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Cultural Dimensions and Their Impact on Intelligent Personal Assistant Adoption in African Contexts

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Abstract

This paper investigates the influence of cultural dimensions on the adoption and user satisfaction of Intelligent Personal Assistants (IPAs) across diverse African contexts. Utilizing a sequential explanatory mixed-methods approach, data were gathered from 528 participants across West, Southern, and Central African regions through surveys and in-depth interviews. Hofstede's cultural dimensions framework comprising power distance, individualism–collectivism, uncertainty avoidance, masculinity–femininity, and long-term orientation was applied to analyze how cultural variability shapes IPA usage behaviors and satisfaction levels. The results reveal significant differences in adoption patterns and interaction preferences, particularly influenced by collectivist values, high power distance, and heightened uncertainty avoidance. These cultural dimensions were found to moderate the relationship between perceived usefulness and user satisfaction, underscoring the importance of context-aware design. The study highlights the critical need for culturally responsive design strategies in the development of IPA interfaces tailored to African markets. This research contributes to the expanding discourse on cross-cultural technology adoption

and offers practical guidance for enhancing human-computer interaction in culturally heterogeneous environments.

Keywords: Intelligent Personal Assistants; Cultural Dimensions; Technology Adoption; African Technology Users; Cross-Cultural Computing; Human-Computer Interaction

INTRODUCTION

Intelligent Personal Assistants (IPAs) have become increas- ingly prevalent in global digital ecosystems, with the market expected to reach approximately 4.8 trillion U.S. dollars by 2030 [1]. These AI-powered systems, including Google Assis- tant, Apple's Siri, Amazon Alexa, and Microsoft Cortana, offer voice-activated support for various tasks, from information retrieval to smart home control. However, the adoption and user experience of these technologies are not uniform across different cultural contexts, particularly in regions outside North America and Europe where most IPAs were initially developed and optimized.

The African continent represents a rapidly growing tech- nology market with unique cultural characteristics that may influence how users interact with and perceive IPAs. With smartphone penetration projected to reach 65% by 2025 [2] and voice-based interfaces offering solutions to literacy barri- ers, IPAs represent a significant frontier for digital inclusion across Africa. However, research on technology adoption has predominantly centered on Western contexts, neglecting the unique socio-cultural nuances of African technology engage- ment.

This research gap is particularly significant given that ex- isting technology acceptance models such as the Technology Acceptance Model (TAM) and the Unified Theory of Ac- ceptance and Use of Technology (UTAUT) were developed and validated primarily in North American and European settings. Their direct application to African contexts may be problematic without appropriate cultural calibration. Recent studies by Oyelere et al. [3] and Adebesin & Mkhize [4] highlight the importance of culturally-sensitive approaches to technology design, taking into account unique contextual factors that influence technology adoption and usage across the continent.

This study addresses this gap by investigating how cultural dimensions influence IPA adoption and user satisfaction across diverse African contexts. Specifically, we examine: 1)

How cultural factors moderate the relationship between IPA characteristics and user satisfaction 2) The specific cul- tural dimensions that most significantly impact IPA adoption patterns 3) Regional variations in user preferences and in- teraction styles across different African contexts 4) Practical implications for culturally responsive IPA design

By examining IPA interactions through an African lens, this research extends and refines existing theoretical frameworks to better accommodate diverse cultural paradigms, potentially revolutionizing how we conceptualize technology adoption in non-Western contexts. The findings provide actionable intelligence for technology developers seeking to adapt their products to African markets, potentially improving user ex- periences for millions of consumers while simultaneously expanding market opportunities.

Literature Review

A. Intelligent Personal Assistants

Intelligent Personal Assistants (IPAs) are software agents designed to perform tasks or services for users based on commands or inputs from various sources, including voice commands, location awareness, and user preferences [5], [6]. These systems employ artificial intelligence techniques to interpret user requests, learn from interactions, and provide personalized responses. As defined by Duque et al. [7], IPAs are"software agents which can perform tasks or actions as required by a user and are able to access information remotely depending on requirements or user profile."

The core functionalities of modern IPAs include voice recognition, natural language processing, contextual aware- ness, adaptive learning, and personalization capabilities. These features form the basis of how the system processes and interprets user input, with their effectiveness having a direct impact on usability and user experience [8], [9].

B. Cultural Dimensions in Technology Adoption

Cultural factors play a significant role in shaping how users interact with and adopt new technologies. Hofstede's cultural dimensions framework [10] provides a theoretical foundation for understanding these influences, identifying six key dimen- sions: power distance, individualism-collectivism, uncertainty avoidance, masculinity-femininity, long-term orientation, and indulgence-restraint.

Power distance refers to how societies handle inequalities among people and can affect how users perceive authority in technology interactions. Individualism-collectivism reflects whether people's self-image is defined as "I" or "we," in-fluencing preferences for personal versus shared technology experiences. Uncertainty avoidance measures a society's tol- erance for ambiguity and can impact willingness to adopt new technologies. Masculinity-femininity distinguishes be- tween societies that value achievement and success versus caring for others and quality of life, potentially affecting the perceived value of different IPA functionalities. Long-term orientation reflects whether a society maintains links with its past while dealing with present and future challenges, which may influence technology adoption timelines.

These cultural dimensions have been applied to technology adoption in various contexts. For example, Straub et al. [11] found that technology transfer across cultural boundaries is not culturally neutral, while Zakour [12] demonstrated that cultural dimensions significantly influence perceived usefulness and ease of use in technology adoption. More recently, Tarhini et al. [13] showed that cultural factors moderate the relationships in the UTAUT model, suggesting that technology acceptance frameworks need cultural calibration.

While Hofstede's framework provides valuable insights into cultural differences, it is important to acknowledge its limitations. Critics have argued that the model oversimplifies complex cultural dynamics by reducing them to a few dimen- sions and may not fully capture the nuanced variations within cultures [14]. The framework has also been criticized for its methodological approach, which was based primarily on IBM employees and may not represent broader societal values [15]. Additionally, the model has been questioned for its assumption of cultural stability over time, potentially overlooking the dynamic nature of cultural evolution, especially in rapidly changing technological contexts [16]. Despite these limita- tions, Hofstede's dimensions remain a useful starting point for understanding cultural influences on technology adoption when applied with appropriate contextual sensitivity.

C. African Cultural Contexts and Technology

Africa represents a diverse continent with over 3,000 distinct ethnic groups and more than 2,000 languages, creating a complex cultural landscape for technology

adoption. Recent studies have begun to explore the unique characteristics of African technology engagement. Mudiare & Okoye [17] iden- tified substantial differences in IPA usage patterns between Western and African users, while Adedoyin & Sanni [18] noted significant adoption challenges specific to African users.

Several cultural factors may be particularly relevant to IPA adoption in African contexts. The strong collectivist orienta- tion in many African societies may influence preferences for shared versus individual technology experiences. High power distance in certain regions may affect how users perceive and interact with authoritative technology voices. Oral traditions and storytelling cultures may create unique expectations for voice-based interactions. Additionally, multilingual contexts present challenges for voice recognition technologies primarily developed for Western languages.

The work of Oyelere et al. [3] has been particularly influential in understanding technology adoption in African educational contexts. Their research demonstrated how cultural factors influence mobile learning adoption in Nigeria, high- lighting the importance of community involvement and social influence in technology acceptance. Similarly, Adebesin & Mkhize [4] explored how cultural values affect user experience design in South Africa, emphasizing the need for interfaces that respect local communication norms and social hierarchies. These studies provide valuable insights into how cultural dimensions manifest in specific African technology contexts and inform our understanding of the unique challenges and opportunities for IPA adoption across the continent.

Despite these unique characteristics, a meta-analysis by Bankole & Onifade [19] revealed that only 3.8% of global IPA studies included African participants, highlighting the significant underrepresentation of African perspectives in the current research landscape. This gap underscores the need for dedicated research on how cultural dimensions influence IPA adoption and user satisfaction in African contexts.

METHODOLOGY

A. Research Design

This study employed a sequential explanatory mixed- methods design with quantitative and qualitative approaches to examine the intricate nature of user experience

with In- telligent Personal Assistants (IPAs) across African contexts. The design was based on the pragmatic worldview presented by Creswell and Plano Clark [20], where research problems inform methodology at the cost of allegiances to any paradigm. The sequential explanatory design was constructed in two distinct phases: a primary quantitative phase followed by a qualitative phase, where the latter provided assistance to explain and offer details of findings from the first stage. This approach enabled the determination of statistically significant trends in a large sample while also exploring the lived experi- ences of IPA users across cultures through phenomenological inquiry.

B. Population and Sampling

The target population comprised adult users (aged 18 and above) of commercially available IPAs across diverse geo- graphical, cultural, and socioeconomic contexts within Africa. Participants were required to be active users of at least one major IPA platform (Apple's Siri, Google Assistant, Amazon Alexa, Microsoft Cortana, or Samsung's Bixby) for a mini- mum of three months.

The study focused on three key regions:

- West Africa (Nigeria, Ghana, Senegal, Coˆte d'Ivoire)
- Southern Africa (South Africa, Botswana, Namibia, Zimbabwe)
- Central Africa (Cameroon and Democratic Republic of Congo)

Table 1. Demographic Distribution of Participants

Region	%	Gender Distribution	Age Distribution
West Africa	42%	58% male, 41% female, 1% non-binary	18–24 (31%), 25–34 (42%), 35+ (27%)
Southern Africa	38%	52% male, 47% female, 1% non-binary	18–24 (25%), 25–34 (44%), 35+ (31%)
Central Africa	20%	61% male, 38% female, 1% non-binary	18–24 (29%), 25–34 (38%), 35+ (33%)

Africa's diverse technological, cultural, and linguistic land- scapes while acknowledging the significant variations in dig- ital infrastructure, connectivity, and technology accessibility across regions.

The sample size for the quantitative phase was determined using Cochran's formula, yielding a baseline sample of 384. This was adjusted to 528 participants to account for the

requirements of structural equation modeling and potential attrition. For the qualitative phase, a sample of 40 participants was selected based on the concept of informational redundancy or theoretical saturation.

Participants were recruited through a combination of ran- dom sampling and snowball techniques. Initial participants were randomly selected from university technology clubs, professional technology networks, and consumer electronics forums across the target regions. These initial participants then referred additional eligible participants, helping to expand the sample to include diverse demographic groups. Small incentives in the form of mobile data credits (equivalent to approximately 5 USD) were provided to participants who completed the full survey to encourage participation and reduce attrition.

C. Data Collection Instruments

The primary instrument for data collection was a compre- hensive structured questionnaire designed to capture multiple dimensions of user experience with IPAs within the African context. The questionnaire consisted of seven distinct sections with a total of 28 items:

- Section 1: Demographic and Usage Profile (6 items)
- Section 2: Factors Affecting User Experience (5 items)

  - measuring user perceptions of key IPA characteristics using a 5-point Likert scale
- Section 3: Perceived Usefulness (4 items)- evaluating participants'perceptions of IPA utility through a 5-point Likert scale
- Section 4: Cultural Dimensions (5 items)- examining how cultural factors affect technology interaction through a 5-point Likert scale
- Section 5: Cognitive Bias Mitigation (4 items)- evaluat- ing participants'perceptions of bias mitigation through a 5-point Likert scale
- Section 6: Overall Satisfaction (2 items)
- Section 7: Open-ended Questions (2 items)

To address language barriers across Africa's linguistically diverse regions, the questionnaire was translated into five major languages: English, French, Swahili, Arabic, and Por- tuguese. A rigorous translation protocol was implemented, including forward

and backward translation by bilingual ex- perts, followed by pilot testing with native speakers to en-sure conceptual equivalence across all versions. Additionally, multilingual research assistants were available during data collection to provide clarification and assistance to participants when needed. For participants in areas with multiple local languages, the questionnaire was administered in their preferred major language, with local research assistants providing verbal translation into indigenous languages when necessary.

For the qualitative phase, semi-structured interviews were conducted with 40 participants selected from the quantitative sample. The interview protocol was designed to explore partic- ipants'lived experiences with IPAs, cultural influences on their interactions, and perceptions of usefulness across different contexts.

D. Data Analysis

The analytical strategy implemented a comprehensive, multi-layered approach aligned with each research objective. For examining cultural influences on IPA adoption, the fol- lowing analyses were conducted:

- Multivariate analysis of variance (MANOVA) to test for significant differences in multiple usefulness dimensions across cultural groups
- Hierarchical multiple regression models to assess the moderating effects of cultural dimensions on perceived usefulness
- Multi-level modeling to account for the nested nature of the data (individuals within cultural groups)
- Structural equation modeling (SEM) to test the proposed theoretical framework derived from the modified Unified Theory of Acceptance and Use of Technology (UTAUT) model
- Multi-group SEM analysis to test for invariance across cultural contexts

Qualitative data were analyzed using a dual approach of researcher-driven thematic analysis following Braun and Clarke's six-step process and computational text analysis through automated theme extraction. The integration of find- ings followed a parallel convergent mixed-methods design, with meta-inferences drawn through joint displays that visu- ally represented the integration of quantitative and qualitative findings.

RESULTS

A. Demographic and Usage Patterns

Table 1 shows the demographic distribution of participants across the three regions, highlighting the gender and age distribution within each region.

Table 2. Usage Patterns of Intelligent Personal Assistants

IPA Platform	Usage %
Google Assistant	41.7%
Samsung's Bixby	27.3%
Apple's Siri	18.4%
Amazon's Alexa	8.2%

Table 3. Cultural Dimensions Across Regions *(Scale: 1–5)*

Dimension	West Africa	Southern Africa	Central Africa
Power Distance	3.8 (0.8)	3.3 (0.9)	4.2 (0.7)
Individualism	2.7 (0.7)	3.1 (0.8)	2.3 (0.6)
Uncertainty Avoidance	3.9 (0.9)	3.4 (0.8)	4.1 (0.7)
Masculinity	3.2 (0.8)	3.0 (0.7)	3.5 (0.8)
Long-term Orientation	3.6 (0.7)	3.8 (0.8)	3.3 (0.9)

Note: Values represent mean scores with standard deviations in parentheses.

Table 4. Regional Feature Preferences (Mean Scores, Scale: 1–5)

Feature	West Africa	Southern Africa	Central Africa
Entertainment	3.7 (0.7)	3.1 (0.9)	3.9 (0.8)
Information Seeking	4.1 (0.6)	4.0 (0.7)	3.8 (0.8)
Social Connectivity	3.9 (0.7)	3.5 (0.8)	4.3 (0.6)
Smart Home Control	2.4 (1.1)	2.8 (1.0)	2.0 (0.9)

Note: Standard deviations are shown in parentheses.

Table 5. Preferred IPA Interaction Modalities by Region (% Participants)

Modality	West Africa (%)	Southern Africa (%)	Central Africa (%)
Voice Commands	67	42	52
Text Input	33	58	48

Table 2 presents the usage patterns of different Intelligent Personal Assistants among the participants, indicating the dominance of Google Assistant in the African market.

Table 3 displays the mean scores for each cultural dimension across the three regions, with scores ranging from 1 (low) to 5 (high).

Our analysis revealed significant regional variations in how cultural dimensions influence IPA adoption and user satisfac- tion. Southern African users demonstrated notably different preferences compared to their West and Central African coun- terparts. For instance, Southern African users preferred more collaborative and consultative interactions with their IPAs, aligning with their relatively lower power distance scores. As one interview participant from South Africa explained:

”I don’t want my assistant to just tell me what to do. I prefer when it gives me options and lets me make the final decision. It feels more like a partnership that way.”(Participant 17, South Africa)

In contrast, West African users, particularly those from regions with higher power distance scores, expressed greater comfort with more directive IPA interactions:

”I trust the assistant to know what’s best. If it recommends something strongly, I usually follow that advice because it has more information than I do.”(Participant 8, Nigeria)

The influence of collectivism was particularly evident in how users across regions conceptualized their relationship with IPAs. Central African participants, who scored lowest on individualism, frequently described their IPAs using familial or community-oriented terms and expressed preference for features that facilitated group interactions:

”I see my Google Assistant as part of my extended network. I use it mostly to coordinate with family and friends, send group messages, and organize community events.” (Participant 32, Cameroon)

These qualitative insights complement our quantitative find- ings, which showed that power distance significantly moderated the relationship between perceived usefulness and adoption intention (= 0.37, p ¡ 0.01), while collectivism influenced preferences for shared versus private IPA interactions (^{2} = 18.7, p ¡ 0.001).

B. Regional Variations in User Preferences

Our analysis revealed distinct regional patterns in IPA usage and feature preferences as shown in Tables 4 and 5. Southern African users demonstrated significantly higher utilization of productivity features (M = 4.2, SD = 0.7) compared to entertainment functions (M = 3.1, SD = 0.9), while West African users showed more balanced usage across feature categories. Central African users reported the highest usage of social connectivity features (M = 4.3, SD = 0.6), aligning with the region's strong collectivist orientation.

These regional differences extended to interaction modal- ities as well. Southern African users preferred text-based interactions (58

"Voice commands make technology accessible to many people in my community who cannot read or write well. My grandmother can now use WhatsApp by speaking to her phone."(Participant 12, Ghana)

Central African users demonstrated a more balanced pref- erence between text-based interfaces (48

Implications

The findings from this study have several important im- plications for the design, development, and deployment of Intelligent Personal Assistants in African contexts:

1) **Culturally Adaptive Interfaces:** IPA developers should implement culturally adaptive interfaces that adjust in- teraction styles based on cultural dimensions. For high power distance contexts, more authoritative and directive interaction styles may be appropriate, while low power distance contexts may benefit from more collaborative approaches.
2) **Collectivist Design Features:** Given the strong col- lectivist orientation across many African regions, IPAs should incorporate features that support group decision- making and shared technology experiences, such as family accounts, group scheduling, and community in- formation sharing.
3) **Linguistic and Dialectal Adaptation:** To address Africa's linguistic diversity, IPA developers should pri- oritize support for major African languages and dialects, with particular attention to tonal languages and regional variations in pronunciation and

vocabulary.

4) **Cultural Knowledge Integration:** IPAs should incorpo- rate culturally relevant knowledge bases that reflect local customs, traditions, and social norms to provide contex- tually appropriate responses and recommendations.

5) **Trust-Building Mechanisms:** For regions with high un- certainty avoidance, implementing explicit trust-building features such as transparency in data usage, clear expla- nation of recommendations, and cultural sensitivity in responses can enhance adoption and satisfaction.

These implications suggest that a one-size-fits-all approach to IPA design is insufficient for the African market. In- stead, developers should adopt a culturally responsive design framework that acknowledges and accommodates the diverse cultural landscapes across the continent.

Limitations

While this study provides valuable insights into cultural influences on IPA adoption in African contexts, several limita- tions should be acknowledged. The sample, while geograph- ically diverse, predominantly represented urban populations with relatively high levels of education and technology ac- cess. This urban-rural divide may limit the generalizability of findings to rural African contexts, where different cultural dynamics and technology access challenges may exist.

Additionally, socioeconomic disparities within the sample may have influenced the results, as access to advanced IPA- enabled devices remains limited to middle and upper- income segments in many African regions. Future research should explore strategies for including more economically diverse participants and examining how socioeconomic factors interact with cultural dimensions to influence technology adoption.

Furthermore, while our regional sampling approach cap- tured broad cultural patterns, it may have obscured impor- tant intra-regional variations in cultural dimensions and tech- nology preferences. The rich cultural diversity within each African country suggests that more granular, ethnographically informed approaches may be necessary to fully understand cultural influences on technology adoption at local levels.

CONCLUSION

This study has demonstrated that cultural dimensions sig- nificantly influence the adoption and user satisfaction of Intel- ligent Personal Assistants across diverse African contexts. Our findings reveal that power distance, individualism-collectivism, and uncertainty avoidance play particularly important roles in shaping user preferences and interaction patterns with IPAs. These cultural influences manifest in various aspects of IPA usage, from preferred interaction modalities to feature utilization and trust development.

The research contributes to the growing body of knowledge on cross-cultural technology adoption by providing empirical evidence for the moderating effects of cultural dimensions on established technology acceptance models. By centering African perspectives and experiences, this study helps address the significant underrepresentation of non-Western contexts in IPA research and highlights the importance of culturally responsive design approaches.

For technology developers and companies seeking to expand into African markets, our findings suggest that cultural cali- bration of IPA interfaces and features is not merely a matter of localization but a fundamental requirement for successful adoption and user satisfaction. The diverse cultural landscape across Africa necessitates flexible, adaptive approaches to IPA design that can accommodate varying cultural dimensions while maintaining core functionality.

Future research should explore how cultural dimensions interact with other factors such as technological infrastructure, economic development, and education levels to influence tech- nology adoption across different African contexts. Addition- ally, longitudinal studies examining how cultural influences on technology adoption evolve over time would provide valuable insights into the dynamic relationship between culture and technology in rapidly developing digital ecosystems.

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