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Article

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Unveiling the Impact of AI-Chatbot Attributes and Anthropomorphic Cues in E-Commerce

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Abstract

The rise of AI chatbots in e-commerce has revolutionized digital customer service, yet understanding the factors influencing customer adoption remains a challenge. Drawing on the Technology Acceptance Model 2 and anthropomorphism theory, the study aims to examine how human-like interaction elements can enhance trust and usability, leading to greater customer engagement with AI chatbots in e-commerce. A quantitative approach was employed, involving a sample of 432 respondents from Malaysia who interacted with AI chatbots on e-commerce platforms. Data were analyzed using partial least square structural equation modeling (PLS-SEM). Findings revealed that perceived usefulness (PU) and perceived ease of use (PEOU) have a significant direct influence on customer adoption, where PU became the strongest predictor, followed by PEOU. Perceived trust (PT) showed no direct influence, but strongly predicted anthropomorphic cues which in turn had a direct positive influence on customer adoption and indirect positive influence as a mediator between trust and adoption. The variable PT showed no direct influence on adoption; instead, anthropomorphic cues and a strong mediating effect by anthropomorphic features such as emotional expressions and human-like communication enhance user experience, build trust, and drive adoption. This research highlights the originality of the study, which clearly explains that functional attributes (PU and PEOU) are not solely determined by adoption but are carefully designed by the mediating variable of anthropomorphic features. These insights are critical for e-commerce businesses and AI developers in designing chatbots that foster customer trust, usability, and satisfaction. The study contributes to the academic discourse on AI adoption and offers practical strategies for optimizing chatbot-human interaction in digital commerce.

Keywords: AI chatbots, customer adoption, E-Commerce, perceived usefulness, perceived ease of use, perceived trust, anthropomorphic cues.

1. Introduction

The use of artificial intelligence (AI) in e-commerce in the past few years has changed the nature of interaction between businesses and customers. Chatbots have been identified as one of the primary facilitators of customer care, payment processing, problem-solving, and going personal (Waladi et al., 2024). The more businesses adopt chatbots, the more efficient they become and can simultaneously gratify and involve customers (Wahbi et al., 2023). AI chatbots imitate human-like communication with the implementation of natural language processing (NLP), machine learning, and real-time integration of data (Nze, 2024).

Such abilities enable companies to offer customer support 24/7, handle a considerable number of queries, and make recommendations (Prasad et al., 2024). Such a change has assisted online shops in streamlining consumer experiences, limiting human labor reliance, and maintaining even service provision (Kayyali, 2025). Nevertheless, customer intentions to use AI chatbots are determined by the primary technological variables, i.e., perceived usefulness and ease of use, trust, and satisfaction of human and AI interaction (Li et al., 2023a; Choung et al., 2023; Ghaniabadi, 2024).

The adoption process goes beyond technological acceptance to encompass cognitive and emotional appraisal of chatbot communication that makes it unique compared to conventional customer service based on humans (Torres et al., 2024; Ocxas et al., 2024). As digital tools develop rapidly, there is a gap in knowledge on user perception and interaction with AI chatbots. The paper attempts to fill that gap by analyzing the drivers of AI-chatbot adoption in the Malaysian e-commerce industry. The results of this study may guide businesses in creating a more efficient chatbot, which will improve customer interaction and increase usage. Truong and Chen (2025) explained that when an AI-integrated system plays a role in human-like interactions, individuals tend to feel a sense of empathy towards it. This study highlights the importance of examining anthropomorphism in e-commerce contexts.

Although AI chatbots have made a considerable progress in technology, the level of customer adoption in e-commerce is comparatively low because of doubts on usability and trust (Sharma et al., 2023; Ryan et al., 2024). Impersonal experience, lack of trust in such decision-making processes, and the perception of lack of utility are the key causes of resistance (Saglam et al., 2021; Shahbandi, 2025). Although extensive research has reported on the adoption of digital technology, incorporating major technological factors such as perceived trust (PT) and anthropomorphic cues in AI chatbots has been less studied (Li & Wang, 2023).

The fidelity of AI chatbots is informed by transparency, privacy, perceptions regarding intelligence, and other human-like interaction behaviors, leading to the perception of user trust (Sheehan et al., 2020; Klein & Martinez, 2023). Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are two of the main factors affecting acceptance of traditional models, such as TAM 2 (Alshammari & Rosli, 2020).

Nonetheless, these variables might not do full justice to the interactivity between humans and a chatbot. As much as PU and PEOU evaluate the usability and usefulness of the system, PT measures the emotional confidence desired by the users, and anthropomorphic gestures appeal to the human nature to socialize and emotionally connect. There is a dearth of empirical research on the mixed effects of PU, PEOU, PT, and the anthropomorphic cues of the use of AI chatbots, especially in developing countries (Azli, 2023). Much of the existing literature is based on Western settings, ignoring the cultural peculiarities of areas such as Southeast Asia. Even in a state like Malaysia, the level of digital literacy, privacy issues, and choices regarding human-like digital interactions can be very different (Geetha et al., 2024). A recent study by Ding and Najaf (2024) emphasized on how a human-like chatbot can directly influence how users gain trust in the adoption of chatbots. This clearly aligns with the current study's aim of making AI chatbots feel more human-like.

This research is theoretically as well as practically important. In theory, it supplements the TAM 2 model with Perceived Trust (PT) and Anthropomorphic Cues, giving a deeper insight into the psyche and social sphere of AI-chatbot communication. In practice, these results can be beneficial to e-commerce companies and AI developers to refine chatbot design. By appreciating the roles of PU, PEOU, PT, and anthropomorphic features, companies can decide on the functionality and user appearance, language tone, and privacy guarantees of chatbots.

This becomes specifically significant in such a market as Malaysia, where consumer habits are largely influenced by trust in technology and a desire to experience personalized service (Abdullah et al., 2024; Yong et al., 2023). This study provides an empirical validation of the proposed chatbot adoption model through the application of PLS-SEM.

Moreover, the study aligns with the larger ambitions of digital transformation in Malaysia, including the ones listed in the MyDIGITAL Blueprint and the National Artificial Intelligence Roadmap (2021-2025) (Ministry of Science, Technology and Innovation, 2023). The following four research questions guided the study.

The results of the study clearly explain how human-like features strongly connect with perceived usefulness, perceived ease of use and the confidence to adopt an AI chatbot. This provides a stronger comprehension of how these factors can directly influence whether individuals choose to use an AI chatbot.

In the real-world context, the research emphasized the importance of e-commerce firms and AI developers in creating chatbots that are interactive, fast in use and highly engaging. The integration of human-like features of communication assists in fostering trust, enhancing usability experiences, keeping clients engaged, and improving the number of people adopting digital commerce.

Despite witnessing a drastic increase in consumers using AI adoption, there are limited studies on how these human-like features in AI chatbots directly influence the process in e-commerce. In particular, very few or almost no studies have examined whether these human-like features play the key role in linking the PU, PEOU, PT and the determination in adoption. This disparity is more visible in countries like Malaysia, where there is a huge gap in trust towards digital tools and perspectives towards technology, unlike in Western countries. In order to address this gap, this study places human-like features, which is the anthropomorphic, as a new linking factor that helps construct its research questions on how these features impact adoptions.

- RQ1. To what extent do perceived usefulness (PU), perceived ease of use (PEOU), and perceived trust (PT) influence customer adoption in e-commerce?
- RQ2. What is the relationship between perceived usefulness (PU), Perceived Ease of use (PEOU), perceived trust (PT), and anthropomorphic cues in AI chatbots?
- RQ3. To what extent do anthropomorphic cues of AI chatbots influence customer adoption in e-commerce?
- RQ4. Do anthropomorphic cues mediate the relationship between perceived usefulness (PU), perceived ease of use (PEOU), perceived trust (PT), and customer adoption in e-commerce?

2. Literature Review

2.1 Introduction to AI Chatbots in E-Commerce

AI chatbots are used in e-commerce to automate various activities such as product recommendation, payment, order tracking, customer service questions, and many others on websites, mobile applications, and messaging platforms. They have gained such importance in their role because they have enabled real-time, personal, and scalable support that covers many time zones (Madana Mohana et al., 2021). There are considerable benefits to implementing AI chatbots in business. AI-chatbot offers 24/7 customer support, and this saves the company operating costs by reducing human representatives in low peak hours (Prasad et al., 2024).

AI chatbots can handle hundreds of conversations simultaneously, and maintaining customer service online during peak periods is especially important and beneficial. As a customer, fast, precise, and consistent response availability helps to create a smooth shopping experience, thus rising customer satisfaction and engagement (Wahbi et al., 2023).

Personalization presents another level of advantages in AI chatbot usage. As AI chatbots have access to customer data and behavior, they can customize answers and recommend products, which would improve the relevance of the interactions and influence conversion rates (Olawuyi & Fadeyi, 2024). Moreover, since they can be improved, chatbots become more intelligent and contextual after every interaction. This makes AI chatbots the key

resource to the digital transformation of retail because they combine operational effectiveness and customer-focused service.

2.2 Theories of Technology Adoption

2.2.1 Technology Acceptance Model

Technology Acceptance Model (TAM), as proposed by Davis (1989), is one of the early frameworks for exploring user acceptance and use of technology (Alshammari & Rosli, 2020). TAM isolates two fundamental determinants of user intention: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). PU is associated with the extent to which users think the system is efficient, i.e., it delivers well-timed responses, customized assistance, and automation of tasks, whereas PEOU is connected to how easy the system is (de Blanes Sebastián et al., 2022; Hamid & Mohamed, 2022). In the case of AI chatbots, PU and PEOU influence the way users perceive the efficiency and usability of the chatbot in online shopping. Nevertheless, the original TAM does not take into account emotional, psychological, and relationship aspects of human-AI interaction. TAM 2 adds subjective norm, experience, and perceived trust (PT) variables to introduce a more versatile image of technology adoption (Muñoz & Kremer, 2023; Li et al., 2023a).

Together, these results emphasize that TAM 2 is a solid theory for this study. The study then builds on TAM 2 by incorporating trust (PT) and anthropomorphic cues, which have limited studies in e-commerce AI chatbot-based studies.

2.2.2 Anthropomorphism Theory

Anthropomorphism means assigning human characteristics, behaviors, and emotions to AI systems to enable social and emotional interactions between users and AI (Li & Sung, 2021; Shin, 2022). This psychological tool satisfies the human factors of connectedness and involvement and highly affects the user experience of dealing with and seeing AI (Salles et al., 2020; Placani, 2024). Human-like features, anthropomorphic expressions, tone, and empathy enhance user experience and boost trust, satisfaction, and enjoyment (Klein & Martinez, 2023).

In addition to this, there are few studies that treated the anthropomorphic cues design elements as a minor role rather than treating it as a key factor of influencing users to adopt AI chatbot. The utilization of anthropomorphism theory views the features of it as a solid link that connects PU, PEOU, and PT with user's decision to adopt AI chatbot, which address a crucial gap in theory.

2.3 Customer Adoption in E-Commerce

The term customer adoption in digital commerce relates to customers accepting and actively using the new technologies, including AI chatbots. A mix of functional characteristics, emotional aspects, and design features, such as perceived helpfulness, reaction time, trust, empathy, interface quality, and personalization, drives adoption

(Rahevar & Darji, 2024; Mostafa & Kasamani, 2022; Ramki et al., 2024; Li et al., 2023b; Klein & Martinez, 2023).

TAM has been mainly utilized as a practical method in understanding adoption behavior in cyberspace. PU and PEOU contributes significantly to the attitude of users to AI chatbots in online retail (Ashfaq et al., 2020). Nevertheless, TAM and variants tend to ignore the emotional aspects of online communication. Recent studies have generalized TAM by introducing such independent or mediating variables as privacy, security, and trust to the process of adoption of chatbots (Choung et al., 2023; Leschanowsky et al., 2024).

Also, research points to the increasing influence of anthropomorphism factors on the reaction of AI chatbot users. Chatbots using a warm, expressive language sounding like human beings improve usability and service experiences through which the AI seems more natural and trustworthy (Shoukat & Kwon, 2024). Such qualities lessen the gap between people and machines and make the experience less artificial and captivating. Therefore, the adoption of chatbots is not only decided by efficiency, but also by the feeling of being human-like and more relational in the interaction.

2.4 Factors Affecting AI-Chatbot Adoption

PU is a perception of the user that the system can assist in accomplishing their tasks reliably, efficiently, and effectively. Typically performed measures of PU are task efficiency, error rates, ease of use, and user satisfaction (Ren et al., 2022). Users are likely to interact with the systems they perceive as applicable, leading to good user experiences. In a study, 34% of users attributed PU to positive customer experience, noting the effect that PU has on user attitudes (Følstad & Brandtzaeg, 2020). Moreover, PU affects the possibility of repeatedly using chatbots, and satisfied users are more likely to reuse them (Ashfaq et al., 2020). Hence, PU results in both short and long-term engagements. PEOU defines how easy a user thinks a system is to use and would take less effort (de Blanes Sebastián et al., 2022). The imminent high response rates are also revealed to increase the ease of interaction and foster further use (Marjerison et al., 2025). The use of AI chatbots trained on users' needs can make them feel their attitude to the business is forward-looking and customer-friendly. On the contrary, instances of slow response, disinterest, and the error of the system decrease satisfaction and set back adoption (Mogaji et al., 2021).

PT plays a key role in e-commerce. It is defined as the subjective belief of a particular user in the integrity, security, and reliability of the chatbot (Nagy & Hajdu, 2021; Muñoz & Kremer, 2023; Silva et al., 2023). Trust is a multidimensional concept that develops based on users' perceptions of system transparency, data privacy, and ethical conduct (Pal et al., 2022). Trust has been found to have more impact than PU or PEOU in e-commerce, particularly in transactions that include sensitive data (Saoula et al., 2021). Among 215 respondents, faith in chatbots influenced their adoption the most. TAM 2 was expanded by incorporating trust and social influence that brought the model to an even greater variance of 65.1% in explaining the adoption compared to the initial 40% by TAM (Uddin et al., 2024).

Having anthropomorphic cues, including a conversational tone, visual avatars, and emotional expressions, is crucial to the user interactions with AI chatbots (Chen et al., 2024). These aspects boost issues of empathy, intelligence, and friendliness. New research highlights the psychological and social effects of anthropomorphism. The friendliness of chatbots' tone and the expressive behavior of human-like chatbots relax users, and they are more likely to engage in chatbot use (Shoukat & Kwon, 2024; Klein & Martinez, 2023). By behaving as humans, chatbots become more trustworthy and closer to the user, contributing to the overall experience (Shahbandi, 2025; Jin & Youn, 2021). It has been proven that anthropomorphic design elements play a huge role in increasing customer adoption rates during e-commerce. This energy creates confidence and develops continuity of communication (Zhang et al., 2025). Therefore, not only does anthropomorphism improve functionality, but it also improves emotional connection between users and AI chatbots stimulating adoption and loyalty.

2.5 Gaps in Current Research

Although there is a voluminous body of literature on technology adoption based on models, including TAM and extensions, the adoption of AI chatbots in e-commerce, notably about anthropomorphic features, is a gap (Sharma et al., 2023; Alboqami, 2023; Torres et al., 2024). One principal gap is that there is limited exploration of the use of anthropomorphic cues as a mediating variable. Whereas the direct effects of PU, PEOU, and PT on chatbot adoption have been studied extensively, the mediating role of anthropomorphic design elements in such relationships has barely been investigated. Human-like communication, tone, and behavior features are not well researched in the aspect of supporting or influencing the results of PU, PEOU, and PT. It demonstrates the necessity to research the emotional and social aspects of human-AI interaction, particularly in service-based applications such as chatbots.

The research that is currently available is also geographically limited. The other studies are done mainly in Western aspects, and little is done about Southeast Asian markets like Malaysia.

Lastly, despite acceptance of trust as a major predictor of adoption, its interplay with emotional response and anthropomorphism cues has not received much attention (Muñoz & Kremer, 2023; Al-Oraini, 2025).

As for the research method, there were many prior studies on TAM and anthropomorphism that used structural equation modelling (SEM) to examine relationships such as mediation. By following this approach, the current study uses PLS-SEM which is particularly suitable for exploratory models with latent constructs and mediation analysis.

3. Research Methodology

3.1 Research Design

The research design used in this study is quantitative. Quantitative techniques have enabled objective quantification of variables, and statistical inference and conclusions are drawn to extrapolate findings to a broader audience. A structured questionnaire was used to obtain data from a heterogeneous sample of e-commerce users in Malaysia.

3.2 Population and Sample

The target group in this study included Malaysian e-commerce users with at least one experience using AI chatbots and aged 18 years and above. Such groups have those digitally clever folk who may visit online stores quite often and are relevant in a study on the adoption of AI chatbots. The choice can be explained by the high rates of e-commerce development in Malaysia and the growing adaptation of AI chatbots to the work of the customer service (Azli et al., 2023). Moreover, the fact that Malaysia has been actively advancing digital transformation efforts, with such programs as MyDIGITAL Blueprint and National Artificial Intelligence Roadmap (Ministry of Science, Technology and Innovation, 2023), supports the relevance and strategic importance of the choice of the context.

Krejcie and Morgan's (1970) formula was used in determining the sample size (Bukhari, 2021). The minimum recommended sample size of a population of more than 100,000 is 384 respondents based on a 95% confidence level and 5% margin of error (Bujang et al., 2018). This agrees with the research done by other researchers on online Malaysian customer behavior, like Sarangapani et al. (2023), who used a sample size of 387. To fill in possible non-responses or outliers and enhance data quality, a 10% buffer was included so that a total of 432 respondents were contacted at the end (Taherdoost & Madanchian, 2024).

Because of limited resources and lack of access to the whole data set, convenience sampling was used. To get representation, the survey link was shared in several popular social media, such as LinkedIn, Facebook, Instagram, and TikTok, on different days and time slots in a fair way over the same group of prospective participants.

3.3 Survey Instrument

The questionnaire comprised six sections. Section A focused on demographic variables. Sections B to F addressed key constructs: Customer Adoption, PU, PEOU, PT, and anthropomorphic cues. Each construct consisted of seven items adapted from validated instruments in the literature. All items used a five-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree), a widely accepted method for assessing technology acceptance. A pilot study with 33 participants confirmed the instrument's reliability, with all constructs achieving Cronbach's alpha values above 0.70 (Ahmad et al., 2024). The pilot also validated the questionnaire's suitability for large-scale deployment and its application in statistical modeling using Smart PLS.

3.4 Data Collection

The data were gathered via Google Forms online and were posted on popular social media, including LinkedIn, Facebook, Instagram, and TikTok, to achieve a wide population range of internet users in Malaysia. The survey took three weeks and candidate screening to ensure that they already had prior experience of using AI chatbots in e-commerce.

3.5 Data Analysis

The online survey data were analyzed with Smart PLS 4.0, which is specifically a statistical tool related to Partial Least Squares Structural Equation Modeling (PLS-SEM). The method is especially appropriate in exploring analyses based on intricate models that are flexible to latent variables estimated using several indicators. This study used PLS-SEM instead of CB-SEM as this study is exploratory where PT and anthropomorphic cues were added to TAM 2 targets to predict the outcome rather than model fit. PLS-SEM is more suitable for complex models with mediation effects and fewer distributional assumptions, while CB-SEM requires stricter conditions such as multivariate normality and larger sample sizes. On the other hand, PLS-SEM functions better for models that involves complexity like that involves mediating variable and fewer conditions about data distributions which is able to handle smaller samples. With 432 responses and an objective of illustrating what impacts AI adoption, PLS-SEM was the smart and reliable choice.

Then, the reliability and validity of the measurement model were evaluated. Internal consistency was also analyzed using Cronbach's alpha and Composite Reliability (CR), and a value above 0.70 denoted good consistency. The outer loading (0.70) and the Average Variance Extracted (AVE 0.50) were used to test the convergent validity. A cross-loading and Heterotrait-Monotrait (HTMT) ratio was used to determine discriminant validity.

After using validation on the measurement model, the structural model was evaluated. This involved assessing collinearity using the Variance Inflation Factor (VIF), ascertaining the ability to explain using R^2 (coefficient of determination), effect sizes (f^2), and the model fitness using factors like Standardized Root Mean Square Residual (SRMR) and Normed Fit Index (NFI). SPSS was also employed to analyze the correlation among constructs that affect the adoption of AI chatbots. The strength and direction of the relationship between variables were measured using Pearson correlation analysis. Moreover, direct, indirect, and mediating effects were tested in bootstrapping analysis within SmartPLS. These techniques gave a thorough and tight way of proving a hypothesis in research on technology adoption.

3.6 Ethical Consideration

The ethical guidelines were also adhered to to safeguard the rights, privacy, and safety of participants in this research. All the respondents were informed about the purpose of the study, its scope, and the academic aim before their participation. Digital informed consent includes specific information about voluntary participation (and the right to cancel without any repercussions). Collection of the data was anonymous, and no personally identifiable

information was collected to protect the respondent's secrecy. The results of the survey were stored in safely locked passworded computer files accessible by the research team only. The research design had made sure that there was no physical, psychological, or social harm to the participants. Additionally, the study was compliant with the ethical provisions of UNITAR International University, based on the international research ethics principles and the Declaration of Helsinki. All these steps prove the integrity, respect, and ethical responsibility of the study in the research process.

4. Results

4.1 Descriptive Statistics

The response rate is 100% with a total of 432 respondents received, of which 402 were accepted as valid respondents and 30 were classified as invalid respondents due to the absence of e-commerce platform experience.

Table 1: Descriptive Statistics

Variables		Frequency	Percentage
Gender	Female	225	56.0%
	Male	177	44.0%
Age Range	18-25 years old	26	6.5%
	26-33 years old	71	17.7%
	34-41 years old	111	27.6%
	42-49 years old	132	32.8%
	50 and above	62	15.4%
Race	Chinese	218	54.2%
	Indian	70	17.4%
	Malay	114	28.4%
Monthly Personal Income	< RM 5000	109	27.1%
	RM 5001- RM 10000	164	40.8%
	RM 10001-RM 15000	59	14.7%
	>RM 15000	70	17.4%
Educational Level	SPM	43	10.7%
	STPM/Matric/Foundation	15	3.7%
	Diploma	63	15.7%
	Bachelor's Degree	230	57.2%
	Master's Degree	44	11.0%
	PHD/ Doctorate	7	1.7%
E-Commerce Platforms	Shopee	354	88.1%
	Lazada	277	68.9%
	Others	57	14.2%
Living State	Johor	12	3%
	Kedah	5	1.2%
	Kelantan	6	1.5%
	Malacca	7	1.7%
	Negeri Sembilan	9	2.2%
	Pahang	5	1.2%
	Penang	13	3.2%
	Perak	6	1.5%
	Perlis	5	1.2%
	Sabah	5	1.2%
	Sarawak	1	0.3%
	Selangor	224	55.7%
	Terengganu	4	1%
	W.P. Kuala Lumpur	93	23.1%
W.P. Putrajaya	7	1.7%	

4.2 *Inferential Statistics Analysis of Measurement Model*

Inferential statistics were performed to assess the relationships between PU, PEOU, PT, anthropomorphic cues, and customer adoption, which includes correlation and using SmartPLS 4.0. The results of this study confirm the robustness and reliability of the proposed model, exploring customer adoption of AI chatbots in e-commerce. The measurement model demonstrated strong internal consistency, with Cronbach's Alpha and Composite Reliability values exceeding 0.90, and AVE values confirming convergent validity. Outer loadings were mostly above 0.70, supporting indicator reliability. Discriminate validity was achieved through cross-loading checks and HTMT ratios, which were below the 0.90 threshold, validating the distinctiveness of the constructs. Furthermore, the absence of multicollinearity was confirmed with all VIF values below 3.3, and the model exhibited a good fit with SRMR (0.060) and NFI (0.831) within recommended limits. These results confirm that the constructs measured are valid and reliable, and the model structure is statistically sound.

The analysis of the Pearson correlation done in SPSS showed that the key variables were highly positively related. Perceived Usefulness (PU) showed a very strong correlation to Customer Adoption (CA), and the coefficient value was $r = 0.814$, implying that the more perceived as useful chatbots are, the more likely the customers will adopt the use of the chatbots. On the same note, Perceived Ease of Use (PEOU) also had a very strong correlation with Customer Adoption ($r = 0.761$), which suggests that easy and simple to use is a very important attribute to promote engagement. Perceived Trust (PT) showed a moderate relationship with the Customer Adoption ($r = 0.563$), and the anthropomorphic cues (AC) were also moderately linked with all constructs ($0.0402 < r < 0.458$).

However, PT showed a strong relationship with AC ($r = 0.674$), which proves the relevance of the human-like features in forming user trust and adoption behavior. Another important result of the structural model is the significant positive path coefficient (β) between PT and AC ($\beta = 0.644$), which means that in case the user has trust in chatbots, they are likely to enjoy the anthropomorphism qualities. Interestingly, there is a low direct relationship between trust and adoption ($\beta = 0.009$), but a more indirect relationship through anthropomorphism. Other than that, the strongest factor that influences adoption is PU ($\beta = 0.542$), and the second strongest is PEOU ($\beta = 0.284$). The small negative relationship between PU and AC ($\beta = -0.118$) could mean that the functionality-oriented user might not be interested in human-like features. These findings indicate that usefulness and ease of use are sufficient triggers of adoption studies, yet trust maximizes engagement through the aspects of humanization of chatbots.

4.3 *Hypothesis Testing*

There were ten hypotheses that were tested to investigate both direct and mediating relationships among the constructs. 6 out of 10 hypotheses are supported, and 4 are not supported. The hypothesis is considered supported if the t-value is high (typically above 1.96 for a 95% confidence level) and the p-value is below 0.05, indicating a statistically significant relationship (Sathyanarayana & Mohanasundaram, 2025; Sarstedt et al., 2021).

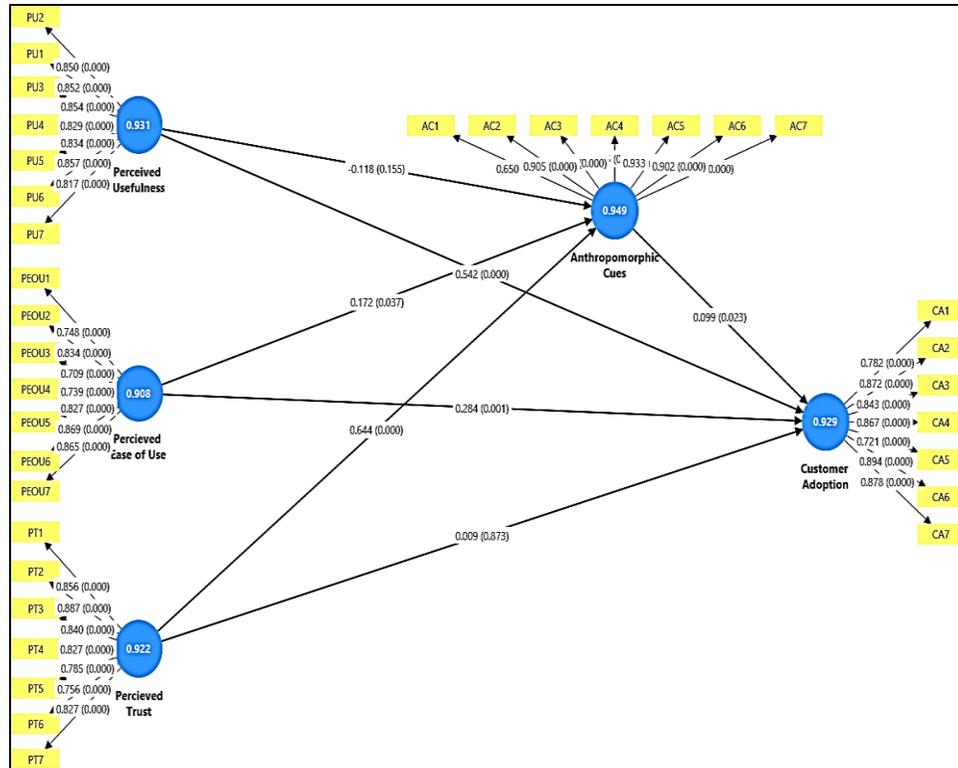


Figure 1: SmartPLS Bootstrapping Output of the Structural Model with Path Coefficients and P-values (with Mediating)

Figure 1 shows the proposed model of combining TAM2 with anthropomorphic cues. This combination is innovative in that anthropomorphism is no longer conceived as a marginal design element but rather as a mediation between PU, PEOU, and PT and adoption. This conceptualization further extends TAM2 through the inclusion of social and emotional constructs, going beyond previous work where these constructs were considered individually.

Table 2: Results of Path Coefficients and Hypothesis Testing

Hypothesis	Relationship	Path Coefficient (β)	t-value	p-value	Decision
Hypothesis 1	Perceived usefulness (PU) of AI chatbots has significant relationship on customer adoption in e-commerce.	0.542	6.347	0.000	Supported
Hypothesis 2	Perceived ease of use (PEOU) of AI chatbots has significant relationship on customer adoption in e-commerce.	0.284	3.218	0.001	Supported
Hypothesis 3	Perceived Trust (PT) of AI chatbots has significant relationship on customer adoption in e-commerce.	0.009	0.160	0.873	Not Supported
Hypothesis 4	Perceived Usefulness (PU) of AI chatbots has significant relationship with anthropomorphic cues in e-commerce.	-0.118	1.423	0.155	Not Supported
Hypothesis 5	Perceived Ease of Use (PEOU) of AI chatbots has significant relationship with anthropomorphic cues in e-commerce	0.172	2.090	0.037	Supported
Hypothesis 6	Perceived Trust (PT) of AI chatbots has significant relationship with anthropomorphic cues in e-commerce.	0.644	11.324	0.000	Supported
Hypothesis 7	Anthropomorphic Cues of AI chatbots have significant relationship on	0.099	2.276	0.023	Supported

	customer adoption in e-commerce.				
Hypothesis 8	Anthropomorphic Cues significantly mediate the relationship between perceived usefulness (PU) of AI chatbots and customer adoption in e-commerce.	-0.012	1.210	0.226	Not Supported
Hypothesis 9	Anthropomorphic Cues significantly mediate the relationship between perceived ease of use (PEOU) of AI chatbots and customer adoption in e-commerce.	0.017	1.427	0.154	Not Supported
Hypothesis 10	Anthropomorphic Cues significantly mediate the relationship between perceived trust (PT) of AI chatbots and customer adoption in e-commerce.	0.064	2.356	0.019	Supported

In H1 and H2, both Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) show strong, significant positive relationships with customer adoption (PU: $t=6.347$, $p=0.000$; PEOU: $t=3.218$, $p=0.001$). This means customers are more likely to adopt AI chatbots if they find them useful and easy to use. For H3, Perceived Trust (PT) does not have a significant direct effect on customer adoption (CA: $t=0.160$, $p=0.873$). This suggests that while trust is important, it may not directly drive adoption unless mediated by other factors such as perceived usefulness or anthropomorphic cues (Uddin et al., 2024).

For H4, PU does not significantly influence anthropomorphic cues (AC: $t=1.423$, $p=0.155$), but PEOU does ($t=2.090$, $p=0.037$), indicating that AI chatbots perceived as easier to use are also seen as more human-like (Torres et al., 2024). PT has a very strong, significant relationship with AC ($t=11.324$, $p=0.000$), showing that trust greatly enhances the perception of human-likeness in AI chatbots. AC themselves significantly influence customer adoption ($t=2.276$, $p=0.023$), supporting the idea that human-like features in AI chatbots can positively impact customer adoption (Yatawara et al., 2025).

For H8 (PU to AC to CA) and H9 (PEOU to AC to CA), however, were not supported, as the t-values and p-values for both paths were not statistically significant. Among the

mediation hypotheses, only H10 (PT to AC to CA) ($t = 2.356$, $p = 0.019$) showed indirect mediating effect of anthropomorphic cues on the relationship between perceived trust and customer adoption. This trend indicates that although PU and PEOU are distinct influences of adoption, existence of human-like characteristics is essential in transforming trust into adoption behavior.

Lastly, these results support the idea of combining functional and emotional aspects, including usability and human-likeness while developing the AI-chatbot is essential in order the chatbot design will improve adoption and engagement.

5. Discussion

According to the results, perceived usefulness (PU) and ease of use (PEOU) were found to be significant predictors of AI chatbot adoption as the TAM 2 theory assumes. Chatbots that are useful and easy to use will be embraced by users. However, perceived trust (PT) has an indirect influence over adoption, which implies that the higher the anthropomorphic cues (AC), the better the trust. Although PEOU will aid in the introduction of such features, PU does not. This is a sign that besides utility as driving force, one can further increase the user involvement with AI chatbots by increasing trust in them by engaging them in emotional, human-like conversations.

5.1 Key Relationships

The PU as well as PEOU were observed to have a significant effect on AI-chatbot adoption. The results are consistent with the available literature underlining that users who perceive AI chatbots as useful and effortless to interact tend to be more willing to use the new technology (Goli et al., 2023; Hasan et al., 2023). Conversely, the analysis finding shows that the relationship between PT and AI-chatbot adoption was statistically not significant. It indicates that trust is not directly a deciding factor to adopt unless there are supplementary supporting factors like user interface design or emotional engagement (Winter & Koebler-Neu, 2023). This study shows that the presence of trust by itself is not enough to make individuals use AI chatbot unless anthropomorphic cues are utilized. This result clearly aligns with study by Truong and Chen (2025), which concluded that anthropomorphic responses create empathy in people which leads users to have a better experience with AI chatbots. Overall, the findings of the study suggest that in countries like Malaysia, users choose AI chatbots not only because it is convenient, but also because of the human-like communication that creates a sense of assurance and make it more interactive.

The findings indicated that PEOU and PT are significant predictors to the perception of a chatbots human-like attributes. That is, the more a chatbot is perceived to be easy to use, the more there is a tendency that it can be identified to behave and communicate like humans (Rapp et al., 2024). Similarly, when users trust the chatbot, they are more likely to perceive that it can show empathy and engage naturally (Sundar et al., 2024; Liao & Yan, 2024). PU did not have a statistically important relationship with anthropomorphic cues.

This means that even when users think the chatbot is helpful, it does not mean they will find the chatbot to be more human-like in its conversational manner.

The factor of anthropomorphic cues played an important role by proving that anthropomorphic cues had significant relationship with AI-chatbot adoption. The finding highlights the significance of human-like design features, including natural language, emotional tone and friendly avatars in creating emotional attachment, increasing users' willingness in AI-chatbot adoption (Khan et al., 2025).

5.2 Mediating Effects of Anthropomorphic Cues

According to the results of the mediation, anthropomorphic cues played mediator role in the association between PT and adoption. Meaning that without human-like features, trust does not directly influence adoption, trust causes adoption only when there are human-like traits of chatbots, thus supporting that people will be more inclined to trust and use a new technology through emotionally appealing interactions (Ding & Najaf, 2024). Conversely, anthropomorphic cues did not mediate the relationship between PU or PEOU and adoption. This implies that although users may find the chatbot is helpful or comfortable to use, it does not mean that it will increase the adoption through additional human-like features, instead, its on-going usage and chatbot engagement is solely depending on human-like interaction (Al-Shafei, 2025). These findings align with the findings of Ding and Najaf (2024), who also found that humanness positively impacts the acceptance of chatbots, but they focused on interactivity as the main channel. In contrast, the present study established anthropomorphic cues as the main mediating factor. The present study builds on Ding and Najaf (2024) who showed that anthropomorphism and humanness play key roles in building trust in chatbot use and indicates the importance of anthropomorphic cues in influencing adoption, thereby highlighting the psychological aspects of AI-human interaction.

5.3 Theoretical Implication

This study makes a number of theoretical contributions. It reaffirms the role of TAM2 in that the relationship between PU and PEOU were still relatively high predictors for chatbot adoption, while PT did not have a direct effect on adoption in the Malaysian context. This is opposite to many studies from the West where PT is a decisive factor, and thus it appears that TAM2 needs refinement to fit the context in non-Western settings.

The results further extend the theory of anthropomorphism by showing that anthropomorphic cues mediate the impact of PT on adoption. These cues are not just complementary but necessary preconditions for PT to translate into usage. This is aligned with Ding and Najaf (2024), where emphasis was placed on the role of interactivity and humanness, and is complementary to Truong and Chen (2025), who demonstrated that anthropomorphic responsiveness enhances empathy.

By linking TAM2 with anthropomorphism theory, the study highlights how functional (PU, PEOU) and social (PT, empathy, anthropomorphic design) dimensions work together in shaping adoption, offering a more integrated view of AI chatbot use.

5.4 Contributions of the Study

The research can provide good understanding of the Malaysian consumers, and it can be used to guide the AI chatbots adoption strategies in Asia since the research has been limited in Asia mostly in Western contexts. Expectations towards technology usage, emotional display, and trust differ in Southeast Asia (Vadivel et al. 2022), so it is crucial to make specific recommendations concerning the region. The results are particularly significant to chatbot creators and strategists that are focused on ASEAN markets (Cheng et al., 2022; Gai, 2024).

This study improves theory through combining TAM2 and anthropomorphism theory. It has identified the mediating role of the anthropomorphic cues between Perceived Trust (PT) and adoption, tackling the limitation of TAM2 that does not recognize emotional connection as a main factor (Sundar et al., 2025). It further enriches the knowledge in the role that human-like design plays on user perception and behavior and demonstrates that anthropomorphism is not merely a surface effect but rather a key determinant of adoption and subsequent use.

The relational trust and human-like interaction are more significant predictors of adoption in the Malaysian study as compared to studies carried in a Western setting where institutional trust and technological assurances are more prominent predictors of adoption (Sheehan et al., 2020; Klein and Martinez, 2023). This implies that the presence of cultural differences determines the ratio between the functional and social reasons of the chatbot adoption, which is why it is critical to consider designing chatbots on a case-by-case basis.

5.5 Limitations and Future Research

This study is not without limitations and recognizing them offers opportunities for future research. First, the conceptual model was mainly based on the perceived usefulness, perceived ease of use, perceived trust, and anthropomorphic cues. While these constructs lie at the core of TAM2 and anthropomorphism theory, other factors which are of relevance such as privacy concern, cultural orientation, and user experience design were not considered. Taking these factors into consideration in future research can lead to a more detailed understanding of chatbot adoption. Second, the data were obtained from one country, Malaysia. This background makes the paper useful for Southeast Asia, but undermines the generalizability of the findings. Future studies should compare results in different countries and regions to understand how cultural and institutional environments influence adoption and trust towards AI technologies.

Finally, the current research utilized TAM2 and anthropomorphism theory to develop research hypotheses. Although these frameworks proved useful, there is potential for future work to benefit from integrating other frameworks such as social presence theory,

expectation confirmation theory, or service dominant logic. Expanding the theoretical lens may facilitate more explanations of user motivations and behavior responses to AI chatbots.

Moreover, the nature of consumer attitudes to AI technologies may change at a different pace based on their exposure to technology and some external events, it would be best to choose a longitudinal or experimental design. Other limitations of the study were not distinguishing the types of anthropomorphic cues, for example, based-on visual, verbal or behavioral aspects, which can have different impact on user trust and adoption. Future studies suggest involving and comparing the impacts of specific anthropomorphic features, including visual expression like avatar, verbal voice, or behavioral human gesture can help to identify the most effective design features on elevating consumer trust and connection.

Beyond e-commerce, future studies could also apply the model to other service sectors where trust, empathy, and emotional connectivity are central, such as healthcare and banking. In healthcare, emotionally responsive chatbots may support mental health or chronic-disease management, while in banking, conversational agents may help build consumer confidence in sensitive financial transactions.

6. Conclusion

This study examined how Malaysians uses AI chatbots when shopping online by combining TAM 2 and anthropomorphism theory. The study clarified that PU and PEOU are crucial, but PT is what leads to customer adoption when chatbot has anthropomorphic cues. This clearly shows that human-like engagement and interaction is essential to transform functional evaluation into adoption behavior. The study enhances TAM 2 for a non-western setting and clearly expands anthropomorphism theory by explaining that anthropomorphic features are important mediators. As for e-commerce businesses and AI developers, the results from the study suggest creating chatbots that are both efficient and highly-engaging to instill trust and keep users inclined towards it. As this study focuses on a wide range of Malaysian users, this study highlights how local cultures and social factors plays a role in adoption. Future studies may test this model across other countries by adding additional factors such as privacy or social presence. These suggestions can further strengthen and track users over a certain period which can shape consumer behavior.

6.1 Practical Implications

As stated in the findings, the indicators of PU and PEOU are perceived to be key drivers of the adoption of AI chatbots, which reaffirm the significance of the concept TAM theory. Important results show that PT was not found to have a direct impact on adoption, it was found to be influenced by anthropomorphic cues through mediating the relationship between trust and adoption. Thus, this result supports an idea to the practitioners in ecommerce that not only operationally but also emotionally resonant chatbots should be

designed, including such human characteristics as empathy, friendly manner of conversation, and social likability can improve adoption and engagement.

6.2 Contributions to the Field

This study adds to the field by combining TAM2 and anthropomorphism theory to explain the adoption of AI-chatbots in e-commerce. It helps to advance the theory by confirming the roles of PU and PEOU, clarifying the limited direct role of PT, and identifying anthropomorphic cues as very important mediators. The study also adds to the evidence base by contextualizing these relationships within Malaysia, which is a developing economy that has been under-represented in previous studies. Practically, it offers advice for e-commerce managers and developers of artificial intelligence on building chatbots that are both functional and human-like in order to encourage trust and engagement.

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