Designing Persuasion: Health Technology for Low-Income African American Communities

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Abstract. In the United States, African Americans face a disproportionate amount of diet-related health problems. For example, African American adults are 1.6 times more likely to have diabetes than their Caucasian counterparts. Individuals in low-income communities may face a greater risk because they typically have less access to healthy foods. Due to the significant diet-related problems within the African American community, public health researchers call for approaches to health promotion that take into account the relationship between culture and dietary habits. In this paper, we discuss three important considerations for the design of technologies that address the diet-related health disparities in low-income African American communities. These considerations include designing for cultural relevancy, modeling health behavior, and encouraging healthy behavior through the use of social psychological theories of persuasion. We use a game design example to illustrate how each of these considerations can be incorporated into the development of new technology.

Keywords: Culture, Health, Low-Income, Nutrition, Persuasive Technology.

1 Introduction

The United States faces a serious crisis as rates of diet-related diseases such as obesity continue to rise. Today 65% of people 20 and older are either overweight or obese [8]. This statistic reflects an increase of over 75% in obesity prevalence since 1991. While these statistics are sobering, the issue becomes even more alarming when looking at the disproportionate amount of diet-related health problems in minority groups such as the African American community. In 2002 the heart disease related mortality rate for African Americans was 30% higher than that of Caucasians [16]. In addition, African American adults are 1.6 times more likely to have diabetes than their Caucasian counterparts [16]. While these statistics reflect an aggregate of income levels, low-income African Americans may be even more at-risk than those with higher income levels. For example, low-income communities typically have less access to healthy foods and may be more accepting of overweight [13, 18]. Because of the disproportionate amount of diet-related diseases that exist within the African American community, public health researchers advocate the development of programs and services that take into account the ways that dietary habits are tied to aspects of culture [1, 3]. These *culturally relevant* interventions should account for the beliefs, norms, behaviors and challenges that exist within a particular cultural

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group [23]. Accounting for these cultural factors can help researchers address health issues in a way that is sensitive to the existing values and practices of a community.

While many culturally targeted approaches to health issues have resulted in programmatic efforts (*e.g.* church-based educational campaigns), few have leveraged the possibilities that technology may afford. Yet, given the nature of the challenge—to promote better dietary patterns—the use of persuasive technology is a promising approach. Technologies designed to persuade individuals to live healthier lifestyles can take the form of tools (*e.g.* by monitoring blood sugar levels), media (*e.g.* by simulating the effects of smoking), or social actors (*e.g.* by rewarding positive behaviors) [7]. Furthermore, there is a growing body of research in the field of Human-Computer Interaction (HCI) to address health, such as work being done on physical fitness [5]. Still, even given this research, few projects have accounted for the relationship between culture and health in technology design. To design a technology that is effective at encouraging a specific cultural group to develop healthy dietary habits, we argue that there are three critical questions to consider:

1. What aspects of culture should be considered in the design?
2. How can theories of health behavior be incorporated into the design?
3. How can social psychological theories of persuasion be used to design technology that encourages healthy behavior?

While each of these considerations by themselves is not novel, the explicit use of the three together in an effort to create persuasive health technology is rarely done. We argue that each of these considerations represents a critical aspect of designing technologies to promote health in specific cultural contexts. In this paper we provide justification for this argument through a discussion of literature from the domains of public health, health behavior theory, and social psychological persuasion theory. We focus our discussion on low-income African American communities, a segment of the population that faces a disproportionate amount of diet-related disease. In addition, we illustrate how each of the three considerations that we propose can be reflected in technology design by describing a hypothetical game in which the goal is to promote healthy dietary habits among low-income African Americans.

To begin, we first provide an overview of the mechanics of the hypothetical game. Following this overview, we describe the public health literature that advocates designing culturally relevant health interventions. Next, we discuss health behavior theory and its importance for designing technology that reflects an understanding of individuals' dietary habits and beliefs. Finally, we describe persuasion theory and how it can be leveraged to design technologies that encourage individuals to develop healthy dietary habits.

2 An Illustration: OrderUP!

Games are becoming a popular way of persuading individuals to engage in healthy behavior (*e.g.* see [7]). They provide an entertaining medium through which issues such as health can be addressed. Because games are a promising way of addressing health issues, we use a hypothetical game to illustrate the three design considerations that we propose in this paper.

Imagine a game, which we will call OrderUP!, in which the user plays the role of a restaurant owner. To begin with, he or she chooses what to include on the restaurant's menu from an assortment of items representing varying degrees of healthfulness (*e.g.* steamed vegetables, apple pie). After the player makes his or her selections, the main portion of game play begins and customers start entering the restaurant. Each customer asks the player for a recommendation of what to order. The player must decide what to serve the customer, taking into consideration any health conditions that he or she may have (some customers will have conditions such as diabetes). In easier levels of the game, the players are provided with hints that will help them understand how to make healthy selections. The game includes a fixed set of customers that come into the restaurant and the goal of the game is to serve the customers a balanced set of foods, allowing them to maintain a high health level. Players receive points for serving customers quickly and keeping their health levels high. Players lose points when their service is slow and when they serve too many unhealthy foods. Players win the game by reaching a certain point level within the specified time limit.

We will refer back to OrderUP! throughout the paper. We now turn to a discussion of the first of the three considerations that we argue are critical in designing persuasive health technology for low-income African American communities.

3 Designing for Cultural Relevancy

3.1 Nutrition in African American Communities

As noted previously, African Americans are a segment of the population that experiences a disproportionate amount of diet-related diseases, motivating numerous researchers to call for culturally relevant interventions [1, 3]. Our operational definition of cultural relevancy is adapted slightly from that of Williams, *et al.* [23]: we argue that cultural relevancy may be achieved when interventions designed for a specific group reflect an understanding of the group's particular needs, beliefs, norms, and behaviors. This is not to say that any intervention that sets out to incorporate these cultural dimensions will automatically be successful. Rather, we argue that an understanding of these dimensions will increase the likelihood that the intervention is culturally meaningful to the target population. In the context of designing persuasive health interventions, this point is critical because programs and technologies that do not take into account the cultural aspects of health may be unsuccessful in persuading individuals to develop positive habits [23].

Airhihenbuwa *et al.* [1] suggest that foods, their flavors, and the way that they are prepared may be utilized to maintain group identity or preserve traditions. Because of this relationship between food and culture, they conclude that it is important to design health interventions that are culturally relevant and sensitive to existing practices. The authors conducted focus groups to examine the cultural aspects of eating among African American residents of Pennsylvania. Their study participants felt that the African American community has some culturally distinct eating traditions, and older participants expressed a preference for eating at home because in the past they had experienced discrimination in restaurants. This study provides examples of eating habits being affected by culture and identifies aspects of culture that should be accounted for in health interventions.

Kreuter & Hughton [12] identified four dimensions of culture which they argue are related to health behaviors: religiosity (*e.g.* prayer), collectivism (emphasis is placed on the group rather than the individual), racial pride (*e.g.* participating in traditional practices), and time orientation (tendency to respond to consequences that are immediate or further in the future). The authors used these dimensions to tailor a cancer prevention program for African American women. In their previous work, the authors found these dimensions to be measurable, correlated with health related behaviors and common amongst urban African Americans [11]. Their work has also shown the importance of using theories of health behavior in conjunction with cultural tailoring to design effective interventions [12].

Stolley & Fitzgibbon [21] also developed a culturally tailored program; theirs was aimed at obesity prevention among low-income African American mothers and their daughters. The researchers made their program culturally relevant in a number of ways, for example, by addressing the common food preparation methods of their participants and the accessibility of healthy foods in the community. Stolley & Fitzgibbon tested the effectiveness of their program using an experimental study. After going through the program, the treatment group consumed significantly less saturated fat and calories from fat than participants in the control group.

For the purposes of designing culturally relevant health technologies for low-income African Americans, the studies described here illuminate three important aspects of culture. First, they illustrate the importance of *identifying common health attitudes and behaviors within the culture*. For example, Stolley & Fitzgibbon [21] studied common food preferences and preparation practices and designed their obesity prevention program to reflect an understanding of these attitudes and behaviors. While we discuss modeling individual health behavior in more detail later in this paper, here we would like to highlight the importance of examining the shared attitudes and behaviors that exist within the culture. For technology designers, understanding culturally perpetuated health behaviors may allow the designed application to be made relevant for a range of individuals within a culture.

Stolley & Fitzgibbon [21] also show the importance of creating interventions that are reflective of the *environmental effects on healthy eating*. For example, these researchers took into account the limited availability of healthy foods in their target neighborhoods While Stolley & Fitzgibbon focused on the effects of the physical environment on health, the social world is another important aspect of environmental effects on health. The importance of the social environment is exemplified in the cultural dimensions that Kreuter & Hughton [12] use to design health interventions, particularly the notion of collectivism. For technology designers, the lesson to be learned here is that to create technology that is effective at helping users practice healthy eating habits, it is critical to take into account the context in which they have to make their health decisions. This requires a thorough examination of how the physical and social environment affects the target community's ability and motivation to engage in healthy behaviors.

In their obesity prevention program for low-income African Americans, Stolley & Fitzgibbon [21] taught their participants how to engage in healthier behaviors while accounting for their existing physical and social environment (*e.g.* how to make healthy choices at local food markets). Thus, the authors provided *culturally relevant behavioral modification suggestions* and in so doing contributed to the improved

health of their participants. For technology designers, this point implies that care must be taken to incorporate culturally relevant behavioral modification suggestions in applications that are targeted toward specific cultural groups.

The studies described here provide useful insight into designing culturally relevant health programs, but only a few studies of this type exist. That is, while many researchers have conducted formative work in which they conclude that designing culturally relevant health interventions is important, few have actually tested the effectiveness of such approaches [12]. Consequently, there are only a few studies that provide evidence for how such interventions should be implemented. Thus the design considerations that we propose in this paper can be seen as a contribution because not only do they add to the limited work on culturally relevant health interventions but they also represent an attempt to use technology to address health disparities.

3.2 OrderUP!: Designing Collectivism

Understanding how to design for cultural relevancy represents the first consideration that we argue should be made when creating persuasive health technology for low-income African American communities. In the preceding section we presented evidence that making health interventions culturally relevant is critical to influencing health behavior change. To explore how to design culturally relevant technology, we now refer back to the hypothetical game we introduced earlier in this paper. Recall that in OrderUP! the player assumes the role of a restaurant owner who is responsible for keeping customers healthy. This game can account for culture by using the concept of collectivism which, as noted above, has been shown to be a valued cultural construct within the African American community [12]. In collectivist cultures, the emphasis is placed on the group rather than the individual. Thus, individuals may feel particularly compelled to advocate for the health of their community members. For example, Kreuter *et al.* [12] find that in a collectivist culture, individuals often tend to the needs of family members before their own. Collectivism could be incorporated into OrderUP! by making each of the customers that enters the restaurant a type of person that the player is likely to interact with in their everyday lives (*e.g.* sisters, church members, etc.). By having each customer be identified by their relation to the player, they will not simply be generic aspects of the game but may instead invoke collectivist feelings within the player. That is, since the customers represent members of the player's family and community, players may feel a greater responsibility to make healthy recommendations. Furthermore, stimulating feelings of collectivism may help the players feel more culturally connected to the game and thus make them feel that what they learn through the game is relevant to their own lives.

This example of the inclusion of collectivism is just one way that technology can be designed to address health problems in a culturally meaningful way. To learn whether or not the stimulation of collectivist feelings in the game would translate to behavioral changes in real life, researchers could conduct a study where behaviors pre- and post-game play are compared. In the next section we discuss the second consideration that should be made when designing culturally relevant health technologies: how to model individual health behavior.

4 Modeling Health Behavior

Much of the formative research into designing new technology begins with studies of human life (*e.g.* behaviors and activities) that will affect how the new technology will be used, reacted to, or appropriated [20]. Indeed, though many technology researchers use methods such as ethnography to study human behavior, it is not always clear how to reflect the study results in the design of new technology [6]. Theories can help scaffold this process by providing ways to map results from empirical studies of human behavior to resulting system design requirements. For example, Nardi *et al.* [14] used activity theory (an approach which studies the mind "within the context of human interaction with the world" [10]) as a framework for studying social networks in the workplace and the implications that they have for technology design. In the domain of health technology, we argue that such theoretical scaffolding can come in the form of health behavior and persuasion theory. While we detail persuasion theory later in this paper, in this section we overview three health behavior theories: the Transtheoretical Model, Social Cognitive Theory and the Health Belief Model. Each of these theories is uniquely useful for developing health technologies for low-income African American communities. After this overview, we provide examples of how health behavior theories can be incorporated into aspects of the OrderUP! game.

4.1 Theories of Health Behavior

Redding, *et al.* [17] state that the Transtheoretical Model (TTM) conceptualizes the change of unhealthy behaviors as a process, not a discrete event. Furthermore, TTM describes the various "stages of change" that occur as people modify their health behaviors. The stages of change most commonly used by researchers include: *precontemplation* (no intention to change behavior), *contemplation* (thinking about changing), *preparation* (committed to modifying behavior soon), *action* (behavior has recently been changed), and *maintenance* (behavior has become a habit). In addition to these stages of change, TTM also describes "processes of change" which refer to the emotional, behavioral, cognitive, and interpersonal techniques that are used to change unhealthy behaviors by helping people progress through the stages of change. Examples of such processes include consciousness raising, that is, learning ways to engage in behavior change. TTM has been used successfully in a variety of empirical studies and within diverse populations, including low-income communities [3] .

Social Cognitive Theory (SCT) takes a holistic view of health behavior by accounting for individual, social and environmental factors [2]. Reciprocal determinism is the foundational principle of SCT and it describes the ongoing interaction that exists between the environment, the individual, and the individual's behavior. This principle resonates with the public health argument for culturally targeted interventions. As we discussed earlier, the physical and social environments represent important aspects of culture that should be taken into consideration when attempting to develop culturally targeted health programs and technologies.

The Health Belief Model (HBM) states that the likelihood that a person will take steps to prevent illness is dependent upon four perceptions: *perceived susceptibility* (their belief that they are vulnerable to the illness), *perceived severity* (the effects of the illness will be serious), *perceived effectiveness* (the preventative action will

effectively prevent the illness), and *perceived cost* (the benefits of reducing the risk of illness outweigh the cost of engaging in the preventative behavior) [17]. The HBM may be an especially useful model for low-income communities because it explicitly addresses the notion of the perceived cost of eating healthy foods. This is a concern that may arise for any individual, but in particular a person with limited financial resources may view it as an insurmountable barrier.

4.2 OrderUP!: Accounting for Health Behavior Theory in Design

Modeling health behavior is the second consideration that we propose for designing culturally relevant health technology. As noted previously, the TTM has been used successfully in health programs designed for low-income populations and this demonstrated effectiveness makes it a promising theory to use in the design of technologies for low-income African American communities. One way that the TTM can be used in technology design is in identifying the target user groups and the subsequent processes of change that need to be supported. For example, OrderUP! could target individuals who are currently in the precontemplative stage identified by TTM. By restricting the target user group to individuals in this stage, the designers of the game would also be able to identify the processes of change that could help users move from the precontemplative to contemplative stage.

The TTM states that for individuals in the precontemplative stage to progress to later stages of change, an important processes of change is consciousness raising (*i.e.,* learning how to engage in healthy behaviors). The designers of OrderUP! could target this process through the use of informative tips throughout the game. For example, recall that at the beginning of the game, players decide what to include on their restaurant's menu. The healthier the food options on their menu, the better the player's chances are to score points. The game designers could give players suggestions for choosing healthy items for their menu which would serve the dual purpose of teaching them how to gain points in the game and also how to make healthy dietary choices in their everyday lives.

In addition to TTM, the Health Behavior Model (HBM) and Social Cognitive Theory (SCT) could be incorporated into health technologies. For example, in OrderUP! players decide what foods will be served at their restaurant, thereby creating the environment for the game characters. This environment has an effect on customer health – the more healthy foods there are to choose from (*environmental influence*), the greater the likelihood that players will serve healthy foods (*behavioral response)*, and consequently customers will be more likely to stay healthy. This game design reflects the SCT focus on the relationship between the environment and behavior (reciprocal determinism, described above), thus giving players a vivid picture of how environments can support or inhibit healthy behaviors.

If a player continually serves customers unhealthy foods, the customers' health levels will decrease. Therefore, the HBM concept of perceived severity is targeted because players will see that the behavior of eating poorly has negative consequences (as manifested by the decrease of the customers' health levels). In addition, game designers can target the extent to which a player believes that engaging in healthy behavior is effective (what HBM calls "perceived effectiveness") because the player

has the chance to see that they can improve the health levels of the customers by making simple changes to the foods served.

5 Encouraging Healthy Behavior

We have discussed different ways of modeling health behavior, which is an important part of understanding how to motivate people to change problem behaviors. Another component is the process of persuasion. Chaiken *et al.* [4] define persuasion as the study of "the variables and processes that govern the formation and change of attitudes". In the following sections we overview three areas of social psychological persuasion research which have implications for the design of health technologies within low-income African American communities: attitudinal advocacy, message-based persuasion and issue framing.

5.1 Methods of Persuasion

Attitudinal Advocacy. Research on attitudinal advocacy looks at how individuals' attitudes change as a result of engaging in a behavior [4]. For example, when someone voices support for a position, even if he or she does not initially agree with that position, the person may come to believe it simply as a result of vocally supporting it. This phenomenon was initially examined in research on role-playing. In this type of research, subjects are presented with a position on an issue and are then asked to advocate support for that position [4]. For example, Janis and King [9] conducted an experiment in which subjects both advocated an opinion on an issue and watched someone else advocate a position on two different issues. Their results showed that when subjects advocated an opinion themselves (through role playing), they were persuaded more than when they listened to others support positions.

Persuasion Through Messages. In addition to attitudinal advocacy, persuasion research has examined how an individual's attitudes can be affected by verbal messages presented by others. According to Chaiken *et al.* [4], up to the 1980s, most research in this area focused on how individuals engage in systematic, controlled processing of the persuasive elements of a message. Since the 1980s however, dual-process theories of persuasion have gained increasing popularity. Such theories account for systematic as well as more automatic cognitive processing. For example, the Elaboration Likelihood Model describes the central and peripheral routes to persuasion where the central route consists of thinking about the content of the message and the peripheral route is an automatic approach to information processing [15]. This model posits that attitudes changed via the central route are more persistent and predictive of behavior than those changed via the peripheral route. This is because the central route allows for cognitive elaboration, the process in which an individual evaluates and reacts to a message's arguments.

Issue Framing. In addition to message-based persuasion, issue framing is a related strategy in which certain aspects of an issue are emphasized more than other aspects [24]. Typically, message-based persuasion takes an *intraattitudinal* approach by describing the attributes of a single attitude object. Contrastingly, issue-framed

approaches are *interattitudinal* in nature because they describe aspects of an attitude object (*e.g.* consequences) in the context of another attitude object. Prospect theory argues that the way a message is framed affects how people respond to the issue at hand [22]. Gain-framed messages emphasize the potential benefits of an issue, or behavior whereas loss-framed messages highlight the potential cost of not engaging in the behavior. In terms of health communication strategies, this theory provides a framework for understanding how to effectively structure messages and influence behavior change [19]. Rothman & Salovey [19] found that loss-framed messages are more effective at promoting disease detection behaviors (*e.g.* monthly breast exams to detect cancer) and gain-framed messages are more effective at promoting preventative behaviors (*e.g.* eating a high fiber diet to raise good cholesterol levels).

5.2 OrderUP!: Implications for Persuasive Design

Using persuasion theory to encourage healthy behavior is the final consideration that we argue is important for designing culturally relevant technology for health promotion. We have highlighted three methods of persuading: attitudinal advocacy, message-based persuasion and issue framing. While this is not an exhaustive list of approaches, each of these methods can be leveraged to create technologies in which the goal is to persuade individuals to engage in healthy dietary habits. The domain of persuasive technology research provides promising case studies of technologies being used to persuade individuals to engage in healthy behavior. For example, Fogg [7] describes Nintendo's Pocket Pikachu toy as a technology that persuades individuals to walk more. However, we argue here not only for the design of technologies that persuade, but technologies that persuade in a culturally meaningful way.

While changing individuals' attitudes does not guarantee a change in behavior, it is an important step towards behavior change. As noted above, research on attitudinal advocacy has found that role-playing is an effective way of helping people change their attitudes [9]. In OrderUP!, the basic premise of the game leverages the concept of attitudinal advocacy by allowing individuals to play the role of restaurant owner. In order to win the game, this role requires users to advocate healthy choices to their customers. Through this advocacy players may come to believe that the suggestions they make are legitimate ones that should be integrated in their own lives. Furthermore, this type of advocacy also draws upon the concept of collectivism (because game players are responsible for the health of other community members), which has been shown to be an important dimension of African American culture.

Designers of the game could also incorporate research on persuasive message framing into the development of the game hints. For example, designers could experiment with using gain versus loss-framed messages to create hints that provide players with suggestions for serving their customers healthy foods. The Elaboration Likelihood Model (ELM) could also be utilized in the game design. Recall that the ELM states that attitude change that occurs through the central route to persuasion is more likely to be persistent. To this end, in OrderUP! a screen could be displayed at the end of each round that allows players to reflect on the decisions they made during the game. This pause in game play would allow players to engage in more controlled processing which may not occur while they are serving customers (due to how quickly they have to serve customers).

6 Discussion

Researchers are becoming increasingly interested in the use of technology to persuade individuals to change their attitudes and behaviors [5]. B.J. Fogg [7] coined the term captology to describe the study of computers as persuasive technology and he states that captology addresses the "design, research, and analysis of interactive computing products created for the purpose of changing people's attitudes or behaviors". Though Fogg lays out a conceptual foundation for designing persuasive technology, the field is quite new and thus much of the development of persuasive technologies has been done with an implicit rather than explicit use of theories of persuasion. In addition, Fogg's framework is broad, encompassing persuasive technologies in a range of domains, from environmental conservation to education [7]. Thus, the ideas that we have presented in this paper contribute to the emerging field of persuasive technology by identifying three important considerations for the design of technologies to promote healthy dietary habits in low-income African American communities.

There is much left to be done in the area of persuasive health technology both from the public health and Human-Computer Interaction (HCI) perspectives. Both fields have a lot to offer one another: within public health there exist a number of theories of health behavior and strategies for health communication that can help HCI researchers design more theoretically sound applications. Conversely, HCI research can help public health researchers leverage, in a user-centered way, the vast range of technological possibilities that exist. The sharing of ideas, theories, and empirical data between the fields of public health and HCI may be stimulated as more research on health technology begins to take account the relationship between culture and health and the implications this has for the design of new applications.

7 Conclusion

In this paper we described three important considerations for creating technology to address nutrition within low-income African-American communities: designing for cultural relevancy, modeling health behavior, and encouraging healthy behaviors through persuasion. While we do not argue that these are the only considerations that should be made, we do suggest that they are fundamental areas of research that should be incorporated into the design of technologies for health promotion. While some of the points we have made here could apply to the design of health technologies for other communities, our goal was not to present an exhaustive framework, but rather to address the concerns of one specific population that experiences a disproportionate amount of diet-related disease. Furthermore, because eating is a culturally situated activity it is important to consider individual cultural groups when designing technologies to promote healthy dietary habits.

Our goal in this paper has not been to promote gross generalizations about the eating habits of a specific culture, but rather to advocate for the focused study of the diet-related health disparities that exist within specific cultural groups. The public health community has advocated for such an approach for years because of the wide gap that exists between the health of the minority and majority populations in the United States. The point is not to ignore the rest of the American population, but

rather to add to the existing research on health more specialized studies of how to address health problems within specific cultural groups. Research into the relationship between culture and nutrition can serve as the foundation for the design of new technologies to promote healthy eating practices and this in turn may reduce the amount of diet-related health problems that exist within minority communities.

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