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Nobuyuki Fukawa
Missouri University of Science and Technology, fukawan@mst.edu

Yu Shan Huang

Barry J. Babin

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Pepper, just show me the way! How robotic shopping assistants should look and act

Nobuyuki Fukawa[1] | **Yu-Shan (Sandy) Huang**[2] | **Barry J. Babin**[3]

[1]Kummer College of Innovation, Entrepreneurship, and Economic Development, Missouri University of Science and Technology, Rolla, Missouri, USA

[2]College of Business, RELLIS Campus, Texas A&M University-Corpus Christi, Bryan, Texas, USA

[3]Department of Marketing, Analytics, and Professional Sales, University of Mississippi, University, Mississippi, USA

Correspondence
Nobuyuki Fukawa, Kummer College of Innovation, Entrepreneurship, and Economic Development, Missouri University of Science and Technology 107 C Fulton Hall, Rolla, MO 65409, USA.
Email: fukawan@mst.edu

Abstract

Artificial intelligence enables modern robots to serve as service and sales assistants. Today's robotic shopping assistants (RSAs) can appear either humanoid or non-humanoid and possess utilitarian and/or hedonic attributes. However, many questions remain unexplored regarding an effective customer-centric RSA design. Do customers prefer a humanoid or non-humanoid RSA with hedonic or utilitarian attributes? To answer those questions, the research deploys a mixed-method approach involving a survey of customers who have interacted with the Pepper Robot, a humanoid robot (Study 1), and follow-up experiments examining customer responses to a humanoid/non-humanoid RSA with hedonic/utilitarian attributes (Studies 2 and 3). The research employs an innovative approach that analyzes both unstructured and structured data simultaneously. Study results suggest that customers prefer humanoid RSAs with utilitarian attributes over those with hedonic attributes. The research contributes to the literature by proposing hedonic (vs. utilitarian) attributes of RSAs as new drivers of anthropomorphic perceptions.

1 | INTRODUCTION

During the COVID-19 pandemic, a team of Pepper Robots, a humanoid robot by Softbank, performed a dance routine coordinated with a team of dog-shaped robots during a televised baseball game in Japan. The routine received mixed responses from viewers (The Indian Express, 2020).[1] Negative reactions included Tweets describing the routine as creepy or weird. Feelings of creepiness and perceptions of weirdness may well be the consequence of anthropomorphism, the tendency of human beings to “attribute human characteristics to inanimate objects” (Duffy, 2003, p. 180; Novak & Hoffman, 2019). Nonhuman objects become anthropomorphized as they take on more human-like characteristics; such is the case when robots take on a human-like appearance (Landwehr et al., 2011; van Prooijen & Bartels, 2019; Vernuccio et al., 2022). Anthropomorphism can drive either favorable (e.g., Fan et al., 2020; Uysal et al., 2022; van Pinxteren et al., 2019) or unfavorable customer responses (e.g., Broadbent et al., 2011; Goetz et al., 2003; Uysal et al., 2022).

[1]The video can be seen here: https://www.youtube.com/watch?v=G9p9jdmJQOQ

Did the Pepper Robots' dancing and singing seem too human and end up coming across as weird and creepy? Perceptually, are hedonic actions, such as dancing and joking, reserved exclusively for humans to perform (Gray & Wegner, 2012)? How about utilitarian actions? For instance, Lowe's LoweBot (a non-humanoid robot) reduces customers' difficulty in locating products and enhances the customer experience by accompanying them in finding products they are looking for (Almquist et al., 2016; Morgan, 2020). How would customers respond to a non-humanoid robot (LoweBot) offering such utilitarian benefits?

Typically, a unique capability of humans lies in the hedonic aspects of our behavior in connecting “with the outside world through our affective experiences” (Longoni & Cian, 2022, p. 93). In contrast, despite its utilitarian benefits, robots are believed to be less capable of offering hedonic benefits compared with humans (Longoni & Cian, 2022). Consistently, people believe that nonhuman objects generally lack “the capacity to feel and to sense” (Gray & Wegner, 2012; p. 126). Thus, if robots seem to possess a human-like mental capacity (*internal* factors of robots), people may respond negatively toward the robot (Appel et al., 2020; Yin et al., 2023). Consequently, people generally prefer recommendations made by humans over those by AI in pursuing a hedonic goal (Longoni & Cian, 2022). However, as *emotional AI* is developed and tested for interacting with customers (Huang & Rust, 2021; Labbé, 2022), "such emotionally intelligent human technology interaction will likely give rise to new business models" (Deloitte, 2020). Consequently, hedonic attributes of robots may become as common as utilitarian attributes.

The literature offers preliminary studies in hedonic and utilitarian service contexts, consumer motivations, and values in relation to anthropomorphized AI without a particular focus on robot *features* (e.g., Liu et al., 2022; Longoni & Cian, 2022; Mara et al., 2022; Odekerken-Schröder et al., 2022). Furthermore, anthropomorphism research has generally focused more on *external* factors of robots (e.g., the physical appearance) than on *internal* factors (e.g., mental capacity) (Gray & Wegner, 2012; Wang et al., 2015). Recent research (e.g., Appel et al., 2020; Yin et al., 2023) suggests that *internal* factors of robots, such as a robot's mental capacity could also trigger uncanny feelings. Similarly, this research proposes hedonic (vs. utilitarian) attributes of an RSA as an *internal* factor in anthropomorphism. Considering the challenge associated with deploying humanoid robots (e.g., Inada, 2021), and the recent deployment of more non-humanoid RSAs (e.g., Mims, 2022; Rindfleisch et al., 2022), this research investigates these RSA features of not only humanoid RSAs but also non-humanoid RSAs.

Overall, this research investigates consumer responses to RSA attributes (*internal* factors of robots) in relation to the RSA appearance (*external* factors of robots). Insights from the research may help retailers and robot manufacturers increase customer receptivity of RSAs, deploy them more effectively and incorporate customer-centric innovation in design (Darani & Kaedi, 2017; Lu et al., 2020; Verganti et al., 2020; Wang & Tseng, 2011). In particular, this research aims to answer the following two research questions: (1) How should hedonic/utilitarian attributes be equipped in humanoid/non-humanoid robots without triggering negative responses from customers? (2) Which attribute-appearance combination would best enhance a customer's willingness to try an RSA?

Toward that end, we present a mixed-method approach involving three studies (e.g., Harrison, 2013). A mixed-method approach allows researchers to generate stronger inferences (Venkatesh et al., 2016) and more robust findings (Davis et al., 2011, p. 467) than a single-method approach. These benefits are especially important when existing studies and theories do not provide a very clear explanation or prediction of phenomena, as in the case of RSAs. In particular, in Study 1, using a panel from a Japanese marketing research firm, we conduct a survey of Japanese customers who report on their actual behavioral experiences with the Pepper Robot using both open-ended and closed-ended question formats. In Studies 2 and 3, we conduct experiments to study how customers respond differently to a humanoid RSA (non-humanoid RSA) with hedonic (utilitarian) attributes (please see Appendix 15 for the overview of our studies).

RSAs, multifunctional robots with physical embodiments, could help build stronger customer relationships due to their physical presence than virtual AI agents (Davenport et al., 2020). However, marketers must first understand how customers respond to RSAs in deciding if and how to use RSAs. In doing so, the research contributes to marketing literature on the acceptance of AI, one of the critical AI research areas as identified by Mariani et al. (2022). In particular, first, we study the effects of attribute type and appearance of RSA on robot-customer behavior. Second, as a method of analysis in Study 1, we propose an innovative approach capable of simultaneously analyzing unstructured and structured data and potentially solving challenges related to Big Data. Third, we review the literature on hedonic/utilitarian attributes of RSAs in relation to anthropomorphism and discuss theoretical and managerial implications of our study results.

2 | LITERATURE REVIEW

2.1 | Robotic shopping assistants and anthropomorphism

Today, among technological innovations, robotic technology is particularly prevalent in retail stores, hotels, and banks; examples include LoweBot at Lowe's, and the Pepper Robot at both Mandarin Oriental Hotel and HSBC banks (Bertacchini et al., 2017; King, 2014). ISO[2] (2012) defines a robot as an "automatically controlled, reprogrammable multipurpose manipulator programmable in three or more axes." Robots that serve as "information technology in a physical embodiment" (Jörling et al., 2019, p. 405) to assist customers during shopping are referred to as RSAs.[3] With the recent advancement of technology, RSAs can now be designed to undertake both operational *and* social functions in various marketing activities such as services, retail, and sales sectors (Grewal et al., 2020). However, existing frontline research has primarily focused on robotic technology in service deliveries. This is concerning as researchers believe that the integration of sales and service is crucial, particularly in the context of AI (Ruyter et al., 2020).

As RSAs become more human-like (e.g., humanoid appearance), users anthropomorphize these nonhuman objects by attributing human-like qualities (e.g., mental states) and social functions to them (Cheng, 2022; Landwehr et al., 2011; van Pinxteren et al., 2019) (please see Appendix 1 for more detailed review). Anthropomorphism may help people effectively interact with technological agents (e.g., robots) and experience a sense of social connection (Epley et al., 2007). Consequently, anthropomorphism could enhance users' favorable responses to AI-enabled agents (Blut et al., 2021; Kiesler et al., 2008; Letheren et al., 2021; Sheehan et al., 2020; Stroessner & Benitez, 2019; Uysal et al., 2022; van Pinxteren et al., 2019). However, the anthropomorphism of a robot may not always produce positive outcomes. For example, according to Goudey and Bonnin (2016), the anthropomorphic appearance of a robot does not

[2]ISO stands for "International Organization for Standardization" and is responsible for creating standards in relation to producing products, delivering services, and managing supply chain processes in relation to these products and services (ISO, 2023).

[3]See Appendices A2 and A3, for examples, of RSAs.

increase its consumer acceptance. Other studies (e.g., Broadbent et al., 2011; Vlachos et al., 2016) argue that people prefer a machine-like robot over a human-like robot. In particular, highly humanoid RSAs could appear weird and uncanny, and trigger customers' feelings of discomfort (Jiang et al., 2022; Mende et al., 2019; Mori et al., 2012; Steinhoff et al., 2019). Additionally, in a context of a service failure, a customer may be less likely to forgive an android RSA than a humanoid RSA (Cheng, 2022).

Given that the significant number of research on anthropomorphism investigates *external* anthropomorphic factors of robots (i.e., a human-like appearance), Gray and Wegner (2012) study *internal*, anthropomorphic factors of robots (e.g., capacity to feel). In particular, eerie and unnerving feelings occur because a human-like appearance could lead humans to perceive the robot as human-minded. In general, humans perceive mind through *agency* (i.e., "the capacity to do, to plan, and exert self-control") and *experience* ("the capacity to feel and to sense") (Gray & Wegner, 2012, p. 126). While human beings possess both *agency* and *experience*, nonhuman entities (e.g., RSAs) are expected to lack *experience* (Gray & Wegner, 2012). Human-like robots could conflict with this expectation by leading humans to perceive that those robots share human sensations and experience real emotions. In particular, nonhuman entities possess capabilities that are expected to belong only to human beings, thus, rendering the robots unnerving (Gray & Wegner, 2012).

Drawing on the work by Gray and Wegner (2012), more recent studies (e.g., Appel et al., 2020; Yin et al., 2023) take anthropomorphism beyond the physical appearance and argue that uncanny feeling could occur from the perceived mentality of robots. In particular, individuals dislike a human-like robot with a higher mental capability more than that with a lower mental capability; this same effect is not observed for a machine-like robot (Yin et al., 2023). Consistent with these efforts, this research aims to advance anthropomorphism beyond the appearance of robots and study whether hedonic (vs. utilitarian) attributes of robots could trigger negative responses of customers in relation to the appearance of robots.

2.2 | The effects of RSA attributes and appearances on customer acceptance

In essence, hedonic attributes provide hedonic value, including affect, sensory enjoyment, and fun experiences (Babin et al., 1994; Batra & Ahtola, 1991; Voss et al., 2003). In contrast, utilitarian attributes provide utilitarian value, including functionality, rationality, and instrumentality (Babin et al., 1994; Batra & Ahtola, 1991; Voss et al., 2003). The realization of utilitarian (hedonic) value is typically more cognitively (emotionally) driven (Longoni & Cian, 2022; Roy & Ng, 2012). While utilitarian attributes are often enabled by *thinking* AI (e.g., designed to perform rule-based tasks), hedonic attributes are enabled by *feeling* AI (e.g., designed to perform emotional tasks) (Huang & Rust, 2021; Liu-Thompkins et al., 2022).

In general, human beings are believed to be more capable than robots of sensing and experiencing emotion (Gray et al., 2007), building trust, and demonstrating empathy (Lu et al., 2020). Thus, robots are perceived to be more unnerving when they seem capable of sensing and feeling (hedonic attributes) than when they just do and act (utilitarian attributes) (Batra & Ahtola, 1991; Botti & McGill, 2011; Dhar & Wertenbroch, 2000; Gray & Wegner, 2012). In turn, for a humanoid RSA, customers may respond more positively to RSAs with utilitarian attributes than those with hedonic attributes.

Regarding customer responses to robots, scholars discuss utilitarian and hedonic service contexts, motivations, and values. Service contexts delivered by robots could be utilitarian (e.g., travel insurance) and/or hedonic (e.g., amusement) (Hu, 2021; Liu et al., 2022; Odekerken-Schröder et al., 2022). Liu et al. (2022) argue that customers are more willing to interact with humanoid robots perceived as warm in hedonic service contexts and robots perceived as competent in utilitarian service contexts. Furthermore, a retailer could employ an RSA (physically embodied AI) for fulfilling either a hedonic or a utilitarian customer motive (Batra & Ahtola, 1991; Bertacchini et al., 2017; Botti & McGill, 2011; Dhar & Wertenbroch, 2000). Longoni and Cian (2022) study how respondents choose to receive recommendations either from a human recommender or an AI recommender (an avatar with a human-look) in pursuing two different goals (hedonic vs. utilitarian goals). Their results show that in pursuing a hedonic (utilitarian) goal, more respondents choose recommendations made by humans (digital AI) over recommendations made by digital AI (human).

Additionally, perceived utilitarian (hedonic) value plays a more important role for future intention to use robots in a utilitarian (hedonic) service context (Hu, 2021). Additionally, for customers to consider robots as a service improvement instead of a gimmick, they must realize both hedonic and utilitarian value from the encounter. These findings are based on empirical studies on Chinese customers who interacted with RSAs without distinguishing between a humanoid RSA and a non-humanoid RSA. In contrast, in their study on a humanoid robot (Odekerken-Schröder et al., 2022), while perceived utilitarian value significantly drives the customer intention to revisit a fast-casual dining restaurant, the effect of hedonic value on the customer intention was only supported in a scenario-based experiment and not in a field study.

Overall, existing research considers utilitarian and hedonic service contexts, motivations, and values in relation to AI without a particular focus on robot *features*. This research joins the recent research that investigates anthropomorphism beyond the appearance of robots (*external* factors of robots) (e.g., Appel et al., 2020; Yin et al., 2023). In particular, this research investigates how customers respond to hedonic (vs. utilitarian) attributes (*internal* factors of robots) in relation to the appearance of robots (*external* factors of robots). In doing so, Study 1 explores actual customer experiences of interacting with the Pepper Robot (a humanoid robot), identifies hedonic/utilitarian attributes of RSAs, and explores customers' responses to these attributes.

3 | STUDY 1

3.1 | Method

A professional marketing research firm in Japan[4] (Intage) deployed a sample derived from a professionally managed consumer-household panel. Each member of the panel represents a Japanese household consumer. The survey was originally created in English and translated into Japanese by one of the authors. The Japanese version of the survey was pretested by three Japanese PhD students at a major private university in Japan. Consistent with other researchers (Brislin, 1970; Levine et al., 2011), we ensured the validity of the translated version through back-translation; an independent translator back-translated the Japanese version into English.

3.1.1 | Sampling pre-screening

Before the main study, a screening study was used to extract a sampling frame of panel members who had interacted with an RSA at a retail store or in a service encounter within the last 6 months. In total, 10,309 panel members participated in the screening study. Each respondent with a recent RSA interaction was asked to indicate how well they remembered the interaction using a 7-point scale anchored by "do not remember at all" (1) and "remember very well" (7). Through the screening, 522 members indicated remembering the interaction with a response of at least 5 on the memory question and qualified for the sample.

3.1.2 | Main study

Out of the 522 qualified sample members invited to participate, 228 members took part in the main study. As expected, among those 228 participants, most (202 respondents) reported that they interacted with the Pepper Robot, the focus of Study 1. Thus, we conducted analyses among these 202 respondents (38.7% response rate). Fifty-six percent were female. The mean age of participants was 46 years (ranging from 19 to 69 years). Consistent with other researchers (e.g., Folkes, 1984; Singh & Wilkes, 1996), participants were first asked to recall and describe their most recent interaction with an RSA. Later, respondents were asked to respond on (1) $\text{WTTR}_{\text{actual}}$ (*willingness to try an RSA* (*actual*): how willing they were to interact with an RSA in the actual encounter they described earlier) and (2) $\text{WTTR}_{\text{future}}$ (*the willingness to try an RSA in the future*).

3.2 | Measures

3.2.1 | $\text{WTTR}_{\text{actual}}$

$\text{WTTR}_{\text{actual}}$ was measured using a three-item measure[5] from Chaudhuri et al. (2010). For instance, given a statement, "Regarding the RSA I described earlier in the study, I was willing to spend time to know the RSA better," participants were asked to respond using a 7-point scale anchored by "completely disagree" (1) and "completely agree" (7). Cronbach's α was .89.

3.2.2 | $\text{WTTR}_{\text{future}}$

In contrast, $\text{WTTR}_{\text{future}}$ reflects respondents' willingness to try an RSA again in the near future should they encounter a Pepper-like RSA. For instance, given a statement, "If I were to encounter an RSA similar to the one I described earlier in the study, I would be willing to spend time to know the RSA better," subjects were asked to respond using the same 7-point scale as in $\text{WTTR}_{\text{actual}}$. Cronbach's α was .92.

3.3 | Analysis

First, we content-analyzed open-ended responses describing their behavioral interactions with the Pepper Robot. Following others (e.g., Fukawa & Erevelles, 2014; Steiger & Steiger, 2008), we deployed proprietary software (i.e., Polyanalyst by Megaputer Intelligence) in conducting text analytics with natural language processing capability. In analyzing open-ended responses in Japanese with an open coding procedure (e.g., Mason, 2002; Pawlowski et al., 2007), 24 categories emerged with the major keyword(s) for each category displayed in Appendix 7 (see also Appendix 5 for more detail about this analysis). Each keyword describes the interpretive theme characterizing those open-ended responses. The reliability of the analysis was computed by assessing the agreement between two coders, one of the authors and another independent coder, regarding the classification of keywords into categories and computing Cohen's kappa for each category (e.g., Cohen, 1960; Landis & Koch, 1977; O'Connor & Joffe, 2020). Cohen's kappa ranged between .65 and 1, which are considered "substantial" to "almost perfect" agreement according to Landis and Koch (1977). Additionally, the validity of the software's category assignments was checked by one of the authors. One of the authors further classified these categories into more abstract themes (e.g., hedonic/utilitarian RSA attributes), the validity of which were checked by all of the authors (See "category classification" column in Appendix 7).

Second, to assess the associations (1) between the categories and $\text{WTTR}_{\text{actual}}$ (Figure 1a), (2) between the categories and $\text{WTTR}_{\text{future}}$ (Figure 1b), and (3) among those categories (Figure 2), cognitive maps were created using the software. Each cognitive map consists of nodes (representations of categories) and links (connecting each node). The size of each node reflects how many respondents mentioned each category or chose a particular scaled response for WTTR. We call this value a *support*.[6] Additionally, the thickness of a link reflects the magnitude of the associations (*co-occurrence index*); the thicker the link is, the larger the co-occurrence index, and the stronger

[4]Because an RSA is more commonly encountered in Japan than in other countries, we conducted this survey in Japan.

[5]See Appendix A4 for all the scale items employed in this study.

[6]When a respondent mentioned a particular category twice, the *frequency* is two, and the *support* is one.

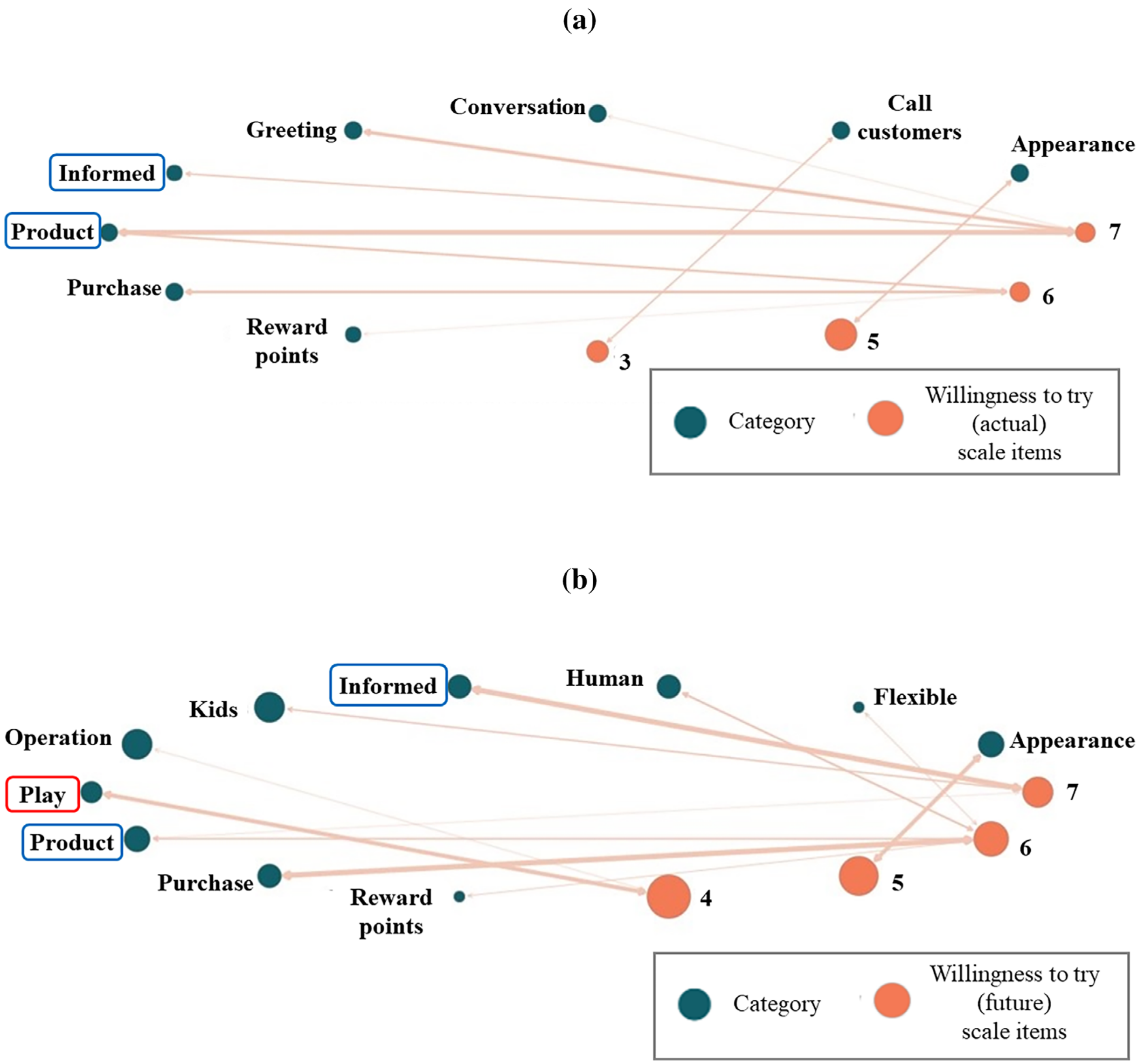

FIGURE 1 (a) Associations between categories and willingness to try—actual (Study 1). (b) Associations between categories and willingness to try—future (Study 1). (1) Please see Appendix 4 for the scale items. (2) "Willingness to try" is considered an ordinal scale, and summated scale was rounded-up and treated as an integer to simplify the analysis. (3) See corresponding co-occurrence index in Appendices 8 and 9.

the association. The co-occurrence index[7] is computed by the Polyanalyst software (see Appendix 6 for the details. See also Fukawa & Erevelles, 2014). Next, we discuss the implications of cognitive maps in relation to hedonic and utilitarian attributes of RSAs.

3.4 | Discussion

3.4.1 | Hedonic/utilitarian attributes

In respondents' descriptions of their interaction with the Pepper Robot, utilitarian-related benefits were more commonly mentioned than hedonic benefits. These utilitarian attributes respondents mentioned formed primarily two segments (see Figure 2). The first includes "product," "location," and "informed" categories, and the second includes "seating," "reception," and "call customers" categories. Perhaps, utilitarian features in the former sets of categories require more sophisticated capability of RSA while those in the latter sets of categories are considered more basic features. A constructive sales role may follow when a humanoid RSA provides sophisticated utilitarian benefits, like product recommendations, or informing customers with useful information (see "product" and "inform" categories in Figures 1 and 2). In Figure 2, this is illustrated by the association between these utilitarian attributes ("product"/"information categories) and "purchase" category (see illustrative comments nos. 2 and 3).

In contrast, as illustrated in Appendix 7, few respondents mentioned hedonic attributes in their RSA-interaction description: "play"

[7]Here, the co-occurrence index relies on the probability, and thus, in computing this index, we do not aim to determine whether an association between two categories is statistically significant. See Appendix A6 for more detail.

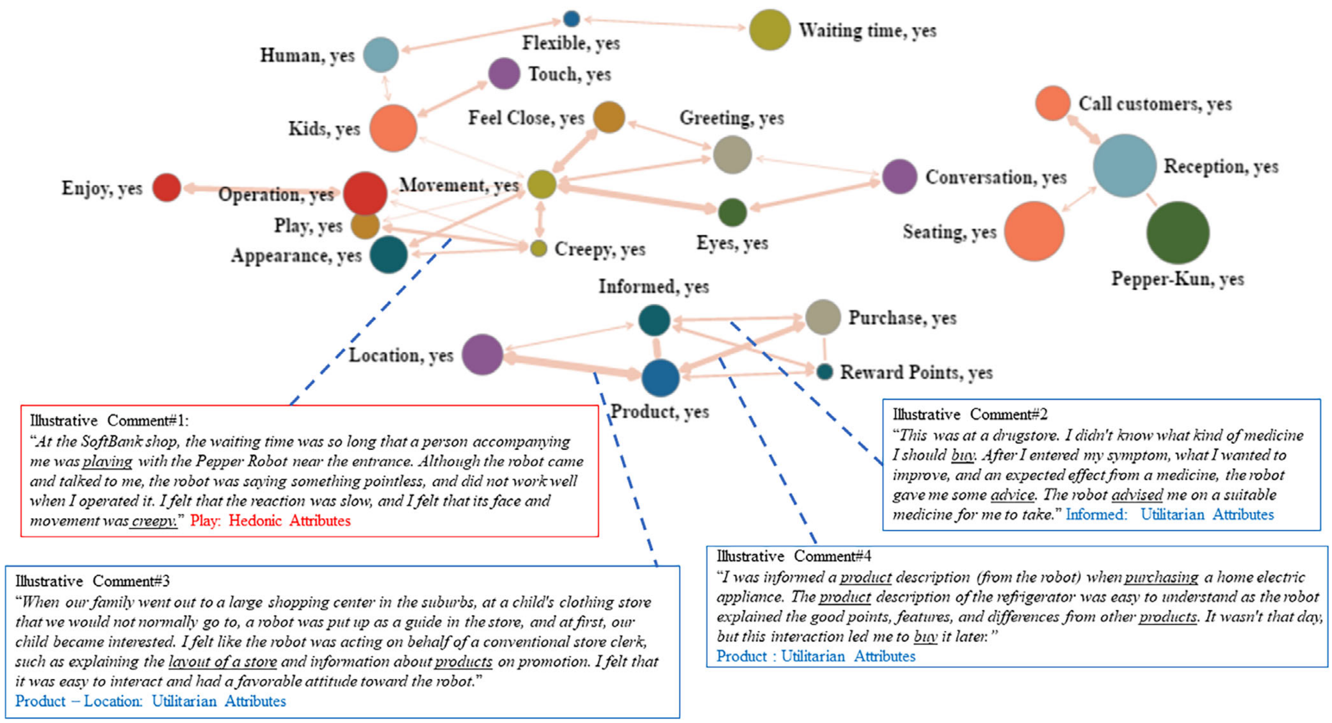

FIGURE 2 Associations among categories (Study 1)—Illustrative comments in relation to hedonic/utilitarian attributes. See corresponding co-occurrence index in Appendix 10.

category (keywords of which were sing, play games, and play rock paper scissors). Consequently, Study 1 results may illustrate that for humanoid robots such as Pepper, customers take advantage of utilitarian attributes more often than hedonic attributes. Humanoid RSAs attempting to provide hedonic benefits may come across as strange, and even creepy, as illustrated by the association between "play" and "creepy" in Figure 2 (see illustrative comment no. 1 in Figure 2). Would such hedonic features typically lie within the human domain (Gray & Wegner, 2012; Lu et al., 2020; Ray et al., 2008)? If so, is this negative association of hedonic features limited to humanoid RSA (vs. non-humanoid RSA)? Overall, why is "play" associated with "creepy" (negative responses) while "informed" and "product" are associated with "purchase?" Do customers find more value in utilitarian attributes than hedonic attributes, thus purchase products and services? Would this trend differ between humanoid robots and non-humanoid robots?

3.4.2 | Attributes and WTTR

We further analyzed how these categories are associated with $WTTR_{actual}$/$WTTR_{future}$. As illustrated in Figure 1a, those advanced utilitarian attributes (e.g., "product," "informed") are associated with the higher $WTTR_{actual}$/$WTTR_{future}$. In contrast, while showing no particular association with $WTTR_{actual}$ (see Figure 1a), the "play" category, a hedonic attribute, is strongly associated with a neutral $WTTR_{future}$ response (see Figure 1b). Customers comprising this association often mentioned that his/her partner or his/her children played with the Pepper Robot while waiting in a store (Respondent no. 95, 38 years old, female; Respondent no. 25, 29 years old, female; Respondent no. 152, 45 years old, male). Another customer mentioned that Pepper autonomously started singing after offering product recommendations at a pastry shop (Respondent no. 17, 51 years old, female). As seen in these responses, most of these customers were passively consuming these hedonic attributes, which may explain a lack of association with high $WTTR_{future}$. Overall, why do utilitarian attributes (e.g., Product, Informed) lead to higher $WTTR_{actual}$/$WTTR_{future}$ while hedonic attributes (e.g., play) only lead to neutral $WTTR_{future}$?

Further analysis revealed that $WTTR_{actual}$ and $WTTR_{future}$ are significantly correlated ($r = .757$, $p < .001$). $WTTR_{actual}$ reflects the extent a customer is engaged in an actual interaction with Pepper in a retail/service encounter. Thus, this correlation implies that $WTTR_{future}$ (a primary dependent variable in Studies 2 and 3) represents such an actual behavior. Consistent with the recent call for more emphasis on actual behavior of customers (Hulland & Houston, 2021; Zeithaml et al., 2020), Study 1 uses the descriptions (data) of actual customers who encountered an RSA in the field. One limitation of Study 1 is that service providers could be focused more on providing utilitarian attributes with RSAs than hedonic attributes. If so, customers may not have had the opportunity to experience substantial amounts of utilitarian and hedonic RSA attributes. Another limitation of Study 1 is that because the Pepper Robot (a humanoid RSA) is by far the most popular RSA in Japan, few respondents provided reactions to a non-humanoid RSA (these were excluded). To address these limitations, Study

2 deploys an experimental design (1) to test whether customers are more willing to use utilitarian than hedonic attributes for a humanoid RSA and (2) to test whether this effect of attribute type is observed for a non-humanoid RSA. In doing so, Study 2 will include a process measure (the attitude toward RSA) to better understand the effects of attribute type and appearance of RSA on WTTR.

4 | STUDY 2

4.1 | Method

Subjects were randomly assigned to one of four conditions in a 2 (RSA appearance: humanoid, non-humanoid) by 2 (types of RSA attributes: utilitarian, hedonic) between-subjects design. The dependent measures were attitude and WTTR. One hundred and forty-nine subjects completed our online study. Subjects were recruited through M-turk with workers' location set to the United States. Sixty-two percent of participating subjects were female. The reported mean age of subjects was 39 years old (range from 18 to 79 years). The subjects first reviewed an informational brochure about an RSA. The brochure contained a picture of either a humanoid or non-humanoid RSA with a list of either hedonic or utilitarian attributes (see Appendix 14 for the stimuli). After reviewing the informational brochure, the subjects reported WTTR and their attitudes toward the RSA. Then, the manipulation checks for the RSA attribute types (hedonic vs. utilitarian) and the RSA appearance (humanoid vs. non-human) were administered. Finally, the attention check question was administered.

4.2 | Manipulations—RSA pretest

A pretest was conducted to identify two sets of RSA attribute types, one set was perceived more as hedonic and the other was perceived more as utilitarian. Another objective of this pretest was to select one human RSA and another non-humanoid RSA. (In Appendix 11, the statistical tests are reported.) In a pretest, 37 undergraduate students were asked to rate 30 attributes of an RSA[8] using five 7-point utilitarian scale items and five 7-point hedonic scale items (Voss et al., 2003). Among the 30 attributes tested, we selected three utilitarian attributes: "provide up-to-date stock information," "inform customers about different products," and "help customers navigate a store to find products." Additionally, we selected three hedonic attributes: "tell a joke," "play games with customers," and "entertain customers," Additionally, we identified one humanoid RSA (i.e., Pepper) and one non-humanoid RSA (i.e., LoweBot) (please see Appendix 14 for the stimuli).

[8]These RSA attributes were identified from both open-ended responses (attributes subjects actually used in a store) in Study 1, and relevant literature search on capabilities of RSAs.

4.3 | Measures

4.3.1 | WTTR

Similar to Study 1, we employed a three-item measure of willingness to try from Chaudhuri et al. (2010). First, subjects were asked to imagine that he or she, as a customer, visited a retail store equipped with the RSA displayed earlier in the study. Then, subjects responded to a scale with items like "I would be willing to spend time to know the robotic shopping assistant better," using a 7-point scale anchored by "completely disagree" (1) and "completely agree" (7). Cronbach's α was .92 (see Appendix 4 for the detail of scale items).

4.3.2 | Attitude

Consistent with other researchers (e.g., Kempf & Laczniak, 2001), attitude toward an RSA displayed was measured using three 7-point semantic differential items (e.g., bad (1) and good (7)). Cronbach's α was .97.

4.3.3 | Manipulation and confound checks

Subjects were asked to evaluate the RSA attribute types using the same hedonic value and utilitarian value scale items as in the pretest and rate familiarity with a scale item anchored by unfamiliar (1) and familiar (7). Cronbach's α was .97 for the hedonic scale and .96 for the utilitarian scale. Furthermore, subjects reported their perception toward the RSA using a 7-point scale item anchored by non-humanoid (1) and humanoid (7) and their familiarity with the RSA using the same familiarity scale. Finally, to check attention consistent with prior research (e.g., Huang & Brown, 2016; Johar, 2016), we asked the following question: "If you are reading this question, please select the never scale."

4.4 | Results

4.4.1 | Screening

As a passive screening for potentially problematic responses 11 subjects out of 149 subjects failed the attention check question and were removed from the analysis. Thus, analyses were conducted for 138 subjects.

4.4.2 | Manipulation and confound checks

The manipulation and confound checks are successful for both the RSA attributes and RSA appearance (see Appendix 11 for the detail).

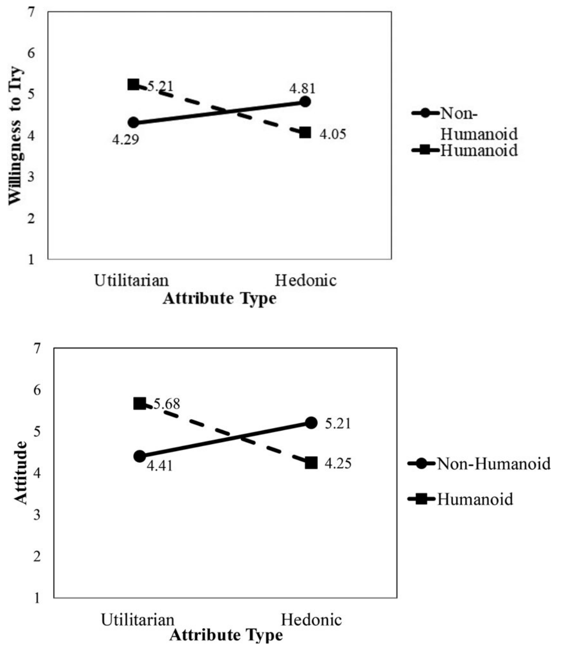

FIGURE 3 Study 2 interaction plots (ANOVA). See Appendix 4 for the scale items.

4.4.3 | WTTR

The effects of the manipulations on WTTR are analyzed in a 2 (types of RSA attributes: hedonic, utilitarian) by 2 (RSA appearance: humanoid, non-humanoid) ANOVA.[9] As illustrated in Figure 3, the two-way interaction is significant ($F(1, 134) = 7.10$, $p = .009$, $\eta^2 = .050$). The interpretation of the interaction suggests that in the humanoid condition, subjects display significantly greater WTTR for an RSA with utilitarian attributes ($M_{\text{utilitarian}} = 5.21$) than for an RSA with hedonic attributes ($M_{\text{hedonic}} = 4.05$) ($F(1, 68) = 6.643$, $p = .012$, $\eta^2 = .089$).[10] However, no statistically significant difference emerges across the utilitarian and hedonic condition for the non-humanoid RSA ($F(1, 66) = 1.40$, $p = .241$, $\eta^2 = .021$; $M_{\text{utilitarian}} = 4.29$, $M_{\text{hedonic}} = 4.81$). Furthermore, a paired comparison suggests that in the utilitarian attribute condition, subjects display greater $\text{WTTR}_{\text{humanoid}}$ than $\text{WTTR}_{\text{non-humanoid}}$ ($F(1, 69) = 4.24$, $p = .043$, $\eta^2 = .058$; $M_{\text{humanoid}} = 5.21$, $M_{\text{non-humanoid}} = 4.29$) (see Appendix A13a for the detailed results).

4.4.4 | Attitude

Similarly, the effects of the manipulations on attitude are analyzed in a 2 (types of RSA attributes: hedonic, utilitarian) by 2 (RSA appearance: humanoid, non-humanoid) ANOVA. As illustrated in Figure 3, the two-way interaction is significant ($F(1, 134) = 14.0$, $p < .001$, $\eta^2 = .095$). Attribute type significantly affects attitude when subjects are presented with a humanoid RSA ($F(1, 68) = 11.27$, $p = .001$, $\eta^2 = .142$); subjects show a more favorable attitude with utilitarian attributes than that with hedonic attributes ($M_{\text{utilitarian}} = 5.68$, $M_{\text{hedonic}} = 4.25$). However, the same effect is not statistically significant when subjects were presented with a non-humanoid RSA ($F(1, 66) = 3.71$, $p = .058$, $\eta^2 = .053$; $M_{\text{utilitarian}} = 4.41$, $M_{\text{hedonic}} = 5.21$). As shown in Figure 3, the pattern of the two-way interaction on attitude is very similar to the two-way interaction on WTTR. Furthermore, a paired comparison reveals that for utilitarian attributes, respondents have a more favorable attitude toward a humanoid RSA than a non-humanoid RSA ($F(1, 69) = 10.04$, $p = .002$, $\eta^2 = .127$). For hedonic attributes, respondents display more favorable attitudes toward a non-humanoid RSA than toward a humanoid RSA ($F(1, 65) = 4.72$, $p = .033$, $\eta^2 = .068$).

4.5 | Discussion

Study 2 addresses two primary objectives. First is to confirm Study 1's implication that a customer is more willing to try a humanoid RSA with utilitarian attributes than with hedonic attributes, and thus, to refute an alternative explanation that utilitarian attributes are simply more common to try in a frontline encounter. Second is to determine whether greater $\text{WTTR}_{\text{utilitarian}}$ than $\text{WTTR}_{\text{hedonic}}$ applies for not only humanoid RSA but also non-humanoid RSA. Consistent with our observation from Study 1, Study 2 results suggest that a customer displayed greater $\text{WTTR}_{\text{utilitarian}}$ than $\text{WTTR}_{\text{hedonic}}$ in a humanoid condition. This is explained by a favorable attitude toward an RSA with utilitarian attributes than that with hedonic attributes. Interestingly, the effect of attribute type was not observed for a non-humanoid RSA for either WTTR or attitude. A customer may have formed negative responses only when a humanoid RSA offers hedonic (vs. utilitarian) attributes. This may support our proposal that hedonic (vs. utilitarian) attributes, as an *internal* factor of robots in anthropomorphism, evoke negative responses of customers in relation to the humanoid appearance (an *external* factor) of robots.

Next in Study 3, we attempt to replicate and further understand the effect of attribute type on WTTR for humanoid RSA observed in Study 2. In particular, non-human objects (e.g., RSA) are expected to lack its ability to feel (i.e., hedonic attributes), and thus, both humanoid appearance, and hedonic attributes are unexpected for an RSA and may induce a feeling of uncanniness (Gray & Wegner, 2012). Thus, uncanniness was added to further understand customers' acceptance of humanoid (vs. non-humanoid) RSAs in relation to hedonic/utilitarian attributes. Furthermore, to measure cultural/individual differences in relation to people's perception toward robots (Manfredo et al., 2020), Study 3 adds two measures: general attitude toward robots and individual differences in anthropomorphism (IDA).

[9]We measured subjects' experience of using RSA, similar to the one displayed during the study, and majority of them (135 out of 138) did not have such an experience. As this experience did not have any meaningful effects in our analysis, we did not include this variable in our analysis.

[10]The effect size of our study is equivalent to or larger than those in related studies (e.g., Letheren et al., 2021; Stroessner & Benitez, 2019).

5 | STUDY 3

5.1 | Method

Subjects were randomly assigned to one of four conditions in a 2 (RSA appearance: humanoid, non-humanoid) by 2 (types of RSA attributes: utilitarian, hedonic) between-subjects design. The dependent measures were uncanniness and WTTR. One-hundred and fifty subjects, residents of the United States recruited through Prolific (e.g., Balaji et al., 2020), completed the online study. Sixty percent of the subjects are female. The reported mean age of subjects is 36 years old (range: 18–69). Subjects first reviewed the same informational brochure about an RSA as Study 2. We followed the same procedure as Study 2 except for three newly added measures: feelings of uncanniness toward the RSA (administered after WTTR), and general attitude toward robots, and IDA (both of which were administered before an attention check question).

5.2 | Measures

5.2.1 | WTTR

WTTR was measured in the same way as in Study 2. Cronbach's α was .92 (see more scale details in Appendix 4).

5.2.2 | Uncanniness.

Consistent with others (e.g., Gray & Wegner, 2012), uncanniness was measured by asking subjects to respond on the extent to which they felt “uneasy,” “unnerved,” and “creeped out” with a 7-point scale anchored by “not at all” (1) to “extremely” (7). Cronbach's α was .95.

5.2.3 | Individual differences in anthropomorphism

A 12-item scale[11] of individual differences in anthropomorphism (IDA) (Waytz et al., 2010) assessed the degree to which subjects believe certain non-human entities possess human characteristics. For instance, subjects were given a statement, “To what extent does the average robot have consciousness?” and responded on the degree to which they believe the entities possess the characteristic described using a 7-point scale anchored by “not at all” (1) to “very much” (7). Cronbach's α was .83.

5.2.4 | General attitude toward robots

Consistent with others (e.g., Kempf & Laczniak, 2001), general attitude toward robots was measured by asking subjects to express their general perception of a robot with three 7-point semantic differential items (e.g., bad (1) and good (7)). Cronbach's α was .96.

5.3 | Results

5.3.1 | Screening

Similar to Study 2, as a passive screening for potentially problematic responses, we included an attention check question. One subject out of 150 subjects failed the attention check question and was removed from the sample.

5.3.2 | Manipulation and confound checks

The manipulation and confound checks are successful for both the RSA attributes and RSA appearance (please see Appendix 12 for the detail).

5.3.3 | WTTR

The effects of the manipulations on WTTR are analyzed in a 2 (types of RSA attributes: hedonic, utilitarian) by 2 (RSA appearance: humanoid, non-humanoid) ANCOVA (see Appendix A13b for the detailed results). IDA and general attitudes toward robots are used as covariates. As expected, and replicating Study 2, in the humanoid RSA condition, subjects display significantly greater $WTTR_{utilitarian}$ ($M_{utilitarian} = 4.75$) than

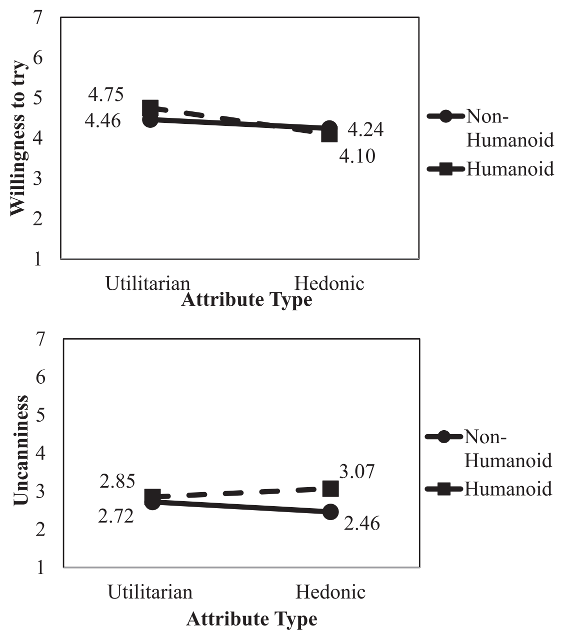

FIGURE 4 Study 3 interaction plots (ANCOVA). See Appendix 4 for the scale items.

[11] Waytz et al. (2010) employ 15 item scale. Through a pretest, three items were dropped from the scale, leaving 12 items in the scale.

$WTTR_{hedonic}$ ($M_{hedonic} = 4.10$) ($F(1, 71) = 5.44$, $p = .023$, $\eta^2 = .071$)[12] (see Figure 4). Furthermore, as expected, no statistically significant difference emerges across the utilitarian and hedonic condition for the non-humanoid RSA ($F(1, 70) = .071$, $p = .79$, $\eta^2 = .001$; $M_{utilitarian} = 4.46$, $M_{hedonic} = 4.24$).

5.3.4 | Uncanniness

Similarly, the effects of the manipulations on uncanniness are analyzed in a 2 (types of RSA attributes: hedonic, utilitarian) by 2 (RSA appearance: humanoid, non-humanoid) ANCOVA (see Appendix A13b for the detailed results). IDA and general attitude toward robots are used as covariates. As expected, and illustrated in Figure 4, uncanniness is the highest for humanoid RSA with hedonic attributes ($M = 3.07$). Statistically, however, uncanniness for the humanoid RSA with hedonic attributes ($M = 3.07$) is significantly higher than only the non-humanoid RSA with hedonic attributes ($M = 2.46$) ($F(1, 70) = 4.15$, $p = .045$, $\eta^2 = .056$). To further understand how the attribute type affects WTTR in relation to the RSA appearance, path analyses were conducted using a multigroup approach.[13]

5.3.5 | Path analyses: Humanoid RSA group

The path analysis (see Figure 5) suggests that the direct effect of attribute type on WTTR is significant ($\beta = -.187$, SE $= .302$, $z = -2.24$, $p = .03$). Additionally, the direct effect of general attitude toward robots on uncanniness ($\beta = -.583$, SE $= .115$, $z = -5.95$, $p < .001$), and that of uncanniness on WTTR ($\beta = -.175$, SE $= .075$, $z = -2.45$, $p = .014$) are significant. However, the direct effects of IDA on uncanniness ($\beta = -.021$, SE $= .177$, $z = -.22$, $p = .83$), and on willingness to try ($\beta = .092$, SE $= .159$, $z = 1.13$, $p = .26$) are not significant.

5.3.6 | Path analyses: Non-humanoid RSA group

The path analysis (see Figure 5) suggests that the direct effect of attribute type on WTTR is not significant ($\beta = -.050$, SE $= .310$, $z = -.485$, $p = .63$). Additionally, the direct effect of IDA on uncanniness ($\beta = .232$, SE $= .159$, $z = 2.29$, $p = .022$) and that of uncanniness on WTTR ($\beta = -.197$, SE $= .075$, $z = -2.45$, $p = .014$) are significant. OLS regression using the PROCESS macro (Hayes, 2018) shows that the indirect pathway (from IDA to uncanniness to WTTR; 95% CI: $-.335$ to $-.026$) is significant, suggesting a possible mediating role of uncanniness.

[12]Please see our footnote no. 10 regarding the effect size.

[13]As its advantages, path analysis with SEM allows us to compare different models and is more appropriate than OLS regression for latent variables (Hayes, 2018, pp. 527–530).

5.4 | Discussion

Study 3 addresses the following two main objectives. First is to replicate the effect of attribute type on $WTTR_{humanoid}$. Second is to understand the mechanism of this effect with newly added variables. Overall, replicating the result from Study 2, subjects showed greater $WTTR_{utilitarian}$ than $WTTR_{hedonic}$ for a humanoid RSA. As expected, and consistent with Study 2 results, this effect was not observed for non-humanoid RSA. Uncanniness and two measures for individual differences (i.e., general attitude toward robots, and IDA) could offer insights into these replicated effects.

Our results may suggest that the effect of attribute type on $WTTR_{humanoid}$ could be robust without cultural/individual differences. For a humanoid RSA condition, IDA did not affect WTTR. We anticipated observing cultural/individual differences in IDA in relation to robots or non-human objects (Manfredo et al., 2020). However, this was not the case. In contrast, for a non-humanoid RSA condition, our path analysis shows that IDA affects WTTR through uncanniness. This may illustrate more significant roles of cultural/individual differences than the RSA attribute manipulation in relation to $WTTR_{non\text{-}humanoid}$. The potential mediating role of uncanniness, explored here, deserves further research attention.

Finally, subjects showed higher uncanniness for a humanoid RSA with hedonic attributes than a non-humanoid RSA with hedonic attributes. However, for utilitarian attributes, the effect of RSA appearance on uncanniness was not observed. Perhaps, in people's minds, utilitarian attributes, unlike hedonic attributes, are not particularly reserved for humans. Thus, for utilitarian attributes, the unnerving feeling may not differ between humanoid RSA and non-humanoid RSA.

6 | GENERAL DISCUSSION

6.1 | Theoretical implications

Traditionally, researchers focused on how external factors of robots, such as a human-like appearance, drive anthropomorphic perception of humans encountering them. This work joins more recent research on anthropomorphism that studies internal factors of robots (i.e., attributes of robots) as additional drivers of consumer perceptions (e.g., Appel et al., 2020; Yin et al., 2023). In particular, by combining both external and internal factors of robots, this research studies the appearance and attributes of an RSA as two important determinants of an effective RSA's design and investigates an effective appearance-feature combination. Currently, there is no single best customer-centric design of a frontline robot (Darani & Kaedi, 2017; Lu et al., 2020; Wang & Tseng, 2011). Thus, our research responds to Lu et al.'s (2020) call for research to explore the determinants of an effective design of robots. To the best of our knowledge, this is the very first study examining the effect of hedonic (vs. utilitarian) attributes on WTTR in relation to the appearance of RSA (humanoid vs. non-humanoid).

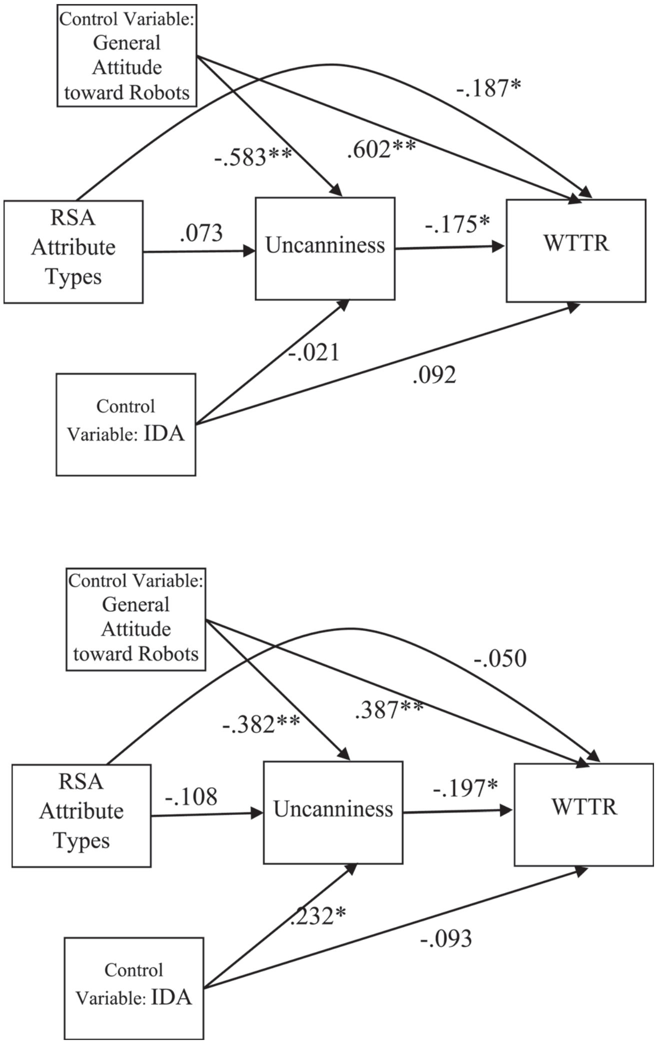

FIGURE 5 Path analyses (Study 3). Humanoid RSA Group ($N = 75$). Non-Humanoid RSA Group ($N = 74$). (1) * shows a statistically significant effect ($p < .05$). ** shows a statistically significant effect ($p < .01$). (2) RSA attribute types (0: Utilitarian, 1: Hedonic). (3) Given no statistical difference between groups, a path from Uncanniness to WTTR was constrained between the groups. (4) The model yielded acceptable fit statistics (RMSEA = 0.00, CFI = 1.00).

In particular, our results suggest that customers demonstrate a greater $WTTR_{humanoid}$ with utilitarian attributes than $WTTR_{humanoid}$ with hedonic attributes. Our findings further illustrate this effect of utilitarian/hedonic attributes on WTTR is not observed for non-humanoid RSAs. Instead, for a non-humanoid RSA, IDA significantly affects WTTR through uncanniness. Our findings illustrate that effects of hedonic/utilitarian attributes on anthropomorphized AI (e.g., Liu et al., 2022; Odekerken-Schröder et al., 2022) could be different for non-anthropomorphized AI (e.g., non-humanoid RSAs). Our research also addresses the call for research that compares customers' responses toward a humanoid RSA with those toward a non-humanoid RSA (e.g., Rindfleisch et al., 2022).

Additionally, prior robotic research (e.g., de Graaf & Allouch, 2013; Klamer & Allouch, 2010) has generally focused on the perceived utilitarian and hedonic benefits, such as usefulness and enjoyment, associated with *user experiences*. Consequently, the hedonic and utilitarian *attributes* of robotic technology have been largely overlooked particularly in relation to the appearance of RSAs (Blut et al., 2016; van der Heijden, 2004). As more emotional AI is developed (Bagozzi et al., 2022; Huang & Rust, 2021; Labbé, 2022), our research adds the theoretical implications of hedonic versus utilitarian attributes of robots in relation to anthropomorphism (Batra & Ahtola, 1991; Botti & McGill, 2011; Wang et al., 2015). We do so by showing how internal factors of robots (hedonic attributes) trigger negative customer responses in relation to external factors of robots (the physical appearance). In line with recent work on anthropomorphism (Appel et al., 2020; Yin et al., 2023), this research shows that internal factors of robots could evoke negative customer evaluations, and proposes hedonic (vs. utilitarian) attributes as one of these additional internal factors.

Finally, our proposed method in Study 1 is capable of analyzing and visualizing complex relations between structured data and unstructured data, and thus, could analyze consumer Big Data, such as consumer reviews along with consumer ratings on Yelp. In particular, it could assign valence to such open-ended customer responses without relying on sentiment analysis or manually coding the valence of each response (Vermeer et al., 2019). One of the challenges of Big Data is its variety (e.g., Balducci & Marinova, 2018; Erevelles et al., 2016). To this end, only limited research (e.g., Xu, 2020) discusses the method of simultaneously analyzing a combination of structured and unstructured data, thus, our research contributes to the Big Data literature.

6.2 | Managerial implications

Departing from a traditional focus on service robots (e.g., Čaić et al., 2019; McLeay et al., 2021; van Doorn et al., 2017; Wirtz et al., 2018), the research investigates the role of robotic technology in frontline encounters as not only service assistants but also sales assistants. In doing so, first, this research suggests that instead of emphasizing hedonic attributes, utilitarian attributes should be emphasized in deploying humanoid RSAs. Interestingly, sophisticated utilitarian attributes that require consulting customers (e.g., product recommendation and explanation) are particularly associated with not only greater WTTR but also facilitate customer purchase decisions. Illustrating RSA's potential capability as a sales associate is an important implication for a retailer like Walmart. In particular, RSAs may allow those retailers to achieve both *cost-effectiveness* and *service excellence* by reducing the number of human associates without sacrificing the store experience of customers (Wirtz & Zeithaml, 2018).

Additionally, the results may uncover some benefits and potential issues of RSAs and their applications in frontline encounters. For instance, the Botler, a non-humanoid RSA, offers services to guests at the Aloft Hotel in the United States. The Botler is able to offer a swirl dance upon completing a delivery of items (bottled water) to a hotel guest. Since our study suggests that a customer forms a more favorable attitude to see such a hedonic attribute in a non-humanoid RSA than a humanoid RSA, other companies may consider following a practice of combining hedonic elements in a non-humanoid RSA design. In contrast, regarding the earlier example of the Pepper Robot offering a dancing performance, our results may suggest that more favorable attitudes of customers may result by offering a dancing performance using non-humanoid RSAs instead of humanoid RSAs. As more non-humanoid RSAs are introduced in retail stores (e.g., Rindfleisch et al., 2022), this is an important implication for retailers and robot manufacturers.

Finally, more advanced AI capabilities (e.g., emotional AI) may allow RSAs to more readily perform hedonic tasks (e.g., drawing arts) that used to be performed exclusively by human associates (Haynes, 2019; Labbé, 2022). Our study results suggest that robot manufacturers should carefully consider the appearance of a robot to deliver such hedonic tasks. Our results may also imply that service providers and retailers could consider delivering such tasks (e.g., drawing arts in front of children) for the practical purpose of occupying children's time, and, thus, letting parents complete their shopping more efficiently.

6.3 | Limitations and future research

The Japanese market was particularly appropriate for us to understand actual behavior and responses toward robots (Hulland & Houston, 2021) in Study 1 given the higher adoption of RSAs than in other parts of the world. However, even in Japan, only 8.1% of respondents experienced an RSA within 6 months before participating in Study 1. What are the obstacles for customers to try RSAs? As some retailers are terminating the uses of RSAs (Gale & Mochizuki, 2019), more research is needed to identify ideal use cases and optimize their experience of RSAs.

Study 1 was conducted on Japanese customers while Studies 2 and 3 were conducted on U.S. residents. Thus, we need to evaluate the implications of this Study 1 in relation to the unique Japanese culture. Some scholars suggest that Japanese customers tend to see spirits in both animate and inanimate objects, and, thus, consider an RSA more human than customers in other cultures (Castelo et al., 2018). Future research could study how customers in various countries (e.g., Japan and the United States) feel differently about humanoid RSAs performing tasks traditionally reserved for humans. For instance, researchers could explore how customers with various cultural backgrounds respond to Ai-Da, the world's first android robot artist, and its creativity (Haynes, 2019).

Finally, in Study 2, customers were exposed to either hedonic attributes or utilitarian attributes of an RSA. In practice, RSAs may provide both hedonic and utilitarian attributes. In the earlier example, Botler, a non-humanoid robot, performed both a utilitarian task (i.e., delivering bottled water to a guest's room at a hotel) and a hedonic task (i.e., dancing). Researchers are encouraged to study customers' responses toward RSAs with a mix of utilitarian and hedonic attributes in relation to their effects on perceived service quality.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ORCID

Nobuyuki Fukawa https://orcid.org/0000-0002-5148-7475

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AUTHOR BIOGRAPHIES

Nobuyuki Fukawa is an associate professor of marketing at Missouri University of Science and Technology. He earned his PhD in marketing from Louisiana State University and worked at Dell and Coca-Cola Company. His latest research focuses on managerial issues on technology and innovation in marketing and has been published in various journals, including *Journal of Product & Innovation Management*, *AMS Review*, *Industrial Marketing Management, and Journal of Business Research*. Shugan's Top 20 Marketing Meta-Journal ranked his article the eighth most cited article in marketing. He received M. Wayne DeLozier Best Conference Paper Award from the Academy of Marketing Science.

Yu-Shan (Sandy) Huang is an associate professor of marketing in the College of Business at Texas A&M University-Corpus Christi. She holds a PhD in Business Administration-Marketing from Oklahoma State University. Her research focuses on the management of interfaces between frontline human and robotic employees and customers. Her work has been published in various peer-reviewed journals, such as *Journal of Applied Psychology*, *European Journal of Marketing*, *Journal of Business Ethics*, *and Journal of Services Marketing*. She was a recipient of the Academy of Marketing Science's M. Wayne DeLozier Best Conference Paper Award.

Barry J. Babin is Phil B. Hardin Professor of Marketing and Head of the Department of Marketing, Analytics, and Professional Sales (MAPS) at the Ole Miss Business School and the Executive Director of the Academy of Marketing Science. He has authored over 100 professional publications with research appearing in the *International Journal of Wine Business Research*, *Journal of the Academy of Marketing Science*, *Journal of Marketing*, *Journal of Retailing*, *Journal of Business Research* (*JBR*), *Journal of Consumer Research*, *International Journal of Research in Marketing*, the *Journal of Wine Research*, and many others. He is a previous recipient of the prestigious AMS Harold W. Berkman Distinguished Service Award and co-author of several leading books including *CB: A Consumer Value Framework*, *Multivariate Data Analysis*, and *Essentials of Marketing Research*.

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APPENDIX 1

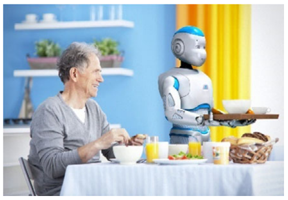
SUMMARY OF EMPIRICAL FINDINGS FROM ILLUSTRATIVE RESEARCH ON ANTHROPOMORPHISM AND ROBOTS

Source	Method type	Robot type	Robot appearance	Robot attributes	Context	Major findings
Blut et al. (2021)	Meta-analysis	Service robot	Humanoid vs. nonhumanoid, Zoonotic vs. nonzoonotic, Female vs. nonfemale, Cute vs. noncute	N/A	Various service contexts (i.e., possession-, information-, people-, and mental stimulus-processing services)	Anthropomorphized service robots mainly produce positive effects
Broadbent et al. (2011)	Longitudinal studies	Healthcare robot "Cafero"	Human-like vs. machine-like	Providing care to the elderly	Elder care services	People prefer machine-like robots
Cheng (2022)	Experiment	Social robot	Android robot vs. Humanoid robot	NA	Customers' perception of service failure in interacting with robots	In the context of a service failure, a customer is more likely to forgive a humanoid robot than an android robot
Goudey and Bonnin (2016)	Experiment and interviews	Companion robots "Emox," "PaPeRo," and "Nao"	High (3 human indicators), medium (2 human indicators), and low (1 human indicator) levels of anthropomorphism	Entertaining; Helping children learn languages and music; Reminding about instructions; Contacting parents, friends, and family	Designed for use with children at home	Anthropomorphic appearance of a robot does not increase customers' acceptance of the robot
Kiesler et al. (2008)	Experiment	Healthcare robot "Nursebot"	Humanoid appearance	Discussing basic health habits	Healthcare services	People respond more positively to an embodied humanoid robot than a robot-like agent
Letheren et al. (2021)	Experiment	Service robot	Android, humanoid, and mechanical robot	Home cooking	Consumer liking of robots	Consumers like android the most, followed by humanoid, and mechanical robot
Mende et al. (2019)	Experiment	Service robot	Anthropomorphized vs. machinized	Providing medical services; providing food services	Healthcare and food services	Customers' compensatory responses to a robot is mitigated as it becomes machinized (vs. anthropomorphized)
Stroessner and Benitez (2019)	Experiment	Social robot	Machine-like vs. human-like, Feminine vs. masculine	N/A	Responses to robots in general	People respond to robots more positively when they appear to be feminine and human-like
van Pinxteren et al. (2019)	Experiment	Service robot "Pepper"	Humanoid appearance	Gazing turn-taking cues; Welcoming visitors; Offering directions	Public services (i.e., robot as a receptionist of a campus)	Anthropomorphism of robots increases customers' trust, intention to use and enjoyment
Vlachos et al. (2016)	Quasi-experiment	Social robot	Machine-like vs human-like robot	N/A	Robot as a part of art exhibitions	People prefer machine-like robot over humanlike robot.

APPENDIX 2

EXAMPLES OF ROBOTIC SHOPPING ASSISTANTS

LoweBot



Romeo

NAO

RoboThespian

Tory

WeRobot

SCITO A5

Pepper

APPENDIX 3

DESCRIPTIONS OF ROBOTIC SHOPPING ASSISTANTS SHOWN IN APPENDIX 2

Name	Primary application	Appearance	Ability to detect emotion	Manufacturer	Major sources
LoweBot	Autonomously navigate customers to locate products, answer simple questions from customers, and assist retail employees with up-to-date inventory information.	Non-humanoid	No	Lowes and Fellow Robots	Gannon (2017), Stern (2017)
Romeo	Care the elderly through opening doors, climbing stairs, and picking up items on a table.	Humanoid	No	Softbank	Maxon (2020), Nichols (2015)
Nao	Educate children through its ability to teach subjects in an exciting and easy way for people to understand.	Humanoid	Yes	Softbank	Tynan (2015), Feitlinger (2015)
RoboThespian	Entertain visitors at museums and universities by performing pre-	Humanoid	No	Engineered Arts	Hickey (2014), Gray (2013)

Name	Primary application	Appearance	Ability to detect emotion	Manufacturer	Major sources
	determined actions. Capable of keeping eye contact.				
WeRobots	Serve as customer service agents at retail stores by providing information and consultation. Capable of storing customer preferences to serve VIP customers.	Non-humanoid	No	Attraktion	Read (2017), Attraktion (2020)
Scitos A5	Autonomously approach customers and communicate through playing videos and slides. Capable of detecting and avoiding obstacles.	Non-humanoid	No	Metralabs	Brown (2014), Metralabs (2019)
Pepper	Greet customers, provide product recommendations and take orders. Capable of personalizing customer experience through accessing a customer relationship management system.	Humanoid	Yes	Softbank	Fowler (2015), Glaser (2017)
Tory	Utilize RFID technology to check inventory and restock merchandise automatically at a retail store in a more efficient manner than manual stocking.	Non-humanoid	No	Metralabs	Metralabs (2018), RFID Journal (2016)

APPENDIX 4

SCALE ITEMS EMPLOYED IN STUDY 1, STUDY 2, AND STUDY 3

Constructs (studies employed) and scale items	Source
Willingness to Try (actual/future) (All studies)	Chaudhuri et al. (2010)
I was/would be willing to spend time to know the robotic shopping assistant better.	
I was/would be willing to make the effort to know the robotic shopping assistant better.	
I was/would be willing to interact with the robotic shopping assistant.	
Attitude (Study 2)	Kempf and Laczniak (2001)
[You] consider this robotic shopping assistant to be … bad … good.	
[You] consider this robotic shopping assistant to be … disliked … liked.	
[You] consider this robotic shopping assistant to be … unfavorable … favorable.	
Uncanniness (Study 3)	Gray and Wegner (2012)
[The] robotic shopping assistant make you feel … uneasy.	
[The] robotic shopping assistant make you feel … unnerved.	
[The] robotic shopping assistant make you feel … creeped out.	
Individual Differences in Anthropomorphism (IDA) (Study 3)	Waytz et al. (2010)
To what extent does technology—devices and machines for manufacturing, entertainment, and productive processes (e.g., cars, computers, television sets)—have intentions?	
To what extent does the average fish have free will?	
To what extent does the average robot have consciousness?	
To what extent do cows have intentions?	
To what extent does the ocean have consciousness?	
To what extent does the average computer have a mind of its own?	
To what extent does a cheetah experience emotions?	
To what extent does the environment experience emotions?	

(Continues)

Constructs (studies employed) and scale items	Source
To what extent does the average insect have a mind of its own?	
To what extent does a tree have a mind of its own?	
To what extent does the wind have intentions?	
To what extent does the average reptile have consciousness?	
General Attitude toward Robots (Study 3)	Kempf and Laczniak (2001)
To me, a robot is … bad (1) … good (7).	
To me, a robot is … disliked (1) … liked (7).	
To me, a robot is … unfavorable (1) … favorable.	
Utilitarian Attributes (Manipulation check for Studies 2 and 3) ______ (one of the RSA features) is … ineffective (1) … effective (7).	Voss et al. (2003)
is … unhelpful (1) … helpful (7).	
is … not functional (1) … functional (7).	
is … unnecessary (1) … necessary (7).	
is … impractical (1) … practical (7).	
Hedonic Attributes (Manipulation check for Studies 2 and 3)	Voss et al. (2003)
______ (one of the RSA features) is … not fun (1) … fun (7).	
is … dull (1) … exciting (7).	
is … not delightful (1) … delightful (7).	
is … not thrilling (1) … thrilling (7).	
is … unenjoyable (1) … unenjoyable (7).	

APPENDIX 5

STEPS OF ANALYZING STRUCTURED AND UNSTRUCTURED DATA (STUDY 1)

Steps	Task description	Data types involved
Step 1: Open-coding procedure[a]	24 categories emerged (Appendix 7) as a result of open detailed-coding procedure.	Unstructured data (open-ended responses)
Step 2: Category classification	Categories (detailed codes) were further classified into more abstract themes (category classification), such as RSA attributes (hedonic and utilitarian), customer perception, customer behavior, and others.	Unstructured data (open-ended responses)
Step 3: Creating cognitive maps	Cognitive maps were created to assess the relationships among 24 categories (Figure 2), as well as their associations with the willingness to try (Actual), and those with the willingness to try (Future) (Figure 1a,b). The method utilized is generally referred to as link analysis, and often discussed in relation to probabilistic graphical (PGM) model.	Unstructured data (open-ended responses) and structured data (close-ended responses)
Step 4: Interpretation	Analyses were conducted with three types of cognitive maps created in Step 3. In the analysis, we focused on RSAs attributes, either hedonic or utilitarian, and assessed their associations with other categories, as well as their associations with their willingness to try RSAs (both actual and future).	Unstructured data (open-ended responses) and structured data (close-ended responses)

[a]To capture unique nuances of Japanese language, we analyzed the open-ended responses without translating into English; Japanese keywords were fed into the software and used to identify 24 categories—named in English.

APPENDIX 6

CO-OCCURRENCE INDEX IN POLYANALYST SOFTWARE

Detailed description on how the co-occurrence index is computed

Suppose there are N records in total. Let $N_A(N_B)$ represent the number of records that Category A (Category B) appears. Additionally, N_{AB} denotes the number of records that Category A and B appears together.

If Category A and B are independent, $(N_{AB}/N) \approx (N_A/N) \cdot (N_B/N)$. However, if (N_{AB}/N) is significantly larger, that is, $(N_{AB}/N) \gg N_A N_B / N^2$, Category A and B are interdependent. Let $P(\mathrm{AB})$ represent the probability that Category A and B co-occur. Denote $\overline{P}$ as the probability that we get N_{AB} or more success (co-occurrence of A and B) among N tests. It can be calculated by the binomial distribution with parameter N and $P(\mathrm{AB})$, that is,

$$\overline{P} = \sum_{n=N_{AB}}^{N} P_{\mathrm{binomial}}(n; N, P(\mathrm{AB})),$$

where $P_{\mathrm{binomial}}(n; N, P(\mathrm{AB}))$ represents the binomial distribution with parameters N and $P(\mathrm{AB})$. It is evident that the probability $\overline{P}$ decreases as N_{AB} increases.

In the Link Analysis of Polyanalyst software, the co-occurrence index of Category A and B is defined as

$$I_{\mathrm{CO-AB}} = -\log(\overline{P}).$$

That is, the lower the probability $\overline{P}$, the larger the co-occurrence index $I_{\mathrm{CO-AB}}$, the stronger the association between Category A and B.

Background of this method

This co-occurrence index is used to create cognitive maps. This method of analysis related to the cognitive maps is generally referred to as link analysis, explained as “a collection of techniques that operate on data that can be represented as nodes and links” (Donoho, 2005, p. 417). More recently, link analysis is often discussed in relation to the probabilistic graphical models (PGMs) (Layeghifard et al., 2017). PGM refers to various types of probabilistic models that compute conditional dependence between variables and projects directed or undirected graphs (Layeghifard et al., 2017; Ma & Sun, 2020). In directed (undirected) graphs, a link connecting nodes A and B has (does not have) direction. Thus, the cognitive maps in our study could be categorized as undirected graphs in PGMs, and the co-occurrence index reflects the conditional dependence among categories or between categories and the Willingness to try (Actual or Future). As one of the ML methods, PGMs are considered among important recent developments (Ma & Sun, 2020).

APPENDIX 7

CATEGORIES DESCRIBED IN CUSTOMERS' EXPERIENCES OF THE PEPPER ROBOT (STUDY 1)

	Keywords (Japanese)	Category classification	Brief description/example	No. of respondents
1. Reception	受付, 番号札, 整理	Utilitarian attributes	A robot serves as a receptionist (e.g., robots may provide customers with a numbered ticket and asked to wait before seated).	97
2. Seating	座席, カウンター, テーブル	Utilitarian attributes	A robot asks customers if they prefer a seat at a counter or a table.	73
3. Waiting time	待ち時間	Utilitarian attributes	A robot lets customers know how long they need to wait to be served.	16
4. Flexible	臨機応変	Customer perception	A robot responds to a customer's request flexibly.	1
5. Call customers	呼び出す	Utilitarian attributes	A robot notifies customers when it is their turn to be served.	11
6. Conversation	会話	Customer-robot interaction	A robot is able to have a conversation with a customer.	10

(Continues)

	Keywords (Japanese)	Category classification	Brief description/example	No. of respondents
7. Informed	教えてもらう	Utilitarian attributes	A customer receives advice and recommendation (e.g., appropriate medicine to take) from a robot.	9
8. Operation	操作	Customer perception	A customer may feel that it is easy or difficult to operate a robot.	21
9. Greeting	挨拶	Customer–robot interaction	A robot offers greeting to a customer.	12
10. Human	人間	Customer perception	A customer refers to a human, often comparing a robot with a human.	13
11. Pepper-Kun	ペッパー君	Anthropomorphism	In Japanese, "xxx-Kun" is used to call a friend casually. Thus, this may imply anthropomorphism (instead, others may call "Pepper-Robot" or simply "Robot").	92
12. Play	じゃんけん, 遊ぶ, 歌, ゲーム	Hedonic attributes	A robot plays with customers (e.g., singing, playing games, and play rock paper scissors).	5
13. Kids	子供	Customer-robot interaction	Kids interact with robots.	27
14. Feel close	親近感, 安心	Customer perception	A customer feels close/safe interacting with a robot.	6
15. Enjoy	楽しむ	Customer perception	A customer enjoys interacting with a robot.	5
16. Touch	触る or なでる	Customer–robot interaction	A customer touches or pat a robot.	6
17. Eyes	目	Customer–robot interaction	A robot keeps an eye contact with a customer.	6
18. Product	商品	Utilitarian attributes	A robot introduces a product, and offers product information to a customer.	13
19. Reward points	ポイント	Utilitarian attributes	A robot provides a customer with information about rewards points and programs.	2
20. Location	場所 orレイアウト	Utilitarian attributes	A robot helps customers locate a product in a store (e.g., inform a store layout to customers).	17
21. Creepy	気持ち悪い	Customer perception	A customer feels that a robot looks creepy.	1
22. Appearance	顔 or 手	Robotic form/activity	A customer refers to a robot's face or hand.	11
23. Movement	動き	Robotic form/activity	A customer refers to a movement of a robot.	5
24. Purchase	購入 or 買う	Customer behavior	A customer may have decided to purchase a product after interacting with a robot. In other cases, a customer may have visited a store to purchase a product and happened to interact with a robot.	9

APPENDIX 8

CO-OCCURRENCE INDEX FOR FIGURE 1a: ASSOCIATIONS BETWEEN CATEGORY AND WILLINGNESS TO TRY (ACTUAL) (STUDY 1)

	1	2	3	4	5	6	7
1 Reception	1.57 (9)						
2 Seating		1.13 (8)	1.67 (9)				
3 Waiting time		1.69 (3)			1.61 (6)		
4 Flexible							
5 Call Customers			3.11 (3)				
6 Conversation					1.76 (4)		2.63 (2)
7 Informed							3.11 (2)
8 Operation		1.16 (3)		1.65 (10)			
9 Greeting							3.93 (3)
10 Human							
11 Pepper-Kun		1.12 (10)	1.62 (11)	1.83 (37)			
12 Play				1.38 (3)			
13 Kids				1.32 (11)			
14 Feel Close							
15 Enjoy							
16 Touch				2.04 (4)			
17 Eyes							
18 Product			1.44 (2)			3.38 (3)	4.46 (3)
19 Reward Points						2.59 (1)	
20 Location					1.54 (5)		1.99 (2)
21 Creepy					1.37 (1)		
22 Appearance					3.32 (6)		
23 Movement	1.15 (1)				2.23 (3)		
24 Purchase						3.67 (3)	

Note: For instance, 1.57 (9) shows the association between a category "Reception" and an "item 1" in the willingness to try (Actual) scale. The Co-occurrence Index is 1.57 and the Support is 9 (i.e., 9 participants mentioned "Reception" as well as chose the item 1).

APPENDIX 9

CO-OCCURRENCE INDEX FOR FIGURE 1b: ASSOCIATIONS BETWEEN CATEGORY AND WILLINGNESS TO TRY (FUTURE) (STUDY 1)

	1	2	3	4	5	6	7
1 Reception					1.22 (21)		
2 Seating	1.86 (8)	1.56 (7)			1.48 (17)		
3 Waiting time							
4 Flexible							
5 Call Customers		2.04 (2)	1.76 (2)	1.22 (5)			
6 Conversation					1.31 (3)	1.63 (2)	
7 Informed							5.10 (3)
8 Operation			1.35 (3)	2.24 (12)			

(Continues)

	1	2	3	4	5	6	7
9 Greeting						1.20 (2)	
10 Human				1.22 (5)		3.17 (3)	
11 Pepper-Kun	1.40 (9)			1.24 (40)	1.36 (21)		
12 Play				4.42 (5)			
13 Kids			1.86 (4)				2.85 (4)
14 Feel Close							
15 Enjoy		1.18 (1)					
16 Touch							
17 Eyes							
18 Product						2.89 (3)	2.17 (2)
19 Reward Points						2.39 (1)	
20 Location				2.16 (8)			
21 Creepy							
22 Appearance					4.38 (6)	1.33 (2)	
23 Movement							
24 Purchase						5.11 (4)	

Note: For instance, 1.86(8) shows the association between a category "Seating" and an "item 1" in the willingness to try (Future) scale. The Co-occurrence Index is 1.86 and the support is 8 (i.e., 8 participants mentioned "Seating" as well as chose the item 1).

APPENDIX 10

CO-OCCURRENCE INDEX FOR FIGURE 2 (STUDY 1)

	1	2	3	4	5	6	7	8	9	10	11	12
1 Reception												
2 Seating	2.49 (39)											
3 Waiting time												
4 Flexible												
5 Call Customers	4.30 (8)											
6 Conversation												
7 Informed												
8 Operation												
9 Greeting						2.24 (2)						
10 Human												
11 Pepper-Kun	3.16 (50)											
12 Play												
13 Kids										2.26 (3)		
14 Feel Close									2.93 (2)			
15 Enjoy								4.59 (3)				
16 Touch												
17 Eyes						3.81 (2)						
18 Product							5.44 (3)					
19 Reward Points							3.32 (1)					
20 Location							2.55 (2)					
21 Creepy								2.20 (1)				3.65 (1)

	1	2	3	4	5	6	7	8	9	10	11	12
22 Appearance												
23 Movement								2.35 (2)	3.26 (2)			2.08 (1)
24 Purchase							3.21 (2)					

	13	14	15	16	17	18	19	20	21	22	23	24
1 Reception												
2 Seating												
3 Waiting time												
4 Flexible												
5 Call Customers												
6 Conversation												
7 Informed												
8 Operation												
9 Greeting												
10 Human												
11 Pepper-Kun												
12 Play												
13 Kids												
14 Feel Close												
15 Enjoy												
16 Touch	3.47 (3)											
17 Eyes												
18 Product												
19 Reward Points						2.98 (1)						
20 Location						5.73 (4)						
21 Creepy												
22 Appearance												
23 Movement	2.04 (2)	4.64 (2)			5.03 (2)				3.64 (1)	3.43 (2)		
24 Purchase						4.62 (3)	3.05 (1)					

Note: For instance, 2.49(39) shows the association between a category "Seating" and a "Reception." The Co-occurrence Index is 2.49 and the support is 39 (i.e., 39 participants mentioned "Seating" as well as "Reception").

APPENDIX 11

ADDITIONAL INFORMATION FOR STUDY 2

Pretest	*RSA attributes*: Consistent with others (e.g., Micu, 2012), among the 30 attributes tested, we selected three utilitarian attributes for which repeated measures ANOVA revealed that the utilitarian score ($M = 6.148$) was significantly higher than the hedonic score ($M = 5.141$; $F(1, 36) = 47.097$, $p < .001$, $\eta^2 = .567$) with no significant difference among the three attributes ($F(2, 35) = 1.070$, $p = .354$, $\eta^2 = .058$). Additionally, we selected three hedonic attributes for which repeated measures ANOVA revealed that the hedonic score ($M = 5.027$) was significantly higher than the utilitarian score ($M = 3.935$; $F(1, 36) = 54.396$, $p < .001$, $\eta^2 = .602$) with no significant difference among the three attributes ($F(2, 35) = 2.420$, $p = .104$, $\eta^2 = .121$). For those six attributes, Cronbach's α for the utilitarian scale ranged between .80 and .94 and that for the hedonic scale ranged between .79 and .97. *RSA appearance*: Participants were also asked to rate the pictures of eight RSAs, as shown in Appendix 2, using the same utilitarian and hedonic scale items. Among the eight RSAs tested, we identified one non-humanoid RSA (i.e., LoweBot) for which we found no difference between the hedonic scores ($M = 4.13$) and the utilitarian scores ($M = 4.32$; $t = .986$, $p = .331$) and one humanoid RSA (i.e., pepper) for which we found no difference between the hedonic scores ($M = 4.71$) and the utilitarian scores ($M = 4.66$; $t = -.213$, $p = .833$).

(Continues)

Manipulation and Confound Checks	*RSA attributes*: As an attribute manipulation check, a paired *t*-test reveals that participants in the utilitarian condition report that the utilitarian score ($M = 5.29$) is significantly higher than the hedonic score ($M = 4.61$; $t(1, 70) = 5.46$, $p < .001$). Furthermore, subjects in the hedonic condition report that the hedonic score ($M = 4.62$) is significantly higher than the utilitarian score ($M = 3.82$; $t(1, 66) = -4.18$, $p < .001$). Furthermore, as expected, repeated measures of ANOVA reveals that the difference between utilitarian score and hedonic score do not vary by the appearance manipulation ($F(1, 136) = .58$, $p = .45$, $\eta^2 = .004$). Similarly, as expected, ANOVA reveals no significant difference between the hedonic ($M = 3.57$) and utilitarian attributes ($M = 3.92$) in terms of familiarity ($F(1, 136) = 1.03$, $p = .311$, $\eta^2 = .008$). *RSA appearance*: As an appearance manipulation check, ANOVA results reveal that the subjects in the humanoid RSA condition report that the RSA is perceived more human-like ($M = 3.37$) than do those in the non-humanoid RSA condition ($M = 2.31$; $F(1, 136) = 10.45$, $p = .002$, $\eta^2 = .071$). As expected, this appearance manipulation check is unaffected by the attribute manipulation ($F(1, 136) = .698$, $p = .405$, $\eta^2 = .005$). Similarly, as expected, we do not find a significant difference between the humanoid ($M = 4.01$) and non-humanoid RSA ($M = 3.47$) in terms of reported familiarity ($F(1, 136) = 2.55$, $p = .113$, $\eta^2 = .018$).

APPENDIX 12

ADDITIONAL INFORMATION FOR STUDY 3

Manipulation and Confound Checks	*RSA attributes*: As a manipulation check, paired *t*-tests reveal that participants in the utilitarian condition report higher average utilitarian scores ($M = 4.84$) than hedonic scores ($M = 4.30$; $t(1, 74) = 3.83$, $p < .001$). Conversely, subjects in the hedonic condition report higher average hedonic ($M = 4.91$) than utilitarian scores ($M = 3.97$; $t(1, 73) = -7.10$, $p < .001$). Additionally, repeated measures ANOVA suggests that the difference between utilitarian score and hedonic score do not vary by the appearance manipulation ($F(1, 147) = .90$, $p = .35$, $\eta^2 = .006$). Similarly, as expected, ANOVA reveals no significant difference between the hedonic ($M = 3.70$) and utilitarian attributes ($M = 3.68$) in terms of familiarity ($F(1, 147) = .008$, $p = .930$, $\eta^2 = .000$). *RSA appearance*: Furthermore, as an appearance manipulation check, ANOVA results show subjects in the humanoid RSA condition reporting relatively higher human-like scores ($M = 2.70$) than do subjects in the non-humanoid RSA condition ($M = 2.15$; $F(1, 147) = 4.78$, $p = .030$, $\eta^2 = .031$). As expected, this appearance manipulation check is unaffected by the attribute manipulation ($F(1, 147) = 3.24$, $p = .074$, $\eta^2 = .022$). Similarly, as expected, we do not find a significant difference between the humanoid ($M = 3.20$) and non-humanoid RSA ($M = 3.59$) in terms of reported familiarity ($F(1, 147) = 1.97$, $p = .163$, $\eta^2 = .013$). Thus, both the manipulation checks and confound checks are successful.

APPENDIX 13

ANOVA (STUDY 2) AND ANCOVA (STUDY 3) RESULTS

(a) Study 2 ANOVA

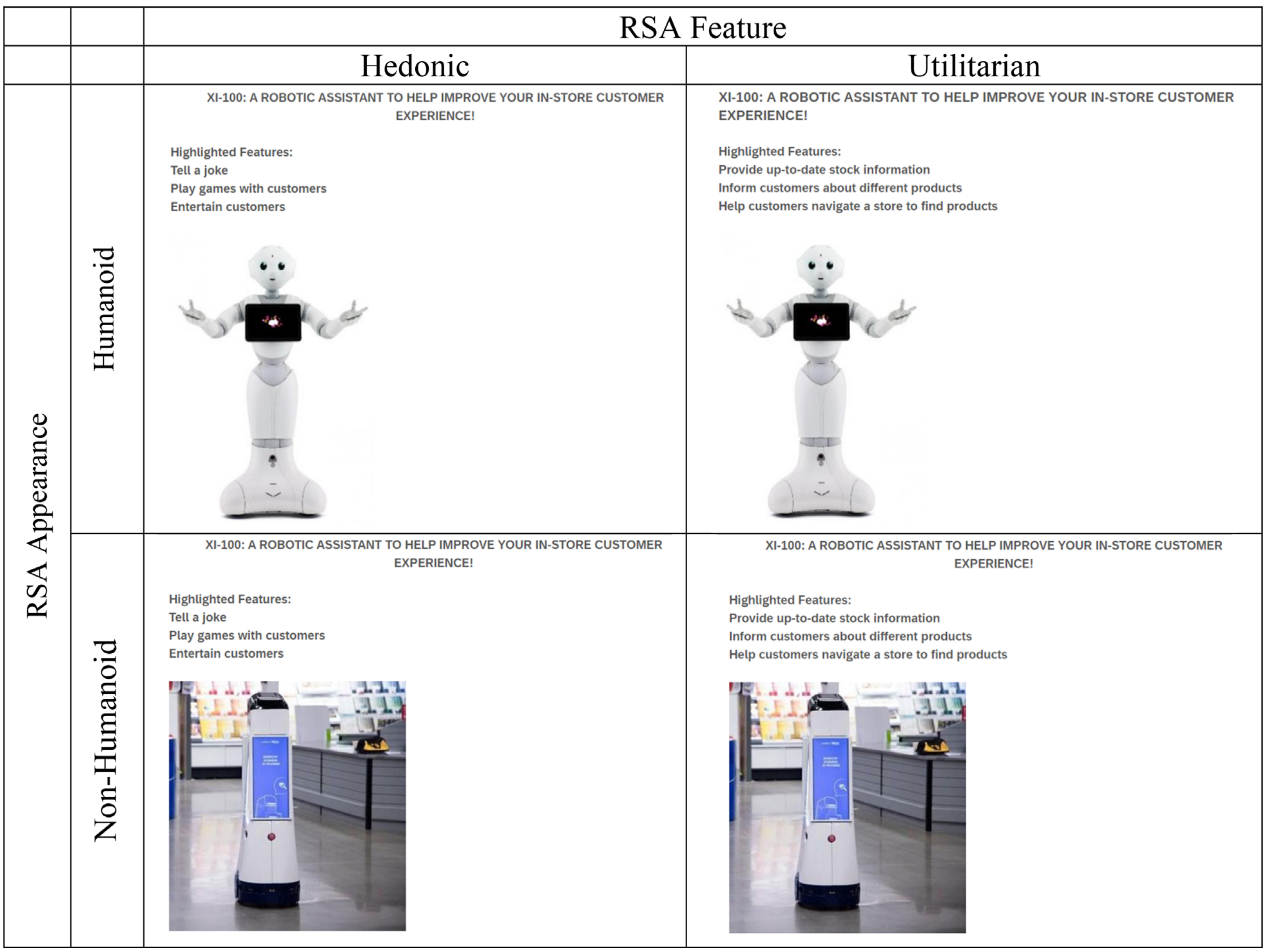
Dependent variable	Source	*df*	*F*	*p*-value	η^2
Willingness to try	Attribute type	1	1.010	.317	.007
	Appearance	1	.062	.804	.000
	Attribute type × Appearance	1	7.097	.009	.050
Attitude	Attribute type	1	1.111	.294	.008
	Appearance	1	.268	.606	.002
	Attribute type × Appearance	1	14.025	<.001	.095

(b) Study 3 ANCOVA

Dependent variable	Source	*df*	*F*	*p*-value	η^2
Willingness to try	IDA (Co-variate)	1	.000	.999	.000
	General attitude toward robots (Co-variate)	1	78.497	<.001	.354
	Attribute type	1	3.606	.060	.025
	Appearance	1	.130	.718	.001
	Attribute type × Appearance	1	.915	.340	.006
Uncanniness	IDA (Co-variate)	1	1.831	.178	.013
	General attitude toward robots (Co-variate)	1	46.969	<.001	.247
	Attribute type	1	.008	.930	.000
	Appearance	1	2.341	.128	.016
	Attribute type × Appearance	1	1.008	.317	.007

APPENDIX 14

RSA ATTRIBUTE AND RSA APPEARANCE MANIPULATIONS (STUDIES 2 AND 3)



APPENDIX 15

OVERVIEW OF OUR STUDIES—MIXED-METHOD DESIGN[a]

	The RSA appearances	Study description	Study objectives
Study 1	Humanoid Robot (Pepper Robot)	*Survey*: Open-ended response about their interaction with customers, and closed-ended questions on $WTTR_{actual}$ and $WTTR_{future}$.	Understand customer's experience of using various attributes of robots in a retail and service context. Understand the relationship between actual use of an RSA and intention to use again in the future. Generate research questions and identify hedonic and utilitarian attributes to be pre-tested and studied in Studies 2 and 3.
Study 2	Humanoid robot vs. Non-humanoid robot	*Experiment*: A 2 (RSA appearance: humanoid, non-humanoid) by 2 (types of RSA attributes: utilitarian, hedonic) between-subjects design. Dependent measures: Attitude and WTTR.	For a humanoid robot, are customers more willing to try utilitarian attributes over hedonic attributes? Would this effect differ for a humanoid robot?
Study 3	Humanoid robot vs. Non-humanoid robot	*Experiment*: A 2 (RSA appearance: humanoid, non-humanoid) by 2 (types of RSA attributes: utilitarian, hedonic) between-subjects design. *Dependent measures*: Uncanniness and WTTR. *Covariates*: general attitude toward robots, and IDA.	For humanoid RSA, why does an individual show higher WTTR utilitarian attributes than hedonic attributes? Would uncanniness help explain this effect? Does the effect observed in Study 2, accompany individual and cultural differences?

[a]In particular, the approach we utilized is similar to "initiation," one type of mixed-method design, in which researchers "use results from an initial study to inform a second study that uses a different method" (Davis et al., 2011, p. 469). Similarly, while Study 1 plays a role as an exploratory study, Study 2 and Study 3 are positioned to confirm the predications generated in Study 1 and relevant literature.