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An Analysis of Artificial Intelligence Adoption Behavior Applying Extended UTAUT Framework in Urban Cities: The Context of Collectivistic Culture †

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Abstract: The objective of this study is to examine an extended version of the Unified Theory of Acceptance and Use of Technology that takes behavioral assumptions (trust, innovativeness, social influence, performance and effort expectancy, and perceived risk) into account as it examines the adoption behavior of artificial intelligence applications in the context of Pakistan. The moderating framework also serves to examine the impact of the collectivism culture. The outcomes supported the hypothesized relationships, and they showed that the suggested model fit the data well. The outcomes also demonstrated that cultural factors strengthened these relationships. This study offers a number of conceptual and practical implications.

Keywords: AI applications; behavioral intention; UTAUT model; collectivism culture; urban cities

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1. Introduction

The imperative for innovation and continuous advancement of digital services is paramount in the context of intense competition and the demands of contemporary society. This elucidates the reason behind the growing significance of cutting-edge technologies, such as artificial intelligence. An urban center is a substantial human settlement characterized by a permanent and densely populated area with officially designated boundaries, whose inhabitants commonly indulge in non-agricultural activities [1].

The Unified Theory of Acceptance and Use of Technology (UTAUT) has been utilized by previous scholars to determine the adoption behavior of a technology, with factors such as trust, innovativeness, social influence, performance and effort expectancy, and perceived risk being taken into consideration [2]. Recent suggestions have been rendered to validate and implement the aforementioned theoretical framework in different countries with consideration given to collectivism as a national cultural dimension [3].

The current research is inspired by the previous research conducted by Slade et al. [2] and focuses on validating the UTAUT model in the Pakistani context. Additionally, this study endeavors to assess the adoption behavior of artificial intelligence (AI) applications while considering the moderating effect of the collectivism cultural dimension [4].

2. Literature Background

2.1. The Unified Theory of Acceptance and Use of Technology (UTAUT)

The UTAUT model, as proposed by Venkatesh et al. [5,6], represents an integration of previous instances of the TAM framework. This model proposes that technology applications are dependent upon the user's intention to use it, which is in turn influenced by factors such as performance expectancy, effort expectancy, and social influence. Nistor

et al. [3] provide initial findings that coincide with the previous research of Venkatesh et al. [5,6], while enhancing the explanatory capacity of the UTAUT framework through the inclusion of computer anxiety as a factor in the adoption of AI applications.

2.2. Cultural Dimension Theory

The classification of a country's national culture can be done through the application of the cultural dimensions theory's refined dimensions [4]. The cultural dimensions under consideration are "Power Distance (PD), Individualism versus Collectivism (IND), Masculinity versus Femininity (MAS), Uncertainty Avoidance (UAI), and Long-Term Orientation (LTO)". The cultural dimensions of Pakistan and critical values are given in Table 1.

Table 1. Hofstede's (2009) cultural dimensions for Pakistan and critical values [4].

Country	PDI	IDV	MAS	UAI	LTO
Pakistan	55	14	50	70	50
Critical Values	81	13	70	29	80

2.3. Technology Used

Chatbots have become increasingly popular as an artificial intelligence application in public services. Chatbots enable governments to perform diverse tasks, including but not limited to arranging appointments, responding to commonly asked inquiries, filling out forms, handling document-related inquiries, and assisting with personnel management.

2.4. Conceptual Framework and Hypotheses Development

The current study's conceptual framework shares resemblance to the Unified Theory of Acceptance and Use of Technology (UTAUT) and has been applied in the context of Pakistan. The study intends to investigate the impact of trust, innovativeness, social influence, performance expectancy, effort expectancy, and perceived risk on adoption behavior. Additionally, the study attempts to investigate the moderating role of the collectivism culture dimension on the association between AI application and adoption behavior. A number of hypotheses are formulated consequent to these causal associations. AI adoption behavior conceptual framework is presented in Figure 1.

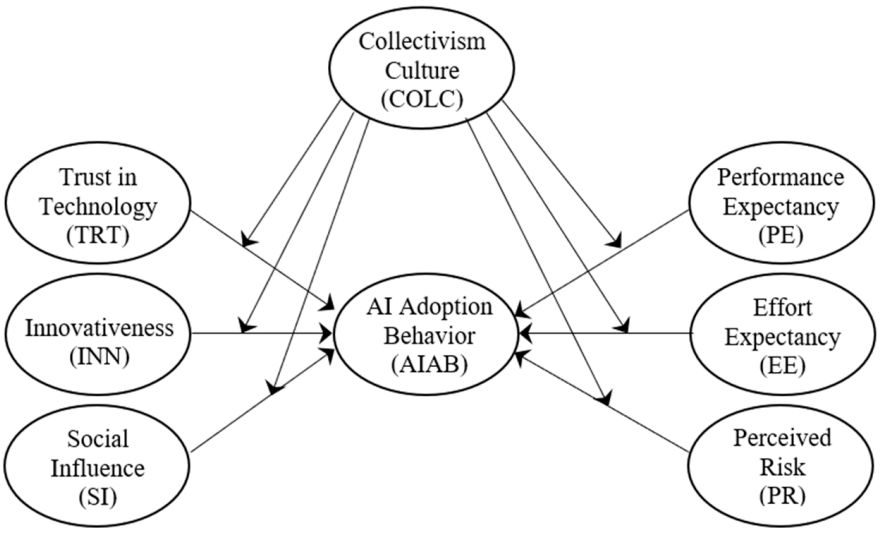


Figure 1. AI adoption behavior conceptual framework.

2.4.1. Trust in Technology and Adoption Behavior

Trust (TRT) is a subjective concept that relates to an individual's belief in the capability of an entity to fulfill their promises. It holds significant importance in electronic transactions, where users are exposed to heightened risks of insecurity and a perceived lack of control [7]. In the context of the growing competition within the public sector, there is an apparent preference to create trust as a means of fostering persistent and strong relationships with service recipients [2]. The concept of trust has been historically challenging to define and has been approached as both a singular and multifaceted construct [8]. The impact of trust, viewed as a singular concept, on behavioral intention has received significant support in the chatbot domain, as evidenced by previously conducted studies [9]. This study intends to use extended UTAUT, similar to the work of [9], and centers on examining the impact of trust on chatbot adoption behavior. Given the emerging nature of customer service and the complex atmosphere, trust is expected to play a crucial role. Hence, the following hypothesis is proposed:

Hypothesis 1. *Trust in technology positively affects adoption behavior to use chatbots.*

2.4.2. Innovativeness and Adoption Behavior

The term "innovativeness" (INN) pertains to an individual's inclination to actively pursue novel and distinctive ideas or approaches. Thakur and Srivastava [10] discovered that personal innovativeness had an influence on the decisions of users, in contrast to non-users, with regards to adopting mobile payments in India. On the contrary, Kasilingam [11] identified innovativeness as the most important indicator of behavioral intention to use chatbots; the adoption of chatbots will be influenced by their perceived usefulness and ease of use as well as their trust in the security and reliability of the technology. The extent of innovativeness is predicted to have a significant impact on the adoption behavior, thus highlighting the significance of it in the adoption process; hence, the following hypothesis is proposed:

Hypothesis 2. *Innovativeness positively affects adoption behavior to use chatbots.*

2.4.3. Social Influence and Adoption Behavior

Social influence (SI) is "the extent to which consumers perceive that important others believe they should use a particular technology" in the behavioral context [6]. Social influence has a substantial effect on adoption behavior because non-users have more control over their behavior and how their decisions will affect their social position. Social influence, one of the four distinctive UTAUT components, has been examined most extensively in the context of chatbots, and its impact on behavioral intention garnered acceptance rather than criticism [12,13]. Based on this theoretical framework, we propose the following:

Hypothesis 3. *Social influence positively affects adoption behavior to use chatbots.*

2.4.4. Performance Expectancy and Adoption Behavior

The term "performance expectancy" (PE) refers to "the degree to which using a technology will provide benefits to consumers in performing certain activities" [6]. Chatbots possess an appealing attribute in the potential to enhance their performance through iterative analysis of user input, utilizing advanced techniques such as natural language processing, machine learning, and artificial intelligence. The implementation of chatbots can enhance customer satisfaction and loyalty by facilitating seamless communication with clients, providing prompt responses to inquiries at all times, and delivering consistent service without interruption [14]. The utilitarian advantages presented by chatbots are anticipated to serve as significant motivators for their adoption. Thus, the following is suggested:

Hypothesis 4. *Performance expectancy positively affects adoption behavior to use chatbots.*

2.4.5. Effort Expectancy and Adoption Behavior

As defined by Venkatesh et al. [6], "effort expectancy" (EE) is "the degree of ease associated with consumers' use of technology"; it is identical to TAM's perceived ease of use. According to Richard et al.'s [14] study, effort expectancy represents among one of the most significant indicators of the intention to use chatbots, and Venkatesh et al. [5] also discovered that effort expectancy significantly influences behavioral intention. In regard to chatbots, the direct influence of the perceived ease of use on behavioral intention has received endorsement from Chen et al. [15] and criticism from Chandra et al. [9], although Shaw [16] found a significant indirect influence of perceived ease of use on adoption behavior through perceived usefulness. This theory and UTAUT's hypotheses predict the following:

Hypothesis 5. *Effort expectancy positively affects adoption behavior to use chatbots.*

2.4.6. Perceived Risk and Adoption Behavior

Perceived risk (PR) refers to a feeling of uncertainty about potential drawbacks when using a product or service. As per the published definition, it is "a combination of uncertainty plus seriousness of involved outcome" [17]. Scholars have found that individuals' perceived risk strongly affects their intention to use chatbots [18]. Similarly, Rajak and Shaw [19] observed that the adoption of information systems has been found to produce a sense of anxiety and stress among both employees and consumers. Park et al. [20] discovered that perceived risk was the key determinant in whether or not a consumer decided to buy a product. Since non-users of chatbots are likely to consider the security of their personal information as extremely risky, it is most likely that perceived risk will play an important role on behavioral intention. Therefore, the following is proposed:

Hypothesis 6. *Perceived risk negatively affects adoption behavior to use chatbots.*

2.4.7. Moderating Role of Individualism/Collectivism

Collectivistic culture (COLC) refers to the extent to which an individual recognizes the relationship between oneself and a community to which they belong to. Individuals in a COLC, where personal acceptance is contingent on collective beliefs, are thought to be influenced by the concepts of TRT, EE, and SI [16]. The findings of a meta-analysis indicate that there is a significant connection between a person's behavior within a COLC group and the dominant standards and values, in particular those associated with trust, innovation, and performance expectancy. The EE approach is especially relevant and applicable within the cultural context of the COLC. The prior argument is consistent with Hofstede's assertion that collectivism is strongly associated with workplace training, physiological variables, and the practical application of knowledge [4]. Pakistan exhibits modest results on Hofstede's cultural dimensions, with only one dimension, collectivism [4], being notable for evaluation. This indicates that individuals who prefer collective goals are inclined towards avoiding risk and exhibit lower levels of liberty in pursuit of objectives evaluated by others [17]. Hence, we proposed the following hypotheses:

Hypothesis 7. *COLC moderates the relationship between TRT and adoption behavior to use chatbots such that the relationship between TRT and adoption behavior is positively strengthened.*

Hypothesis 8. *COLC moderates the relationship between INN and adoption behavior to use chatbots such that the relationship between INN and adoption behavior is positively strengthened.*

Hypothesis 9. *COLC moderates the relationship between SI and adoption behavior to use chatbots such that the relationship between SI and adoption behavior is positively strengthened.*

Hypothesis 10. *COLC moderates the relationship between PE and adoption behavior to use chatbots such that the relationship between PE and adoption behavior is positively strengthened.*

Hypothesis 11. *COLC moderates the relationship between EE and adoption behavior to use chatbots such that the relationship between EE and adoption behavior is positively strengthened.*

Hypothesis 12. *COLC moderates the relationship between PR and adoption behavior to use chatbots such that the relationship between PR and adoption behavior is weakened.*

3. Research Methodology

The data sample was obtained through an online survey questionnaire, with each dimension of the questionnaire being evaluated on a five-point Likert scale. The validity of the scale was established by complying with established guidelines. The collected data was analyzed using SmartPLS version 4 software, which involved an instance of confirmatory factor analysis (CFA), correlation, and structural equation modeling techniques. Following the circulation of the questionnaire to citizens of Pakistan, a total of 462 completed survey responses were obtained. The utilization of outer factor loading and composite reliability was implemented to assess the reliability of the measurement. Convergent validity analysis was conducted to examine the average variance extracted (AVE) of the components. The Cronbach's alpha coefficient was utilized to assess the internal consistency of the constituent elements.

4. Study Results

In the measurement model, items containing factor loadings of 0.70 or higher were assumed to be reliable [21]. The composite reliability was assessed by the reliability of its component constructs. Cronbach's alpha (α), composite reliability (CR), and average variance extracted (AVE) are commonly used measures to assess the reliability and validity of elements.

The study findings applying structural equation modeling are presented in Table 2. The study examines the impact of UTAUT factors on the adoption behavior of AI applications as well as the moderating influence of collectivism culture on the relationship between UTAUT factors and AIAB. Findings indicate that TRT, INN, SI, PE, and EE were positively associated with AIAB, while PR had a negative impact on AIAB. These findings provide support for Hypotheses 1 through 6. To examine Hypotheses 7 through 12, a framework for moderated-hypothesis testing was constructed [22]. This framework incorporated the influence of collectivism culture as a moderating factor in the relationship between UTAUT factors and the adoption behavior of AI applications. The collectivist culture exhibited positive interaction effects that served to strengthen the relationships between the independent and dependent variables, and vice versa. Therefore, the hypotheses H7 through H12 were supported.

Table 2. Structural equation modeling findings.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	*p* Values
TRT -> AIAB	0.457	0.458	0.019	24.638	0.000
INN -> AIAB	0.101	0.102	0.008	13.215	0.000
SI -> AIAB	0.066	0.064	0.016	4.084	0.000
PE -> AIAB	0.381	0.381	0.022	17.32	0.000
EE -> AIAB	0.642	0.641	0.019	32.982	0.000
PR -> AIAB	−0.023	−0.023	0.011	2.054	0.04
COLC -> AIAB	0.424	0.424	0.015	28.907	0.000
COLC × TRT -> AIAB	0.087	0.086	0.01	8.823	0.000
COLC × INN -> AIAB	0.02	0.019	0.007	2.989	0.003

Table 2. *Cont.*

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	*p* Values
COLC × SI -> AIAB	0.16	0.157	0.018	8.89	0.000
COLC × PE -> AIAB	0.542	0.543	0.017	32.382	0.000
COLC × EE -> AIAB	0.407	0.408	0.015	27.404	0.000
COLC × PR -> AIAB	−0.076	−0.077	0.012	6.312	0.000

5. Conclusions

The current study provides a thorough analysis of the variables influencing AI application adoption behavior. This study was inspired by the finding that existing models frequently overestimate the influence of collectivism culture on the user adoption of AI applications. A comprehensive framework for AI application adoption behavior was developed and subsequently applied across a wider range of instances using the UTAUT model in order to bridge these gaps. The findings demonstrate that collectivism culture has a significant moderating effect on the relationship between UTAUT factors and AI application adoption behavior.

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References

1. Orum, A.M. *The Wiley-Blackwell Encyclopedia of Urban and Regional Studies*; John Wiley & Sons: Hoboken, NJ, USA, 2019.
2. Slade, E.L.; Dwivedi, Y.K.; Piercy, N.C.; Williams, M.D. Modeling consumers' adoption intentions of remote mobile payments in the United Kingdom: Extending UTAUT with innovativeness, risk, and trust. *Psychol. Mark.* **2015**, *32*, 860–873. [CrossRef]
3. Nistor, N.; Lerche, T.; Weinberger, A.; Ceobanu, C.; Heymann, O. Towards the integration of culture into the Unified Theory of Acceptance and Use of Technology. *Br. J. Educ. Technol.* **2014**, *45*, 36–55. [CrossRef]
4. Hofstede, G. *Geert Hofstede Cultural Dimensions*; Universities of Maastricht: Maastricht, The Netherlands; Universities of Tilburg: Tilburg, The Netherlands, 2009.
5. Venkatesh, V.; Morris, M.G.; Davis, G.B.; Davis, F.D. User acceptance of information technology: Toward a unified view. *MIS Q.* **2003**, *27*, 425–478. [CrossRef]
6. Venkatesh, V.; Thong, J.Y.; Xu, X. Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Q.* **2012**, *36*, 157–178. [CrossRef]
7. Mubarak, M.F.; Petraite, M. Industry 4.0 technologies, digital trust and technological orientation: What matters in open innovation? *Technol. Forecast. Soc. Chang.* **2020**, *161*, 120332. [CrossRef]
8. Przegalinska, A.; Ciechanowski, L.; Stroz, A.; Gloor, P.; Mazurek, G. In bot we trust: A new methodology of chatbot performance measures. *Bus. Horiz.* **2019**, *62*, 785–797. [CrossRef]
9. Chandra, S.; Srivastava, S.C.; Theng, Y.-L. Evaluating the role of trust in consumer adoption of mobile payment systems: An empirical analysis. *Commun. Assoc. Inf. Syst.* **2010**, *27*, 29. [CrossRef]
10. Thakur, R.; Srivastava, M. Adoption readiness, personal innovativeness, perceived risk and usage intention across customer groups for mobile payment services in India. *Internet Res.* **2014**, *24*, 369–392. [CrossRef]
11. Kasilingam, D.L. Understanding the attitude and intention to use smartphone chatbots for shopping. *Technol. Soc.* **2020**, *62*, 101280. [CrossRef]
12. Balakrishnan, J.; Abed, S.S.; Jones, P. The role of meta-UTAUT factors, perceived anthropomorphism, perceived intelligence, and social self-efficacy in chatbot-based services? *Technol. Forecast. Soc. Chang.* **2022**, *180*, 121692. [CrossRef]
13. Terblanche, N.; Kidd, M. Adoption factors and moderating effects of age and gender that influence the intention to use a non-directive reflective coaching chatbot. *SAGE Open* **2022**, *12*, 21582440221096136. [CrossRef]

14. Richad, R.; Vivensius, V.; Sfenrianto, S.; Kaburuan, E.R. Analysis of factors influencing millennial's technology acceptance of chatbot in the banking industry in Indonesia. *Int. J. Civ. Eng. Technol.* **2019**, *10*, 1270–1281. [CrossRef]
15. Chen, H.-L.; Widarso, G.V.; Sutrisno, H. A chatbot for learning Chinese: Learning achievement and technology acceptance. *J. Educ. Comput. Res.* **2020**, *58*, 1161–1189. [CrossRef]
16. Shaw, N. The mediating influence of trust in the adoption of the mobile wallet. *J. Retail. Consum. Serv.* **2014**, *21*, 449–459. [CrossRef]
17. Bauer, R.A. *Consumer Behavior as Risk Taking. Risk Taking and Information Handling in Consumer Behavior. DF Cox*; Harvard University Press: Cambridge, MA, USA, 1960.
18. Silva, S.C.; De Cicco, R.; Vlačić, B.; Elmashhara, M.G. Using chatbots in e-retailing–how to mitigate perceived risk and enhance the flow experience. *Int. J. Retail. Distrib. Manag.* **2023**, *51*, 285–305. [CrossRef]
19. Rajak, M.; Shaw, K. An extension of technology acceptance model for mHealth user adoption. *Technol. Soc.* **2021**, *67*, 101800. [CrossRef]
20. Park, J.; Amendah, E.; Lee, Y.; Hyun, H. M-payment service: Interplay of perceived risk, benefit, and trust in service adoption. *Hum. Factors Ergon. Manuf. Serv. Ind.* **2019**, *29*, 31–43. [CrossRef]
21. Hair, J.F., Jr.; Howard, M.C.; Nitzl, C. Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *J. Bus. Res.* **2020**, *109*, 101–110. [CrossRef]
22. Bokhari, S.A.A.; Myeong, S. AI Applications in Smart City Employing Technology Adoption Model: Hofstede's Cultural Perspective. In Proceedings of the 2023 2nd International Conference for Innovation in Technology (INOCON), Bangalore, India, 3–5 March 2023.

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