model suggests the convergence towards a mixed team of humans and robots (Wirtz et al. 2018). Despite the convergence of HHI and HRI dynamics (Waytz et al. 2010; Gervasi et al. 2020), individuals exhibit distinct proxemic and affective expectations when engaging with service robots (Hüttenrauch et al. 2006; Koay et al. 2014). Research suggests that people may allow robots to enter their personal space more than they would with other humans, indicating a divergence in social norms between human and robot interactions (Walters et al. 2005; Joosse et al. 2021). Incorporating social cues, such as gaze and proximity, into service robots during customer interactions, we posit that customers respond differently to different types of sales assistance, HRI versus HHI. In particular, young customers respond to the interaction with a service robot by increasing their emotional responses. We also posit that young customers perceive social presence more positively with a robot sales assistant. Therefore, we propose the following hypothesis:

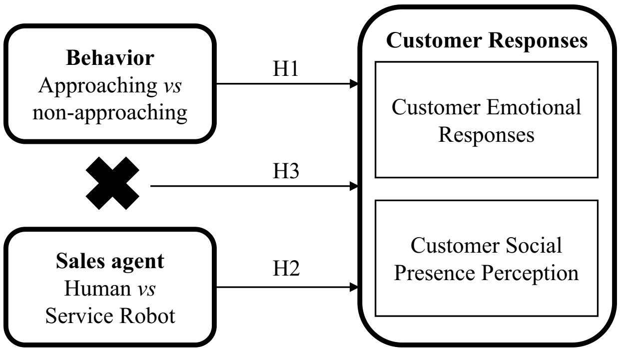

Fig. 1: The conceptual framework and hypotheses

H2: In young customers, the HRI will positively impact (a) affective states (measured through PANAS and Flow scale), (b) emotional responses (measured through GSR), and (c) the perception of social presence (measured through Social Presence Inventory) compared to the HHI.

We also posit that being in the presence of a service robot or a human sales assistant without approaching the participants has a negative impact on customers. Additionally, customers perceive an approaching sales assistant differently. In particular, young customers welcome a helpful and welcoming approach by both human and robotic sales assistants (Rau et al. 2009; Kang and Hyun 2012). For example, customers are more welcoming towards approaching robots than humans (Joosse et al. 2021). Consequently, we propose an interaction between the behavioral approach of the sales assistants and whether the sales assistant is a human or a robot, creating an HHI or HRI.

H3: In young customers, there is an interaction between the approaching condition and the sales assistance modes that affect their (a) affective states (measured through PANAS and Flow scale), (b) emotional responses (measured through GSR), and (c) perception of social presence (measured through Social Presence Inventory).

For the approaching behavior, we in particular draw on the automated social presence theory (e.g., van Dorn et al. 2017) and for the sales assistant on the service robot deployment model (e.g., Wirtz et al. 2018). *Fig. 1* presents the conceptual framework of this study and related hypotheses.

4. Methodology and empirical study

4.1. Research design

Data were collected using a purposive sample of 116 undergraduate and graduate students from the Catholic University of Milan (61M, 55F; M = 23.87; SD = 5.92). This sample has been selected since it matched the target market population of young customers using luxury products and brands (Cheah et al. 2020). The participants were recruited on social media.

A priori power analysis was conducted using G*Power version 3.1.9.7 (Faul et al. 2007) to determine the minimum sample size required to test the study hypotheses. Results indicated that the required sample size to achieve 80 % power for detecting an effect of 0.3, at an α-level of .05, was $N = 90$ for a two-way ANOVA. Thus, the obtained sample size of $N = 116$ was adequate to test the study hypotheses. Additionally, previous research proves how people show similar physiological responses while being exposed to a stimulus (Barnett and Cerf 2015; Barnett and Cerf 2017), therefore a small subset of participants can be used to predict responses of a larger population when using neuropsychological measures (Dmochowksi et al. 2014; Barnett et al. 2016).

We used a 2×2 experimental design to understand participants' reactions to two sales assistance modes (i.e., service robot vs. human sales assistant) and two approaching behaviors (i.e., approaching vs. non-approaching). Participants were divided into four conditions, and for each condition, they were asked to do the same task of observing a store's virtual merchandise containing a luxury item via desktop, in line with former research that Generation Z is known for seeking unique and unconventional luxury items (Duran and Kilic 2022). For example, previous research shows that customers usually perceive iconic artworks as more prestigious and rarer (Ippolito 2007; Lee et al. 2015). For this study, we used the Starry Night Bag by the designer Olympia Le-Tan (www.olympialetan.com), whose work is associated with creativity, craftsmanship, and exclusivity. The Olympia Le Tan – Van Gogh bag can be positioned as an "everyday luxury" item (Vickers and Renand 2003) since it is more expensive than ordinary bags. Still, the accessible pricing and cultural appeal make it a feasible choice for Gen Z. The cultural appeal of Olympia Le Tan bags is due to the vibrant and youthful designs, often incorporating pop culture and artistic elements inspired by classic literature and art. We specifically selected The Van Gogh bag, which resonates with Generation Z's appreciation for art-infused luxury products (Pino et al. 2017).

The social anthropomorphic robot used in this study was Misty II (Avgousti et al. 2021; Lynch 2021), whose appearance is non-humanoid to reduce the likelihood of the uncanny valley phenomenon (Wang et al. 2015; Kim et al. 2019). The human sales assistant was a female research collaborator, chosen because of previous work experience in the retail context and because she matched the (assumed) gender of the service robot (Ackerman 2018). Before and after the study, participants were asked to report their emotions through the self-report PANAS scale (Terraciano et al. 2003). Exclusively after the study, participants' social presence and flow experience were assessed through the Social Presence Inventory (Fiore et al. 2013) and the short FSS (Martin and Jackson 2008), measured on 5-point Likert scale items. We also calibrated and set up the GSR tools.

Then, participants were randomly assigned to one of the four different experimental conditions presented in *Fig. 2*.

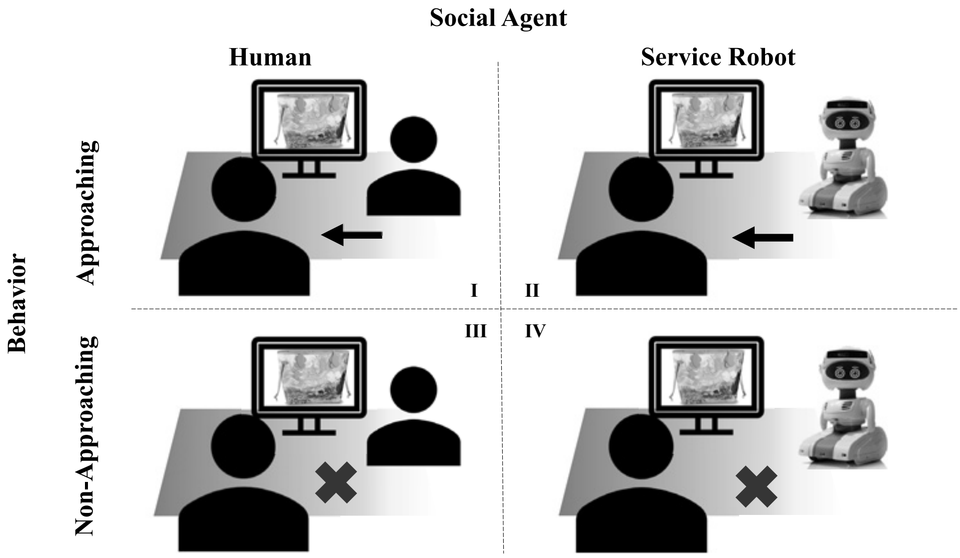

Fig. 2: Research design

It shows the type of behavior and type of sales assistant and their respective levels within our research design (i.e., approaching vs. non-approaching and human vs. service robot).

Condition I – human sales assistant approaching: the human sales assistant showed an approaching behavior and greater proximity (Hall 1966). Namely, the human sales assistant's gaze was directed toward the participant's eyes while she was performing an approaching movement, reaching a side-by-side position. After this movement created intersubjectivity and connectedness, the human sales assistant turned her head towards the screen where the product was displayed.

Condition II – service robot approaching: the service robot performed an approaching movement (mimicking the human sales assistant in Condition I) by moving towards the participant while directing its gaze towards him and reaching a side-by-side position in the intimate proximal zone (Hall 1966). After this movement, the service robot moved its head towards the screen where the product was displayed. As done in a previous study, these behavioral cues are expected to convey greater social presence (Wiltshire et al. 2013).

Condition III – human sales assistant non-approaching: characterized by the human sales assistant's non-approaching behavior, involving the sales assistant maintaining the same position as in Condition I. While remaining alert, the human sales assistant's gaze surveyed the surroundings without expressing any explicit intention to engage with the participant. This deliberate non-approaching stance makes the participant aware of the presence of the human sales assistant, who remains available without initiating direct interaction.

Condition IV – service robot non-approaching: the service robot was placed in the same position as in Condition II. The robot was turned on, alert, with its gaze moving around, mimicking the behavior of the human sales assistant in Condition III; also, in this case, the participant could be aware of the presence of the robot sales assistant who remains available without initiating direct interaction.

4.2. Multidisciplinary research methodology

Traditionally, research in the service domain has been mainly conducted through qualitative or quantitative studies that utilize self-reported, opinion-based assessments of the shopping experience to analyze the customer experience (e.g., Darley et al. 2010; De Keyser et al. 2019). Situational and cultural factors could heavily influence the traditional approach to studying service encounters (Fazio and Olson 2003; Zhao et al. 2018). It also does not reflect the dynamic nature of the experiences (Nguyen et al. 2014; Verhulst et al. 2020). Recently, scholars have pointed out the need to engage in multidisciplinary research to expand the boundaries of the service domain, develop broader conceptual models, and consider new measurement protocols capable of objectively quantifying the aspects of the service encounter (Benoit et al. 2017; Verhulst et al. 2019).

Multidisciplinary studies, including neuro-tools, have already begun to prove their worth in service research (Baldo et al. 2022) in measuring customer behavior (Plassman et al. 2015; Spence 2019), customer experience (Rancati et al. 2023), and human-robot interactions (Lajante et al. 2023; Rancati and Maggioni 2023). Specifically, neurophysiological measures allow capturing the dynamic nature of the service encounter, overcoming subjective biases without intruding on the experience of the process itself (Lemon and Verhoef 2016; Verhulst et al. 2019) and unveiling additional insights into the service encounter (Plassman et al. 2015). Naturally, several neuro-tools can be applied for neuromarketing research. One group directly records brain activities, whereas the other group collects neurophysiological responses based on the brain's neural activities (Zurawicki 2010). In this study, we answer the call for multidisciplinary research combining self-reports with neu-

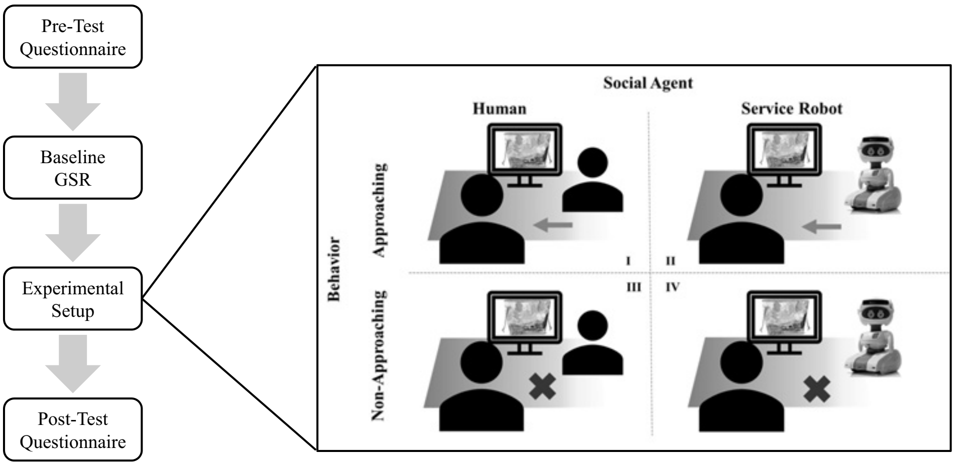

Fig. 3: Schematization of the research process

rophysiological measures. *Fig. 3* outlines the study's research process.

Participants were introduced to the task with an explanatory statement outlining the purpose of the study and the neurophysiological sensors' functionalities to sign an informed consent document to participate in the research. Before and after the experimental session, participants' overall positive and negative emotional states were assessed through the Positive Affect (PA) and Negative Affect (NA) model (Watson et al. 1988), which enabled us to derive a scale to measure emotions widely used in literature: the Positive Affect and Negative Affect Scale (PANAS) (Terraciano et al. 2003). The PA subscale presented five adjectives describing positive emotions (Active, Attentive, Enthusiastic, Excited, Interested), while the NA subscale presented five adjectives describing negative emotions (Hostile, Irritable, Jittery, Nervous, Upset). Participants were required to rate these adjectives on a 5-point Likert scale ranging from 1 (very slightly or not at all) to 5 (extremely).

During the study, the GSR captures the neurophysiological responses during the service encounter. Following previous literature that successfully used the GSR to support the PANAS (Pollak et al. 2011; Setyohadi et al. 2018), we decided to measure the state of physical and mental alertness in response to external stimuli and indicate the intensity of emotional stimulation (Lang 1995). GSR responses were measured through Shimmer 3 sensors by placing the sensor velcro straps around the participants' index and middle fingers on the palm of the non-dominant hand (Stern and Kaplan 1967). GSR was detected over a 4-minute time window (comprehending the baseline, the interaction with either the human or the robotic agent, and stimulus presentation) to determine participants' emotional states during the product presentation. iMotions 9.1 software was used for data acquisition and synchronization of the neuro-tools signals (Cacioppo et al. 2007).

Immediately after the experimental session, the perceived immersive state of the participants during the experience was evaluated using the short Flow Scale (FSS) (Martin and Jackson 2008). This scale is made of nine items (e.g., "I was completely focused on what I was doing") that are evaluated on a five-point rating scale ranging from 1 (strongly disagree) to 5 (strongly agree). In addition, the sense of social presence perceived by participants during the service encounter was evaluated using The Social Presence Inventory, adapted from the original scale of Biocca and Harms (2004). In this adapted version of the Social Presence Inventory, 24 items on a five-point rating Scale ranging from 1 (strongly disagree) to 5 (strongly agree) were inserted, but for items 13 and 14, the word "intentions" substitutes "thoughts" in the original scale. Unlike Fiore et al. (2013), in this study, we didn't add the question "How confident are you in your assessment?" after each item. The Social Presence Inventory comprises four distinct subscales, each probing different aspects of social interaction: (i) Co-presence subscale. These questions gauge the awareness of others in the environment. For example, participants might be asked whether they noticed specific individuals, such as "I noticed Misty;" (ii) Attentional Allocation subscale. This set of questions delves into the ability to maintain focus on others amidst competing distractions. An example might be, "I found it challenging to remain focused on Misty when other activities were happening;" (iii) Perceived Message Understanding subscale. These items explore the clarity with which participants perceive the intentions or messages of others. For instance, participants might be asked to rate statements like, "I understood Misty's intentions clearly;" (iv) Perceived Behavioral Interdependence subscale. Hereby, the perceived influence or responsiveness of others to one's actions is examined. Participants might be asked to reflect on statements such as, "Misty's behavior often seemed to respond to my actions directly."

4.3. Data analysis

Following the 2×2 experimental design, we first evaluated the skewness and kurtosis of the self-reported scales (i.e., PANAS, short-FSS, and Social Presence Inventory), which were not drastically skewed. The GSR measure yields a potentially skewed distribution but as ANO-

VA is particularly robust against violations of normality, we also proceed with the analysis in this case. Importantly, in our analysis using the PANAS scale, we conducted separate analyses for the PA and NA subscales. This means that we treated PA and NA as distinct variables and performed independent analyses for each. By analyzing PA and NA separately, we aimed to gain richer insights into participants' positive and negative emotional states, rather than combining them into a single composite score (as also suggested by the authors of the scale).

To analyze the GSR, raw values and summary scores were extracted through the software iMotions 9.1. Then, the presence of peaks and the peak amplitude were calculated as the sum of the response amplitudes of all participants' responses over each simulation. Because the GSR signal is highly subject-dependent, i.e., the average skin conductance varies significantly between individuals (Lin et al. 2011; Nourbakhsh et al. 2017), we calibrated each feature of each subject, normalized the signal, and then we calculated the square root of the peak amplitude for each participant (Lang 1995; Cacioppo et al. 2007; Boucsein 2012).

4.4. Results

In correspondence with our 2×2 experimental design, we tested the hypotheses with a two-way ANOVA comparing the sales assistants' behavior and the sales assistance mode regarding the affective states, emotional responses, and the perception of social presence. No Levene test was significant at the 0.05 level, so variance homogeneity can be assumed in all cases.

Self-reports for affective states (PANAS and Flow Scale)

A two-way ANOVA was conducted to examine the effect of approaching behavior (approaching vs. non-approaching) and sales assistant (human vs. robot) on both post-test PANAS subscales separately (NA and PA) and the FSS. Simple main effects analysis showed that the approaching conditions reported greater levels of PA post-service encounter ($M = 16.60$; $SD = 3.66$) than non-approaching behavior conditions ($M = 14.05$; $SD = 4.49$) ($F(1,111) = 11.42$, $p < .001$). However, no difference was noted for human or robot sales assistants ($F(1,111) = 3.39$, $p = .068$). There was a statistically significant interaction effect between the sales assistant and the approaching behavior ($F(1,111) = 5.50$, $p = .021$).

Post hoc comparisons using Tukey honest significant difference (HSD) indicated that participants' perception of human non-approaching ($M = 12.64$; $SD = 3.87$) behavior significantly differed from human approaching ($M = 16.92$; $SD = 3.06$) behavior ($p < .001$). Similarly, a non-approaching human sales assistant ($M = 12.64$; $SD = 3.87$) differed from approaching robot sales assistant ($M = 16.30$; $SD = 4.20$) ($p = .004$). The human sales assistant ($M = 12.64$; $SD = 3.87$) yielded a lower positive attitude than the robot sales assistant ($M = 15.55$; $SD = 4.76$) in the non-approaching condition ($p = .027$). Overall, the approaching behavior was generally perceived with a positive attitude, whereas participants perceived robot non-approaching behavior more positively than human non-approaching behavior.

The two-way ANOVA for the NA post-service encounter yielded a main effect for the type of sales assistant ($F(1,111) = 8.13$, $p = .005$), such that the negative attitude was significantly lower for robot ($M = 6.18$; $SD = 1.96$) than for human ($M = 7.71$; $SD = 3.54$) sales assistant. The main effect of the sales assistant behavior ($F(1,111) = 0.29$, $p = .59$) and the interaction effect ($F(1,111) = 1.45$, $p = 0.23$) were not significant.

For the FSS, the two-way ANOVA also yielded significant results. The main effect of approaching vs. non-approaching behavior was statistically significant ($F(1,111) = 5.01$, $p = .027$). However, the sales assistance modes did not affect the perceived flow ($F(1,111) = 0.02$, $p = .88$). There was also a significant interaction between sales assistant mode and behavior types ($F(1,111) = 5.36$, $p = .023$). Specifically, participants from approaching behavior conditions reported greater levels of flow post-service encounter ($M = 3.69$; $SD = 0.64$) than non-approaching behavior conditions ($M = 3.40$; SD = 0.74). Post hoc comparisons using Tukey honest significant difference (HSD) identify one significant group difference. Perceived flow was higher for the approaching behavior with a human sales assistant ($M = 3.87$; $SD = 0.52$) compared to the non-approaching behavior with a human sales assistant ($M = 3.29$; $SD = 0.66$) ($p = .009$).

Overall, the results of the self-reported affective states support H1a and H3a by positive attitudes (PA) and flow, whereas negative attitudes (NA) arise due to sales assistance modes (H2a). Specifically, the robot sales assistant induced lower levels of perceived negative attitude. In summary, the approaching behavior condition was generally perceived as positive. Still, if the sales assistant did not approach, participants more positively reacted to the non-approaching behavior of the robot sales assistant.

Neuro-tools for emotional responses (GSR)

We conducted a two-way ANOVA for the GSR to analyze the emotional responses. Simple main effects analysis showed that the approaching behavior conditions reported greater levels of emotional responses via GSR ($M = 7.45 \cdot 10^{-6}$; $SD = 27.22 \cdot 10^{-6}$) than non-approaching behavior conditions ($M = -0.67 \cdot 10^{-12}$; $SD = 5.51 \cdot 10^{-12}$) ($F(1, 105) = 4.34$, $p = .040$). However, no difference was noted between human and robot sales assistants ($F(1,105) = 1.02$, $p = .31$). The test yielded no statistically significant interaction effect between the sales assistance mode and the approaching/non-approaching behavior ($F(1,105) = 1.23$, $p = .27$). The neuro-tool results thus support H1b but not H2b and H3b. Consequently, the approaching behavior increases participants' emotional responses, which are consistent with expected consumer behavior.

Variable	H1	H2	H3
Positive Attitude	Supported	Not supported	Supported
Negative Attitude	Not supported	Supported	Not supported
Flow Short Scale	Supported	Not supported	Supported
Galvanic Skin Response	Supported	Not supported	Not supported
Social Presence Inventory Co-Presence	Not supported	Not supported	Not supported
Social Presence Inventory Attentional Allocation	Supported	Supported	Not supported
Social Presence Inventory Message Understanding	Not supported	Supported	Not supported
Social Presence Inventory Behavioral Interdependence	Not supported	Not supported	Not supported

Tab. 1: Overview of hypotheses testing

Self-reports for social presence (Social Presence Inventory)

Lastly, we conducted a two-way ANOVA for all four dimensions of the social presence inventory. The tests yielded no statistical results for the subdimensions of co-presence and perceived behavioral interdependence. In the case of the perceived message understanding, the two-way ANOVA identified a significant main effect of sales assistant type ($F(1,111) = 3.83$, $p = .053$). However, neither the approaching behavior conditions ($F(1,111) = 1.50$, $p = .22$) nor the interaction effect ($F(1,111) = 1.34$, $p = .25$) were significant. For the attentional allocation subdimension, the two-way ANOVA yielded a significant main effect for sales assistance modes ($F(1,111) = 16.26$, $p < .001$), such that the attentional allocation average was significantly higher for robots ($M = 18.1$; $SD = 3.80$) than for humans ($M = 15.75$; $SD = 2.78$). The main effect of approaching behavior conditions was also significant ($F(1,111) = 8.50$, $p = .004$). The approaching behavior condition ($M = 17.9$; $SD = 3.04$) showed a higher level of attentional attitude than the non-approaching behavior condition ($M = 16.1$; $SD = 3.59$). However, the interaction effect was not significant ($F(1,111) = 0.42$, $p = .52$). Participants in the approaching behavior conditions reported greater attentional allocation toward both sales assistance modes. Furthermore, the two sales assistance modes affect the perception of social presence differently, at least in this subscale. The groups, however, did not differ in the other subscales of the social presence inventory.

Overall, the results suggest support for H1c and H2c, but only in the case of perceived attentional allocation. Based on the social presence inventory, the interaction effect was not significant, rejecting H3c.

Tab. 1 summarizes all hypotheses and results.

5. Discussion and conclusions

5.1. Theoretical implications

Although there is general agreement that service robots will revolutionize the service and retail industries (Mende et al. 2019), the impact of HRI and ASP in luxury retail requires further attention, especially for the younger market segment, which is prone to get in contact with new technologies (Gupta and Pande 2023). This study advances current research on service robots by examining how young customers respond to a service-oriented and technology-infused servicescape in luxury retail. To our knowledge, this is the first study focused on Generation Z that provides insights into the dynamic nature of HRI by applying a multidisciplinary approach that combines self-reports with neuroscientific tools to analyze young customers' emotional responses (De Keyser et al. 2019; Verhulst et al. 2019; Davenport et al. 2020).

We show how young customers' emotional responses vary across different service delivery modes, namely HHI vs. HRI. We also extend research in retailing by examining how young customers' positive affect and emotional responses vary between approaching and non-approaching behaviors during a luxury product presentation. This study shows that the approaching behavior of a service robot or a human elicits a higher emotional response from customers than the non-approaching behavior. We also tested the role of the sales assistance mode in the approaching and non-approaching conditions. The PANAS subscale, the attentional allocation, and the GSR found no difference between the HRI and HHI. However, the interaction with a human sales assistant generates more positive states, immerses the customer in the flow, and better understands the communication during the service encounter. It is also worth pointing out that customers better perceive non-approaching behavior than a human sales assistant. This generates a lower negative attitude during the service encounter.

We contribute to the existing literature on luxury and service robots in the service frontline across four main areas. First, this study extends existing knowledge about young customers. Although digital natives and tech-savvy, young customers prefer a service-oriented approach with humans or service robots in luxury stores, service employees with an interaction-oriented communication style (e.g., they show empathy, personal touch, and socialize with customers) develop a deeper rapport with customers (Kim et al. 2011; Dion and Borraz 2017; Ko et al. 2019). In addition, an approaching behavior (i.e., being attentive, open, and friendly) positively affects attention level and immersion during the service encounter (Rancati and Maggioni 2023). Attention and immersion in a flow, in turn, activate customer engagement (Kang and Hyun 2012; Moses et al. 2018), leading to high relationship quality (Bucklin and Sismeiro 2003; Pallant et al. 2017).

Second, this study demonstrates the evolving role of service robots during the service encounter. Although robot-mediated communication is artificial, young customers no longer differentiate between service robots and humans (Shamdasani et al. 2008; Iwamura et al. 2011). This result can be explained by the ongoing use and integration of service robots in retail environments during the service encounter, which has reduced the short-term "novelty effect" that occurs when participants interact with a service robot for the first time (Kanda et al. 2004; Breazeal 2009; Leite et al. 2014; Rancati and Maggioni 2023). However, when interacting with a human sales assistant, customers are more immersed in a flow and understand the message better than when interacting with a service robot. Interactions with a service robot make the experience more efficient. However, current limitations in the ability of service robots to accurately convey social cues and intentions lead customers to perceive the emotions robots show as artificial (Wirtz et al. 2021). Additionally, service scripts give human sales assistants more leeway when adapting their service delivery to best serve customer needs (Sands et al. 2021). Therefore, interaction with a service robot may eventually lose meaning and significance (Lu et al. 2020), so that (currently) non-verbal communication remains a distinctly human prerogative (Henschel et al. 2020). Furthermore, a service robot that is not "fully human" cannot elicit the full range of intersubjective expectations that characterize a genuine human-human interaction (Lu et al. 2020). For the service robot to be considered a social actor, it must be designed and programmed to respond to social cues and extrapolate their meaning, just as humans do (Brinck and Balkenius 2020). Transforming robots into social actors, therefore, requires a shift in focus from an instrumental view of robots to a more relational view that explores how robots and humans can share meaningful experiences and relationships to enable more human-like, effective, and automatic interactions (Gaggioli et al. 2021; Zonca et al. 2021).

Third, our results contribute to understanding the customer's reactions to the lack of interaction during the service encounter. The lack of approach by a service robot does not trigger negative emotional responses, while the role of humans is of central importance, especially in highly symbolic and exclusive consumption contexts such as the luxury sector (Chevalier and Mazzalovo 2008). This difference in reactions can be explained by the need for a stronger social-relational component characterized by personalized customer experiences and deep and intimate connections during the service encounter (Ko et al. 2019; Bock et al. 2020). Fourth, our multidisciplinary approach combines self-reports with neuromarketing techniques. There have been several calls in the past to augment self-report data with neuro-tools (Lemon and Verhoef 2016; Verhulst et al. 2019). Our research explores the merits of such an approach. Comparing the two different measures, we find that they complement each other.

5.2. Managerial implications

From a practical perspective, our findings provide managers with guidance for strategically using service robots in a luxury service context and developing interactions with young customers. From a retail perspective, our study supports emerging research on the relevance of combining humans and new technologies in-store. It provides managers with guidance on strategically integrating service robots into the frontline. While service robots can effectively engage customers through initial approaches, human sales assistants are critical for deeper, more personalized service. This change underscores the need to understand the strengths of both entities for customer service and develop a balanced strategy that leverages the strengths of both robots and humans. Managers should focus on training human sales assistants to excel in areas where service robots are limited, such as personalized advice and emotional engagement. Establishing clear roles for robots and humans can optimize the customer experience by ensuring that robots perform routine tasks while humans provide the differentiated interactions that customers value.

The findings suggest that carefully designed interactions with service robots can complement human service. For example, we recommend that premium and luxury retailers consider introducing service robots into their stores to improve the customer experience in terms of efficiency. Service robots could take over specific tasks that are more operational while leaving customer relationship management to human sales assistants. By optimizing how a service robot can capture customers' attention, in-store sales strategies could be improved. However, retailers should not underestimate the value of human contact, and the role of human sales assistants is critical. In highly symbolic consumption contexts such as the luxury sector (Granulo et al. 2021), a stronger social component and stronger motives of uniqueness are the driving forces in the service encounter (Bock et al. 2020). The narrative script used in a service interaction can also determine the service encounter. This suggests that the narrative script used in service delivery is an important consideration for managers. Importantly, value is embedded not only in the products but also in the service. In this way, customers can enter a flow state and better understand another human or service robot during the customer experience.

As the study focuses on young customers, the results also show the importance of understanding and catering to the preferences of Generation Z, who may be more accepting of technology in retail. Tailoring services to these preferences can be a crucial differentiator in the competitive luxury retail market.

5.3. Limitations and future research

As one of the first contributions in this area, this study has limitations that offer opportunities for future research. First, this research has employed a specific service robot with humanoid features. Future studies should consider different types of service robots and determine whether results vary accordingly. Examples may include male versus female-looking or mechanoids (non-anthropomorphic mechanical-like robots) versus humanoids (anthropomorphic mechanical-like robots) versus androids (highly human-like).

Second, this study analyzes a one-time interaction with a service robot during the product presentation, limiting our findings' generalizability. Because the effect of a robot's social presence and the related perception of novelty decreases over time, future research should investigate recurrent interactions in several moments of the service encounter to ascertain whether physiological responses persist across multiple encounters and over the long term. Also, the possibility of assessing customer emotions in several moments of the service encounter might allow us to understand if there are moments in the service encounter that could benefit the most from the interaction with a service robot or a human sales assistant. This knowledge, in turn, would allow us to design better customer experiences.

Third, the age of participants could influence the acceptance of service robots. Digital natives, generally more familiar with technology, are early adopters of new technologies (Thompson 2013) and are more likely to accept service robots more readily than other segments (Chen et al. 2022). Therefore, future research is needed across different age groups.

Fourth, in our study, we considered art-infused leather goods products of one well-known painter. Future studies should investigate the reactions to art-infused products and examine the factors that might strengthen or lessen the customer's emotional and social responses, such as previous knowledge of the artists and their artworks (Hagtvedt and Patrick 2008) or brand awareness (Percy and Rossiter 1992). Also, future research could examine other luxury products, such as clothes and accessories (Lee et al. 2015).

Lastly, this study was conducted in a laboratory setting, limiting our results' generalizability. Future research should consider an actual retail environment.

Appendix

Positive and Negative Affect Schedule (PANAS)	
This scale consists of a series of words that describe different feelings and emotions. Please read each item and mark, in the space provided next to the word, the appropriate response that describes how you are feeling right now on a Likert Scale ranging from 1 (Very Little) to 5 (Extremely). Use the following scale to record your responses:	
Item Number	**Adjectives**
1	Active
2	Attentive
3	Enthusiastic
4	Excited
5	Interested
6	Hostile
7	Irritable
8	Jittery
9	Nervous
10	Upset

Tab. A1: Positive and Negative Affect Schedule (PANAS)

Short Flow State Scale (Short-FSS)	
Good morning, we kindly ask you to answer the following questions related to your experience regarding the event/activity that has just concluded. These questions are related to thoughts or feelings you may have experienced during the experience/activity. There are no right or wrong answers. Think about how you felt during the event/activity. Please respond using the scale provided below. For each question, find the number that best describes your experience on a Likert Scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).	
Item Number	**Name of the Activity**
1	I felt sufficiently capable of handling the challenges presented by the situation.
2	I carried out the activity spontaneously and automatically, without having to think about it.
3	I was sure of what I wanted to do.
4	I had a good sense of how well I was performing the task.
5	I was completely focused on what I was doing.
6	I had a sense of complete control over what I was doing.
7	I wasn't concerned about what others might have thought of me.
8	The way time was passing seemed different from usual.
9	I found the experience extremely satisfying.

Tab. A2: Short flow state scale (short-FSS)

Social Presence Inventory Questionnaire

You will be presented with a series of statements related to social presence. Please indicate the extent to which you agree or disagree with each statement based on your personal experiences or beliefs. Use the following scale to express your response. All responses are on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Item Number	Subscale	Statement
1	Co-presence	I noticed Misty / the other person.
2	Co-presence	The other person / Misty noticed me.
3	Co-presence	Misty's / the other person's presence was evident to me.
4	Co-presence	My presence was evident to Misty / the other person.
5	Co-presence	Misty / the other person captured my attention.
6	Co-presence	I captured Misty's / the other person's attention.
7	Attentional Allocation	I easily got distracted from Misty / the other person when other things were happening.
8	Attentional Allocation	Misty / the other person easily got distracted from me when other things were happening.
9	Attentional Allocation	I remained focused on Misty/ the other person throughout our interaction.
10	Attentional Allocation	Misty / the other person remained focused on me throughout our interaction.
11	Attentional Allocation	Misty / the other person did not receive all of my attention.
12	Attentional Allocation	I did not receive all of Misty's / the other person's attention.
13	Perception of Message Understanding	My intentions were clear to Misty / the other person.
14	Perception of Message Understanding	Misty's / the other person's intentions were clear to me.
15	Perception of Message Understanding	It was easy to understand Misty / the other person.
16	Perception of Message Understanding	Misty / the other person found it easy to understand me.
17	Perception of Message Understanding	Understanding Misty / the other person was difficult.
18	Perception of Message Understanding	Misty / the other person had difficulty understanding me.
19	Perceived Behavioral Interdependence	My behavior was often in direct response to Misty's / the other person's behavior.
20	Perceived Behavioral Interdependence	Misty's / the other person's behavior was often in direct response to my behavior.
21	Perceived Behavioral Interdependence	I reciprocated Misty's / the other person's actions.
22	Perceived Behavioral Interdependence	Misty / the other person reciprocated my actions.
23	Perceived Behavioral Interdependence	Misty's / the other person's behavior was closely tied to my behavior.
24	Perceived Behavioral Interdependence	My behavior was closely tied to Misty's / the other person's behavior.

Notes: Adapted from Biocca and Harms (2004). For items 13 and 14, the word "intentions" replaces the word "thoughts" in the original scale.

Tab. A3: Social presence inventory questionnaire

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