Measuring the Effect of Culture on Usage of Encrypted Communication in India

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Figure 1: Usability in Encrypted Communication

ABSTRACT

Cryptography was once the realm of academics, intelligence services, and a few cybersecurity enthusiasts who sought to break the monopoly on that science of secrecy. Today, the enthusiasts have won: Encryption is everywhere. It's easier to use than ever before. In fact, secure communications are now not only attainable but perhaps even the new default. Still, effective encryption doesn't always just happen, especially once one moves beyond basic messaging. Our study focuses on the topics of usage of encrypted communication, social influence, collection and analysis of data for measuring culture and the reliability and validity of culture measures. Through our analysis, we try to find the impact of culture on the usage of encrypted communication in society.

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1 RESEARCH OBJECTIVES

The causality of data globalization and the need for the hour secure information systems have led encryption to become a part of every user connected to a network. The intention of this project is to measure the impact of cultural dimensions on the acceptance and usability of encryption in domains of communication. The study will be defined on the method of *Instant Messaging* in communication as it has been proposed to be the most prominent and equally susceptible in terms of privacy and security.[4] Unlike regular voice or video communication methods, instant messaging considers all aspects of the extended CIA model emphasizing accountability (non-repudiation factor).[13] This project shall consider existing work on different information technologies, which summarize that the effect of culture can be measured through the social influence variable on user acceptance.[2]

1.1 Research Questions

Our approach will be guided by 2 research questions:

(1) What is the relative impact of social influence compared to others on the usage of encrypted communication systems?
(2) Is the impact of social influence on the usage of encrypted communication systems correlated to the different variables of culture?

1.2 Models and Principles

To derive the impact of social influence on encryption, we focus on the `Unified Theory of Acceptance and Use of Technology` (UTAUT) developed by Venkatesh et al. [2003][18]. UTAUT was chosen as the basic model as it is a parsimonious and robust model of technology acceptance. It shall enable us to measure the relative impact of the social influence construct with respect to *effort expectancy, performance expectancy, facilitating conditions influence.*

As per the demographics of our target region - India, we follow cross-cultural research principles. Based on cross-cultural research literature, we choose `Hofstede's 5-dimensional framework` [1980[[7]], 1991[[6]]] incorporating *individualism-collectivism, masculinity-femininity, power acceptance, uncertainty avoidance, and time orientation* to explain the cultural aspects in results of the model testing. **Power distance** is the degree to which a culture accepts the unequal distribution of power; **uncertainty avoidance** is the degree to which a culture tolerates ambiguity and uncertainty; **individualism** is a cultural orientation in which people belong to lose social frameworks, and their primary concern is for themselves and their families; **masculinity** is the cultural orientation in which assertiveness and materialism are valued; **time orientation** is whether a culture's values are long-term or short-term oriented.[9] For authenticity in our research methodology, we assume the *etic* approach, which states that there is a set of universal cultural dimensions that are equally relevant to all cultures.[5] These cultural dimensions are considered to be the ones defined by Hofstede.

2 HYPOTHESES

- **Hypothesis 1:** Social influence has the highest impact on the usage of encrypted communication when compared to effort expectancy, performance expectancy, facilitating conditions' influence.
- **Hypothesis 2:** There exists a very high correlation between Social influence on the usage of encrypted communication and the cultural dimension of Individualism-Collectivism, where collectivistic people stipulate strong social influence.
- **Hypothesis 3:** Measure of Uncertainty avoidance is directly proportional to the usage of encrypted communication.

2.1 Formulated theories by authors

(1) In general, social pressure for an individual to perform a behavior is partly influenced by cultural differences. In collectivist cultures like India, where the group tends to be more important than the individual, the person is more likely to be concerned about the thoughts and opinions of others and, thus, more likely to conform to behaviors deemed important to the group.[2] The social influence construct in this study represents social pressure felt by the individual to perform a specific behavior by assessing the influence other people may have on the respondent's behavior.
(2) India is a collectivist culture that may be affected by different factors than the typical individualistic culture, such as the United States, when it comes to IT acceptance.[7] Collectivism refers to societies in which the interests of the group prevail over the interest of the individual.[6] Ergo, encrypted communication usage shall be more accepted in people with higher ratings of this dimension.
(3) Uncertainty avoidance includes the following measures: risk avoidance and ambiguity avoidance.[15] As risk is an integral part of threat modeling, usage of encryption to curb it can be considered to rise along with its scale.

Table 1: UTAUT constructs to measure acceptance

UTAUT constructs	Root Contructs	Model
Performance Expectancy	Perceived Usefulness	TAM[1][3]
Effort Expectancy	Perceived ease of use	TAM[2][3]
Social Influence	Subjective Norm	TRA[3][1]
Facilitating Conditions	Behavioral Control	TPB[4][1]

[1] Technology Acceptance Model [2] Technology Acceptance Model [3] Theory of Reasoned Action [4] Theory of Planned Behavior

3 STUDY METHODOLOGY

The objective of our study is to quantitatively measure the anthropological concepts like usage and culture. To equally account for the technological acceptance and the behavioral intention to use by the causality of culture, the study is divided into 2 parts for all measurements henceforth. The first part deals with gathering data regarding usage and acceptance of encrypted communication in instant messaging. The second part enables collecting responses for measuring the cultural dimensions. The data for our study will be collected by conducting surveys.

The survey will be split into 4 parts: `overview and consent`, `UTAUT based questions`, `cultural background`, `demographics`. Consent shall be placed first to maintain ethical performance and gather data from only willing respondents. Culture based questions shall be asked later to not cause any biases while answering the UTAUT questions. Demographics have been placed last as previous studies have shown that it causes high skewness in data.[16]

4 QUESTIONNAIRE OVERVIEW

The project scenario is set as inclusive of two famous instant messaging apps. One of which is *Whatsapp* and the other being *Facebook Messenger*. Whatsapp is an app that is known to prioritize it's user's privacy based on the fact that all conversations on it are end-to-end encrypted. Facebook Messenger is a competitor of Whatsapp that focuses more on user satisfaction in terms of display appeal than user privacy, however it does have a hidden feature called secret messaging that employs end to end encryption which has low accessibility. We deploy our scenario by naming these apps in such way so as to not cause any perception bias. We then fetch data from

Table 2: Various measures for individual cultural variable

Cultural Variable	Measure
Individualism-Collectivism	Self v/s Group Interest Teamwork and loyalty Self-perception Personal independence Family integration Conformity Social Responsibility
Masculinity-femininity	Assertiveness Confrontation avoidance Competitiveness
Power Distance	Accepted inequality Hierarchical preference
Uncertainty avoidance	Risk avoidance Ambiguity avoidance
Time orientation	Tradition Decision-making approach

our users about their preference towards these instant messaging apps based on their social and cultural backgrounds.

Our survey will be based on the 4 constructs of UTAUT as mentioned in Table 1, and 5 variables of Hofstede's model noted in Table 2, which will help us measure the impact of social influence and culture on the usage of encrypted systems. This data on analysis will assist us in drawing a correlation between different variables of culture and social impact.

4.1 Measurement Metric

For measuring dimensions of culture self-report questionnaires are perceived to be the best tool task. Because alternative assessment methods, such as observation or experiment, are much more resource-demanding, the self-report questionnaire remains the most popular method of quantifying culture.[14] We wish to deploy self-report questionnaires consisting of ratings for cultural measurement. Respondents will have to rate the importance of each value on a Likert Scale consisting of 7 interval points[11] or the respondent may be asked to rate his consensus with a set of statements[17].

4.2 Risk Mitigation

Likert scales generally lead to two types of response biases[12]:

- `Extreme response bias`: Systematic tendency to over express agreement or disagreement by choosing anchors towards the ends
- `Acquiescence bias`: promptness to agreement[14]

We plan to correct acquiescence bias by combining positively and negatively worded items in a single instrument.[10], [8] For solving extreme response bias we shall apply within-subject standardization as suggested by Hofstede[7].

5 STUDY DESIGN

Use of convenience samples has been been focused for vast majority of previous studies.[15][6][12] Moreover, over a half of the reviewed models were developed and validated using student samples.[15] However, every attempt has been made to focus on a very specific theoretically-justified target group.

Our study consists of 3 variables `namely Social Influence, Individualism-Collectivism, Uncertainty Avoidance`. In addition to the detailed analysis metrics explained in Analysis Approach it will include the comparison of individuals from different cultural backgrounds (groups). By analysis of the data collected from the survey we aim to find correlation between at least 2 of the above variables. We wish to collect data by conducting surveys on student subjects at undergraduate universities in India that have a heterogeneous mix of different cultural backgrounds. Moreover, to solve age bias, we plan to collect data from different generations by also gathering responses from parents of students of Indian universities. We plan to float the survey in college groups and notice-boards to target a larger audience.

5.1 Recruitment Process

While recruiting individuals for answering our surveys we aim to focus on having representatives from multiple demographic and social backgrounds to ensure sufficient variance in the dimensions of culture. In India, *Indian Institutes of Technology* (IITs) are known to have a heterogeneous mix of individuals in terms of significantly different social and cultural backgrounds. Keeping these social and cultural differences, and previous study results in mind we wish to recruit students from IITs and their parents for the survey, shortlisting a sample space of around 50 individuals who are willing to participate in the survey with sincerity in agreement with consent. For the initial pilot run to check the integrity of the survey, current plans are to test the survey on the authors' network circle.

6 DATA ANALYIS

Although only the technology acceptance constructs of perceived usefulness, perceived ease of use, subjective norms, and behavioral intention to use were directly incorporated into the research model, reliability and validity also need to be established for the cultural dimensions as they provide an explanation of the results.[12] To account for them, we plan to use **Partial Least Squares method** (PLS) to assess the discriminant validity and internal consistency (reliability) of the constructs in the UTAUT model. For culture measurement instruments, **Cronbach's alpha** shall be used as the coefficient of reliability. Confirmatory factor analysis will result for the final scales. To assess the reliability of the scales, **internal composite reliabilities** (ICRs) will be calculated. Descriptive statistics shall also be gathered for considering gender biases and demographic correlation. Weighted-average consideration/ within-subject standardization will be used to combine antecedents per construct to produce one output for a single construct, so that further statistical test models produce converging results in a comparatively easier manner. Finally for deriving conclusions, **T-test** will be conducted for calculating significance of individual constructs of UTAUT on the overall usage and acceptance of usage of encrypted communication in the account of instant messaging.

7 RESOURCES

For conducting the surveys, we have to consider two important segments: a) `Likert Scales` and b) `Scenario based questions`. To measure up for both these we have scouted form clients such as *Google Form, Typeform and SurveyPlanet*. We have decided to choose among these 3 considering their flexibility in data handling and convenient user interface for respondents of the survey.

For conducting statistical analysis, regression tools shall be utilized. *Microsoft Excel* will be used to handle the data and maintain records. Correlations shall be found using statistical softwares like *R Studio* and *Minitab*.

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