Elements influencing maternal health and fitness information-seeking behavior in persuasive design strategies

[1]**Charity E. Mbanusi,** [2]**Virginia. E Ejiofor,** [3]**Irabor Chuks Clarence and** [4]**Uchenna C. Onyemauche**

[1,2,3]**Department of Computer of Science,** [4]**Federal University of Technology, Owerri. Nnamdi Azikiwe University, Awka.**

Email: Chary4sam@gmail.com

ABSTRACT

Pregnant women and new mothers seek health and fitness information to inform their decision and attention to medical aid. This study identifies elements influencing maternal health and fitness information-seeking behavior in persuasive design strategies. A systematic review of existing literature on persuasive design, health communication, and maternal health was conducted. It revealed that personal, psychological, social, technological and design factors impact information-seeking behavior. Understanding these elements is crucial for designing effective persuasive strategies that promote informed decision-making and healthy behaviors. This study informs the development of targeted intervention that carter to the unique needs and preferences of pregnant women and new mothers, ultimately promoting better health outcomes.

Keywords: Maternal Health, Fitness Information-Seeking, Persuasive Design Strategies

INTRODUCTION

Pregnancy and motherhood are life-changing experiences that necessitate informed decision-making to ensure optimal health outcomes. Pregnant women and new mothers seek health and fitness information to inform their choices, from prenatal care to postpartum recovery. However, the vast amount of available information can be overwhelming, and the quality of information varies widely. Persuasive design strategies have emerged as a promising approach to promote healthy behaviors and informed decision-making among pregnant women and new mothers. These strategies leverage psychological, social, and technological factors to influence behavior and motivate positive change. Despite the potential of persuasive design strategies, little is known about the elements that influence maternal health and fitness information-seeking behavior. Understanding these elements is crucial for designing effective persuasive strategies that cater to the unique needs and preferences of pregnant women and new mothers.

Persuasive Technology (PT)

Persuasive technologies or systems are interactive technologies which are designed to motivate individuals or groups to transform their attitudes and behaviors without compulsion or deception [1]. In persuasive computing, designers leverage on the influential roles that technology plays in everyday life to develop interactive systems that could be employed to encourage and reinforce positive behaviors in various areas [2]. According to [3] in his dissertation titled "culturally-relevant persuasive technology, Fogg defined the term persuasive technology (PT) as "any interactive computing system designed to change people's attitudes or behaviors". PTs can be designed to support various groups of citizens in distinct geographical areas to carry out their intended behaviors. Central to the concept of persuasive technology is the notion of persuasion, which Fogg explained as "an attempt to shape, reinforce, or change behaviors, feelings, or thoughts about an issue, object, or action" [4]. Persuasive Technology

(PT) is currently being developed in a multitude of forms, such as for portable hand-held devices [5] web-based applications [6], standalone programs [7], and computerized games [8]. Various PT interventions have been designed to motivate desirable behaviors from users in many domains such as education [3], sustainable environment [8] and health [9]. The PTs are integrated with essential persuasive strategies which have the capability to provide online shopping experiences which are distinctive and relevant to customers. In the safety and security domain, PTs are employed to prevent home and public accidents. For instance, *Drive RS* is a persuasive mobile application for discouraging young drivers from speeding [10]. Over the last decade, the health and wellness domain are receiving significant attention, especially in the global south (Africa). This is because it is wide, very important, and constitutes a global challenge. Moreover, it has been argued that most of the health-related challenges such as sedentary health issues, mental health, maternal and child health, etc faced by our society today are behavior-related [11]. Therefore, it might be possible to solve them by motivating people to make behavioral and attitudinal changes. Therefore, researchers are of the opinion that "*developing persuasive intervention which could solve a small part of the overall problems and support promote long-term sustainable behavior-change would be very helpful*" [12]. Other studies have shown how PTs can be designed to encourage individual and communal actions in different health and wellness domains [13]. Health and wellness is a significant application area of persuasive technology because of the growing need to main a state of good health. Consequently, this dissertation focuses on PT for behavior change with emphasis on motivating appropriate and timely antenatal care for expectant mothers.

Persuasive System Design Models

Over the years, designers have developed ground-breaking models for building persuasive solutions that stimulate users to carry out their intended behaviors. The two most popular of these models are the Fogg's 8-step design process [4] and the persuasive system design (PSD) model illustrated by [14]. According to [4], the eight-step design process of designing PT interventions are as follows:

i. **Target a simple behavior:** First, the designer would have to break down the big goal into a sequence of seemingly tiny objectives that anyone can easily achieve.

ii. **Select a target audience:** Secondly, Fogg advocates that the designer should know and understand the target audience. He is of the view that, "finding the right combination of behavior and audience is vital to laying the foundation for the subsequent steps in the design process".

iii. **Discover what is preventing the target behavior from being performed:** The designer should find out what is preventing the behavior – is it lack of motivation? Lack of ability? Lack of a well-timed trigger to prompt behavior performance? Or is it a combination of the three factors? Here, there is a great need for a user study to determine to systematically investigate the users, their behaviors, the factors influencing them, creating persuasive profiles of the users, and tailoring PT interventions to users. The behavior theories are in conducting a user study.

iv. **Use a technological channel familiar to the target audience:** The best channel usually depends on three factors: the target behavior, the audience, and what is preventing the audience from adopting the behavior. This implies that the designers cannot decide on the appropriate channel until the first three steps have been completed.

v. **Identify previous examples of PT that are relevant to the current problem:** This entails finding an existing intervention that relates to the PT you want to design. One of the challenges in finding relevant examples, as identified by Fogg is that the design team will not always know if a given PT intervention is successful. Most existing PTs do not make explicit these factors because they are neither based on behavior theories nor on any form of data about the audience.

vi. **Emulate successful other:** Here, the designer would need to build his own PT based on the outcome of the user study conducted in step iii. This is important so as not to either match the wrong audience to the wrong behavior or target completely different factors influencing behavior.

vii. **Evaluate and repeat quickly:** This step promotes iterative development. A series of small rapid tests are more effective than one big test.

viii. **Expand on success:** PT designers can expand on success by making the target behavior more complex or by including new audiences. The expansion should be gradual and systematic – varying one or two attributes from the success achieved in step vii.

Besides, [15], proposed a three-step approach to the analysis and development of a PT intervention design as:
Understand key Issues: Designers should understand the key issues behind PT intervention.

Analyze Persuasion Context: Designers of a PT should analyze and evaluate the context of persuasion to understand the intent, and the event and well as the strategy;

Design System Qualities: Designers should consider the persuasive strategies to be employed in design of the Persuasive Technology (PT). The strategies are classified into 4 groups: primary task support, dialogue support, system credibility and social support.

Persuasive Strategies

However, to actually develop these persuasive interventions, designers will have to operationalize some persuasive strategies otherwise known as techniques. A number of persuasive strategies exists which can be employed to motivate a change of attitudes and behavior from people. For instance, [3] developed six persuasive principles, which are fundamental principles of influence. While Fogg developed seven persuasive tools which can be used to motivate an individual to achieve a target goal [4], [14] expanded Fogg's work to develop an all-inclusive strategy, consisting of twenty-eight (28) persuasive system design (PSD) framework. In this doctoral dissertation, we make use of the [14] PSD framework. We choose this framework because it is the most widely employed in PT design, globally. The strategies are grouped into four (4) categories based on the type of support they can be designed to provide for potential users. They are the primary task support, dialogue support, system credibility support, and social support (see Figure 1 below).
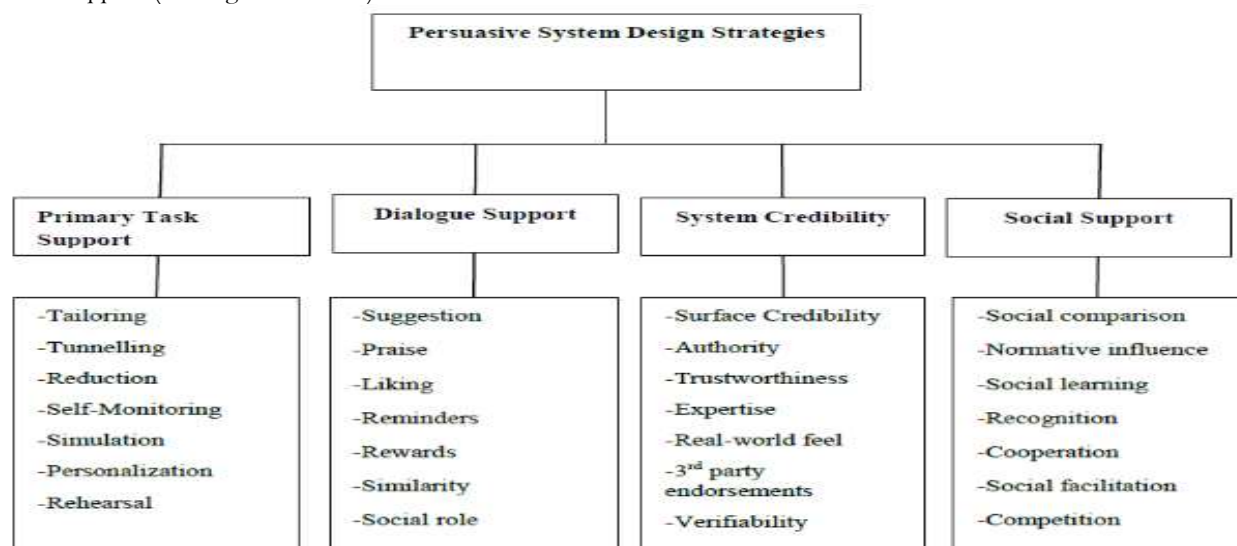

Figure 1: Persuasive Strategies of the Persuasive System Design Framework

Primary Task Support: The persuasive strategies in this category make it simpler and easier for people to perform important tasks. They include reduction, personalization, tailoring, self-monitoring, simulation, and rehearsal.

Dialogue Support: The persuasive strategies in this category make the system more persuasive by providing some degree of system feedback to users, via verbal information and other types of system summaries. Users are provided with communication channels through which could be motivated to carry out intended tasks. They include: praise and rewards, reminder, suggestion, similarity, and social role.

System Credibility Support: The persuasive strategies in this group describe how to build a system to become more convincing and persuasive to users. They include trustworthiness, surface credibility, real-world feel, authority and third-party endorsement, verifiability.

Social Support: The persuasive strategies in this category explain how to design a system or application which can inspire users by leveraging social influence or providing some kind of social support. Through social influence, we could be motivated to take on a target behavior based on what we observe others do in the same situation. The principles here include social learning, normative influence, social comparison, social facilitation, cooperation, competition, and recognition. Indeed, persuasive strategies are the building blocks of persuasive technologies. They could be employed to design and implement efficient persuasive technologies that can be used to motivate attitudinal and behavioral changes in different application domains, including maternal and child health.

Maternal Health and Antenatal Care

Maternal health is the health of women during pregnancy, childbirth and in six weeks after delivery [15]. 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. 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 [16]. An estimated 2.8 million pregnant women and newborns die every year, or 1 every 11 seconds, mostly of preventable causes, according to new mortality estimates released by UNICEF, the World Health Organization (WHO), the United Nations Population Division, UNFPA and the World Bank Group. Almost all maternal deaths (99%) occur in the developing world, and more than half occur in Africa [16]. For mothers and their babies, the period surrounding birth is a particularly vulnerable time. For mothers, complications leading to maternal death can occur without warning at any time during pregnancy and childbirth. It is worthy to note that antenatal care is an important determinant of high maternal mortality rate and one of the basic components of maternal care on which the life of mothers and babies depend [17]. Though it is difficult to identify which pregnancies will have complications in delivery, antenatal care is still an important preventive intervention, particularly for detecting sexually transmitted infections and anemia. This is crucial as nearly a fifth of all maternal deaths in Nigeria are attributed to severe anemia. A prenatal tetanus injection is known to be life-saving for the mother. In addition, women can be warned about danger signs and symptoms during labor and delivery by their antenatal care providers. Proper ANC is one of the important ways of reducing maternal and child morbidity and mortality [18]. 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. However, even after having received appropriate access to antenatal care, skilled care at delivery time is essential in the case of unexpected complications.

Theories and Models of Reasoning

In this section, the researcher describes some of the important theories and models of reasoning, as it affects human behavior.

The Theory of Reasoned Action

This theory is one of the oldest theories employed by persuasive systems design models [19]. The theory and model find its origin in social psychology and was conceived initially as an attempt to measure attitudes, but was later expanded to describe how attitudes influence behavior. The initial model distinguished attitudes to a behavior (the way a person sees the behavior based on previous experience or expectations) and subjective norms (how they think other people they care about will view this behavior). These factors lead to an intention, which in turn is translated into an actual behavior. This "theory of reasoned action" was sufficiently extended with a third dimension: perceived control. This tries to take into account the fact that not all behaviors are voluntary (or believed to be so by the subject), possibly influencing the intention. Figure 4 below describes the "theory of reasoned action" which is adapted from [19].
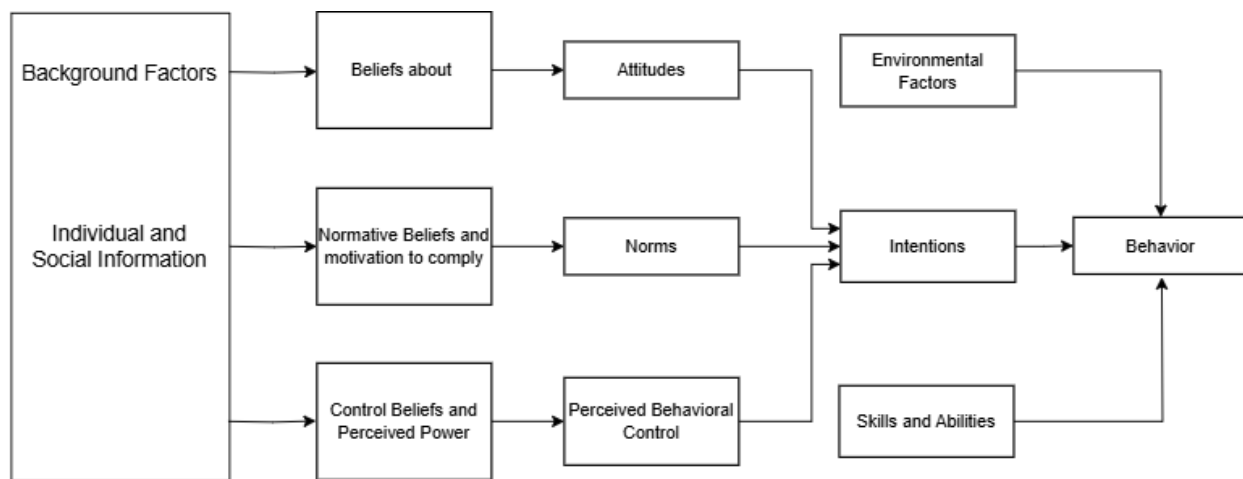

Figure 2 – Theory of Reasoned Action – Adapted from [19]

Behavior Change Theories

Theory helps designers to go beyond feelings, into designing and evaluating behavior changing interventions based on an understanding of human behavior. Many years of studies on behaviors, attitudes and what could make people

change their behavior yielded various theories in so many areas of human endeavors. In this dissertation, the researcher reviewed some of the theories relevant to this study.

Max Weber Theory of Social Action

Studies show that social action is an action performed by an individual whom someone attached a meaning to. Weber in [20] opines that understanding peoples' action within a social context requires an understanding of the meaning attached to it by the actor. This is because; such action is not done out of reflex but based on motives or intentions. These motives are to be achieved in relation to the view of others and their reactions. Therefore, the attitude of a pregnant mother to her personal health and that of the unborn child, according to Weber's theory, can be evaluated by what she stands to benefit from engaging in responsible pregnancy behaviors.

The Health Belief Model

The health belief model (HBM) offers a functional framework for evaluating health behaviors among individuals [21]. This model has been widely employed to study various factors that may influence different types of health behaviors or attitudes of a person [22], [23]. This research adopts the HBM as its conceptual framework because of the wide adoption and appropriateness for our study. Typically, the HBM highlights six factors that may influence the health behaviors of people and they include: *perceived benefit, perceived barrier, self-efficacy, cue to action, perceived susceptibility,* and *perceived severity.* In this research, we consider *perceived benefits* and *perceived barriers.* We merged perceived *severity and perceived susceptibility* and treated them as one entity referred to as *perceived threat, which is* associated to the non-adoption of healthy behaviors. Susceptibility and severity can be referred to as risk vs. consequences and can be merged and treated together [24]. In addition, we extended the HBM by adding one extra factor that may influence breastfeeding behaviors: socio-cultural factors. Thus, in this study, we evaluated four distinct factors that may influence antenatal care which is the primary maternal health care and they include *perceived benefits, perceived barriers, perceived threat,* and socio-*cultural factors.* Specifically, *perceived benefits* refer to an individual's beliefs concerning the effectiveness of an action to reduce threat [25]. In the context of our study, perceived benefits are referred to as a mother's belief in the perceived usefulness of adopting appropriate behavior towards maternal healthcare. Thus, higher perceived benefits are likely to motivate better maternal health behaviors to the health belief model. Secondly, the *perceived barrier* refers to the barriers to adopting appropriate behaviors that are recommended by health and wellness professionals to be good for promoting healthy living. In the context of our study, perceived barriers refer to those things that prevent a mother from adopting appropriate behavior towards maternal health. According to the health belief model [26], perceived barriers affect behaviors negatively. Thus, higher perceived barriers are likely to affect maternal health behaviors negatively. Thirdly, *perceived threat* refers to the risks and consequences associated to the non-adoption of healthy or appropriate behaviors. In the context of our study, it refers to the mother's fear of the risks and consequences of failing to adopt appropriate maternal health behaviors and practices. Thus, higher perceived threat is likely to influence/compel the adoption of appropriate maternal health behaviors. Fourthly, *socio-cultural* factors such as ethnic sentiments, traditional and religious practices and beliefs about pregnancies, pregnant mothers and their families may influence her maternal healthcare [27]. It is therefore essential for stakeholders to understand local traditions, cultures, customs, and religious beliefs related to maternal health to be able to offer effective interventions to support maternal health practices.

Behavior Change and Persuasive Technology

A number of studies have been done in the human-computer interaction (HCI) and persuasive technology as well as in the health and wellness domain to make a summary of key motivational techniques that HCI designers must be aware of if they desire to encourage desirable health behavior [28]. Among other central issues was the manner in which information may be used to influence citizens to make a change, "information have to be simple to understand, dependent upon, draw attention and is retained" [29]. Furthermore, [30] carried out research to evaluate various ways of using persuasive technology based on empirical findings from behavioral science to motivate behavioral change in users. They worked based on the fact that many technology products rely too much on positive reinforcement; they found that one way to effect positive change in citizens is to use negative messages as well as sad smileys to encourage change [8]. The result from this research was a number of recommendations for the types of system interventions and personalized messages that positively impact an individual's behaviors. In the light of the above findings, many research efforts are being conducted to show that persuasive system can be designed to encourage positive health behaviors [31]. Several themes were extracted based on this research. Furthermore, research have revealed that social influence will be a valuable strategy for encouraging health and wellness [18] and in the sustainability domain [2]. For example, Let's play! is a mobile health and wellness game for adults developed by [32]. In a sustainable environment domain, UbiGreen, which is a mobile intervention for tracking and promoting green transportation behaviors was developed by [29]. When persuasive technologies are integrated

with social influence strategies such as social learning and social comparison, competition and recognition, they tend to become effective at increasing people's ability to adopt desirable behaviors [5].

Behaviour Change Support Systems

According to [33], behavior change support system (BCSS) refers to a social information system with emotional and behavioral effects designed to shape, alter or strengthen attitudes and behaviors; or the act of conforming without compulsion or deception. It is a kind of persuasive technology (PT) intervention that is aimed at providing contents and features that help users take on new behaviors, make behaviors easy to achieve and help users in their daily lives. The PSD model developed in this dissertation is a mobile-based persuasive technology for antenatal care and it is based on the BCSS model.

Ethics of Persuasive Technology Design

Although persuasion implies a voluntary change in people's attitudes as well as in their behaviors or both, sometimes people respond with criticism to the idea of being persuaded. They might say that they do not want to be manipulated or they believe that nobody can influence their attitudes and behavior. According to [6], many people become very upset when they hear that psychologists are trying to control them". However, psychology is a science that not only attempts to describe and predict attitudes and behavior, but also to control, and perhaps even to manipulate them [6], and thus it always raises ethical concerns. Often persuasion literature justifies the research by stating that persuasion is present in our everyday lives whether we want or not because people are influenced all the time when they communicate with each other. The principles of persuasive communication, such as reciprocity, are built into our communication system. [6], has stated: *"Language is by all odds the most subtle and powerful technique we have for controlling other people. Nothing that psychologists can invent in their laboratories is likely to be nearly as influential in controlling people as it is a familiar tool we call language".*

Persuasion is essential for participatory democracy and the existence of civilization as we know it. When technology products are used by individuals the persuader is often the user himself and thus, there are fewer ethical concerns to be considered. [4], states that individuals frequently put themselves voluntarily into tunnel situations to modify their behaviors or attitudes. As an example, they can employ personal trainers to direct them during workouts. However, if a government or an agency such as the state waste management outfit in Nigeria adopts a new technology that leverages social support and even peer-pressure, there might be ethical concerns that should be considered. Persuasion researchers and technology designers come from diverse backgrounds, and they make their decisions based on their own ethical viewpoints. There are many perspectives on ethics that may help us to understand these viewpoints. The perspectives include pragmatism, utilitarianism, universalism, dialogic ethics, and situationalism. According to [34], they seem relevant to the ethics of persuasion. In short, pragmatism responds to questions of ethics by transforming them into pragmatic questions about the consequences – probable costs and benefits of taking the given action. The basic principle of utilitarianism is to "do more good than harm" [34]. It means that ends are weighed against means, means against ends, and both against circumstances. From many options, the persuader should select the option that will provide the maximum good for the highest number of individuals. The persuader is entitled to use ethically questionable means only if their goals as a persuader are worthy beyond question. Universalism "…assumes that some practices are intrinsically virtuous or intrinsically objectionable, despite what the objective or the circumstances" [34]. In universalism, the ethics are derived from law or tradition or religion. According to dialogic ethics, communication is ideally dialogic and it is facilitated only if the persons treat each other as a person rather than as an object to manipulate. Communication is based on interpersonal trust. According to situationalism, ethics should be a role- or situation-specific, and exceptions to rules are allowed. The persuader should pay attention to the special circumstances of a matter, such as the role of the persuader for the audience, expectations of the receivers, the degree of the receiver's persuasion knowledge, the goals and values of the receivers, the degree of urgency and ethical standards for communication held by the receivers [34].

Persuasive technology researchers have also considered ethical questions. [4], states that many of the ethical questions related to persuasive technology are similar to those for persuasion in general. However, he identified six matters that are exclusive for persuasive technology only:

- The originality of the technology may cover its persuasive intention because users are unaware of the tactics that are being used, and tactics can be subtle.
- Persuasive technology can exploit the positive reputation of computers and therefore users are very eager to accept information and advice from technology.
- Computers can be proactively persistent, and there is a risk that users will finally give in to a suggestion even if they objected to it at first.

- Computers control the interactive possibilities and therefore users have a limited set of choices available which differs from human communication.
- Computers can affect emotions but cannot be affected by them and therefore there is a risk that communication will lead to non-ethical outcomes.
- Computers cannot shoulder responsibility and therefore they cannot be blamed from errors; the responsible instance varies case by case.

Fogg has presented many approaches to deal with ethical questions in design [4]. In 1988 he suggested that a simple gain/loss analysis for different stakeholders can be employed to show whether the technology is ethically questionable. As an example, if a company gains profit or information and an individual loses money, privacy, or freedom, the persuasive technology could be ethically questionable. In 2003 he suggested that "by investigating the intentions of the individuals or the organization who built persuasive technology, the techniques used to persuade, and the results of using the technology, it is feasible to measure the ethical implications" [4]. One approach to assessing the ethical implications of this technology is stakeholder analysis. Ethical concerns are related to certain persuasion techniques or principles more often than to others. As an example, [4], identified that *tunneling technologies* can include unethical elements when they ask people to enter their personal information to successfully complete a software installation and give little choice to the user to exit the tunnel without causing any damage. Also *tailoring technologies* might be used unethically because studies have shown that only perception that the information has been tailored is more influential than regular information. This can be explained by the fact that people pay extra attention to the information because they think that it has been tailored for them. Provision of supposed tailored information may lead to situations where users blindly believe that the provided information is beneficial for them, whereas, in fact, it benefits the web service provider [4]. Ethical questions vary not only depending on the persuasion principle but also depending on the information processing approach. According to [34], there are more ethical concerns related to peripheral information processing as well as use of cognitive shorthand, because then people act mindlessly and are unable or unmotivated to think critically. When people act mindfully and engage in central processing, they have the motivation to think critically. Thus, there are less ethical concerns related to designs that support central processing.

Pro-Health Mobile Technologies

Mobile technologies that are aimed at motivating users to become more mindful of their health behaviors and activities are sometimes called mhealth or ehealth technologies [35]. They are designed to promote or support users to adopt attitudes and behaviors that are appropriate to their overall health and wellbeing. With the aid of this kind of technology, users would be able to perform their target behaviors without compulsion or force. Various kinds of mobile applications have been designed for a variety of purposes, to encourage users to change or improve their behaviors towards their own health. In this section, we report some of the health areas where mobile interventions have been applied.

i. **Mental Health**: Mobile applications have been designed to promote mental and other related health conditions. For instance, the Gwam-Okwu App was designed to support mental health patients to seek and receive expert attention from community health workers from the comfort of their homes [2]. This app will provide reminders and notifications to patients and allow them to access health resources for their needs. It also offers a text-to-speech feature which translates messages to the local patients in their native language. The application was designed to run on mobile devices and desktop PCs. The results from this study show that the prototypes were effective at supporting the mental health patients in making quick recovery. Other persuasive technologies for mental health were described in the following studies [36], [37], [38].

ii. **Sexual Health:** Aside from mental health, [39] design an persuasive game that enlightens and teaches people about sexually risky behaviors. It was built to persuade players to become more conscious of their own sexual activities and play safe using various cautionary measures. The system was built to run on both smartphones and Tablet PCs to investigate which platform the users preferred. Findings from this study revealed that users found it a supportive tool to use to learn about the dangers of illicit sexual relations.

iii. **Healthy Eating:** Here, [9], developed an app which could assist in tracking and encouraging users to embrace healthy eating habits. It also visualizes activities leading to poor eating habits and consequences to the health and wellness of the individual. There were attempts to develop games to promote healthy eating behaviors [9].

iv. **Maternal Health:** While [40], investigated the impact of smartphone-assisted prenatal home visits on women's use of facility delivery in Africa, [41] developed an intervention to support antenatal care in developing countries through mobile diagnostic systems. This intervention was designed to assist in mobile analysis of expectant mothers to understand their health condition. In addition, other studies have gone ahead to propose

and actually design interventions to support maternal healthcare related activities. For instance, [42], discussed their study; co-designing with mothers and neonatal unit staff. This intervention is aimed at supporting mothers of preterm infants in their journey.

The findings from our literature reviews of the above pro-health persuasive mobile technologies show certain guiding principles which must be put into consideration in designing mobile persuasive technology to encourage health and wellness. They include the use of Self-Comparison, use of Triggering Messages – to push the user in a proposed direction, Mobile Platform, Understandable Messages – using smileys and combine positive & negative reinforcement-messages, tailored information and community information – used for comparison, expert's advice – used for comparison, behavior change over time. These pro-health mobile applications could build into a user, the sense of responsibility and motivate an expectant mother to change her behaviors towards her health and that of her unborn baby.

Mobile Web App as Persuasive Technology

In recent years, the demand for mobile phones (smartphones) has seen an unprecedented increase both in production and sales. With embedded sophisticated technology, smartphones have become ubiquitous, versatile, and readily accessible almost anywhere. The adaptability of the smartphones is attained through third-party softwares that run on smartphones (commonly known as mobile apps) [43]. Therefore, smartphone apps are employed to do diverse activities like checking email, social networking, managing finances etc., outside making/receiving calls. According to research, there are an estimated 404126, 274555, 30784, 19796 mobile apps offered in Apple, Android, Blackberry and Windows platforms respectively [44]. In his contribution, [4] forecasted that mobile phones would become the dominant platform for persuasion. He maintained that mobile platforms could encourage individuals to accomplish their own personal goals. He was of the view that mobile technology can layer information into our everyday lives in a way that changes our behavior [4]. These submissions inspired the researcher to believe that mobile apps as a persuasive technology tool can be used to improve the welfare and wellbeing of our communities. It can be engaged to influence the public to modify their behavior to waste management and promote the clean and sustainable environment. According to [44], mobile phones are pervasive and commonly used as a vital part of our daily life, regardless of whether we are at home, work, play or travel. They possess the capability to gather and report current and localized information that is pertinent to us and our goals, in this circumstance. As [4] says, "Information provided by computer technology will more likely be persuasive if it is customized to the individual's interests, needs, personality, usage context or other associated factors applicable to the individual". Besides, the advancement in mobile and internet technologies and its increasing penetration in many developing nations have created opportunities for designers to develop and deploy interventions that could support users to achieve intended behaviors [7]; [2]. Therefore, there are great advantages in studying how mobile apps and technologies may be used to motivate attitudinal and behavioral changes in the manner people manage their wastes in the communities.

CONCLUSION

This study aims to identify the elements that influence maternal health and fitness information-seeking behavior in persuasive design strategies. By exploring the personal, psychological, social, technological, and design factors that impact information-seeking behavior, this research will inform the development of targeted interventions that promote informed decision-making and healthy behaviors among pregnant women and new mothers.

REFERENCES

1. Suruliraj, B., Nkwo, M., & Orji, R. (2020). *Persuasive Mobile Apps for Sustainable Waste Management: A Systematic Review* (Vol. 1). Springer International Publishing. https://doi.org/10.1007/978-3-030-45712-9.
2. Nkwo, M., Suruliraj, B., Orji, R., & Ugah, J. (2020). Socially-oriented Persuasive Strategies and Sustainable Behavior Change : Implications for Designing for Environmental Sustainability. *Persuasive 2020, Adjunct Proceedings of the 15th International Conference on Persuasive Technology.*, 1–5.
3. Khaled, R. (2008). *Culurally-relevant Persuasive Technology.* A thesis submitted to the Victoria University of Wellington.
4. Fogg, B. (2002). Persuasive Technology: Using Computers to Change What We Think and Do. In M. Kaufmann (Ed.), *Persuasive Technology: Using Computers to Change What We Think and Do.* Morgan Kaufmann, Los Altos. https://doi.org/10.1145/763955.763957
5. Sillence, E., Briggs, P., Fishwick, L., & Harris, P. (2004). Trust and mistrust of online health sites. *In CHI '04: Proceedings of the 2004 Conference on Human Factors in Computing Systems*, 663–670.
6. Sillence, E., Briggs, P., Fishwick, L., & Harris, P. (2004). Trust and mistrust of online health sites. *In CHI '04: Proceedings of the 2004 Conference on Human Factors in Computing Systems*, 663–670.

7. Nkwo, M., & Orji, R. (2018a). Persuasion in eCommerce. *In Proceedings of 2nd African Computer Human Interaction Conference (AfriCHI'18), Windhoek, Namibia, 4 Pages.* https://doi.org/https://doi.org/10.1145/3283458.3283516

8. Gustafsson, A. (2010). *Positive Persuasion Designing enjoyable energy feedback experiences in the home .* [University of Gothenburg]. www.ait.gu.se

9. Nkwo, M., Suruliraj, B., & Orji, R. (2020). Public Perception of Mental Illness: Opportunity for Community-based Collaborative Intervention. *In the Proceedings of CHI' 2020*, 1–7.

10. Orji, R., Vassileva, J., & Mandryk, R. (2012). Towards an Effective Health Interventions Design: An Extension of the Health Belief Model. *Online Journal of Public Health Informatics, 4*(3). https://doi.org/10.5210/ojphi.v4i3.4321

11. Berkovsky, S., Coombe, M., Freyne, J., Bhandari, D., & Baghaei, N. (2010). Physical activity motivating games: virtual rewards for real activity. *Proceedings of the International Conference on Human Factors in Computing Systems, ACM*, 243–252.

12. Torning, K., Hall, C., & Oinas-kukkonen, H. (2009). Persuasive System Design: State of the Art and Future Directions. *Information Systems.*

13. Nkwo, M., Orji, R., & Ajah, I. (2021). A Health Belief Model Approach to Evaluating Maternal Health Behaviors among Africans-Design Implications for Personalized Persuasive Technologies. *Adjunct Proceedings of the 29th ACM Conference on User Modeling, Adaptation and Personalization*, 309–317.

14. Oinas-Kukkonen, H., & Harjumaa, M. (2009). Persuasive systems design: Key issues, process model, and system features. *Communications of the Association for Information Systems, 24*(1), 485–500. https://doi.org/10.17705/1cais.02428

15. WHO. (2015). *World Health Organisation recommendations for intrapartum care for a positive childbirth experience.* http://www.who.int/reproductivehealth/publications/intrapartum-care-guidelines/en/

16. Mbanusi, C., Nkwo, M., Orji, R., & Ejiofor, V. (2020). Personalized Persuasive Technology for Maternal Healthcare in Nigeria. *PPT at the 15th Persuasive Technology Conference (Persuaisve20)*, 1–10.

17. Entsieh, A. A., Emmelin, M., & Pettersson, K. O. (2015). Learning the ABCs of pregnancy and newborn care through mobile technology. *Global Health Action, 8*(1), 1–10.

18. Ogunba, B., & Abiodun, O. (2017). Knowledge and Attitude of Women and Its Influence on Antenatal Care Attendance in Southwestern Nigeria. *J Nutr Health Sci, 4*(2), 207.

19. Brynjarsd. (2012). Sustainably Unpersuaded: How persuasion narrows our vision of sustainability. *In the Proceedings of Conference on Human Factors in Computing Systems*, 947.

20. Nicholas, G. (2005). Max Weber as Social Theorist: 'Class, Status, Party.' *European Journal of Social Theory, 8*(2), 211–226.

21. Rosenstock, I. M. (1977). The Health Belief Model and Preventive Health Behavior. *Health Education & Behavior, 2*(4), 354–386. https://doi.org/10.1177/109019817400200040

22. Deshpande, S., Basil, M. D., & Basil, D. Z. (2009). Factors influencing healthy eating habits among college students: An application of the health belief model. *Health Marketing Quarterly, 26*(2), 145–164. https://doi.org/10.1080/07359680802619834.

23. Kabiru, C. W., Beguy, D., Crichton, J., & Zulu, E. M. (2011). HIV/AIDS among youth in urban informal (slum) settlements in Kenya: What are the correlates of and motivations for HIV testing?

24. Sukeri, S., Zahiruddin, W. M., Shafei, M. N., & Hamat, R. A. (2020). Perceived Severity and Susceptibility towards Leptospirosis Infection in Malaysia. *International Journal of Environmental Research and Public Health.* https://doi.org/doi:10.3390/ijerph17176362.

25. Nkwo, M., Orji, R., & Ugah, J. (2018). Persuasion for Promoting clean and sustainable environment. *ACM International Conference Proceeding Series*, 259–262. https://doi.org/10.1145/3283458.3283515.

26. Emmanuel, A. (2015). A Literature Review of the Factors That Influence Breastfeeding : *International of Nursing and Health Science, 2*(3), 28–36.

27. Fagbamigbe, A. F., & Idemudia, E. . (2017). Wealth and antenatal care utilization in Nigeria: Policy implications. *Health Care Women Int, 38*, 17–37.

28. Nkwo, M. (2019b). Mobile persuasive technology: Promoting positive waste management behaviors in developing African nations. *Conference on Human Factors in Computing Systems - Proceedings CHI'19 Extended Abstracts.* https://doi.org/10.1145/3290607.3299071

29. Froehlich, J., Dillahunt, T., & Klasnja, P. (2009). UbiGreen: investigating a mobile tool for tracking and supporting green transportation habits. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1043–1052.

30. Kabiru, C. W., Beguy, D., Crichton, J., & Zulu, E. M. (2011). HIV/AIDS among youth in urban informal (slum) settlements in Kenya: What are the correlates of and motivations for HIV testing?

31. Fernando Parada et al. (2019). Using Persuasive Systems Design Model to Evaluate" Cuidatu A´nimo": An Internet-Based Pilot Program for Prevention and Early Intervention of Adolescent Depression. *Published by Mary Ann Liebert, Inc.* https://doi.org/DOI: 10.1089/tmj.2018.0272

32. Grimes, A., Tan, D., & Morris, D. (2009). Toward technologies that support family reflections on health. *Proceedings of the {ACM} 2009 International Conference On Supporting Group Work, ACM,* 311–320.

33. Oinas-kukkonen, H., Karppinen, P., Oinas-kukkonen, H., Alahäivälä, T., & Jokelainen, T. (2018). Opportunities and Challenges of Behavior Change Support Systems for Enhancing Habit Formation : A Qualitative Study International Journal of Medical Informatics Persuasive user experiences of a health Behavior Change Support System : A 12-month study for . *International Journal of Medical Informatics, 96*(June), 51–61. https://doi.org/10.1016/j.ijmedinf.2016.02.005.

34. Suruliraj, B., Nkwo, M., & Orji, R. (2020). *Persuasive Mobile Apps for Sustainable Waste Management : A Systematic Review* (Vol. 1). Springer International Publishing. https://doi.org/10.1007/978-3-030-45712-9.

35. Iyawa, G. E., & Hamunyela, S. (2019). mHealth Apps and Services for Maternal Healthcare in Developing Countries. *IST-Africa 2019 Conference Proceedings Paul Cunningham and Miriam Cunningham (Eds) IIMC International Information Management Corporation..*

36. Alqahtani, F. H., Alkhalifah, G., Oyebode, O., & Orji, R. (2019). Apps for Mental Health: An Evaluation of Behavior Change Strategies and Recommendations for Future Development. *Front. Artif. Intell, 2,* 30. https://doi.org/10.3389/frai.2019.00030.

37. Bagroy, S., Kumaraguru, P., & Choudhury, M. De. (2017). A Social Media Based Index of Mental Well-Being in College Campuses. *In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17). ACM, New York, NY, USA,* 1634–1646. https://doi.org/https://doi.org/10.1145/3025453.3025909.

38. Gavin, D., Coyle, D., & Sharry, J. (2012). Engagement with online mental health interventions: an exploratory clinical study of a treatment for depression. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (2012),* 1421–1430. https://doi.org/https://doi.org/10.1145/2207676.2208602

39. Nkwo, M. (2019c, May 2). Mobile persuasive technology: Promoting positive waste management behaviors in developing African nations. *Conference on Human Factors in Computing Systems - Proceedings.* https://doi.org/10.1145/3290607.3299071

40. Hackett, K., Lafleur, C., Nyella, P., Ginsburg, O., Lou, W., & Sellen, D. (2018). Impact of smartphone-assisted prenatal home visits on women's use of facility delivery: Results from a cluster-randomized trial in rural Tanzania. *PloS One, 13*(6).

41. Mburu, C. W., & Densmore, M. (2018). Co-designing with Mothers and Neonatal Unit Staff : Use of Technology to Support Mothers of Preterm Infants. *AfriCHI'18.*

42. Ezemenaka, E. (2013). The usage and impact of Internet enabled phones on academic concentration among students of tertiary institutions: A study at the University of Ibadan, Nigeria *International Journal of Education and Development Using Information and Communication Technology (IJEDICT), Vol. 9*(Issue 3), 162–173.

43. Froehlich, J., Findlater, L., & Landay, J. (2010). The design of eco-feedback technology. *In Proc. CHI 2010, ACM,* 1999–2008.*BMC Public Health, 11,* 1–12. https://doi.org/10.1186/1471-2458-11-685.

44. Walton, L. M., Brown, D., & Schbley, B. (2012). Cultural Barriers to Maternal Health Care in Rural Bangladesh. *SSRN Electronic Journal, February 2018.* https://doi.org/10.2139/ssrn.2042694