Mobile Phone-Based Chatbot for Family Planning and Contraceptive Information

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Abstract. This study is about a mobile phone-based Chatbot specifically designed to provide information about family planning and contraceptives. Chatbot is essentially a text-messaging service that follows a decision-tree structure to provide feedback to users. The Chatbot was built using a text-messaging platform developed by *Trext* and can be accessed in the United States by sending 'BCS' as a text message to phone number +1-313-228-3034. The contents of Chatbot are derived from the Balanced Counseling Strategy (BCS) prepared by The Population Council. UTAUT model of technology adoption was employed to assess the attitudinal and behavioral factors that determine the intention to use Chatbot. The study included 49 participants, age 18 and above, married or in a relationship. Regression analysis show positive attitude as the main predictor of behavioral intention to use Chatbot to acquire family planning related information. Consequently, positive attitude was determined by effort expectancy and performance expectancy to use the Chatbot. The study has implications to design mobile phone-based texting services to help mothers, husbands and community health providers to learn about family planning in a private, interactive and enjoyable manner. To the best of our knowledge, this is the first study to systematically evaluate the effectiveness of a mobile phone-based Chatbot for family planning counseling. The study is a proof-of-concept with limited number of participants within USA. However, the study offers implications to scale-up existing family planning interventions both domestically and internationally.

Keywords: Chatbot · Family planning · SMS · Mobile health · UTAUT

1 Introduction

Every woman has a fundamental right to plan if-and-when to have children [18]. Women with unintended pregnancies often receive inadequate prenatal care along with poor health outcomes for their children [11]. Moreover, children born to mothers with an unplanned pregnancy show developmental delays and poor relationships with their

mothers [2]. On the other hand, the ability to plan for pregnancy and spacing between births reduces maternal mortality and morbidity [5]. One way to address this problem is by providing universal access to information about family planning and contraceptive health-related services to masses.

Family planning is defined as "the ability of individuals and couples to anticipate and attain their desired number of children and the spacing and timing of their births, achieved through use of contraceptive methods and the treatment of involuntary infertility" [17]. Unfortunately, in many developing as well as developed countries, talking about family planning is a taboo and surrounded by social and cultural stereotypes. Further barriers to family planning include reduced access to information and contraceptives, choosing wrong contraceptive method, misappropriate use of the contraceptive or lack of motivation to avoid pregnancy [8]. Consequently, many women have an unmet need to practice family planning and reduced access to the modern contraceptive methods.

Access to information about family planning methods and contraceptives is an important first step towards adopting such services. When couples have access to information they experience less emotional strain and more opportunity to plan and access resources. In the past decade, mobile phones have been instrumental in health information seeking by masses. Based on this rationale, the present study objective is to explore how a mobile phone texting service can be used to improve access to information about family planning. To achieve this objective, mobile phone-based Chatbot was developed and tested. Chatbot can be defined as a text messaging service that follows a decision-tree structure to provide feedback to users on specific family planning methods. The Chatbot was built using a text-messaging platform developed by *Trext* and can be accessed in the United States by sending 'BCS' as a text message to phone number +1-313-228-3034. Our primary objective was to measure users' behavioral intention to use Chatbot to acquire information about family planning and contraceptives.

2   What Is a Chatbot?

The Chatbot is essentially a text-messaging in which a user converses with a smart robot, instead of a real person. The conversation follows a tree structure starting with the main menu and then branching out to sub-menus depending on the options selected by the user. In our case, the user is first prompted to provide basic information about family size, pregnancy status, and existing contraceptive method being used (see Fig. 1). If the user is pregnant or expecting a child, then the Chatbot terminates after a brief explanatory message. Otherwise, the Chatbot proceeds with displaying a list of contraceptive methods and prompts the user to select an option for more details. After looking at a message, the user could go back to the list of contraceptive methods and pick another method, and so on. At any stage, the user could terminate the Chatbot or go back to the main menu. The screenshots of Chatbot are presented in Fig. 1 below. The content of Chatbot is based on the Balanced Counseling Strategy (BCS) manual prepared by The Population Council [15].

Fig. 1. Screenshots of chatbot service designed to provide information about family planning.

2.1 Text-Messaging to Spread Information About Family Planning

Short message service (SMS) is undoubtedly among the most widely utilized inter-personal mobile phone service in the world. In United States alone, more than 1.91 trillion SMS were sent in year 2013 [13]. Based on the pervasive use of text-messaging, several public health interventions have been implemented to reach the users for health messages. SMS interventions are particularly popular for health education due to ability to send tailored messages, increased interactivity with receivers, message personalization and, send repeat messages [14]. In terms of response from users, SMS offers a viable intervention strategy, as 99% of all SMS-received are opened, and 90% are read within three minutes of receiving [10].

Text-messaging interventions have consistently proven to be effective in a range of health topics such as patient self-management [3] or to manage patient appointment attendance [6]. To further emphasize the significance of using mobile phone-based texting services, few examples of existing family planning interventions from around the world are presented here. A prominent example is CycleTel, which is an mHealth (mobile health) service in India. The program uses text messaging to facilitate the use of the Standard Days Method (SDM), of family planning. Users start with providing the date of menstrual period and associated health information. The services provide feedback shown as either brown days (pregnancy unlikely) or white days (pregnancy likely) in both calendar and necklace views. Another example is the Mobile Alliance for Maternal Action (MAMA) project that provides health messages designed to support mothers through pregnancy and first year of child development. The messages

are available in both text and audio format and can be tailored as per cultural needs. The Dot app is a mobile-phone based SMS service based on Dynamic Optimal Timing (Dot) which is a family planning method to determine a woman's risk of pregnancy for each day of her cycle based on period start date. The Bedsider project is developed by the National Campaign to Prevent Teen and Unplanned Pregnancies that provides information about family planning methods and SMS reminders. The Case.io is a web-based platform that allows to share patient cases in plain text, images and other text files with people having a simple phone or a smartphone. Case.io is designed to work in areas with slow internet connectivity. The MOTIF (Mobile Technology for Improved Family Planning) has been designed for users with basic mobile phones and limited literacy in Cambodia. The project is currently operated by Management Sciences International (MSI) in multiple countries.

3   Chatbot for Family Planning and Contraceptives Information

Family planning has largely been a one-sided conversation through mass media or community health workers. People don't typically learn unless they join the conversation in a two-way communication. In this regard, a Chatbot offers users an opportunity to actively explore contraceptive options, as opposed to just being told what the answer is. Keeping this mind, a family planning Chatbot provides users a guided learning experience about which contraceptive methods to use, confront potential misconceptions about each method, and choose the one that best meets their needs. Using a step-by-step conversation model, participants may also learn new information about things wrongly perceived about family planning.

This project is innovative in its ability to bring interactivity and guided learning through basic phones or smartphones. The Chatbot offers a disruption in family planning counseling in multiple ways. First, Chatbot offers a standardized way of acquiring information about which contraceptive method to pick, thus reducing the complexity and stigma of contacting a family member or healthcare worker. Second, Chatbot allows for information to be transferred via customized text-messages rather than through commonly used content-heavy materials like brochures, posters and flip charts. Third, Chatbot reduces health systems cost of operating a helpline requiring dozens of staff members. Fourth, Chatbot offers a superior counseling experience that is engaging, fun and interactive for users and provides culturally tailored and personalized information.

4   UTAUT Model of Technology Adoption

The development and evaluation of family planning Chatbot is based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model [16]. The model draws inspiration from previous theories of technology adoption like Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPPB), Social Cognitive

Theory (SCT), Technology Acceptance Model (TAM), and model of Personal Computer Utilization [16].

The UTAUT model is based on seven constructs which are hypothesized to be fundamental determinants of users' behavioral intention to use and adopt a technology. Measuring the behavioral intention to use technology is the central theme of UTAUT model, while the factors; performance expectancy, effort expectancy, attitude towards technology, social influence, facilitating conditions, self-efficacy, and anxiety, serve as determinants of behavioral intention to use the technology. Attitude towards the technology could be either positive, negative or neutral [1]. As per the model, attitude towards the technology doesn't provide unique information about the intention to use technology and is dependent on constructs like performance and effort expectancy. Moderating variables include age, sex, education, past-experience and voluntariness of technology usage.

5   Research Question

The study objective is to assess the feasibility of using a mobile phone-based Chatbot to acquire family planning related information. The seven constructs described above were measured to determine which constructs best predict the use of Chatbot. As such, research question is posed: What are the predictors of behavioral intention to use family planning Chatbot?

6   Method

6.1   Participants

Inclusion criteria for the study comprised of participants who are of age 18–65 years, married, living together or engaged and may be thinking about which family planning method to choose. The study questionnaire was distributed to 49 participants through a PAID-participant pool in the mid-west region of United States. There were 3 invalid returned responses that had to be eliminated before the data analysis. Study participants (n = 49, Mean Age = 31, SD = 8.7), were mostly White (69%), and African American (8%).

Table 1. Inter-item correlation matrix

UTAUT variables	PE	AT	SI	FC	SE	AX	BI	EE
Performance Expectancy (PE)	1							
Attitude towards Tech (AT)	.793**	1						
Social Influence (SI)	.715**	.807**	1					
Facilitating Conditions (FC)	.294*	.193	.246	1				
Self-Efficacy (SE)	.309*	.417**	.395**	.453**	1			
Anxiety (AX)	.122	.145	.106	−.476**	−.128	1		
Behavioral Intention (BI)	.645**	.769**	.693**	.164	.300*	.348**	1	
Effort Expectancy (EE)	.639**	.567**	.517**	.433**	.420**	−.084	.431**	1

6.2   Measures

The 31 questionnaire items were adapted from the UTAUT study of Venkatesh et al. [16]. These items represent independent and dependent variables utilized in this study. The results of inter-item correlation matrix (Table 1) provide more evidence to establish the reliability of the UTAUT scale.

Other than wording modifications to fit the specific technology studied in this research, no changes were made to the scale. All items were measured on a seven-point Likert scale: 1 = completely disagree, 2 = moderately disagree, 3 = somewhat disagree, 4 = neutral (neither disagree nor agree), 5 = somewhat agree, 6 = moderately agree, and 7 = completely agree. Cronbach's Alpha was employed to assess the internal consistency reliability (Table 2).

Table 2.   Scale reliability

Construct	Cronbach's Alpha
Performance Expectancy (PE)	.93
Attitude towards Technology (AT)	.93
Effort Expectancy (EE)	.96
Social Influence (SI)	.89
Anxiety (AX)	.89
Behavioral Intention (BI)	.97
Self-Efficacy (SE)	.81
Facilitating Conditions (FC)	.35

Scale items include: "Using FP Chatbot increased my chances of choosing the right contraceptive method" (PE), "I find FP Chatbot easy to use" (EE), "Using FP Chatbot is a good idea" (ATT), "My spouse will be supportive of me using the FP Chatbot" (SI), "Chatbot is not compatible with the phone I use" (FC), "FP Chatbot is somewhat intimidating to me" (AX), and "I plan to use FP Chatbot in the future" (BI). All scale items, and associated Mean and SD values, are presented in Appendix A.

6.3   Procedure

Before implementing the main study, a pretest was conducted (n = 5) to validate the Chatbot structure and content. Feedback about the layout and messages was obtained and changes were made to the Chatbot as deemed appropriate. In the main study, after completing the consent form, participants were asked to send 'BCS' as a text message to phone number +1-313-228-3034. As a response, they received back an automated text message providing them different menu options to choose from. Participants could use the Chatbot as many times as they want to be familiar with the information. The cost of text messages depends on users' cellular plan. After using the Chatbot, participants were provided a web link to proceed with the Qualtrics survey. The questions tap into seven constructs of the Venkatash model followed by demographic questions. After the survey, participants were asked to enter their email address so that a $5 online gift card could be sent to them. The email address was collected for the sole purpose of

sending gift card and this information was not linked with the survey responses. The study was approved by IRB of the respective institution.

7   Results

7.1   RQ: Factors Predicting the Behavioral Intention to Use Family Planning Chatbot

We proposed a research question about the factors predicting the behavioral intention (BI) to use the Chatbot. To answer this RQ, a serial mediation analysis was performed using Hayes' [9] PROCESS macros (Model 6) with effort expectancy as IV, behavioral intention as DV, and performance expectancy and attitude towards using Chatbot as serial mediators ordered respectively (Fig. 2). Our underlying hypothesis was that perceptions about the amount of effort required to use the Chatbot is likely to increase performance expectancy among the participants, in turn making the attitudes toward Chatbot more appealing, therefore inducing greater intentions to use the Chatbot.
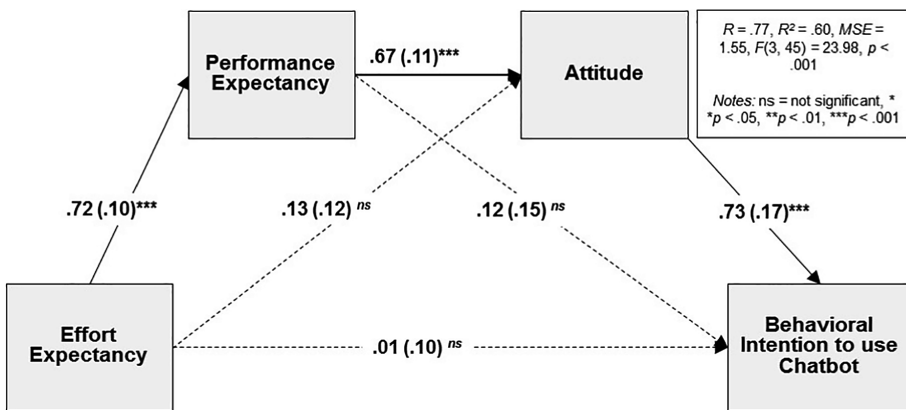
Fig. 2. A Serial mediation analysis. This figure illustrates the mediating effects of performance expectancy, and attitude towards Chatbot to predict behavioral intention to use Chatbot to seek family planning related information.

Performance Expectancy
The model explaining variability in performance expectancy was significant, $R = .64$, $R2 = .41$, $MSE = 1.98$, $F(1, 47) = 51.87$, $p < .001$. The direct effect of effort expectancy on performance expectancy was significant, Coefficient $= .72$, $SE = .10$, $t = 7.20$, $p < .001$, CILL-UL $= .52$ to $.92$, indicating that participants expressed more performance expectancy based on their perceptions about effort required to use Chatbot.

Attitude Towards the Chatbot
The model explaining variability in attitudes toward the Chatbot was significant, $R = .79$, $R2 = .63$, $MSE = 1.14$, $F(2, 46) = 44.07$, $p < .001$. The direct effect of effort

expectancy on attitude towards using Chatbot was not significant, Coefficient = .13, SE = .12, t = 1.05, p = .29, CILL-UL = −.12 to .39. However, the direct effect of performance expectancy on attitude towards using Chatbot was significant, Coefficient = .67, SE = .11, t = 5.92, p < .001, CILL-UL = .44 to .90, indicating that the more performance expectancy participants perceived, the more favorable their attitudes was towards the Chatbot.

Behavioral Intentions to Use the Chatbot
The overall model predicting behavioral intentions to use the Chatbot was significant, R = .77, R2 = .60, MSE = 1.55, F(3, 45) = 23.98, p < .001. Effort expectancy did not directly predict behavioral intention, Coefficient = .12, SE = .15, t = .81, p = .42, CILL-UL = −.19 to .45, and so didn't performance expectancy, Coefficient = .01, SE = .10, t = .13, p = .89, CILL-UL = −.19 to .21. However, attitudes toward using Chatbot appeared as a significant predictor, Coefficient = .73, SE = .17, t = 4.32, p < .001, CILL-UL = .39 to 1.08.

To sum, among the potential indirect effects through the serial mediation combinations, only one path was significant, comprising of a two-mediator model where effort expectancy's effect on behavioral intentions to use Chatbot, was mediated by performance expectancy and attitude towards the Chatbot respectively, Effect = .55, Boot SE = .09, CILL-UL = .37 to .76. All other serial mediation paths were not significant (Table 3).

Table 3. Serial mediation analysis for the effect of effort expectancy (IV) on behavioral intention to use Chatbot (DV), mediated by (1) performance expectancy, and (2) attitude towards the Chatbot.

Direct Effects	Performance Expectancy β (SE)	Attitude towards Chatbot β (SE)	Behavioral Intention to use Chatbot β (SE)
Constant	.69 (.57)	.47 (.51)	−.59 (.45)
Effort Expectancy	.72 (.10) ***	.13 (.12)[ns]	.01 (.10)[ns]
Performance Expectancy	–	.67 (.11) ***	.12 (.15)[ns]
Attitude towards Chatbot	–	–	.73 (.17) ***
Model Statistics	R^2 = .41, $F(1, 47)$ = 51.87, p < .001	R^2 = .63, $F(2, 46)$ = 44.07, p < .001	R^2 = .60, $F(3, 45)$ = 23.98, p < .001

Indirect Effects of effort expectancy on behavioral intention to use Chatbot via …	Effect (SE)	Boot CI$_{LL-UL}$
Total Indirect Effect	.5554 (.0991)	.3778 to .7642
Effort Expectancy → Performance Expectancy → BI	.0935 (.1153)	−.1467 to .3175
Effort Expectancy → Performance Expectancy → Attitude → BI	.3624 (.1165)	.1880 to .6531
Effort Expectancy → Attitude → BI	.0995 (.1030)	−.0662 to .3449

Notes. *p < .05, **p < .01, ***p < .001, [ns] Not Significant

8   Discussion

This study presents the development and empirical testing of a mobile-phone based Chatbot to provide information about family planning and contraceptives. The study employed UTAUT model of technology adoption to assess the main predictors of behavioral intention to use Chatbot. The regression analysis showed that participants' perceptions about the amount of effort required to use the Chatbot increased performance expectancy among the participants, in turn making the attitudes toward Chatbot more appealing, therefore inducing greater intentions to use the Chatbot. Said differently, the positive attitude towards using Chatbot for family planning was determined by the effort required such as ease of use and clarity to operate Chatbot, which in turn determined the value of information gained such as ability to choose the right family planning method as well as acquiring information more quickly through mobile phones.

Overall, the study is based on the argument that the best way to learn is by doing stuff and getting feedback. People are more likely to remember concepts when they discover them on their own. In this regard, the study offers concrete implications in terms of (1) enabling healthcare providers to see the world as people do, as they battle with family planning decisions, myths, stigma, taboos and stereotypes, and providing a culturally sensitive family planning Chatbot using feature phones to improve access, demand and acceptance for modern contraceptives.

Specifically, in terms of achieving the sustainable development goals, the family planning Chatbot offers following concrete implications. For example, the Chatbot intervention may help in reducing the rate of unintended pregnancy and unsafe abortions. Participating families will be able to decide about the number of children they can care for, thus reducing medical costs with increased likelihood of healthy growth in children due to birth spacing. Increased likelihood of healthy growth in children due to spacing of births approximately 24 months apart. The study may also inform health providers and policy makers to better understand reasons for low contraceptive prevalence and implement culturally sensitive family planning services. The Chatbot is also easily replicable in other countries especially in fragile and high-risk regions with limited access to community health workers.

Although, the study was conducted in United States, still, considering the need for family planning counseling, the Chatbot is relevant for implementation in both developed and developing countries alike. For example, separate Chatbot can be developed on sensitive topics like menstruation, HIV/AIDS and mental health. Additionally, a Chatbot can be introduced either as a stand-alone intervention or integrated with an existing family planning and reproductive health intervention. For example, family planning counseling interventions in developing countries, may face a reduced uptake of contraceptives even after the products and services are made readily available. This could be because of social stigma around accessing family planning related information or just because of geographic barriers. In both cases, a family planning Chatbot can be introduced as a safe and culturally sensitive way to connect with the community. Consequently, the Chatbot can be used to improve the performance of

existing family planning services by introducing more potential customers to the contraceptive products and services.

9   Conclusion and Future Research

Family planning is regarded as one of the 10 great public health accomplishments of the 21st century [4]. Think of a global social development problem and it will inevitably find its roots in population growth. Whether its poverty, energy crisis, climate change, food scarcity or political turmoil, all issues have a direct or indirect association with increasing population and limited resources. At current rate of 80 million people born per year, there will be 9.2 billion people on planet by 2050 [12]. We cannot have an infinite population growth, when we have a finite planet with finite resources [7].

For future research, we propose to further test the Chatbot integrated with existing family planning service providers. For example, family planning projects could include a Chatbot in existing interventions. Additionally, users could provide their contact information to receive contraceptives by mail, which is of specific relevance to users living in remote rural communities with little or no access to a family planning service providers. Additionally, users could be provided an option to request a call-back to seek more interpersonal counseling, if needed. To conclude, this study contributes in the global conversation about family planning counseling, by introducing a SMS-based Chatbot with far-reaching, implications for health of women and families in both developing and developed parts of the world.

References

1. Ajzen, I., Fishbein, M.: Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research (1975)
2. Baydar, N.: Consequences for children of their birth planning status. Fam. Plann. Perspect. **27**(6), 228–245 (1995)
3. Car, J., Gurol-Urganci, I., de Jongh, T., Vodopivec-Jamsek, V., Atun, R.: Mobile phone messaging reminders for attendance at scheduled healthcare appointments. Cochrane Database Syst. Rev. (4) (2008)
4. Centers for Disease Control and Prevention (CDC): Ten great public health achievements–United States 1900–1999. MMWR Morb. Mortal. Wkly. Rep. **48**(12), 241 (1999)
5. Cleland, J., Bernstein, S., Ezeh, A., Faundes, A., Glasier, A., Innis, J.: Family planning: the unfinished agenda. Lancet **368**(9549), 1810–1827 (2006)
6. De Jongh, T., Gurol-Urganci, I., Vodopivec-Jamsek, V., Car, J., Atun, R.: Mobile phone messaging telemedicine for facilitating self-management of long-term illnesses. Cochrane Database Syst. Rev. (4) (2008)
7. Ehrlich, P.: The Population Bomb, p. 47. New York Times, New York (1970)
8. Frost, J.J., Finer, L.B., Tapales, A.: The impact of publicly funded family planning clinic services on unintended pregnancies and government cost savings. J. Health Care Poor Underserved **19**(3), 778–796 (2008)
9. Hayes, A.F.: Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach. Guilford Press, New York (2013)

10. Johnson, D.: SMS open rates exceed 99%. Tatango (2013)
11. Kost, K., Landry, D.J., Darroch, J.E.: Predicting maternal behaviors during pregnancy: does intention status matter? Fam. Plann. Perspect. **30**, 79–88 (1998)
12. Lea, R.A.: World Development Report 1993: Investing in Health (1993)
13. Liu, B.: How many text messages are sent each year (2013). http://www.bloomberg.com/video/how-many-text-messages-are-sent-each-year-RDvLwi1WRgii6HMmiVk_Fw.html
14. Parvanta, C., Nelson, D.E., Parvanta, S., Harner, R.N.: Essentials of Public Health Communication. Jones & Bartlett Publishers, Burlington (2010)
15. Population Council: The Balanced Counseling Strategy Plus: A Toolkit for Family Planning Service Providers Working in High HIV/STI Prevalence Settings, 3rd edn. (2015)
16. Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D.: User acceptance of information technology: toward a unified view. MIS Q. **27**, 425–478 (2003)
17. WHO: World Health Organization Definition of Quality. Population Reports Series J, No. 47 (1998)
18. Wulf, D., Donovan, P.: Women and societies benefit when childbearing is planned (2002)