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Acceptability of an Embodied Conversational Agent-based Computer Application for Hispanic Women

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Abstract

There are few Spanish language interactive, technology-driven health education programs. Objectives of this feasibility study were to: 1) learn more about computer and technology usage among Hispanic women living in a rural community; and 2) evaluate acceptability of the concept

of using an embodied conversational agent (ECA) computer application among this population. A survey about computer usage history and interest in computers was administered to a convenience sample of 26 women. A sample video prototype of a hospital discharge ECA was administered followed by questions to gauge opinion about the ECA. Data indicate women exhibited both a high level of computer experience and enthusiasm for the ECA. Feedback from community is essential to ensure equity in state of the art dissemination of health information.

Hay algunos programas interactivos en español que usan la tecnología para educar sobre la salud. Los objetivos de este estudio fueron: 1) aprender más sobre el uso de computadoras y tecnología entre mujeres Hispanas que viven en comunidades rurales y 2) evaluar la aceptabilidad del concepto de usar un programa de computadora utilizando un agente de conversación encarnado (ECA) en esta población. Se administro una encuesta sobre el historial de uso y del interés de aprender sobre computadoras fue a 26 mujeres por muestreo de conveniencia. Un ejemplo del prototipo ECA en forma de video de un alta hospitalaria fue administrado y fue seguido por preguntas sobre la opinión que tenían del ECA. Los datos indican que las mujeres mostraron un alto nivel de experiencia con las computadoras y un alto nivel de entusiasmo sobre el ECA. La retroalimentación de la comunidad es esencial para asegurar equidad en la diseminación de información sobre la salud con tecnología de punta.

Keywords

Hispanic Americans; health education; health promotion; primary health care; technology; health communication; Embodied conversational agent; health disparities; Hispanic; women’s health; health information technology

Population health is influenced by both the social and economic circumstances as well as the available healthcare services. Approximately 17% of the United States population is Hispanic, with about 9.6 million people speaking only Spanish (Krogstad, 2014). Upon immigrating to the United States, many Hispanics demonstrate better health outcomes when compared to non-immigrant populations, as reflected in lower death rates (Teruya & Bazardan-Hejazi, 2013). However, in general, both immigrant and non-immigrant Hispanics in the United States have lower levels of health insurance coverage, experience higher cost barriers to accessing health care, report worse self-rated general health, and underuse preventive health care services when compared to the general population (Center for Disease Control and Prevention, 2011; Liao et al., 2011; Livingston, Minushkin, & Cohn, 2008).

Communication and linguistic barriers contribute to the health disparities experienced by Hispanic populations (Timmins, 2002). Many hospitals and clinics provide interpretation services, but do not always present information that is culturally appropriate (Cheng, Chen, & Cunningham, 2007). Previous research indicates that many Hispanics prefer to receive health-related information through sources of media, such as the Internet, radio, television, and newspaper/magazines (De Jesus, 2013; Livingston et al., 2008; Pena-Purcell, 2008). Health education designed for Spanish speakers is often delivered using low-cost passive methods, such as videos or written materials, or it is provided in person by a physician, nurse, patient navigator, or other health care worker (Harvey & O’Brien, 2011; Livingston et al., 2008). Videos and written materials typically require few resources to deliver, whereas

delivery of health education by a health care worker can be time consuming (Aronson, Plass, & Bania, 2012; Kools, Ruiter, van de Wiel, & Kok, 2007; Livingston et al., 2008; Powell, Edelson, O'Leary, Christianson, & Henrich, 2011). In addition, recent research has suggested that health education through multimedia and interactive technology may assist Hispanics in improving health literacy (Aguirre, Wilhelm, & Joshi, 2012).

Interactive, technology-driven health education programs improve on passive receipt of health information by allowing users to interact with educational material. Virtual agents, also known as embodied conversational agents (ECAs), are computer characters that can simulate face-to-face conversation with the end user (Cassell et al., 1999). ECAs embody a person in appearance, behavior, and dialect. Research indicates patients with varying levels of health literacy find ECAs acceptable and simple to use for automated health communication to supplement information provided by a health care worker (Bickmore et al., 2010). ECAs are used to deliver health education for post-hospitalization care (Pfeifer & Bickmore, 2011), anesthesia (Ehrenfeld, Sandberg, Warren, Kwo, & Bickmore, 2010), exercise for older adults (Bickmore, Caruso, & Clough-Gorr, 2005; Bickmore et al., 2010), hospital discharge (Bickmore, Pfeifer, & Jack, 2009), and stress management (Jin, 2010). However, most patient-friendly ECAs in the United States are available only in English, potentially creating disparities in health knowledge by limiting the ability of Spanish speakers to access state-of-the-art health communication tools that complement information provided by health care providers. Only one known Spanish-language ECA (targeting physical activity) has been reported in the literature (Yin, Bickmore, Byron, & Cortes, 2010).

An ECA computer application might serve as a convenient method to engage patients in the process of health education, leading to more informed and empowered health care consumers, and potentially assisting health care providers in providing health education. However, it is important to consider whether the target population of end users would accept and trust this method of health education. In the present study, women receiving health care at Catholic Mobile Medical Services (CMMS), a faith-based primary care clinic, comprised the target population. Thus, the objectives of this feasibility study were: 1) to learn more about use of computers and technology among Hispanic women living in a rural community; and 2) to evaluate the acceptability of the concept of using an ECA computer application among Hispanic women in a rural community.

Method

Overview

The University of South Florida Institutional Review Board approved this descriptive, feasibility study. All research participants provided written informed consent prior to participating in the study.

Partnership and Setting

The Tampa Bay Community Cancer Network (TBCCN), a National Cancer Institute-funded partnership of 20 community and academic organizations has been working to improve

access to cancer care and cancer-related information for 9 years. The ultimate goal of the TBCCN is to reduce cancer health disparities among medically and historically underserved populations in Hillsborough, Pinellas, and Pasco counties in Florida. One of TBCCN's longstanding community partners is CMMS, a faith-based community primary care clinic located in a rural area of Hillsborough County, Florida (Wells et al., 2012). CMMS provides health care to a predominantly Hispanic population. Many of the CMMS patients and their families work in agricultural occupations, are migrant farmworkers, and prefer to receive their health information in Spanish.

Participants

Recruitment of participants took place from June 13, 2011, to July 11, 2011, in the waiting room of the CMMS primary care clinic. A bilingual research coordinator worked with clinic personnel to identify eligible women during evening clinics using convenience sampling. To be included in the study, participants were required to be: 1) female; 2) 18 years of age or older; 3) receiving health care at CMMS; 4) able to speak Spanish or English; and 5) able to provide informed consent. All participants, except for one, spoke only Spanish. The one exception was a participant who spoke both English and Spanish.

Baseline Survey Data Collection

Upon identifying a potentially eligible participant, the research coordinator described the study, screened the patient for inclusion, and obtained informed consent. The research coordinator then orally administered a baseline survey in Spanish consisting of 10 closed-ended questions about their prior experience with computers, main reasons for their computer usage, and willingness to use a computer to obtain health information if taught how to use it. The one participant who spoke both English and Spanish requested that the interview be presented in Spanish, so all interviews were conducted in Spanish.

Administration of the Embodied Conversational Agent Video

After each participant completed the baseline computer use survey, the research coordinator showed her a video example of an ECA computer program highlighting a nurse who provided health information. Since a Spanish-language ECA program was not readily available, an English language version of the ECA was shown to participants. The ECA depicted in the video was a nurse who provided information about hospital discharge planning (Bickmore, Pfeifer, & Jack, 2009; Bickmore, Pfeifer, & Paasche-Orlow, 2007). The 5.01 minute video was developed by the Relational Agents Group at Northeastern University and is publicly available (see the Virtual Discharge Nurse video: http://relationalagents.com/demos/index.html). The ECA program is divided into segments where the ECA spoke and then asked a question and an ECA program "user" was shown answering the question through the clicking of an "answer button" in the computer program. The research coordinator paused the video after the question was answered by the "user" in the video to orally translate the segment into Spanish for the participants. Only the one participant who spoke both English and Spanish could understand any of the English language dialogue in the ECA. The intent of administering the ECA computer program was to ascertain interest in the ECA format rather than to obtain feedback on the content of the ECA program.

Follow-up Survey Data Collection

After the participants had adequate time to view the ECA computer program video, the research coordinator asked them a series of six open-ended questions regarding the ECA and recorded their answers verbatim (in Spanish) on a standardized form. Questions gaged participants' overall reaction to the program (Overall, what is your reaction to it? What did you like or dislike about the program?); their thoughts about getting information about health from an ECA (What do you think about getting health information this way?); their interest in using an ECA (If a program like this was created to provide health information and we would help you use it, would you be interested in using it? Why or why not?); their trust of information provided by an ECA (Would you trust the information that came from a computer program like the one you just saw? Why or why not?; and their suggestions for creating an ECA to provide information about women's health (What suggestions would you have for making a new computer program about women's health?). In addition, participants were invited to provide their own comments regarding the experience of using the ECA.

Data Analysis

IBM SPSS 20 (IBM Corp., 2011) was used to descriptively summarize baseline survey data. The responses to open-ended questions were translated by the research coordinator into English for analysis by the research team. Using an inductive approach, authors independently reviewed and coded data collected from participants' responses to three of the open-ended questions on the follow-up surveys. Authors identified common themes in the answers, as indicated by multiple responses regarding that theme. The two authors compared their selected quotes for accuracy. Once the authors agreed on the final set of themes, a table summarizing the quotes was prepared for further analysis of the themes. Finally, quotes were organized under common themes. Multiple authors reviewed the final table to validate the categorization of the quotes for each theme.

Results

Baseline Survey

Twenty-six Hispanic women participated in the study, all of whom spoke Spanish. All 26 participants completed a baseline survey. Half of the women surveyed said they have used their cellular phones to access the Internet, check their email, or access social networking sites. The majority of women surveyed (n = 20, 77%) had a family member living in their home that used a computer. Half of the women had a computer in their home, whereas 38.5% had never used a computer before. Of the women who reported ever having used a computer (n = 16; 61.5%), half reported using a computer nine times or more during the last month. Among women with previous computer experience, seeking information was reported most often as the reason for use (n = 15; 93.8%), followed by accessing email (n = 10; 62.5%), for hobbies (n = 7; 43.8%), and for work-related use (n = 7; 43.8%). Other usage of a computer mentioned by the participants included social media access (n = 6), playing games (n = 4), paying bills (n = 2), and looking for employment (n = 1). The majority of the women who used a computer before (n = 15, 93.8%) reported feeling confident in their ability to use a computer to access or find out information. Half of the

women surveyed said they had used a computer to obtain health information (*n* = 13, 50%). Finally, all of the women surveyed (100%) reported an interest in utilizing a computer to obtain health information. Each participant reported she would be willing to use a computer, and use it to obtain health information if someone showed her how to use it for that purpose.

Follow-Up Survey

After watching a demonstration of the ECA program on a video, all 26 participants completed a follow-up interview immediately following the ECA demonstration. Almost all of women interviewed (*n* = 25; 96.1%) reported they would be interested in using this type of computer program to obtain health information if taught how to use it. In addition, all of the women reported they would trust health information provided through an ECA computer program.

A review of responses to the six open-ended questions by two of the study authors indicated that there were five broad content themes in the responses. The themes were related to: 1) the overall appearance (voice and visuals) of the ECA-delivered computer program, 2) the language in which it should be presented, 3) where and when people could have access to use it, 4) health topics of interest, and 5) concerns about the ECA-delivered computer program.

Appearance (voice and visuals)

Participants (*n* = 19) repeatedly commented in a positive way on the visuals and sound of the voice when describing the overall appearance of the ECA-delivered computer program. In general, they expressed that the sound of the voice seemed acceptable. Some common remarks were: “The voice is fine” and “The voice sounds fine.” There were two negative comments about the sound of the voice. An example of a negative comment is: “It doesn't sound like a person's voice. It sounds like a computer, not realistic.” With respect to the visual appearance of the ECA computer program, most participants provided positive feedback. For instance, one participant said: “It is good, the way it looks” and “The visuals are fine.” However, there were some negative comments (*n* = 4); for instance, one participant stated, “The character is a bit robotic. It could perhaps be a little better,” and another indicated, “The character looks strange and outdated, but the voice is very clear.”

Language

Participants made it clear that the computer program should be in their native language, Spanish. A total of seven participants commented on this matter. They expressed their views saying: “It must be in Spanish,” “It should be in Spanish,” and “The program should be in Spanish and appeal to the Hispanic community.”

Where and When People Could Use an ECA

Some participants (*n* = 8) suggested places where people could use the ECA-delivered computer program. Places like a health clinic (*n* = 5), a person’s home (*n* = 2), and the library (*n* = 1) were mentioned. There were also four comments regarding the best times to use an ECA; all four participants suggested that a good time to use an ECA-delivered computer program would be while patients were waiting for a clinic appointment.

Health Topics of Interest

Participants shared a variety of health topics that interested them for the development of a future ECA. Their most common responses included disease prevention and early detection (*n* = 11); breast health and breast cancer (*n* = 7); cervical cancer and human papillomavirus (*n* = 4); cervical cancer screening (*n* = 6); reproductive health, sexually transmitted infections, and family planning (*n* = 6); nutrition and diet (*n* = 7); and emergency preparedness (*n* = 2). With respect to her interest in using the ECA for the early detection of disease, one participant stated people "would like to learn how to check ourselves, be in tune with our bodies, and be alert to possible symptoms so that we can find things before it is too late." With respect to cervical cancer prevention, one woman said "You can use the program to talk to women about Pap tests by letting them know that it is nothing out of the ordinary, nothing to worry about." In addition to these topics, two women mentioned that an ECA could reduce stress related to a medical appointment. One participant mentioned that an ECA could "calm someone's nerves before they go in with the doctor."

Concerns

A small number of participants expressed concern about their limited knowledge of how to use a computer (*n* = 2) and their feelings of intimidation when confronted with having to use a computer (*n* = 2). For instance, one participant commented: "For me, it is difficult because I don't know how to use a computer. I would feel a bit timid." A second participant said "The computer intimidates many people."

Discussion

The purpose of this feasibility study was to learn more about use of computers and technology and to evaluate the acceptability of the concept of using an ECA program for health promotion among Hispanic women living in a rural community. The majority of our study participants had used a computer before and, among those who had used a computer before, most felt confident in their ability to use one in the future. Our results differ from previous research which found Hispanic women had less computer knowledge when compared to Caucasian and African American women (Askins et al., 2009). However, our research was conducted more recently, perhaps indicating the widespread use of computers in the United States. This idea is supported by the 2011 Pew Survey (Livingston, 2011) that found 55% of Hispanics reported having access to a computer and internet at home, whereas in a 2012 study, 81% of Hispanics had access to a computer in the home (Aguirre et al., 2012). This could suggest an upward trend of this minority population having access to computers in their home. The current study found that most women who participated in the study had used a computer before, and many used their cell phones for accessing the Internet. Among women who used a computer, obtaining information was one of the most frequent reasons for its use. All women surveyed indicated an interest in learning about health from a computer, even if they had no prior experience using a computer.

Harvey and O'Brien (2011) have suggested that Hispanics desire more options for health education than are currently available to them. This suggestion is consistent with our study's findings. Interactive multimedia technology strategies may ultimately be more effective than

traditional, non-interactive methods for delivering health education (Aguirre et al., 2012). There are currently very few high tech health communication interventions available in Spanish to supplement the education given by health care providers. This gap creates a language barrier for monolingual Hispanics who wish to use these health communication tools (Aguirre et al., 2012). Limited previous research has found support for electronic presentation of health care information in Spanish. Askins et al. (2009) found the use of technology to provide health education to mothers with children newly diagnosed with cancer was appealing to Spanish-speaking mothers. Results from this study showed several benefits of using a Personal Digital Assistant (PDA) to present Problem-Solving Skills Training (PSST), over traditional methods of presenting PSST. Use of the PDA was more desirable by participants, more cost effective, and allowed for minimal therapist assistance. The results of the present study combined with that of Askins et al. (2009) suggest that use of an interactive technology program may be preferred by Spanish speakers over other health communication interventions. In addition, the use of technology for delivering health education would allow for a greater number of people to be reached and helped faster and in a more standardized method (Askins et al., 2009).

An ECA may conveniently deliver comprehensive health information in response to users' preferences, leading to more informed health care consumers who are better able to understand and obtain health care recommended by health care providers. Bickmore and colleagues (2010) found that across different levels of health literacy, patients found ECAs to be acceptable and easy to use for automated health communication interventions. Previous research indicates an ECA program can improve health literacy by giving patients options for repetition that they may otherwise feel uncomfortable asking for in an in-person setting (Bickmore, Pfeifer, & Paasche-Orlow, 2009). Similar to our study, the most common negative feedback reported by participants regarding the ECA program includes the robotic voice, the language barrier, and the less personal communication approach (Timmins, 2002). Our study is the first known study to assess Hispanic women's interest and preferences in receiving health education using an ECA. Consequently, this study provides relevant information that will inform the development of a Spanish-language health communication intervention using an ECA. The findings from our study concur with previous recommendations for developing a successful ECA, which include the creation of excellent content; an intuitive user interface; a compelling presentation; and reliable, consistent, and useful functionality (Askins et al., 2009).

This small feasibility study has several limitations. One limitation present in the current study was the small sample size consisting solely of Hispanic women from a rural area in central Florida in the United States. It is possible that the findings may not generalize well to women from other areas or minority populations. Future research should include larger sample sizes assessing a range of contexts within this population. Another limitation of the study was that the ECA program video demonstration was only available in English. The translation may not have been as understandable to the participants as if it had been originally presented in Spanish and in a culturally relevant presentation of the information. However, it is clear from this lack of available Spanish language ECA programs, that ECA programs need to be developed in Spanish. In addition, participants were unable to interact with the program because they were presented with a video demonstrating an ECA program

rather than an actual ECA program. These study limitations could have affected the participants' ability to fully evaluate the ECA program.

In conclusion, there was a high degree of enthusiasm for Spanish language health education interventions delivered via computer technology to supplement and reinforce the health education provided by physicians, nurses, and other health care workers. In addition, there was a significant interest in this community for Spanish language ECA programs. Of particular interest were ECAs focused on prevention and early detection of disease, women's health, and reproductive health. The development of culturally and linguistically appropriate Spanish language ECAs through interaction with and feedback from the community is essential to ensure equity in the state of the art dissemination of health information. Future directions include the development of a Spanish language, culturally-tailored health education program providing interactive information regarding human papillomavirus and cervical cancer screening, and evaluation of the efficacy and cost-effectiveness of ECA health education programs.

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