WARMTH, COMPETENCE, OR BOTH? DUAL-PATHWAY CONCEPTUALISATION OF ROBOTIC RESTAURANT ENCOUNTER AND CUSTOMER REVISIT INTENTION

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Abstract. Service robots have become a routine presence in restaurants across Asia, yet customer responses to them remain ambivalent. Studies of service robots in hospitality typically bundle the attributes of the machine into a single quality score and regress satisfaction on it. Social cognition research suggests a different structure. People judge any agent, human or artificial, along two largely independent dimensions, competence and warmth, and these dimensions carry different emotional and behavioural consequences. This paper applies that logic to the robotic restaurant encounter and proposes a dual-pathway conceptual model. Robotic service quality and robotic efficiency are specified as competence cues, robotic anthropomorphism and robotic empathy as warmth cues; the two sets of cues form separate appraisals that jointly determine customer satisfaction and, through it, revisit intention. Eight propositions are advanced, including a non-monotonic relationship between anthropomorphism and perceived warmth, and two boundary conditions: cultural service expectations and the utilitarian or hedonic character of the dining occasion. The model offers a way of explaining why robots that perform flawlessly can still disappoint, and it treats the mixed case of a competent but cold robot as the commercially common outcome rather than a measurement anomaly. It also predicts that a service failure met with a warm response will damage satisfaction less than one met with correct but impassive handling. For operators, the framework gives a basis for allocating investment between the two pathways, separating competence attributes fixed at procurement from warmth attributes that can be staged after deployment. For researchers, it specifies a validation strategy combining experimental manipulation with survey-based estimation.
Keywords: *service robots, warmth and competence, anthropomorphism, artificial empathy, customer satisfaction, revisit intention*

Introduction

Service robots are now a routine presence in restaurants across Asia, taking orders, delivering food and clearing tables (Cheng et al., 2026; Choi et al., 2020). In Malaysia, their spread is driven by a labour shortage in the food and beverage sector (Ibrahim et al., 2024) and reinforced by policy encouraging automation in services (Vafaei-Zadeh et al., 2024). The operational logic is clear; the customer response is not. The same

machine that one guest finds efficient and novel, another finds cold, untrustworthy or out of place at a meal (Chi et al., 2023; Song et al., 2022). Research has largely met this ambivalence by refining the measurement of robotic service quality. A recently validated scale treats task efficiency and artificial empathy as dimensions of robotic service quality that jointly explain a large share of variance in satisfaction (Hacikara et al., 2026). The advance is substantial, but it presumes that customers integrate a robot's attributes into a single judgement. Social cognition research suggests they do not.

Across four decades of work on person perception, judgements of social agents resolve onto two near-orthogonal dimensions: warmth, which concerns perceived intent, and competence, which concerns the capacity to act on that intent (Fiske et al., 2002). The two are inferred from different cues and carry different emotional consequences. The same structure should hold in robotic encounters, since people attribute human characteristics to non-human agents readily (Epley et al., 2007), and automated social presence in the frontline makes social perception, not only technology acceptance, the relevant frame (van Doorn et al., 2017). This paper develops that argument into a conceptual model of the robotic restaurant encounter. Robotic service quality and robotic efficiency are assigned to a competence pathway, and robotic anthropomorphism and robotic empathy to a warmth pathway. Each set forms its own appraisal; the two appraisals jointly determine satisfaction, which in turn shapes revisit intention. The model is meant to explain what a single-index treatment cannot: why a robot can execute a service episode without fault and still leave the guest unwilling to return.

Theoretical background

Warmth and competence as universal dimensions

The stereotype content model holds that perceivers assess any social target on warmth and competence, that the two dimensions are largely independent, and that most targets are rated highly on one and poorly on the other (Fiske et al., 2002). Applied to service, it predicts that a provider judged competent but cold will elicit a different response from one judged warm but ineffectual, even where an overall quality score would be identical. Extending this to machines requires only that customers treat robots as social agents, and the evidence that they do is substantial. Anthropomorphic attribution is a default rather than an exception (Epley et al., 2007), frontline automation creates a sense of social presence that changes how service is experienced (van Doorn et al., 2017), and human-like cues lead customers to engage with machines much as they would with staff (Wirtz et al., 2018). Social exchange framing points the same way, treating robotic encounters as exchanges in which both instrumental and relational returns are assessed (Kim et al., 2022).

Why acceptance models under-specify the encounter

The dominant alternative treats the robot as a technology to be adopted and explains response through perceived usefulness, ease of use and performance expectancy (Saeed et al., 2026; Vafaei-Zadeh et al., 2024). Yet a diner does not decide to adopt the robot, and often has no choice in the matter once seated. What the diner does is form an impression of an agent that arrives at the table, performs and leaves, and impressions of agents are structured by warmth and competence (van Doorn et al., 2017; Fiske et al., 2002). This is why acceptance-based accounts explain functional attributes well but

struggle with affective ones (Choi et al., 2020), and why calls to integrate the emotional and relational dimensions of robotic dining have grown more insistent (Ghazali et al., 2025).

The robotic restaurant encounter as a dual-signal environment

Restaurants are a demanding test of this structure because they emit both kinds of signal continuously. The robot's navigation, timing and accuracy speak to competence (Cao et al., 2025); its form, voice, greeting behaviour and response to a guest's mood speak to warmth (Premathilake et al., 2024; Zhang et al., 2022). The machine is co-present for the whole meal and works alongside human staff whose warmth provides an implicit benchmark (Hu and Min, 2026). Existing findings already cluster this way without being theorised as such: speed of service dominating satisfaction (Sharma et al., 2023; El-Said and Al Hajri, 2022), artificial empathy driving intimacy and bonding (Weng et al., 2026; Zhu et al., 2025), and authenticity concerns where robots disturb the ritual of a traditional meal (Cheng et al., 2026). The Malaysian case sharpens the contrast. Robots have entered the food and beverage sector largely in response to a labour shortfall (Ibrahim et al., 2024), so the competence case for deployment is made before any customer is consulted. Yet the same market, and Penang in particular, sustains a dining culture in which attentiveness is part of what is being bought (Hin et al., 2024). Deployment decided on competence grounds therefore lands in a market that also evaluates warmth.

A dual-pathway model

Competence cues and perceived competence

Robotic service quality, understood as the efficiency, expediency and adaptability perceived during the interaction, and robotic efficiency, understood as the capacity to execute functions with precision and sustained concentration (Hacikara et al., 2026), are diagnostic of capability rather than intent. Delivery time, routing accuracy and recovery from obstruction require no interpretation by the guest. Performance expectancy operates similarly in adoption research (Saeed et al., 2026), and service quality has long been linked to behavioural outcomes through evaluative judgement (Zeithaml et al., 1996).

P1: Robotic service quality and robotic efficiency are positively associated with perceived robotic competence.

Warmth cues and perceived warmth

Anthropomorphism and empathy are diagnostic of intent. Human-like form, voice and responsiveness invite customers to read the machine as a social counterpart (Premathilake et al., 2024; Zhang et al., 2022), while artificial empathy, whether specified as perspective taking and empathic concern (Weng et al., 2026), as adaptation to affective states (Zhu et al., 2025) or as the computational codification of empathy (Guo et al., 2026), signals orientation toward the guest. That these displays are simulated does not weaken the inference customers draw from them; meta-analytic evidence shows anthropomorphism raising perceptions of intelligence and safety as well as satisfaction (Blut et al., 2021).

P2: Robotic anthropomorphism and robotic empathy are positively associated with perceived robotic warmth.

Appraisals and satisfaction

Both appraisals should contribute to satisfaction, but through different mechanisms. Competence satisfies the instrumental terms of the exchange, lowering the effort and uncertainty the guest absorbs (Kim et al., 2022), and it carries most of the current restaurant evidence (Hacikara et al., 2026; Sharma et al., 2023; El-Said and Al Hajri, 2022). Warmth satisfies the relational terms, supplying the social presence that makes a meal feel hosted rather than dispensed (Weng et al., 2026; van Doorn et al., 2017). Separating them predicts a pattern that a combined index obscures: high competence with low warmth should yield adequate but unenthusiastic evaluations, the robotic analogue of service that is correct without being hospitable.

P3: Perceived robotic competence is positively associated with customer satisfaction.
P4: Perceived robotic warmth is positively associated with customer satisfaction.
P5: Customer satisfaction is positively associated with revisit intention.

Mixed appraisals and their consequences

The value of separating the pathways lies in what happens when they diverge, since each combination of warmth and competence carries a distinct emotional signature (Fiske et al., 2002). Four configurations follow (Table 1). A robot judged competent and warm should produce the strongest satisfaction and revisit intention. A competent but cold robot, which describes most tray-delivery units, should produce acceptance without attachment: nothing is wrong, and nothing recommends return over a substitute. A warm but incompetent robot should produce affection alongside frustration, with revisit depending on how far the occasion tolerates delay. A robot low on both should be avoided. A single-index model predicts only the first and last; the middle two, the commercially common cases, are where the dual-pathway specification earns its keep.

Table 1. *Predicted responses by appraisal configuration.*

Configuration	Illustrative deployment	Predicted response
High competence, high warmth	Expressive unit performing reliably in an unhurried dining room	Strongest satisfaction; revisit intention supported by both pathways
High competence, low warmth	Tray-delivery unit on a high-volume floor	Adequate satisfaction without attachment; revisit contingent on price and convenience
Low competence, high warmth	Expressive unit on a congested or poorly mapped floor	Amusement offset by frustration; revisit sensitive to the tolerance of the occasion
Low competence, low warmth	Under-specified unit in a high-expectation setting	Dissatisfaction and avoidance of the outlet rather than of the robot alone

The non-monotonicity of anthropomorphic warmth

The warmth pathway carries a qualification the competence pathway does not. Affinity for a humanlike entity rises with human likeness up to a point, then falls sharply before recovering: the uncanny valley (Mori et al., 2012). Service research describes anthropomorphism as a dual-natured trigger that can attract approval or criticism (Yang et al., 2024) and reports effects that attenuate at high human likeness (Blut et al., 2021), a risk sharpened in restaurants by the proximity and duration of the encounter. The anthropomorphism–warmth relationship is therefore better specified as

concave than linear, while empathy, being behavioural rather than morphological, should not carry the same penalty.

P6: The relationship between robotic anthropomorphism and perceived robotic warmth is non-monotonic, with warmth declining beyond a threshold level of human likeness.

Cultural service expectations

The relative weight of the two pathways should depend on what customers expect service to be. Acceptance of artificially intelligent service robots varies systematically with trust and cultural orientation (Chi et al., 2023), and Malaysian food and beverage service carries a strong expectation of personalised attention that robotic deployment necessarily disturbs (Ibrahim et al., 2024). Where norms emphasise relational care, warmth should weigh more heavily; where they emphasise speed and price, competence should dominate. This explains cross-national inconsistency in the literature without appealing to measurement differences.

P7: Cultural service expectations moderate the appraisal–satisfaction relationships, such that the effect of perceived warmth is stronger where norms emphasise personalised care.

The dining occasion

Occasion type should matter for the same reason. Anthropomorphic robots produce different attitudinal responses in fine-dining and quick-service settings (Qian and Wan, 2024), and the components of value that drive satisfaction shift with the hedonic or utilitarian framing of the visit (Ghazali et al., 2025; Seo and Lee, 2025). A guest collecting a quick lunch is buying throughput; a guest marking an occasion is buying an experience in which being attended to be part of the product.

P8: The dining occasion moderates the appraisal–satisfaction relationships, such that perceived competence weighs more heavily in utilitarian occasions and perceived warmth in hedonic occasions.

Theoretical contribution

The model (*Figure 1*) reframes an established question. Instead of asking which robot attributes predict satisfaction, it asks how customers organise those attributes before evaluating them, drawing on social perception rather than technology acceptance. Three consequences follow. Mixed evaluations become expected rather than anomalous, since high competence with low warmth is a stable quadrant rather than a measurement failure. Inconsistent findings across countries and formats gain a candidate explanation in the differential weighting of pathways. And the non-monotonic warmth pathway predicts what linear models cannot: that greater human likeness can reduce satisfaction while raising every other favourable perception. The framework also clarifies what recent scale development settles. Treating task efficiency and artificial empathy as dimensions of one construct is defensible as measurement (Hacikara et al., 2026), but less so as a model of cognition if the two are processed through different appraisals. Composite scores can then arise from opposite configurations, which may explain why

reported effects of robotic service quality vary so widely across formats and countries (Seo and Lee, 2025; Sharma et al., 2023; El-Said and Al Hajri, 2022).

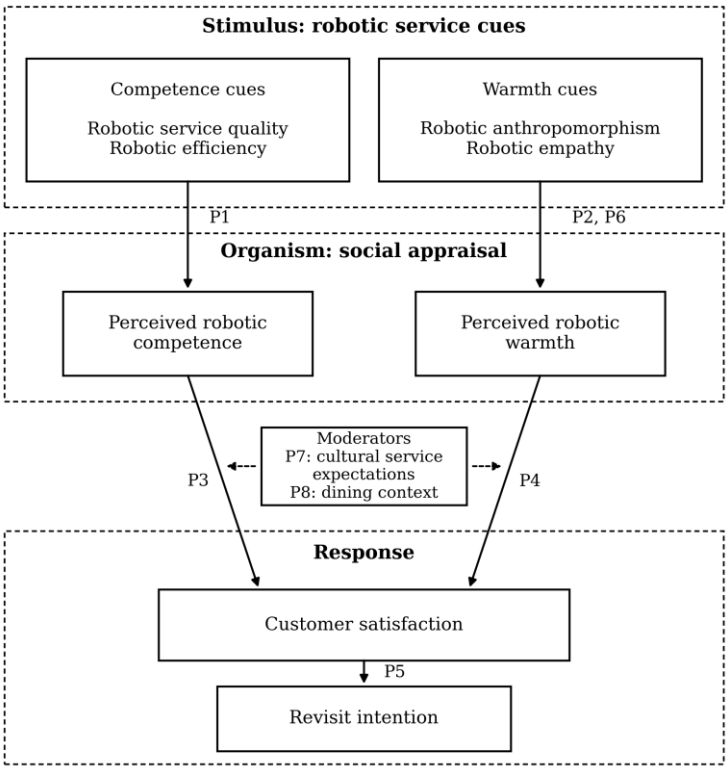


Figure 1. *Dual-pathway model of competence and warmth appraisals in the robotic restaurant encounter.*

Implications for service recovery

Service failure is where the two pathways come apart most sharply. A delayed or misdelivered order is a competence failure, but the guest's subsequent evaluation depends on the response, which is read as evidence of intent. Artificial empathy has shown its clearest effects in recovery settings, supporting constructive rather than punitive customer behaviour (Guo et al., 2026) and improving interaction satisfaction even after anthropomorphism was controlled (Weng et al., 2026). The model therefore predicts that a competence failure met with a warm response will damage satisfaction less than one met with correct but impassive handling, although warmth cannot substitute for repeated competence failure, since the instrumental terms of the exchange remain unmet (Kim et al., 2022). The practical reading is that robots may be permitted to fail, but not to handle the failure: routing recovery to human staff protects the warmth pathway at the moment it carries the most weight.

Managerial implications

For operators, the practical value lies in allocation. Competence is largely purchased: navigation, payload, battery endurance and error rates are specified at procurement and improve with capital. Warmth is largely designed and staged: greeting behaviour, voice, timing and the choreography between robot and staff cost less to change and can be adjusted after deployment. If warmth carries independent weight, operators can improve

outcomes without buying a better machine, by scripting greeting and handover behaviour, timing the robot's approach to the rhythm of the table and deciding which moments of the meal a human should own. The occasion-based moderation adds a second rule: deploy competence-weighted configurations where throughput is the product, and preserve human contact at the relational moments of a hedonic meal. For developers, the non-monotonicity result argues against treating human likeness as a specification to maximise.

Scope conditions

The model applies to co-present service robots in dine-in settings, where the machine is visible to the guest and works alongside human staff; it does not cover kiosks, kitchen automation or conversational agents, whose warmth cues are absent or linguistic (Guo et al., 2026). It rests on two testable assumptions: that the guest reads the robot as an agent rather than as equipment, failing which a competence-only model should fit better (Epley et al., 2007), and that the guest has a choice of outlet, which makes revisit intention meaningful.

Validation strategy

Testing the model requires both manipulation and measurement. The non-monotonic proposition is best addressed experimentally, exposing diners to robots at graded levels of human likeness and estimating a quadratic term, since field data will rarely span the required range. The remaining propositions suit a survey of diners with genuine robot-service experience, which avoids the hypothetical bias of scenario-based designs (Hacikara et al., 2026). Penang provides a workable setting, combining an established dining economy (Hin et al., 2024) with documented robot adoption (Ibrahim et al., 2024). Cue measures can be adapted from the robotic service quality scale (Hacikara et al., 2026) and service-robot anthropomorphism items (Yang et al., 2024); appraisal measures from warmth and competence scales adapted to a machine target (Fiske et al., 2002); and satisfaction and revisit intention from validated restaurant instruments (Kim et al., 2013; Grissemann and Stokburger-Sauer, 2012). Partial least squares structural equation modelling accommodates the higher-order specification and the quadratic term, with discriminant validity assessed through the heterotrait–monotrait ratio (Henseler et al., 2015), and moderation through multi-group analysis across formats and countries (Chi et al., 2023). Two measurement cautions apply. Warmth and competence items were written for human targets, so pre-testing and cognitive interviewing should precede full administration. And because cue and appraisal measures come from the same respondent at the same moment, common method variance threatens the mediation claims; procedural separation of the measurement blocks and a marker-variable assessment are the minimum response.

Conclusion

Whether a restaurant robot succeeds is usually framed as a question of performance. This paper has argued that it is also a question of perceived intent, and that the two are judged separately. Specifying competence and warmth as parallel appraisals, with a concave warmth pathway and two boundary conditions, yields eight propositions that are testable with existing methods and that make predictions a single-index model

cannot. The pattern the framework is designed to explain is a familiar one in practice and an awkward one in theory: a machine that does everything right and is still not missed.

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Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

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