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The Contextual Autonomy Principle: When and Why Social Service Robots Are Perceived as Ethical

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ABSTRACT

As social service robots move into both public and private settings, perceived ethicality becomes a key condition of adoption. We propose that the same robotic capability can acquire different ethical meanings depending on context, governance form, and social presence. Across three studies, we show that restaurant (vs. home) deployment increases perceived ethicality, which in turn increases intention to use. We further show that human-in-the-loop oversight is evaluated as more ethical than full autonomy in the home, whereas the reverse emerges in restaurants, primarily when social presence is high. Guided neural topic modeling further reveals that practical utility is more salient in homes, whereas dining innovation is more salient in restaurants. These findings advance a contextual autonomy principle, position perceived ethicality as a legitimacy judgment that links context and governance to adoption, and identify social presence as the condition under which robot governance becomes morally diagnostic.

1 | Introduction

Social service robots are no longer confined to pilots or futuristic demonstrations. In restaurants and hotels, firms such as Bear Robotics and SoftBank Robotics already market robots as practical solutions for food delivery, guest logistics, and repetitive frontline tasks, whereas in private homes, companion robots such as ElliQ are being deployed to support older adults with conversation, reminders, wellness routines, and social connection (Belanche et al. 2020; Wirtz and Zeithaml 2018). Their promise extends beyond efficiency to independence, safety, and well-being, especially in the context of population ageing and caregiver shortages (Huang and Rust 2021; Alaiad and Zhou 2014; Søraa et al. 2021). As these robots move into routine service encounters, managers face not only a technological adoption challenge but also a governance form challenge: the same robotic capability may be welcomed in one setting yet resisted in another depending on whether it is

perceived as appropriate, accountable, and respectful of human boundaries. The core managerial question is therefore not simply whether robots should be deployed, but under which governance form conditions robotic autonomy is perceived as legitimate in a given context.

This paper examines how consumers evaluate the appropriateness of different governance forms for service robots across public and private service settings. More specifically, it addresses an ethical dilemma that arises because the same robotic capability may be welcomed as efficient and useful in public service settings, yet judged more critically in intimate or privacy-sensitive environments where accountability, boundary respect, and human oversight become more salient. We therefore conceptualize this ethical dilemma as a tension between efficiency-driven automation and accountability-driven oversight (Huang and Rust 2018; Longoni et al. 2019). This framing builds on contextual integrity theory, which suggests that

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appropriateness depends on the norms of the setting (Nissenbaum 2010), on prior work showing that different robot governance arrangements can signal competence and efficiency in routinized service encounters (Huang and Rust 2018), and on research demonstrating that in morally sensitive or intimate contexts, consumers often prefer human oversight to preserve accountability, empathy, and recourse (Dietvorst et al. 2015; Bigman and Gray 2018; Longoni et al. 2019). In line with legitimacy theory, we therefore conceptualize perceived ethicality as a judgment of whether a robot's behavior is appropriate, fair, and answerable in a given context (Leventhal 1980; Lind and Tyler 1988; Suchman 1995).

Our theoretical positioning draws on four complementary lenses. First, contextual integrity explains why identical robot behaviors may be judged differently across public restaurant settings and private home environments because the norms governing appropriateness, accountability, and acceptable intrusion differ across contexts (Nissenbaum 2010). Second, prior work on service automation, algorithm aversion, and machine agency suggests that autonomy does not carry a fixed evaluative meaning: in some service encounters it signals competence, consistency, and efficiency, whereas in others it signals loss of human control, weak recourse, and unaccountable decision-making (Huang and Rust 2018; Dietvorst et al. 2015; Bigman and Gray 2018; Longoni et al. 2019). Third, research on social presence suggests that robots become morally evaluable when they are perceived not merely as tools but as intentional social actors. In this sense, the relevant form of social presence in our framework is primarily interactional and behavioral—such as responsiveness, expressiveness, directed engagement, and conversationality—rather than mere appearance alone (Waytz et al. 2014; Van Doorn et al. 2017; Kätsyri et al. 2015; Pitardi et al. 2022; Kühne and Peter 2023). Fourth, legitimacy and procedural justice research suggests that people are more willing to accept and rely on technologies when they are perceived as fair, transparent, correctable, and normatively appropriate (Leventhal 1980; Lind and Tyler 1988; Suchman 1995; Araujo et al. 2020; McLeay et al. 2021; Etemad-Sajadi et al. 2022; Castelo et al. 2023).

These perspectives suggest that ethical evaluations of service robots cannot be inferred from general acceptance constructs alone. Prior work has often focused on trust, usefulness, satisfaction, or downstream willingness to use, but less often isolates perceived ethicality itself as the legitimacy-oriented judgment through which contextual and robot governance form cues are interpreted. This matters because a robot may be seen as competent or useful while still being judged inappropriate, intrusive, or insufficiently accountable in a particular setting. We therefore focus on perceived ethicality as a judgment of appropriateness, fairness, boundary respect, and accountability, and on service context, governance form, and social presence as the three theoretically central conditions under which such judgments become more or less salient. We focus on restaurants as the focal public service setting because they combine visibility, routinized interaction, and organizational accountability, making them a useful contrast to the intimacy, persistence, and personal stakes of the home context (Belanche et al. 2020; Wirtz and Zeithaml 2018). Restaurants and homes are therefore not merely different physical locations, but distinct normative

environments in which the same robot capability can acquire very different ethical meanings (Nissenbaum 2010; Alaiad and Zhou 2014; Jaspers and Pearson 2022; Søråa et al. 2021). Accordingly, this paper examines how service context, governance form, and social presence jointly shape consumers' ethical evaluation of service robots and, through that evaluation, their intention to use them. We test whether the same service robot is judged differently in restaurant versus home deployment, whether preferences for full autonomy versus human-in-the-loop (HITL) oversight depend on context, and whether these effects become stronger when the robot is perceived as a socially present actor.

Across three studies, we show that restaurant deployment increases perceived ethicality relative to home deployment and that this ethicality judgment carries forward to behavioral intention. We further show that the robot governance form effect is context-dependent: in the home, HITL oversight is judged as more ethical than full autonomy, whereas in the restaurant a more favorable evaluation of full autonomy emerges primarily under high social presence. Finally, guided topic modeling of open-ended responses helps illuminate the content mechanisms underlying these evaluations, with practical utility dominating home responses and dining innovation dominating restaurant responses.

This paper makes three contributions to the service robotics literature. First, it shows that the perceived ethicality of robot governance form is context-dependent, such that the same governance arrangement is evaluated differently in public restaurant settings and private home environments (Huang and Rust 2018; Dietvorst et al. 2015; Bigman and Gray 2018; Longoni et al. 2019). Second, it conceptualizes perceived ethicality as the legitimacy judgment through which contextual and governance cues are translated into intention to use (Araujo et al. 2020; McLeay et al. 2021; Etemad-Sajadi et al. 2022; Castelo et al. 2023). Third, it identifies social presence as the boundary condition that makes governance choices morally salient by increasing the extent to which robots are perceived as intentional social actors (Waytz et al. 2014; Van Doorn et al. 2017; Kätsyri et al. 2015; Pitardi et al. 2022; Kühne and Peter 2023).

2 | Background and Theoretical Development

2.1 | Social Service Robots

Social service robots are defined as embodied service technologies that interact directly with users during a service encounter and perform service-related tasks with some degree of autonomous decision-making (Belanche et al. 2020; Wirtz et al. 2018). This definition excludes back-end automation that remains invisible to the user and focuses instead on frontline robots whose behavior can be observed, interpreted, and socially evaluated by consumers.

2.2 | Perceived Ethicality

We use perceived ethicality to refer to the consumer's judgment that the social robot operates in a manner that is appropriate,

fair, respectful of personal boundaries, and answerable within the focal context (Leventhal 1980; Lind and Tyler 1988; Suchman 1995). We focus on perceived ethicality because prior work in service robots and AI-enabled services has often emphasized trust, usefulness, or satisfaction, while less often isolating ethicality itself as the legitimacy-oriented judgment through which consumers evaluate whether a robot should be allowed to operate in a given setting (Araujo et al. 2020; McLeay et al. 2021; Etemad-Sajadi et al. 2022; Castelo et al. 2023). Perceived ethicality is therefore not a synonym for general positivity toward the technology, nor is it interchangeable with trust, legitimacy, or behavioral intention. Rather, it captures the user's more immediate and context-specific judgment that the robot's conduct is appropriate, fair, respectful of boundaries, and answerable in the focal setting.

Our research focuses on three theoretically central drivers of perceived ethicality: service context, governance form, and social presence. We focus on these variables because prior literature suggests that context shapes normative fit, governance form shapes whether autonomous action is experienced as accountable or unchecked, and social presence shapes whether these governance cues are processed as morally meaningful rather than merely functional. Other attributes, such as transparency and fairness cues (Araujo et al. 2020; McLeay et al. 2021; Etemad-Sajadi et al. 2022; Castelo et al. 2023) and anthropomorphic design (Kätsyri et al. 2015; Mende et al. 2019), remain important, but are treated here as adjacent rather than focal explanatory factors.

2.3 | Theoretical Foundations

This section develops the theoretical foundations underlying the model—contextual integrity and normative fit, autonomy versus human oversight, social presence, legitimacy, fairness, and transparency—to explain why social service robots are judged as more or less ethically acceptable across settings.

2.3.1 | Contextual Integrity and Normative Fit

Contextual integrity theory argues that behaviors and information practices are judged relative to contextual norms: an action can be appropriate in one setting and norm-violating in another because expectations differ across contexts (Nissenbaum 2010). Applied to social service robots, this means that identical sensing, recording, and decision-making capabilities may be judged differently depending on where the robot is deployed. Prior literature suggests that context determines normative fit and what counts as appropriate conduct in a given setting (Nissenbaum 2010; Paluch and Wirtz 2020; Castelo et al. 2023). Service work suggests that customers tolerate some monitoring, automation, and standardization as part of the public service experience, whereas in domestic or caregiving service settings, similar capabilities can trigger concerns about surveillance, autonomy loss, and intrusion (Paluch and Wirtz 2020; Lin et al. 2024; Castelo et al. 2023). Context, therefore, serves as a theoretically central driver of perceived ethicality because it establishes the normative baseline against which robot behavior is judged.

2.3.2 | Governance Form, Human Oversight, and Algorithm Aversion

Governance form refers specifically to the degree to which autonomous action is paired with accountable human oversight (Dietvorst et al. 2015; Bigman and Gray 2018). We distinguish between fully autonomous social robots and HITL oversight. HITL is conceptualized not simply as “less autonomy” in an abstract sense, but as a governance arrangement in which the social robot can perform tasks while a human supervisor remains able to monitor, intervene, and override the robot's actions (Longoni et al. 2019). Accordingly, we conceptualize HITL as a distinct collaborative-governance form rather than as a simple linear reduction in autonomous capability. This distinction matters because consumers may react not only to what the robot can do, but also to whether an accountable human remains in the loop (Longoni et al. 2019).

Service research characterizes higher autonomy as desirable because it signals efficiency, reliability, impartiality, and scalability in routinized public services (Huang and Rust 2018). Empirical work links perceived social robot governance autonomy to higher perceived competence, smoother experiences, and more favorable evaluations in public service settings (Lin et al. 2024; Liu et al. 2024). In contrast, in morally sensitive, identity-relevant, or high-stakes domains, people prefer explicit human oversight to ensure accountability, empathy, and alignment with human values. This is a pattern consistent with algorithm aversion, in which people resist fully autonomous systems after observing perceived errors or value misalignments and demand human supervision (Dietvorst et al. 2015; Bigman and Gray 2018; Longoni et al. 2019). Robot governance form therefore shapes whether autonomy is experienced as competence and efficiency or as unaccountable and insufficiently supervised agency.

2.3.3 | Social Presence and Moral Evaluation

Social presence refers to the extent to which the robot is experienced as a socially present and intentional interaction partner rather than as a purely functional tool (Waytz et al. 2014; Van Doorn et al. 2017; Kühne and Peter 2023). This perception can arise from interactional and behavioral cues such as responsiveness, conversationality, directed engagement, and expressive behavior, as well as from broader cues of humanlikeness and social agency (Waytz et al. 2014; Van Doorn et al. 2017; Kätsyri et al. 2015; Pitardi et al. 2022; Holthöwer and Van Doorn 2023; Kühne and Peter 2023). Social presence matters because it determines whether robot behavior is processed mainly in instrumental terms or instead becomes subject to stronger social and moral evaluation through mind attribution.

Robots that display high social presence—conversational responsiveness, emotional expressiveness, directed gaze, embodied interaction—are more likely to be attributed agency (e.g., capacity to act intentionally; Waytz et al. 2014; Van Doorn et al. 2017; Kätsyri et al. 2015; Pitardi et al. 2022; Kühne and Peter 2023). This agency matters because it invites moral judgment: once a robot is treated as a social other rather than a neutral tool, people evaluate whether it behaves appropriately,

fairly, and respectfully. Social presence can also reduce embarrassment or social discomfort because robots are often perceived as less judgmental than humans (Pitardi et al. 2022; Holthöwer and Van Doorn 2023). At the same time, poorly calibrated human-likeness can evoke eeriness or intrusiveness if it feels deceptive or norm-violating (Kätsyri et al. 2015; Mende et al. 2019).

2.3.4 | Legitimacy, Fairness, and Transparency

Perceived ethicality is grounded in legitimacy-related judgments about whether a robot behaves appropriately, fairly, and accountably in a given setting (Leventhal 1980; Lind and Tyler 1988; Suchman 1995). Prior research suggests that transparency, fairness, and human oversight can enhance the perceived legitimacy of technology-enabled service encounters (Araujo et al. 2020; McLeay et al. 2021; Etemad-Sajadi et al. 2022; Castelo et al. 2023). Accordingly, perceived ethicality is not merely a general positive attitude toward social service robots, but a more specific judgment that a robot's conduct is normatively acceptable in context. Legitimacy therefore serves as the broader theoretical foundation for perceived ethicality rather than as an interchangeable label for the construct itself, and helps explain how contextual cues, governance arrangements, and social presence translate into willingness to rely on or continue using the robot.

2.4 | Contextual Application to Service Settings

The meaning of autonomy is context-dependent and might have a different interpretation according to the service settings, competence, consistency, efficiency, versus concerns about answerability, privacy, and loss of control.

2.4.1 | Public Restaurant Service Encounters

We focus on restaurants as the focal public service setting because they combine high visibility, routinized interaction, organizational accountability, and increasing real-world robot deployment, making them a theoretically useful contrast to the intimacy and persistence of the home (Belanche et al. 2020; Wirtz et al. 2018; Paluch and Wirtz 2020). In such settings, consumers typically encounter robots as part of an institutionalized service script: the robot is visible, task-bounded, and embedded within an organization that is itself perceived as responsible for the service encounter. Prior work further suggests that, in these public service encounters, customers expect robots to be reliable, responsive, and socially competent enough to facilitate the interaction without becoming disturbingly humanlike or normatively inappropriate (Wirtz et al. 2018; Kätsyri et al. 2015).

This public and organizationally framed character changes how autonomy is interpreted. In restaurant-like encounters, autonomous functioning is more likely to be read as a competence cue: the robot appears efficient, standardized, reliable, and able to perform routinized service tasks without delay or inconsistency (Huang and Rust 2018; Lin et al. 2024; Liu et al. 2024). Prior work in service settings similarly shows that favorable evaluations of robot quality, interactivity, and social-

emotional capability can increase trust, rapport, and behavioral intention to use the robot-assisted service (Park et al. 2021; Kim et al. 2022). Contextual integrity further suggests that localized monitoring and delegated machine action are more likely to be perceived as norm-congruent in public settings than in intimate domestic spaces because the service is time-bounded, publicly observable, and tied to organizational accountability (Nissenbaum 2010; Paluch and Wirtz 2020; Castelo et al. 2023).

The theoretical point is not that ethical judgment disappears in public encounters, but that governance choices are less likely to be interpreted through the lenses of privacy intrusion, personal vulnerability, and loss of intimate control. Ethical concerns remain possible, especially when a robot appears socially overreaching, overly intrusive, or uncannily humanlike (Kätsyri et al. 2015; Mende et al. 2019). Absent such violations, a relatively autonomous robot in a restaurant is more likely to be evaluated in terms of service smoothness, efficiency, and competence than in terms of ethical risk.

Public settings can also normalize robot use through visible institutional framing and repeated observation. When robot deployment appears already embedded in the service environment, consumers may infer that the technology is monitored and accountable at the organizational level, which can further support favorable evaluations of autonomous operations (Subero-Navarro et al. 2022). Thus, autonomy is more likely to be interpreted as an efficient and legitimate governance form, provided that the robot remains behaviorally appropriate to the setting.

2.4.2 | Private Home Service Encounters

In contrast, private home settings impose a markedly different normative structure. Domestic social robots are expected to provide routine support, companionship, or empathic assistance, and enhanced independence and safety (Alaiad and Zhou 2014; Søraa et al. 2021). Unlike a robot encountered briefly in a restaurant, a home robot is persistent and embedded in everyday routines within an intimate environment.

That persistence makes robot governance form more ethically consequential. In the home, autonomous action can more easily be interpreted as surveillance, boundary intrusion, loss of personal control, or reduced human recourse. Because the setting is intimate and personally consequential, the same robot capability that appears efficient in a public restaurant setting may be experienced as insufficiently accountable in the home. Contextual integrity therefore implies a stricter normative bar: sensing, monitoring, or acting autonomously in the home is judged not only by whether it works, but by whether it respects privacy, preserves control, and remains answerable to human values and intervention (Nissenbaum 2010; Jaspers and Pearson 2022).

This is where HITL oversight becomes theoretically important. In our framework, HITL is not merely the opposite pole of autonomy on a continuum, but a governance mechanism that preserves human monitoring, override, and accountability while still allowing the robot to perform tasks. Prior work on algorithm aversion and machine agency suggests that in

morally sensitive, identity-relevant, or high-stakes domains, people often prefer explicit human involvement because it preserves empathy, moral judgment, and recourse (Dietvorst et al. 2015; Bigman and Gray 2018; Longoni et al. 2019). Applied to the home, this implies that full autonomy faces a higher burden of ethical justification unless consumers know that a human remains answerable.

Perceived ethicality therefore becomes more central in private settings not because public settings are “non-ethical,” but because home deployment makes questions of boundary respect, control, intrusion, and accountability harder to back-ground. Consumers are more likely to ask whether the robot is acting ethically here, whether it respects the intimacy of the setting, and whether an accountable human can intervene if needed. In this sense, home settings shift robot governance form evaluation from a predominantly functional reading of autonomy toward a more explicitly legitimacy-based one. This logic is consistent with research showing that long-term domestic acceptance depends not only on functional benefits such as safety, independence, and support, but also on whether these benefits are achieved without creating unacceptable concerns about surveillance, dehumanization, and loss of control (Meyer-Waarden and Cloarec 2022; Teychenie et al. 2025; Meyer-Waarden et al. 2026).

The meaning of autonomy is thus context-dependent. In public restaurant encounters, autonomy is more likely to signal competence and efficient execution, whereas in private home encounters, the same autonomy is more likely to raise concerns about answerability, privacy, and loss of control unless tempered by HITL oversight. A related implication is that service context may also shape where agency is perceived to reside: in restaurant settings, the robot is more likely to be interpreted as acting on behalf of the provider, whereas in home settings it may be interpreted more as acting on behalf of, or in close relation to, the user.

2.5 | Integrative Synthesis of Prior Research

Research across services marketing, human–robot interaction, robot governance, and social psychology converges on four recurring lenses that shape responses to social service robots: (i) contextual integrity and normative fit, (ii) autonomy versus human oversight, (iii) social presence and mind perception, and (iv) transparency, legitimacy, and fairness. Tabel 1 (Appendix 1) synthesizes representative conceptual and empirical studies from these four streams. The goal is not to provide an exhaustive review of service-robot research, but to organize the literature most relevant to our model and clarify both what is known and why this study is needed.

Three patterns stand out. First, autonomy is often evaluated positively in routinized public service settings, but more cautiously in intimate or morally sensitive domains. Second, social presence can either humanize the robot or make it more morally consequential. Third, transparency and human oversight tend to strengthen legitimacy and fairness perceptions, yet most studies treat ethics indirectly through trust, satisfaction,

compliance, or acceptance rather than measuring perceived ethicality itself.

2.6 | Remaining Gaps

The literature remains fragmented across contexts, outcomes, and theoretical lenses, highlighting three unresolved gaps that motivate the present research. First, prior work rarely compares the social robot performing the same task across public restaurant and private home settings, while varying robot governance form (full autonomy vs. HITL oversight) (Huang and Rust 2018; Dietvorst et al. 2015; Bigman and Gray 2018; Longoni et al. 2019; Lin et al. 2024; Liu et al. 2024). Second, much of the literature addresses ethics indirectly through trust, satisfaction, compliance, or adoption (Araujo et al. 2020; McLeay et al. 2021; Etemad-Sajadi et al. 2022; Borghi et al. 2023) rather than isolating perceived ethicality itself. Third, although social presence and human oversight have been studied separately, prior research has not examined their joint effects or whether governance form becomes more or less ethically important as the robot's social presence changes (Waytz et al. 2014; Pitardi et al. 2022; Holthöwer and Van Doorn 2023; Kühne and Peter 2023).

Our research addresses these gaps. We propose that (i) context (restaurant vs. home) sets the normative baseline for what counts as ethically acceptable social robot behavior; (ii) governance form (autonomy vs. HITL oversight) interacts with that context; (iii) perceived ethicality functions as a legitimacy judgment that mediates effects on behavioral intention to use; and (iv) these effects depend on the robot's social presence.

3 | Conceptual Model and Hypotheses Development

The model centers on two key outcomes, perceived ethicality and behavioral intention to use, and on three core factors: service context (restaurant vs. home), robot governance form (full autonomy vs. HITL oversight), and social presence (high vs. low). We first establish the baseline mechanism linking service context to perceived ethicality and behavioral intention, and then examine how governance form and social presence condition that mechanism.

3.1 | Service Context and Perceived Ethicality

Contextual integrity theory holds that people assess the appropriateness of behaviors—including sensing, monitoring, and autonomous action—relative to what is considered normal, acceptable, and accountable in a given setting (Nissenbaum 2010). In a restaurant-like setting, localized and time-bounded monitoring is often seen as part of the service script, carried out under visible organizational accountability (Wirtz et al. 2018; Paluch and Wirtz 2020; Park et al. 2021). The same sensing and decision-making capabilities, when embedded in a private home, feel persistent, intimate, and personally revealing, and therefore invite concerns about surveillance, loss of control, and intrusion (Malhotra et al. 2004; Awad and Krishnan 2006). In other words,

the same robot behavior faces a stricter ethical bar in the home than in the restaurant. Thus:

H1. *A social robot in a restaurant context will be perceived as more ethical than a robot operating in a home context.*

3.2 | Perceived Ethicality as a Legitimacy Judgment That Predicts Intention to Use

We conceptualize perceived ethicality as a legitimacy judgment—that is, whether a robot's behavior is seen as appropriate, fair, respectful of personal boundaries, and accountable to humans (Leventhal 1980). Although rooted in legitimacy, perceived ethicality differs from trust and behavioral intention because it captures the evaluative judgment that shapes downstream adoption responses. Legitimacy and procedural justice research suggest that when processes are perceived as fair, transparent, and correctable, people are more willing to accept outcomes and cooperate, even under uncertainty (Leventhal 1980; Lind and Tyler 1988; Suchman 1995). In frontline AI and service robotics, higher perceived appropriateness, fairness, and legitimacy predict stronger behavioral intention to use (Araujo et al. 2020; Park et al. 2021; Etemad-Sajadi et al. 2022). Thus:

H2. *Perceived ethicality is positively associated with behavioral intention to use.*

If perceived ethicality grants the robot the right to operate, then higher perceived ethicality should increase intention to use. If restaurant contexts are judged as more ethically appropriate than home contexts (H1), that difference should carry forward to behavioral intention. Thus:

H3. *The effect of service context on behavioral intention to use is mediated by perceived ethicality.*

3.3 | Service Context, Governance Form, and Perceived Ethicality

Preferences for robot governance form, full autonomy versus HITL oversight, are context-dependent. In routinized, transactional, publicly monitored service encounters such as restaurants, higher autonomy tends to signal competence, impartiality, and efficiency, consistent with expectations of standardization and speed (Huang and Rust 2018; Lin et al. 2024; Liu et al. 2024). In intimate, persistent, and personally consequential home settings, full autonomy can instead signal unaccountable control, privacy intrusion, or misalignment with human values. In such settings, HITL oversight is more likely to communicate accountability, empathy, and recourse (Dietvorst et al. 2015; Bigman and Gray 2018; Longoni et al. 2019). This logic implies that the effect of governance form on perceived ethicality depends on service context. In the home, HITL oversight should be viewed as more ethical than full autonomy. In the restaurant, full autonomy should be viewed as more ethical than HITL. Thus:

H4. *The effect of robot governance form on perceived ethicality depends on service context, such that HITL oversight will be perceived as more ethical than full autonomy in the home context,*

whereas full autonomy will be perceived as more ethical than HITL oversight in the restaurant context.

3.4 | Social Presence as a Boundary Condition for Ethical Appraisal

Governance form becomes most ethically diagnostic when the robot is perceived as an intentional social actor rather than as a mere tool Kim et al. (2022). High social presence—responsiveness, conversational ability, emotional expressiveness, directed gaze, embodied engagement—increases mind attribution, which in turn activates moral expectations regarding fairness, appropriateness, and accountability (Waytz et al. 2014; Kätsyri et al. 2015; Kühne and Peter 2023). Under high social presence, a fully autonomous robot is more likely to be interpreted as an unsupervised moral actor, whereas a HITL robot is more likely to be interpreted as supervised and answerable. Under low social presence, by contrast, the robot is more easily categorized as a tool, and governance-form differences should become less ethically diagnostic (Pitardi et al. 2022; Holthöwer and Van Doorn 2023). We therefore expect social presence to strengthen the context-dependent effect of governance form on perceived ethicality. Thus:

H5. *The context-dependent effect of social robot governance form on perceived ethicality predicted in H4 will be stronger when the robot has high social presence than when it has low social presence.*

3.5 | Control Variables

Our model includes the following control variables: gender, age, and user innovativeness (i.e., the general tendency to adopt novel technologies early; Steenkamp and Gielens 2003). These variables have been linked to higher openness to new technologies such as AI-based services (e.g., Malhotra et al. 2004; Araujo et al. 2020). Controlling for these factors helps ensure that observed differences in perceived ethicality and intention to use are attributable to context, robot governance form, and social presence (Figure 1) represents the research model.

4 | Methodology and Study Overview

The empirical research proceeds in three steps. Study 1 establishes the baseline ethicality mechanism by testing whether service context influences behavioral intention indirectly through perceived ethicality. Study 2 extends this mechanism by introducing governance form and social presence as moderators. Study 3 is an exploratory follow-up that uses guided neural topic modeling of open-ended responses to illuminate the content mechanisms underlying the earlier findings.

5 | Study 1—Baseline Ethicality Mechanism

5.1 | Research Design

Study 1 tested the baseline mechanism linking service context to behavioral intention through perceived ethicality. We used a one-factor between-subjects design in which the same social

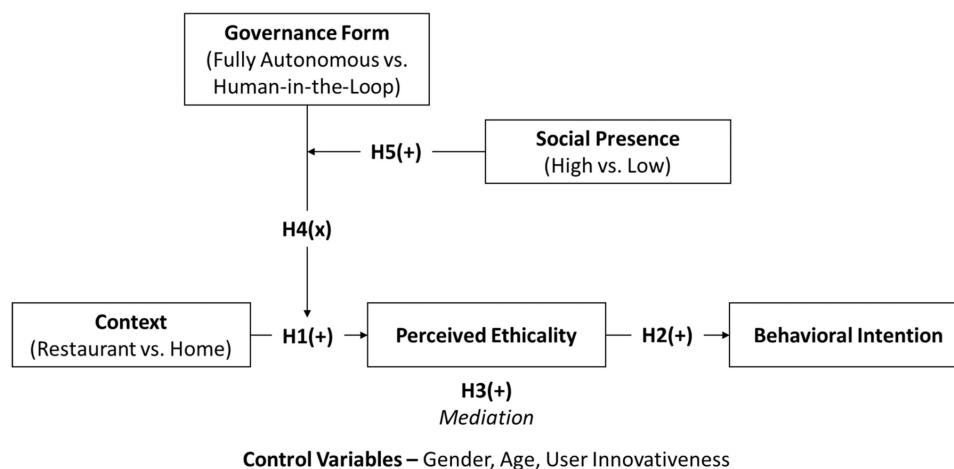


FIGURE 1 | Research model.

robot performing the same dining-related task was embedded either in a restaurant context or in a home context. Participants first viewed a short video and then evaluated the robot in the assigned setting. The two videos were matched in length, soundtrack, robot appearance, and camera logic, with the focal difference being whether the robot operated in a public restaurant environment or a private home environment.¹ Participants then completed the questionnaire.

5.2 | Sample

300 US-based adult participants were recruited through Prolific (eligibility required US residency, age 18 or older, and attention-check completion). No respondents were excluded due to failed attention checks or incomplete responses. The sample averaged 46.0 years of age ($SD = 15.72$), and 52.7% self-identified as women.

5.3 | Measures

All constructs were measured using established 7-point Likert-type scales adapted from prior research. Perceived ethicality was assessed using Olson et al. (2016) (e.g., “I would find this service robot unethical/ethical”). Behavioral intention was assessed using Venkatesh et al. (2012) (e.g., “I am likely to use this type of service robot in the future”). User innovativeness was assessed using Steenkamp and Gielens (2003) (e.g., “If I hear about a new technology, I like to try it”). The psychometric results indicate satisfactory measurement quality: reliability coefficients exceed recommended thresholds (Hair et al. 2021), average variance extracted supports convergent validity, and HTMT ratios support discriminant validity across the focal constructs (Henseler et al. 2015). Full measurement results are in Appendix 2 and Appendix 3.

5.4 | Results

In line with H1, an ANCOVA on perceived ethicality, with age, gender, and user innovativeness as covariates, revealed a significant main effect of the context, $F(1, 295) = 7.62$, $p = 0.006$, $\eta^2 = 0.021$. Participants in the restaurant context reported higher perceived ethicality ($M = 4.68$, $SD = 1.08$) than those in the home context ($M = 4.35$, $SD = 1.14$).

To test H2–H3, we estimated a mediation model using PROCESS in R (Model 4) with 5000 bootstrapped samples. Consistent with H2, perceived ethicality is positively associated ($b = 0.80$, $p < 0.001$) with behavioral intention to use the robot. In turn, the restaurant (vs. home) context increases behavioral intention indirectly through perceived ethicality (indirect effect: $b = 0.26$, $p < 0.05$, 95% CI = [0.0787, 0.4525]), supporting H3. Full results are in Appendix 4.

6 | Study 2—Context-Dependent Governance Effects and Social Presence Boundary

6.1 | Research Design

Study 2 examined whether the ethicality mechanism established in Study 1 depends on governance form and social presence. We used a 2 (context: restaurant vs. home) $\times$ 2 (governance form: full autonomy vs. HITL oversight) $\times$ 2 (social presence: high vs. low) between-subjects experimental design.

As in Study 1, participants first viewed a short video depicting the same social robot performing the same dining-related task in either a restaurant or a home context. The videos were matched in length, soundtrack, robot appearance, camera logic, and task sequence so that the primary difference concerned the surrounding environment rather than the task itself. Participants then read a scenario consistent with their assigned

¹ A pre-test with a US convenience sample ($N = 200$; 52% men; $M_{Age} = 43.5$, $SD = 14.6$) confirmed that the video manipulation was effective. Participants in the restaurant condition perceived the setting as significantly more restaurant-like ($M = 6.39$, $SD = 1.05$) than those in the home condition ($M = 1.57$, $SD = 1.01$), $t(198) = 33.07$, $p < 0.001$, $d = 4.68$. Importantly, the two conditions did not differ on perceived video length ($M_{Home} = 5.43$, $SD = 1.67$; $M_{Restaurant} = 5.74$, $SD = 1.53$; $t(198) = 1.37$, $p = 0.17$, $d = 0.19$), background sound ($M_{Home} = 3.71$, $SD = 1.56$; $M_{Restaurant} = 3.83$, $SD = 1.48$; $t(198) = 0.56$, $p = 0.58$, $d = 0.08$), robot appearance ($M_{Home} = 2.36$, $SD = 1.43$; $M_{Restaurant} = 2.58$, $SD = 1.34$; $t(198) = 1.12$, $p = 0.26$, $d = 0.16$), or camera quality ($M_{Home} = 5.44$, $SD = 1.42$; $M_{Restaurant} = 5.47$, $SD = 1.44$; $t(198) = 0.15$, $p = 0.88$, $d = 0.02$). These checks were therefore not reassessed in the main studies.

condition. The governance form was manipulated by describing either a fully autonomous robot or a HITL robot subject to human monitoring and override. Social presence was manipulated by describing either a socially interactive robot or a robot with minimal social interaction. Participants then completed the questionnaire, including manipulation checks for perceived autonomy and social presence.

6.2 | Sample

One thousand US-based adult participants were recruited through Prolific. No respondents were excluded due to failed attention checks or incomplete responses. Participants were on average 45.4 years old ($SD = 16.83$), and 51.8% self-identified as women.

6.3 | Measures

All constructs were measured with the same 7-point Likert-type scales as in Study 1. The complete psychometric results indicate satisfactory measurement quality according to established standards (Henseler et al. 2015; Hair et al. 2021). Full measurement results are reported in Appendix 2 and Appendix 3.

6.4 | Results

6.4.1 | Manipulation Checks

We assessed the manipulations using factorial analyses consistent with the study design. A 2×2 ANOVA on the autonomy manipulation-check measure revealed a significant main effect of the governance form, $F(1, 996) = 43.82$, $p < 0.001$, $\eta^2 = 0.042$, confirming that participants in the fully autonomous condition reported higher perceived autonomy ($M = 4.65$, $SD = 1.79$) than those in the HITL condition ($M = 3.89$, $SD = 1.82$). The main effect of the social presence manipulation was not significant, $F(1, 996) = 0.35$, $p = 0.557$, $\eta^2 < 0.001$, nor was the interaction, $F(1, 996) = 0.33$, $p = 0.567$, $\eta^2 < 0.001$. These results indicate

that the governance-form manipulation successfully altered perceived autonomy without contamination from the social-presence factor.

A 2×2 ANOVA on the social-presence manipulation-check measure revealed a significant main effect of the social presence manipulation, $F(1, 996) = 15.16$, $p < 0.001$, $\eta^2 = 0.015$, confirming that participants in the high-social-presence condition reported greater perceived social presence ($M = 3.83$, $SD = 1.83$) than those in the low-social-presence condition ($M = 3.38$, $SD = 1.88$). The main effect of governance form was not significant, $F(1, 996) = 1.21$, $p = 0.271$, $\eta^2 = 0.001$, and the interaction was non-significant, $F(1, 996) = 3.12$, $p = 0.078$, $\eta^2 = 0.003$. These results support the effectiveness of the social-presence manipulation without meaningful cross-contamination from the governance-form factor.

6.4.2 | Perceived Ethicality

To test H4, we first examined whether the effect of governance form on perceived ethicality depended on service context. A two-way ANCOVA revealed a nonsignificant main effect of context, $F(1, 992) = 0.68$, $p = 0.41$, $\eta^2 = 0.000$, a nonsignificant main effect of governance form, $F(1, 992) = 0.96$, $p = 0.33$, $\eta^2 = 0.001$, and a significant interaction between context and governance form, $F(1, 992) = 4.10$, $p = 0.04$, $\eta^2 = 0.003$; see Figure 2.

In the home context, perceived ethicality was higher for a robot with HITL oversight ($M = 4.58$, $SD = 2.40$) than for a fully autonomous robot ($M = 4.34$, $SD = 2.60$), $t(992) = -2.13$, $p = 0.03$, $d = -0.19$. In the restaurant context, however, perceived ethicality did not differ significantly between a fully autonomous robot ($M = 4.57$, $SD = 2.55$) and a robot with HITL oversight ($M = 4.49$, $SD = 2.49$), $t(992) = 0.74$, $p = 0.46$, $d = 0.07$. H4 received only partial support: the home-side pattern was consistent with expectations, whereas the restaurant-side pattern was not supported in the two-way test.

We then tested H5 by examining whether the context-dependent governance effect itself depended on social presence

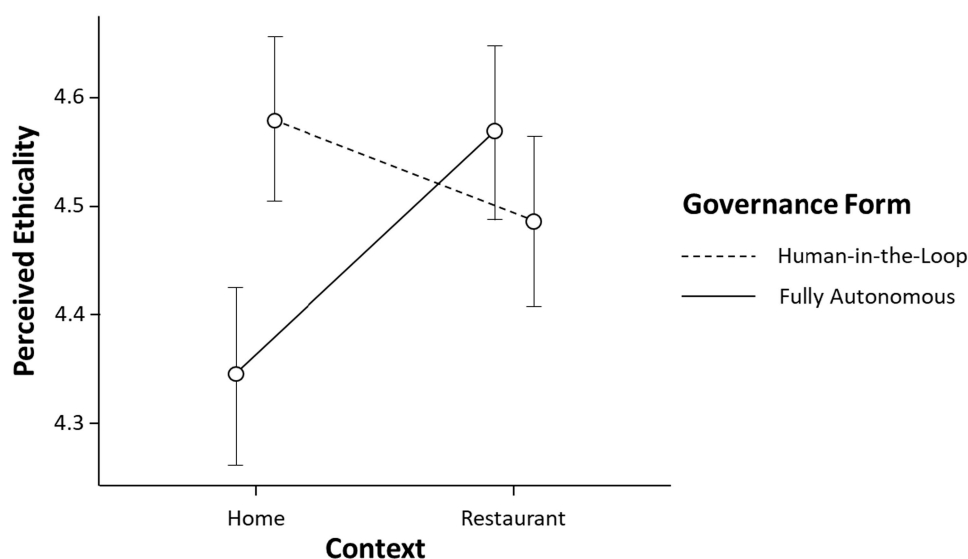


FIGURE 2 | Perceived ethicality as a function of context and governance form.

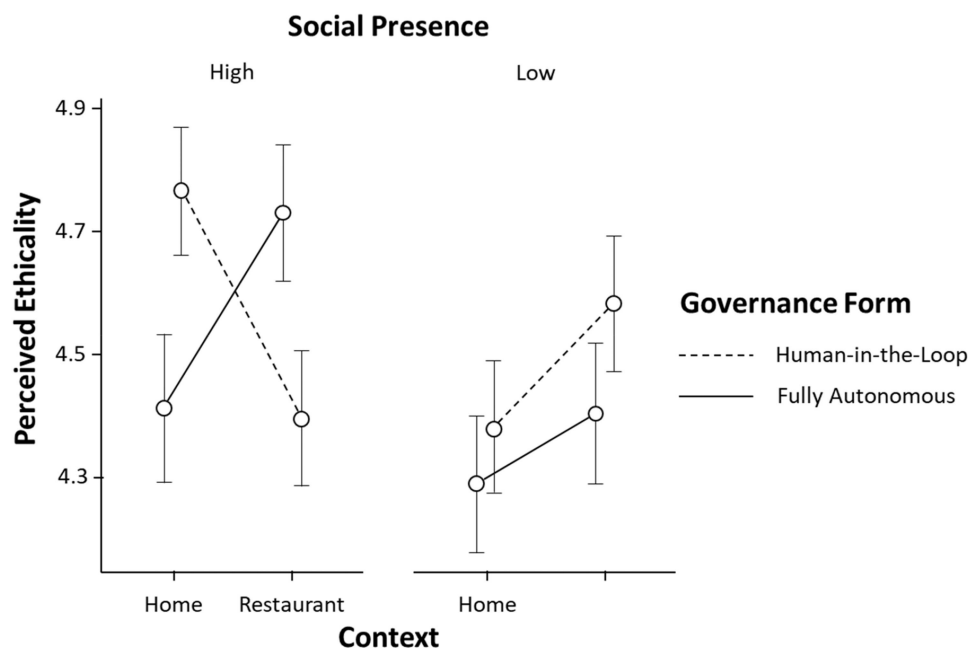


FIGURE 3 | Perceived ethicality as a function of context, governance form, and social presence.

(Figure 3). A three-way ANCOVA revealed a nonsignificant main effect of context, $F(1, 988) = 0.70$, $p = 0.40$, $\eta^2 = 0.000$, a nonsignificant main effect of governance form, $F(1, 988) = 0.86$, $p = 0.35$, $\eta^2 = 0.001$, and a significant main effect of social presence, $F(1, 988) = 4.24$, $p = 0.04$, $\eta^2 = 0.003$, and a significant interaction between context, governance form, and social presence, $F(1, 988) = 6.06$, $p = 0.01$, $\eta^2 = 0.004$.

Under high social presence, the context-dependent effect of governance form on perceived ethicality clearly emerges. In the home context, perceived ethicality was higher for a robot with HITL oversight than for a fully autonomous robot ($M_{\text{HITL}} = 4.76$, $SD = 3.31$; $M_{\text{FA}} = 4.41$, $SD = 3.81$), $t(988) = -2.23$, $p = 0.03$, $d = 0.29$. In the restaurant context, the pattern reversed: perceived ethicality was higher for a fully autonomous robot than for a robot with HITL oversight ($M_{\text{FA}} = 4.73$, $SD = 3.54$; $M_{\text{HITL}} = 4.39$, $SD = 3.50$), $t(988) = 2.14$, $p = 0.03$, $d = 0.27$. By contrast, under low social presence, governance form no longer produced significant differences in either context. In the home context, perceived ethicality did not differ significantly between HITL oversight ($M = 4.38$, $SD = 3.47$) and full autonomy ($M = 4.28$, $SD = 3.54$), $t(988) = -0.60$, $p = 0.55$, $d = -0.08$. Similarly, in the restaurant context, perceived ethicality did not differ significantly between full autonomy ($M = 4.40$, $SD = 3.63$) and HITL oversight ($M = 4.58$, $SD = 3.52$), $t(988) = -1.13$, $p = 0.26$, $d = -0.14$. These results directly support H5: the context-dependent effect of governance form on perceived ethicality is stronger when the robot has high social presence than when it has low social presence.

6.4.3 | Behavioral Intention

We next tested whether the indirect effect of service context on behavioral intention through perceived ethicality varied by governance form. Using PROCESS in R (Model 7; full results in Appendix 3, Model 1), the index of moderated mediation was significant (index = 0.18, $p < 0.05$, 95% CI [0.0063, 0.3700]),

indicating that the indirect effect identified in Study 1 differs across governance forms. Specifically, under a fully autonomous governance form, the restaurant context indirectly increased behavioral intention through perceived ethicality relative to the home context ($b = 0.13$, $p < 0.05$, 95% CI [0.0010, 0.2603]). Under HITL oversight, the corresponding indirect effect was negative and nonsignificant ($b = -0.18$, $p > 0.05$, 95% CI [-0.1790, 0.0639]). These findings are consistent with H4, showing that the context-dependent ethicality mechanism varies by governance form.

We then tested whether this moderated mediation pattern itself depended on social presence. Using PROCESS in R (Model 11; full results in Appendix 3, Model 2), the index of moderated mediation was significant (index = 0.45, $p < 0.05$, 95% CI [0.0897, 0.7932]). The conditional moderated mediation index was significant when social presence was high (index = 0.40, $p < 0.05$, 95% CI [0.1339, 0.6487]) but not when it was low (index = -0.05, $p > 0.05$, 95% CI [-0.3012, 0.1949]). Under high social presence, the restaurant context indirectly increased behavioral intention when the robot operated under a fully autonomous governance form ($b = 0.18$, $p < 0.05$, 95% CI [0.0021, 0.3685]), but indirectly decreased behavioral intention when the robot operated under HITL oversight ($b = -0.21$, $p < 0.05$, 95% CI [-0.3973, -0.0357]). Under low social presence, this context-dependent indirect pattern disappeared. Taken together, these results are consistent with H5: the context-dependent effect of governance form on perceived ethicality, and through it on behavioral intention, is stronger when social presence is high than when it is low.

7 | Study 3—Exploratory Topic-Based Mechanisms

7.1 | Research Design

Study 3 was designed as an exploratory follow-up to Studies 1 and 2. Using the same 2 (context: restaurant vs. home)

between-subjects design as in Study 1, we collected open-ended responses after exposure to the matched restaurant versus home videos. This allowed us to examine whether participants emphasized different considerations across contexts while holding the robot and task constant.

7.2 | Sample

300 US-based adult participants were recruited through Prolific (eligibility required US residency, age 18 or older, and attention-check completion). No respondents were excluded due to failed attention checks or incomplete responses. Participants were on average 46.1 years old ($SD = 15.85$), and 51.0% self-identified as women.

7.3 | Measures

All constructs were measured using established 7-point Likert-type scales adapted from prior research. Behavioral intention (dependent variable) was assessed using items from Venkatesh et al. (2012) (e.g., “I am likely to use this type of service robots in the future”). User innovativeness (control variable) was assessed using items from Steenkamp and Gielens (2003) (“If I hear about a new technology, I like to try it”). The complete psychometric properties—including reliability, convergent validity, and discriminant validity—are presented in Appendix 2 and Appendix 3.

7.4 | Results

7.4.1 | Neural Topic Modeling

We analyzed responses to the open-ended question using neural topic modeling (BERTopic in Python; Grootendorst 2022). Study 3 was not intended as a fully bottom-up rediscovery of the earlier theoretical model, but as an exploratory extension grounded in the focal evaluative domain identified in Studies 1 and 2. We therefore used a guided exploratory topic-modeling approach, anchored in the ethicality domain (derived from Olson et al. 2016) but allowing context-specific themes to emerge from participants' own language. Following best practices, we computed Sentence-BERT embeddings, reduced dimensionality with UMAP, identified clusters via HDBSCAN, and derived topics using class-based TF-IDF. We retained the 10-topic solution because it offered the most interpretable balance between thematic granularity and semantic redundancy. Appendix 5 reports the resulting topics, their counts, salient terms, and representative responses.

7.4.2 | Perceived Ethicality-Seeded Topics

We examined the effects of context (controlling for covariates) on the ten perceived-ethicality-seeded topics to assess how the manipulation altered topic salience. Topic-wise ANCOVAs revealed four significant main effects of context. Practical utility was more prevalent in the home context ($M = 0.13$, $SD = 0.24$) than in the restaurant context ($M = 0.04$, $SD = 0.03$), $F(1, 295) = 22.40$, $p < 0.001$, $\eta^2 = 0.070$. Privacy concerns were also more prevalent in the home context ($M = 0.07$, $SD = 0.16$) than in the restaurant context ($M = 0.04$, $SD = 0.03$), F

$(1, 295) = 6.94$, $p = 0.01$, $\eta^2 = 0.023$. Conversely, dining innovation was more prevalent in the restaurant context ($M = 0.08$, $SD = 0.18$) than in the home context ($M = 0.04$, $SD = 0.03$), $F(1, 295) = 6.32$, $p = 0.01$, $\eta^2 = 0.021$. Similarly, childlike entertainment was more salient in the restaurant context ($M = 0.07$, $SD = 0.16$) than in the home context ($M = 0.04$, $SD = 0.03$), $F(1, 295) = 4.70$, $p = 0.03$, $\eta^2 = 0.016$.

7.4.3 | Behavioral Intention

We modeled the ten perceived-ethicality-seeded topics as parallel mediators of the effect of context on behavioral intention using PROCESS (Model 4) with 5000 bootstrapped samples. Two significant indirect effects of restaurant (vs. home) context emerged: a negative effect via practical utility ($b = -0.15$, $p < 0.05$, 95% CI $[-0.3056, -0.0249]$) and a positive effect via dining innovation ($b = 0.08$, $p < 0.05$, 95% CI $[0.0083, 0.1820]$). These findings suggest that the two contexts activate different evaluative pathways. In restaurants, utility is expressed mainly in terms of organizational efficiency, standardization, and smooth service execution, whereas in homes it takes a more personal and experiential form centered on everyday help, convenience, and support. Study 3 therefore refines the earlier argument by showing that utility is not absent from public settings, but takes a different meaning across contexts. A contrast test further showed that the indirect effect through practical utility was significantly stronger than the indirect effect through dining innovation ($b = -0.23$, $p < 0.05$, 95% CI $[-0.4476, -0.0585]$).

8 | Discussion

8.1 | Discussion and Theoretical Contributions

The three studies yield three connected theoretical contributions. Study 1 establishes the baseline ethicality mechanism, Study 2 identifies its boundary conditions, and Study 3 provides exploratory evidence on the content mechanisms underlying these effects.

Our first contribution is to show that consumers do not evaluate robot governance in the abstract, but interpret the same governance cue differently across contexts (Nissenbaum 2010). In line with AI-service research (Wirtz et al. 2018; Paluch and Wirtz 2020), identical robotic capabilities are judged through different normative lenses across public, transactional venues and private, intimate homes. In the home, retained HITL oversight communicates answerability and recourse (Dietvorst et al. 2015; Bigman and Gray 2018; Longoni et al. 2019). In the restaurant, full autonomy communicates competence and operational fluency, especially when the robot is socially present enough to make governance morally diagnostic (Huang and Rust 2018; Lin et al. 2024; Liu et al. 2024).

Our second contribution is conceptual. We treat perceived ethicality not as a synonym for trust or satisfaction, but as a legitimacy judgment concerning whether the robot operates appropriately, fairly, and accountably in the focal setting (Suchman 1995). This framing helps explain why contextual and governance cues carry forward into intention to use (Araujo et al. 2020; McLeay et al. 2021; Etemad-Sajadi et al. 2022), and

why the same robot can be embraced publicly yet scrutinized privately (Castelo et al. 2023). Our findings further suggest that this mechanism operates at two related levels. When social presence is high, consumers are more likely to treat the robot as a proximate moral actor and ask whether its behavior is appropriate, supervised, and answerable. At the same time, especially in public service settings, they may also interpret the deployment as a governance choice made by the provider. In this sense, perceived ethicality concerns not only the robot itself, but also the legitimacy of the broader deployment configuration within which it operates.

Our third contribution is to show that autonomy and HITL oversight become ethically diagnostic chiefly when the robot is sufficiently social to be treated as an intentional other (Waytz et al. 2014; Van Doorn et al. 2017; Kätsyri et al. 2015; Kühne and Peter 2023). Social presence is therefore not simply an additive design feature, but changes the meaning of governance by determining whether consumers process the robot as an intentional social actor or as a functional tool. Under high social presence, users apply moral standards and differentiate between unsupervised and supervised agency; under low presence, governance-form cues lose much of their ethical force (Pitardi et al. 2022; Holthöwer and Van Doorn 2023).

8.2 | Managerial Implications

For managers, the findings translate into three practical decisions. First, robot governance form should be aligned with context. In public, transactional venues such as restaurants and hotels, higher autonomy can be deployed where it improves speed and consistency, provided that accountability remains visible through clear supervision and escalation points. In private or assistive home settings, HITL oversight should be the default so that accountability, recourse, and human supervision remain salient. More broadly, firms should specify which tasks may run autonomously and which require authorization or escalation, in line with contextual integrity norms.

Second, firms should calibrate social presence and communicate legitimacy. In restaurants, this means brief, engaging, and non-intrusive interactions that avoid over-humanization; in homes, it means respectful, low-intrusion behaviors, explicit boundary acknowledgment, and predictable turn-taking. Transparency should be the default: firms should disclose capabilities, limitations, data practices, and motives, frame deployments as augmenting rather than replacing staff, and provide users with clear controls and understandable logs of sensing, decisions, and supervision.

Third, firms should treat social robot adoption as a legitimacy journey that requires ongoing measurement. Ethicality-related indicators should be monitored alongside operational metrics, and field pilots should vary autonomy, oversight visibility, and social presence while holding the task constant. In restaurants, managers may emphasize dining innovation, whereas in homes they should foreground practical utility and user control. More broadly, governance arrangements and social presence should be revisited as contexts and norms evolve.

8.3 | Limitations and Future Research

This research has several limitations. First, although several effects are statistically significant, their magnitude is modest and should therefore be interpreted as directional evidence of context-sensitive ethical appraisal rather than as large behavioral shifts. Second, the studies rely on US-based online panels and vignette/video exposures to matched restaurant versus home scenarios, which may limit external validity and cultural generalizability. Third, governance form was operationalized as a binary contrast and social presence as a relatively coarse manipulation, whereas real deployments involve more graded and situationally contingent configurations. Fourth, perceived ethicality was measured via self-report; although consistent with legitimacy theory, such measures may diverge from behavioral indicators and from the perceptions of stakeholders beyond end users.

The social-presence manipulation also produced a moderate rather than extreme perceptual shift. This cautions against overclaiming its strength, but also suggests that even modest changes in perceived social presence may be sufficient to make governance cues more ethically diagnostic. Future studies should therefore use stronger multimodal manipulations and pretests to identify threshold effects more precisely. The comparatively strong role of user innovativeness further suggests that contextual ethical judgments coexist with stable individual differences in openness to new technologies.

More broadly, although the restaurant and home stimuli were matched as closely as possible, vignette and video methods cannot fully eliminate environmental confounds. Future research should therefore use stronger stimulus pretests, tighter environmental control, and, where feasible, field-based designs using identical robots across real service settings. Longitudinal and high-ecological-validity designs would also help track how ethical judgments evolve over time, including post-error reactions and recovery processes. Cross-cultural replications and multi-stakeholder samples, including customers, caregivers, and employees, are needed to map boundary conditions tied to norms, power, and role expectations. Extending beyond dining, researchers should also test the framework in premium retail, high-touch services, healthcare, and assistive settings.

Methodologically, future work should unpack governance form and social presence as multi-level constructs by comparing different HITL variants, transparency modalities, and forms of presence calibration. Mixed methods combining ethnography, interaction logs, and experiments could further triangulate perceived ethicality with behavioral and physiological markers. Finally, scale development and validation across contexts should continue refining perceived ethicality as a legitimacy construct, distinguishing it more clearly from trust and satisfaction and clarifying its causal role in adoption and continued use.

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The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data available on request from the authors.

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TABLE A1 | Selective synthesis of prior research relevant to the present model.

Authors	Theoretical lens	Focal outcome	Evidence type	Main insights	Gaps
Nissenbaum (2010)	Contextual integrity and normative fit	Ethical acceptability; contextual norms	Conceptual	Appropriateness depends on context-specific norms	Lacks empirical tests
Waytz et al. (2014)	Anthropomorphism mind attribution and morality	Trust; morality; mind attribution	Lab/field studies	Mind attribution increases trust and moral concern	Not specific to service robots or home/public settings
Kätsyri et al. (2015)	Social presence and human-likeness calibration	Liking; eeriness; human-likeness	Meta-analysis	Human-likeness must be carefully calibrated	Lacks empirical tests
Dietvorst et al. (2015)	Algorithm aversion and human oversight	Human versus algorithm choice	Experiments	Errors increase preference for human oversight	No service-robot context; ethics not directly measured
Van Doorn et al. (2017)	Automated social presence	Customer engagement; social presence	Conceptual	Robots trigger social responses similar to humans	Lack empirical tests on ethics and legitimacy
Huang and Rust (2018)	Service automation and autonomy	Service outcomes; automation	Conceptual	Higher autonomy signals efficiency and reliability	Lacks empirical tests
Wirtz et al. (2018)	Service robots in frontline services	Trust; well-being; adoption	Integrative review	Ethics, trust, well-being impact adoption	Lacks empirical tests
Bigman and Gray (2018)	Moral acceptability of machine decisions	Moral acceptability; autonomy versus oversight	Experiments	Preference human involvement in moral decisions	Lack of Contextual moderators
Mende et al. (2019)	Social presence and anthropomorphism	Acceptance; humanness/social presence	Experiments	Humanness improves and over-humanization backfires acceptance	Lack of Ethicality
Longoni et al. (2019)	Algorithm aversion	Willingness to use AI; human versus AI provider	Experiments	Human involvement preferred due to empathy/ethics	Healthcare context only
Paluch and Wirtz (2020)	Contextual contingencies in service robots	Customer responses; robot role; context	Conceptual review	Robot evaluations depend on context	Lack focus moral/ethical evaluation
Araujo et al. (2020)	Transparency, fairness, legitimacy	Fairness; trust; transparency	Surveys/experiments	Transparency and oversight increase fairness and ethicality	Focus on AI systems, not embodied service robots
McLeay et al. (2021)	Legitimacy and transparency of service robots	Trust; adoption; fairness	Survey	Transparency and augmentation framing improve acceptance	Lack focus public versus private settings
Pitardi et al. (2022)	Mind attribution and embarrassment reduction	Preference; adoption; agency	Experiments	Robots reduce embarrassment as less judgmental	Autonomy and oversight not manipulated
Park et al. (2021)	Trust-based acceptance	Adoption; quality; trust	Survey	Trust links service quality to adoption	Lack focus Ethics and oversight

(Continues)

TABLE A1 | (Continued)

Authors	Theoretical lens	Focal outcome	Evidence type	Main insights	Gaps
Song and Kim (2022)	Computer-as-social-actors	Acceptance; social capability; usefulness	Survey	Social capability and usefulness increase acceptance	Lack focus ethicality and legitimacy
Lin et al. (2024)	Autonomy and ethical appraisal	Ethical concerns; acceptance; autonomy	Experiments	Autonomy shapes ethical appraisal	Home versus restaurant contrast not tested
Castelo et al. (2023)	Service automation skepticism, legitimacy	Service evaluations; satisfaction	Lab + field experiments	Bot use trigger skepticism; transparency mitigate it	Does not isolate contextual ethical norms
Holthöwer and Van Doorn (2023)	Social presence and embarrassment reduction	Satisfaction; adoption; embarrassment	Survey	Social presence improves adoption in awkward encounters	Home versus restaurant contrast not tested
Borghini et al. (2023)	Service robot satisfaction	Satisfaction; robot deployment	Quasi-experiments	Robot deployment improves satisfaction	Lack ethicality and robot attributes
Liu et al. (2024)	Autonomy and dehumanization	Emotions; acceptance; autonomy	Experiments	Autonomy shapes emotions and acceptance	Lack Ethicality
Lin et al. (2026)	Ethical risk and adoption	Ethical risk perceptions; adoption	Scale development	Ethical concerns reduce adoption	Lack empirical validation in home settings

TABLE A2 | Measurement instruments and psychometric properties.

	Study 1		Study 2		Study 3	
	α	AVE	α	AVE	α	AVE
Perceived ethicality (Olson et al. 2016)	0.88	0.74	0.90	0.76	—	—
I would find this service robot cruel/kindhearted						
I would find this service robot immoral/moral						
I would find this service robot unethical/ethical						
User Innovativeness (Steenkamp and Gielens 2003)	0.80	0.64	0.85	0.66	0.79	0.60
If I hear about a new technology, I like to try it						
I am usually the first one to use a new technology in my entourage						
I feel able to use a new technology by myself						
Behavioral Intention (Venkatesh et al. 2012)	0.98	0.93	0.95	0.88	0.97	0.93
In view of their advantages, I intend to use this type of service robots in the future.						
Considering their advantages, if I had access to this type of service robots, I intend to use them						
I am likely to use this type of service robots in the future						

TABLE A3 | Descriptive statistics and HTMT discriminant validity.

		<i>M</i>	<i>SD</i>	<i>PE</i>	<i>UI</i>	<i>BI</i>
Study 1	PE	4.51	1.12	1.00		
	UI	4.77	1.24	0.47	1.00	
	BI	4.22	1.92	0.66	0.55	1.00
Study 2	PE	4.49	1.48	1.00		
	UI	4.42	1.56	0.60	1.00	
	BI	4.00	1.85	0.72	0.72	1.00
Study 3	UI	4.94	1.19	—	1.00	
	BI	4.18	1.85	—	0.41	1.00

TABLE A4 | PROCESS results for studies 1–2.

	Study 1		Study 2		
	<i>PE</i>	<i>BI</i>	<i>Model 1 PE</i>	<i>Model 2 PE</i>	<i>BI</i>
Focal variables					
Context	0.33**	0.13 ns	−0.10 ns	0.20 ns	−0.13 ns
Autonomy			−0.24*	−0.09 ns	
Context x autonomy			0.32*	−0.09 ns	
Social presence				0.39*	
Context x social presence				−0.57**	
Autonomy x social presence				−0.26 ns	
Context x autonomy x social presence				0.78*	
Perceived ethicality		0.80***			0.57***
Control variables					
Gender	−0.05 ns	0.15 ns	0.14 ns	0.15 ns	0.10 ns
Age	0.01 ns	0.01 ns	0.01***	0.01***	−0.01**
UI	0.38***	0.51***	0.52***	0.52***	0.46***
<i>R</i> ²	0.19	0.46	0.29	0.30	0.58

TABLE A5 | Guided topic modeling results: perceived ethicality-seeded topics representative responses are included as illustrative verbatim examples selected for their thematic fit with each topic (i.e., high HDBSCAN correlation coefficient).

Topic	Count	Construct	KeyBERT	Representative answers
0	50	Default topic	—	—
1	121	Service robots	Robots robot service helpful serving served futuristic human help helps	“The robot in the video is one that i would enjoy being served by. it does not have human or even quasi-human features. it serves as a service robot and is very entertaining the see and be served by it without being eerie.” “It would be helpful to have this service robot at home” “I think it would be helpful to have a service robot.”
2	35	Uncanny feelings	Weird strange unusual odd interesting surprise awkward creepy unique normal	“I would find it a bit strange at first. Not sure how to interact with it.” “I would find it rather strange and I don't think I would like it.” “I think that this situation would typically feel a little weird no matter what. I also think that it would be a little exciting because it would be something new.”
3	23	Practical utility	Useful helpful beneficial help hobby great definitely task would good	“I believe this will be good because it can help me out with some petty things i'm too lazy to do.” “I think it is efficient and adaptive. It makes my life easier and can help me with simple things” “I think this is going to be great! This could help free up some time for me to enjoy a hobby!”
4	19	Novel experience	Innovative innovating new experience novel unique interesting strange different fun	“it's interesting and new experience” “An innovative, new and unique experience.” “New and innovative, Unique experience.”
5	18	Automation impact	Service services serve waiter nice job bad waiters human kinda	“I think it's a really cool and convenient experience no matter what service they provide. I'm happy that it would be saving me time and effort.” “I think this would be extremely convenient, though for most tasks it seems like more of a luxury than a necessity as I would worry that for most services I am getting too lazy.” “It seems like this is less effective as a human waiter. I am sure it saves small businesses money but it isn't advanced enough to replace a person.”
6	13	Enjoyment	Fun interesting exciting excited curious would cool intrigued sounds will	“I like it this situation and would find it interesting, fun, and exciting in addition to helpful.” “It would be fun and it would make for good dinner conversation. I think I would like it.” “It would be fun and interesting”

(Continues)

TABLE A5 | (Continued)

Topic	Count	Construct	KeyBERT	Representative answers
7	6	Dining innovation	Restaurant restaurants interesting dining fascinating modern food table think cool	"I think it's fascinating to say the least. I love this and would definitely frequent the restaurant" "I think it's interesting and adds an element of entertainment to dining out although I worry about human job loss" "I think this is a normal thing and it can be something that is more relevant in more restaurants. I think this is a cool concept."
8	6	Privacy concerns	Privacy safety personal trust worry seems access devices fine me	"Convenient, but I'd worry about privacy, glitches, and safety." "It seems to be helpful but I'm a bit weary of the privacy aspect." "I'm not sure about this. May be a privacy issue. Not sure I could trust it."
9	5	Childlike entertainment	Toys kids children childish fun cool enjoy weird play stupid	"I think that it looks pretty cool and kids would enjoy it, but it moves very slow." "My kids were really excited about this and my son asked me to play it again, so it must be good!" "It seems stupid and childish. If it was for kids, fine, but as an adult, I don't want to play with toys. I want to interact with a person. »"
10	4	Social discomfort	Uncomfortable anxiety would feel antisocial idea if think okay prefer	"I would feel uncomfortable. I would not love the idea" "If it can record me or transmit video or audio, I'm uncomfortable." "i think its ok im antisocial so i would prefer it it would give me less anxiety odering"