



Guest Perception in using Service Robots in the Restaurant Industry

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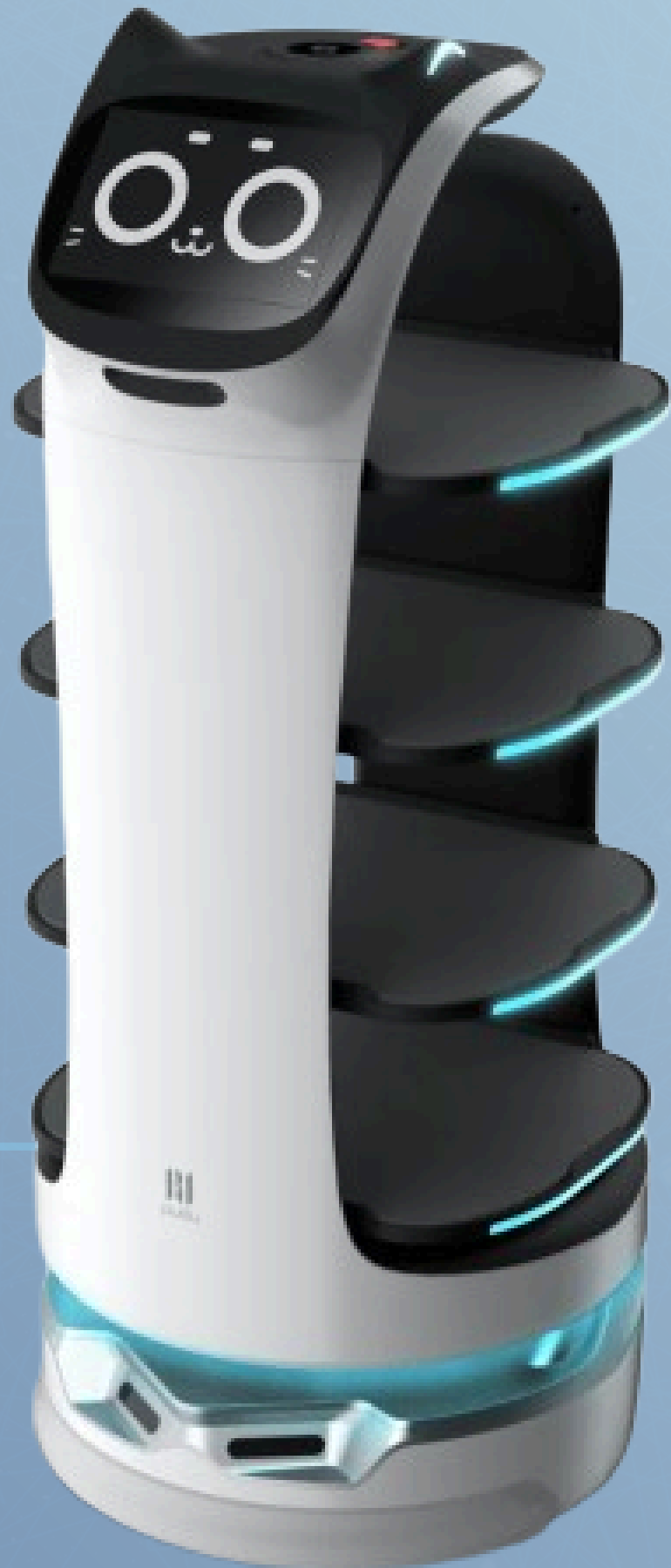


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Introduction





Research Motivation

Restaurants are increasingly using **service robots**, yet customer responses remain mixed, with excitement and enjoyment coexisting with concerns that influence their intention to use robot-assisted services (Çalışkan & Sevim, 2025; Seo & Lee, 2021).

Customer acceptance still depends on **trust, perceived risk, and satisfaction**, which directly influence **revisit intention and acceptance** in robot-service restaurants (Seo & Lee, 2021). Research also shows that customers' perceptions of **AI robot service quality** (e.g., automation, personalization, efficiency and precision) and robot **anthropomorphism** affect customer engagement and, in turn, **customer acceptance**, underscoring the need to understand how guests evaluate robot-assisted dining (Shah et al., 2023).



Service Robots

The global restaurant service robot market is accelerating rapidly, valued at over US\$1.18 billion and projected to reach US\$4.1 billion by 2032. Driven by labor shortages and rising operating costs, these automated solutions save restaurants 30% to 70% in direct labor expenses and allow servers to serve 30% to 50% more tables per shift.



Research Gaps

Although prior studies have examined various service robot attributes in hospitality and restaurant contexts, existing research has primarily focused on functional attributes, such as reliability and competence, and emotional attributes, particularly anthropomorphism (Tuomi et al., 2021; Seo & Lee, 2021). **Little attention has been given to the hygiene-related attribute**, a distinct concept that reflects customers' evaluations of cleanliness, sanitation practices, and disease-prevention capabilities, and **their impacts on perceived risks**. Given the heightened public awareness of hygiene and health concerns in the post-COVID era, the role of hygiene as a service-robot attribute remains underexplored in restaurant settings.

In addition, service-robot research in hospitality is still described as fragmented, indicating the need for a stronger theory-based framework in restaurant contexts (Yörük et al., 2024).

This study adopts the **Stimulus-Organism-Response (SOR) framework** (Mehrabian & Russell, 1974), conceptualizing service-robot **attributes as stimuli** that influence guests' internal **psychological states** (trust, perceived risk, and attitude) as the **organism**, which in turn determine their **behavioral intention** toward robot-assisted dining services as the **response**, thereby addressing this **research gap** in the existing literature (Seo & Lee, 2021).



Research Objectives

- To examine how guests' perceptions of restaurant service robots influence their behavioral intention to use robot-assisted dining services.
- To investigate the effects of hygiene, reliability, competence, and anthropomorphism on guests' performance risk, trust, and attitude toward service robots in restaurants.
- To assess how performance risk, trust, and attitude, in turn, affect guests' behavioral intention toward restaurant service robots.
- To provide practical recommendations for restaurant operators on designing and implementing service robots in ways that reduce perceived risk, build trust, and enhance guest acceptance.





Literature Review »

Service Robots in the Restaurant Industry

Service robots in restaurants are autonomous systems that perform tasks such as **food delivery, order taking, cleaning, and basic customer interaction** instead of, or alongside, **human staff** (Wirtz et al., 2018; Ivanov & Webster, 2019). They have spread rapidly, especially in quick-service and casual dining, largely because of labor shortages, cost pressures, and heightened attention to hygiene after COVID-19 (Belanche et al., 2020; National Restaurant Association, 2023).



Studies indicate that service robots can improve **efficiency and consistency, enable more contactless and hygienic service**, and create **novelty** that attracts **customers** (Mende et al., 2019; Tussyadiah & Park, 2018). At the same time, research highlights important drawbacks, including **high investment and maintenance costs**, technical and integration challenges, and the risk that robot-mediated encounters feel impersonal or reduce perceived warmth and human connection (Čaić et al., 2019; Ivanov & Webster, 2019).

Stimulus–Organism–Response Theory

- Theoretical Basis of SOR model

CORE POINT OF VIEW:

Guests do not respond directly to the presence of **service robots** in restaurants; instead, robot-related cues such as **hygiene, reliability, competence, and anthropomorphism** first shape their internal psychological states (**perceived performance risk, trust, and attitude**), and these internal states then determine their **behavioral intention** toward robot-assisted restaurants (Mehrabian & Russell, 1974; Seo & Lee, 2021).

- Theoretical development and extension

- SOR is widely used in hospitality to link servicescape cues to customer emotions and behaviors.
- It has been extended to tech-based and robot-assisted restaurant services, including hygiene and safety cues.
- This supports using SOR here, with robot attributes (hygiene, reliability, competence, anthropomorphism) → internal states (performance risk, trust, attitude) → behavioral intention.

- The SOR structure of this study

- S - Hygiene, reliability, competence, anthropomorphism.
- O - Performance risk, trust, attitude.
- R - Behavioral intention.



Hygiene - Performance Risk & Trust

In hospitality and restaurant contexts, **perceived hygiene** is one of the **most important cues** guests use to judge whether a dining experience is **safe and of high quality**. It reflects both **visible cleanliness** (how clean the environment, equipment and service interfaces appear) and **perceived sanitation practices**, such as frequent cleaning, disinfection and careful handling of food and utensils (Vos et al., 2019; Yu et al., 2021).

Restaurant guest perceives **performance risk** when service robots bring the wrong dishes to their table, take too long causing food to get cold, or mix up orders when serving multiple nearby tables during busy service periods. These failures disappoint guests and ruin the expected flow of their restaurant meal (Seo & Lee, 2021).

Trust is defined as the belief that other people will behave within a predictable range (Luhmann 1979, Seo & Lee, 2021).

Restaurant guests perceive trust when service robots successfully complete food delivery and table assistance tasks correctly during multiple restaurant visits, proving they consistently put guest needs first and work without major problems that could disrupt dining pleasure.

Hygiene - Performance Risk & Trust

In robot-assisted service, these hygiene cues shape expectations about errors and contamination: clean, well-managed robots signal lower performance risk, whereas poor hygiene signals a higher chance of negative outcomes (Hong Kong Centre for Food Safety; Parvez et al., 2024).

H1: HYGIENE PERCEPTION NEGATIVELY INFLUENCES PERFORMANCE RISK IN SERVICE ROBOTS



Empirical findings further show that **strong hygiene perception** increases guests' **sense of safety and confidence**, which are **core foundations of trust** in hospitality providers and in robot-delivered services (Vos et al., 2019; Yu et al., 2021; Parvez et al., 2024).

H2: HYGIENE PERCEPTION POSITIVELY INFLUENCES TRUST IN SERVICE ROBOTS.

Reliability - Performance Risk & Trust

Reliability in services means **performing the promised service dependably and accurately**, and is a **core dimension of service quality** (Parasuraman et al., 1988; Cronin & Taylor, 1992). For restaurant service robots, reliability refers to **stable, error-free task performance in real operating conditions** (order delivery, navigation, peak-hour operation).

- Studies on service robots show that **reliable, error-free robot performance enhances perceived service quality and supports the development of trust**, while **frequent failures increase uncertainty and perceived performance risk** (Wirtz et al., 2018; Lu et al., 2020; Byrne & Marin, 2018).
- In this study, **reliability** therefore captures guests' belief that the robot **consistently completes tasks without errors**, delivers orders accurately, operates steadily even at peak times and provides dependable service overall, which should **lower expected problems** (reduced performance risk) and **strengthen guests' confidence** to rely on the robot.

H3: RELIABILITY NEGATIVELY INFLUENCES PERCEIVED PERFORMANCE RISK IN SERVICE ROBOTS.

H4: RELIABILITY POSITIVELY INFLUENCES TRUST IN SERVICE ROBOTS.

Anthropomorphism- Performance Risk & Trust

Anthropomorphism refers to inanimate objects being ascribed human forms, attributes, or behavior (Bartneck et al.,m 2009). Anthropomorphism indicates how **human-like** customers experience the service robot to be in its social behavior and interaction style. This construct reflects the degree to which guests feel the robot interacts in a human-like manner, behaves in a socially appropriate human-like way in the dining room, communicates in a polite manner, and shows human-like interaction behaviors during service, such as turning toward guests, pausing naturally, and following social rules.

When service robots are more human-like in appearance and behavior and can, in some cases, enhance **social connection and warmth**, supporting **positive evaluations** which may improve customers' responses to service robots (van Doorn et al., 2017; Mende et al., 2019). However, high levels of **anthropomorphism** can also backfire by creating **uncanniness and discomfort**, increasing perceived **psychological and functional risk**, and leading to **harsher judgments** when **failures** arise (Mori, 1970; Mathur & Reichling, 2016). Because “more human-like” does not always translate into “more trusted,” especially in **risk-sensitive dining contexts**, this study treats anthropomorphism as a **double-edged cue** and proposes that it increases **perceived performance risk** and reduces **trust** in service robots.

H5: ANTHROPOMORPHISM POSITIVELY INFLUENCES PERFORMANCE RISK IN SERVICE ROBOTS.

H6: ANTHROPOMORPHISM NEGATIVELY INFLUENCES TRUST IN SERVICE ROBOTS.

Competence - Performance Risk & Trust

Competence refers to guests' perception that the **service robot** is **capable and intelligent** in handling restaurant tasks, such as understanding **specific requests, handling dietary needs** accurately, managing **custom orders**, and responding intelligently during service (Bartneck et al., 2009; Ling et al., 2025).

Prior research shows that **robot competence** increases **trust**, because people are more willing to rely on robots they perceive as **capable** and **effective** (Schaefer et al.; 2021). Higher perceived competence also helps reduce **perceived risk**, since capable robot service is associated with fewer expected **problems** and better **performance outcomes** (Seo & Lee; 2021).

In this study, when guests believe the robot can correctly understand requests and handle **personalized service needs**, they are expected to experience **lower perceived performance risk** and **greater trust** in the robot (Bartneck et al., 2009; Seo & Lee, 2021; Ling et al., 2025).

H7: COMPETENCE NEGATIVELY INFLUENCES PERCEIVED RISK IN SERVICE ROBOTS.

H8: COMPETENCE POSITIVELY INFLUENCES TRUST IN SERVICE ROBOTS.

Performance Risk, Trust, & Attitude

This study examines how **performance risk** and **trust** in **restaurant service robots** shape guests' **attitude** toward using service robots, with **performance risk** expected to weaken and **trust** expected to strengthen attitudes (Pavlou; 2003).

- In **technology and service adoption research**, higher perceived performance risk consistently leads to less favorable **attitudes** and lower **acceptance**, because customers avoid options they associate with possible **loss or service failure** (Pavlou; 2003; Forsythe & Shi; 2003). **In hotel and service-robot studies**, higher perceived risk reduces customers' willingness to **accept and use service robots** (Seo & Lee; 2021; Shin & Jeong; 2023).




H9: PERFORMANCE RISK NEGATIVELY INFLUENCES ATTITUDE TOWARD SERVICE ROBOTS.

- **Trust** is repeatedly shown to improve **attitudes** toward **new technologies and services**, as trusting systems lowers **psychological barriers** and highlights benefits (Gefen; 2000; Pavlou; 2003). In **restaurant robot settings**, higher trust in service robots is linked to more **positive attitudes** and **stronger acceptance of robot service** (Seo & Lee, 2021), and research on service robots more generally identifies trust as a key driver of consumer acceptance (Qin, 2025)..

H10: TRUST POSITIVELY INFLUENCES ATTITUDE TOWARD SERVICE ROBOTS.

Attitude & Behavioral Intention

Attitude toward using service robots in restaurants is an individual's overall favorable or unfavorable evaluation of dining with service robots, that is, of being served by robots and having robots involved in the restaurant service experience (Ajzen, 1985; Ajzen, 1991; Ivanov, Webster, & Garenko, 2018).

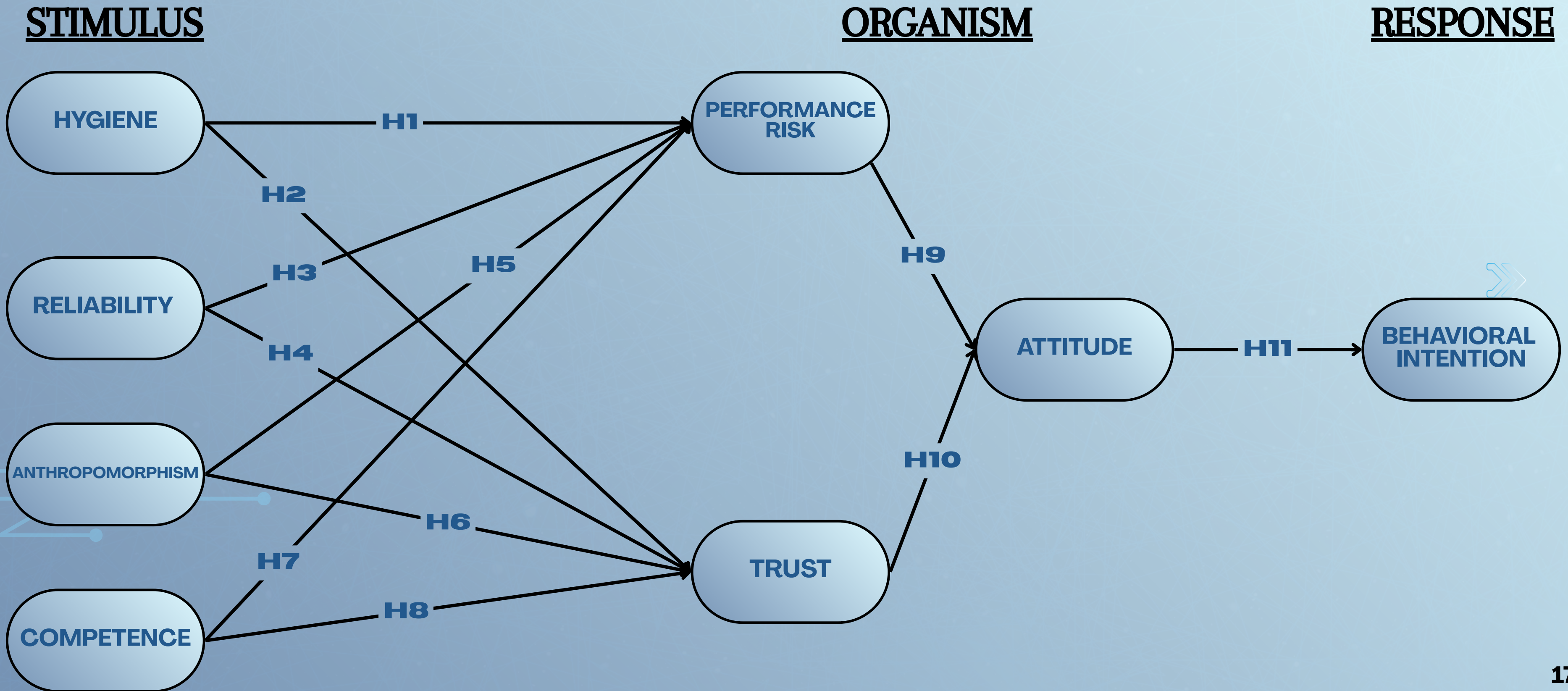
Guests' **attitude** toward using **service robots** in restaurants influences their **behavioral intention** to use or support **robot-assisted dining**, proposing that a more favorable **attitude** leads to stronger intention, in line with behavioral intention relationships in the **Theory of Planned Behavior (TPB)** and **Technology Acceptance Model (TAM)** (Ajzen; 1991; Davis; 1989). 

Empirical studies on **robot restaurants** show that when customers hold more **positive attitudes** toward robot use in restaurants, they report higher **behavioral intention to visit, revisit, and recommend these restaurants** (Seo & Lee; 2021; Guan et al.; 2021). Research that directly examines **attitude and acceptability** of robot use in restaurants finds that **attitude** has a significant positive effect on **behavioral intention to use robot-service** restaurants (Erdem et al., 2023). These findings confirm that **positive attitudes** toward service robots in restaurant settings translate stronger **behavioral intention**.

H11: TRUST POSITIVELY INFLUENCES ATTITUDE TOWARD SERVICE ROBOTS.



Section I: Research Framework



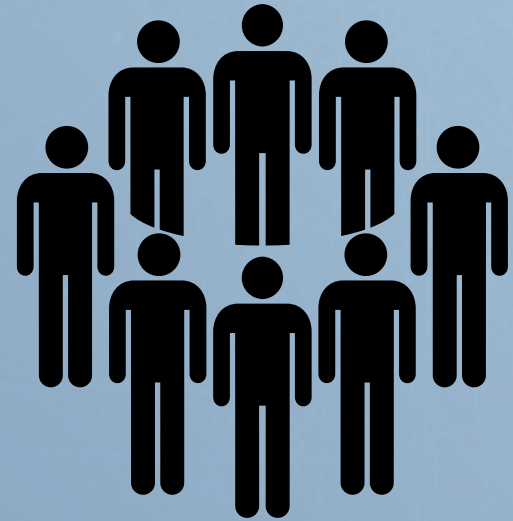


Methodology



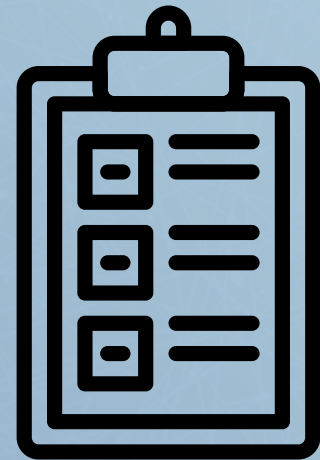


Section II : Research Subjects & Data Analysis Methods

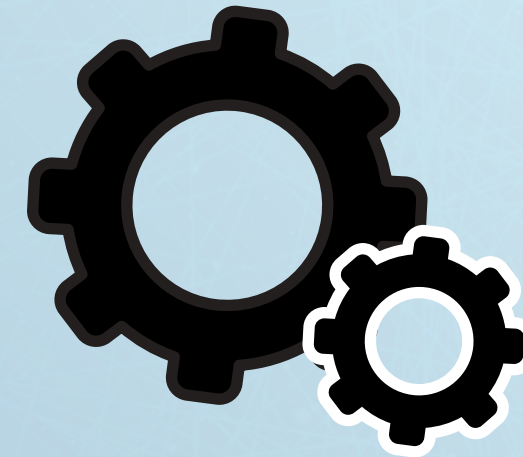


Convenience Sampling Approach

- 127 restaurant customers with prior experience using service robots.



Self-administered online questionnaire (Google Forms), distributed via Threads, Facebook, and Instagram.



Confirmatory factor analysis (CFA) and path analysis were conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4.0.

Section III: Questionnaire Design

CONSTRUCT	REPRESENTATIVE ITEM	NO. OF ITEMS	SCALE SOURCE
Hygiene	"The service robot appears clean."	3	Yu, Seo, and Hyun (2021); Vos et al. (2019)
Reliability	"The robot consistently completes its tasks without errors."	4	Cronin and Taylor (1992); Parasuraman et al. (1988)
Anthropomorphism	"The robot interacts in a human-like manner."	4	Bartneck et al. (2009)
Competence	"The robot understands my specific requests."	4	Bartneck et al. (2009)
Performance Risk	"My food arrives cold because the robot took too long."	3	Grewal et al. (1994)
Trust	"I trust the robot to serve dependably."	4	Jian et al. (2000)
Attitude	"Service robots in restaurants are a good idea."	4	Ivanov, Webster, and Garenko (2018)
Behavioral Intention	"I intend to dine at restaurants using these robots again."	3	Seo and Lee (2021); Zeithaml et al. (1996)

TOTAL QUESTIONS: 29 questions



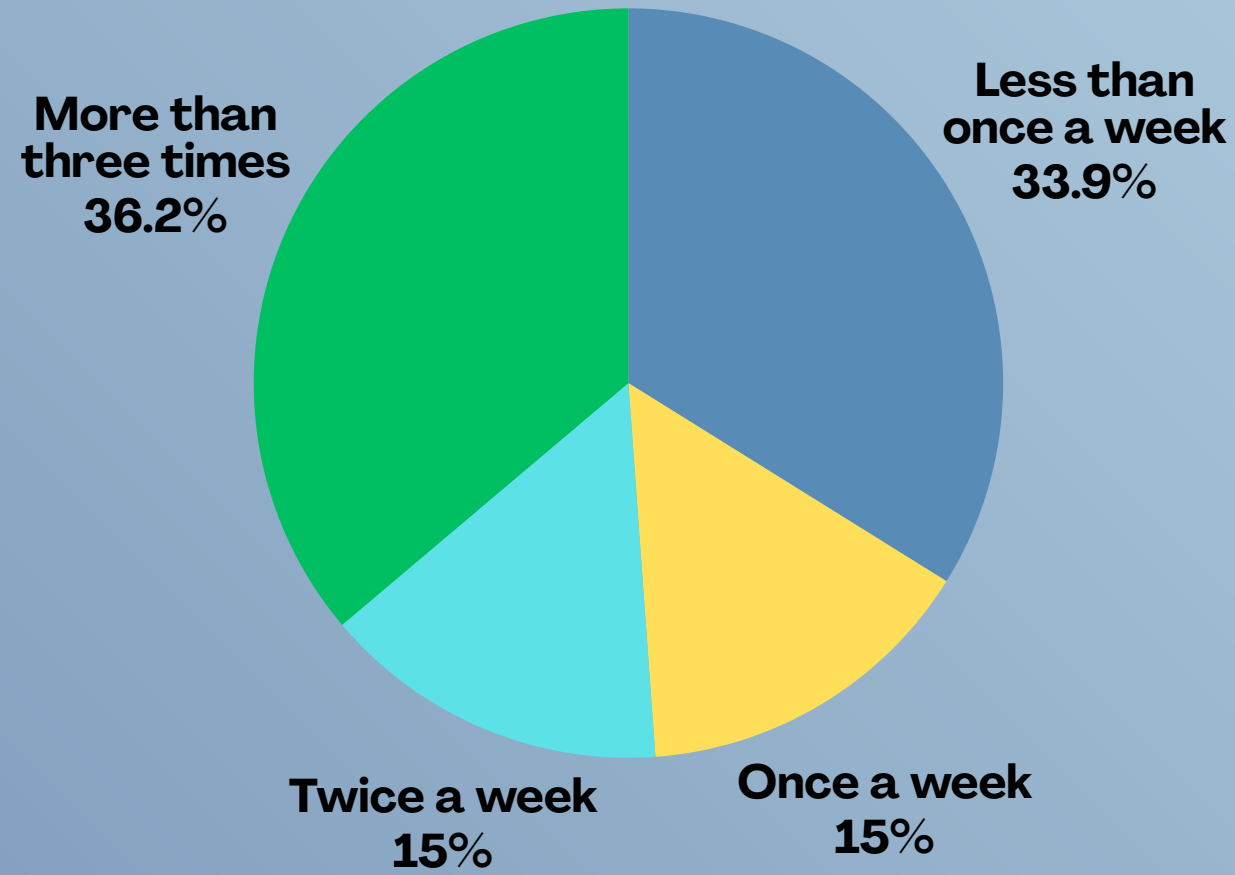
Results



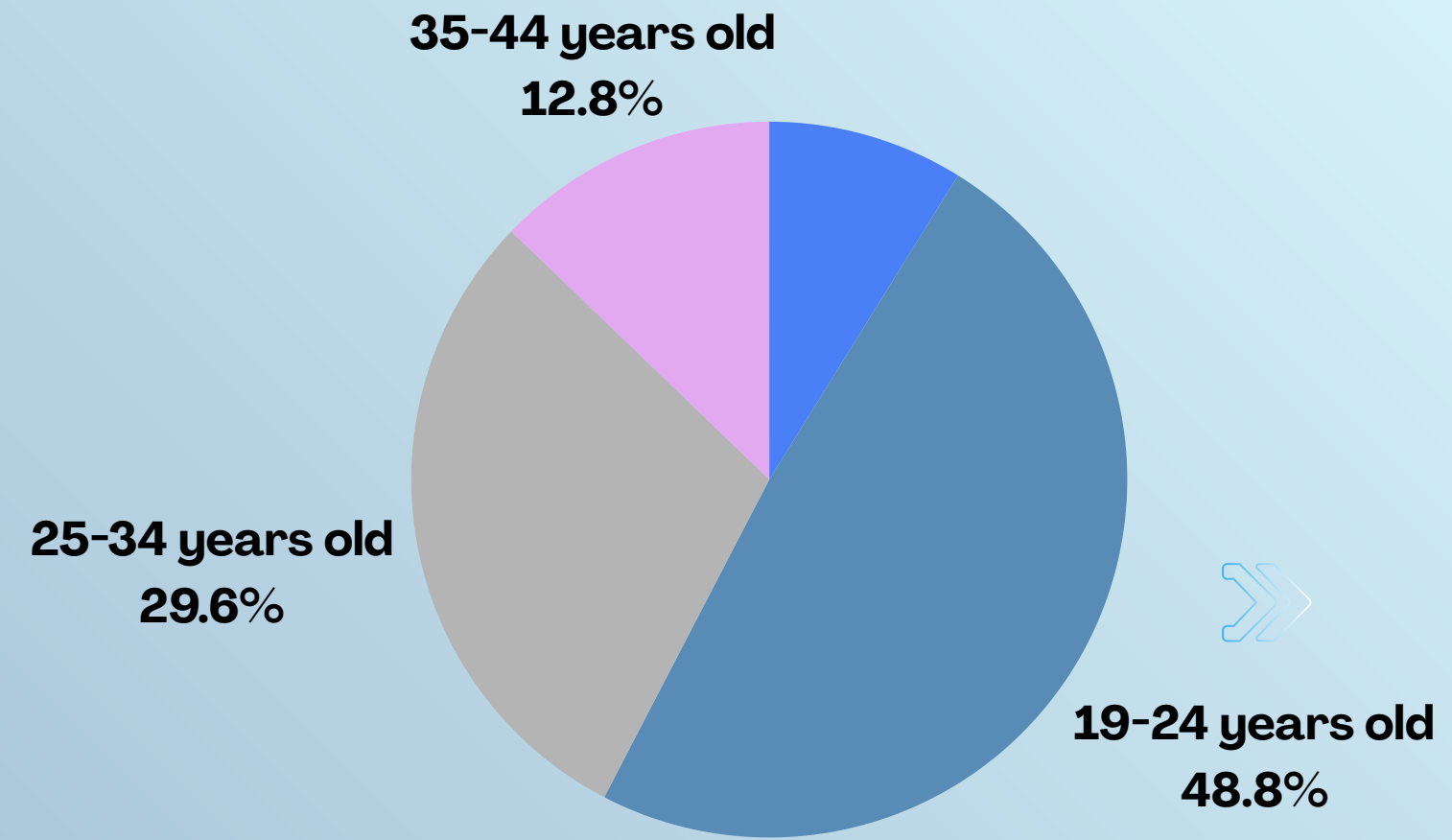


Participants' Profile

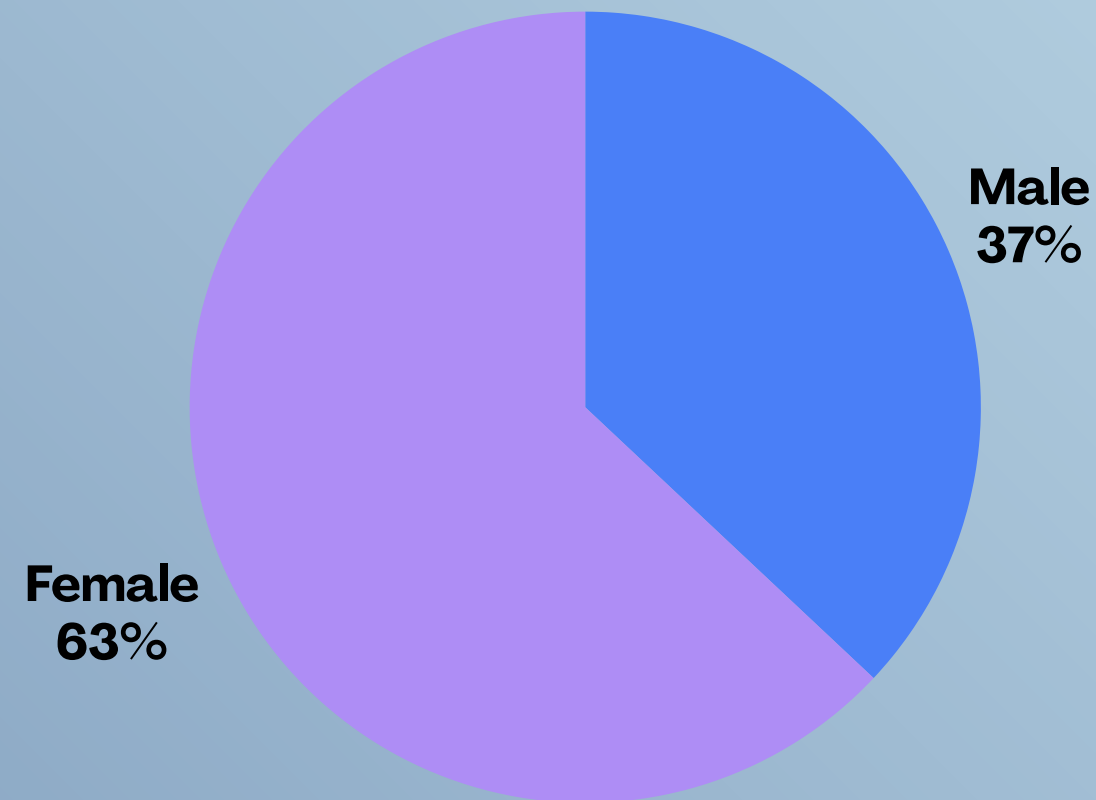
Dining Frequency



Age



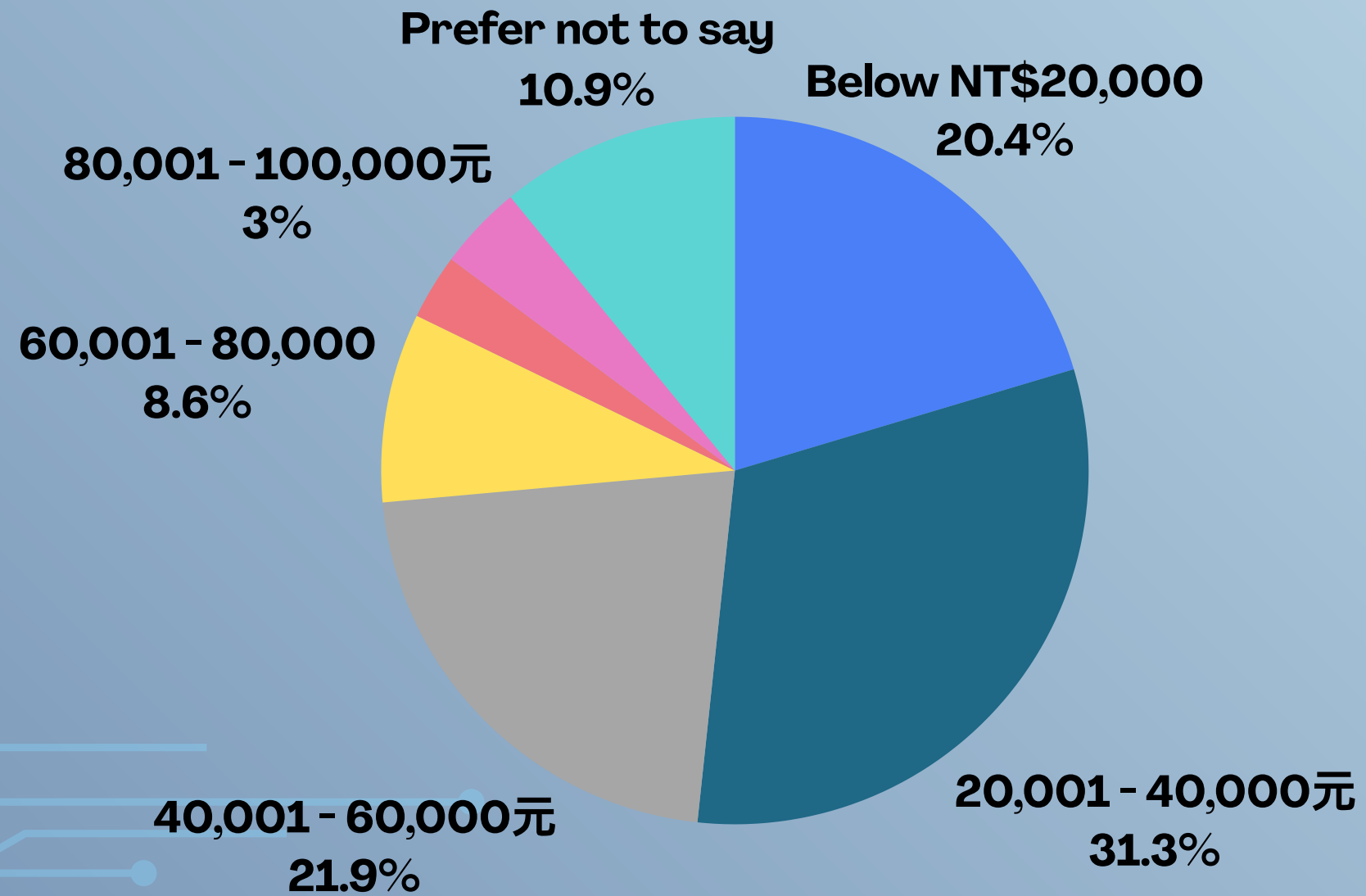
Gender



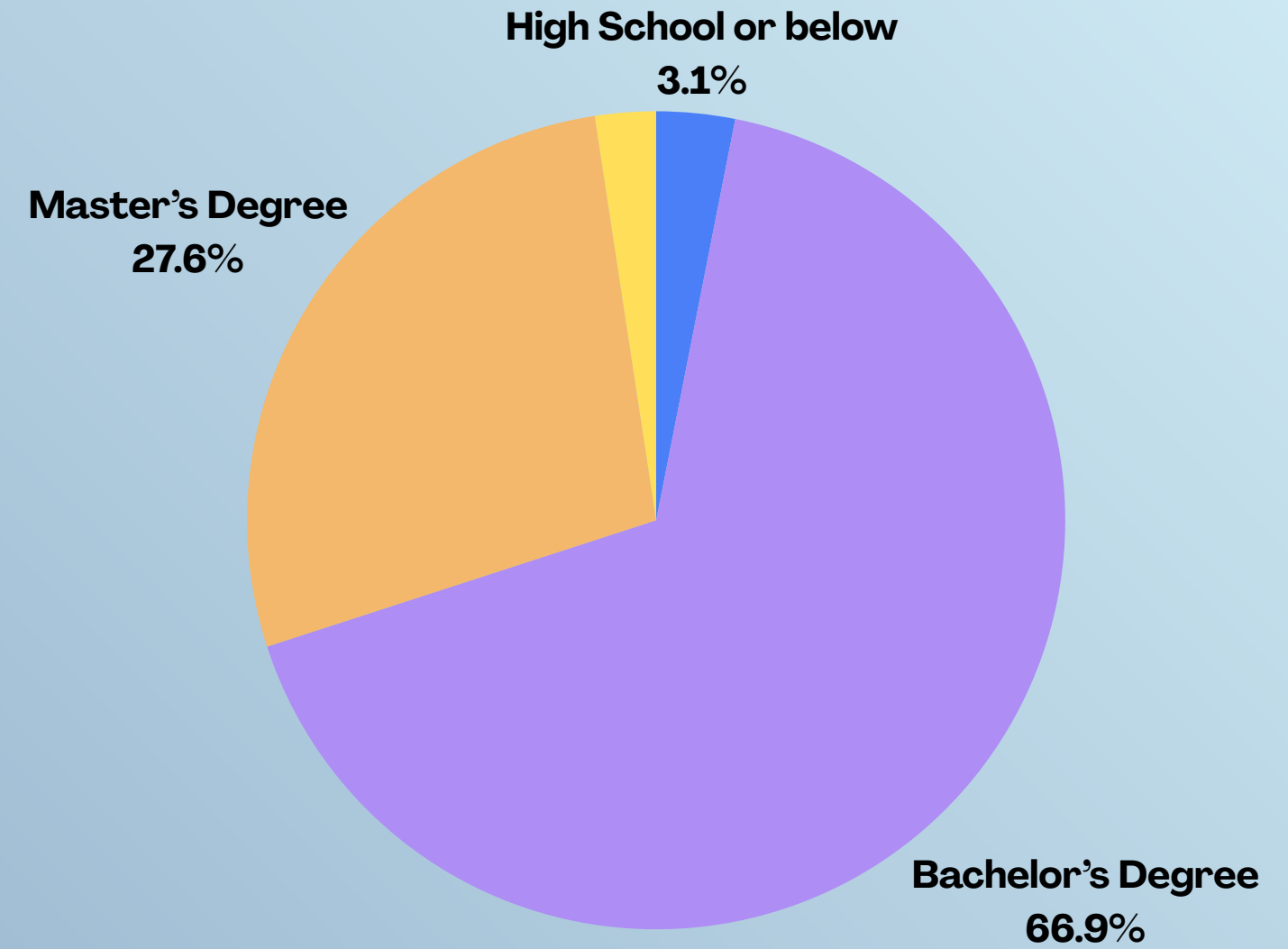


Participants' Profile

Average Monthly Income



Educational Level





Reliability and Validity Analysis

CONSTRUCT	Cronbach's a	CR Value	AVE Value
Hygiene	0.892	0.933	0.823
Reliability	0.861	0.905	0.705
Anthropomorphis m	0.863	0.907	0.710
Competence	0.859	0.904	0.701
Performance Risk	0.799	0.881	0.712
Trust	0.802	0.871	0.628
Attitude	0.892	0.925	0.756
Behavioral Intention	0.849	0.909	0.770

- All factor loadings are greater than 0.7
- Cronbach's alpha values are all greater than 0.7
- CR values are all greater than 0.7, indicating good overall internal consistency.
- AVE values are all greater than 0.5, indicating good convergent validity.



Discriminant Validity Analysis

Constructs	A	AN	BI	CO	HY	PeR	RE	T
Attitude								
Anthropomorphism	0.418							
Behavioral Intention	0.899	0.581						
Competence	0.503	0.680	0.428					
Hygiene	0.574	0.337	0.448	0.425				
Performance Risk	0.079	0.311	0.204	0.167	0.130			
Reliability	0.518	0.518	0.509	0.537	0.703	0.208		
Trust	0.896	0.602	0.792	0.735	0.617	0.124	0.721	

All HTMT values are less than 0.9, indicating good discriminant validity among the latent constructs.

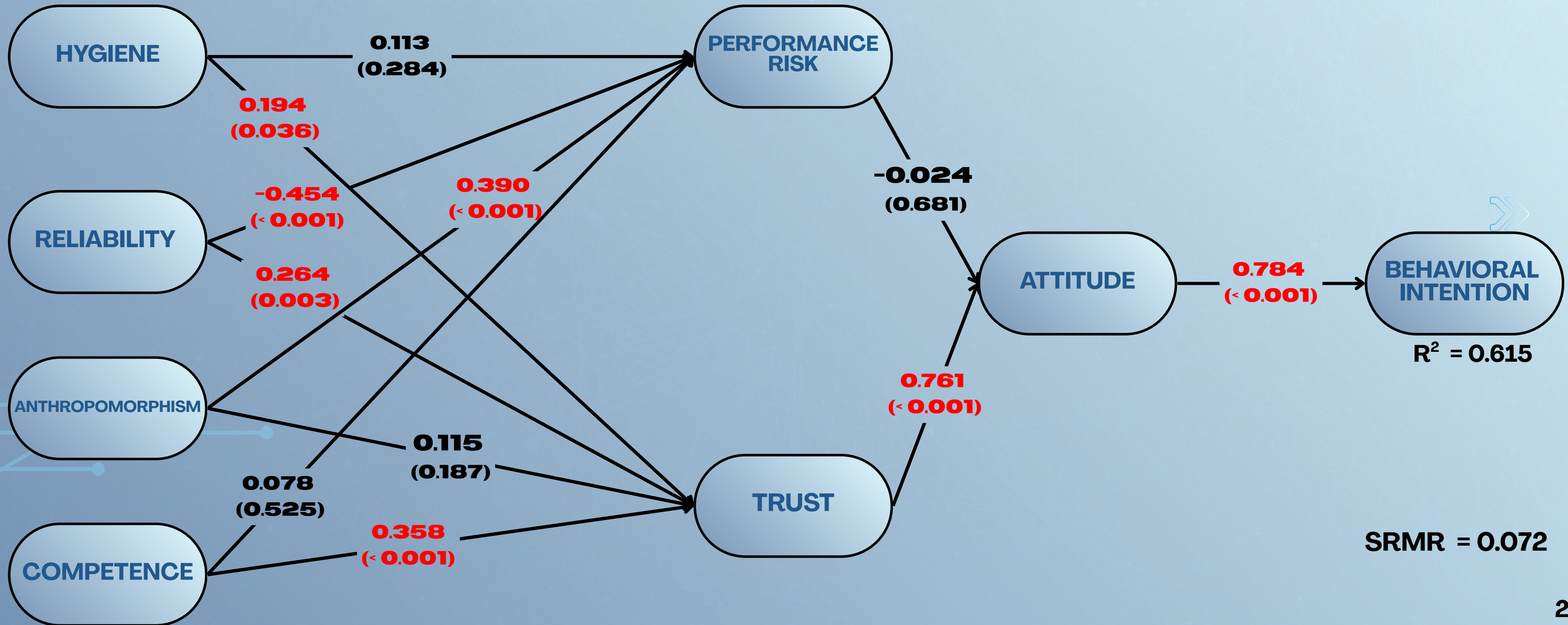


Hypothesis	Path	Path Coefficient	P-value	Results
H1	HY → PeR	0.113	0.284	Not Significant
H2	HY → T	0.194	0.036	Significant, small effect
H3	RE → PeR	-0.454	< 0.001	Significant, moderate effect
H4	RE → T	0.264	0.003	Significant, small effect
H5	AN → PeR	0.390	< 0.001	Significant, moderate effect
H6	AN → T	0.115	0.187	Not Significant
H7	CO → PeR	0.078	0.525	Not Significant
H8	CO → T	0.358	0.000	Significant, moderate effect
H9	PeR → A	-0.024	0.681	Not Significant
H10	T → A	0.761	< 0.001	Significant, large effect
H11	A → BI	0.784	<0.001	Significant, large effect





Hypothesis Testing





Discussion & Conclusion





Discussion

Trust significantly improves **attitude**, while **performance risk does not significantly affect attitude**, showing that confidence in robots matters more than fear of failure (Gefen, 2000; Pavlou, 2003; Seo & Lee, 2021).

Attitude is the strongest predictor of **behavioral intention**, consistent with TPB, TAM, and prior restaurant-robot studies (Ajzen, 1991; Davis, 1989; Seo & Lee, 2021).

Competence, reliability, and hygiene help build trust, showing that **guests prefer robots** that are capable, consistent, and clean (Parasuraman et al., 1988; Cronin & Taylor, 1992; Bartneck et al., 2009; Vos et al., 2019; Seo & Lee, 2021).

Anthropomorphism raises **performance risk**, while **reliability** lowers it, supporting the idea that highly human-like robots may create discomfort in dining settings (Mori, 1970; Mathur & Reichling, 2016).

Discussion: not significant paths

Hygiene → Performance Risk

Customers may perceive hygiene and operational performance as distinct service dimensions. While cleanliness signals sanitation and health protection, it does not necessarily indicate the robot's ability to deliver orders accurately or efficiently.

Competence → Performance Risk

Competence may enhance confidence in the robot's overall capability, but may not be sufficient to alleviate concerns regarding specific operational failures during service encounters.

Anthropomorphism → Trust

In utilitarian service contexts such as food delivery, anthropomorphic cues may be insufficient to enhance trust because customers prioritize operational effectiveness over human-like interaction.

Performance Risk → Attitude

The non-significant effect suggests that customers' attitudes toward service robots may be shaped more strongly by trust than by risk perceptions. Once trust is established, concerns regarding operational performance may become less influential in determining overall evaluations.



Theoretical Contributions

This study extends the **SOR framework** in restaurant service-robot research by integrating **hygiene, reliability, competence, and anthropomorphism** as stimuli that shape performance risk, trust, attitude, and behavioral intention.

It also helps address the **fragmentation** in prior hospitality service-robot research by examining these **key robot attributes** in one integrated model.

The findings identify **trust as the central mechanism** in guest acceptance, because trust strongly affects attitude, and attitude strongly affects behavioral intention.

Managerial Implications

Restaurant operators should emphasize **competence, reliability, and visible hygiene cues**, because these factors help build guests' trust in service robots.

Anthropomorphic design should be used cautiously, since highly human-like robots may increase perceived performance risk without significantly increasing trust.

Managers should focus on **trust-building** as a core implementation strategy, because **trust strongly improves attitude**, and attitude is the strongest predictor of revisit and recommendation intention.



Limitation and Suggestion

- Limited generalizability due to **non-probability sampling** in a specific restaurant context in Taiwan; future studies should include broader samples from different regions and restaurant types.
- **Cross-sectional and self-reported data** may limit causal interpretation and introduce bias; future research may adopt longitudinal designs or multiple data sources.
- This study focused on **delivery robots, one specific service scenario**, and a limited set of constructs; therefore, future studies should examine other robot designs, service roles, contextual conditions, and additional variables such as usefulness, enjoyment, and social influence.



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Thank you!!

