Personalized Persuasive Technology for Maternal Healthcare in Nigeria

Charity Mbanusi[1]* Makuochi Nkwo[2], Rita Orji[3] and Virginia Ejiofor[1]

[1] Department of Computer Science, Nnamdi Azikiwe University Awka, Nigeria
[2] Department of Computer Science, Ebonyi State University Abakaliki, Nigeria
[3] Faculty of Computer Science, Dalhousie University, Halifax NS, Canada
chary4sam@gmail.com

Abstract. This study employs four social influence strategies including social learning, social comparison, normative influence and recognition, to personalize a persuasive system aimed at regular and timely ante-natal, intra-partum and post-partum care amongst women in developing nations such as Nigeria. This new persuasive system will take the privacy into consideration while presenting a customized display of relevant and up-to-date maternal health information to the potential users. It will provide avenues for expectant mothers to observe and learn appropriate maternal health behaviors, compare their performances with similar others' performances, imbibe healthier and safer maternal lifestyles and receive some form of recognition for performing target maternal health behaviors. Via the operationalization of these socially-oriented persuasive strategies, we hope to investigate how the new intervention will be able to support expectant mothers to change, improve and/or reinforce a positive attitude to their health and that of their unborn and suckling children. We contribute to research by demonstrating how socially-oriented strategies can be tailored in a persuasive technology for maternal healthcare to promote information and health-seeking behaviors amongst local women.

Keywords: Maternal Health, Socially-oriented Strategies, Social Influence, Personalization, Persuasive Technology, ICT4D, Persuasive4D, PT4D, Africa

1 Introduction.

Persuasive technologies (PTs) are interactive systems that are designed for the primary purpose of motivating people to change their behaviors, without using coercion or deception [6, 7, 16, 23]. PTs achieve their behavior change objectives via the use of persuasive strategies [19]. Research has shown how persuasive strategies have been effective in motivating users to achieve specific goals in various domains such as environmental management [13, 14, 18], education [29], physical activities [11], and even in different health domains [20, 31][35].

Maternal health is the health of women during pregnancy, childbirth and in six weeks after delivery [2, 27]. Antenatal care (ANC) is the specialized care a pregnant woman receives during her pregnancy through a series of antenatal visits with trained health care professionals in order to help her attain and maintain a state of good health all through her pregnancy [2, 27].

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Research has shown that each year, more than 500,000 women between the ages of 15 and 49 die of causes related to pregnancy and child birth [8]. Almost all maternal deaths (99%) occur in the developing world, and more than half occur in Africa [8]. Proper ANC is one of the important ways of reducing maternal and child morbidity and mortality [27]. Women's attitude towards antenatal care and that of the maternal healthcare providers are crucial to the expectant mothers' ability to access the requisite maternal healthcare.

Many studies have focused on investigating and developing fundamental programs and strategies for persuasion in the health domain [26, 31, 36, 37]. For instance, the new WHO guideline [37] highlighted the importance of woman-centered care to optimize the experience of labor and childbirth for women and their babies through a holistic, human rights-based approach. Traditional media, such as radio, TV and newspapers have also been used to motivate pregnant women to imbibe positive maternal health lifestyles [26]. However, these programs and strategies have not been successful since most expectant mothers in the communities would choose to continue with their negative attitudes/behavior to maternal health due to poverty, availability and accessibility of maternal healthcare services, rural community and household power dynamics, compliance with traditional practices, and outright ignorance [4, 5, 34].

Besides, maternal healthcare facility managers and other stakeholders apply the traditional approach of persuasion (via human-human persuasion) to motivate expectant mothers to attain and maintain a state of good health all through their pregnancy [36, 37]. In this approach, humans or a health institutional authority tries to persuade another human – expectant mother to perform a target behavior, manually. For instance, [3] observed that human-human social facilitation and cooperation is used to persuade women to go for antenatal visits to ensure that both the mother and child remain healthy and to reduce maternal mortality. However, despite these efforts, there are ever-increasing incidences of absenteeism, non-adherence and ignorance about the essential maternal health behaviors and practices amongst local women. These developments ultimately lead to the constant health crises of these women, delivery of newborn babies with serious health problems and deformities; and increase in pregnancy and child birth-related deaths amongst the people. Therefore, there is a need for a shift; the adoption of a new approach to motivate acceptable health and information-seeking behaviors amongst expectant mothers which can be achieved via the combination of Information and Communication Technology for Development (ICT4D) tools and relevant persuasive strategies. We refer to the integration of ICT4D tools and Persuasive Strategies in the design of indigenous and culturally-appropriate behavior-change support systems for developing nations as Persuasive Technology for Development *(Persuasive4D or PT4D)*.

In a recent meta-review, we discovered that Africans are susceptible to persuasive strategies [32, 33]. Most existing studies focus on how persuasive technology techniques could be applied to support users to perform target behaviors in domains such as eCommerce [16, 23, 24], education [29], environment [13, 17] and healthy eating [31]. However, there is yet no study on what persuasive techniques could be implemented to promote positive maternal health (regular and timely ante-natal and intra-partum care) amongst expectant mothers in Nigeria. This shows that there is dearth of research on the application of persuasive technology in maternal health in the developing nations of the world. To advance research in this direction, we focus on how to design and evaluate a personalized persuasive technology for maternal health which will have the capacity to motivate pregnant women to change/improve their attitudes and behaviors towards their health and that of their unborn/newly born babies.

We contribute to research by demonstrating how socially-oriented strategies can be designed to be culturally-appropriate [15, 22] and tailored in a persuasive technology for maternal healthcare to promote information and health-seeking behaviors amongst local women.

2 Related Works

In this section, we review allied literatures in maternal health, persuasive designs and strategies.

2.1 Maternal Health

The overall health of expectant mothers during pregnancy, childbirth and six weeks after childbirth is referred to as maternal health [2, 27]. Pregnant women are usually given special care which is achieved via a series of antenatal visits to maternal healthcare facilities managed by trained healthcare professionals. These visits are done to help her attain and maintain a state of good health all through her pregnancy [2, 27]. However, research has shown that more than 500,000 women between the ages of 15 and 49 die of pregnancy and childbirth related cases each year [8], with most of these deaths (99%) occurring in the developing world. These avoidable incidences could be attributed to women's attitudes/behaviors towards their maternal health (antenatal) cares. Although several strategies like the use of traditional media and manual persuasion have been used to motivate women to embrace positive maternal healthcare behaviors, however, these programs and strategies have not been successful. Most expectant mothers would choose to continue with their negative attitudes/behavior to maternal health due to poverty, availability and accessibility of maternal healthcare services etc [4, 5, 34]. Therefore, a new approach for motivating community women to change their behaviors and attitude towards maternal healthcare is wanted since it will have the capacity to support expectant mothers to attain and maintain a state of good health all through their pregnancy [2]. This new approach could be achieved via the operationalization of persuasive technology strategies in a maternal healthcare application.

2.2 Persuasive Strategies

Persuasive technologies are interactive systems which have the capacity to motivate users to perform target behaviors or change their attitudes towards certain phenomena. Persuasive strategies provide the building tools for such behavior-change support systems [13, 21]. Over the years, researchers have come up with various strategies [7][28]. For instance, while Fogg proposed eight design steps for building a persuasive system [7], Oinas-Kukkonen and Harjumaa proposed twenty-eight persuasive strategies which are employed in designing and evaluating persuasive systems [28]. Based on the type of support that persuasive strategies provide to the users of a system, they are classified into four distinct categories: the primary task, dialogue, system credibility, and social support categories [23, 28]. Specifically, the social support category consists of socially-oriented strategies such as social learning, social comparison, normative influence and recognition, which encourage users by leveraging social influence [23, 28].

When implemented in a system, *social learning strategy* motivates a user to perform a target behavior by allowing her to see and learn from what similar others did or is doing [23, 28]. This strategy differs from other strategies since there is no actual comparison or competition involved. The learner could only learn as a passive onlooker; by mere observation, imitation and behavior modelling and does not have to be involved physically.

The *social comparison strategy* motivates a user to perform a target behavior by allowing her to use the system to compare her performance with that of others that are performing or have performed target behavior [23, 28]. It could be upward (when it is used for self-improvement as people compare themselves to others who are performing well in the specified task) or down (when it is used by people to raise self-worth as they compare themselves to other people they performed better than) [23, 28].

Normative influence strategy takes advantage of peer pressure to motivate a user to adopt or perform a target behavior [23, 28]. This principle could be implemented such that the system will provide a common ground for users with similar goals to connect, share, collaborate, grow their knowledge together, and influence one another.

The Recognition technique involves offering public recognition to a user or group of users for performing or adopting a specific target behavior [23, 28]. By natural drive, people appreciate it and tend to perform more when their performances are recognized. Recognition could be implemented in persuasive technology (PT) via the provision of displays of best users or publishing a personal story of the people who have succeeded in their target behaviors.

Many of these strategies have been employed and have proved to be effective in developing and evaluating persuasive technologies in various domains [10, 19][25][31]. In this study therefore, we will employ these socially-oriented strategies to personalize a hyper-localized persuasive system for maternal health for developing nations such as Nigeria.

3 Method

This section describes the current phase of our work which seeks to investigate how socially-oriented strategies and personalization could be used to promote information and health-seeking behaviors amongst women in developing nations. To achieve our objective, we address the following research questions: (1) what are the obstacles to adopting proper maternal information and health-seeking behaviors amongst women? (2) How can we operationalize relevant socially-oriented persuasive strategies in a health intervention to motivate potential users to adopt appropriate maternal information and health-seeking behaviors? In the following subsections, we describe our preliminary and the current studies.

3.1 Context and Initial Study Design

This study is set at Orumba General Hospital Umunze, Nigeria, where pregnant women already receive training on monthly antenatal care visits; coaching them to access useful resources to improve nutrition, health knowledge and promote preventive health practices. Timely and frequent use of antenatal care enables delivery of essential services, including malaria treatment, immunizations, and health counselling. After three months, there is a check of women whose antenatal attendance is frequent and timely. This report is used to recognize publicly those who have been consistent in coming for antenatal; they are displayed on the notice board of the antenatal section. Through this method, it is expected that those recognized will be motivated to continue to come and defaulters will be inspired to change their attitude and attend antenatal.

Besides, to address research question 1, we conducted a preliminary user study on the women and caregivers after the first three months of their antenatal visits (first trimester) to understand the obstacles that hinder expectant mothers from adopting proper maternal information and health-seeking behaviors amongst women. We used a questionnaire based on Busch et al.'s

persuadability inventory (PI) [1] and modified to fit into our area of study maternal health. This was done to identify users' persuasion strategy preferences and to construct a simple persuasion profile for each expectant mother. The PI scales consist of five (5) items each, for measuring *social learning; social comparison, normative influence, recognition and personalization* strategies. We weighed up our questionnaires using the participants' agreement to a 5-Likert scale ranging from "1 = Strongly Disagree" to "5 = Strongly Agree". Seventy respondents participated in the survey. According to Busch et al. [1], *"Participants having higher scores in one or more of the scales are expected to be more susceptible to these specific persuasive strategies.*" This approach is adopted to help determine persuasive strategies that are most effective and could be employed to design our proposed app.

The findings from our preliminary studies uncovered various socio-cultural factors which affect the adoption of proper maternal information and health-seeking behaviors amongst women. Some of these obstacles are: religious and cultural beliefs, aversion for caesarean sections, high hospital bills, poverty and outright ignorance. For instance, many of the respondents think that "*safe delivery is only a function of belief in God"* and *"God has promised they shall deliver their babies like the Hebrew women in the bible".* On the other hand, some of the respondents failed to attend antenatal sessions and engage in proper health and information-seeking behaviors due lack of time and outright carelessness. These attitudes deter them from seeking proper health checkup during pregnancy. The rising rate of pregnancy and childbirth-related deaths in developing African nations confirms this finding [8, 27]. In addition, we discovered through our study that many of the women make use of mobile phones and computers, while some have internet access. These findings are essential because research has shown that ICT4D has created opportunities for users to connect, share, collaborate and learn new things [18, 24].

3.2 Application Design

This is the current phase of our research. We are employing Fogg's eight-step processes [6, 7] to develop our persuasive technology for maternal health. The steps includes: 1) Target a simple behavior, 2) Know the target audience, 3) Discover obstacles to performing the target behavior, 4) Use technology channel familiar to users, 5) Identify appropriate persuasive technology examples, 6) Emulate effective examples, 7) Evaluate and repeat fast, 8) Expand on success. We chose the Fogg's persuasive design steps because it provides us the opportunity to iteratively design a maternal healthcare intervention that will be culturally-appropriate and suitable for the delivery of healthcare services to our target population.

Specifically, we sought for a simple behavior, which was motivating expectant mothers (target audience) to attend antenatal visits at local maternal healthcare facilities. These health centers are government owned and they provide free services for expectant and newly delivered mothers who registers with them. Besides, the findings from our initial study *(section 3.1)* shows that religious and cultural beliefs, aversion for caesarean sections, high hospital bills, poverty and outright ignorance are some of the obstacles preventing local women performing the target behaviors. Again, based on our findings, we chose to employ an integrated platform (mobile and desktop) as our technology media since both media are common gadgets familiar to the women and the caregivers in the maternal healthcare facility. In order to identify appropriate persuasive technology example to use in our study, we conducted a systematic review of related literatures and uncovered that social influence strategies along with other persuasive strategies have been effectively used to develop and motivate attitudinal and behavioral chang-

es in various domains [19][30]. For example, Nkwo et al. [19] employed social learning, social comparison, recognition and personalization to design a persuasive system for promoting clean and sustainable environment. We emulated that design to start off the development of our persuasive technology for maternal health which will have the capacity to motivate expectant mothers to change and/or improve their health and information-seeking behaviors. Our design will utilize four socially-oriented strategies (social learning, social comparison, normative influence and recognition) from the persuasive system design framework [28] to personalize and tailor important maternal healthcare services to the potential users of the system.

3.3 Implementation of the Socially-oriented Persuasive Strategies

Social Learning Display: This strategy is usually implemented in such a way that users will be able to observe other's performances, learn new things and find out best practices which they could passively learn from [12]. Specifically, we plan to operationalize our *social learning display* to show a graphical view of the number of pregnant women and the points earned for frequent and timely attendance to antenatal sessions each month, see figure 1.

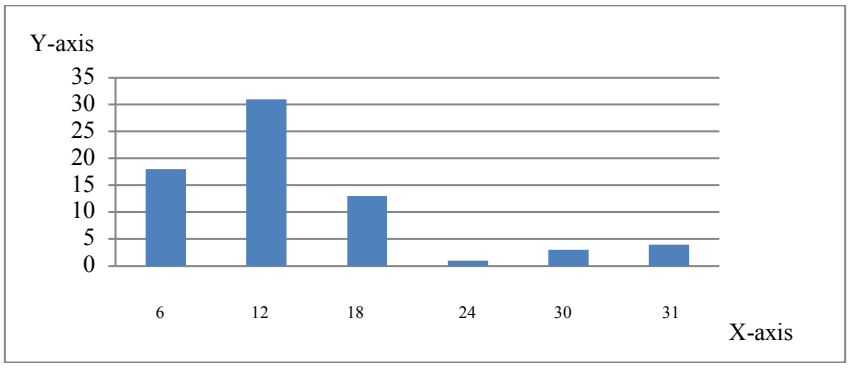

Fig. 1 Proposed Social Learning Performance Display

The Y-axis depicts the number of users while the X-axis depicts the performance points based on the number of visits to antenatal care sessions. We expect that the display will help to model the attitudes of pregnant women towards their antenatal care visits and support them to adopt positive maternal healthcare behaviors.

Social Comparison Display: We plan to operationalize this strategy via an instant messaging component. This feature will allow users to share and compare information related to their maternal health (good health of the mother and the child). Here, the logged in user of the system will see a display of her real name and her own maternal healthcare progress information shared on the application. However, she would only be able to see the maternal healthcare progress information of other registered pregnant women with pseudo-names. The display will be limited to like seven users per screen to make it easier for the logged in user see and compare her performance with that of other expectant mothers registered in the system. The logged-in user will also have the opportunity to send personalized feedbacks (reaction) using any of the

three keys: Okay, Surprised, and Oh No. The app will be automatically updated with new records such that users could have the opportunity to compare attendance as time progresses.

Normative Influence Display: This strategy entails leveraging social or peer pressure to increase motivate a user to perform or adopt a target behavior. We plan to implement normative influence by allowing users to use their mobile devices to view pictures of newborn babies with serious health problems and deformities due to the mother's inability to attend antenatal care frequently and timely. We hope that this display will awaken their consciousness on the dangers of absenting or irregularly attending antenatal care (ANC). Also, we plan to use this display to encourage the delivery and receipt of essential maternal healthcare services such as malaria treatment, immunizations, and health counselling. Besides, since our proposed system is an integrated platform (mobile and desktop system), we plan to ensure that the aforementioned displays are also shown on a public LCD (Liquid Crystal Display) located in a strategic location in the antenatal section of the maternal healthcare facility, where everyone can see it. We are confident that these persuasive displays will potentially increase the likelihood that a user will adopt or perform target behaviors.

Recognition Display: We will implement recognition in our new system by allowing users to view through their mobile devices, a list of expectant mothers who have regularly attended antenatal visits over a given period, and have successfully performed assigned target behaviors. The system will also publish personal success stories of successfully delivered mothers and what they did to achieve that feat. Again, since our proposed system is an integrated platform (mobile and desktop system), we plan to ensure that the recognition displays are also shown on a public LCD (Liquid Crystal Display) located in a strategic location in the antenatal section of the maternal healthcare facility, where everyone can see it. Progressively, the list will be automatically updated using attendance points entered for each user after three months calculation of how frequent and timely are the antenatal visits of these pregnant women.

Personalization: A system that offers personalized content or services has a greater capability for persuasion [9]. We will operationalize personalization in this system by providing a unique identification card number to the women at the point of registration. This interface will show contents that are pertinent to the expectant mothers. For example, through personalization, the logged-in user (expectant mother) can be able to envisage and compare her attendance to that of other women performing the same task. She can equally react (send her feedback) by using any of the three keys: contented, astonished, and discouraged.

Moreover, we are iteratively developing an integrated system for maternal health which will offer diverse but personalized persuasive interfaces of the four social influence strategies to support and inspire potential users (expectant mothers and caregivers) to perform target behaviors. We are taking security and user's privacy into consideration by ensuring that user login credentials (username and unique card numbers) are authenticated and abstracted with pseudonames to check against illegal access and other harmful activities.

4 Study Status, Future Work and Expected Outcome

The persuasive technology for maternal health is currently at the development phase. It will be integrated with the relevant persuasive strategies described above in order to motivate users (expectant mothers) to adopt positive maternal healthcare behaviors. We will evaluate a clickable prototype of the system by testing it with the potential users (expectant mothers and caregivers) of the system.

In specific terms, we plan to conduct usability evaluation with individual users to get a feedback about the effectiveness and value of our design concepts in terms of: (1) motivating users to learn new things and find out best practices, (2) encouraging users share and compare information related to their maternal health (good health of the mother and the child), (3) awaken users consciousness on the dangers of absenting or irregularly attending antenatal care (ANC), and (4) inspiring users to adopt positive maternal health and help-seeking behaviors. Through this evaluation, we hope to learn about the effect of the different persuasive displays on the users and discover how persuasive systems can be tailored to support pro-maternal healthcare services in developing African nations. We will compare our findings against the current maternal healthcare practices to show its obvious benefits.

5 Conclusion

Persuasive technologies (PTs) are interactive system that is designed for the primary purpose of motivating people to change their behaviors, without using coercion or deception. In this early work, we used four social influence strategies (social learning, social comparison, normative influence and recognition) to show how the persuasive system will be personalized to promote regular and timely ante-natal and intra-partum care amongst expectant mothers in developing nations like Nigeria. This new persuasive system would take the privacy of users into consideration while it presents them with a customized display of relevant and up-to-date maternal health information. Generally, through the operationalization of these socially-oriented persuasive strategies, we hope to investigate how the new intervention will be able to support expectant mothers to change, improve and/or reinforce a positive attitude to their health and that of their unborn and suckling children. In addition, we will measure user behaviors and compare them with what it used to be before the introduction of the automated persuasive system in other to see the benefits of the new intervention.

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