

A Study on E-Commerce Chatbot Security, Memory Performance, and Complex Query Handling for Consumer Satisfaction

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Peer Review Information	Abstract
<p>Type: Article Received: 28 March 2026 Revised: 26 April 2026 Accepted: 11 May 2026 Published: 02 June 2026</p>	<p>AI chatbots are increasingly used in e-commerce customer service; however, issues related to data privacy, contextual memory, and complex query handling continue to affect user trust and experience. This study uses a survey of 160 digitally active Indian consumers to examine these challenges and their impact on consumer satisfaction. Analysis using chi-square tests of independence ($\alpha = 0.05$) revealed statistically significant concerns: 76.3% of participants reported moderate to extreme anxiety related to phishing and data privacy; context loss affected 59.4% of respondents, with high frustration reported by 47.5%; and 76.9% preferred human assistance when chatbots failed to resolve complex matters. Overall consumer satisfaction remained only moderate ($M = 3.49/5$). The most desired enhancements were AI-based fraud detection and persistent memory solutions.</p> <p>This study contributes by integrating security, memory performance, and complex query handling within a unified empirical framework in an emerging market context, offering actionable insights for improving chatbot reliability and user satisfaction.</p> <p>Keywords: E-Commerce Chatbots; Data Privacy; Conversational Memory; Multi-Turn Queries; Consumer Satisfaction; Hybrid AI Systems; Technology Acceptance Model (TAM).</p>

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Introduction

The rapid growth of e-commerce has prompted platforms worldwide to adopt AI-powered chatbots for round-the-clock customer support, personalized product recommendations, order tracking, and seamless transaction assistance (McTear, 2016; Huang & Rust, 2021). These conversational agents aim to enhance operational efficiency and reduce costs while delivering instant responses to customers. India's e-commerce market is projected to grow by 12.4% in 2026, reaching INR 19.7 trillion (approximately \$225.9 billion), driven by strong consumer demand and digital payment adoption (GlobalData, 2026).

However, despite advances in natural language processing and machine learning, users continue to encounter serious challenges in three key areas: security and data privacy, consistent conversational memory, and effective handling of complex, multi-step, or emotionally charged queries (Luger & Sellen, 2016; Yang et al., 2023). These persistent issues erode trust, heighten frustration, increase escalations to human agents, and ultimately reduce consumer satisfaction and platform loyalty (Beldad & Hegner, 2018; Adam et al., 2021).

Although prior studies have examined these problems individually, notable research gaps persist. Few investigations integrate security, memory, and complex query handling within a unified framework, particularly in emerging economies like India, where e-commerce is expanding rapidly amid varying levels of digital literacy. Moreover, theoretical integration between privacy-extended TAM models and multi-level AI intelligence frameworks remains limited in user-focused evaluations. This study addresses these gaps by (1) examining user perceptions and experiences across security, memory, and complex queries, (2) anchoring the analysis in robust theoretical foundations, and (3) generating actionable insights from a digitally engaged Indian sample. The primary objectives are to identify key user concerns, statistically test relevant hypotheses, and propose practical solutions for more reliable and user-friendly e-commerce chatbots.

Literature Review

Theoretical Foundation

The conceptual framework of this study is built on two complementary scholarly models. The first is Beldad and Hegner's (2018) expanded Technology Acceptance Model (TAM), which incorporates trust (explicitly linked to privacy and security risks in data-disclosing contexts), social influence, and additional valuation factors beyond traditional usability metrics. This extension is especially pertinent where user vulnerability is elevated. The second is Huang and Rust's (2021) layered taxonomy of AI service intelligence, which spans mechanical execution, data-driven analysis, intuitive judgment, and empathetic engagement, while advocating symbiotic human–AI collaboration for nuanced service scenarios. Together, these frameworks explain how deficiencies in chatbot security, memory retention, and query resolution erode consumer confidence and satisfaction.

Security and Privacy Concerns

Data protection and conversational privacy remain major barriers to chatbot adoption. Yang et al. (2023) identified several security risks in chatbots, including data leakage and privacy vulnerabilities. Beldad and Hegner (2018) demonstrated empirically that elevated risk perception suppresses technology adoption. In the e-commerce domain, Waheed et al. (2022) identified critical security gaps in web-based chatbots, highlighting the mismatch between perceived and actual safeguards. Recent studies further reinforce these issues in emerging markets, including the influence of AI on customer relationship management security (Hossain et al., 2024).

Memory Performance and Contextual Recall

A persistent limitation in conversational AI is unreliable long-term memory. Luger and Sellen (2016) described the “gulf” between user expectations and actual agent capabilities, where chatbots frequently forget prior interactions and force users to repeat information, leading to inefficiency, frustration, and disengagement.

Complex Query Handling and the Role of Hybrid Systems

Chatbots excel at simple queries but often falter with ambiguous, multi-intent, emotionally charged, or multi-step requests requiring deeper reasoning (Adam et al., 2021). Huang and Rust (2021) emphasize that intuitive and empathetic intelligence is best achieved through hybrid human–AI models. Luo et al. (2019) demonstrated the value of seamless escalation to human agents. Recent empirical work in e-retailing confirms that usability and responsiveness gaps in AI chatbots widen the user expectation divide (Chen et al., 2021; Mohamed & Ismail, 2024), while AI-driven chatbots for customer support and personalized recommendations show promise yet require hybrid integration for complex scenarios (Prasad et al., 2024; Rahevar & Darji, 2024).

While prior studies have extensively examined chatbot security, memory limitations, and query-handling capabilities independently, limited research has explored their combined impact on consumer satisfaction within a unified analytical framework. Moreover, most existing studies are concentrated in developed markets, leaving a significant contextual gap in emerging economies such as India, where varying levels of digital literacy and trust influence technology adoption.

Therefore, this study addresses an important research gap by integrating these three critical dimensions and empirically evaluating their collective influence on user satisfaction in a rapidly growing e-commerce environment.

Methodology

Research Design

This study employed a quantitative, descriptive survey design to assess consumer perceptions of AI-powered chatbot interactions in digital retail environments.

Sample Design

A convenience-based, non-probability sampling approach was used. Participants (N = 160) were digitally active Indian consumers with prior online purchasing experience. The survey was distributed through targeted channels including WhatsApp groups, LinkedIn professional networks, and university student forums across major Indian cities to ensure broad digital engagement.

Sources of Data

Primary data were collected via a researcher-developed online questionnaire administered through Google Forms.

Instrument Development

The instrument underwent pilot testing with 15 respondents to refine wording, eliminate ambiguities, and confirm face validity prior to full deployment.

Research Variables

Three independent variables were examined: Chatbot Security & Privacy, Chatbot Memory Performance, and Complex Query Handling. Consumer Satisfaction served as the dependent variable.

Relation Between the Variables (IV/DV)

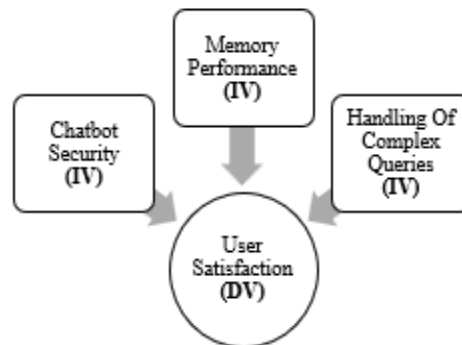


Fig. 1. Relation Between the Variable (IV/DV)

Measurement

Security and privacy were measured via a binary item (experience of sensitive information requests) and a 5-point Likert scale for phishing anxiety. Memory performance used a binary context-retention item paired with a 5-point frustration scale. Complex query handling and overall satisfaction were assessed on 5-point scales. Cronbach's alpha for the phishing concern scale was 0.919, indicating strong internal consistency. Additional scales (memory frustration and query satisfaction) were single- or dual-item measures. Due to survey constraints, some constructs were measured using limited items, which may affect scale robustness.

Hypotheses

- H₁: Users have concerns about chatbot data privacy.
- H₂: Chatbot memory problems lead to user dissatisfaction.
- H₃: Chatbots are not able to handle complex queries without human help.

Data Collection and Analysis

Descriptive statistics summarized response distributions. Chi-square tests of independence ($\alpha = 0.05$) examined relationships between key categorical variables (e.g., for H₁: phishing concern level dichotomized as high/moderate vs. low crossed with sensitive-information

experience; similar 2×2 contingency approaches for H₂ and H₃). All procedures adhered to ethical standards, including voluntary participation, informed consent, and data confidentiality.

Analysis and Results

Demographic Profile of Respondents

Table 1: Demographic Profile of Survey Respondents (n = 160)

Demographic Variable	Category	No. of Respondents	Percentage (%)
Age Group	18–25	108	67.5
	26–35	45	28.1
	36–45	6	3.8
	Above 46	1	0.6
Gender	Male	89	55.6
	Female	71	44.4
Occupation	Student	79	49.4
	Employed	62	38.8
	Unemployed	16	10.0
	Others	3	1.8
Prior Chatbot Interaction	Yes	126	78.8
	No	25	15.6
	Maybe	9	5.6

Hypothesis Testing

Table 2: Chi-Square Hypothesis Test Results ($\alpha = 0.05$)

Hypothesis	Research Question	χ^2 Value	df	p-value	Result
H ₁	Users have concerns about chatbot data privacy	12.10	1	< 0.05	Rejected
H ₂	Chatbot memory problems lead to user dissatisfaction	5.63	1	< 0.05	Rejected
H ₃	Chatbots are not able to handle complex queries without human help	46.00	1	< 0.05	Rejected

Data Analysis

Table 3: Chatbot Security – Experience of Sensitive Information Requests and Phishing Concern

Metric	Category	No. of Respondents	Percentage (%)
Been asked to share sensitive info	Yes	58	36.3
	No/Not asked	102	63.7
Phishing Concern Level	High/Extreme (4–5)	63	39.4
	Moderate (3)	59	36.9
	Low (1–2)	38	23.8

Note: AI-based fraud detection received the highest perceived effectiveness (weighted average = 3.47/5).

Interpretation

The findings indicate that although only 36.3% of respondents have experienced requests for sensitive information, a significantly higher proportion (76.3%) report moderate to high levels of phishing concern. This highlights a strong perception of risk among users, suggesting that trust deficits exist even in the absence of direct negative experiences, reinforcing the importance of perceived security in chatbot adoption.

Table 4: Chatbot Memory Performance – Context Loss, Frustration, and Preferred Improvements

Metric / Category	Category	No. of Respondents	Percentage (%)
Chatbot forgets past conversations	Yes	95	59.4
	No	65	40.6
Frustration Level	High/Extreme (4–5)	76	47.5
	Moderate (3)	50	31.3
	Low (1–2)	34	21.3
Preferred Improvements (multi-select)	AI-based memory	92	57.5
	User session history	72	45.0
	CRM integration	63	39.4

Interpretation

The results reveal that 59.4% of respondents experience chatbot memory failures, with 47.5% reporting high levels of frustration. This indicates that lack of contextual continuity is a major source of user dissatisfaction, as repeated interactions and information input reduce efficiency and overall experience quality. The preference for AI-based memory solutions further emphasizes the demand for improved conversational intelligence.

Table 5: Complex Query Handling – Success Rate, Satisfaction, and Human Preference

Metric	Category	No. of Respondents	Percentage (%)
Success in handling complex queries	Always/Often	68	42.5
	Sometimes	65	40.6
	Rarely/Never	27	16.9
Overall Satisfaction	Satisfied/Very Satisfied (4–5)	63	39.4
	Moderate (3)	67	41.9
	Dissatisfied (1–2)	30	18.8
Prefer human assistance when chatbot fails	Yes	123	76.9
	No	37	23.1

Interpretation

The analysis shows that while chatbots are moderately effective in handling complex queries (42.5% reporting success), a substantial proportion of users still face limitations. Notably, 76.9% prefer human assistance when chatbots fail, indicating that chatbots alone are insufficient for complex problem resolution, and hybrid support systems are essential for enhancing service effectiveness.

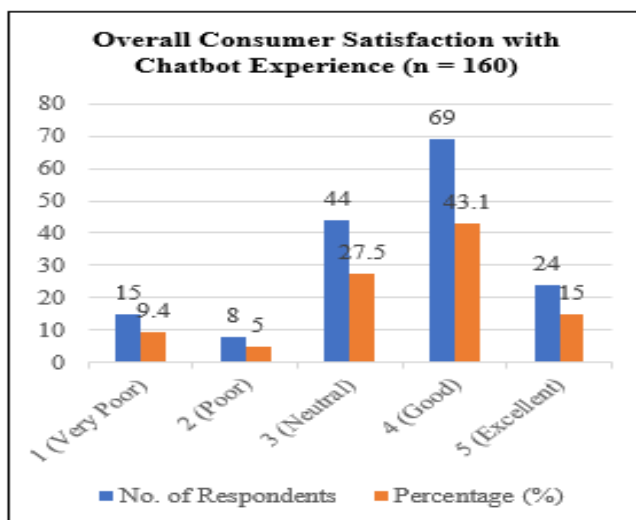


Fig. 2. Satisfaction Levels of Respondents

Interpretation

The overall satisfaction ratings indicate a moderate user experience (Mean = 3.49), with the majority of responses clustered around “Good” and “Neutral.” This suggests that while chatbots provide functional value, key limitations in security perception, memory, and query handling prevent higher levels of user satisfaction and engagement.

Discussion

The findings strongly align with existing literature while offering deeper contextual insights. The elevated phishing concern (76.3%) despite relatively lower exposure to sensitive information requests reflects the privacy paradox, supporting Beldad and Hegner (2018), who identified perceived risk as a critical barrier to technology adoption.

The observed memory limitations (59.4% context loss) are consistent with Luger and Sellen (2016), who described the gap between user expectations and chatbot capabilities, leading to frustration and disengagement. Similarly, the inability of chatbots to effectively handle complex queries aligns with Adam et al. (2021), who found that AI chatbots struggle with nuanced and multi-step interactions.

Furthermore, the strong preference for human assistance (76.9%) reinforces Huang and Rust’s (2021) argument that empathetic and intuitive intelligence cannot be fully automated, emphasizing the importance of hybrid human–AI service models. These findings also support Luo et al. (2019), who demonstrated that seamless escalation to human agents improves user trust and service outcomes.

Overall, the study highlights that consumer satisfaction is not determined by a single factor but by the combined effect of security perception, memory reliability, and problem-solving capability, thereby extending existing theoretical frameworks.

Conclusion

This study provides compelling evidence that security concerns, memory limitations, and shortcomings in complex query handling collectively constrain consumer satisfaction with e-commerce chatbots. By integrating established theoretical frameworks with empirical data from an emerging market, the research delivers both theoretical advancement and actionable practical guidance. E-commerce platforms must evolve toward intelligent, secure, and genuinely hybrid human–AI systems to foster enduring trust and sustain competitive advantage.

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