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ABSTRACT

Solo consumption has become an emerging trend in recent years. However, the service experiences of solo customers with the growing adoption of frontline humanlike robots remain unclear, particularly in direct comparison with joint customers. Building on the literature of anthropomorphism and information processing theory, this study examines whether and how frontline anthropomorphized robots (FAR) might improve the service experiences of solo customers relative to their joint counterparts. Data from four studies, including field and online experiments, reveal that solo customers are more likely than joint customers to perceive FAR as offering rapport but also as being eerie, leading to different service evaluations (both attitudinal and behavioral outcomes). Nevertheless, as parallel mechanisms, these levels of social rapport and eeriness are contingent on features of the FAR, the service delivery process, and customers' consumption goals. The rapport (eeriness) mechanism is strengthened (weakened) when the robot is of in-group favoritism, the service process deprives customers of control, and customers have a hedonic consumption goal. With the boom in adopting frontline humanlike robots in hospitality services, this study offers managerially relevant implications for serving solo customers as an emerging segment along with the traditional segment of joint customers.

Keywords: solo and joint consumption, frontline anthropomorphized robots (FAR), information processing, social rapport, eeriness.

While customer experience is considered social in nature (Lemon and Verhoef 2016), recent years have seen a boom in solo customers who consume services alone, representing a promising market segment (Pfalz 2021). Solo travelers and solo diners are two prime examples. In the United States, sales of single roundtrip travel tickets increased by 200% during summer 2021, compared with the same period in 2020 (Diakite 2021); single bookings in the first three quarters of 2021 increased by 300% compared with reservations made for families or groups of friends (Kamin 2021). Restaurants also note the sweeping prevalence of the "table for one" trend; single diners represented up to 35% of US restaurants' market share in 2020 and became the largest restaurant visitor segment (Cheng 2020). In this sense, solo customers are no longer the exception but represent a growing segment that hospitality providers must consider.

While research on solo or joint consumption is gaining more attention, it predominately tackles these two trends in isolation. More importantly, questions on solo customers' views of frontline service robots, in direct comparison with those of joint customers, remain unaddressed. Although a few prior studies (e.g., Fraune, Šabanović, and Kanda 2019; Preusse et al. 2021) have attempted to compare individuals with groups when encountering robots, the underlying mechanisms and the boundary conditions are mostly not explored (see Table 1 for a review). Notably, in the field of information systems, though a few studies have examined how the social presence of others affects one's technology usage (e.g.., Goel et al. 2013; Schultze and Brooks 2018), they primarily explore the role of "remote" others in virtual environments, such as 3D virtual world, and do not specifically examine (anthropomorphized) service robots in physical frontline environment, not to mention their focus on non-marketing outcome variables. These gaps are crucial given the recent post-pandemic proliferation of service robotics (Wan, Chan, and Luo 2021), especially those frontline anthropomorphized robots (FAR) –service robots with humanlike features (e.g., name, embodiment, voice) serving at the frontlines. The use of FAR is rising in service settings, particularly in the

hospitality sector (Choi and Wan 2021), where companies adopt them as concierges in hotels or servers in restaurants (McLeay et al. 2020). Some service businesses (e.g., Dadawan restaurant in the Netherlands) even rely almost entirely on FAR, with minimal or no human service presence (Kim, Choe, and Hwang 2021). Such service robots that evoke strong anthropomorphism can create and elicit social rapport (Qiu et al. 2019). Social rapport means the extent to which customers perceive that they have a personal, emotional connection or bond with the FAR (Gremler and Gwinner 2000), subsequently exerting positive effects on service evaluations, such as satisfaction, word-of-mouth (WOM) (Becker, Mahr, and Odekerken-Schröder 2022), and loyalty (Gremler and Gwinner 2000). However, anthropomorphism might not always be beneficial. For instance, Akdim, Belanche, and Flavián (2021) show that customers develop negative attitudes towards service robots with high humanlikeness and are inclined to reject them. Specifically, when a humanoid robot imitates human characteristics but falls short of achieving full humanness, it can elicit the feelings of discomfort (e.g., eeriness). This is because consumers perceive a discrepancy between the robot's expected human features and its actually imperfect humanlike qualities (i.e., the uncanny valley; Mende et al. 2019). This perceived eeriness, in turn, leads to poor service outcomes, such as undermining customers' satisfaction and loyalty (Mende et al. 2019) or shaping negative attitudes toward robots that potentially evoke adverse WOM (Kim, Schmitt, and Thalmann 2019).

Considering these disparate findings about the effectiveness of FAR together with the growing expansion of the solo customer segment in hospitality, the current research, therefore, builds on the literature of anthropomorphism and information processing theory to explicitly investigate how the social context (i.e., solo vs. joint consumption) might affect service evaluations when encountering FAR. With the contention that solo (joint) customers adopt a more analytic (holistic) thinking style (Bhargave and Montgomery 2013; Krishna, Zhou, and Zhang 2008; Smith and Redden 2020), we posit that solo customers' "zoom in" approach and discrete thinking heighten their focal attention on

FAR. On the one hand, because solo customers, unlike their joint counterparts, lack any companions and FAR act as the key frontline agents that socialize with them, they might thus perceive a stronger social rapport with FAR during the frontline interactions, which would positively affect their service evaluations (Gremler and Gwinner 2000). We name this effect the *positive social rapport mechanism.* On the other hand, with their heightened attention on FAR and their analytic thinking, those solo customers would also perceive FAR as more distinctive and dissimilar than their joint counterparts would (e.g., Krishna, Lwin, and Morrin 2010), which could heighten their perceptions of FAR eeriness and thus negatively affect their service evaluations (Kim, Schmitt, and Thalmann 2019; Mende et al. 2019). We name this effect the *negative eeriness mechanism*. As these two opposing mechanisms might nullify the direct effect of FAR on customers' ultimate service evaluations, it is thus essential to put forth conditions that will likely influence both mechanisms simultaneously. Hence, we further identify features of the FAR (in-group favoritism), service delivery process (degree of control deprivation), and customers' consumption goals (hedonic vs. utilitarian) as three key managerially relevant boundary conditions that likely influence customers' information processing style and thus activate levels of social rapport and eeriness differently, with distinct ultimate influences on solo (vs. joint) customers' service experiences. To comprehensively capture customers' overall service evaluations and enhance our findings' robustness, we include attitudinal (i.e., satisfaction, WOM, revisit intention) and behavioral (i.e., pay-per-person, WeChat posting) service outcomes.

With data from one field and three online experiments, we reveal the existence of the two opposing (i.e., positive social rapport and negative eeriness) mechanisms (Study1). Importantly, we show that the social rapport (eeriness) mechanism is strengthened (weakened) if (a) the robot evokes strong in-group favoritism (Study 2), (b) the service process deprives customers of a sense of control (Study 3), and (c) customers have a hedonic consumption goal (Study 4). Such insightful findings

thus bring several key contributions to existing literature. First, we add knowledge to existing studies that predominately examine solo or joint consumption in isolation (see Table 1) by providing comparative insights that help differentiate these two forms of consumption in the wave of the rapid rise of service robots in hospitality. Second, we extend the literature on robotics anthropomorphism by challenging the conventional assumption of the decontextualized positive effect of anthropomorphism on the customer–robot frontline interactions and hence expanding our holistic understanding of the effectiveness of robot anthropomorphism. Notably, we unveil that anthropomorphism can simultaneously evoke both social rapport and eeriness mechanisms, with opposite effects for solo (vs. joint) customers. This investigation thus responds to the recent call for identifying new, theoretically meaningful mediators of robot anthropomorphism (Blut et al. 2021). To this end, we also enrich the stream of human user-technology interactions by explicating the underlying mechanisms driving the effect of users' social context on their experience with new technologies (e.g., robots). Third, from a contingency approach, our findings offer more nuanced insights into the activation processes of social rapport and eeriness mechanisms by identifying a set of managerially relevant moderators and capturing objective service outcomes that are often overlooked in prior literature. Accordingly, our study provides timely and relevant implications for service firms in relation to adopting FAR. When implementing FAR, these service providers must be aware of the customers' social context (solo vs. joint consumption). For instance, to better serve the emerging and promising solo segment of guests, hotels might add local cues to their FAR (e.g., national flag, mother language) to evoke in-group favoritism and/or adopt a highly automated process that is fully managed by FAR. Meanwhile, restaurants might use ambient cues (e.g., lighting, scent, music) to encourage a sensory hedonic consumption experience for solo diners.

Theoretical Background and Hypotheses Development

Solo (vs. joint) consumption and information processing style

We define solo consumption as doing things alone in the marketplace (Leary et al. 2003) and solo customers as anyone participating in consumption behaviors on his or her own without any companions (Goodwin and Lockshin 1992). In contrast, joint customers are those who consume with at least one companion. While solo consumption has started growing considerably, particularly in hospitality services, extant research primarily examines the drivers of one's solo consumption and related experiences (e.g., Hwang, Shin, and Mattila 2018). Studies largely lack investigations into their interactive experience with frontline service robots or make a direct comparison between solo and joint customers (e.g., Her and Seo 2018; Moon, Bonn, and Cho 2020). The only exceptions are the works of Fraune, Šabanović, and Kanda (2019) and Preusse et al. (2021), which examine how individuals vs. groups interacted differently with service robots. However, both the underlying mechanisms that drive how solo vs. joint group interacts with robots differently and the boundary conditions that might alter this difference are not considered and addressed in these two studies. Also, existing research on solo consumption is predominately focused on only a single service context (e.g., solo restaurant, Her and Seo 2018; solo traveling, Su, Cheng, and Swanson 2020) and only captures subjective or attitudinal service outcomes, a broader study context covering diverse types of services and the inclusion of more objective or behavioral service outcomes are imperative in enhancing the validity of research along this stream (see Table 1).

[Insert Table 1 here]

Against these backdrops, we aim to offer a more nuanced understanding of the interplay of customers' social context (i.e., solo vs. joint consumption) with the adoption of FAR in hospitality services. In particular, we rely on information processing theory as the key theoretical lens for our propositions. In general, individuals embrace two types of information processing styles, holistic and analytic, that differ in their attention and depth of information processing (Hossain 2018). Holistic thinkers adopt a top-down, "zoom-out" information integration style, so they consider the context of

information that they assimilate when making judgments. Analytic thinkers instead rely on a bottom-up style and make judgments based on individual elements, separate from the context and with a "zoom-in" approach (Nisbett 2003). For example, to evaluate a new product, customers with a holistic and concrete thinking style exhibit flexibility in categorizing and emphasizing relationships across categories. They are willing to accept stimuli that deviate from categorization norms. In contrast, analytic thinkers, with their discrete thinking orientation, seek to impose a well-defined structure and embrace categorization norms (Hossain 2018). Suppose analytic thinkers encounter a new product with incongruent attributes, they are more attentive to those specific attributes and perceive substantial and bothersome dissimilarity, whereas holistic thinkers find similarities by focusing on their relatedness to the base product (Förster 2009; Lee and Chu 2021).

While individuals generally have a culturally dominant processing style (Nisbett et al. 2001), recent research has shown that thinking styles also can vary within an individual across situations (Benoit and Miller 2017; Choi, Koo, and Choi 2007). For instance, in their study on the temporal sequence of episodes in art galleries, Bhargave and Montgomery (2013) show that one's social context affects information processing styles, such that solo visitors, who experience less social connection than joint visitors, engage in analytic (less holistic) information processing, which then diminishes the contextual dependence of solo visitors' judgments of the episodes throughout the experience. Likewise, Krishna et al. (2008) find that priming interdependence with others triggers more holistic (less analytic) processing on subsequent tasks.

These lines of reasonings together suggest that solo customers tend to exhibit an analytic thinking style while joint customers might hold a holistic thinking style. Accordingly, we propose that when solo (vs. joint) customers engage in more analytic (vs. holistic) information processing during service encounters, it influences their perceptions of FAR and subsequent attitudinal and

behavioral service evaluations (i.e., satisfaction[1], WOM, revisit intention and actual purchases). More importantly, we propose social rapport and eeriness as the two opposing underlying mechanisms and further put forth with boundary conditions. Please refer to Figure 1 as our conceptual framework.

[Insert Figure 1 here]

Frontline Anthropomorphized Robots (FAR), Social Rapport, and Eeriness

Anthropomorphism refers to attributing humanlike properties and characteristics to a nonhuman entity, such as a robot (Epley, Waytz, and Cacioppo 2007). Certain features can evoke anthropomorphism, such that adding a face, arms, or a voice to a robot could activate people's sense that the robot resembles a human (Blut et al. 2021). Anthropomorphized robots provoke enhanced social rapport with customers, including a sense of interpersonal and emotional connection between customers and robots (Biedenbach et al. 2011; Gremler and Gwinner 2000). Such connections are found to ultimately increase customer service evaluations (e.g., satisfaction and WOM, Becker et al. 2022; loyalty, Gremler and Gwinner 2000).

Nevertheless, the association between anthropomorphism and customers' acceptance and evaluations of service robots is not always positive (Blut et al. 2021). Robots that highly resemble human beings can evoke negative feelings (i.e., uncanny valley effect, Kim et al. 2019; Mende et al. 2019; Mori 1970). People might find them eerie, with a feeling of creepiness and strangeness that leads to reduced likability (Kätsyri et al. 2015) and increased rejection (Akdim et al. 2021). As Mori (1970) notes, the degree of affinity (likeability) of humanlike robots may depend on positive *shinwakan* (i.e., social rapport) and negative *bukimi* (i.e., eeriness) (MacDorman et al. 2009). Taken together, because service robot anthropomorphism might have varying effects on customers' ultimate service evaluations, we therefore seek to advance our understanding of how the two opposing

[1] We refer satisfaction in this research as one's transaction-specific satisfaction. That is, customers' experience after a particular service encounter with the service robot (Jones and Suh 2000).

mechanisms (i.e., social rapport and eeriness) above might be activated differently by one's social consumption contexts (i.e., solo vs. joint), as well as identify relevant boundary conditions. Specifically, we draw on the information processing styles embraced by solo (vs. joint) customers and the literature on anthropomorphism to develop our hypotheses.

Social Rapport Mechanism. Given their analytic thinking style in solo consumption, those solo customers might be relatively more attentive to FAR, as they viewed the robot as the key social agent with which they can socialize and interact. Customers in solo consumption are both physically alone and less socially connected (Goodwin and Lockshin 1992), they might therefore experience a greater situational need for belonging relative to their joint counterparts (Hwang, Su, and Mattila 2020). As noted by Baumeister and Leary (1995), a strong desire to belong might lead customers to look for companionship for their consumption, by seeking more social interactions and devoting more thoughts to relationship partners. As such, solo customers will perceive a stronger social rapport with FAR. Because social rapport has been shown to enhance satisfaction, WOM, and loyalty (Gremler and Gwinner 2000), those solo customers will consequently be more satisfied with the services and engage more in positive WOM and revisiting. In contrast, joint customers, as they adopt a more holistic thinking style and make judgments by assimilating with the context, including their companions, appear to focus relatively less on FAR and are less likely to regard it as their key social agent. Overall, relative to joint counterparts, solo customers might seek out and find more social rapport from FAR, which subsequently enhances their service evaluations. In turn, we posit:

> **H_1:** (a) Solo (vs. joint) customers perceive greater social rapport with FAR, (b) which in turn positively affects their service evaluations. [*Positive social rapport mechanism*]

Eeriness Mechanism. In solo consumption, customers tend to adopt an analytic processing style and are more context-independent with discrete thinking (Bhargave and Montgomery 2013; Smith and Redden 2020); they would thus find FAR more distinctive and dissimilar relative to the surrounding environment. Research on distinctiveness suggests that a stimulus can be distinctive if it

differs from its immediate surrounding context or is unexpected, unusual, or contextually inappropriate (e.g., Krishna et al. 2010). Such stimuli can capture people's attention and be particularly perceived as distinctive for those who embrace an analytic thinking style (Herz 1997). As such, we extrapolate that solo customers would perceive FAR as detached from the context and more likely to attend to its dissimilarity (Lee 2018), thus perceiving FAR as eerier. Since robots' eeriness or creepiness would lead to reduced customers' liking and acceptance of robots (Kätsyri et al. 2015), we expect that solo customers will ultimately feel less satisfied and less likely to revisit (Mende et al. 2019) or recommend the services to others (Kim, Schmitt, and Thalmann 2019). Conversely, joint customers tend to exhibit holistic processing and are more context-dependent and have connected thinking (Bhargave and Montgomery 2013). They are more likely to take an integrative view and perceive FAR as less unusual and more acceptable. Lee and Chu (2021) propose that holistic thinkers tolerate the addition of incongruent attributes to a base product. However, analytic thinkers exhibit narrow, inflexible categorizations and deem such additions to violate their categorization norms, resulting in negative evaluations. In sum, because the perceived distinctiveness of FAR could be more pronounced for solo customers due to their analytic processing, they would perceive FAR as eerier, which in turn dampens their service evaluations. Formally, we propose:

> **H_2:** (a) Solo (vs. joint) customers perceive greater eeriness of FAR, (b) which in turn negatively affects their service evaluations. [*Negative eeriness mechanism*]

Boundary Conditions for Social Rapport and Eeriness Mechanisms

With the concurrent existence of the two opposing mechanisms, namely social rapport and eeriness, the effects on service outcomes counterbalance and could be canceled out (e.g., Li, Chan, and Kim 2019). Hence, it is imperative to investigate relevant boundary conditions that might activate different levels of these two parallel mechanisms, thereby improving service outcomes for solo (vs. joint) customers. As thinking styles are malleable and contextual (Bhargave and Montgomery 2013; Nisbett et al. 2001), we, therefore, capture the features of FAR (i.e., in-group

favoritism), service delivery process (i.e., control deprivation), and customers' consumption goals (i.e., hedonic vs. utilitarian) that are closely linked to one's information processing style and also managerially relevant to firms' practices (Table W-A1, in Web Appendix A, provides a summary of theoretical reasonings for the moderation effects). This enables us to offer a more nuanced understanding of the interplay of customers' social context with FAR.

In-Group Favoritism. People categorize themselves and others into in-group members who are similar or out-group members who are dissimilar to them (Hogg and Terry 2000; Turner 1987). This categorization relies on comparisons of the self with others on various factors, including arbitrary ones (e.g., birth date, gender, surname), especially if the categorization involves unknown others (Kuchenbrandt et al. 2013). Depending on whether an in-group or out-group perception forms, in-group favoritism might arise (Hwang, Shin, and Mattila 2018; Tajfel and Billic 1974). Such favorable attitudes toward in-group (vs. out-group) members have primarily been documented among human social groups, but they can be extended to robots (Eyssel and Kuchenbrandt 2011). Notably, in-group favoritism is not a fixed trait but can be evoked by situational cues, such as the salience of the categorization cues (Her and Seo 2018; Hwang, Shin, and Mattila 2018).

In-group favoritism might influence one's information processing style, such that when individuals perceive others with high in-group favoritism, their social connectedness and interdependence are enhanced, leading to a more holistic thinking approach. This effect is especially evident among solo customers, who, upon sensing a high level of in-group favoritism toward FAR, are more inclined to view FAR as an in-group member which is similar and closely connected to them. As a result, they experience a stronger sense of connection and perceive a closer relational bond with FAR (i.e., enhanced social rapport). On the other hand, given that such enhanced interdependence caused by in-group favoritism also evokes more holistic thinking (Krishna et al. 2008) among solo customers, such that they, who used to adopt an analytic thinking style with rigid

categorization norms, would now perceive FAR as more acceptable, less distinctive and less creepy (i.e., reduced eeriness). Consequently, solo customers would be more satisfied with services provided by FAR and increase their re-patronage and WOM due to enhanced social rapport and reduced eeriness driven by in-group favoritism perceptions. Meanwhile, as joint customers have already established connections with their companions (e.g., friends, family) prior to their interactions with FAR, in-group favoritism, as a categorization cue, might be less salient and receive less attention from those joint customers (Hornsey 2008; Hwang, Shin, and Mattila 2018). In other words, in-group favoritism is less likely to improve social rapport or further reduce the perceived eeriness of FAR among joint customers. Taken together, we predict that in-group favoritism might strengthen the positive social rapport mechanism while also weakening the negative eeriness mechanism for solo (vs. joint) customers, which in turn enhances solo (vs. joint) customers' service evaluations (e.g., satisfaction and WOM). Formally stated:

> **H_{3a}:** The positive social rapport mechanism is strengthened when in-group favoritism toward FAR is present (vs. absent).
> **H_{3b}:** The negative eeriness mechanism is weakened when in-group favoritism toward FAR is present (vs. absent).

Control Deprivation. Human beings have an innate desire for control over their environment (Chen, Lee, and Yap 2017). While the adoption of FAR in services is booming, there are rising concerns about the loss of control over FAR, too (Choi and Wan 2021; Puntoni et al. 2021). Fast and Horvitz (2017) demonstrated in their analysis of articles published between 1986 and 2016 that the risk of losing control following the deployment of novel technological agents consistently ranks among people's top concerns.

Prior research states that a sense of control could influence one's information processing style, such that when individuals are deprived of control, their thinking style becomes more analytic, and they are in a motivational state to regain their lost control (Chen, Lee, and Yap 2017; Zhou et al. 2012). Applying to our context, when sensing a lack of control over the service process, which

becomes more prevalent in hospitality when the fully automated service encounter with only FAR is increasingly preferred in post-pandemic (Wan, Chan, and Luo 2021), those joint customers who used to adopt a holistic thinking style might now shift to become more analytic, resulting in increased attention to FAR. As such, they might seek to reassert control by regaining their identity, such as upholding their uniqueness and superiority (as humans) over the robot by drawing a clear boundary or distinction between humans and robots (Lu, Zhang, and Zhang 2021). Such a boundary would reduce joint customers' perceived social rapport with FAR while intensifying the distinctiveness of FAR. That is, they would perceive FAR as more distinctive, creepier and less acceptable under control deprivation. In sum, deprived control appears to further hamper the already low level of social rapport with FAR and heighten eeriness for joint customers, reducing their service evaluations (Gremler and Gwinner 2000; Mende et al. 2019).

In contrast, under control deprivation, solo customers also hold an analytic thinking style. However, they might now seek to regain their control by coordinating with the robot instead, as which is the only agent that can help them get the task done. As Chen, Lee, and Yap (2017) noted, control deprivation elicits problem-solving tendencies that can reaffirm a sense of control over the environment. Therefore, when relying on FAR and treating it like a partner to deal with deprived control, solo customers might experience greater social rapport. Indeed, according to Swann, Stephenson, and Pittman (1981), control deprivation could trigger a search for social information; as the key social agent available for interactions with solo customers, FAR should then prompt a stronger sense of social rapport for solo ones (i.e., enhanced social rapport). Also, they would now be prone to perceive FAR as less distinctive and less creepy (i.e., reduced eeriness). Thus, unlike joint customers, we expect that control deprivation improves rapport with but lowers eeriness of FAR for solo customers, which in turn enhances their service evaluations (Gremler and Gwinner 2000; Mende et al. 2019). Overall, we posit that:

H_{4a}: The positive social rapport mechanism is strengthened when control is deprived (vs. not).

H_{4b}: The negative eeriness mechanism is weakened when control is deprived (vs. not).

Hedonic and Utilitarian Consumption Goals. Hedonic consumption is focused on affective, sensory experiences, and emotional feelings (Botti and McGill 2011), while utilitarian consumption is cognitively driven and goal-oriented, designed to fulfill basic needs (e.g., hunger). These consumption goals influence customers' information processing (Melnyk, Klein, and Völckner 2012), such that hedonic (utilitarian) consumption is more associated with an emotional (rational) approach and facilitates more holistic (analytic) thinking (Hossain 2018).

When the consumption goal is hedonic, solo customers become less analytic and take a more holistic approach to FAR and the service experience. They focus more on the affective, sensorial, and experiential pleasure, as well as enjoyable feelings of the whole service experience (Botti and McGill 2011), which may prompt their stronger desire for companionship as a crucial social element that can enhance the experiential component of their hedonic consumption (Kim and Ratner 2018). As such, they would perceive a stronger social rapport from FAR, which subsequently drives their satisfaction, WOM and revisit intention (Gremler and Gwinner 2000). Regarding the perceptions of eeriness in hedonic consumption, due to the solo customers' diminished attentiveness and sensitivity to the dissimilarity of FAR as a result of their shift to holistic thinking (Hossain 2018), the perceived eeriness likely decreases too, as they would now find FAR less distinctive, less creepy, and therefore more acceptable. On the other hand, while joint customers are also motivated to fulfill this hedonic need (e.g., enjoyment), they can turn to their companions who share the consumption experiences with them and so are unlikely to rely on FAR for seeking social rapport. In other words, FAR is unlikely to improve those joint customers' service evaluations via social rapport. Also, since joint customers already adopt a holistic, "zoom-out" thinking approach, hedonic consumption is less likely to alter their attention to and perceived eeriness of FAR.

If the consumption goal is utilitarian though, we predict no differences between solo and joint customers on perceptions of either social rapport or eeriness. According to Kim and Kim (2014), in utilitarian consumption settings, people make decisions based on value calculations rather than feelings. They are unlikely to care whether they are alone or with others as they only hope to fulfill the utilitarian needs, such that their main focus is just getting the task done to reach their functional goal (Ratner and Hamilton 2015). Simply put, they might not care about what FAR looks like (e.g., creepy-looking) and whether they can build a social rapport with it when their consumption goal is utilitarian. Overall, given the enhanced social rapport and reduced eeriness of FAR for solo (vs. joint) customers under hedonic (vs. utilitarian) condition that consequently influence service evaluations, we posit that:

> **H_{5a}:** The positive social rapport mechanism is strengthened when the consumption goal is hedonic (vs. utilitarian).
> **H_{5b}:** The negative eeriness mechanism is weakened when the consumption goal is hedonic (vs. utilitarian).

We conducted four empirical studies, using diverse samples (field data, MTurk, Prolific, Clickworker) and across different hospitality settings (restaurant, airport, hotel) to establish the parallel mechanisms (Study 1) and determine the influences of the three boundary conditions: features of the FAR (in-group favoritism, Study 2), the service delivery process (control deprivation, Study 3), and the customers' consumption goals (hedonic vs. utilitarian, Study 4). We also control for the effects of gender and consumption frequency, together with some contextual-specific covariates to enhance the validity of our findings. We summarize our studies in Table 2 and report the descriptive statistics and measurement items of constructs in Web Appendices A (Table W-A2) and C, respectively.

[Insert Table 2 here]

Study 1: Field Experiment (Restaurant Dining)

We first contrasted solo customers with joint customers regarding their perceptions of the social rapport and eeriness toward actual FAR used at a restaurant, as well as their service evaluations, including both attitudinal (satisfaction) and behavioral service outcomes (pay-per-person and WeChat posting) (H_1 and H_2). We also ruled out alternative explanations (e.g., warmth, competence).

With a pretest, we confirmed that the solo consumption condition induced less holistic (more analytic) processing and a greater need to belong compared to the joint consumption condition (Bhargave and Montgomery 2013). Diners at a Beijing-based restaurant that implemented real service robots (see Web Appendix D) participated in this pretest (52.7% female; 45 solo diners, 48 joint diners). FAR at this restaurant not only greet customers but also move around tables to take orders and serve food and drink to diners. The pretest procedure relied on a survey link embedded into a QR code, which restaurant staff presented to each diner after they completed their meal, with a request to complete a short survey in exchange for a free dish (maximum of ¥50 RMB). In each joint group, only one person could take the survey. Data were collected at different times (e.g., lunch, dinner) and on both weekdays and weekends to minimize any time effects.

Participants first rated five items that gauged their holistic thinking style (e.g., "The whole is greater than the sum of its parts," $\omega = .95$; Choi et al. 2003). As expected, solo diners indicated less holistic thinking than joint diners ($M_{solo} = 4.96$ vs. $M_{joint} = 5.94$, $t(91) = 4.589$, $p < .001$) [2]. We further measured loneliness, social exclusion, and mood on 7-point Likert scales (1 = not at all, 7 = very much) (Web Appendix C). We found no differences between solo and joint groups for these factors.

Design and Procedure

[2] The respondents also answered four items that captured their current need to belong (e.g., "I am feeling a strong 'need to belong,'" $\omega = .95$; Web Appendix C). As anticipated, solo diners expressed a higher need for belonging than joint diners ($M_{solo} = 4.97$ vs. $M_{joint} = 4.14$, $t(91) = 2.951$, $p = .004$).

In our main study, we collected field data from the same restaurant, using the same procedure as in the pretest. Servers approached 248 customers, and we obtained 223 valid respondents (57.8% female; M_{age} = 28.49 years; 104 solo diners, 119 joint diners). These participants rated two items, measuring their satisfaction with the dining experience involving FAR on 7-point scales ("very dissatisfied/very satisfied," "very displeased/very pleased"; $r_{Spearman–Brown}$ = .78; Spreng et al. 1996). They also responded to four social rapport items (e.g., "The service robot in the restaurant related well to me," ω = .91; Biedenbach et al. 2011; Gremler and Gwinner 2000) and three eeriness items (eerie, unnatural, creepy; ω = .92, Mende et al. 2019) [3]. Lastly, we obtained the actual behavioral data of pay-per-person and WeChat posting after the meal (0 = no, 1 = yes, recorded by the staff on site [4]).

Results

Social rapport and eeriness. An analysis of variance (ANOVA) indicated significant main effects for social rapport (M_{solo} = 5.17 vs. M_{joint} = 4.44; $F(1, 221) = 15.368$, $p < .001$, $\eta^2_{partial} = .065$) and eeriness (M_{solo} = 3.30 vs. M_{joint} = 2.44; $F(1, 221) = 14.026$, $p < .001$, $\eta^2_{partial} = .060$)—in line with our expectations that solo diners would perceive higher levels of both social rapport and eeriness for FAR than joint diners. We thus found support for H_{1a} and H_{2a} (see Figure W-A1, Web Appendix B). Consistent with the pretest, we also found no significant differences between solo and joint diners in terms of their loneliness (M_{solo} = 2.46 vs. M_{joint} = 2.35, p = .613), social exclusion (M_{solo} = 2.32 vs. M_{joint} = 2.16, p = .447), or mood [5] (M_{solo} = 5.41 vs. M_{joint} = 5.61, p = .315). Our results remained robust when we controlled for gender, monthly frequency of dining out, number of diners, number of

[3] All diners also completed two checks, related to robot anthropomorphism (1 = "very machinelike," 7 = "very humanlike"; 1 = "more like an object," 7 = "more like a person"; $r_{Spearman\ Brown}$ = .91, Choi, Mattila, and Bolton 2020). They perceived the restaurant service robots as anthropomorphic ($M_{average}$ = 4.69 vs. 4.00 as the midpoint, $t(222) = 6.173$, $p < .001$).

[4] WeChat is the most popular social media platform in China and WeChat Moments allows users to create postings and share their status update with friends who can then like and comment, a platform similar to Facebook Newsfeed. Postings on WeChat about diners' experiences at the restaurant could thus serve as an actual behavior capturing recommendations.

[5] Per an anonymous reviewer's suggestion, we additionally performed mediation analysis on mood and the indirect effects via mood were non-significant for all three outcome variables (satisfaction, CI = [-.23, .06]; PPP, CI = [-2.92, .61]; WeChat posting, CI = [-.43, .11]). We can thus rule out mood as an alternative explanation.

dishes (per person), dining duration, and dining time (1 = lunch, 2 = dinner). We thus did not discuss these variables in our further analyses.

Mediation. To formally verify the parallel mechanisms of social rapport and eeriness, we separately conducted a parallel mediation test, using PROCESS Model 4 with 10,000 bootstrapping iterations (Hayes 2017) on satisfaction, pay-per-person (PPP), and WeChat posting. We dummy-coded the social context (0 = joint; 1 = solo) as the independent variable and included social rapport and eeriness as parallel mediators. The relationships from social rapport to satisfaction (b = .25, SE = .06, 95% CI = [.13, .36]), ppp (b = 3.83, SE = 1.91, 95% CI = [.06, 7.60]), and WeChat posting (b = .30, SE = .11, 95% CI = [.08, .51]), were all significant with positive coefficients. H_{1b} was thus supported. Similarly, the relationships from eeriness to satisfaction (b = -.16, SE = .05, 95% CI = [-.26, -.07]), ppp (b = -3.37, SE = 1.55, 95% CI = [-6.43, -.32]), and WeChat posting (b = -.30, SE = .09, 95% CI = [-.47, -.12]), were all significant with negative coefficients. H_{2b} was then supported. Consistently, the indirect effects from social context to satisfaction, via social rapport (ab = .15, SE = .07, 95% CI = [.04, .31]) and eeriness (ab = -.18, SE = .07, 95% CI = [-.33, -.07]), were both significant, but in opposite directions. We found similar result patterns for the indirect effects on pay-per-person and WeChat posting through social rapport (ppp: ab = 2.33, SE = 1.29, 95% CI = [.13, 5.07]; posting: ab = .18, SE = .11, 95% CI = [.02, .44]) and eeriness (ppp: ab = -3.71, SE = 2.03, 95% CI = [-8.30, -.39]; posting: ab = -.33, SE = .12, 95% [CI] = [-.60, -.13]). Overall, social rapport and eeriness simultaneously mediate the effect of solo (vs. joint) context on service evaluations, in further support of H_1 (positive social rapport mechanism) and H_2 (negative eeriness mechanism). We reported all the direct, indirect, and total effects of this study in Table W-A3 (Web Appendix A).

Outcomes. Meanwhile, regarding the effect of the social context (solo vs. joint consumption) on downstream outcomes, as expected, one-way ANOVAs on satisfaction (M_{solo} = 5.63 vs. M_{joint} = 5.76; $F(1, 221)$ = .711, p = .400), pay-per-person (in RMB) (M_{solo} = 128.92 vs. M_{joint} = 123.37; $F(1, 221)$ =

1.145, $p = .286$), and WeChat posting ($\beta = .05$, $SE = .27$, Wald = .04, $p = .850$) indicated no differences across conditions. These null effects imply the opposing effects of social rapport and eeriness mechanisms that seemingly counterbalance each other, which thus unveils the importance of identifying the relevant boundary conditions in activating the mechanisms in our subsequent studies.

Alternative Explanations

Previous research identifies warmth and competence as psychological states that might account for the effects of robot anthropomorphism (e.g., Choi, Mattila, and Bolton 2020; Kim, Schmitt, and Thalmann 2019). To rule out these alternative explanations, we measured warmth and competence (Bolton and Mattila 2015) and found no statistically significant difference between solo and joint customers for either warmth ($M_{solo} = 5.08$ vs. $M_{joint} = 5.18$; $t(221) = .469$, $p = .640$) or competence ($M_{solo} = 5.44$ vs. $M_{joint} = 5.20$; $t(221) = 1.372$, $p = .172$). In another parallel mediation test (PROCESS Model 4), the results further indicated non-significant indirect effects for both warmth (95% CI = [-.19, .10]) and competence (95% CI = [-.02, .15]) on satisfaction, pay-per-person (warmth: 95% CI = [-2.18, 1.00]; competence: 95% CI = [-.83, 2.37]) and WeChat posting (warmth: 95% CI = [-.31, .18]; competence: 95% CI = [-.05, .15]). Thus, we could rule out warmth and competence as alternative underlying mediators. Our results remained robust when including them as covariates.

Discussion

This field experiment in a natural restaurant setting confirms that a solo consumption context triggers less holistic (more analytic) thinking. We also offer insights that solo diners perceive FAR as greater in terms of social rapport but also eerier than their joint counterparts do, with concomitant influences on both attitudinal (i.e., satisfaction) and behavioral service outcomes (i.e., pay-per-person, WeChat posting), in opposing directions. Hence, we next consider boundary conditions in which social rapport and eeriness mechanisms might be activated differently, thereby improving service outcomes for solo (vs. joint) customers.

Study 2: Moderation of In-Group Favoritism (Airport Check-In)

To investigate the boundary condition of in-group favoritism (H_{3a} and H_{3b}), we studied an airport check-in context with FAR, using a 2 (social context: solo vs. joint) × 2 (in-group favoritism: present vs. absent) between-subjects experimental design. We primed robot anthropomorphism with four elements: appearance (with an image of an anthropomorphized robot), a name (Amezen), a first-person pronoun, and a humanlike voice generated by Naver Papago (Li and Sung 2021).[6] In a pretest with 43 MTurk workers (53.5% female; M_{age} = 41.42 years), we validated this anthropomorphism manipulation with the two items from Study 1 ($r_{Spearman\ Brown}$ = .73). The pretest participants perceived the service robot in the scenario as anthropomorphic ($M_{average}$ = 4.99 vs. 4.00 midpoint, $t(42) = 6.210$, $p < .001$). To manipulate in-group favoritism, we followed prior literature to manipulate it through home-country similarity (i.e., "Robot is developed in your home country," Eyssel and Kuchenbrandt 2011) and incidental similarity (i.e., "Robot is manufactured on the same date and month as your birthday," Wan and Wyer 2018).

In the main study, participants first wrote down their home country, which created an initial prime of home country (dis)similarity with the robot. They then had to imagine that they were traveling on their own (vs. with friends) and had already booked a flight. The scenario indicated that when they arrived alone (vs. with their friends) at the airport, they approached a frontline service robot named Amezen at the check-in counter. They noticed that Amezen featured stickers on its left arm and waist, indicating it was made in their home country and manufactured on the same date and month as their birthday. The detailed experimental stimuli are available in Web Appendix D.

[6] This study presents a Pepper robot that has been deployed in airports in reality (https://thepointsguy.com/2018/02/munich-airport-humanoid-robot-josie-pepper/). In a pretest, we determined that Amezen was perceived as a gender-neutral, culturally non-sensitive name, which was unlikely to affect customers' perceived in-group favoritism. Its human-like voice is available here: https://soundcloud.com/d-k-696080300/study2_aiport.

Design

We recruited 145 qualified MTurk workers (53.8% female; M_{age} = 42.72 years) through the CloudResearch platform. They were first randomly assigned to one of the four experimental conditions. Then they rated the same items as in Study 1 to gauge their satisfaction with the check-in experience ($r_{Spearman–Brown}$ = .91), sense of social rapport (ω = .90), and perceived eeriness (ω = .85). They also responded to one manipulation check question on social context (i.e., In the scenario above, your check-in at the airport is a (a) solo experience (alone) or (b) joint experience (with your friends)) and three manipulation check items for in-group favoritism (e.g., "I feel favorable to have this service robot as part of my group"; ω = .82; Hwang, Shin, and Mattila 2018, Web Appendix C).

Manipulation checks. All participants' responses matched their assigned social context [7]. Also, participants in the presence of in-group favoritism perceived FAR more favorably (i.e., in-group member) than those in the absence of in-group favoritism ($M_{presence}$ = 4.65 vs. $M_{absence}$ = 4.10, $t(143)$ = 2.595, p = .01). We further assessed the scenario realism with two items (e.g., "How realistic is the scenario?" 1 = not realistic at all, 7 = very realistic; $r_{Spearman\ Brown}$ = .81). Participants regarded the scenario as realistic ($M_{average}$ = 5.60 vs. 4.00 midpoint, $t(144)$ = 18.734, p < .001).

Control variables. To rule out potential confounding of the country-of-origin effect with our in-group favoritism manipulation, we measured patriotism (ω = .96) and ethnocentrism (ω = .94) (Web Appendix C). The results revealed no differences between the absence and presence of in-group favoritism conditions on patriotism ($M_{absence}$ = 5.06 vs. $M_{presence}$ = 5.21, $t(143)$ = .564, p = .573) or ethnocentrism ($M_{absence}$ = 4.10 vs. $M_{presence}$ = 4.36, $t(143)$ = .965, p = .336). Our results of ANOVA and mediation tests remained robust when controlling for them.

Results

[7] We also included a similar manipulation check on social context for Studies 3 and 4, and the results revealed that all participants' responses matched their assigned condition (solo or joint). Hence, our manipulation was successful.

Social rapport and eeriness. For the 2 (social context: solo vs. joint) × 2 (in-group favoritism: present vs. absent) design, a two-way ANOVA on social rapport yielded a significant main effect of social context (F(1, 141) = 39.541, p < .001, $\eta^2_{partial}$ = .219) and a significant main effect of in-group favoritism (F(1, 141) = 11.289, p = .001, $\eta^2_{partial}$ = .074). The results showed a marginally significant interaction effect (F(1, 141) = 2.980, p = .087, $\eta^2_{partial}$ = .021). Thereby, without in-group favoritism, solo travelers reported higher social rapport with FAR than joint travelers ($M_{solo\ absent}$ = 5.25 vs. $M_{joint\ absent}$ = 4.48, p = .004). As we predicted, when we evoked in-group favoritism, solo travelers displayed even more heightened social rapport than joint travelers ($M_{solo\ present}$ = 6.11 vs. $M_{joint\ present}$ = 4.76, p < .001), consistent with H_{3a} (Figure 2, Panel A). On the other hand, a two-way ANOVA on eeriness indicated a non-significant main effect of social context (F(1, 141) = .215, p = .644, $\eta^2_{partial}$ = .002) but a significant main effect of in-group favoritism (F(1, 141) = 13.521, p < .001, $\eta^2_{partial}$ = .088). Notably, there was a significant interaction effect (F(1, 141) = 12.841, p < .001, $\eta^2_{partial}$ = .083). According to the planned contrasts, when in-group favoritism was absent, solo travelers reported higher eeriness perceptions than joint travelers did ($M_{solo\ absent}$ = 3.20 vs. $M_{joint\ absent}$ = 2.57, p = .037). In contrast, solo travelers expressed lower eeriness perceptions than their joint counterparts when in-group favoritism was present ($M_{solo\ present}$ = 1.74 vs. $M_{joint\ present}$ = 2.55, p = .003), consistent with H_{3b} (see Figure 2, Panel A)

[Insert Figure 2 here]

Mediation. To formally test the parallel mechanisms, we conducted a moderated mediation test using PROCESS Model 8 with 10,000 bootstrapping iterations (Hayes 2017). We first dummy-coded social context (0 = joint; 1 = solo) as the independent variable and in-group favoritism (0 = absent; 1 = present) as the moderator. Then, we specified satisfaction as the dependent variable and included social rapport and eeriness as mediators. When in-group favoritism was absent (baseline), the indirect effects through both social rapport (ab = .43, SE = .17, 95% CI = [.10, .77]) and eeriness (ab = -.14,

SE = .09, 95% CI = [-.34, -.01]) were significant, but in opposite directions, replicating Study 1's results. When in-group favoritism was present, the indirect effect via social rapport (*ab* = .89, *SE* = .15, 95% CI = [.61, 1.19]) was still significant but stronger (i.e., due to the strengthened positive social rapport mechanism, formally supporting H_{3a}). In contrast, the indirect effect via eeriness (*ab* = .19, *SE* = .09, 95% CI = [.05, .38]) was also significant but in a positive direction (i.e., due to the weakened negative eeriness mechanism, formally supporting H_{3b}. Similar results emerged for recommendation intention (Web Appendix B). Details of direct and indirect effects and moderated mediation indexes are presented in Table W-A3, Web Appendix A.

Outcomes. A two-way ANOVA on satisfaction exhibited a marginally significant interaction effect ($F(1, 141) = 3.591$, $p = .06$, $\eta^2_{partial} = .025$). According to the planned contrasts, there was no difference in satisfaction between solo and joint travelers in the absence of in-group favoritism condition ($M_{solo\ absent} = 5.59$ vs. $M_{joint\ absent} = 5.32$, $p = .217$), confirming the canceling out effects of the two opposing mechanisms. However, when we induced in-group favoritism, solo travelers reported higher satisfaction than joint travelers did ($M_{solo\ present} = 6.20$ vs. $M_{joint\ present} = 5.36$, $p < .001$). We also found a statistically significant increase in satisfaction among solo travelers in the absence versus presence of in-group favoritism ($M_{solo\ absent} = 5.59$ vs. $M_{solo\ present} = 6.20$, $p = .003$) but a non-significant difference for joint travelers across the two conditions ($M_{joint\ absent} = 5.32$ vs. $M_{joint\ present} = 5.36$, $p = .875$; Figure W-A2, Web Appendix B). In-group favoritism thus helps improve service outcomes for solo travelers, but not joint ones. Our results were robust with the outcome of recommendation intention (Figure W-A3, Web Appendix B).

Discussion

We establish in-group favoritism as a boundary condition, such that its presence improves service outcomes for solo customers relative to joint ones. Specifically, in-group favoritism strengthens the positive social rapport mechanism and weakens the negative eeriness mechanism,

consequently evoking greater satisfaction and recommendation intention among solo travelers. While prior research predominately established the benefits of fostering in-group favoritism among humans (e.g., Hwang et al. 2018), we offer additional insights to service providers that they can also leverage in-group favoritism toward FAR, mainly when serving solo customers. For instance, airline carriers can promote in-group favoritism by adding "local" cues to anthropomorphized robots (e.g., national flags) to help enhance the service experience for solo domestic passengers during check-in.

Study 3: Moderation of Control Deprivation (Hotel Check-In)

Fully automated services without human staff have become a rising trend, yet concerns about loss of control are accelerating too (Fast and Horvitz 2017). In this study, we examined deprived control during the service delivery process by considering a hotel check-in setting using FAR, with a 2 (social context: solo vs. joint) × 2 (control deprivation: yes vs. no) between-subjects experiment (H_{4a} and H_{4b}). We manipulated anthropomorphism with a different humanlike robot image but primed it with the same human name as in Study 1 (Amezen), a first-person pronoun, and a humanlike voice.[8] Participants had to imagine traveling on their own (vs. with their friends) and that they had already booked the hotel. When they arrived alone (vs. with their friends) at the hotel, they came to the front desk and encountered FAR. In the control deprivation condition, they read that there were no frontline human staff around and no signs for accessing them, so they had to use the robot to check in. In the baseline control, we did not offer such information; the scenario described how they approached FAR to check into their room (Web Appendix D).

We conducted a pretest with 38 Prolific panelists (44.7% female; M_{age} = 33.34 years) to confirm the effectiveness of anthropomorphism features as well as the manipulation check of control deprivation with four items (e.g., "I feel not in good control when dealing with the check-in process

[8] The image showed an actual anthropomorphized robot used at Henn-na, the world's first robot-run hotel in Japan. The humanlike voice can be found here: https://soundcloud.com/d-k-696080300/study3_hotel

at the hotel"; ω = .86, Web Appendix C). Participants perceived the service robot as anthropomorphic ($M_{average}$ = 4.39 vs. 4.00 midpoint, $t(37) = 2.634$, $p = .012$). Also, those in the control deprivation condition reported a higher perceived loss of control than those in the baseline condition ($M_{control\ deprivation}$ = 5.43 vs. $M_{baseline}$ = 4.35, $t(36) = 3.004$, $p = .005$); the manipulations were successful.

Design

In the main study, we recruited 218 qualified Prolific panelists (51.4 % female; M_{age} = 32.80 years) and randomly assigned them to one of the four experimental conditions. We asked them to rate their satisfaction with the check-in experience ($r_{Spearman\ Brown}$ = .92), sense of social rapport (ω = .93), and eeriness (ω = .85). We also included two items to measure WOM (e.g., "I will encourage my friends and relatives to stay at this hotel," $r_{Spearman\ Brown}$ = .96; Han et al. 2011, Web Appendix C).

Results

Social rapport and eeriness. The results of a two-way ANOVA on social rapport revealed a significant main effect of social context ($F(1, 214) = 37.834$, $p < .001$, $\eta^2_{partial} = .150$) but a non-significant main effect of control deprivation ($F(1, 214) = .003$, $p = .957$, $\eta^2_{partial} = .000$). Importantly, there was a significant interaction effect ($F(1, 214) = 7.124$, $p = .008$, $\eta^2_{partial} = .032$). According to the planned contrasts, solo customers reported higher social rapport in the baseline condition than joint customers ($M_{solo\ baseline}$ = 4.73 vs. $M_{joint\ baseline}$ = 4.04, $p = .047$). When deprived of control, solo customers manifested much more social rapport than joint customers ($M_{solo\ deprivation}$ = 5.28 vs. $M_{joint\ deprivation}$ = 3.51, $p < .001$). The social rapport mechanism thus became strengthened when deprived of control, consistent with H_{4a} (see Figure 2, Panel B). Another two-way ANOVA for eeriness also indicated a significant main effect of social context ($F(1, 214) = 6.056$, $p = .015$, $\eta^2_{partial} = .028$) and a marginally significant main effect of control deprivation ($F(1, 214) = 2.762$, $p = .098$, $\eta^2_{partial} = .013$). Notably, the interaction effect was significant ($F(1, 214) = 34.548$, $p < .001$, $\eta^2_{partial} = .139$). In the planned contrasts, we found that, in the baseline condition, solo customers reported higher eeriness

than joint customers ($M_{\text{solo baseline}} = 4.38$ vs. $M_{\text{joint baseline}} = 3.74$, $p = .045$). When deprived of control, however, solo customers now perceived less eeriness than joint ones ($M_{\text{solo deprivation}} = 3.59$ vs. $M_{\text{joint deprivation}} = 5.16$, $p < .001$); the eeriness mechanism was thus weakened under deprived control, consistent with H_{4b} (Figure 2, Panel B).

Mediation. To formally verify the parallel mechanisms, we performed a moderated mediation test using PROCESS Model 8 with 10,000 bootstrapping iterations (Hayes 2017). We dummy-coded social context (0 = joint; 1 = solo) as the independent variable and control deprivation (0 = baseline; 1 = control deprivation) as the moderator, specified satisfaction as the dependent variable, and included social rapport and eeriness as mediators. In the baseline condition, the indirect effects through both social rapport (*ab* = .54, *SE* = .27, 95% CI = [.01, 1.09]) and eeriness (*ab* = -.34, *SE* = .17, 95% CI = [-.67, -.01]) were significant, in opposite directions, replicating the mediation effect results from Studies 1 and 2. However, in the control deprivation condition, while the indirect effect via social rapport (*ab* = 1.36, *SE* = .17, 95% CI = [1.04, 1.71]) remained significant and stronger (i.e., due to the strengthened positive social rapport mechanism, formally supporting H_{4a}); the indirect effect via eeriness (*ab* = .82, *SE* = .17, 95% CI = [.52, 1.17]) was significant but in the positive direction (i.e., due to the weakened negative eeriness mechanism, formally supporting H_{4b}). We also obtained similar mediation results for WOM (Web Appendix B). Details of direct and indirect effects and moderated mediation indexes are reported in Table W-A3, Web Appendix A.

Outcomes. For the two-way ANOVA on satisfaction, the interaction effect was significant ($F(1, 214) = 10.198$, $p = .002$, $\eta^2_{\text{partial}} = .045$). The planned contrasts indicated, in the baseline condition, no difference in satisfaction between solo and joint customers ($M_{\text{solo baseline}} = 5.22$ vs. $M_{\text{joint baseline}} = 4.76$, $p = .160$) due to the opposing mechanisms. However, in the control deprivation condition, solo customers expressed higher satisfaction with the hotel check-in process than joint customers ($M_{\text{solo deprivation}} = 5.80$ vs. $M_{\text{joint deprivation}} = 4.12$, $p < .001$) (Figure W-A4, Web Appendix B). The results

pertaining to WOM were similar (Figure W-A5, Web Appendix B).

Discussion

This study reveals that deprived control is not necessarily damaging; the effect depends on customers' social context. While deprived control (e.g., without the presence of human staff when in need) is unfavorable for joint customers as it heightens their perceived eeriness of FAR, it improves solo customers' service experiences due to the enhanced social rapport and the reduced eeriness toward FAR. Practically, our results thus suggest that a fully automated service process managed by anthropomorphized robots could be adopted to serve the solo segment but not the joint segment.

Study 4: Moderation of Consumption Goals (Restaurant Dining)

Customers differ in their consumption goals, which could influence their information processing styles when encountering FAR. In this study, we thus examined the boundary condition of consumption goals (hedonic vs. utilitarian; H_{5a} and H_{5b}) in a restaurant dining context using FAR. We used a 2 (social context: solo vs. joint) × 3 (consumption goals: hedonic vs. utilitarian vs. baseline) between-subjects factorial design. We provided the participants with another anthropomorphized robot image while priming other anthropomorphic components,[9] the same as Studies 2 and 3.

We followed Botti and McGill's (2011) work to manipulate hedonic vs. utilitarian goals. Specifically, participants were told to imagine that they had just finished their morning work, were free, and wanted to find a place for lunch while seeking enjoyment, joy, and relaxation (vs. felt very hungry and merely wanted to find a place to have lunch quickly before getting back to work in the afternoon). The baseline condition did not describe any such consumption goals. The scenario

[9] This robot appears at the Dadawan restaurant in Maastricht, the Netherlands (https://www.trouw.nl/binnenland/in-dit-maastrichtse-restaurant-neemt-robot-james-voortaan-uw-bestelling-op~b52b5e49/). The pretest indicated that Amizen was perceived as a gender-neutral name. Its human-like voice is available here: https://soundcloud.com/d-k-696080300/study4_restaurant

indicated they went solo (vs. with their friends) to a restaurant for lunch. When they arrived alone (vs. with their friends), they noticed a frontline service robot named Amizen, which came to greet them and instruct them on how to place an order. After completing the order, Amizen delivered the food items, returned to refill their water glass, and finally dropped off their bill (Web Appendix D).

We carried out a pretest with 85 Clickworker participants (56.5% female; M_{age} = 31.71 years) to check anthropomorphism with the same two items as in previous studies ($r_{Spearman\ Brown}$ = .90). Participants perceived the service robot as anthropomorphic ($M_{average}$ = 4.86 vs. 4.00 midpoint, $t(84) = 4.759$, $p < .001$). We included two manipulation check items for consumption goals (e.g., "How would you perceive your dining at this restaurant?" 1 = definitely utilitarian, 7 = definitely hedonic; $r_{Spearman–Brown}$ = .63, Kim and Kim 2014). A one-way ANOVA (consumption goals: hedonic vs. utilitarian vs. baseline) yielded a significant main effect ($F(2, 82) = 21.187$, $p < .001$, $\eta^2_{partial}$ = .341), and the planned comparison indicated that participants in the hedonic condition expressed stronger perceptions of hedonic consumption goal than those in either the utilitarian ($M_{hedonic}$ = 5.38 vs. $M_{utilitarian}$ = 3.05, $p < .001$) or baseline ($M_{hedonic}$ = 5.38 vs. $M_{baseline}$ = 4.02, p = .001) condition. Respondents in the utilitarian condition also reported lower perceived hedonism than those in the baseline condition ($M_{utilitarian}$ = 3.05 vs. $M_{baseline}$ = 4.02 as close to the midpoint of 4.00, p = .016). Our manipulation was thus successful. The three conditions did not differ in terms of perceptions of the restaurant's luxury (i.e., "Overall, the restaurant looks…," 1 = very casual, 7 = very luxurious; $M_{average}$ = 4.06 vs. 4.00 midpoint, $t(84) = .347$, p = .729).

Design

We recruited 316 qualified subjects from the Clickworker online panel (57.3% female; M_{age} = 34.46 years) and randomly assigned them to one of the six conditions. Participants responded to the same items as in prior studies to capture their satisfaction with the dining experience ($r_{Spearman–Brown}$ =

.85), social rapport (ω = .92), and eeriness 2 (ω = .75). We also used three items to gauge their revisit intention (e.g., "I intend to revisit this restaurant in the near future," ω = .95; Kim et al. 2013).

Results

Social rapport. For the 2 (social context: solo vs. joint) × 3 (consumption goals: hedonic vs. utilitarian vs. baseline) design, the two-way ANOVA on social rapport exhibited a significant main effect of social context ($F(1, 310) = 15.919$, $p < .001$, $\eta^2_{partial} = .049$) and a significant main effect of consumption goals ($F(2, 310) = 22.257$, $p < .001$, $\eta^2_{partial} = .126$). There was a marginally significant interaction effect ($F(2, 310) = 2.376$, $p = .095$, $\eta^2_{partial} = .015$). Planned contrasts showed that, in the baseline condition, solo diners sensed higher social rapport toward FAR than joint diners ($M_{solo\ baseline} = 5.48$ vs. $M_{joint\ baseline} = 4.67$, $p = .002$); in the utilitarian condition, we found no significant differences in the social rapport between solo and joint groups ($M_{solo\ utilitarian} = 4.18$ vs. $M_{joint\ utilitarian} = 4.04$, $p = .656$). Meanwhile, as expected, in the hedonic condition, solo diners reported much greater social rapport than joint diners ($M_{solo\ hedonic} = 5.82$ vs. $M_{joint\ hedonic} = 4.88$, $p < .001$). That is, the social rapport mechanism became strengthened in hedonic (vs. utilitarian) consumption, consistent with H_{5a} (Figure 2; Panel C).

Eeriness. Another two-way ANOVA on eeriness indicated a non-significant main effect of social context ($F(1, 310) = .102$, $p = .749$, $\eta^2_{partial} = .000$) but a significant main effect of consumption goals ($F(2, 310) = 10.092$, $p < .001$, $\eta^2_{partial} = .061$). Notably, the interaction effect was significant ($F(2, 310) = 4.648$, $p = .010$, $\eta^2_{partial} = .029$). According to the planned contrasts, the solo diners' group reported higher eeriness perceptions in the baseline condition than the joint diners' group ($M_{solo\ baseline} = 3.47$ vs. $M_{joint\ baseline} = 2.89$, $p = .024$). Surprisingly, in the utilitarian condition, joint diners instead manifested a stronger eeriness than solo ones ($M_{solo\ utilitarian} = 3.56$ vs. $M_{joint\ utilitarian} = 4.22$, $p = .042$). When the consumption goal was hedonic, there were, however, no significant differences in eeriness across two groups ($M_{solo\ hedonic} = 2.99$ vs. $M_{joint\ hedonic} = 3.07$, $p = .775$). In other words, though the

eeriness mechanism was still attenuated in the hedonic condition compared to the baseline condition, the eeriness mechanism was unexpectedly not weakened in the hedonic condition, relative to the utilitarian condition (Figure 2; Panel C).

Mediation. To formally test the parallel mechanisms, we undertook a moderated mediation test using PROCESS Model 8 with 10,000 bootstrapping iterations (Hayes 2017). We dummy-coded social context (0 = joint; 1 = solo) as the independent variable, specified satisfaction as the dependent variable, and included social rapport and eeriness as two parallel mediators. The consumption goals is a multi-categorical factor with three levels; hence we adopted the indicator coding method (Hayes and Montoya 2017) to establish two dummy variables: D1 (0 = baseline, 1 = utilitarian, 0 = hedonic) and D2 (0 = baseline, 0 = hedonic, 1 = utilitarian). In the baseline condition, the indirect effects through both social rapport (*ab* = .42, *SE* = .14, 95% CI = [.16, .69]) and eeriness (*ab* = -.07, *SE* = .04, 95% CI = [-.17, -.01]) were significant and in opposite directions, as in our previous studies. In the utilitarian condition, the indirect effect through social rapport (95% CI = [-.25, .40]) was non-significant (i.e., social rapport level was equivalently low for both solo and joint groups under the utilitarian goal). In contrast, the indirect effect through eeriness (*ab* = .08, *SE* = .05, 95% CI = [.002, .19]) was significant but "flipped" in direction due to the unexpected upsurge of eeriness for joint diners. In the hedonic condition, the indirect effect via social rapport (*ab* = .48, *SE* = .14, 95% CI = [.22, .78]) became significant, whereas such indirect effect via eeriness (95% CI = [-.07, .09]) became non-significant. Together, these findings indicate that the positive social rapport mechanism became stronger in the hedonic condition, in formal support of H_{5a}. However, the negative eeriness mechanism did not get much weaker in the hedonic condition compared to the utilitarian condition, H_{5b} was thus not supported. Similar results were obtained for revisit intention (Web Appendix B).

Outcomes. In a two-way ANOVA for satisfaction, the baseline condition indicated no significant difference between solo and joint groups ($M_{\text{solo baseline}} = 5.93$ vs. $M_{\text{joint baseline}} = 5.59$, $p = .133$). While

we also uncovered no significant differences in the utilitarian condition ($M_{\text{solo utilitarian}} = 5.09$ vs. $M_{\text{joint utilitarian}} = 4.91$, $p = .579$), solo diners reported higher satisfaction than their joint counterparts in the hedonic condition ($M_{\text{solo hedonic}} = 6.27$ vs. $M_{\text{joint hedonic}} = 5.60$, $p = .001$) (Figure W-A6, Web Appendix B). An ANOVA on revisit intention yielded similar results (Figure W-A7, Web Appendix B).

Discussion

Study 4 partially supports the moderation of consumption goals (hedonic vs. utilitarian). That is, the adoption of FAR is particularly beneficial for solo customers who would perceive greater social rapport and lower eeriness toward FAR in pursuit of a hedonic consumption goal. Nevertheless, firms must be cautious of adopting FAR for joint customers who pursue a utilitarian consumption goal as they would perceive FAR as far eerier, consequently hampering their satisfaction and revisit intention. This might be due to their dramatic shift to more analytic thinking with a utilitarian goal. Given the presence of companions, those joint customers might feel more compelled to draw a clear boundary to differentiate FAR from their peer group to secure their human identity (Lu et al. 2021). This motivation might thus further heighten their perceived eeriness of FAR. To potentially alleviate this problem, service providers can manipulate ambient cues (e.g., lighting, scent, layout) to create more hedonic consumption experiences for their customers.

General Discussion

The trend of solo consumption (e.g., traveling alone, dining out alone) has proliferated in recent years, representing a promising service segment for the hospitality sector. Meanwhile, the post-pandemic era has also witnessed the broader implementation of frontline anthropomorphized robots (FAR) across services, particularly in the hospitality industry, to enhance customers' experiences (Lemon and Verhoef 2016). Surprisingly, despite these two growing trends, they have mostly been studied separately, without convergent consideration of how FAR might be deployed more effectively to serve solo customers than their joint counterparts. Drawing on the literature of

anthropomorphism and information processing theory, the current study reveals how and in which conditions FAR might facilitate service experiences for solo (vs. joint) customers. To that end, we collect both field and online data, using diverse samples (MTurk, Prolific, Clickworker) and across different hospitality settings (airport, restaurant, hotel) to propose and empirically examine the dual social rapport–eeriness mechanisms that drive the interactions of FAR with solo (vs. joint) customers (Study 1) on both attitudinal and behavioral service outcomes. We also identify three relevant boundary conditions (in-group favoritism, Study 2; control deprivation, Study 3; consumption goals, Study 4) in which social rapport and eeriness mechanisms get activated differently, with varying ultimate influences on various service outcomes for solo (vs. joint) customers.

Theoretical Contributions

The current research makes several contributions to extant literature. First, although a few previous attempts have tapped into solo and joint consumption in isolation, we lack rooted research evidence that directly compares or differentiates these two consumption patterns concurrently and systematically, particularly in relation to service robots (see Table 1). This research offers an initial empirical direct comparison of solo with joint consumptions, and we situate this explicit comparison within the service robotics context. We thus establish a strong theoretical foundation for contrasting solo with joint consumptions and add a more nuanced view of the interplay between frontline service robots and social context (solo vs. joint), which in turn expands a broader understanding of customer experience in the service robotics era (Lemon and Verhoef 2016). To this end, we also enrich the recent IS literature that examined the impacts of social presence of others on individuals' technology usage, though they primarily explored the role of "remote" others in virtual environments and with non-marketing outcomes.

Second, recent service research has made impressive strides in exploring robot anthropomorphism, primarily in studies that advocate its positive effects (e.g., via enhanced social

rapport) but largely ignore its potential dark sides. Even in research that acknowledges the negative eeriness effect (e.g., Kim, Schmitt, and Thalmann 2019; Mende et al. 2019), we hardly find simultaneous considerations of the two opposing mechanisms, nor do we have sufficient knowledge about the conditions that might amplify or attenuate these effects. In response, we leverage Blut et al.'s (2021) call to contextualize the complex, multifaceted essence of robot anthropomorphism. As we affirm, robot anthropomorphism evokes both social rapport and eeriness mechanisms, with opposing effects on both attitudinal and behavioral service outcomes for solo (vs. joint) customers. That is, relative to joint customers, solo customers perceive greater social rapport yet higher eeriness toward FAR, thereby affecting their service evaluations differently. We, therefore, shed light on the two-sided nature of robot anthropomorphism in (solo) consumption context.

Third, we enrich existing literature with a contingency view on the conditions in which the positive social rapport and the negative eeriness mechanisms get activated differently. To offer a more comprehensive view of the interplay between FAR and solo (vs. joint) consumption, we identify three critical and managerially relevant boundary conditions that capture features of the FAR (in-group favoritism), the service delivery process (control deprivation), and the customers' consumption goals (hedonic vs. utilitarian). Our findings reveal a facilitating role of in-group favoritism, deprived control during the service delivery process, and a hedonic consumption goal to enhance social rapport and reduce eeriness among solo (vs. joint) customers, which in turn improves solo service experiences. These results hence offer a deeper understanding of the conditional effect of the interplay between FAR and social context on solo (vs. joint) experiences. In addition, we also cultivate the extant literature on solo vs. joint consumption by including a diverse scope of service contexts (i.e., hotel, restaurant, airport) as well as capturing both subjective and objective (e.g., pay-per-person) service outcomes for a more holistic assessment of the proposed effects and their robustness, a crucial attempt to establish external validity of our findings.

Managerial Implications

This research provides managerially relevant implications for service providers pursuing or considering adopting FAR in the wave of the upward segment of solo customers.

Social context matters. Our work uncovers that using FAR can be a double-edged sword in that it can trigger both social rapport and eeriness, depending on customers' social context (solo or joint). Specifically, relative to joint customers, solo customers sense more social rapport with FAR but also perceive them as eerier, which concurrently improves and dampens service outcomes (e.g., satisfaction, pay-per-person), respectively. Thus, we go beyond the common belief that a human-like service robot is always desirable by suggesting that there is no one-size-fits-all formula for predicting the outcomes of robot anthropomorphism in services. Service providers should carefully consider the service context surrounding their target customers when deploying FAR to serve their customers.

Promoting in-group favoritism of FAR. While in-group favoritism has been shown to exert favorable effects among human groups (Hwang et al. 2018). Our results show that service firms can also enjoy such advantages by eliciting solo customers' in-group favoritism toward FAR. This may be possible with easy-to-implement interventions, such as signaling close similarities between solo customers and robots. Taking the tourism sector for example, many tourists now still prefer to travel domestically rather than internationally due to ongoing concerns about health safety in post-pandemic, so hotel and restaurant managers could add "local" cues to their anthropomorphized robots (e.g., national flags [10], traditional costumes, other home country signs), which could help provoke greater in-group favoritism among solo domestic tourists. Functioning FARs using local language to communicate with domestic customers (e.g., greeting customers in their native tongue) is another way to evoke in-group favoritism for the local solo group. If companies (e.g., hotels) have customers'

[10] For instance, the anthropomorphized robot featured in this link (https://www.bbc.com/pidgin/tori-53792797) displays a national flag on its chest and left arm to indicate its origin.

data prior to their arrival, FARs can also rely on such information to build closer communications with customers (e.g., conversing with customers by their name during the check-in process). Such implications could also be extended to digital service encounters. Adopting anthropomorphized intelligent agents is prevalent in online services (Schanke, Burtch, and Ray 2021). For instance, Air New Zealand implements an anthropomorphized chatbot named Oscar for online booking. Hence, we recommend that online marketing communications use incidental similarity cues, such as highlighting anthropomorphized robots' names or other demographic features similar to those of their customers, to trigger customers' favoritism toward these anthropomorphized intelligent agents. With advanced technologies and generative AI, firms should also be able to tailor FAR's responses to align with customers' personal needs and preferences, which thereby enhances customers' favoritism toward FAR during their interactions.

Deprived control is not always bad. Service providers like hotels or airlines should determine what constitutes an appropriate amount of control for their customers over the service delivery process. People have innate needs to control their tasks, but sometimes, a certain degree of control deprivation (e.g., customers must interact with the robot because no human staff are available) could improve service outcomes for solo customers. Hence, marketers might adopt a fully automated service process managed by FAR to serve solo customers. Nevertheless, they should be cautious about joint customers, for whom deprived control will drive them to perceive FAR as creepier and be less satisfied with this fully automated service. As such, marketers might delegate more control to those joint customers by letting them know they can get help from human employees when in need. For instance, hotels might provide simple cues, like a "help" button on the cashier or counter, that would be pertinent in this effort. Overall, firms should be careful when deciding or assigning the service provider (i.e., FAR or human staff) to serve their customers, as a fully automated service delivery process managed by FAR might be beneficial for solo customers but backfire for joint ones.

Hedonic consumption experience can be fostered. Service providers often can determine in advance whether customers' intended consumption goal is hedonic or utilitarian (e.g., "Are you traveling for business or leisure?" "Are you celebrating any special events at dinner tonight?"), as well as whether they are traveling alone or with others with a short questionnaire. Alternatively, they might also leverage analytical tools to analyze customers' purchasing history and browsing behaviors to infer their motivations. For instance, a hotel might notice if a customer frequently browses high-end hotel rooms, suggesting hedonic consumption goal, whereas another customer only browses rooms with the best deal, indicating utilitarian goal. Such information would be instrumental in helping service providers that rely on FAR to adjust their service provisions. Because both solo and joint customers perceive FAR more positively (more social rapport, less eeriness) under hedonic consumption, especially for solo customers, marketers might create hedonic consumption experiences that encourage customers to focus more on and enjoy the holistic consumption process. Hospitality operators might create ambient cues (e.g., layout, lighting, scent, music) and servicescape to facilitate positive sensory experiences. For instance, Five Guys fast-food restaurant is renowned for its surprising and delightful experience. Its kitchen is in plain view, and customers can watch their burgers being made in an authentic way to order. Similarly, L'Hotel in Paris is known for its luxurious design and unique interiors. Specifically, its ambient elements like chic furnishings, dim lighting, and soothing background music create a relaxing atmosphere for guests. In addition, restaurants can consider the visual presentation of food (sight), the sizzle of a dish (sound), the texture of a dish (touch), and the aroma from the kitchen (smell) to engage diners with their senses for better hedonic dining experience. In his case study, Ponsignon (2023) also demonstrates the effectiveness of making the customer experience journey more hedonic in a traditionally utilitarian service context by fostering experiential involvement with fun activities to evoke feelings of pleasure or excitement. In this regard, technologies like virtual reality (VR) and augmented reality (AR)

would help to enhance such experiential element of the consumption. One example is Marriott Hotels that offers "VRoom Service" by allowing guests to request VR headsets to their room for virtual travel tours. This is further accompanied by "VR Postcards" with 3D immersive travel stories about the journey to different destinations [11]. This Vroom service, by incorporating technology and storytelling together, creates authentic and hedonic experiences for guests. In sum, if FAR is in place, firms would have a handful of feasible approaches to elicit more hedonic consumption experiences for their customers. However, if the customers' consumption goal is of utilitarian, aiming to just get their service tasks done, firms might consider deploying alternatives, such as self-service kiosks, as interacting with FAR would increase its perceived eeriness and hamper customers' service evaluations, particularly for joint customers.

Limitations and Further Research

We acknowledge several limitations that warrant further research. First, considering the emergence of service robotics and solo consumption in the hospitality sector, we examine the interplay of FAR with social context (solo vs. joint) in this specific context. However, continued research might explore whether our findings can be generalized to other service contexts, such as financial service, where both solo customers and service robots are also prevalent. We also call for studies that extend the investigation into transformative services, such as healthcare and education, which promise to contribute meaningfully to consumers' well-being (Ge and Schleimer 2023). Relatedly, future research could also explore our proposed effects in the service failure context as which might constitute a negative experience, whereby customers' service expectations might vary and cause different perceptions of FAR. Second, while our central focus is on solo customers, future research could deepen the comparative group of joint customers by considering their composition

[11] https://news.marriott.com/news/2015/09/09/marriott-hotels-introduces-the-first-ever-in-room-virtual-reality-travel-experience

such as the number of joint companions (Mora and González 2016), their cohesiveness with companions (Luo 2005), or shared identity (Kovacheva and Lamberton 2018), as which might affect joint consumption experiences. For instance, a highly cohesive group might be less responsive to external cues and more focused on the group's activity. This could consequently reduce their attention towards FAR. Third, emerging research has begun to distinguish among different types of artificial intelligence (AI), namely mechanical, thinking, and feeling AI (Schepers et al. 2022). Future research could elucidate whether these different types of AI influence solo customers' experience with FAR. For example, it is worth investigating whether feeling AI might be more valued by solo customers. Fourth, another fruitful direction is to explore other relevant moderators, such as personality traits (e.g., self-construal) or cultural background, that might alter people's information processing styles and thereby influence their evaluations of FAR. Specifically, past research contends that people with an independent (vs. interdependent) self-construal tend to prefer humanoid robot over mechanoid robot (Chang et al. 2023). Prior research also suggests that individuals in Western cultures tend to construe themselves as independent and be more analytic in thinking, whereas people in Eastern cultures are likely to associate themselves with others, emphasize social needs and with holistic thinking (Hwang, Shin, and Mattila 2018). This suggests the potential moderating roles of self-construal and culture in solo customer-FAR interaction. Finally, future research might also want to capture other behavioral outcomes, particularly negative ones such as customers' switching or destructive behaviors, to provide a more comprehensive view of the processes we identify in this research.

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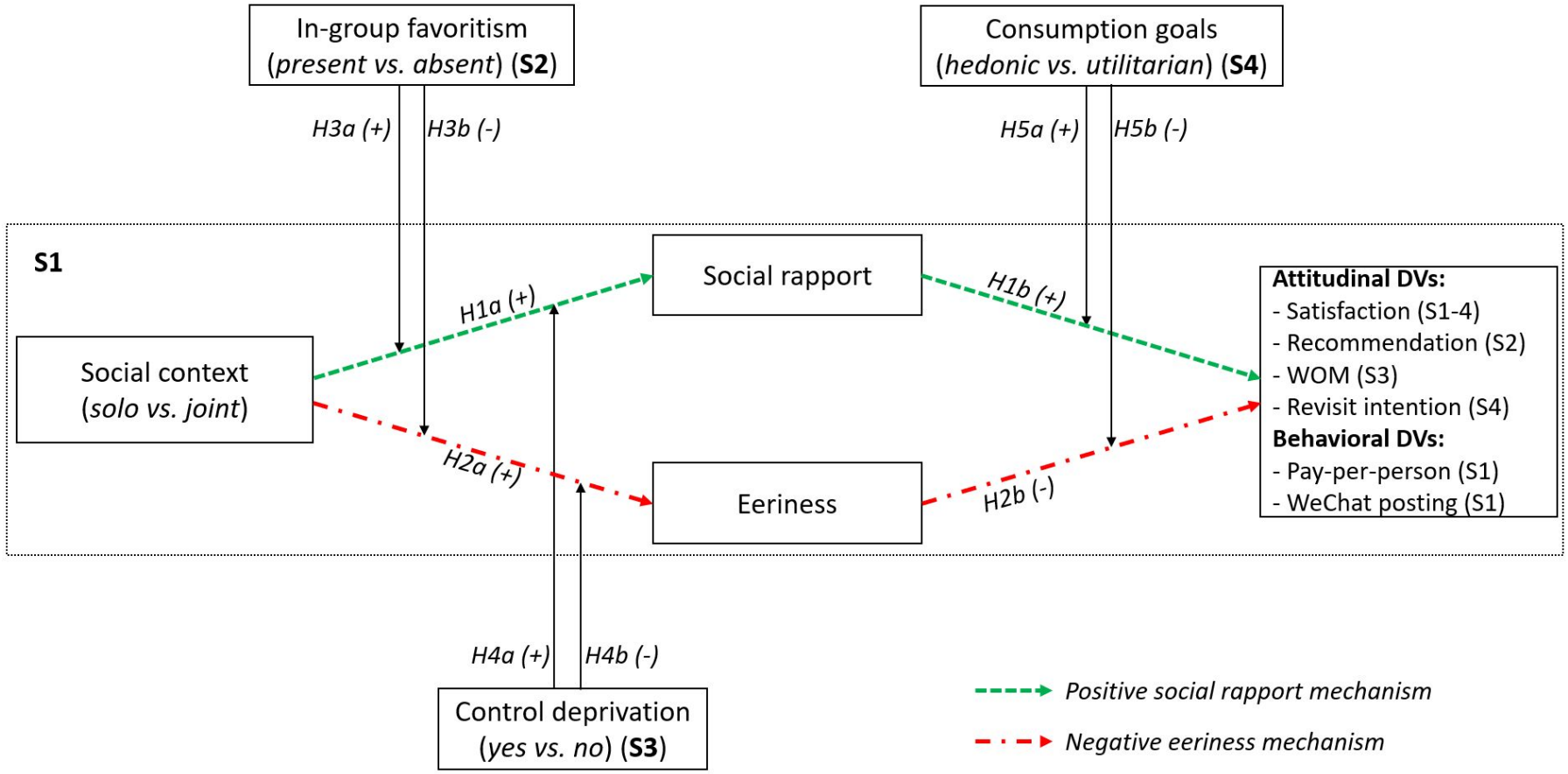
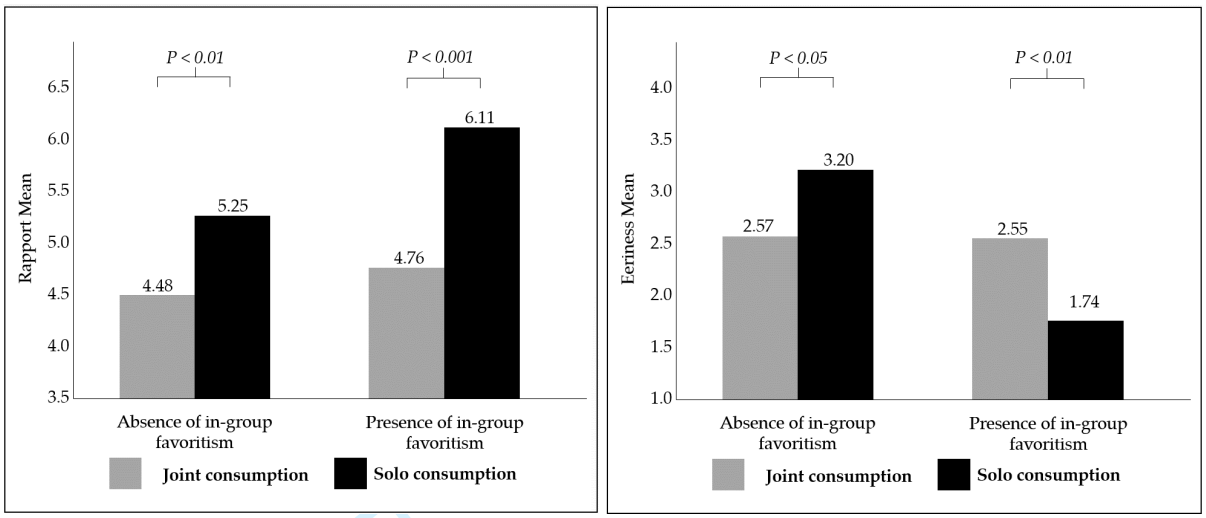
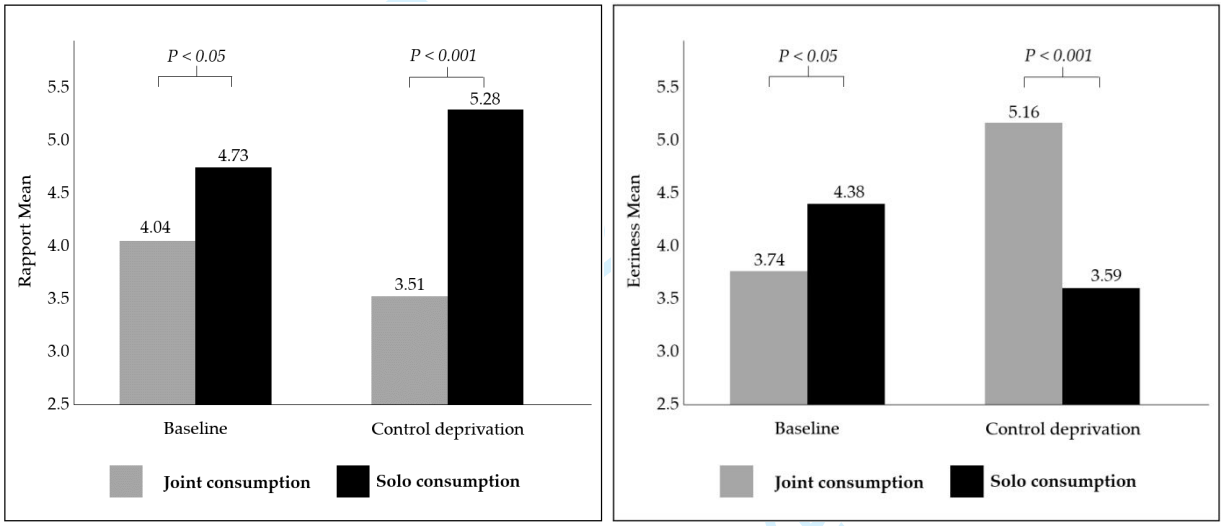


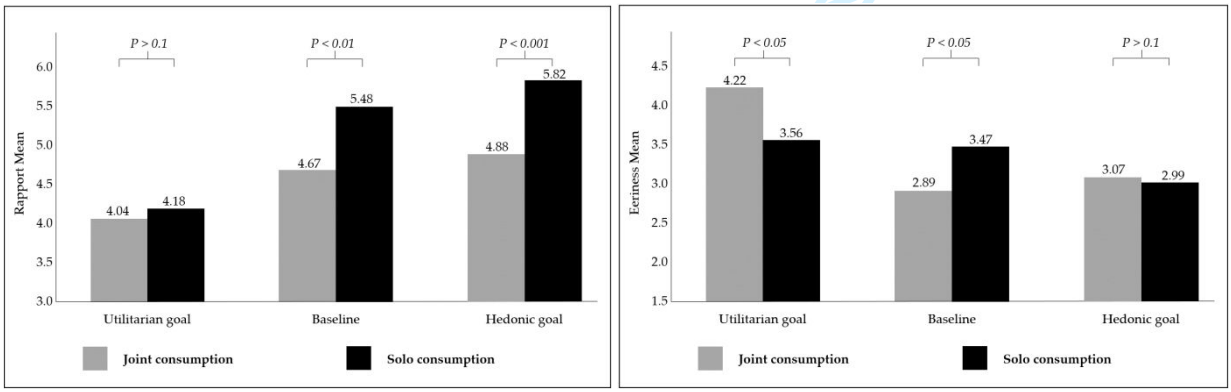
Figure 1. Conceptual framework



A. Effects of in-group favoritism on social rapport and eeriness for solo vs. joint customers (Study 2)



B. Effects of control deprivation on social rapport and eeriness for solo vs. joint customers (Study 3)



C. Effects of consumption goals on social rapport and eeriness for solo vs. joint customers (Study 4)

Figure 2. Graphical plots for Studies 2, 3 and 4

Table 1. Previous Studies of Solo and Joint Consumption

Paper	Purpose	Robot	Context (Solo or Joint)	Mediators/ Moderators	Outcome(s)
Bhargave and Montgomery (2013)	Comparison of solo with joint experience for temporal sequence of episodes (e.g., series of paintings)	No	Hedonic activities (Art gallery) (solo and joint)	Mediator: *evaluations of final episode in a sequence* Moderator: *social context*	Global, retrospective evaluations Moment-to-moment rating
Bianchi (2015)	Drivers for (dis)satisfaction among solo holiday travelers	No	Traveling (solo)	N/A (qualitative interview, CIT method)	(Dis)satisfaction
Brick et al. (2021)	Impact of shared decision making (shared decision vs. self-decision vs. partner-made decision) on relationship satisfaction	No	Shopping (car, couch, household items) (solo vs. joint)	Mediators: *self-influence, partner engagement, perceived power* Moderator: n/a	Relationship satisfaction
Brown, Buhalis, and Beer (2020)	Investigate feelings of dining alone when traveling	No	Traveling (solo)	N/A (qualitative narrative interview)	Discomfort
Etkin (2016)	Impacts of relationship time perspective on variety preference for joint consumption	No	Committed relationship activities (joint)	Mediator: *value of excitement* Moderator: *physical presence of relationship partner*	Variety-seeking
Garcia-Rada , Norton and Ratner (2023)	Study the choice between experience quality and physical togetherness in sharing activity with close (vs. distant) relationship partner	No	Hedonic activity sharing (joint)	Mediator: *desire to create shared memories* Moderators: *outcome asymmetry of self and partner, experience type, reminder of ability to share memories*	Preference for togetherness (vs. experience quality)
Hart and Dale (2014)	Impacts of jointness (companions) on service consumption	No	Restaurant and retail shopping (solo and joint)	Mediator: n/a Moderator: *gender*	Satisfaction Attitude Time and money spent
Her and Seo (2018)	Impacts of other diners on focal solo diner's intention	No	Restaurant (solo)	Mediators: *loneliness, negative evaluation from others* Moderator: *crowding level*	Intention to eat alone
Hwang, Shin and Mattila (2018)	Roles of spatial distance and social distance in affecting solo dining experience	No	Restaurant (solo)	Mediator: *in-group bias* Moderator: *power*	Enjoyment
Kim et al. (2022)	Effect of no-preference communication on joint decision making and consumption experience	No	Restaurant, movie, and game (joint)	Mediator: *perception of undisclosed preferences* Moderator: *decision role (decision maker vs co-consumer)*	Decision difficulty Reduced liking Choice of preferred options
Liu and Min (2020)	Impact of decision role (requestor vs. responder) in joint consumption decision	No	Restaurant, museum (joint)	Mediators: *mitigated decision burden, likability via easygoingness* Moderators: *category similarity, group size*	Preference expression
Lteif et al. (2023)	Impact of sharing product with others (strangers as sharing-out vs. close people as sharing-in) on product efficacy perception	No	Product consumption sharing (joint)	Mediator: *identification with the product* Moderator: *self-brand connection*	Perceived product efficacy Behavioral intentions (purchasing, recommending)

Table 1. (continued)

Paper	Purpose	Robot	Context (Solo or Joint)	Mediators/ Moderators	Outcome(s)
Luo (2005)	Role of others' presence in influencing focal consumer's impulsive purchasing	No	Shopping (joint)	Mediator: n/a Moderators: *group cohesiveness, susceptibility to influence*	Impulsive purchasing choice
Moon, Bonn, and Cho (2020)	Impacts of key physical and psychological factors on solo dining experience	No	Restaurant (solo)	Mediator: *perceived territoriality* Moderator: *solo diners' motivations*	Satisfaction Revisit intention
Nikolova and Nenkov (2021)	Effect of joint goal progress (high vs. low/no) on subsequent individual goal-consistent decisions	No	Financing plan, team work (joint)	Mediator: *relational self-concept boost* Moderator: *relationship power*	Goal-consistent behavior
Raghunathan and Corfman (2006)	Impact of exposure to others' opinions about hedonic experiences (congruent vs. incongruent) on the enjoyment of such shared experiences	No	TV advertising, orange juice tasting (joint)	Mediators: *sense of belonging, confidence in accuracy* Moderators: *need to belong, need for accuracy*	Enjoyment of shared experience
Ramanathan and McGill (2007)	Influence of the presence of others on one's moment-to-moment and retrospective evaluations of an experience	No	Video watching (solo and joint)	Mediator: n/a Moderator: type of presence	Video evaluation Rewatch intention
Ratner and Hamilton (2015)	Role of accompanying partners' presence in solo activities' experience	No	Hedonic public consumption (solo)	Mediator: *Inference about number of others* Moderators: *culture, activity type*	Interest in activity Enjoyment
Shin, Hwang, and Mattila (2018)	Effects of self-esteem on solo diners' experience	No	Restaurant (solo)	Mediator: *perceived fit* Moderator: *incidental similarity cue*	Satisfaction
Su, Cheng, and Swanson (2020)	Effects of tourism activity type (experiential vs. material) on storytelling	No	Traveling (joint)	Mediator: *emotional arousal* Moderators: *presence and ability of travel companion*	Storytelling intention
Wu et al. (2021)	Impacts of clarity about partner's interest in activity on enjoyment in shared experiences	No	Leisure activities (solo and joint)	Mediators: *ability to focus on activity, distraction* Moderators: *need for navigation, relevance of partner's interest*	Enjoyment
Fraune, Šabanović, and Kanda (2019)	Impacts of group and group traits (i.e., entitativity, social norms) on interacting with robots	Yes	Retail shopping (solo and joint)	Mediator: n/a Moderator: *gender*	Interaction with robot Duration of interaction Social gesture toward robot
Preusse et al. (2021)	How individuals (alone) and group members (with others) interact with service robots	Yes	Restaurant (solo and joint)	Mediator: n/a Moderator: n/a	Interactions (both verbal and non-verbal) with robot Acceptance of robot
Current research	**Impacts of solo context (solo vs. joint) on customers' experiences with frontline anthropomorphized robots (FAR)**	**Yes**	**Airline, restaurant, and hotel (Solo and Joint)**	**Mediators: *social rapport and eeriness*** **Moderators: *in-group favoritism, control deprivation, consumption goals***	**Satisfaction** **WOM** **Recommendation** **Revisit intention** **Pay-Per-Person** **WeChat Posting**

Table 2. Summary of Four Studies

Study	Key Purpose	Context	Outcome Variable(s)	Key Findings
Study 1 (Social context: solo vs. joint) N= 223 actual diners	Test the social rapport and eeriness mechanisms by contrasting solo vs. joint customers' experiences when encountering FAR (H_1 and H_2)	Restaurant dining (field setting)	Satisfaction Actual behavioral outcomes: -Pay-Per-Person -WeChat posting	Solo customers perceive a stronger social rapport with FAR than joint customers, which in turn positively affects service evaluations [*positive social rapport mechanism*]. Solo customers perceive greater eeriness of FAR than joint customers, which in turn negatively affects service evaluations [*negative eeriness mechanism*].
Study 2 (Social context: solo vs. joint) x (In-group favoritism: present vs. absent) N=145 MTurk workers	Examine the boundary condition of in-group favoritism (H_{3a} and H_{3b})	Airport check-in	Satisfaction Recommendation intention	The social rapport and eeriness mechanisms are strengthened and weakened, respectively, when in-group favoritism is present. Consequently, in-group favoritism improves service outcomes for solo travelers, relative to joint travelers.
Study 3 (Social context: solo vs. joint) x (Control deprivation: yes vs. no) N= 218 Prolific panelists	Investigate the boundary condition of control deprivation (H_{4a} and H_{4b})	Hotel check-in	Satisfaction WOM	The rapport mechanism is enhanced and the eeriness mechanism is attenuated, when control is deprived. Consequently, service outcomes are improved for solo travelers, relative to joint counterparts, under control deprivation.
Study 4 (Social context: solo vs. joint) x (Consumption goals: hedonic vs. utilitarian vs. baseline) N= 316 Clickworker participants	Study the boundary condition of consumption goals (H_{5a} and H_{5b})	Restaurant dining	Satisfaction Revisit intention	The rapport mechanism is strengthened in hedonic (vs. utilitarian) condition, whereas the eeriness mechanism is unexpectedly not weakened in hedonic (vs. utilitarian) condition. Service outcomes are improved for both groups (being more salient for solo customers) when the consumption goal is hedonic.

Being Alone or Together: How Frontline Anthropomorphized Robots Affect Solo (vs. Joint) Service Consumption

WEB APPENDICES

WEB APPENDIX A: SUPPLEMENTARY TABLES

Table W-A1. Summary of Theoretical Reasoning for Three Moderators

Mechanism	In-group favoritism	Control deprivation	Consumption goals
Information processing style	-Shifting one's thinking style to be more hedonic.	-Shifting one's thinking style to be more analytic.	-Hedonic (utilitarian) consumption goal shifts one's thinking style to be more hedonic (analytic).
Positive social rapport mechanism	- In-group favoritism enhances social connectedness and thus fosters solo customers' social rapport with FAR. - In-group favoritism does not affect much the social rapport with FAR for joint customers who have companions around and already establish social connections with these people prior to their interactions with FAR.	- Control deprivation motivates solo customers to be closer to FAR as which is viewed as the key social agent to help them get the task done, in turn fostering their social rapport with FAR. - Control deprivation drives joint customers to regain their identity by upholding their uniqueness and superiority (as humans) boundary with the robot, thus reducing their perceived rapport with FAR.	- Hedonic consumption promotes stronger desire for seeking companionship among solo customers, in turn enhancing their social rapport with FAR. - Joint customers instead rely on their companions to fulfil the need for companionship in hedonic consumption, thus hedonic goal does not affect joint customers' social rapport with FAR.
Negative eeriness mechanism	- In-group favoritism shifts solo customers' analytic thinking style to be more holistic, in turn reducing their eeriness perceptions of FAR. - In-group favoritism does not affect much the perception of eeriness for joint customers who already hold holistic thinking style.	- The collaborative attitude toward FAR (by treating it as a partner) lowers the perceived distinctiveness and eeriness with FAR for solo customers. - Control deprivation shifts joint customers' holistic thinking style to be more analytic, thus increasing their perception of eeriness with FAR.	- Hedonic goal shifts solo customers' analytic thinking style to be more holistic, consequently reducing their perceived eeriness with FAR. - As joint customers already hold holistic thinking style, hedonic goal does not alter much their eeriness perceptions with FAR.

Table W-A2. Descriptive Statistics

Study 1

Variables	ω	M	SD	1	2	3	4	5
1. Social rapport	.91	4.78	1.43	1				
2. Eeriness	.92	2.84	1.76	0.11	1			
3. Satisfaction	.78 (r)	5.70	1.23	0.23**	-0.22**	1		
4. WeChat post (Y vs. N)	n/a	0.43	0.50	0.14*	-0.19**	0.46***	1	
5. Pay-per-person (RMB)	n/a	125.96	38.71	0.14*	-0.11	0.23***	0.19**	1

Study 2

Variables	ω	M	SD	1	2	3	4
1. Social rapport	.90	5.10	1.17	1			
2. Eeriness	.85	2.53	1.30	-0.49***	1		
3. Satisfaction	.91 (r)	5.59	0.97	0.73***	-0.36***	1	
4. Recommendation intention	n/a	5.12	1.34	0.68***	-0.44***	0.68***	1

Study 3

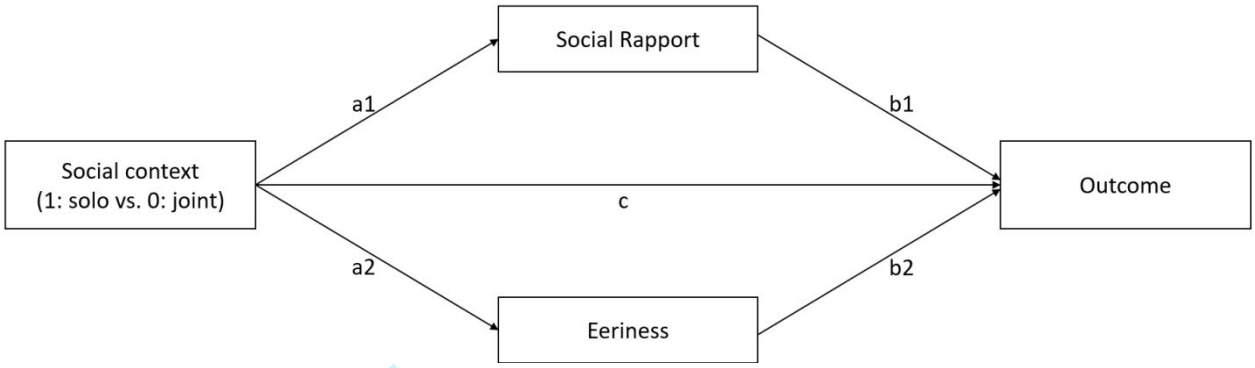
Variables	ω	M	SD	1	2	3	4
1. Social rapport	.93	4.40	1.61	1			
2. Eeriness	.85	4.25	1.51	-0.65***	1		
3. Satisfaction	.92 (r)	4.97	1.52	0.85***	-0.57***	1	
4. WOM	.96 (r)	4.54	1.61	0.85***	-0.55***	0.85***	1

Study 4

Variables	ω	M	SD	1	2	3	4
1. Social rapport	.92	4.87	1.53	1			
2. Eeriness	.75	3.34	1.51	-0.48***	1		
3. Satisfaction	.85 (r)	5.59	1.34	0.69***	-0.44***	1	
4. Revisit intention	.95	5.10	1.72	0.77***	-0.49***	0.76***	1

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table W-A3. Direct, Indirect, and Total Effects



Study 1

Outcome: Satisfaction

Effect	Coeff.	SE	LLCI	ULCI	Sig.
a1	.61	.21	.19	1.02	Significant and positive
b1	.25	.06	.13	.36	Significant and positive
a1xb1 (indirect effect via social rapport)	.15	.07	.04	.31	Significant and positive
a2	1.10	.26	.59	1.61	Significant and positive
b2	-.16	.05	-.26	-.07	Significant and negative
a2xb2 (indirect effect via eeriness)	-.18	.07	-.33	-.07	Significant and negative
c (direct effect)	-.19	.19	-.56	.18	Non-significant
c' (total effect)	-.22	.19	-.59	.15	Non-significant

Outcome: WeChat posting

Effect	Coeff.	SE	LLCI	ULCI	Sig.
a1	.61	.21	.19	1.02	Significant and positive
b1	.30	.11	.08	.51	Significant and positive
a1xb1 (indirect effect via social rapport)	.18	.11	.02	.44	Significant and positive
a2	1.10	.26	.59	1.61	Significant and positive
b2	-.30	.09	-.47	-.12	Significant and negative
a2xb2 (indirect effect via eeriness)	-.33	.12	-.60	-.13	Significant and negative
c (direct effect)	.45	.35	-.23	1.13	Non-significant
c' (total effect)	N/A for dichotomous variable				

Outcome: Pay-per-person (PPP)

Effect	Coeff.	SE	LLCI	ULCI	Sig.
a1	.61	.21	.19	1.02	Significant and positive
b1	3.83	1.91	.06	7.60	Significant and positive
a1xb1 (indirect effect via social rapport)	2.33	1.29	.13	5.07	Significant and positive
a2	1.10	.26	.59	1.61	Significant and positive
b2	-3.37	1.55	-6.43	-.32	Significant and negative
a2xb2 (indirect effect via eeriness)	-3.71	2.03	-8.30	-0.39	Significant and negative
c (direct effect)	7.65	6.21	-4.59	19.89	Non-significant
c' (total effect)	6.28	5.97	-5.48	18.04	Non-significant

Study 2

Outcome: Satisfaction

Effect	Coeff.	SE	LLCI	ULCI	Sig.
a1xb1 (indirect effect via social rapport for baseline)	.43	.17	.10	.77	Significant and positive
a1xb1 (indirect effect via social rapport for in-group favoritism)	.89	.15	.61	1.19	Significant and positive
Index of moderated mediation for social rapport	.46	.22	.05	.90	Significant and positive
c (direct effect via social rapport for baseline)	-.18	.16	-.49	.14	Non-significant
c (direct effect via social rapport for in-group favoritism)	-.05	.18	-.40	.30	Non-significant
a2xb2 (indirect effect via eeriness for baseline)	-.14	.09	-.34	-.01	Significant and negative
a2xb2 (indirect effect via eeriness for in-group favoritism)	.19	.09	.05	.38	Significant and positive
Index of moderated mediation for eeriness	.33	.14	.10	.65	Significant and positive
c (direct effect via eeriness for baseline)	.41	.20	.01	.81	Significant and positive
c (direct effect via eeriness for in-group favoritism)	.65	.22	.22	1.08	Significant and positive

Outcome: Recommendation intention

Effect	Coeff.	SE	LLCI	ULCI	Sig.
a1xb1 (indirect effect via social rapport for baseline)	.59	.23	.14	1.04	Significant and positive
a1xb1 (indirect effect via social rapport for in-group favoritism)	1.22	.22	.80	1.67	Significant and positive
Index of moderated mediation for social rapport	.63	.30	.05	1.25	Significant and positive
c (direct effect via social rapport for baseline)	-.59	.23	-1.05	-.13	Significant and negative
c (direct effect via social rapport for in-group favoritism)	-.17	.26	-.69	.35	Non-significant
a2xb2 (indirect effect via eeriness for baseline)	-.28	.14	-.58	-.02	Significant and negative
a2xb2 (indirect effect via eeriness for in-group favoritism)	.36	.14	.12	.66	Significant and positive
Index of moderated mediation for eeriness	.63	.22	.25	1.09	Significant and positive
c (direct effect via eeriness for baseline)	.33	.28	-.22	.88	Non-significant
c (direct effect via eeriness for in-group favoritism)	.66	.30	.07	1.24	Significant and positive

Study 3

Outcome: Satisfaction

Effect	Coeff.	SE	LLCI	ULCI	Sig.
a1xb1 (indirect effect via social rapport for baseline)	.54	.27	.01	1.09	Significant and positive
a1xb1 (indirect effect via social rapport for control deprivation)	1.36	.17	1.04	1.71	Significant and positive
Index of moderated mediation for social rapport	.83	.32	.20	1.44	Significant and positive
c (direct effect via social rapport for baseline)	-.08	.16	-.39	.24	Non-significant
c (direct effect via social rapport for control deprivation)	.31	.17	-.02	.64	Non-significant
a2xb2 (indirect effect via eeriness for baseline)	-.34	.17	-.67	-.01	Significant and negative
a2xb2 (indirect effect via eeriness control deprivation)	.82	.17	.52	1.17	Significant and positive
Index of moderated mediation for eeriness	1.16	.25	.70	1.67	Significant and positive
c (direct effect via eeriness for baseline)	.80	.24	.33	1.26	Significant and positive
c (direct effect via eeriness for control deprivation)	.85	.25	.37	1.33	Significant and positive

Outcome: WOM

Effect	Coeff.	SE	LLCI	ULCI	Sig.
a1xb1 (indirect effect via social rapport for baseline)	.58	.30	.01	1.18	Significant and positive
a1xb1 (indirect effect via social rapport for control deprivation)	1.47	.19	1.11	1.84	Significant and positive
Index of moderated mediation for social rapport	.89	.35	.21	1.56	Significant and positive
c (direct effect via social rapport for baseline)	-.17	.17	-.50	.17	Non-significant
c (direct effect via social rapport for control deprivation)	.21	.18	-.14	.56	Non-significant
a2xb2 (indirect effect via eeriness for baseline)	-.34	.17	-.67	-.01	Significant and negative
a2xb2 (indirect effect via eeriness control deprivation)	.83	.16	.54	1.16	Significant and positive
Index of moderated mediation for eeriness	1.18	.24	.72	1.67	Significant and positive
c (direct effect via eeriness for baseline)	.76	.26	.25	1.26	Significant and positive
c (direct effect via eeriness for control deprivation)	.85	.27	.32	1.38	Significant and positive

Study 4

Outcome: Satisfaction

Effect	Coeff.	SE	LLCI	ULCI	Sig.
a1xb1 (indirect effect via social rapport for baseline-B)	.42	.14	.16	.69	Significant and positive
a1xb1 (indirect effect via social rapport for utilitarian goal-U)	.07	.16	-.25	.40	Non-significant
a1xb1 (indirect effect via social rapport for hedonic goal-H)	.48	.14	.22	.78	Significant and positive
Index of moderated mediation for social rapport (U-H)[1]	.38	.20	.003	.79	Significant and positive
c (direct effect via social rapport for baseline-B)	-.01	.19	-.39	.37	Non-significant
c (direct effect via social rapport for utilitarian goal-U)	.02	.20	-.37	.41	Non-significant
c (direct effect via social rapport for hedonic goal-H)	.18	.19	-.19	.54	Non-significant
a2xb2 (indirect effect via eeriness for baseline-B)	-.07	.04	-.17	-.01	Significant and negative
a2xb2 (indirect effect via eeriness for utilitarian goal-U)	.08	.05	.002	.19	Significant and positive
a2xb2 (indirect effect via eeriness for hedonic goal-H)	.01	.04	-.07	.09	Non-significant
Index of moderated mediation for eeriness (U-H)	-.09	.08	-.27	.04	Non-significant
c (direct effect via eeriness for baseline-B)	-.01	.19	-.39	.37	Non-significant
c (direct effect via eeriness for utilitarian goal-U)	.02	.20	-.37	.41	Non-significant
c (direct effect via eeriness for hedonic goal-H)	.18	.19	-.19	.54	Non-significant

[1] Since moderated mediation index comparing utilitarian with hedonic condition is unavailable in PROCESS Model 8 with the indicator coding method (D1 (0 = baseline, 1 = utilitarian, 0 = hedonic); D2 (0 = baseline, 0 = hedonic, 1 = utilitarian; Hayes and Montoya 2017), we thus excluded data for baseline condition from the original dataset to re-run a new moderated mediation with only two levels (utilitarian vs. hedonic) in order to obtain these moderated mediation indexes contrasting utilitarian condition with hedonic condition.

Outcome: Revisit intention

Effect	Coeff.	SE	LLCI	ULCI	Sig.
a1xb1 (indirect effect via social rapport for baseline-B)	.63	.19	.25	1.01	Significant and positive
a1xb1 (indirect effect via social rapport for utilitarian goal-U)	.11	.24	-.38	.58	Non-significant
a1xb1 (indirect effect via social rapport for hedonic goal-H)	.72	.21	.33	1.16	Significant and positive
Index of moderated mediation for social rapport (U-H)	.67	.35	.001	1.37	Significant and positive
c (direct effect via social rapport for baseline-B)	-.33	.22	-.75	.10	Non-significant
c (direct effect via social rapport for utilitarian goal-U)	.09	.22	-.34	.52	Non-significant
c (direct effect via social rapport for hedonic goal-H)	.28	.21	-.13	.69	Non-significant
a2xb2 (indirect effect via eeriness for baseline-B)	-.09	.05	-.19	-.01	Significant and negative
a2xb2 (indirect effect via eeriness for utilitarian goal-U)	.10	.06	.005	.24	Significant and positive
a2xb2 (indirect effect via eeriness for hedonic goal-H)	.01	.04	-.07	.11	Non-significant
Index of moderated mediation for eeriness (U-H)	-.08	.07	-.26	.03	Non-significant
c (direct effect via eeriness for baseline-B)	-.33	.22	-.75	.10	Non-significant
c (direct effect via eeriness for utilitarian goal-U)	.09	.22	-.34	.52	Non-significant
c (direct effect via eeriness for hedonic goal-H)	.28	.21	-.13	.69	Non-significant

Note: coefficients in all tables above are unstandardized[2]

[2] http://processmacro.org/faq.html

WEB APPENDIX B: SUPPLEMENTARY FIGURES

Additional Analyses for Study 1

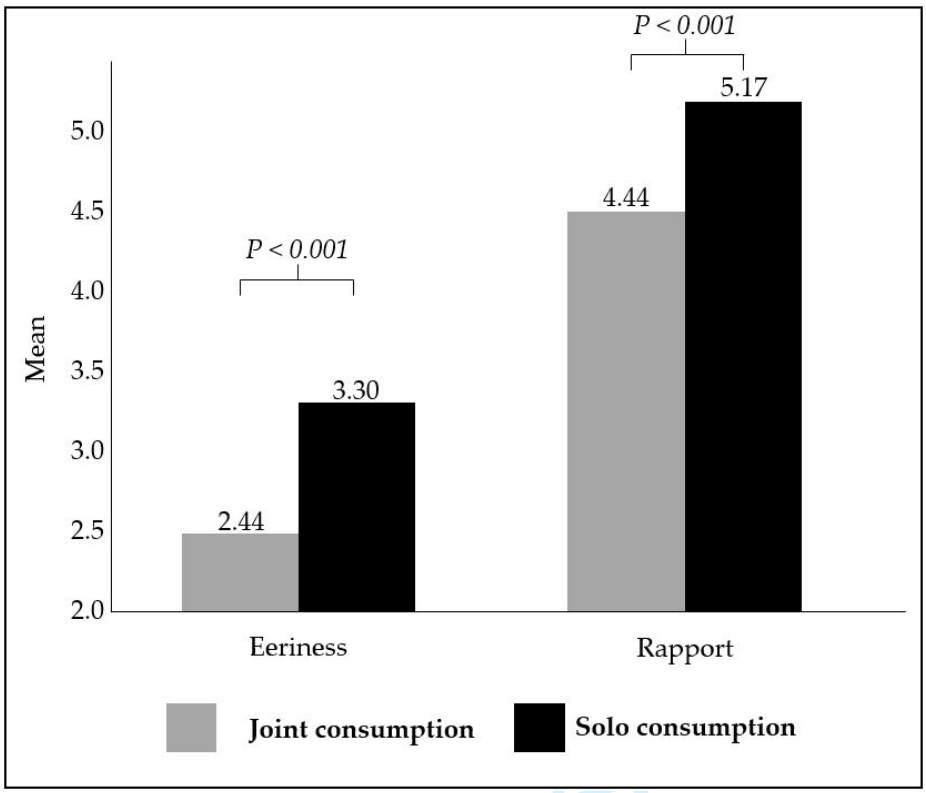


Figure W-A1. Mean comparison between solo and joint customers on eeriness and social rapport (Study 1)

Additional Analyses for Study 2

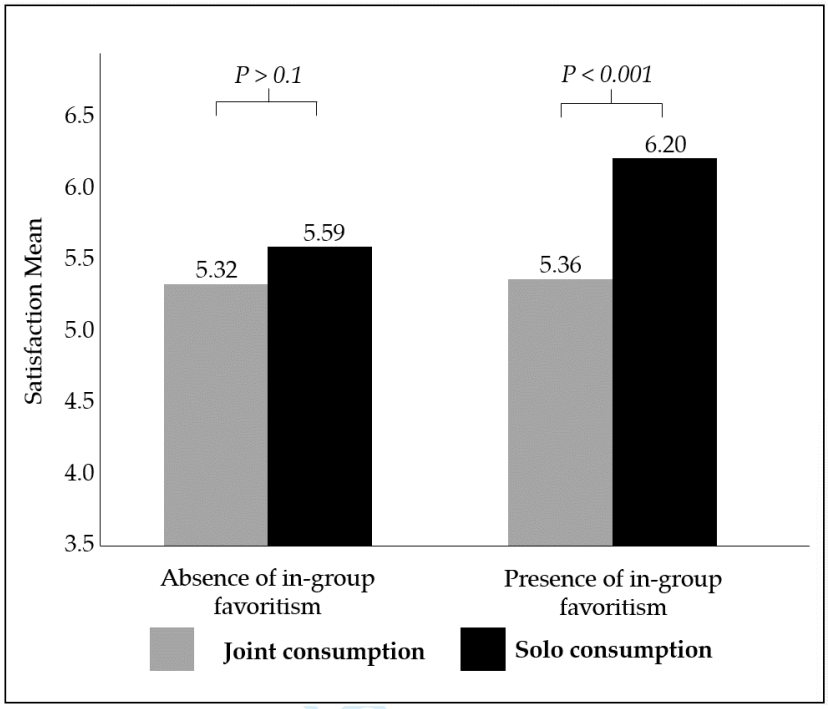


Figure W-A2. Interaction effect of social context and in-group favoritism on satisfaction (Study 2)

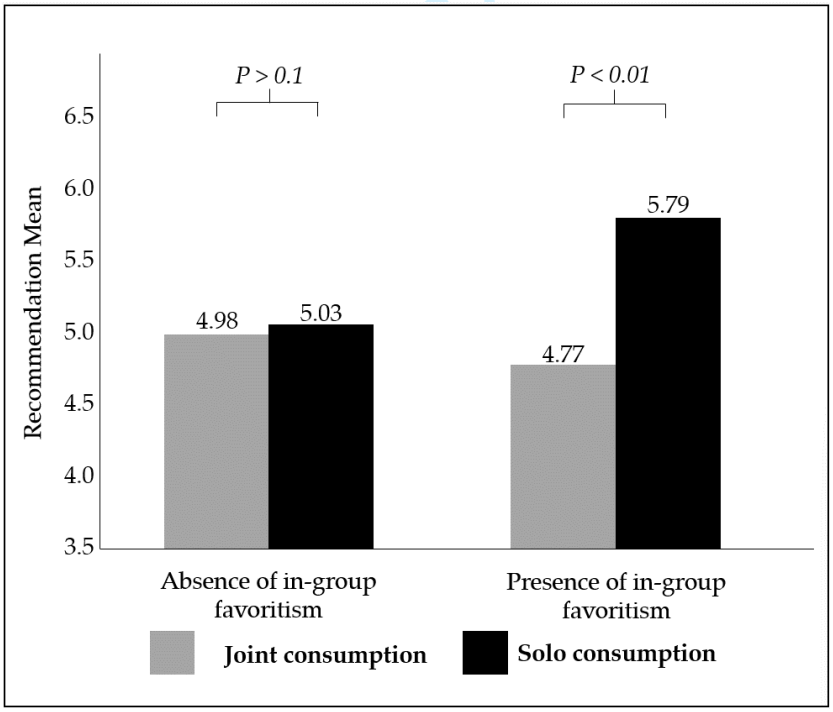


Figure W-A3. Interaction effect of social context and in-group favoritism on recommendation intention (Study 2)

Additional Analyses on Recommendation Intention (Study 2)

Mediation analysis. We measured recommendation intention as a proxy for service evaluations (i.e., "How likely are you to recommend that your friends/relatives use this robot for flight check-in?" 1 = very unlikely, 7 = very likely; Han et al. 2011). We also conducted a moderated mediation test (PROCESS Model 8; 10,000 bootstrapping iterations; Hayes 2017) for recommendation intention as the dependent variable. In the absence of in-group favoritism, the indirect effects through both social rapport (*ab* = .59, *SE* = .23, 95% CI = [.14, 1.04]) and eeriness (*ab* = -.28, *SE* = .14, 95% CI = [-.58, -.02]) were significant and in opposite directions. But when in-group favoritism was present, the indirect effects via both social rapport (*ab* = 1.22, *SE* = .22, 95% CI = [.80, 1.67]) and eeriness (*ab* = .36, *SE* = .14, 95% CI = [.12, .66]) were significant and in the same positive direction. In other words, the eeriness and social rapport mechanisms are weakened and strengthened, respectively, in the presence of in-group favoritism, further supporting H_{3a} and H_{3b}.

Outcome. A two-way ANOVA on this recommendation intention showed a significant main effect of social context (F(1, 141) = 6.093, p = .015, $\eta^2_{partial}$ = .041) but a non-significant main effect of in-group favoritism (F(1, 141) = 1.640, p = .202, $\eta^2_{partial}$ = .011). Importantly, the interaction effect was significant ($F(1, 141) = 4.957$, $p = .028$, $\eta^2_{partial} = .034$). Planned contrasts showed no difference in recommendation intention between solo travelers and joint travelers when in-group favoritism was absent (baseline) ($M_{solo\ absent} = 5.03$ vs. $M_{joint\ absent} = 4.98$, $p = .860$). When in-group favoritism was present, solo (vs. joint) travelers indicated higher recommendation intention ($M_{solo\ present} = 5.79$ vs. $M_{joint\ present} = 4.77$, $p = .002$). A statistically significant increase in recommendation intention emerged for solo travelers in the absence versus presence of in-group favoritism ($M_{solo\ absent} = 5.03$ vs. $M_{solo\ present} = 5.79$, $p = .017$). Yet, the difference was insignificant

for joint travelers ($M_{\text{joint absent}} = 4.98$ vs. $M_{\text{joint present}} = 4.77$, $p = .497$), implying that in-group favoritism works for recommendation intentions among solo customers, but not joint ones (see Figure W-A3).

Additional Analyses for Study 3

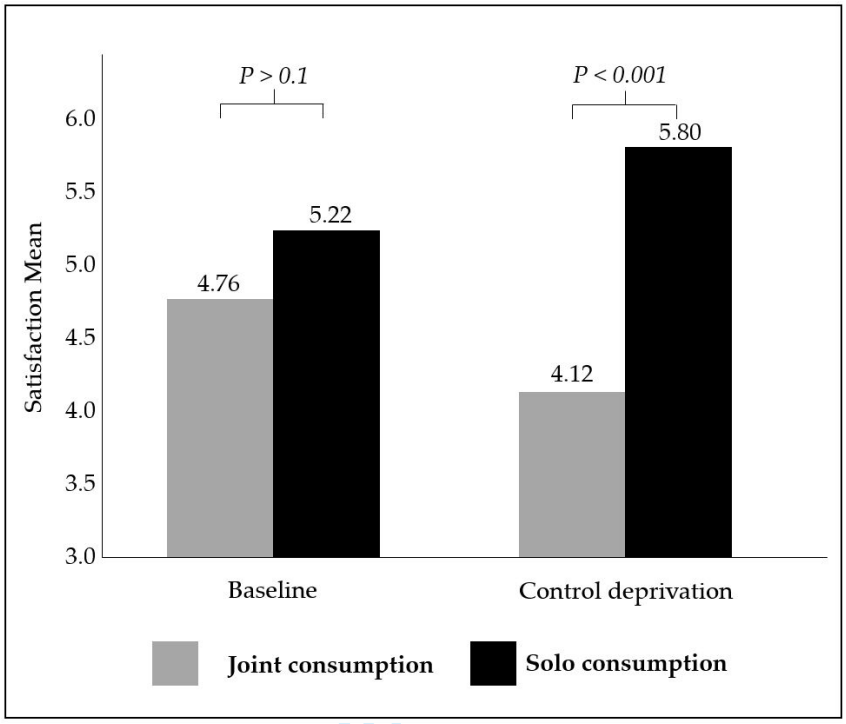


Figure W-A4. Interaction effect of social context and control deprivation on satisfaction (Study 3)

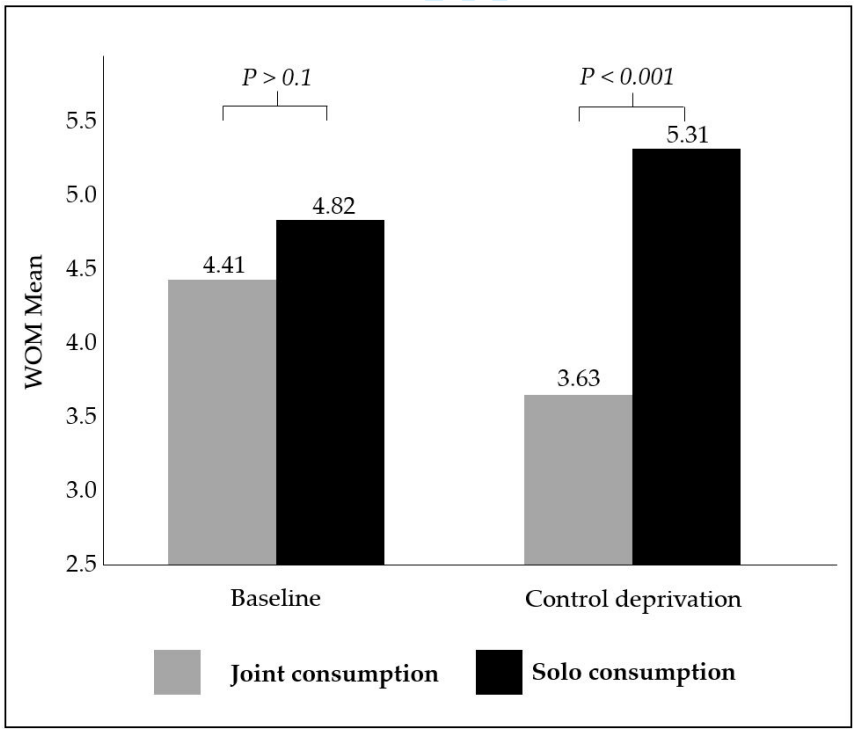


Figure W-A5. Interaction effect of social context and control deprivation on WOM (Study 3)

Additional Analyses on WOM (Study 3)

Mediation analysis. We ran a moderated mediation test (PROCESS Model 8; 10,000 bootstrapping iterations; Hayes 2017) with WOM as a proxy dependent variable (i.e., I will encourage my friends and relatives to stay at this hotel, I would recommend this hotel to other people, 1 = strongly disagree, 7 = strongly agree; $r_{\text{Spearman–Brown}} = .96$, Han et al. 2011). In the baseline condition, the indirect effects through both social rapport (*ab* = .58, *SE* = .30, 95% CI = [.01, 1.18]) and eeriness (*ab* = -.34, *SE* = .17, 95% CI = [-.67, -.01]) were significant and in opposite directions. In the control deprivation condition, the indirect effects through both social rapport (*ab* = 1.47, *SE* = .19, 95% CI = [1.11, 1.84]) and eeriness (*ab* = .83, *SE* = .16, 95% CI = [.54, 1.16]) were significant and in the same positive direction. The positive social rapport is strengthened, and the negative eeriness is weakened for solo customers, in further support of H_{4a} and H_{4b}.

Outcome. We performed a two-way ANOVA on WOM; the main effect of social context ($F(1, 214) = 26.733$, $p < .001$, $\eta^2_{\text{partial}} = .111$) was significant but the main effect of control deprivation ($F(1, 214) = .482$, $p = .488$, $\eta^2_{\text{partial}} = .002$) was non-significant. Importantly, the interaction effect remained significant ($F(1, 214) = 9.747$, $p = .002$, $\eta^2_{\text{partial}} = 0.044$). Planned contrasts displayed that, in the baseline condition, there was no difference in WOM between solo and joint customers ($M_{\text{solo baseline}} = 4.82$, $M_{\text{joint baseline}} = 4.41$, $p = .219$). When control was deprived during the service process, solo (vs. joint) customers reported higher WOM ($M_{\text{solo deprivation}} = 5.31$ vs. $M_{\text{joint deprivation}} = 3.63$, $p < .001$). Also, we found a marginally significant increase in WOM for solo customers, shifting from the baseline to control deprivation condition ($M_{\text{solo baseline}} = 4.82$ vs. $M_{\text{solo deprivation}} = 5.31$, $p = .063$), driven by decreased eeriness and increased social rapport for solo customers in the control deprivation condition (see Figure W-A5).

Additional Analyses for Study 4

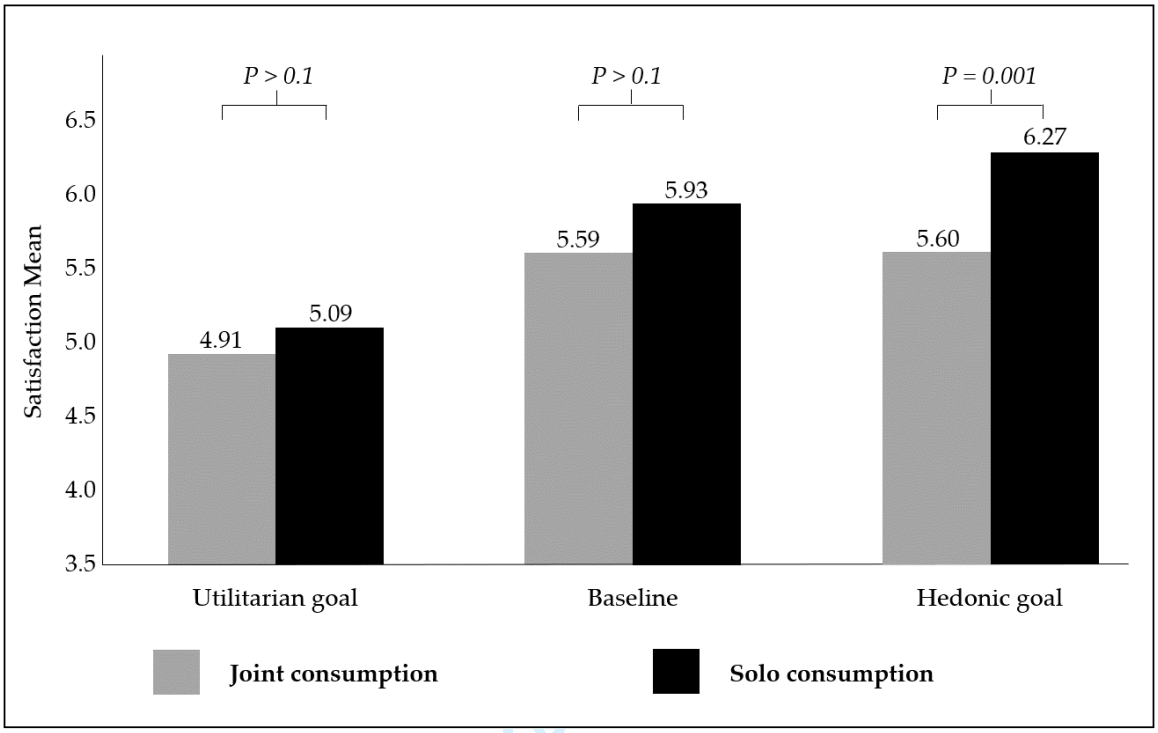


Figure W-A6. Interaction effect of social context and consumption goals on satisfaction (Study 4)

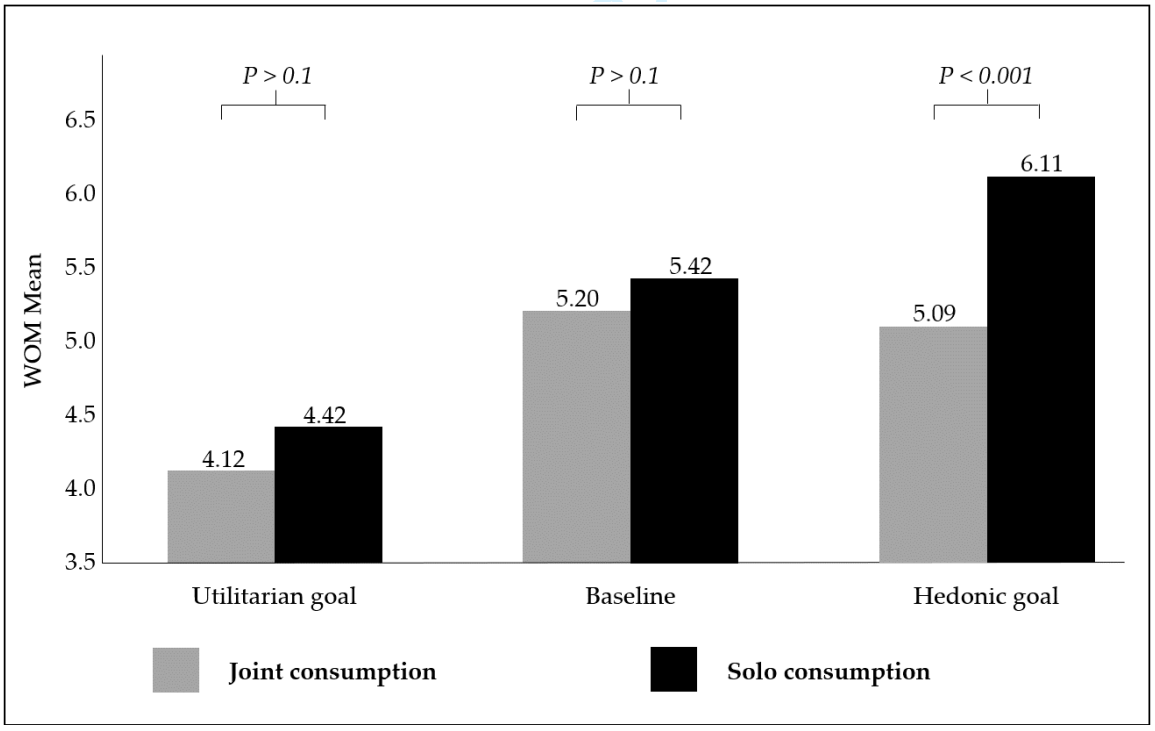


Figure W-A7. Interaction effect of social context and consumption goals on revisit intention (Study 4)

Additional Analyses on Revisit Intention (Study 4)

Mediation analysis. We undertook a moderated mediation test (PROCESS Model 8; 10,000 bootstrapping iterations; Hayes 2017) with revisit intention as a proxy dependent variable (i.e., I intend to revisit this restaurant in the near future, It is very likely that I will revisit this restaurant, I would like to visit this restaurant more often; 1 = very unlikely, 7 = very likely; ω = .95, Kim et al. 2013). In the baseline condition, the indirect effects through both social rapport (*ab* = .63, *SE* = .19, 95% CI = [.25, 1.01]) and eeriness (*ab* = -.09, *SE* = .05, 95% [CI] = [-.19, -.01]) were significant and in opposite directions. In the utilitarian condition, the indirect effect through social rapport (95% CI = [-.38, .58]) was non-significant; while the indirect effect through eeriness (*ab* = .10, *SE* = .06, 95% CI = [.005, .24]) was significant, with a flipped direction. In the hedonic condition, the indirect effect via social rapport (*ab* = .72, *SE* = .21, 95% CI = [.33, 1.16]) was significant but the indirect effect via eeriness (95% CI = [-.07, .11]) was non-significant. These results are consistent with the mediation results for satisfaction.

Outcome. A two-way ANOVA on revisit intention showed that, in the baseline condition, there was no significant difference in revisit intention between solo and joint groups ($M_{\text{solo baseline}}$ = 5.42, $M_{\text{joint baseline}}$ = 5.20, p = .429). In the utilitarian condition, similarly, there was no significant difference ($M_{\text{solo utilitarian}}$ = 4.42 vs. $M_{\text{joint utilitarian}}$ = 4.12, p = .442). But in the hedonic condition, solo diners reported greater revisit intention than their joint counterparts ($M_{\text{solo hedonic}}$ = 6.11 vs. $M_{\text{joint hedonic}}$ = 5.09, p < .001). We found a statistically significant increase in revisit intention for both the solo ($M_{\text{solo hedonic}}$ = 6.11 vs. $M_{\text{solo utilitarian}}$ = 4.42, p < .001) and joint ($M_{\text{joint hedonic}}$ = 5.09 vs. $M_{\text{joint utilitarian}}$ = 4.12, p = .009) groups when shifting from utilitarian goal to hedonic goal (with a greater magnitude of increase for the solo group). These results are consistent with our findings for satisfaction (see Figure W-A7).

WEB APPENDIX C: MEASUREMENT ITEMS

Main Variables

Social rapport *(1 = strongly disagree, 7 = strongly agree; Biedenbach, Bengtsson, and Wincent 2011; Gremler and Gwinner 2000) (Studies 1-4)*

1. I enjoyed interacting with the service robot in the restaurant/airport/hotel.
2. The service robot in the restaurant/airport/hotel related well to me.
3. I had a harmonious relationship with the restaurant/airport/hotel service robot during the check-in process.
4. I was comfortable interacting with the service robot in the restaurant/airport/hotel.

Eeriness *(1 = not at all, 7 = very much; Mende et al. 2019) (Studies 1-4)*

1. Eerie
2. Unnatural
3. Creepy

Satisfaction (*Spreng, MacKenzie, and Olshavsky 1996) (Studies 1-4)*

1. Very dissatisfied (1) – very satisfied (7)
2. Very displeased (1) – very pleased (7)

Recommendation intention *(Han et al. 2011) (Study 2)*

1. How likely are you to recommend your friends/relatives use this robot for flight check-in? (1 = very unlikely; 7 = very likely)

WOM *(1 = strongly disagree, 7 = strongly agree; Han et al. 2011, Study 3)*

1. I will encourage my friends and relatives to stay at this hotel.
2. I would recommend this hotel to other people.

Revisit intention *(1 = very unlikely, 7 = very likely; Kim et al. 2013) (Study 4)*

1. I intend to revisit this restaurant in the near future.
2. It is very likely that I will revisit this restaurant.
3. I would like to visit this restaurant more often.

Manipulation Checks

Anthropomorphism check *(Choi, Mattila, and Bolton 2020) (Studies 1-4)*

1. Very machinelike (1) – very humanlike (7)
2. More like an object (1) – more like a person (7)

Manipulation checks for social context

- Study 2: In the scenario above, your check-in at the airport is a (a) solo experience (alone) or (b) joint experience (with your friends).
- Study 3: In the scenario above, your check-in at the hotel is a (a) solo experience (alone) or (b) joint experience (with your friends).
- Study 4: In the scenario above, your dining-in at the restaurant is a (a) solo dining consumption (alone) or (b) joint dining consumption (with your friends).

Manipulation checks for in-group favoritism *(1 = strongly disagree, 7 = strongly agree; Hwang, Shin, and Mattila 2018) (Study 2)*

1. I feel the service robot in this scenario is favorable.
2. I feel favorable to have this robot as part of my group.
3. I feel this robot is part of my group.

Manipulation check for control deprivation *(1 = strongly disagree, 7 = strongly agree; Michinov, 2005) (Study 3)*

1. There is little I can do to change the check-in process at the hotel.
2. I feel not in good control when dealing with the check-in process at the hotel.
3. What happens during the check-in process at the hotel is beyond my control.
4. I have little control over the things that happen during the check-in process.

Manipulation check for consumption goals *(Kim and Kim 2014) (Study 4)*

1. Please indicate your manner of decision-making to dine in at the restaurant (1 = decided mainly by utilitarian goal; 7 = decided mainly by hedonic goal;)
2. How would you perceive your dining at this restaurant? (1 = definitely utilitarian; 7 = definitely hedonic)

Additional Variables

Holistic thinking style *(1 = strongly disagree, 7 = strongly agree; Choi et al. 2003 (Study 1-Pretest)*

1. Everything in the universe is somehow related to each other.
2. Nothing is unrelated.
3. It's not possible to understand the pieces without considering the whole picture.
4. The whole is greater than the sum of its parts.
5. Paying attention to the field is more important than paying attention to its elements.

Need to belong *(1 = strongly disagree, 7 = strongly agree; Leary et al. 2013) (Study 1-Pretest)*

1. I worry about whether other people care about me.
2. I need to feel that there are people I can turn to in times of need.

3. Being apart from my friends for long periods of time does not bother me (r).
4. I have a strong "need to belong".

Loneliness *(1 = not at all, 7 = very much; Pieters 2013) (Study 1 and Pretest)*

1. Isolated
2. Lonely

Social exclusion *(1 = not at all, 7 = very much; Su et al. 2016) (Study 1 and Pretest)*

1. Excluded
2. Ignored

Mood *(1 = not at all, 7 = very much; Quirin, Kazén, and Kuhl 2009) (Study 1 and Pretest)*

1. Happy

Warmth *(1 = not at all, 7 = very much; Bolton and Mattila 2015) (Study 1)*

1. Caring
2. Helpful

Competence *(1 = not at all, 7 = very much; Bolton and Mattila 2015) (Study 1)*

1. Capable
2. Competent

Patriotism *(1 = strongly disagree, 7 = strongly agree; Kosterman and Feshbach 1989) (Study 2)*

1. I love my country.
2. I am proud to be a citizen of my country.
3. In a sense, I am emotionally attached to my country and emotionally affected by its actions.
4. When I see the national flag of my country, I feel great.
5. The fact that I am a citizen of my country is an important part of my identity.

Ethnocentrism *(1 = strongly disagree, 7 = strongly agree; Shimp and Sharma 1987) (Study 2)*

1. As a citizen of my country, I should always use my home country-made products.
2. It is always best to use my home country products.
3. It may cost me in the long-run but I prefer to support my home country products.

Realism check *(Wu et al. 2015) (Studies 2-4)*

1. How realistic is the scenario? (1 = not realistic at all, 7 = very realistic)
2. How easy is it for you to imagine yourself in the scenario? (1 = very difficult, 7 = very easy)

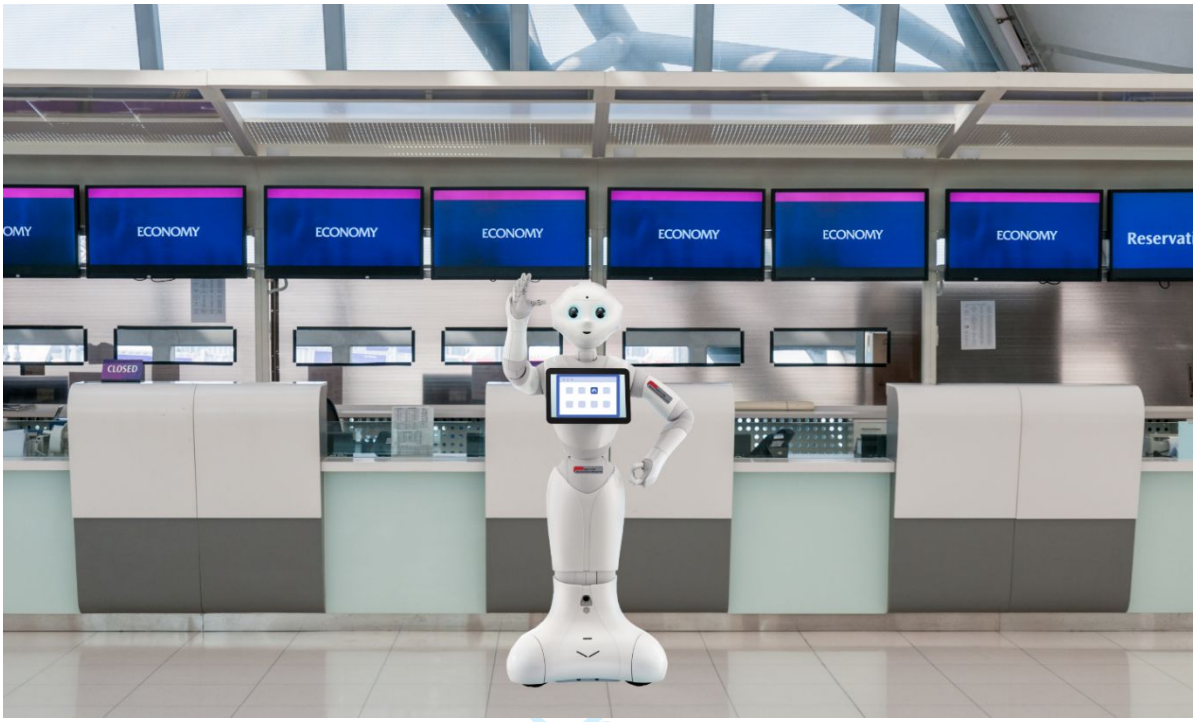
WEB APPENDIX D: EXPERIMENTAL STIMULI

Study 1. Field experiment (Restaurant setting)

Photos of real anthropomorphized robots

Study 2. Moderation of In-group Favoritism (Airport setting)

Image of Frontline Anthropomorphized Robot (FAR)



Presence of in-group favoritism condition	Absence of in-group favoritism condition (baseline)
Imagining you were in the hypothetical scenario below (please read it carefully): You decide to travel SOLO (on your own) (vs. WITH YOUR FRIENDS) and you have already booked the flight ticket. When you arrive *alone* (vs. *with your friends*) at the airport, you approach a frontline service robot, named *Amezen*, to check-in for your flight. At the check-in counter, you notice that *Amezen* carries a sticker on both left arm and waist stating that *Amezen* is made **in your home country** and manufactured on **the same** *date and month as your birthday*.	Imagining you were in the hypothetical scenario below (please read it carefully): You decide to travel SOLO (on your own) (vs. WITH YOUR FRIENDS) and you have already booked the flight ticket. When you arrive *alone* (vs. *with your friends*) at the airport, you approach a frontline service robot, named *Amezen*, to check-in for your flight. Note: In this condition, two stickers on the arm and waist of the robot (shown above) are empty and do not contain any manufacturing information.
Amezen first greets you and then asks you to follow the instructions to successfully check-in and get an e-boarding pass (2D barcode image). Please click 🔊 to hear Amezen's voice. Below is Amezen's script: *"Hello, welcome to our airline. My name is Amezen and I am here to help you check-in for your flight. Please first input your booking details into my screen…* *Please wait a couple of minutes, your information is being processed…* *Your check-in process is completed, please find an electronic boarding pass just sent to your email inbox and I hope you will enjoy your flight.* *Thank you again for choosing our airline."*	

Study 3. Moderation of Control Deprivation (Hotel setting)

Image of Frontline Anthropomorphized Robot (FAR)

Control deprivation condition	Baseline condition
You are going to travel SOLO (on your own) (vs. WITH YOUR FRIENDS) and you have already booked the hotel. When you arrive ALONE (vs. WITH YOUR FRIENDS) at the hotel, you come to the front-desk and **only** see a service robot, named *Amezen*, **without any frontline human staff around and without any sign that you can seek help from frontline human staff if needed**. You then **have to** approach the robot to check-in for your room.	You are going to travel SOLO (on your own) (vs. WITH YOUR FRIENDS) and you have already booked the hotel. When you arrive ALONE (vs. WITH YOUR FRIENDS) at the hotel, you come to the front-desk and see a service robot, named *Amezen*. You then approach the robot to check-in for your room.

Amezen first greets you and then asks you to follow the instructions to successfully check-in and get a four-digit PIN number to access your room.

Please click 🔊 to hear Amezen's voice.

Below is Amezen's script:

"Hello, welcome to our hotel. My name is Amezen and I am here to help you check-in for your room.
Please first input your booking details into the tablet on the counter…
Please wait a couple of minutes, your information is being processed…
Your check-in process is completed. Please find a four-digit PIN number, along with room number, just sent to your email inbox. You need to enter this passcode to unlock your room.
I hope you will enjoy your stay at our hotel. Thank you."

Study 4. Moderation of Consumption Goa (Restaurant setting)

Image of Frontline Anthropomorphized Robot (FAR)

Hedonic condition	Utilitarian condition	Baseline condition
You just finish your morning work, you are free and thus want to find a place for *seeking enjoyment, joy, and relaxation*. You then go SOLO (vs. WITH YOUR FRIENDS) to the restaurant below for lunch. When you arrive ALONE (vs. WITH YOUR FRIENDS) at the restaurant, you notice that this restaurant uses frontline service robots as servers. After seated, a service robot named **Amizen** comes to serve you.	You just finish your morning work, you *feel very hungry* and thus merely want to find a place to *quickly have lunch* before getting back to your work in the afternoon. You then go SOLO (vs. WITH YOUR FRIENDS) to the restaurant below for lunch. When you arrive ALONE (vs. WITH YOUR FRIENDS) at the restaurant, you notice that this restaurant uses frontline service robots as servers. After seated, a service robot named **Amizen** comes to serve you.	You just finish your morning work and then go SOLO (vs. WITH YOUR FRIENDS) to the restaurant below for lunch. When you arrive ALONE (vs. WITH YOUR FRIENDS) at the restaurant, you notice that this restaurant uses frontline service robots as servers. After seated, a service robot named **Amizen** comes to serve you.

Amizen first greets you and then asks you to follow the instructions to make an order.
Please click 🔊 to hear Amizen's voice.
Below is Amizen's script:

"Hello, welcome to our restaurant. My name is Amizen and I am here to help you place the order. Please first select your dishes by using the e-menu on my screen…
I have received your order, your order is now being prepared for you.
Thank you very much!"

When the order is done, **Amizen** then delivers the food items to you, comes back to refill water glass, and also drops off your bill at the end.

Additional References (for Table 1 and additional variables in WA-C)

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