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The impact of service robots in retail: Exploring the effect of novelty priming on consumer behavior

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ABSTRACT

This study aims to bridge a gap in the extant research by examining consumer behavior that is unrelated to, but elicited by, service robots. The results of six studies showed that participants primed with robots (vs. humans) were more likely to engage in exploratory consumption behaviors. This effect was mediated through the elicitation of a sense of novelty, affected by the degree of service robots' intelligence and moderated by consumers' subjective knowledge. The study also examines different types of exploratory buying behaviors that have implications for marketers' and retailers' use of service robots to promote exploratory consumption.

1. Introduction

Robots are used in a variety of fields, including domestic settings, the hospitality industry, and healthcare (Fan et al., 2016; Green et al., 2016), and are changing consumers' everyday lives (Chuah and Yu, 2021; Zibafar et al., 2021). In restaurants such as Haidilao (a famous catering chain in China) and Spyce, robots are replacing human employees to take customers' orders and serve them. Against the backdrop of the COVID-19 pandemic, it promoted the use of robots in service encounters as service robots can help consumers avoid infection by reducing interpersonal interactions (Xiong et al., 2021; Romero and Lado, 2021). To date, the technological advances brought about by robots have attracted considerable attention from scholars to deal with the dilemma between the potential benefits of service robots and the possibility that consumers will reject them (e.g., Huang and Rust, 2018; Mende et al., 2019; Silva and Bonetti, 2021). However, there are still a lot of unexplored aspects concerning consumers' specific reactions toward this new form of a service provider. In the current research, we explored consumers' consumption behavior that was elicited by but unrelated to service robots.

The term "service robots" used in this research refers to physical machines embedded with AI technologies that can interact with one another and contribute to the dynamics of consumers' service experience (Xiao and Kumar, 2021). A line of research has investigated human reactions to robots in the robotics field. The technology acceptance model (TAM) and extended versions of the TAM are widely used to explore the underlying mechanism of robot adoption (Lu et al., 2019; Shin and Jeong, 2020). In a summary, perceived usefulness, perceived ease of use, hedonic motivation, social cognitive function, and trust have been found to be primary factors influencing consumers' willingness to use service robots (Lu et al., 2019; Ghazali et al., 2020). With the permeation of service robots into service encounters (Chuah and Yu, 2021), consumers' different psychological and behavioral reactions toward service robots and human employees have also been explored. For instance, consumers feel less embarrassed when served by service robots (vs. human servers) because they are perceived to have less agency than service employees (Pitardi et al., 2021). Further, consumers' perceptions of service robots can vary to such a large extent that, for example, they are more willing to use a service robot perceived as warm in hedonic service contexts, whereas a service robot is perceived as competent in utilitarian service contexts (Liu et al., 2022). Similarly, service robots are compared by consumers with human employees in terms of their appearance and abilities. A humanoid robot is viewed as more acceptable than a mechanized one as they are human-like, whereas an

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extremely realistic humanoid robot would make people feel like their own identity is threatened (Mori et al., 2012; Kim et al., 2019).

These studies have explored consumers' perceptions, attitudes, and behaviors toward robots; however, they offer limited insights into consumer behaviors elicited by but unrelated to service robots. Understanding how service robots can be useful is necessary since they can be relocated for marketing campaigns and to create value (Wirtz et al., 2018). For example, Mende et al. (2019) showed that humanoid service robots may threaten the consumer's human identity and elicit compensatory consumption from them, though this consumption is unrelated to the robot. The current study seeks to narrow the above research gap by investigating how consumers' perceptions of service robots can lead them to exhibit various behaviors that are unrelated to the robots themselves. The perception explored here is the sense of novelty elicited by service robots. This is emphasized by the results of our pilot studies, which revealed that consumers do perceive service robots as a novelty. Also, in previous former research, "novelty" has been determined as a factor influencing consumers' satisfaction and their behavioral intentions toward robots (Kim et al., 2021). The results of our six studies demonstrate that participants primed with robots (vs. humans) tend to engage in various behaviors that are unrelated to the robots, specifically, exploratory consumption behaviors.

We contribute to the literature in several ways. First, to examine unrelated consumption in the presence of service robots, we propose a model whereby the sight of a service robot can prime the sense of novelty in the customer, in turn leading to unrelated exploratory consumption behavior. Second, we confirm that service robots are perceived to be consistent with the notion of novelty (i.e., new, different, and interesting), which contributes to the strong association between service robots and the sense of novelty evoked in the consumer. Finally, in contrast to previous research on exploratory consumption behaviors conducted in individual settings, our findings classify exploratory consumption behaviors through unified studies across a variety of service conditions. Thus, we present a feasible experimental method for research on exploratory consumption.

2. Literature review and conceptual framework

2.1. Service robots and unrelated consumption: A new research paradigm

To better understand consumer behavior research on service robots, we conducted a literature review of empirical and conceptual articles published in marketing journals between 2004 and 2022 (see Appendix A for search details). After each co-author separately coded the final selected articles, they were found to fall into four categories: Table 1 provides an overview of the key empirical studies reviewed.

First, the contradiction of benefits by service robots to managers and the consumers' ambiguous attitudes to service robots has led most of the research to focus on the adoption of service robots (Silva and Bonetti, 2021; Park et al., 2021; Song and Kim, 2022; Xu and Wang, 2021). The TAM holds that factors such as perceived usefulness and perceived ease of use influence consumers' willingness to adopt new technologies (Lu et al., 2019). Ghazali et al. (2020) introduced a robot acceptance model to explore the adoption of robots and found that trust and liking also play essential roles in consumers' acceptance of them. Second, with the permeation of robots into service scenarios, consumers have first-hand experience of interacting with this new form of service provider (Wirtz et al., 2018). Therefore, consumers' experiences in human-robot interaction were thoroughly investigated (e.g., Choi et al., 2019; Odekerken-Schröder et al., 2020). The clearest and most complex finding confirmed that consumers' service experiences are greatly shaped by service robots (Čaić et al., 2019). Both positive (e.g., experienced pleasantness, perceived empathy, and positive word of mouth: Pozharliev et al., 2021) and negative outcomes (e.g., uncanny valley: Mori

Table 1
Review of consumer behavior research in service robot settings.

Research category	Total studies	Representative research	Robot type	Findings
Consumers' acceptance of service robots	57	Amelia et al. (2021)	Frontline service robots (FSRs) in retail banking services	Five main themes that influence customer *acceptance of frontline service robots* in retail banking services: (1) the utilitarian aspect, (2) social interaction, (3) customer responses to FSRs, (4) customer perspectives of the company brand, and (5) individual and task heterogeneity.
		Choe et al. (2021)	Robots in restaurants	Perceived ease of use positively affects *perceived usefulness*, which thereby exerts a positive influence on acceptance.
		Li and Wang, 2021	Service robots in service encounters	Anthropomorphism, autonomy, and ability are positively related to perceived usefulness, while autonomy, ability, and role clarity are positively related to perceived ease of use. Both perceived usefulness and perceived ease of use are affecting customer *acceptance of service robots* in service encounters.
		Liu et al., 2022	Service robots	Customers/tourists are more *willing to use a service robot* perceived as warm/competent in hedonic/utilitarian service contexts.
Consumers' service robot experience	44	Guan et al. (2021)	Robots in restaurants	Service delivery dominated by service robots is conducive to *providing a pleasant and unforgettable experience* for customers.
		Huang et al. (2021)	Service robots	Four categories of *customer experience*: (1) sensory experience, (2) cognitive experience, (3) affective experience, and (4) conative experience.
		Ma et al. (2021)	Robots in restaurants	*Customers' experience* differs due to variations in product/service levels that robots applied in the selected cases.
		Pitardi et al. (2021)	Service robots	Interactions with service robots attenuate customers' *anticipated embarrassment*.
Consumers' satisfaction with/relates to service robots	30	Çakar and Aykol (2020)	Service robots in tourism	Robots significantly improve *the quality of service* offered to travelers.
		Hu et al. (2021)	Service robots	People perceive service recovery provided by a human to be more sincere than that provided by a service robot, thereby leading to *higher levels of satisfaction*.
		Kim et al. (2021)	Robots in coffee shops	Confirmed the importance of atmosphere, novelty, and consumer return on investment as factors that influence *customer satisfaction* and behavioral intention toward a robot barista coffee shop.
		Luo et al. (2021)	Robotic services in hotels	Sentiments related to robotic services positively correlate with hotel *service satisfaction*.
Consumer behavior that is elicited by, but unrelated to, service robots	3	Baek et al. (2021)	Charity AI	When nonprofit charity marketers design AI agents to resemble humans and smile like humans, potential donors feel a greater psychological closeness to the agents and are motivated to increase their *charitable giving*.
		Mende et al., 2019	Humanoid service robots (HSR)	Consumers display *compensatory responses* when they interact with an HSR rather than a human employee.

et al., 2012; expectancy violations: Crolic et al., 2022) have been observed. These experiences have been found to influence consumers' overall satisfaction after human-robot interaction (Huang et al., 2021), which could be categorized into the third research topic. Consumer (dis) satisfaction in a robot service encounter is generally found to relate to perceptions of the robot's ability (Yam et al., 2021). The specified relationship has been established as the higher the value of a consumer experience with robots, the higher the consumer's satisfaction level (Kim et al., 2021). Nevertheless, contradictory results indicate that consumers perceive the service recovery provided by a service robot as less sincere, which leads to a lower level of satisfaction (Hu et al., 2021). However, neither of the above topics considers why consumers have developed these kinds of perceptions and attitudes towards service robots.

Publications in the fourth category have considered the influence of service robots on consumer decisions that are unrelated to the robots. Apart from Mende et al. (2019), Baek et al. (2021) found that the anthropomorphism of robots greatly increases charitable giving. Though this category of research remains limited, service robots have significantly influenced our decisions that are unrelated to robots and will reshape the service industry. To address this gap, the present research develops and tests a new framework for how seeing a robot as a primer might influence a totally unrelated consumption outcome-exploratory consumption. Our research is the first to show how consumers' perceptions of the novelty of service robots have led them to make exploratory consumption decisions that are unrelated to robots.

2.2. Service robots and novelty

Novelty represents unexpected or unfamiliar objects, locations, etc. (Wittmann et al., 2008), and involves the three connotations of being new, different, and interesting (New Oxford Dictionary of English, 1998). Unexpectedness and unfamiliarity arise from humans' comparison of their current experience with the immediate past or with the networks of acquired representations stored in their long-term memory (Kagan, 2009). Thus, when a service robot appears on the frontline where the staff is usually human, consumers may find it a new experience and feel it conflicts with their long-formed representation of servers. This experience signifies a kind of "conceptual novelty," which involves events that alter one or more features of a schematic prototype or semantic network stored in the long-term memory (Matsumoto et al., 2007).

Conceptual novelties also include unfamiliar combinations of familiar objects (Matsumoto et al., 2007). For service robots, they are made in a familiar way and from the same materials as other machines and high-tech products. However, they demonstrate emotions and voices that belong exclusively to humans (Leo and Huh, 2020). The theory of anthropomorphism also holds that humans are unfamiliar with service robots' combination of "machine and human" qualities indicating that attributing human-like appearance to nonhuman entities along with human qualities could make that entity more familiar, explainable, or predictable to consumers (Epley et al., 2007; Diller, 2011). Therefore, we argue that service robots are unfamiliar combinations of familiar materials and unexpected functions, making them a new and different entity for consumers.

Conceptual novelties usually prompt thought, indicating interest in exploring the novel event or object, where being interesting constitutes the sense of novelty. Service robots, in contrast to the invisible, embedded, and cutting-edge technologies that are far removed from our daily lives provide visual cues for consumers. Their visual cues and presentation in everyday life constitute psychological and physical proximity between customers and service robots, which is a premise for the development of interest (André et al., 2018; Hidi and Renninger, 2006). Previous studies have inferred that the robots are considered interesting because they provide perceived enjoyment, which can be considered as a motivation for the adoption of service robots (Ashfaq et al., 2020; Subero-Navarro et al., 2022).

Based on the above, we deem that service robots are new, different, and interesting, which is consistent with the notion of novelty. "Novelty perception" is the extent to which an individual considers an object to be novel, regardless of whether or not the object is actually new or different (Kagan, 2009). Therefore, though service robots are gaining popularity, they are novel as long as consumers perceive them to be.

As shown in priming effect theories, a specific construct can be elicited through direct exposure to related signals (e.g., using the word "new" to evoke consumers' perceptions of novelty; Sung et al., 2016) or unconsciously perceived cues (e.g., the low availability of objects could prime indulgent consumption through the rarity effect; May and Irmak, 2018). Consequently, service robots may serve as an external cue to elicit a sense of novelty in consumers. The fact that individuals' interactions with service robots differ significantly from their normal experiences may be the source of the association between service robots and the sense of novelty evoked in the consumer. Accordingly, we undertook two pilot studies to confirm that service robots indeed activate the core concept of novelty in consumers' minds. Through comparison with a control group that was exposed to other advanced technologies, we also verified that this activation is due to the new, different, and interesting essence of service robots.

2.3. The novelty priming effect and exploratory responses

According to social psychology research, the effect of priming stems from the situational activation of mental constructs and indicates that external cues can have consequential effects on consumer behavior (Bargh et al., 1996; Poushneh, 2021). Thus, priming one concept in the associative network makes a second concept salient, which, in turn, influences subsequent behaviors (Fiske, 1980). Consistent with priming theory, the activation and downstream behavior resulting from the priming effect has been shown to result from individuals' automatic processes in a direct perception–behavior link, without requiring any effort, consciousness, or awareness (Bargh et al., 2001). Following this reasoning, the conceptual novelty activated in consumers by service robots should lead to downstream behaviors. To address what kinds of behaviors consumers might show, we draw on the notion of exploratory behavior, that is, actions individuals undertake to satisfy their intention to discover something new or different or explore something that elicits their curiosity (Poushneh, 2021; Sadiq et al., 2021). In service encounters, the main goal of consumers' behaviors is satisfying their needs through buying (Hartley et al., 1974; Chen and Yao, 2018). Thus, exploratory consumption is a kind of exploratory behavior that reflects buying preferences.

Exploratory consumption can be categorized into three categories. Risk-taking behavior involves choosing between unfamiliar alternatives that are perceived as risky (Baumgartner and Steenkamp, 1996; Kareklas et al., 2018). Variety-seeking behavior is expressed in the buyer switching between familiar alternatives, including brand switching, and a tendency toward unusual behaviors (Etkin, 2016). Finally, curiosity-motivated behavior stems from the desire for information and knowledge (Beck and Crié, 2018; McAlister and Pessemier, 1982) and can be expressed by greater preferences for window-shopping or an interest in detailed knowledge about products (Streicher et al., 2020). The three key elements constituting the notion of novelty (i.e., new, different, and interesting) are all relevant to exploratory consumption; therefore, we claim that consumers perform various exploratory consumption behaviors as a consequence of their primed sense of novelty. Specifically, newness is a predictor of the tendency to take risks (Herzenstein et al., 2007; Shahzad and Fareed, 2019), and individuals who exhibit risk-taking tendencies demonstrate more innovative behavior and adopt new products early (Kareklas et al., 2018; Baumgartner and Steenkamp, 1996; Hoeffler, 2003). Likewise, consumers primed with the sense of novelty exhibit tendencies to differ from others or their former selves, which is demonstrated by variety-seeking behaviors. The sense of

novelty also indicates a feeling of interest: it is a state of curiosity about something (Chang and Shih, 2019), which signifies that the person's behavior is motivated by their curiosity. In this case, consumers primed with novelty may engage in curiosity-motivated behavior, such as searching for information on a product. To summarize, the novelty priming effect leads to exploratory consumption among consumers. Empirical research has supported this idea and identified numerous exploratory consumer behaviors. For example, Michaut (2009) found that product newness serves as an antecedent of consumers' exploratory buying behavior.

Drawing on these insights, we posit that seeing a service robot might initiate exploratory buying behaviors among consumers through their activation of the sense of novelty. Thus, we hypothesized that:

H1. Seeing a service robot primes consumers to the concept of novelty.

H2. Seeing a service robot motivates consumers to engage in exploratory consumption behaviors (including risk-taking, variety-seeking, and curiosity-motivated behaviors).

H3. The primed sense of novelty mediates the effect of seeing a service robot on consumers' exploratory behaviors.

2.4. Impact of service robots' degree of intelligence and consumers' subjective knowledge

The degree of service robots' intelligence describes the extent to which a robot can perform a task automatically and intelligently (Chen et al., 2018; Marinova et al., 2017). According to their intelligence, robots are usually divided into several categories, from sensor-type robots (i.e., robots controlled by external computers and without an intelligent unit) and interactive robots (i.e., robots operated by a programmer or algorithm to perform simple thinking and judgment tasks) to autonomous robots (i.e., robots that can automatically complete tasks that were previously performed by humans) (Lai et al., 2018). Recent research has suggested that the degree of service robots' intelligence closely correlates with consumers' perceptions of them. Hoeffler (2003) verified that service robots with familiar and standardized functions are perceived as less intelligent and, in turn, less novel. Eliminating the traits of robots based on social identity, which is an aspect of intelligence, can also reduce the perception of novelty (Skewes et al., 2019). Although humans have the highest intelligence level, consumers find it a familiar experience to see a human on the frontline; therefore, we focused on the effect of the different intelligence degrees of service robots.

The above discussion reveals that the newness of service robots and the perception that they are different and interesting primes the sense of novelty; thus, we expect this effect to be attenuated when service robots are perceived as familiar and ordinary. In other words, when the attributes that constitute the novelty of a service robot are eliminated, the sense of novelty is not activated. Given that less intelligent service robots are more familiar to consumers, we assume that service robots with low degrees of intelligence will be unlikely to elicit a sense of novelty in consumers or, consequently, lead to exploratory consumption. Thus, we posited the following:

H4. When a service robot has a low degree of intelligence, the novelty priming effect is likely to disappear.

The literature has shown that different individuals have diverse possibilities for being primed by the same stimuli (Higgins et al., 1985; Murphy and Zajonc, 1993). For instance, gender identity maintenance contributes to men's relatively low engagement in green behaviors (Brough et al., 2016). In this study, we explored the role consumer knowledge played in our findings.

Research on consumer behavior in the field of technology adoption has revealed that knowledge plays an essential role in various dependent outcomes (Gurlitt and Renkl, 2010). Consumer knowledge refers to the amount of product- or service-related experiences accumulated by a consumer (Alba and Hutchinson, 1987; Bolek, 2020), among which subjective knowledge is the belief a consumer holds about how much they know about an object (Brucks, 1985; Liu et al., 2018). This subjective knowledge influences consumer attitudes and behavioral intentions toward technologies (Cowley and Mitchell, 2003); for example, when consumers become more aware of robots, their likelihood of accepting them rises (Flavián et al., 2021). Moreover, consumers believe that the more they know about a product (i.e., the stronger their subjective knowledge), the more familiar they feel with it (Pieniak et al., 2010; Rao and Monroe, 1988).

We reason that consumers' exploratory consumption is caused by a sense of primed novelty and that consumers' perception of service robots as new, different, and interesting primes this sense of novelty. Therefore, if consumers believe they have high subjective knowledge about service robots, they will be highly familiar with them, leading to a reduced possibility of priming the sense of novelty. Thus, we posited H5 and finally formed our conceptual framework in Fig. 1:

H5. When consumers have high subjective knowledge about service robots, the novelty priming effect is likely to disappear.

3. Overview of the studies

We tested our hypotheses through six experiments, including two pilot studies (see Table 2 for an overview). The participants for online studies were all recruited through Credamo, a platform (similar to Amazon Mechanical Turk) in China that allows potential participants to select small tasks to complete for compensation. A questionnaire link was posted online for participants using a convenience sampling technique. And the only selection criterion we used to compose the final sample was that a participant passed our attention check. As for the sample size of the studies, we estimated a minimum required sample size of 52 participants per experimental condition to achieve the desired power of 0.80 at an alpha level of $p = .05$. Thus, we used a minimum of 65 participants (Study 1 = 100; Study 2 = 75; Study 3 = 65; Study 4 = 100) per experimental condition for each study.

The pilot studies revealed that consumers perceive service robots as novel (H1) because these robots simultaneously meet the three elements of novelty, consolidating the research foundation of this research. Study 1 tested the main effect (H2), and Study 2 tested the underlying mechanism whereby the sense of novelty mediates the effect of seeing a robot on exploratory consumption behavior (H3). Studies 3 and 4 found that the main effect was eliminated when the perceived degree of the service robot's intelligence was low (H4) and when consumers had high subjective knowledge of service robots (H5).

4. Pilot studies 1 & 2: consumers' perceptions of service robots as novel

The two pilot studies examined the priming effect of the environmental cue—seeing a robot—on the activation of the sense of novelty. Pilot Study 1 verified that only simultaneously satisfying all the key characteristics of novelty could prime the effect. Pilot Study 2 was a field study conducted in a restaurant to verify the robustness of our finding that consumers perceive service robots as novel.

4.1. Experimental procedure

A total of 179 participants were recruited through Credamo during late June 2021 in return for a nominal payment (1 Chinese yuan). Participants played a picture game, and randomly rated four conditions including pictures of a service robot, human staff, space technology, and the latest iPhone. The resolution of all images was 467*487 (see Fig. 2). They were then asked to choose three words out of 12 alternatives that best described their feelings when seeing the content. Based on the definition of novelty (Lee and Crompton, 1992; Pearson, 1970) and the

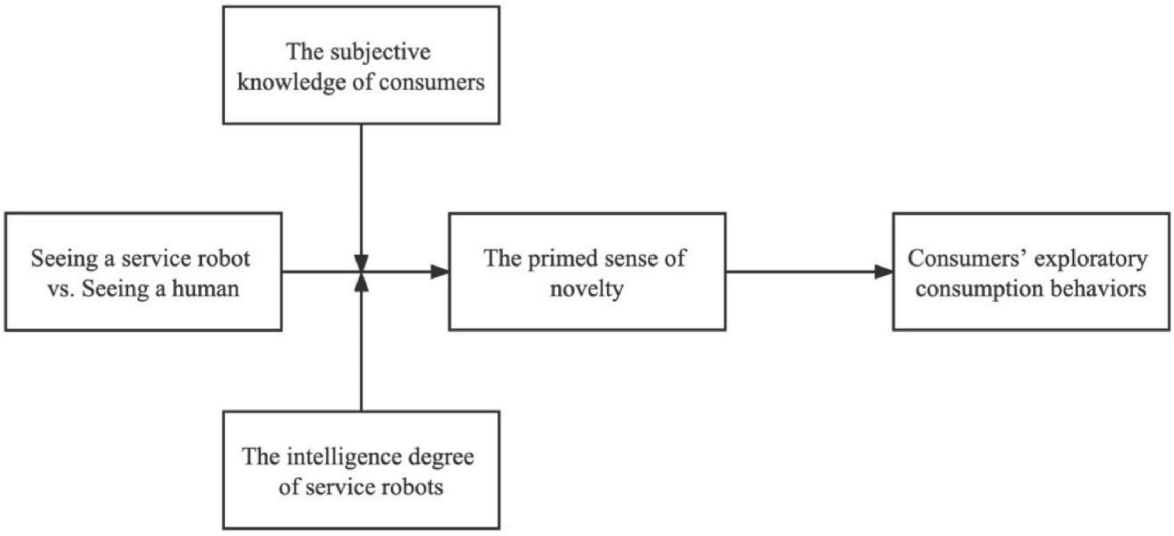

Fig. 1. Proposed conceptual framework.

Table 2
Overview of all studies.

Study	Participants' demographic characteristics	Objective	Consumption scenarios	Exploratory consumption behavior	Location in article
Pilot Study 1	160 participants M_{age} = 29.58, SD_{age} = 7.11; 63.13% female. Collection method: online.	Demonstrate that the effect of novelty priming is elicited only when the participant sees a robot (vs. seeing a human, space technology, or the latest iPhone)	–	–	Section 4
Pilot Study 2	157 participants M_{age} = 18.97, SD = 3.58; 68.8% female. Collection method: offline.	Demonstrate that the effect of novelty priming is elicited when a participant sees a robot in a real scenario.	Real scenario	–	Section 4
Study 1	200 participants M_{age} = 30.13, SD = 9.27; 61.5% female. Collection method: online.	Test the main effect.	Imaginary museum	Variety-seeking behavior	Section 5
Study 2	150 participants M_{age} = 30.67, SD = 4.97; 68.7% female. Collection method: online.	Test for mediation effect through novelty.	Imaginary amusement park	Risk-taking behavior	Section 6
Study 3	260 participants M_{age} = 30.42, SD = 6.94, 60.8% female. Collection method: online.	Document the effect of robot's intelligence and we found that the main effect was eliminated when the perceived degree of the service robot's intelligence was low (vs. high).	Imaginary restaurant	Curiosity-motivated behavior	Section 7
Study 4	200 participants M_{age} = 30.29, SD_{age} = 9.44; 60.5% female. Collection method: online.	Test the moderating effect of consumers' subjective knowledge on exploratory consumption behavior.	Imaginary restaurant	Curiosity-motivated behavior	Section 8

potential positive and negative influence of words, the 12 words were equally extracted from among the synonyms and antonyms of the words "new," "different," and "interesting." Specifically, the "new" dimension comprised the words "new," "old," "fresh," and "familiar"; the "different" dimension comprised "unusual," "universal," "uncommon," and "common"; and the "interesting" dimension comprised "interesting, " "uninteresting," "novel," and "boring" (New Oxford Dictionary of English, 1998). Subsequently, participants were asked about the level of novelty they perceived when they saw the picture. The participants reported their demographic information and were asked to recall what they had seen in the picture for an attention check.

4.2. Results

Data from the 160 (M_{age} = 29.58, SD_{age} = 7.11; 63.13% female) participants who passed the attention check were analyzed. First, only the synonyms of "new," "different," and "interesting" were coded to determine the number of dimensions each answer fell into; for example, if a participant chose "new," "uncommon," and "interesting," the answer would be coded as representing three dimensions (see Table 3 for the

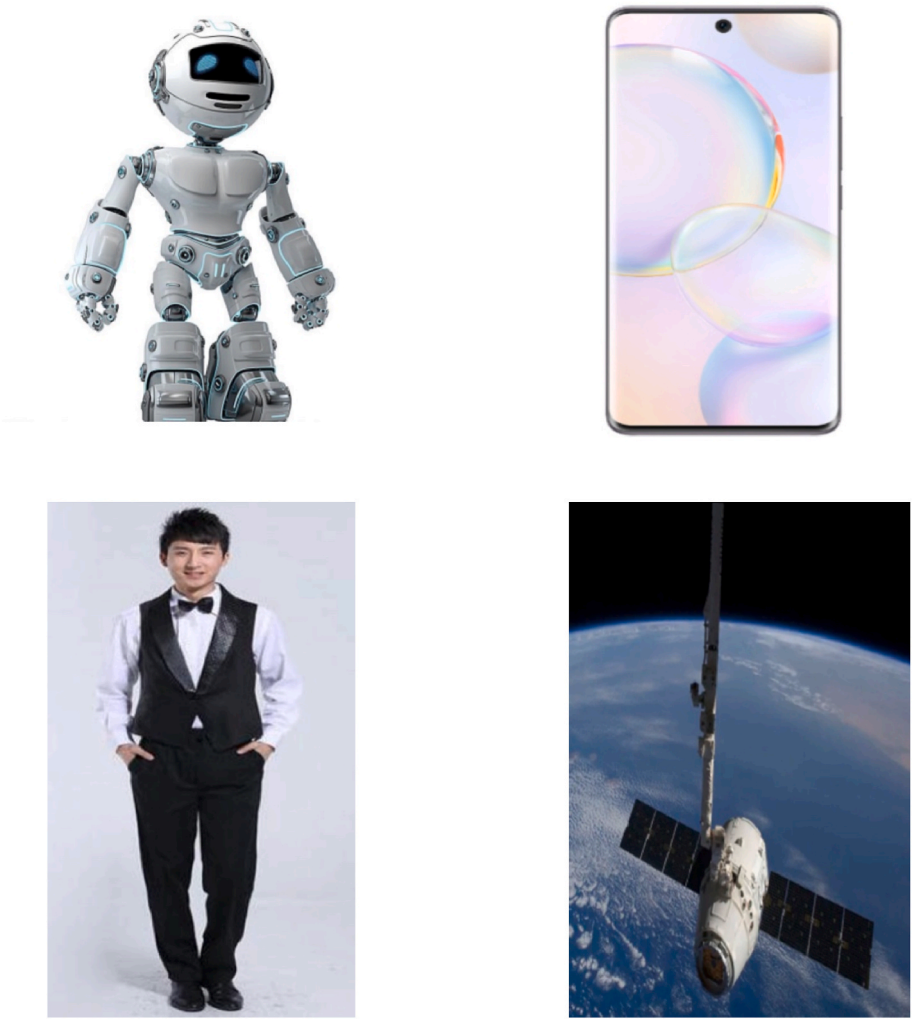

Fig. 2. Stimulating pictures used in the pilot study 1.

Table 3
Descriptive statistics of the three dimensions of novelty in the pilot study 1.

	New	Different	Interesting	All three dimensions
Service robot	100%	57.5%	92.5%	97.5%
Human staff member	50%	17.9%	61.5%	37.5%
Space technology	85.4%	88%	41.5%	73.2%
iPhone	82.1%	20%	50%	56.4%

results). A *t*-test analysis showed that participants who saw a picture of a robot reported more positive dimensions than the other three groups ($M_{robot} = 2.98$, $M_{human} = 1.48$, $t(1,78) = 6.94$, $p < .01$; $M_{robot} = 2.98$, $M_{space\ technology} = 2.63$, $t(1,79) = 3.17$, $p< .01$; $M_{robot} = 2.98$, $M_{iphone} = 2.23$, $t(1,77) = 4.48$, $p < .01$).

Second, we separately coded all the chosen words (including both synonyms and antonyms) of the three dimensions of new, different, and interesting. Each positive and negative word was assigned a value of 1 and -1, respectively. The scores were then summed to serve as the dependent variable.

An ANOVA analysis showed that participants who saw a picture of a robot chose more words from all three dimensions than the other three groups ("new": $M_{robot} = 1.38$; $M_{human} = 0.23$; $M_{space\ technology} = 0.90$; $M_{iphone} = 1.13$; $F(1,159) = 10.26$, $p < .01$; "different": $M_{robot} = 0.60$; $M_{human} = -0.65$; $M_{space\ technology} = 0.95$; $M_{i\text{-}phone} = -0.31$, $F(1,159) = 26.28$, $p < .01$; "interesting": $M_{robot} = 0.98$; $M_{human} = 0.38$; $M_{space\ technology} = 0.41$; $M_{i\text{-}phone} = 0.64$; $F(1,159) = 6.30$, $p < .01$). Finally, another ANOVA was conducted to test the priming effect of novelty (using the responses to the question, "How novel did you perceive the content in the picture to be?"). The results showed that seeing a robot elicited the concept of novelty more than the other content ($M_{robot} = 5.40$; $M_{human} = 4.28$; $M_{space\ technology} = 5.17$; $M_{iphone} = 4.82$; $F(1,159) = 5.61$, $p < .01$).

4.3. Discussion

The results of Pilot Study 1 provided initial support for the hypothesis that seeing a robot elicits a sense of novelty among consumers. In addition, the results showed that, compared to other advanced technologies, seeing a robot simultaneously activates the three core concepts of novelty. Pilot Study 2 was conducted to verify the robustness of these findings. A total of 157 participants ($M_{age} = 18.97$, $SD_{age} = 3.58$; 68.8% female) were recruited from a university in central China and invited to eat in a restaurant for a nominal payment (10 Chinese yuan) during late January 2022. They were informed of the nature of the research and only voluntary participants were included. They provided consent to participate such that their data will not be used in subsequent articles. The participants were randomly assigned to be served by a service robot or human and filled out a questionnaire after ordering. Those who saw a service robot perceived a higher sense of novelty than those who saw a human concerning the three dimensions ("new": $M_{robot} = 5.40$; $M_{human} = 4.75$; $F(1,156) = 9.02$, $p < .01$; "different": $M_{robot} = 5.38$; $M_{human} = 4.89$; $F(1,156) = 6.04$, $p < .05$; "interesting": $M_{robot} = 5.18$; $M_{human} = 4.67$; $F(1,156) = 5.13$, $p < .05$). These two studies provide convergent

evidence that seeing a service robot elicits the concept of novelty among consumers.

5. Study 1: main effect

Study 1 was conducted to explore the main effect, whereby seeing a robot would lead to exploratory consumption behavior, which was a variety-seeking behavior in this study.

5.1. Experimental procedure

Credamo was used to recruit 200 participants ($M_{age} = 30.13$, $SD_{age} = 9.27$; 61.5% female), who were randomly assigned to two conditions and completed two unrelated tasks during late June 2021. First, participants were shown a picture and told to imagine that they were visiting a museum where their narrator was a robot (vs. a human; see Fig. 3.). They, then, answered questions about their activities (e.g., "What do you want to do next weekend? Please choose from the following activities: watch a film, take a walk, cook a meal, exercise, eat out, or go shopping."; adopted from Etkin (2016). Finally, participants' demographic information was collected, and they were asked to guess the purpose of the study.

5.2. Results

None of the participants guessed the study's purpose and all of them passed the attention check. Variety-seeking behavior was measured by counting the number of different activities participants chose (Gullo et al., 2019). A one-way ANOVA of the effect of seeing a robot on variety-seeking behavior revealed a significant result ($F(1,199) = 4.97$, $p < .05$), supporting our hypothesis that seeing a robot prompted individuals to choose to partake in more activities than when they saw a human ($M_{robot} = 3.81$, $SD = 0.12$ vs. $M_{human} = 3.45$, $SD = 1.10$).

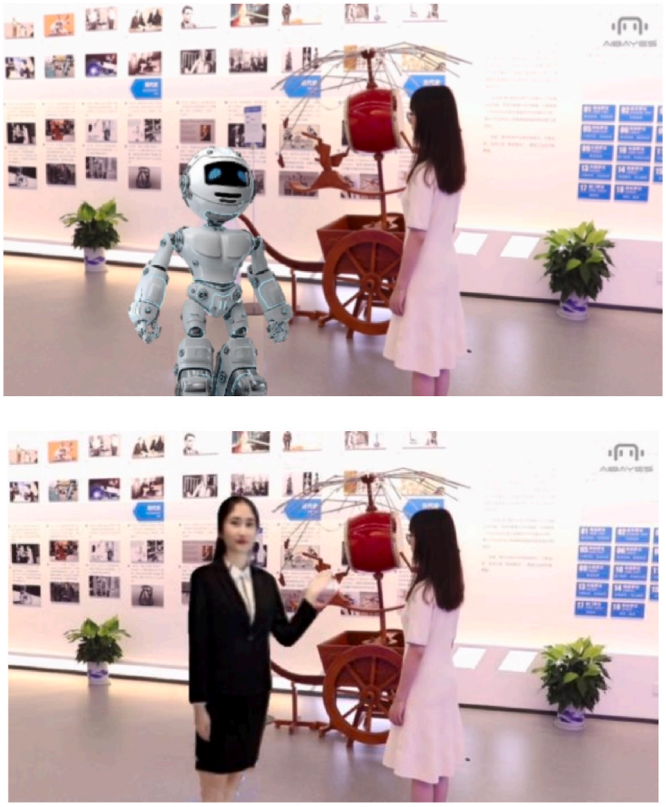

Fig. 3. Stimulating pictures used in study 1.

5.3. Discussion

Study 1 revealed that participants who saw a robot (vs. a human) in a service scenario tended to choose to partake in more activities, indicating variety-seeking behavior.

6. Study 2: mediating effect

Study 2 first aimed to replicate Study 1's findings through another exploratory consumption behavior and risk-taking behavior. Second, it aimed to test the underlying mechanism of the main effect of the sense of novelty evoked by seeing a robot, which, in turn, could enhance consumers' preferences for risk-taking behavior. Third, it aimed to rule out positive affect as a possible alternative explanation.

6.1. Experimental procedure

The 150 participants, recruited from Credamo during late June 2021, were randomly assigned to two groups and were told to imagine that they were visiting an amusement park and had encountered the service provider in the picture (a service robot vs. a human; the pictures of the robot and human staff members were similar to those used in the pilot study, see Fig. 4.). They were then asked to choose a ride in the amusement park from the two options: a Ferris wheel (coded with negative values −3, −2, −1) and a drop tower (coded with positive values 1, 2, 3). In the pretest, 92.5% of the participants (200, $M_{age} = 30.25$, $SD_{age} = 9.34$; 61.5% female) considered the Ferris wheel to be riskier than the drop tower; the higher the value they scored in the main test, the more likely they would be to engage in risk-taking behaviors. Finally, the participants were asked to indicate how novel they perceived the scenario to be in the three aspects (new, different, and interesting) using a seven-point Likert scale from Hsuan Hsiao and Xu (2017). The participants also reported the level of happiness they experienced when they saw the service provider. As a manipulation check, the participants were asked to indicate which provider they met in the amusement park, as well as to guess the purpose of the experiment and provide their demographic information.

6.2. Results

None of the participants correctly guessed the study's purpose, and all passed the manipulation check, resulting in a total of 150 valid observations ($M_{age} = 30.67$, $SD_{age} = 4.97$; 68.7% female). Then, a confirmatory factor analysis (CFA) was adopted to analyze the reliability and validity of this study as shown in Table 4 and Table 5. The CA value was higher than 0.6, and CR values were higher than the threshold value of 0.6. The AVE values are greater than the threshold value of 0.5, so the convergent validity for all the constructs is proved (Hair et al., 2017; Wang et al., 2013). This suggests that the questionnaire and constructs in this study boast high reliability and convergent validity.

The results of a one-way ANOVA supported our hypothesis that participants who were served by a robot would be more likely to engage in risk-taking behaviors ($M_{robot} = 0.07$, $SD = 2.59$ vs. $M_{human} = -0.80$, $SD = 2.24$, $F(1,149) = 4.80$, $p < .01$). In addition, a greater sense of novelty was elicited in participants who saw the picture of a robot than in those who saw the picture of a human ("new": $M_{robot} = 5.88$; $M_{human} = 5.09$; $F(1,149) = 20.17$, $p < .01$; "different": $M_{robot} = 6.16$; $M_{human} = 5.36$; $F(1,149) = 16.19$, $p < .01$; "interesting": $M_{robot} = 6.32$; $M_{human} = 5.69$; $F(1,149) = 14.51$, $p < .01$; Total: $M_{robot} = 6.12$, $SD = 0.62$ vs. $M_{human} = 5.38$, $SD = 1.20$, $F(1,149) = 22.35$, $p < .01$).

We tested the mediating effect of novelty priming using Hayes' (2014) PROCESS model 4 (5000 bootstrap samples). This method has been widely used in previous research (e.g., Adapa et al., 2020; Beck and Crié, 2018) to test mediation effects. We found that seeing a robot (vs. a human) had an indirect effect on the subjects' risk-taking behaviors via the sense of novelty (b = −0.31, SE = 0.16, 95% CI: [−0.63, −0.03]),

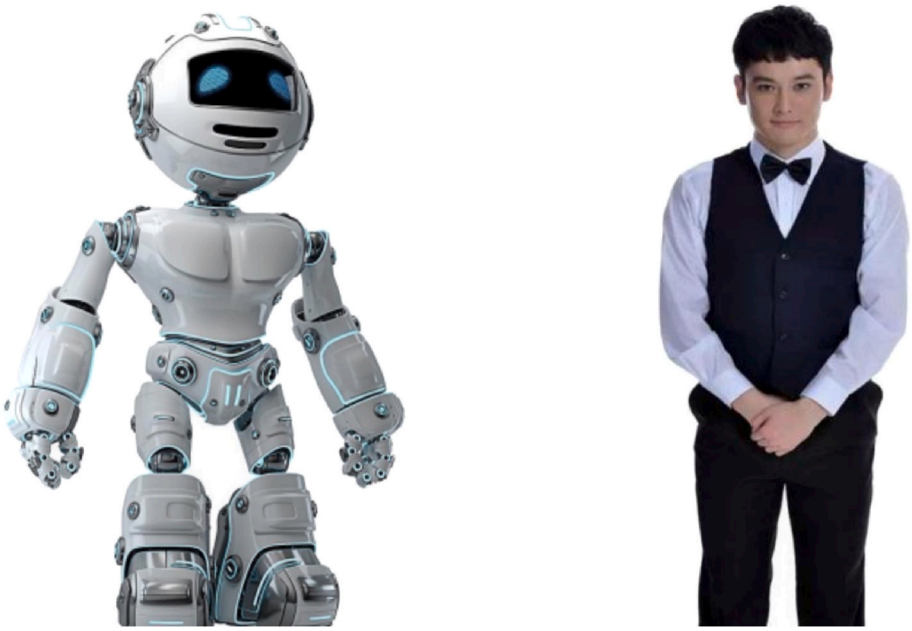

Fig. 4. Pictures used in study 2.

Table 4
Confirmatory factor analysis, reliability and convergent validity test in study2.

Factor	Items	Loading	z	CA	CR	AVE
X				/	/	/
	X1	1.000	/			
M				**0.855(>0.6)**	**0.861(>0.6)**	**0.676(>0.5)**
	M1	0.913	fixed			
	M2	0.798	10.9***			
	M3	0.746	10.1***			
Y				/	/	/
	Y1	1.000	/			

X: Seeing a robot (vs. a human); M: The primed sense of novelty; Y: Consumers' risk-taking behavior. *** = $p < .01$; "/" appears. because of single item factor. Model Fit: $Chi^2 = 1.13$, df = 4, CFI>0.99, TLI>0.99, RMSEA<0.01, SRMR = 0.011.

Table 5
Correlation analysis and discriminant validity test in study2.

	1. X	2. M	3. Y
1. X	/		
2. M	−0.386 (<0.01)	***0.822***	
3. Y	−0.177 (0.033)	0.241 (0.007)	/

X: Seeing a robot (vs. a human); M: The primed sense of novelty; Y: Consumers' risk-taking behavior. The $AVE^{0.5}$ is shown in bold on the diagonal.

demonstrating the mediation effect of the sense of novelty. The result of the affect measurement showed that participants who saw the picture of a robot felt happier than those who saw the picture of a human ($M_{robot\text{-}happy} = 6.28$, $SD = 0.73$ vs. $M_{human\text{-}happy} = 5.99$, $SD = 0.94$, $F(1,149) = 4.59$, $p < .01$). This result could be explained by the nature of novelty that it indicates a positive effect. It is, thus, unsurprising that consumers seeing a novel server (i.e., a robot) would feel happier than those seeing their counterpart (i.e., a normal human server). However, PROCESS model 4 did not show any mediating effect on happiness (95% CI: [−0.29, 0.26]).

6.3. Discussion

Study 2's results supported our hypothesis that the sense of novelty mediates the effect of seeing a service robot on exploratory consumption behaviors.

7. Study 3 & Study 4: the effect of the degree of service robots' intelligence and consumers' subjective knowledge

To determine whether all robots elicit exploratory consumption behaviors and verify the robustness of our previous findings, Study 3 examined the effect of the degree of service robots' intelligence using another exploratory consumption behavior (curiosity-motivated behavior) in daily service scenarios. Study 4 examined another effect of the subjective knowledge of consumers in the same scenario to test the robustness of our research findings.

7.1. Study 3

7.1.1. Experimental procedure

A total of 260 adults were recruited via Credamo during late January 2022. Since it is not possible to manipulate humans' degrees of intelligence, unlike the traditional method of a 2 × 2 experimental design, we used a three-factor experimental design to which all participants were randomly assigned. The participants read the indicator: "You enter a restaurant and notice that an intelligent robot/ordinary robot/human is ready to serve you. Hold this image in your mind for at least 60 s and write down your conversations with them." Referring to the previous definition, three elements distinguish intelligent robots from ordinary robots: sensory, movement, and thinking elements (Tussyadiah, 2020). We used the different introductions to manipulate the two types of robots. The participants who were asked to imagine being served by an intelligent robot read an introduction stating, "Intelligent robots perform better than ordinary robots in terms of their abilities to feel, move, and think." The ordinary robot group was asked to read the statement: "Ordinary robots perform more poorly than service robots in terms of their abilities to feel, move, and think." Participants were then asked to order a new dish. We measured their intention to order the new dish as curiosity-motivated behavior with the scale developed by Lowe et al. (2019). By way of an attention check, we asked the participants to indicate the picture that they had seen (1 = robot, 2 = human). In contrast to Study 2, we used a different measurement of novelty. The participants directly rated how novel they perceived the scenario to be

(1 = not novel at all, 7 = totally novel) on a one item, seven-point Likert scale (Mitas and Bastiaansen, 2018; Vasutinska and Kuzminska, 2019), their satisfaction with the service (1 = not satisfied at all, 7 = totally satisfied), and the server's perceived level of intelligence (1 = not intelligent at all, 7 = very intelligent). Finally, the participants provided their demographic information and were asked to guess the study's purpose.

7.1.2. Results

All participants passed the attention check. A total of 260 observations (M_{age} = 30.42, SD_{age} = 6.94, 60.8% female) were analyzed; no participant correctly guessed the study's purpose. The participants who imagined being served by an intelligent robot reported the highest degrees of intelligence among the three groups ($M_{intelligent\ robot}$ = 6.37, SD = 0.81; $M_{ordinary\ robot}$ = 4.90, SD = 1.59, M_{human} = 5.77, SD = 0.66, F (259) = 39.60, $p < .01$).

Consistent with our hypothesis, the participants who imagined the intelligent had a stronger intention to order a new dish at the restaurant than the other two groups ($M_{intelligent\ robot}$ = 5.38 (1.33) vs. M_{human} = 4.74 (1.46), t(172) = 3.04, $p < .05$; $M_{intelligent\ robot}$ = 5.38 (1.33) vs. $M_{ordinary\ robot}$ = 4.90 (1.66), t(171) = 2.12, $p < .05$; see Fig. 5). However, there was no significant difference between participants exposed to the ordinary robot and those exposed to a human ($M_{ordinary\ robot}$ = 4.90 (1.66) vs. M_{human} = 4.74 (1.46), t (171) = 0.67, p = .502).

As expected, participants who imagined the intelligent robot (vs. human) perceived more novelty than the other two groups ($M_{intelligent\ robot}$ = 5.96(0.83) vs. M_{human} = 5.30 (1.50), t(172) = 3.55, $p < .05$; $M_{intelligent\ robot}$ = 5.96(0.83) vs. $M_{ordinary\ robot}$ = 4.56 (1.68), t(171) = 6.91, $p < .05$). However, there was no significant difference between the participants exposed to the ordinary robot and those exposed to a human ($M_{ordinary\ robot}$ = 4.56(1.68) vs. M_{human} = 5.30 (1.50), t (171) = 3.05, p = .0.08).

Some studies have suggested that satisfaction with a restaurant may affect a visitor's food order (Pei and Ching-Yick, 2018). Though participants reported different levels of satisfaction when imagining different servers ($M_{intelligent\ robot}$ = 6.06 (0.70), $M_{ordinary\ robot}$ = 5.48 (1.31), M_{human} = 5.76 (0.86), F (259) = 7.44, $p < .01$), there was no significant difference in the choice of a new dish between the ordinary robot group and human group ($M_{ordinary\ robot}$ = 4.90(1.66) vs. M_{human} = 4.74(1.46), t(171) = 0.67, p = .502). This indicates that the level of satisfaction with the restaurant did not influence participants' choice of a new dish and, therefore, ruled out the possible alternative explanation of different satisfaction levels in the influence of seeing robots on new product choices. To better confirm our finding of the result of study 3, we performed the robustness tests using the path analysis (see Appendix B for details).

7.2. Study 4

7.2.1. Experimental procedure

A total of 200 adults were recruited via Credamo during late January 2022. The participants were randomly assigned to one out of a robot server or human server condition. The participants read the same indicator as in Study 3 and were asked to order either an ordinary dish or a new one (Lowe et al., 2019). By way of an attention check, we asked the participants to indicate what they had seen (1 = robot, 2 = human). They also rated how novel they felt the scenario to be (1 = not novel at all, 7 = totally novel) and their satisfaction with the service (1 = not satisfied at all, 7 = totally satisfied). Participants were then required to answer three questions on their subjective knowledge of robots: "Do you know anything about service robots?" (1 = very little, 4 = average, 7 = a lot); "Are you familiar with service robots?" (1 = very unfamiliar, 4 = average, 7 = very familiar); and "Do you often see service robots in your life?" (1 = never, 4 = occasionally, 7 = often) (adapted from Cowley and Mitchell, 2003). Finally, the participants provided their demographic information and were asked to guess the study's purpose.

7.2.2. Results

All the participants passed the attention check. A total of 200 observations (M_{age} = 30.29, SD_{age} = 9.44, 60.5% female) were analyzed; none of the participants correctly guessed the study's purpose. Consistent with our hypothesis, participants who imagined seeing a robot had a stronger intention to order a new dish at the restaurant than other groups (M_{robot} = 4.70 (1.15) vs. M_{human} = 4.23 (1.57), F (199) = 5.84, $p < .05$). As expected, participants who imagined seeing a robot also perceived more novelty than other groups (M_{robot}= 5.04 (1.26) vs. M_{human} = 4.26 (1.74), F (199) = 13.12, $p < .05$). Participants' satisfaction levels did not differ when they imagined seeing different servers (M_{robot} = 5.77 (0.74) vs. M_{human} = 5.70 (0.92), F (199) = 0.36, p = .56), indicating that their levels of satisfaction with the restaurant did not influence their choice of a new dish. We then examined the underlying mechanism of novelty and the moderating effect of subjective knowledge in the relationship between seeing different servers and choosing a new product. There was no significant difference in subjective knowledge between the robot and human groups (α = 0.86; M_{robot} = 4.79 (1.24) vs. M_{human} = 4.76 (1.28), F (199) = 0.28, p = .87).

7.2.3. Moderated mediation analysis

To further strengthen our understanding of the underlying mechanism of novelty in the relationship between seeing a different server and choosing a new product, we performed moderated mediation analysis with model 7 in Process (Hayes, 2014). This analysis used seeing a service robot (vs. a human) as the independent variable (service robot =

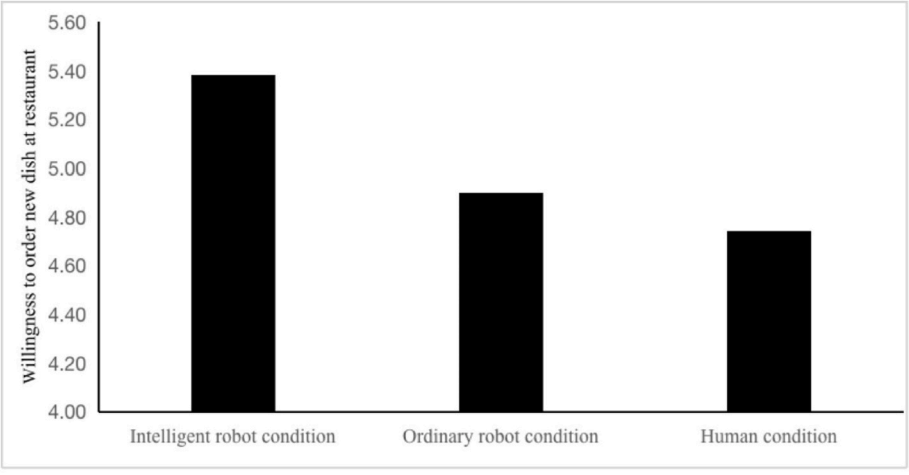

Fig. 5. Willingness to order new dish at restaurant (study3).

0, human = 1).

Then we used measured subjective knowledge as a moderator, novelty as a mediator, and new product intentions as the dependent variable. A 10,000 resample bootstrap analysis revealed that the indirect effect of novelty was significant when participants' subjective knowledge was low ($b = -0.63$, $SE = 0.18$, % 95 CI: [−1.01, −0.31]. In contrast, the indirect effect was not significant when their subjective knowledge was low ($b = 0.10$, $SE = 0.12$, % 95 CI: [−0.09, 0.36]. The moderated meditation of subjective knowledge was significant ($b = 0.29$, $SE = 0.10$, %95 CI: [0.12, 0.51].

7.2.4. PLS-SEM analysis: testing the robustness of the results across study4

To better confirm our finding of Study 4, we performed robustness checks using confirmatory factor analysis and PLS-SEM analysis. We used seeing a service robot (vs. a human) as the independent variable (X), novelty as a mediator (M), levels of subjective knowledge as the moderator variable, and new product choosing intentions as the dependent variable (Y).

As per Table 6, the CA values were higher than 0.6, and CR values were higher than the threshold value of 0.6. The AVE values are greater than the threshold value of 0.5, so the convergent validity for all the constructs is proved (Hair et al., 2017; Wang et al., 2013). The validity and reliability of the measurement model were confirmed and then the path analysis was done to examine the relationship between the constructs using the structural model.

The calculations of the path coefficients and their significance levels are mentioned in Table 7. The results indicated that seeing a service robot (vs. a human) significantly influences the novelty and new product choosing intentions.

Table 8 shows the global model fit of our model, where the value does not exceed 95% and 99% of the distribution. Table 9 shows the goodness of fit of our model, where the GoF value is 0.358.

Consistent with the result we found before, the sense of novelty mediates the effect of seeing a service robot on new product choosing intentions (see Table 10). The result of SEM showed that different levels of subjective knowledge also have a moderating effect between seeing a service robot (vs. a human) and the sense of novelty, in support of H5 (see Table 11).

This PLS-SEM analysis replicated the main effect findings and revealed the effect of consumers' subjective knowledge. If consumers have high levels of subjective knowledge about robots, it does not contribute to their willingness to engage in exploratory consumption behaviors (see Fig. 6).

7.3. Discussion

This study replicated the main effect findings and revealed the effects

Table 6
Confirmatory factor analysis, reliability and convergent validity test in study4.

Factor	Items	Loading	z	CA	CR	AVE
X				/	/	/
	X1	1.000	/			
M				/	/	/
	M1	1.000	/			
Y				/	/	/
	Y1	1.000	/			
W				**0.860 (>0.6)**	**0.867 (>0.6)**	**0.686 (>0.5)**
	W1	0.823	fixed			
	W2	0.905	12.9***			
	W3	0.750	11.4***			

X: Seeing a robot (vs. a human); M:The primed sense of novelty; Y: New product choosing intentions; W: Levels of subjective knowledge of consumers. *** = p < .01; "/" appears because of single item factor.
Model Fit: $Chi^2 = 3.90$, df = 6, CFI>0.99, TLI>0.99, RMSEA<0.01, SRMR = 0.0162.

Table 7
Correlation analysis and discriminant validity test in study4.

	1. X	2. M	3. Y	4. W
1. X	/			
2. M	−0.249 (<0.01)	/		
3. Y	−0.169 (0.018)	0.397 (<0.01)	/	
4. W	−0.022 (0.775)	−0.225 (0.004)	−0.029 (0.705)	***0.828***

X: Seeing a robot (vs. a human); M:The primed sense of novelty; Y: New product choosing intentions; W: Levels of subjective knowledge of consumers. The $AVE^{0.5}$ is shown in bold on the diagonal.

Table 8
Global model fit.

Criterion	Value	95%, 99% of distribution
SRMR		
Saturated	0.045	0.041,0.046
Estimated	**0.048**	**0.057, 0.075**
d_ULS		
Saturated	0.043	0.035, 0.076
Estimated	**0.048**	**0.068, 0.120**
d_G		
Saturated	0.035	0.053, 0.112
Estimated	**0.035**	**0.053, 0.079**
NFI		
Saturated	0.881	/
Estimated	0.879	/

SRMR (<0.08), d_ULS (<0.95), d_G (<0.95) NFI(close to 0.9).
Or the Value do not exceed 95% (or 99%) of distribution.

Table 9
R^2 and communality.

	adj-R^2	communality(AVE)	Q^2	GoF
M	0.219	0.686	1.000	
Mod. Effect	/	/	1.000	
W	/	/	0.537	
X	/	/	1.000	
Y	0.154	/	1.000	
Mean value	0.187	0.686	0.907	**0.358**

M: The primed sense of novelty; Mod. effect = M*W; W: Levels of subjective knowledge of consumers; X: Seeing a robot (vs. a human); Y: New product choosing intentions.

Table 10
Mediation analysis.

Mediation	Direct effect			Indirect effect		Total effect
	c'	a	b	ab	CI (BS-Test)	ab + c'
X - > M - > Y	−0.075	−0.252	0.378	**−0.095**	**[-0.142, −0.052]**	−0.170

X: Seeing a robot (vs. a human); M: The primed sense of novelty; Y: New product choosing intentions; CI= Confidence Intervals Bias corrected. BS=BOOTSTRAP.

Table 11
Moderation analysis.

Moderation	Moderation effect		
	Coeff.	t stat	p value
Mod. effect - > M	0.344	4.900	0.000

M:The primed sense of novelty; W: Levels of subjective knowledge of consumers; Mod. effect = M*W.

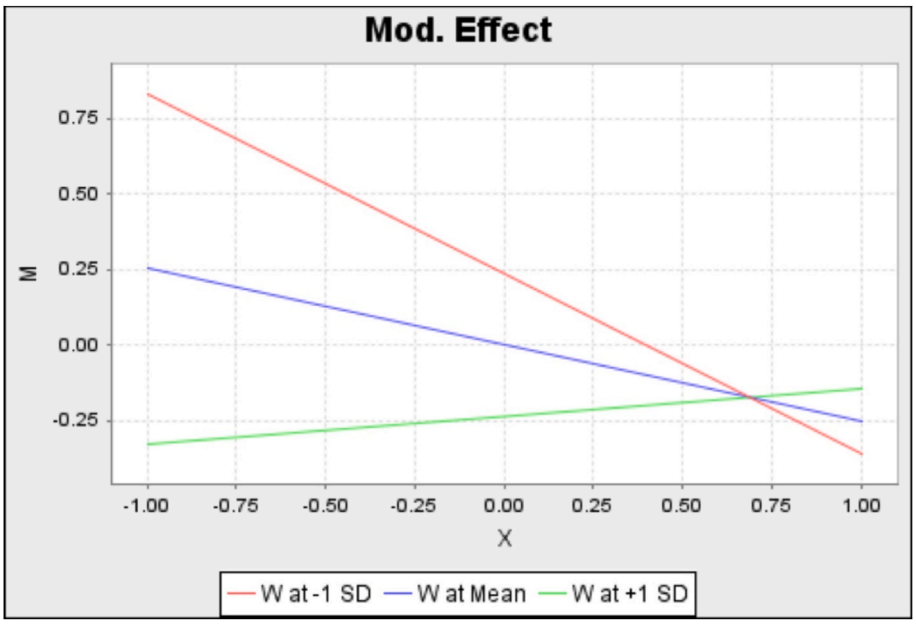

Figure 6. The moderating effect of subjective knowledge (Study 4).

of service robots' degree of intelligence and consumers' subjective knowledge: When a server is an ordinary robot (vs. an intelligent robot), the priming effect is likely to disappear; If consumers have high levels of subjective knowledge about robots, it does not contribute to their willingness to engage in exploratory consumption behaviors.

8. Discussion and conclusion

This study explored the priming effect of service robots on consumer behavior. The findings from the pilot studies indicated that service robots, compared with human beings and other high-tech innovations, are qualified by the notion of novelty. Prior research has explored customers' perceptions of service robots, for example, that they are highly efficient and standardized (Longoni et al., 2019); however, the present research demonstrated that service robots are perceived as novel. Study 1 revealed that exploratory consumption behaviors are enhanced when customers see a service robot in service encounters than when they are served by traditional human staff.

Study 2 showed that the sense of novelty plays a significant mediating role in the effect of seeing service robots on exploratory consumption behaviors. Seeing a service robot can prime the sense of novelty among consumers, influencing their subsequent behavior (e.g., exploratory consumption behavior). Though the priming effect has been widely investigated (May and Irmak, 2018), this study showed that seeing a service robot automatically primes the sense of novelty in consumers' minds and their downstream behavior caused by this priming, which takes the form of exploratory consumption behavior.

Study 3 investigated the effect of the degree of service robots' intelligence. The results showed that when the perceived intelligence of a robot decreases, the priming effect is eliminated, confirming that only highly intelligent robots are consistent with the notion of being novel. Study 4 investigated the effect of consumers' subjective knowledge. The results demonstrated that if consumers have a high level of subjective knowledge about robots, it does not result in their willingness to engage in exploratory consumption behaviors.

9. Theoretical implications

The theoretical contributions of our research findings are threefold. First, our results establish the research on consumer behavior through the insights they offer into consumption that are unrelated to but elicited by service robots. Our main effect demonstrated that seeing robots during the service experience could serve as a predictor of other unrelated consumer behaviors. Service robots quietly enter people's lives and gradually affect consumer's psychology and behavior and are changing the everyday lives of consumers (Chuah and Yu, 2021; Zibafar et al., 2021). Previous studies have highlighted consumers' acceptance and satisfaction with service robots and their service robot experience (e.g., Çakar and Aykol, 2020; Amelia et al., 2021; Guan et al., 2021; see Table 1 for details). In contrast to these findings, our studies emphasized consumers' feelings, that is, the sense of novelty and its impact on unrelated exploratory consumption behavior. We also prove that this perception is elicited automatically and unconsciously and is constituted by the robot's characteristics.

Second, our findings expand the literature on the priming effect. "Novelty" has been determined as a factor influencing consumers' satisfaction and their behavioral intentions toward robots (Kim et al., 2021). Among various priming cues, we confirmed that service robots are perceived to be consistent with the three key notions of novelty (new, different, and interesting), and we demonstrated the mechanism underlying the formation of the association network between these concepts. Other products and technologies that we tested did not satisfy the three elements of novelty and, thus, cannot be used to prime the novelty construct in consumers' minds.

Third, our findings contribute to the extant work on exploratory consumption behavior. Exploratory behaviors indicate the actions individuals undertake to discover something new or different or something that elicits their curiosity (Poushneh, 2021; Sadiq et al., 2021). Previous studies proved that consumers would satisfy their needs for exploration through exploratory buying behaviors (Sadiq et al., 2021). In contrast to the previous research, we considered exploratory consumption behaviors in several service conditions and presented a feasible experimental method for examining exploratory consumption. Our six studies showed that the sense of novelty is tightly connected with exploratory behaviors. In addition, three types of exploratory consumption, variety-seeking, risk-taking, and curiosity-motivated behavior, were also affected by the sense of novelty.

10. Practical implications

Service robots have important implications at every level and for all stakeholders. Our research offers a perspective based on individual consumers' experiences. First, we demonstrated that service robots can induce exploratory consumption behaviors, and our findings confirmed that the novelty sensation is partially derived from the interesting perception of service robots by consumers. Such exploration is significant for promoting new products (Arnaut, 2009), and service robots could be used to attract more consumers to stores. This is significant because unplanned browsing can result in unplanned buying (Streicher et al., 2020). Using service robots as a promotional campaign strategy is, therefore, valuable. For example, when launching a new product, service robots could be used as narrators to attract more consumers to pay attention to this new product, and the more consumers are unintentionally attracted, the more likely the new launch will sell well.

Second, our research found that service robots are new, different, and interesting at the same time. These notions are usually aligned with an image of being active and innovative (Youn and Jin, 2021). Brands with the personality of being innovative or interesting may, thus, employ service robots in their front-line to make an accordant impression and to strengthen their brand image. For instance, a high-tech chain could employ service robots as their shopping assistants to build an innovative brand image.

Furthermore, service robots have been found to be able to lead consumers to various exploratory behaviors including variety-seeking, risk-taking, and curiosity-motivated behaviors. For instance, when consumers are induced to broaden their food choices by service robots, it is more possible for them to choose foods that have a lower impact on the environment. Moreover, under the circumstance that the Covid-19 pandemic has cast a shadow on the implementation of the Sustainable Development Goals (SDGs) (Cheng et al., 2021; Hörisch, 2021), service robots may play a role in promoting and realizing these goals. For example, replacing fuel vehicles with electric vehicles is a good measure for sustainable development of the environment, which is aligned with SDGs 14 and 15 (Asekomeh et al., 2021). To better encourage the adoption of electric vehicles, service robots could be employed in the introduction manual to attract potential buyers. Overall, our findings suggest that service robots could be employed as a tool to attract consumers to newly launched products and policies, which may enhance unplanned buying and sustainable development goals.

Furthermore, our findings have important managerial implications for the marketing of consumed green products. First of all, since consumers are induced to broaden their food choices by service robots (Study 3, Study 4), it becomes possible for them to choose foods that have less impact on the environment. Moreover, by introducing green products using service robots, retailers can enhance consumers' experiences and sales of environmentally friendly products. To specify, replacing fuel vehicles with electric vehicles is a good measure for sustainable development of the environment which is aligned with SDGs 14 and 15 (Griggs et al., 2017). To better encourage the adoption of electric vehicles, service robots could be employed in the introduction manual to attract potential buyers. Lastly, under the circumstance that the Covid-19 pandemic has cast a shadow on the implementation of the Sustainable Development Goals (SDGs) (Cheng et al., 2021; Hörisch, 2021), service robots may play roles in promoting and realizing these goals.

11. Limitations and future work

Our work has several limitations, which open up the avenue for future research. In the current study, we did not investigate the delayed effect of the priming of a sense of novelty. Although past research has indicated that only goal-related priming has a delayed effect on consumer behaviors (Baumgartner and Steenkamp, 1996), in Study 1, the participants who saw a robot (vs. a human) in a service place tended to choose more activities, indicating that seeing a robot may also influence unrelated activities in the future. Later studies can focus on future unrelated activities.

Another limitation lies in the application of our research methods. Although we used different manipulations of scenarios involving service robots or human staff, all the main studies were confined to the lab. This limits the generalization of the findings to empirical situations. To overcome this shortcoming, cooperation with retailers and other businesses is required. Field experiments should be used to verify our conclusions here. In addition, the fact that all participants were recruited from China might have influenced the robustness of our findings. Because of different levels of economic development and varying cultural backgrounds, consumers from other countries may have different perceptions of novelty when seeing robots. Future studies should address this limitation by targeting a wider variety of samples with different backgrounds. Lastly, the fact that we did not directly examine the implicit association between seeing a robot and the sense of novelty is a technical limitation. Previous research has used new technologies (e.g., electroencephalogram) to record changes in electrical waves in the brain to prove mindset changes (Yuan et al., 2006; Liu et al., 2016). Novelty priming, as a physiological activity, could also be reflected on the surface of the cerebral cortex. Future research should examine how seeing a robot influences the process of novelty priming.

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Declaration of interest

None.

Appendix A. . Literature search and exclusion rules for Section 2.1

The recent growing amount of fragmented research across disciplines on human-robot interaction requires a systematic literature review to integrate findings and perspectives (Snyder, 2019). The systematic literature review serves as an unbiased way to evaluate objectively a stream of literature on a specific topic (Lyngdoh et al., 2021) and provides insightful directions for future research in the field.

This study covered peer-reviewed journal publications in English up to the end of 2021 (including "express" of some papers to publish in 2022 by the end of 2021).

To contribute to consumer behavior research in the management and business field, the search was confined to particular journal categories in the Web of Science Core Collection. As a leading database, Web of Science is widely used for systematic reviews (e.g., Ivanov et al., 2018). The categories were first determined by marketing and consumer research journals in UTD 24 (The University of Texas at Dallas) journals and FT50 (Financial Times) journals. Marketing and consumer research relevant journals in these two lists fall into three categories: Business, Management, and Psychology Applied in SSCI (Social Sciences Citation Index) edition of the Web of Science Core Collection.

To ensure a comprehensive overview of the consumer behavior research field and concerning the increasing augmentation of robot use in the hospitality sector, the relevant Web of Science Category "Hospitality, Leisure, Sport, and Tourism" was also searched. As the research fields were

already confined by WoS categories roughly to management and business, the keyword used to search is "robot*" in the Web of Science (WoS) database through titles, abstracts, author keywords, and keywords plus. The asterisk in Boolean operator allows covering all words beginning with "robot" thus extending the scope of retrieval. Relevant journal/conference articles (including review articles) but not book chapters have been the focus of the search.

At the screening stage, a total of 616 papers published between 2004 and 2021 were retrieved. To begin the exclusion process, we read the abstracts and applied a set of inclusion and exclusion criteria to eliminate papers that we deemed to be beyond the scope of our review.

We first excluded studies exploring ways to improve and perfect algorithms and studies that had employed artificial intelligence methods in collecting or analyzing data but did not discuss the consumer interaction with robots. (Exclusion criterion 1).

Then, we excluded studies in which "robot*" were mentioned in the abstract or keywords but the authors did not discuss them in the full text of those talk about technology revolutions in general but not specifically a robot. (Exclusion criterion 2).

Finally, studies exploring employees' or companies' reactions toward robots and research on robot contributions to business performance were excluded. (Exclusion criterion 3).

Papers the full-text of which were not accessible from the databases were excluded from the literature review. (Exclusion criterion 4).

Studies concerning only consumer responses to and interactions with artificial intelligence systems/chatbot were eliminated from the literature review scope. (Exclusion criterion 5).

Following the inclusion and exclusion criteria, 134 papers were selected for the literature review."

Appendix B. . Robustness test of Study 3 (Path analysis)

To better confirm the effect of study3, we did the robustness test using the path analysis again. We used an intelligent robot(vs ordinary robot) as the independent variable (X), novelty as a mediator (M), and new product choosing intentions as the dependent variable (Y).

The path analysis was done to examine the relationship between the different constructs using the Smart PLS 3.0.

Table 3
Path analysis using PLS method.

Path	PLS results			
	Coeff.	t stat	p value	VIF
M -> Y	0.204	2.867	0.004	1.171
X -> M	−0.382	8.241	0.000	1.000
X -> Y	−0.097	1.434	0.152	1.171

M:The primed sense of novelty; Y: New product choosing intentions; X: Seeing a robot (vs. a human).

Table 4
Mediation analysis

Mediation	Direct effect			Indirect effect		Total effect
	c'	a	b	ab	CI (BS-Test)	ab + c'
X - > M - > Y	−0.097	−0.382	0.204	**−0.078**	**[-0.127, −0.029]**	−0.175

X: Seeing a robot (vs. a human); M: The primed sense of novelty; Y: New product choosing intentions; CI= Confidence Intervals Bias corrected. BS= BOOTSTRAP.

The results indicate that seeing an intelligent robot (vs ordinary robot) significantly influences novelty and new product choosing intentions. The mediation effect of novelty is also significant(b = −0.078, CI(-0.127, −0.029). This result replicated the findings of study3: When a server is an intelligent robot (vs ordinary robot), it induced more of a novelty feeling and new product choosing intentions."

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