

The Role of Culture in User Adoption of Mobile Applications for Self-management of Health: A Conceptual Framework

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Abstract: There are increasing calls to harness Information and Communications Technology (ICTs) more effectively towards the attainment of the Sustainable Development Goals (SDGs) through innovative digital health strategies. Diabetes mellitus, is one example of a global health problem that is increasing rapidly, affecting the poor and disadvantaged populations the most. Self-care practices for diabetes self-management are important to implement in one's daily life as morbidity and mortality are preventable. Diabetes complications and early fatalities are preventable through proper diabetes management and lifestyle modification. Mobile health applications have been proposed as an important emergent technology to assist in self-care activities of diabetes patients. However, the uptake and usage of mobile health (m-health) applications for self-management of disease is low, especially among communities who are considered to be poor and economically marginalised. This paper posits that individual's culture persuasions have an influence on diabetes patient's decision to adopt and use mobile applications for diabetes self-management. A conceptual framework is developed to understand the role of culture in the adoption of m-health mobile applications for the self-management of disease.

1 INTRODUCTION

Since the advent of mobile phone, mobile-health (m-health) has increasingly come under focus of health care systems around the world as a means of transforming the way health care is managed and delivered. m-Health has therefore become prominent in the literature emerging as a central element of electronic health (e-health). M-health applications can serve as a useful tool in the health care sector, as they can help people manage their chronic conditions. The literature provides evidence that it is a useful tool to be used to decrease Non-Communicable Disease (NCD) risk factors (Zhao et al., 2016). For example Waki et al. (2014) aver that it plays an important role in supporting the achievement of health-related goals such as improving glycaemic levels of diabetes patients. The American Association of Diabetes Educators (AADE) (1997) which includes healthy eating, being active, monitoring, taking medication, problem solving, healthy coping, and reducing risks is important for successful self-management.

However, for any individual to self-manage their conditions, they have to first accept and use the technology (Dou et al., 2017). However, there are indications of levels of low uptake and use of Information and Communication Technologies (ICTs) among people with NCDs who are from poor and under-resourced communities. While diabetes affects all population groups, the demographic data indicates that the elderly have more difficulty in using mobile applications to manage their diabetes (Petersen, et al., 2019).

There are several factors that have an influence on the adoption of technology, including those in relation to culture. For example, globally, people have different traditions, values, religious practices eating habits and social customs. Therefore, these factors point to there being additional influences that affect the adoption of mobile health (m-health) applications (Abdulrehman et al., 2016; Ung, 2017). According to Dehzad et al. (2014), cultural beliefs of people are known to be key factors that influence technology uptake and adoption. Essentially, the

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cultural background influences a number of aspects of people's lives, including beliefs, behaviour, perception and attitudes towards health (Swierad et al., 2017).

Researchers have investigated culture and the role of cultural differences in the adoption and acceptance of Information Technology. Research indicates that cultural backgrounds play an imperative role in affecting the uptake and use of technology (Al-jumeily & Hussain, 2014; Masimba et al., 2019; Tarhini et al., 2017). These studies illustrate that cultural backgrounds play an imperative role in influencing the uptake and use of technology (Masimba et al., 2019). While there are ample studies in the literature regarding technology adoption in varying contexts, there is a dearth of understanding concerning adoption in the context of Non-Communicable Disease management. Importantly, the notion of culture in relation to mobile technology use, for a personal diseases management is closely linked to factors that are of an individualised nature, such as one's cultural persuasions. However there is scant evidence to date to understand the latter. While there is ample understanding of technology adoption constructs, and a fair understanding of the concept of culture, there is no research that has conceptually aligned the two concepts. This is the central problem this paper addresses by presenting a framework to understand the role of culture in application adoption for self-management of health.

The paper is organized as follows: First, the technology adoption models are discussed. Second, culture and the cultural models are identified. Thereafter, the technology adoption models are compared and the cultural models; Two of the often cited research are assessed and compared with each other, viz. Hofstede's cultural dimensions (1980, 2010) and Trompenaars & Hampden-Turner cultural model (1997). Subsequently, understanding culture within a country context is discussed. Next, the Unified Theory of Acceptance and Use of Technology 2 (Venkatesh et al., 2012) is mapped against Hofstede's cultural dimensions to identify the relationships between them. This is the foundation on which a conceptual model is derived.

2 USER ACCEPTANCE OF TECHNOLOGY MODELS

Technology acceptance is defined as a user's intention to use and continue making use of a particular IT product (Davis, 1989) (e.g., a mobile phone or computer).

Technology acceptance has been an important subject in IS research. It has been studied since the 1970s in the field of computer science where studying the adoption, acceptance and use of Information Systems (IS) is an area of study in the software engineering field (Momani & Jamous, 2017). The mainstreaming of technology and the importance of the people dimension in terms of gaining benefit from the use of technology rose to the fore when researchers such as Venkatesh et al. (2003) found that users were not deriving benefits from technology.

Historically, this area of research focuses on the problem that the availability of technology does not necessarily convert into adoption and use. Understanding the reasons why users accept or reject information technology is one of the crucial areas in IS research (Venkatesh et al., 2007). In the study of m-health acceptance, understanding technology adoption and usage is essential. Venkatesh et al. (2016) have stated that users must first use technology before the desired outcome can be achieved.

Technology adoption models have been developed to understand how users understand, accept and use technology (Venkatesh et al., 2003). In addition, these models introduce factors that can affect user decisions to adopt new technologies. Models such as the technology acceptance model (TAM) developed by (Davis, 1989) explain user acceptance of new technologies. Even though there have been many studies conducted using technology adoption models, it is crucial to understand how the models have evolved throughout the years as this reveals the similarities and differences between them. Figure 1 represents the dominant technology adoption models in the area of m-health and how it evolved over time.

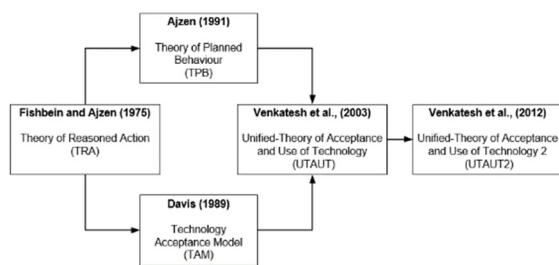


Figure 1: The prominent technology adoption models over time.

The above figure depicts that the Unified-Theory of Acceptance and Use of technology (UTAUT) was developed based on prior models such as the theory of reasoned action (TRA), technology acceptance model (TAM) and the theory of planned behaviour

(TPB). The UTAUT was then extended to the UTAUT2. The similarities between the five prominent models are discussed in Table 1 section, section 4.

The succeeding section discusses the Unified-Theory of Acceptance and use of Technology 2 which is conceptually a central aspect of this study.

2.1 Unified-Theory of Acceptance and Use of Technology 2

Unified-Theory of Acceptance and Use of Technology (UTAUT) was believed to be a complete model to forecast IT acceptance (Martins et al., 2014) until Unified-Theory of Acceptance and Use of Technology 2 was developed. The Unified- Theory of Acceptance and Use of Technology 2 model (UTAUT2) (Figure 2) is an extension of the UTAUT for understanding consumer acceptance of new technology better, and is centred on the individuals' perspectives of technology adoption (Venkatesh et al., 2012). The UTAUT2 includes three additional moderators: hedonic motivation, price value and habit.

Hedonic motivation was regarded as a significant predictor in prior research (Venkatesh et al., 2003), and it was integrated into the Unified-Theory of Acceptance and Use of Technology 2 (UTAUT2) for more stressing utilities. The price value construct was introduced in the UTAUT2 model as the quality of the product, cost and utility compared with the price will in turn influence adoption decisions (Hennigs et al., 2013). Habit is a significant predictor of mobile internet use (Venkatesh et al., 2012, 2016) and has appeared to be the strongest determining factor of individual technology use (Tamilmani et al., 2020). In the UTAUT2, habit is assumed to directly

influence both behavioural intention and use behaviour (Hwang et al., 2016).

The UTAUT2 core constructs are defined below:

- *Performance Expectancy (PE)*: “is the degree to which an individual believes that using the system will help him or her to attain gains in job performance” (Venkatesh et al., 2003, p.447).
- *Effort Expectancy (EE)*: “is the degree of ease associated with the use of the system” (Venkatesh et al., 2003, p.450).
- *Social Influence (SI)*: “is the degree to which an individual perceives that important others believe he or she should use the new system” (Venkatesh et al., 2003, p.451).
- *Facilitating Conditions (FC)*: “is the degree to which an individual believes that an organisational and technical infrastructure exists to support the use of the system” (Venkatesh et al., 2003, p.453).
- *Hedonic Motivation (HM)*: is defined as “the fun or pleasure derived from using a technology” (Venkatesh et al., 2012, p.161).
- *Price Value (PV)*: is defined as “consumers’ cognitive trade-offs between the perceived benefits of the applications and monetary costs for using them” (Venkatesh et al., 2012, p.161).
- *Habit (HT)*: “the extent to which people tend to perform behaviours automatically because of learning” (Venkatesh et al., 2012, p.161).

The UTAUT2 model has been used to explore various research problems such as health applications (Dwivedi et al., 2016; Yuan et al., 2015; Pancar & Ozkan Yildirim, 2021) and technology adoption and culture (Baptista & Oliveira, 2015; Lai et al., 2016; Tarhini et al., 2017; Teo & Huang, 2018).

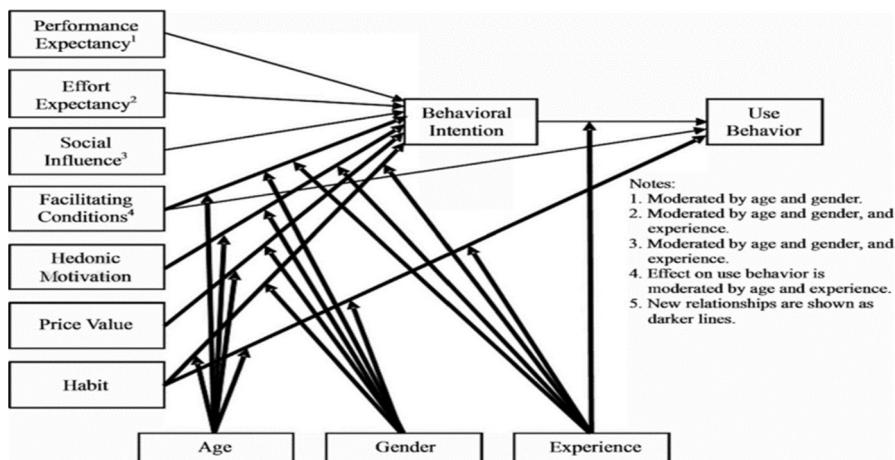


Figure 2: The Unified-Theory of Acceptance and Use of Technology 2 (Source: Venkatesh et al., 2012, p.160).

3 MODELS OF CULTURE

Having set a foundational understanding of technology acceptance in the previous section, the next consideration is to understand culture. Amongst other essential points identified in the literature, the notion of culture was identified as being one of the main conceptual gaps in one of the most often applied models, viz. the Unified-Theory of Acceptance and Use of Technology model (UTAUT).

According to Hofstede et al. (2010), cultural differences are displayed on different levels of depth such as symbols, heroes, rituals and values (Figure 3).

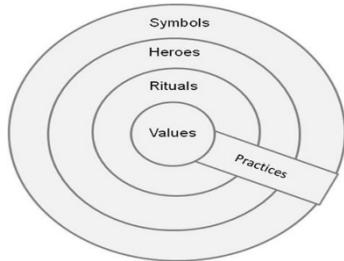


Figure 3: The “Onion”: Manifestations of Culture at Different Levels of Depth (Source: Hofstede et al. (2010, p.8)).

The levels of depth are defined below by Hofstede et al. (2010, p.8-9) :

Symbols: In the first, outermost layer, are pictures, words and jargons that contain a specific meaning that is understood by those people who form part of the same culture.

Heroes: The second layer is defined as people dead or alive that possesses qualities that are glorified by people in a particular society, for example, Nelson Mandela, the first president post- apartheid.

Rituals: The third layer is collective activities that are seen as socially essential. The ways of greeting, social and religious ceremonies are examples of rituals.

Values: The fourth, innermost layer, are wide-ranging terms that prefer certain states as opposed to others, for example, good rather than evil.

Hofstede et al., (2010) argue that culture is learned and not inherent. By the term “learned” they indicate that people’s culture is adopted by the effect of social values and personal incidents that are unique to an individual (Hofstede et al., 2010). However, it is argued that even though individual members perceive culture based on what they see or hear, culture can also be transmitted consciously or unconsciously from one generation to another. Beukman (2005) states that culture is two dimensional. It can either be explicit or implicit.

Explicit consists of behavioural patterns in a given situation and implicit is a manifestation of attitudes, values, beliefs, and norms, which collectively give meaning to explicit behaviour.

Hofstede posits that culture is made up of six different layers. It can exist at a “national level or country level, a regional and/or ethnic and/or religious level, a gender level, a social class level, an organisational level, and lastly an individual level” (Hofstede et al., 2010, p.18). At a country level, culture functions through religions, languages, and social structures (Hassan et al., 2016). Some markers distinguish one individual from another in a given society such as their demographics, educational background, religion, location and income status (Hodgetts et al., 2005).

As culture exists differently in all parts of the world, American, Asian, European and African culture is unique in all forms and expressions (Yavva & Twinomurinzi, 2018). Culture, as a social concept, has been studied for many years. Research findings have found that there is a link between culture and technology adoption. Culture can either impede technology adoption (Hasan & Ditsa, 1999) or can facilitate technology acceptance (Sriwindono & Yahya, 2012). It is, therefore, vital to incorporate culture into the models of user acceptance.

3.1 Hofstede’s Cultural Dimensions

Hofstede’s definition of culture is broad and has been widely accepted in IS literature. He defines culture as “the collective programming of the mind which distinguishes the members of one human group from another” (Hofstede, 1980, p.13). Hofstede (1980) developed an index model and presented four cultural values of culture: Power Distance, Individualism versus Collectivism, Masculinity versus Femininity, and Uncertainty Avoidance. Hofstede then included Long-Term versus Short-Term Orientation as a fifth dimension (Hofstede, 2001). He later added Indulgence versus Restraint as a sixth dimension (Hofstede et al., 2010).

Hofstede et al. (2010) have defined cultural values as follows:

Power Distance: “extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally” (p.61).

Individualism- collectivism: “refers to societies in which the ties between individuals are loose: everyone is expected to look after him or herself and his or her immediate family. Collectivism as its opposite pertains to societies in which people from

birth onward are integrated into strong, cohesive in-groups, which throughout people's lifetime continue to protect them in exchange for unquestioning loyalty" (p.92).

Masculinity- femininity: Masculinity refers to a "society in which emotional gender roles are clearly distinct" (p.519). Femininity is seen as a "society in which emotional gender roles overlap: both men and women are supposed to be modest, tender, and concerned with the quality of life" (p.517).

Uncertainty avoidance: "the extent to which the members of a culture feel threatened by ambiguous or unknown situations" (p.191).

Long-term orientation- Short-term orientation: "the fostering of virtues oriented toward future rewards—in particular, perseverance and thrift" (p.239). Short-term orientation "the fostering of virtues related to the past and present—in particular, respect for tradition, preservation of face, and fulfilling social obligations" (p.239).

Indulgence- restraint: Indulgence refers to a "society that allows relatively free gratification of basic and natural human desires related to enjoying life and having fun" (p.519). Restraint refers to a "society that suppresses gratification of needs and regulates it by means of strict social norms" (p.521).

Hofstede's culture framework has been extensively studied in the areas of Information Systems (IS) and Information Technology (IT) studies (e.g. (Lee et al., 2013; Sriwindono & Yahya, 2012, 2014; Tarhini et al., 2017)). These studies suggest that a significant relationship exists amongst national culture and the rate of technology adoption and acceptance.

In a study carried out by Sriwindono & Yahya, (2012), long-term orientation has been found to have the highest effect on perceived usefulness of technology, then followed by power distance and individualism on perceived ease of use of technology.

Although Hofstede's cultural values have been influential in many disciplines, they have not escaped criticism. Hofstede work has been criticised for a lack of generalisability and over-simplifying culture (Ng et al., 2007). Furthermore, Hofstede (1980) stated that a country-level analysis is unable to predict individual behaviour. However, national cultural values have been examined as being espoused at the individual level in previous research (Srite & Karahanna, 2006; Sun et al., 2019; Teo & Huang, 2018). Later, Hofstede recommended that culture should be investigated at the social level and values should be studied at the individual level (Hofstede, 2001). He further claimed that cultural values are the foundation of daily practices (Figure 3 - the onion model), and

daily practice was affected by a person's cultural values (Hofstede, 2001).

The application of Hofstede's cultural dimensions to diabetes patients self-care behaviour activities are discussed in the appendix.

3.2 Trompenaars & Hampden-Turner Cultural Dimensions

Trompenaars & Hampden-Turner (1997) cultural model was developed to explain cultural differences based on the challenges people encounter when forming social communities. According to Trompenaars & Hampden-Turner, "culture is the way in which a group of people solve problems and reconcile dilemmas" (Trompenaars & Hampden-Turner, 1997, p.6). They further state that preferences differentiate people into various cultural dimensions. These dimensions were then developed to illustrate the differences between one culture compared to another and how culture relates to societal level characteristics. The dimensions illustrated by this model are useful in comprehending how people from different national cultures interact.

The Trompenaars & Hampden-Turner (1997) model consist of seven dimensions:

Individualism versus Communitarianism: In Individualism describes cultures where ties between individuals are loose. The individual rather than any group norms determine decision making on lifestyle. In Communitarian cultures, groups are considered to be the most important, unlike individuals. As Communitarian refers to groups, rewards are given to group performance, decisions are taken collectively, and individual performances are not publicly praised (p.9).

Universalism versus Particularism: In a Universalistic culture, people abide by standards that are collectively decided upon by all who form part of this culture. This culture consists of laws, values and rules and which are applied to everyone. Alternatively, in Particularistic cultures, personal relationships are valued as a substitute for laws and rules (p.8).

Specific versus Diffuse: In specific culture, people believe that their private lives ought to be kept separate from their professional lives. In diffuse oriented culture, personal and professional relationships overlap (p.9).

Affectivity versus Neutrality: In Affectivity cultures, people are allowed to display their emotions to others and may partially allow emotions to influence their decision. While in neutral cultures,

individuals should practice self-control regarding their emotions (p.69).

Internal direction versus External direction: In internal-directed cultures, to achieve goals people deem that they can control their surroundings while in external direction, people deem that they are controlled by their surroundings.

Achieved Status versus Ascribed Status: In achievement cultures, status is given based on how well people perform at a particular task. While in Ascription culture, people are endorsed on what or who they are. Status may be conferred according to demographics, family and racial group (p.102).

Sequential Time versus Synchronic Time: In a sequential time culture, people tend to be inflexible. The sequence of events is of utmost importance in this regard, as individuals value planning and punctuality as imperative. In contrast, people who view plans and obligations as flexible form part of a Synchronic time as they work on multiple tasks at once (p.124).

An assessment of the above indicates that, in relation to the study, Trompenaars & Hampden-Turner (1997) cultural dimensions may be a relevant model to study culture in this context. The application of Trompenaars and Hampden-Turner cultural model to diabetes patients' self-care activities are discussed in the appendix.

The similarities between Trompenaars & Hampden-Turner cultural model and Hofstede's cultural dimensions are discussed in the next section (section 4, Table 2).

4 COMPARISON OF USER ACCEPTANCE MODELS AND CULTURAL MODELS

Table 1 presents the five prominent models. This includes the key constructs of the user acceptance model who were found to have some alignment to the study research problem.

Through the comparison of the user acceptance models, the TRA is similar to that of the TPB. The TPB can be compared to the UTAUT model as the key constructs (PE, EE and Social Influence) of the UTAUT model is similar to that of the TPB model. An examination of the definitions of the constructs indicates that "attitude" represents "performance expectancy" and "effort expectancy" constructs in the UTAUT model because PE and EE are attitudinal constructs. "Subjective norm" in the TAM is similar to the Social Influence (SI) construct in the UTAUT model, and the "perceived behavioural control"

Table 1: Comparison of the user acceptance model.

	TRA	TPB	TAM	UTAUT	UTAUT 2
Key constructs					
Attitude towards behaviour (A)	✓	✓	PU	PE and EE	PE and EE
Subjective norms (SN)	✓	✓		SI	SI
Perceived behavioural control (PBC)		✓	PEOU	EE	EE
Perceived ease of use (PEOU)		PBC	✓	EE	EE
Perceived usefulness (PU)		A	✓	PE	PE
Performance expectancy (PE)				✓	✓
Effort expectancy (EE)				✓	✓
Social influence (SI)				✓	✓
Facilitating conditions (FC)		✓		✓	✓
Hedonic Motivation (HM)					✓
Price value (PV)					✓
Habit (H)					✓

construct is similar to that of facilitating conditions in the UTAUT model (Sun et al., 2013). Furthermore, both the TPB and UTAUT models have been used in the area of health research and Information Technology adoption.

Table 2 presents the similarities between Hofstede's cultural dimensions and Trompenaars & Hampden-Turner's cultural model.

Table 2: Comparison of Hofstede's cultural dimensions and Trompenaars & Hampden-Turner cultural model.

	Hofstede cultural dimensions	Trompenaars & Hampden-Turner Cultural model
Dimensions of culture		
Power Distance	✓	
Individualism -collectivism	✓	✓
Masculinity -Femininity	✓	Similar to affectivity/ neutrality
Uncertainty avoidance	✓	
Long term orientation - Short term orientation	✓	
Indulgence -Restraint	✓	
Individualism vs communitarianism	Similar to Individualism -collectivism	✓
Universalism versus Particularism		✓
Specific versus Diffuse		✓
Affectivity versus Neutrality		✓
Nature Orientation		✓
Achieved Status versus Ascribed Status		✓
Sequential Time versus Synchronic Time		✓

In regard to the cultural dimensions, Trompenaars & Hampden-Turner, individualism versus communitarianism and universalism versus particularism dimensions are similar to Hofstede's cultural individualism– collectivism dimensions. In addition, affectivity versus neutrality is similar to Hofstede's cultural masculinity–femininity. As previously mentioned, Hofstede's constructs have been used to study the relationship between culture and technology adoption. Based on the cultural dimension of individualism versus collectivism, culture may likely have some influence on attitude toward technology use (Bandyopadhyay & Fraccastoro, 2007).

Both men and women can exhibit masculine and feminine traits (Cyr et al., 2017) and this can influence technology adoption. Furthermore, Hofstede's construct, uncertainty avoidance has received much attention in the field of technology adoption (Özbilen, 2017). It has been found that informational influence from family can encourage people in uncertainty avoidance cultures to adopt and use technologies (Alhirz & Sajeev, 2015). On the other hand, Trompenaars & Hampden-Turner (1997) has received little attention. Furthermore, this

framework does not provide an applied approach to measure culture (Su & Sauers, 2009).

5 INTEGRATING CULTURE AT AN INDIVIDUAL LEVEL WITH THE MODELS FOR USER ACCEPTANCE

Table 3 represents the user acceptance models that have been used together with cultural models to answer various research questions

Table 3: Studies on culture and technology in different contexts.

Author	Constructs used in this study	Methodology and models used
Sun et al. (2019)	Individual-level Culture Hofstede cultural dimensions Perceived usefulness Perceived ease of use	Technology Acceptance Model Hofstede Questionnaire
Zhang et al. (2018)	Performance expectancy Effort expectancy Social influence Perceived risk Trust Hofstede's cultural dimensions	Unified- Theory of Acceptance and Use of Technology Hofstede's cultural dimensions Questionnaire
Teo & Huang (2018)	Hofstede cultural dimensions Perceived ease of use Perceived Usefulness Attitude towards use Behavioural intention	Extended Technology Acceptance Model Hofstede cultural Model Questionnaire
Lu et al. (2017)	Age, gender, experience Hofstede's cultural dimensions Perceived effort expectancy Perceived performance expectancy Perceived mobile social influence Perceived privacy protection	Spousaled cultural dimension of Hofstede Unified- Theory of Acceptance and Use of Technology Questionnaire

Table 3: Studies on culture and technology in different contexts (cont.).

Author	Constructs used in this study	Methodology and models used
Tarhini et al. (2017)	Individual-level culture Perceived ease of use Subjective norms quality of work-life Behavioural Intention	Technology Acceptance Model Questionnaire
Lai et al., (2016)	Long-term orientation Collectivism Power Distance Uncertainty avoidance Performance expectancy Effort expectancy Social influence Hedonic Motivation Facilitating conditions	Hofstede cultural dimensions UTAUT2 Survey
Baptista & Oliveira, (2015)	UTAUT2 Hofstede cultural dimensions Behavioural intention Use behaviour	UTAUT2 Hofstede cultural dimensions Questionnaire
Hoehle et al. (2015)	Uncertainty avoidance, Perceived usefulness Perceived ease of use Perceived usefulness	Collected data from consumers using ICT in four countries, Hofstede cultural dimensions
Al-jumeily & Hussain, (2014)	Individualism-Collectivism, Uncertainty Avoidance Power Distance Perceived usefulness Perceived ease of use	Technology Acceptance Model Hofstede cultural dimensions Survey
Al-Gahtani et al., (2007)	Hofstede cultural dimensions Unified-Theory of Acceptance and Use of Technology	Unified-Theory of Acceptance and Use of Technology Survey

By an assessment, it can be noted that Hofstede's cultural dimension can be used in studies of culture and technology adoption (Table 3). The methodology that many of the studies adopted has been a questionnaire method approach. Previous studies have used the Technology Acceptance Model (TAM) and the Unified-Theory of Acceptance and Use of Technology (UTAUT) as a lens for analysis. However, it has been found that the TAM model is unable to forecast technology use across every culture (Straub et al., 1997). To understand diabetes self-

management in marginalised communities, challenges such as cultural backgrounds and beliefs should also be considered.

Hofstede's cultural model has been used in studies relating to technology adoption in various contexts as Hofstede's cultural dimensions aid researchers to comprehend what motivates technology adoption and use (Hoehle et al., 2015; Leidner & Kayworth, 2006). Additionally, Hofstede's constructs allow scholars to study issues in a variety of phenomena (Hoehle et al., 2015). Literature indicates that many studies focusing on culture and technology adoption have used Hofstede's cultural dimensions (e.g. Srite & Karahanna, 2006; Sun et al., 2019; Tarhini et al., 2017). A recent study by Alam et al. (2020) explored factors affecting the adoption of m-health in a developed country. The authors recommend that further research ought to be done in different socio-economic groups, rural areas and other cultures and groups with different religious beliefs. Petersen et al., (2019) suggested that further research should be conducted on culture in the use of m-health for diabetes self- management.

6 UNDERSTANDING CULTURE WITHIN COUNTRY CONTEXTS

Culture manifests differently across nations. Figure 4 depicts that culture in developing countries (South Africa and Bangladesh) differs from developing countries (Canada and United States).

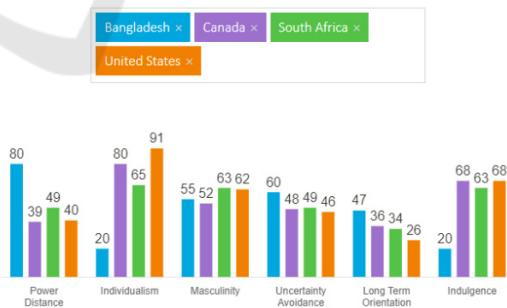


Figure 4: Hofstede's insights (Source: Hofstede, 2019).

There is a low power distance value for South Africa, Canada, and the United States. The value indicates that people accept hierarchical order (Hofstede, 2019). Context-wise, diabetic patients from low power distance countries are likely to conform to the opinions and decisions of their health care professional.

The individualism dimension indicates that people care for themselves and immediate family (Hofstede, 2019). In Bangladesh, the value shows that people conform more towards a collectivism culture. This suggests that diabetic patients will conform to the decisions of their society, or communities in which they live. In the remaining countries, the data suggests that the decisions are made at the individual's discretion.

The masculinity dimension indicates that people "live to work" (Hofstede, 2019). All four countries score high in this dimension which indicates that individuals will prioritise work over other matters. This for example, could imply that a diabetic patient in such a country may not prioritise the use of tools such as m-health applications for disease self-management.

The uncertainty avoidance dimension indicates a high value for Bangladesh and suggests that people in this country fear uncertainty. A consequence of such a cultural persuasion implies that people may shun new technologies and innovations if the adoption and uptake thereof is associated with uncertainty.

South Africa and the United States indicates low long-term orientation which indicates that traditions are more important, and change is viewed adversely. Therefore, if one considers this cultural dimension in the case of diabetic patients, it could imply that they would prefer traditional face-to-face consultations with doctors as compared to using technology to manage their health condition.

South Africa, United States and Canada illustrates a culture of indulgence which indicates that people in these countries prefer having a good time and spending their time as they wish. In the context of this study's problem this could imply that if persons engage in self-care behaviour, including using technology for it, they will ensure that they make decisions that provide them with fulfilment and satisfaction.

7 MAPPING UNIFIED-THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY 2 AGAINST HOFSTEDE'S CULTURAL DIMENSIONS

Table 4 presents the outcome of this. It maps the seven constructs of the Unified-Theory of Acceptance and Use of Technology 2 (UTAUT2) against Hofstede's cultural dimensions in order to assess which of the theoretical definitions of the

Hofstede's cultural dimensions fit against the UTAUT2 technology adoption (as depicted by UTAUT2) amongst diabetic patients in previously disadvantaged communities.

Table 4: Mapping UTAUT2 constructs against Hofstede's cultural dimensions.

Utaut2 \ Hofstede	PE	EE	SI	FC	HM	PV	H
Power Distance		X					
Individualism-Collectivism		X			X		
Masculinity Femininity	X						
Uncertainty avoidance		X		X			
Long term orientation - Short term orientation						X	
Indulgence - Restraint							X

8 CONCEPTUAL FRAMEWORK

The underpinning theoretical framework from the extant literature (Figure 2) and Hofstede's cultural dimensions (Section 3.1) provide a basis for the conceptual framework below. Figure 5 is conceived from the foregoing analyses (Sections 4, 5 and 7). It provides a conceptual foundational understanding of how the dimensions of culture influence technology adoption in the context of self-management of NCDs such as diabetes.

The literature review presented evidence that the UTAUT2 is the best suited model to study technology adoption and culture. After reviewing literature on culture, Hofstede's cultural dimensions have been deemed as an appropriate fit to study culture in the context of technology acceptance.

Looking ahead, researchers should consider empirical investigations into the problem area as follows:

- There are six concepts that explain the phenomenon of culture. In investigating such problems in the field all of these must be taken into account to understand whether and how diabetes patients' culture influences their self-care behaviours and whether their culture influences their m-health acceptance and usage for their self-management.

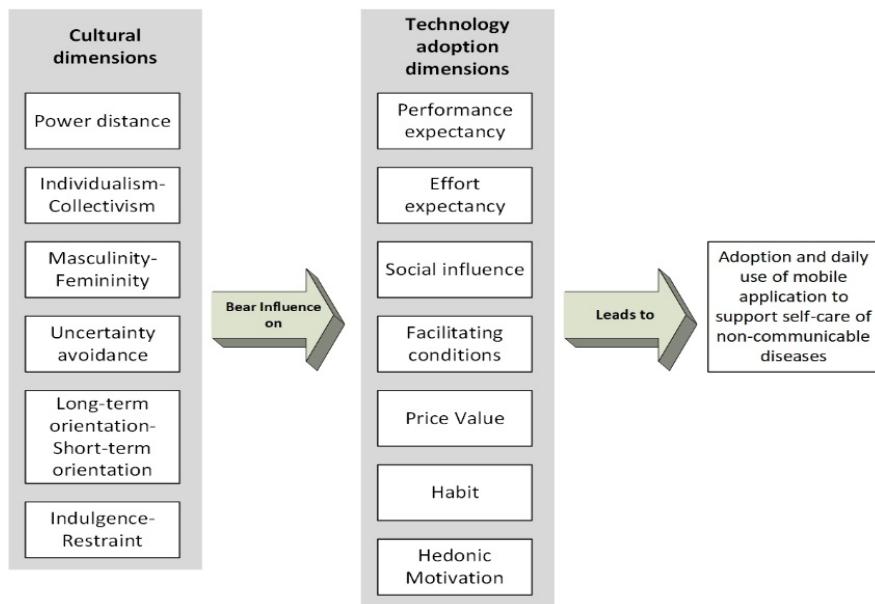


Figure 5: A conceptual framework of the role of culture on mobile technology acceptance and use.

- Seven constructs drawn from the *Unified Theory of Acceptance and Use of Technology* 2 provide insight into diabetes patients acceptance and usage of m-health to self-manage their condition.
- Finally, the *AADE 7* self-behaviour activities provide a framework of actual day to day living of people with NCDs. These provide the context in which to study the concepts of culture and technology acceptance.

9 CONCLUSIONS

This paper derived a conceptual framework to explain the problem of how culture influences technology adoption in the context of self-care behaviour activities. The conceptual framework can serve as a starting point to assist policymakers and application developers to tailor mobile applications for this target population. In addition, this model can inform and improve current m-health related interventions, which could result in the improved or successful adoption and uptake of ICT, specifically m-health applications among diabetic patients in poor and under-resourced communities.

The paper presents a first step to address a gap in the literature with respect to the understanding of culture in m-health acceptance and use for health self-management in general, and for diabetes self-management in particular. We conclude that to achieve effective self-management of diabetes using

a mobile application, cultural factors that prevail on users must be taken into consideration. Therefore this paper contributes to a better understanding of the nexus between culture and technology adoption. The paper furthermore contributes towards a better understanding of how to successfully apply ICT towards the attainment of the UN's Sustainable Development Goal 3.

The next step in the research process is to use the conceptual framework and related understandings to inform both a mobile application design process and, importantly, how to mitigate low adoption of an application. By understanding the role of culture in uptake and use of m-health applications, government, and any other stakeholders, can be informed as to how to mitigate low adoption scenarios, by considering the outcomes of this study. For example, effort expectancy points to user-centred design; performance expectancy points to application functionality. Many of the other dimensions point to how potential users would uptake technology e.g. power distance points to whether and how influential people influence users to adopt mobile applications and uncertainty avoidance points to whether ambiguous situations hinder people from utilising a mobile application.

The research framework provides us with insight not only into potential mobile application functionality – e.g., tracking health information. The research model will be tested in under-resourced communities in the Western Cape, South Africa using a co-design approach such as that proposed by

Kyakulumbye & Pather (2022). Such marginalised communities appear to be bearing the brunt of social and health ills. The effective deployment of ICT based solutions will go a long way towards sustainable solutions to improve living conditions for such communities.

In conclusion, the conceptual framework of this paper can be used in the next stage of research to undertake a further study of a mobile application functionality requirement as needed by the aged. That would be a first step towards creating a usable application to be deployed in a context that accounts for the cultural dimensions influences identified in this paper.

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APPENDIX

Hofstede's cultural dimensions in relation to diabetes self-care behaviours	
Power distance	If a DM patient subscribes to a power distance culture, they may only trust their doctors or prefer visiting a doctor. The patient would prefer professional assistance and advice from a health care professional rather than using an m-health application.
Individualism -collectivism	If a DM patient forms part of an individualistic society, they will make their own informed decision as to how to manage their condition. If a DM patient who forms part of collectivistic culture, they will make health-related decisions based on the values and beliefs of their society
Masculinity-femininity	If a DM patient subscribes to a masculine society, the individual may not self-manage their condition effectively as working is a means of survival and success. If a DM patient subscribes to a femininity culture, they will be viewed as nurturers who care for others. These patients will make informed health decisions to assist others in leading healthier lifestyles. This suggests that they cannot manage their condition as they must see to the needs of others.
Uncertainty avoidance	If a DM patient subscribes to an uncertainty avoidance society, the patient may find it difficult to self-manage their diabetes due to factors such as crime and the fear of making an error

	which could result in someone obtaining their personal information.
Long-term orientation-short-term orientation	If a DM patient subscribes to a long-term orientation culture, they will plan their diabetes self-care activities to ensure enough finances are available to maintain their condition. If a DM patient subscribes to a short-term orientation culture, the patient will follow the traditions of their society in terms of managing their condition.
Indulgence-Restraint	If a DM patient subscribes to an indulgence society, they will make health-related decisions that are satisfactory to them to ensure that they are happy. If a DM patient subscribes to a restraint culture, they will not take the initiative to make their own health-related decision as rules are essential in following a diabetes self-management regime.
Trompenaars & Hampden-Turner cultural model in relation to diabetes self-care behaviour activities	
Individualism versus Communitarianism	if a DM patient subscribes to an "Individualistic culture", the patient might be inclined to seek out solutions in relation to making their own informed decision and take care of themselves
Universalism versus Particularism	If DM patients subscribe to a "Universalism culture", the individual may make diabetes self-care decisions based on their values and beliefs.
Specific versus Diffuse	If a DM patient subscribes to a "Specific culture", they may share their thoughts and feelings about their diabetes self-care activities and decision-making with others
Affectivity versus Neutrality	if a DM patient subscribes to an "Affective culture", the patient may express and share their emotions and feelings to their doctors about their diabetes self-care activities
Internal direction versus External direction	People who form part of an internal direction culture believe they can control their environment to achieve their goals.
Achieved Status versus Ascribed Status	If a DM patient subscribes to an ascribed status, their demographics (race, age and gender) may influence their diabetes self-management decision.
Sequential Time versus Synchronic Time	People who form part of a sequential culture may prefer to have a detailed agenda of activities and would perform one activity at a time.