

Community-Based Cultural Tailoring of Virtual Agents

Teresa K. O'Leary, Elizabeth Stowell, Everlyne Kimani, Dhaval Parmar, Stefan Olafsson, Jessica Hoffman, Andrea G. Parker, Michael K. Paasche-Orlow, Timothy Bickmore

{Oleary.t,Stowell.e,Kimani.e,d.parmar,Olafsson.s,j.hoffman}@northeastern.edu,
Andrea@cc.gatech.edu,mpo@bu.edu,t.bickmore@northeastern.edu

Northeastern University, Boston, MA

Georgia Institute of Technology, Atlanta, GA

Boston University School of Medicine & Boston Medical Center, Boston, MA

ABSTRACT

Culturally informed design for virtual agents has been shown to positively impact health outcomes when tailored to target audiences. We present a participatory design methodology for culturally tailoring virtual agents. Investigators worked with key informants from our target population, members of predominantly Black church communities, to design culturally-relevant and sensitive virtual agent health promotion interventions. In the first participatory session, key informants designed agents to assist them with different aspects of their lives, providing input on agent appearance and agent functionality. In a second design session, participants re-wrote the content of a health conversation with an agent, to include personally-relevant content related to their community (e.g., religious and scriptural references). We report design principles for religious tailoring derived from these studies. We conducted a validation study to assess the effects of applying these principles to agents that promoted two health behaviors, finding that participants responded very positively to the tailored agents.

CCS CONCEPTS

- Human-centered computing → Participatory design; User studies;
- Computing methodologies → Intelligent agents.

KEYWORDS

Embodied conversational agents, Participatory design, Cultural tailoring, Health promotion, User study, Faith-based communities

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1 INTRODUCTION

Many virtual agent applications are developed for very specific user populations that have unique beliefs, attitudes, language, and cultural practices. For these users, seemingly subtle mismatches between agent behavior and community norms can lead to lower satisfaction, engagement, and use, and in some cases complete rejection if agent behavior is deemed inappropriate or offensive. It can be very difficult for agent designers who are not already members of target communities to incorporate subtleties into their agents without exhaustive iterative prototyping and user testing.

While often difficult to achieve, cultural tailoring is important to maximize the impact of virtual agents. Cultural tailoring works by increasing user engagement with and processing of information that appears personally relevant [18]. Several studies have demonstrated that culturally-tailored virtual agents lead to better user attitudes and persuasion compared to non-tailored agents [18].

Participatory design methods, in which members of a target user group participate directly in system design decisions, represent a promising approach to the development of culturally-tailored virtual agents. Representative users can ensure, from the outset, that agent designs will be acceptable to and appropriate for members of their community by filtering out inappropriate designs at the earliest possible stage and guiding designers towards options that will be valued by the community. Although some research has been conducted on tools to support end user-authorable agents, a methodology that enables users to participate in all aspects of agent design—from role and appearance to language and dialogue structure—has yet to be developed.

Religious congregations are one example of a specialized population requiring many subtleties in design, thus representing a design challenge for virtual agents that are targeted for their use. There are roughly 4,200 religions in the world, and within each of these, a specific congregation that meets at a particular church, temple, or other gathering place has its own unique culture, norms, and practices. Religion plays a significant role in the lives of many people. Therefore, leveraging religious beliefs and practices may be important for many kinds of virtual agent applications and interventions involving congregants. Many studies have established the link between religious involvement and health behaviors, suggesting that religion may be particularly influential for health promotion [19].

In this work, we describe a novel participatory design methodology for developing culturally-appropriate virtual agent applications, and describe our experience using it to design a virtual agent-based health intervention targeted at members of a network of predominantly African-American churches in the Boston area.

Through a series of workshops with members of this community, our method elicited design decisions on agent role, functionality, appearance, dialogue, language, and use of community artifacts, directly from members of the church communities for which the agent is being designed. We first discuss related work, then the methodology and results from two workshops we held with participants to design a virtual agent-based health application. We then describe results from a validation study and ongoing development.

2 RELATED WORK

We briefly review related work in cultural tailoring of agents, and the use of virtual agents in health interventions, in addition to a brief review of Community Based Participatory Research.

2.1 Culturally Tailored Virtual Agents

Research has explored how the effects of a culturally tailored virtual agent impacts target user perceptions and attitudes. In several studies, researchers found that when the visual appearance (skin-tone) of an agent is incongruent with the user's self-identified ethnic background, the user's behavior towards the agent is impacted [22] and that interacting with an agent with a culturally compatible communication style (e.g., length of pauses and speech-overlapping) may be viewed as more realistic and likable [8, 9] [13]. Beyond user preference, work in social persuasion provides evidence for the relevance of designing an agent's appearance and communication style to match the user's ethnic background [20].

However, cultural tailoring cannot be superficial. In a systematic review of tailoring virtual agents, Baylor et al. suggest that, while users may benefit from agents that resemble themselves, this benefit may be mediated by contextual factors [1]. Thus, simply tailoring the visual appearance of the agent is likely to be an oversimplification as surface-level tailoring may not lead to sufficient positive affiliation. Instead, researchers should consider identifying additional salient cultural factors and features central to the target audience as well as to the situational context.

Incorporating cultural tailoring has been shown to be particularly effective when developing health promotion agents. Spence et al. tailored an African American agent with high levels of expressed ethnic identity compared to low levels of ethnic identity on a social media web page designed to deliver health messages to at risk users, finding that the agent with high ethnic identity positively impacted behavioral intent when users similarly expressed high ethnic identification [23].

Several researchers have demonstrated the efficacy of agents tailored to users' culture or ethnic background. Both King et al. and Yin et al. developed bilingual, culturally tailored, virtual agent systems to promote exercise in Latino populations [14, 28]. Results showed that tailoring the agent by ethnic background, language, and relevant references to local Latino community and values led to improved attitudes towards health behavior change.

2.2 Virtual Agents in Health Interventions

Virtual agents have been used in a variety of health interventions as virtual coaches or counselors, including: medication adherence counseling for patients living with chronic medical conditions [2, 3] such as atrial fibrillation [15]; exercise promotion

for older adults [4]; preconception care for medically underserved Black Americans [12] and health assessment for health decision support [7, 21]. Although these applications have been shown to have positive results with general populations, culturally tailoring a health system to reflect values of a specific population can have a greater impact on health outcomes [16].

2.3 Community-Based Participatory Design

Participatory research, also called community-based participatory research (CBPR), has two overarching goals: engaging people from marginalized communities, and recognizing the voice of those community members in the process of constructing knowledge [24]. Participatory research emphasizes "effective and meaningful collective action" [17]. Important principles include the belief that research should be directly beneficial to the community and community members are important actors throughout the entire research process from problem formulation to the interpretation of data with the goal of solving important social problems [10]. CBPR has been successfully applied to the design of technology-enabled health applications and has been effective in increasing engagement in diverse populations [27].

3 APPLICATION DOMAIN: CHURCH-BASED HEALTH PROMOTION

In this project we are developing virtual agents to promote a variety of health behaviors in a network of 30 predominantly Black churches in the Boston area with over 20,000 members. People who identify as African American in the US suffer a disproportionate burden from major chronic diseases, including heart disease, hypertension, diabetes, and cancer, as well as general life expectancy. Candidate health behaviors include physical activity, diet, and stress management. Health promotion counseling will be delivered by virtual agents on congregants' smartphones.

Within the network, several denominations are represented and, as we have learned, each church has its own unique history and culture, requiring us to take a design approach that is sensitive to the needs and norms of each church community.

4 OVERVIEW OF PARTICIPATORY DESIGN METHODOLOGY

Our overall design methodology was conducted in the context of a series of 22 focus group meetings with congregants from churches in the network. Virtual agent specification activities were conducted in three of these meetings. In the Agent Design Workshop (Section 5), participants first identified health problems they thought virtual agents could address in their community, and designed agent personas to perform these tasks. In the Dialogue Tailoring Workshop (Section 6), participants adapted an existing health promotion virtual agent for their own church community by revising its dialogue and language. Finally, in the Validation Study (Section 7), we conducted a qualitative evaluation on the impact of spiritual tailoring on participant satisfaction and attitudes towards a health counseling conversation. Each of these is described in detail in the following sections. All activities were approved by our institution's Institutional Review Board, and participants were compensated for their time.

We recruited the participants to engage in a two-year long participatory design process from two protestant churches that are members of our partner network. Participants were required to be 18 years or older, self-identified as a member of one of the two churches, English-speaking, and owned a smartphone. At the time they participated in agent design, they had already engaged in 4 workshops covering background information about their church culture and use of technology.

4.1 Participants

A total of 11 church members participated in the design and evaluation workshops. Participants were mostly (8/11) female, aged 27 to 73, and generally well-educated (1 had some high school education, 3 had some college, 4 had a BS/BA, and 3 had advanced degrees). Their health literacy was high, with all participants scoring 64 or above on the REALM health literacy test [6]. Participants had been members of their respective churches for an average of 9 years ($SD=8.4$, range: 2-27). Their involvement in church affiliated groups or ministries ranged from no involvement to serving multiple roles, including attendee, ministry leader, and trustee.

4.2 Common Qualitative Analysis Methodology

Focus groups and interviews were audio recorded and transcribed, resulting in a total of 6 hours and 51 minutes of audio files and 290 pages of transcription for the agent design activities. Using a grounded theory approach [25], we conducted a thematic analysis of focus group content that included transcripts and other participant generated materials from the focus groups. Using NVivo 12.5.0 software, two researchers inductively coded transcripts separately, labeling emergent phenomena in the data to arrive at a codebook. Two researchers then independently applied the codebook to focus group transcripts and participant generated materials. To reach inter-rater agreement, the researchers met regularly to discuss codes, reconcile discrepancies, and iteratively cluster codes to identify higher-level themes.

5 PARTICIPATORY AGENT DESIGN WORKSHOP

The aim of this session was to explore participant preferences for and expectations of the personas that agents can embody and the functions agents could perform for church members. We conducted 4 focus group workshops with 11 participants.

5.1 Method

Introduction to Virtual Agents. To start the session, participants interacted with two different existing virtual agents, one designed to assist people living with atrial fibrillation, and the second created to provide palliative care counseling to people with an advanced illness, including use of religious content for spiritual support. Both agents were introduced to participants to: 1) ground participant conception of embodied conversational agents, including how a virtual agent could look or behave when deployed on a smartphone, 2) demonstrate how religious content could be included in an mHealth

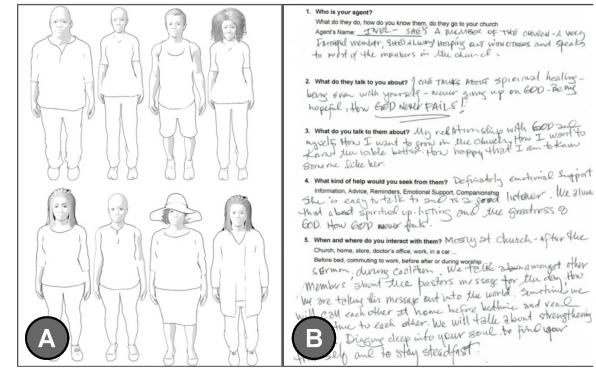


Figure 1: A) Blank Agent Templates. B) Completed Worksheet.

system, 3) and gauge participant reaction to a faith-based agent that is not tailored to them.

Design an Agent. Next, participants were instructed to design their own agent by being asked: "Think of a time in the past week or month that you needed help, design an agent who could have helped you. Give this agent a name and think about who they are." To ensure that the activity was accessible to participants with all design background and skills, we created 13 agent templates (8 female, 5 male) as a starting point for participant design. The templates were based on agents/people of color with a variety of body sizes, hair styles (including lack of hair), and clothing styles. The agent templates were printed out in black and white and had the appearance of unfinished drawings (Figure 1(A)) to encourage participants to make their own designs [11]. Participants were encouraged to customize the agent template using design materials provided by the facilitator. With each agent, participants completed a worksheet that prompted them for the agent's name, details about the types of support the agent could provide, and where and when they would interact with the agent (Figure 1). Participants were encouraged to create three different agents in the 60 minutes allocated to agent design. Participants then discussed differences and similarities in their designs, giving them an opportunity to endorse or challenge each other's agent designs. The workshop lasted 2.5 hours.

Creation of Agent Templates. We created the agent templates used as stimuli (Figure 1(A)) using Adobe Fuse character creator software to first generate 3D models of the agents, Adobe Mixamo for rigging, and Unity for rendering. For the characters to appear like a lo-fi coloring book sketch, we modified textures, and used toon outline shading and lighting.

5.2 Results

Reaction to existing virtual agents. Participant responses were focused on the palliative care agent that provided spiritual support. Participants suggested changes in the agent's appearance related to attire and to perceived ethnic-identity. Given the agent's faith-related functions, participants did not approve of the manner of dress. As P8 explained, "*She had on jeans. Well, you know, [it] wasn't that I didn't like them. It was just that she was a ... You know, for what she was doing, she was a bit casual.*" While the agent's clothing would have been acceptable in other contexts, such as a health



Figure 2: Created Agents.

coach, participants identified that casual clothing was incongruent with their preconception of someone they would turn to for guidance in their faith. Further, the caucasian demo agent was described by participants as a “*typical reverend at nursing home or hospital*.” One participant challenged the agent design and explained that for herself, she would prefer a Black agent. When asked why, she explained, “*I think it's the idea of trying to have a character that reflects your, whoever your audience is. That is going to allow them to identify with the character, 'cause what... I think people are more likely to listen to and get mess-, and receive messages from people that they identify with.*” This message of creating agents that are similar to themselves was echoed by several other participants.

Most of our participants indicated they attended church for most of their lives and engaged in Bible study. While they appreciated the attempt at incorporating spiritual discussions into the dialogue, the prayers and scriptures included were from a different version of the Bible than is used by their church communities. Further, the dialogue was too basic and uninteresting to be helpful. P7 explains, “*I don't know if they're taking [the religious knowledge] into consideration as to the type of user... it's like, the tempo. It sort of seemed kind of, talking down? As opposed to I'm here with you.*” Participants also indicated that the religious knowledge demonstrated by an agent should be tailored to their own level of religious knowledge and expertise. For example, when prompted by the agent to say another prayer, P3 anticipated the prayer that would be used, stating, “*That's why I said, no [to praying with the agent]. I know that's the default one [The Lord's Prayer]. So that's why I said, "No," okay?*” By accurately predicting the prayer the agent would suggest, the participant demonstrates how the agent loses credibility and functionality by presenting materials without taking into account the user's religious knowledge.

Participant created Agents. Participants designed 33 agents that could provide them with support in various aspects of their lives. Participants gave these agents detailed personas, and often designed them with multiple functions. Fourteen of the agents are based on family or friends of the participants, suggesting that in the creation of agents a strategy for grounding the exercise might be to ask about people in their lives who support them.

Agent Persona. There are a variety of personas that agents embodied in our findings (Table 1). Over half of the agents were described as Peers or Friends where participants imagined engaging in social chat, spiritual discussions and encouraging each other on their health goals. Three peer agents offered expertise and advice, sometimes on serious health concerns such as domestic violence and intimate partner violence. Church Leader agents embodied the persona of a pastor, minister, and long-time church member, all a source of information, resources, and advice. Church support staff included agents labeled as a special event coordinator, and a Bible

study coordinator. Health & Wellness Experts included various roles such as a yoga instructor and a nutrition coach.

Persona	N
Friends - Peers	17
Church Leaders	3
Church Support Staff	3
Health and Wellness Experts	3
Personal Assistants	5
Church Newcomer	1
Role Model	1

Table 1: Number of Agents by Persona

Agent Functions: Participants created agents to support them in various aspects of their lives, in many cases, assigning multiple functions to a single agent (e.g., encouragement, advice, nutrition support, check-ins, stress management). While the prompt for the types of support or functions the agent could provide to the user was broad, participants created a striking number of agents that engaged with them about faith-based challenges or incorporated the participant's faith into discussions about health and wellness (24/33). We refer to these agents who provide these functions as “Spiritual agents.” Agents supported participant spirituality through encouraging prayer, teaching about the Bible, discussing spiritual content to encourage participants to accomplish their goals, and even sending reminders for church events. P12 shares how he would interact with his agent, “*I talk to [her] about my relationship with God and how I want to grow in the church, and how I want to know the Bible better, how she could help me, and how happy I am to know someone like her.*”

Of the 33 agents, 13 (40%) focused only on the participants' spiritual development, and an additional 11 (33%) agents supported the participants' spiritual journey and also provided other support (Table 2). P4 describes her interactions with the agent, saying “It sort of goes from one thing to another [nutrition], but we always come back to that personal path and that journey. That spirituality.” She demonstrates how spirituality and faith are not limited to Sundays, but are interwoven throughout all aspects of her life. As a result P4 expects that her core beliefs would be included in the design as part of her interactions with the agent.

Fourteen agents were also designed to support participants' health and wellness goals (42%) through guidance in meditation, facilitating connections to health resources, and supporting their self-care through preparation for a doctor's appointment.

	Spiritual	Non-Spiritual
Spiritual Only	13	0
Health	9	5
Personal Assistant	1	3
Work Assistant	1	1

Table 2: Spiritual and Non-Spiritual Agent Functionality

5.3 Discussion

The Agent Design Workshop provided us with insight into participant preference in agent appearance, personas, and functions.

Importance of Spirituality in Agent Design. The majority of the agents fulfilled a spiritual function for the participants (e.g., provide spiritual encouragement) suggesting that spirituality incorporated into the persona and function of an agent is not only acceptable, but desired by users. While most participants stated that they would prefer the agent's appearance and ethnic background to resemble other members in their predominantly Black American community, all participants designed an agent who incorporated the participant's faith into its behavior.

Importance of Agents as Peers. Nearly half the agents were based on the friends and families of the participants. Through their agent creations and follow-up discussions, participants communicated the importance of connecting to others within their church community, a term that they refer to as fellowship. Given the value of fellowship in their lives and in their worship, it was unsurprising that when prompted to "think of who supports you in your life, if you could combine a few of these people into an agent, what might this agent be like?" participants created many peer agents.

6 PARTICIPATORY DIALOGUE TAILORING WORKSHOP

We conducted a subsequent workshop to explore how participants might use language related to their faith and religious background to frame health-related dialogue.

The creation of a conversational agent that can guide users through a multi-day health behavior change program is a complex undertaking, involving knowledge of general dialogue structure and conversation management, as well as theories and techniques from behavioral medicine. Since we could not have expected our key informants to learn all of this in order to author a virtual coach application de novo, we provided them with an existing exercise promotion application that used a virtual agent coach, and asked them to review and tailor the language for their culture. The general dialogue structure used was transition networks with fully-constrained user input (i.e., multiple-choice menus of user utterances). A daily check-in conversation with the virtual coach was designed that included greeting, review of progress, positive feedback if goals were met or problem solving if not met, and farewell. The purpose of this workshop was for participants to adapt this initial, secular, agent application and dialogue.

6.0.1 Method. Authoring Worksheets. To scaffold participant responses, we created worksheets that decomposed the agent-user conversation into adjacency pairs (Figure 3). Each sheet contained one turn of dialogue: one agent utterance and a menu with possible user utterances. On the left hand side of each worksheet, participants were presented with the conversational agent utterances and user menu options that they saw in the demo. On the right hand side, participants could rewrite the utterances and reimagine the user menu options. Participants were instructed to leave the right hand side of the document blank if they endorsed the current conversational script. We intentionally created worksheets with lo-fi design attributes to encourage participants to adapt content, challenge current design, and elicit additional feedback.

Authoring Session. Five participants took part in the workshop. To begin, participants were shown a live demonstration of the health promotion conversation that they would be adapting. Participants

Conversation 1

S8: Worksheet Date: _____ ID: _____

Step 1 - Clara says:

Have you had any other problems walking that you would like to talk about?

Step 2 - Write your own message from Clara.

Clara should say: WHAT CAN WE DO
TO MAKE YOUR WALKING A
MORE ENTHUSIASIZING EXPERIENCE

Step 3 - Cross out responses you do not like.

You can say:

Yes.
 No.
 I THINK THAT'S A GOOD IDEA

Step 4 - Write your own responses.

You would respond:

A I WOULD LIKE TO TALK WITH
MY WORK ASSOCIATE TO DISCUSS
THEIR INTEREST IN WALKING WITH ME
AS MY WALKING BUDDY.

Figure 3: Dialogue Worksheet.

were then given authoring worksheets of the conversation. They were instructed to endorse agent utterances and user menu options that were representative of what they would say or what they would want to hear when in conversation with another member of their community. For utterances and user menu options that were not representative, participants were instructed to author new turns of dialogue guided by the following prompts: (a) If you were having a conversation with someone at your church, how would you phrase this? (b) How would you change what the agent says, using language or content related to your faith? (c) How do you use language or content related to your faith to encourage or congratulate another church member on their health-related progress? (d) What language or content related to your faith would you find encouraging, motivating, or meaningful to hear while you worked on a new health goal? These prompts were displayed for participants to refer to throughout the 60 minutes they worked on the packets. Directly following, an investigator-led 40 minute group discussion containing open-ended interview questions allowed participants to contextualize their script choices and provide feedback on the design session overall.

6.1 Analysis

The workshop transcript was qualitatively analyzed using methods from section 3. For analysis, participant worksheets were separated by user menu and agent utterance. Each complete agent utterance or user menu was then classified as containing language related to one of the following: 1) Scripture, either verbatim or paraphrased, 2) Faith-based language or topics excluding scripture (e.g., "Thank the Lord", "Try saying a prayer for motivation", "Let's pray."), or 3) Secular topics only (Table 3). Two coders independently classified all utterances. Agreement among coders was high (100%).

6.2 Results

Participants authored a total of 71 agent utterances ($M=14.2, SD=2.5$) and 35 user menu options ($M=7, SD=2.5$) each. All but 2 agent utterances and 1 user menu were modified, and 3 of the 5 participants contributed an additional turn of dialogue through the extra pages provided. The majority of the utterances were secular (e.g., "Clara should say: Let's discuss the main problem that prevented you from hitting your walking objectives.") Language related to the user's

	Secular	Faith	Scripture
Agent Utterance (n=71)	69% (49)	12.7% (9)	18.3% (13)
User Menu (n=35)	82.9% (29)	11.4% (4)	5.7% (2)

Table 3: % (n) of Utterances by Category

religion was woven into both agent utterances (e.g., “Clara should say: I know things can be hard at the beginning, but with perseverance and prayer we can get through this, if you need me I am just a click away”) and user menus (e.g., “You would respond: A) Blessings to you. B) May God continue to bless you. C) See you next week!”); however, scripture was used in agent utterances far more often than user menus (25.4% and 5.7% respectively). Of the 20 utterances with scripture, 16 unique passages were chosen from 8 different books of the Bible.

During the facilitator-led workshop, participants discussed considerations for spiritual content included in health conversations. Overall, participants agreed that scripture and scriptural content should be interwoven into the dialogue, emphasizing that the agent should speak similarly to how their friends would speak. Further, participants indicated that the degree of religious tailoring may need to be dynamically tailored for individual users, even from the same church. For example, a newcomer to the church or to religion may feel intimidated by too much faith-related language. P12 explains, “*I also think about newbies. People that are just come into the faith? Sometime[s] they might feel a bit intimidated, to talk a lot of scriptures... so that might be a barrier.*” Participants proposed two solutions to tailoring religious content to user-preference: 1) explicitly asking the target user if they would like the agent to share faith-based content and; 2) creating adaptive user menu options that dynamically alter the levels of faith-based content in the conversation, that is, as users select more faith-based responses (e.g., “Praise the Lord”), the agent would respond more frequently with faith-based language.

6.3 Discussion & Design Guidelines

Through engaging with participants to tailor a health conversation, we gained insight into the nuances of framing a health conversation with faith-based language. Through group discussion, participants identified key contextual factors that may impact how a member in their community perceives the conversation, namely how embedded the person is in the church community and their (self-perceived) knowledge of the Bible.

Design Guidelines. We distilled the following design guidelines for spiritually tailoring dialogue based on our observations:

- Establish the role and cultural background of the agent. Set user expectations, early in a dialogue, by having the agent signal its cultural background and role explicitly through appropriate greeting rituals, and having the agent state its role and the purpose of the dialogue [26].
- Establish common ground and solidarity through tailored social chat. Simulated “getting to know you” conversation can be used early to further establish the agent as a member of the user’s culture [26].
- Leverage religious concepts and scripture to motivate and persuade thereby increasing self-efficacy.

- Provide culturally-tailored problem solving.
- Adapt the degree of tailoring to the user’s degree of cultural involvement and preferences.

7 VALIDATION STUDY

We conducted a counterbalanced within-subjects experiment to evaluate the effect of spiritual tailoring on attitudes towards health behavior change. The study had two conditions: SPIRITUAL, in which the agent used religious and spiritual language in its counseling dialogue, based on our design guidelines, and SECULAR, in which the agent used secular dialogue of equivalent duration in place of the religious content. Participants had conversations with two different characters during a study session. One promoted exercise and the other promoted diet (fruit and vegetable consumption), with one of these conversations SPIRITUAL and the other SECULAR. The order and association of character, topic, and study condition was randomized.

7.1 Designing a Spiritual Agent

In the SPIRITUAL condition, agent dialogue was tailored to incorporate topically relevant spiritual content in the form of spiritual affirmations, scripture, and prayer. Scripture was woven into agent dialogue to signal support, provide empathy, and demonstrate that the agent’s underlying core values and principles aligned with the participants. Further, the SPIRITUAL agent was not designed as a health expert, but rather a member of her church’s health promotion program. As a result, the agent shared first hand testimonials on why the health topic was personally important to her, as well as strategies she’s found helpful in accomplishing her goals. In contrast, the SECULAR agent shared the same advice as direct suggestions, framing such suggestions as being helpful to others facing similar experiences. At the end of the session, the SPIRITUAL agent ends the conversation asking participants if they would like to pray. Invitation to prayer is a contextually appropriate and customary end to church-situated social interactions. A church member from both church communities validated the SPIRITUAL agent script to ensure authenticity and appropriateness of the agent’s scriptural use and spiritual behaviors.

The embodied conversational agent (ECA) system was created using a 3D game development engine and deployed on a web browsers. The agent system used a hierarchical task-network-based dialogue manager to drive the ECA dialogue. It presented users with a multiple-choice response menu at each turn of the conversation (Figure 4). Nonverbal conversational behavior was generated using BEAT [5], to accompany synthetic speech.

7.2 Participants, Measures, and Method

Participants were recruited using an email advertisement sent directly to leaders in their church communities. Participants were required to be at least 18 years old, have access to a computer, be able to speak and read English, and self-identify as a member of a predominantly Black, Protestant church community. The study was conducted entirely online over a video conference link. Conversations with each agent lasted approximately 10 minutes. Directly following the interaction with both agents, we conducted a qualitative semi-structured interview. Participants were asked about their



Figure 4: Agent Praying (left). Agent with Spiritual Menu-Set (center). Agent with Secular Menu-set (right).

impressions of both agents, as well as their attitudes towards and perceptions of the spiritual language. In addition, participants were asked to describe the impact of spiritual language in the context of this healthcare conversation with an agent.

7.3 Qualitative Results

We report the results from our validation study. Six participants successfully completed the study, age ranging from 30-74 years, and 5/6 were female. During the interviews, participants stated that they recognized the incorporation of language and content related to their faith when interacting with the SPIRITUAL agent. They further endorsed the use of spiritual and religious content, and described it as appropriate, genuine, and motivating when used in the context of a health counseling conversation with an agent. When asked which agent they'd like to continue to talk with, all participants endorsed the SPIRITUAL agent.

Participants characterized the positive and holistic impact that spiritual language had in agent dialogue. P5 stated, “She’s talking my language. It reinforces what I believe, I never mind talking about prayer life, and never mind talking about...the good he [God] wants for you. It’s healthy. It’s spiritually healthy. You can do other things because the Word, it gives you strength.” This demonstrates that spiritual language was not only welcomed, but it evokes participants’ self-efficacy that their underlying core belief system provides, helping them to follow through with coping strategies. P1 echoed this sentiment when she expressed, “I think it’s helpful to hear a message when you are trying to change your life, or do something that is seriously difficult,” reaffirming that incorporating spiritual support can be powerful when promoting behavior change.

All participants stated that they felt more connected to the SPIRITUAL agent, who demonstrated membership in the church community. Not only was the agent’s use of spiritual language perceived as genuine, it contributed to the perception that the agent was a member of the participant’s faith community. P4 affirmed, “...what she [SPIRITUAL agent] did is very much akin to some of the people I talk to at church. I would have liked the first one [SECULAR agent] if some of that had been in there.” One participant specifically highlighted that the SPIRITUAL agent, when compared to the SECULAR, felt like a friend. In contrast, she identified the SECULAR agent as a clinician. She stated, “overall [SECULAR agent] had a clinical feel. She wasn’t a buddy. I don’t need a clinician, I need help, a friend.” P2’s preference for an agent she identifies as a friend demonstrates how

the value she and her community place on peer support translates to preferences for the role of a virtual agent.

Participants offered direct feedback on the authenticity, placement, and frequency of the tailored dialogue. P2 voiced, “I liked the way the scripture was infused into the dialogue, it lifted my spirits. They were appropriate, they came at the right time, it gave us a better connection.” All participants reported that the frequency of scripture and religious language was ‘subtle’ and ‘just right,’ but that future iterations may consider fine tuning the tailoring. P6 explained, “when I’m super stressed, I need to pray more... I could use the spiritual language more when things are harder. Less when things are good.” Other participants expressed that a user’s age and current level of engagement within the church community may also impact the desired frequency and distribution of religious content throughout the agent conversation.

8 CONCLUSION

We developed a novel methodology for designing culturally-tailored virtual agents for specialized populations. Through these methodologies, we distilled design guidelines for spiritual tailoring dialogue and developed a variety of design concepts for health promotion agents for two church communities. Following these guidelines, we developed two health promotion agents, and conducted a qualitative evaluation of the effects of spiritual tailoring. Results indicated that spiritual tailoring positively influenced the relationship between the user and agent. Further, faith-based content was the primary reason that users chose to keep working with the SPIRITUAL agent.

8.1 Participatory Design Workshop Considerations

Our methodology allows researchers to co-create agent designs with target users utilizing lo-fi design materials to elicit rapid feedback on agent characteristics. However, limitations of the methodology exist. Special consideration must go to the literacy level of the target population, and for participants who have difficulty with the physical act of writing or drawing. In the agent design workshop, participants had the opportunity to express their ideas through one or multiple of the following activities: drawing the agent, writing on the worksheet, or speaking about the agent at the end of the session; however, the dialogue tailoring workshop, as currently conceived, requires the participant to write. In lieu of a group activity, these participants may benefit from individual interviews where a researcher works directly with the participant to edit dialogue.

Our work demonstrates that participatory design is essential when creating culturally tailored virtual agents for specialized populations. In the Agent Design Workshop, participants expressed that cultural tailoring needs to go beyond visual characteristics. They identified both faith and ability to use faith-based language as highly-valued characteristics for an agent designed for their community. In the Dialogue Tailoring Workshop, participants discussed the importance of subtle representations of their culture, and insisted that this was necessary for the agent to appear as a genuine community member. While tailoring an agent on surface-level characteristics has been shown to improve agent interventions, these preliminary findings point to the powerful potential impact of extending cultural tailoring to include core values of the audience.

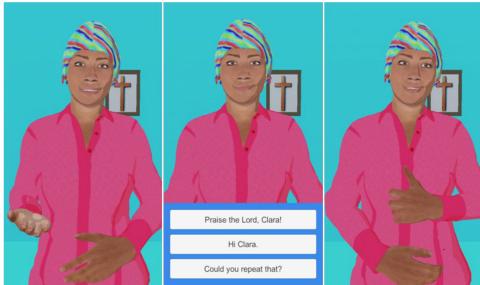


Figure 5: Prototype of Walking Promotion Agent

8.2 Future Work

To understand how participants would accept and use a spiritual virtual agent in their everyday lives, we are developing a smartphone-based exercise agent, that promotes daily walking behavior (Figure 5). To date we have adapted an existing intervention for longitudinal exercise promotion based on our Design Guidelines.

Preliminary field testing has been conducted by four participants with the agent installed on their smartphones for three days. Interviews with participants indicate that the smartphone-based agent application was easy-to-use, intuitive in design, and that they were able to successfully use the application in a variety of locations. Participants also stated that the smartphone-based agent reminded them not only of a member of their church, but also of themselves. One participant explicitly stated, “*Clara [the agent] seemed more like someone I could really talk to... because she seemed more like myself.*” The participant explained that she felt a connection because she perceived multiple shared traits with the agent who she identified as a Black woman and also a person of faith. Our ongoing work is focused on extending this smartphone prototype to promote a range of health behaviors, and to leverage crowdsourced input to dynamically augment the agent’s dialogue.

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REFERENCES

- [1] Amy L Baylor. 2009. Promoting motivation with virtual agents and avatars: role of visual presence and appearance. *Philosophical Transactions of the Royal Society B: Biological Sciences* 364, 1535 (2009), 3559–3565.
- [2] Timothy Bickmore. 2010. Relational agents for chronic disease self management. *Health Informatics: A Patient-Centered Approach to Diabetes* (2010), 181–204.
- [3] Timothy W Bickmore, Kathryn Puskar, Elizabeth A Schlenk, Laura M Pfeifer, and Susan M Sereika. 2010. Maintaining reality: Relational agents for antipsychotic medication adherence. *Interacting with Computers* 22, 4 (2010), 276–288.
- [4] Timothy W Bickmore, Rebecca A Silliman, Kerrie Nelson, Debbie M Cheng, Michael Winter, Lori Henault, and Michael K Paasche-Orlow. 2013. A randomized controlled trial of an automated exercise coach for older adults. *Journal of the American Geriatrics Society* 61, 10 (2013), 1676–1683.
- [5] Justine Cassell, Hannes Högni Vilhjálmsson, and Timothy Bickmore. 2004. Beat: the behavior expression animation toolkit. In *Life-Like Characters*. Springer, 163–185.
- [6] Terry C Davis, Sandra W Long, Robert H Jackson, EJ Mayeaux, Ronald B George, Peggy W Murphy, and Michael A Crouch. 1993. Rapid estimate of adult literacy in medicine: a shortened screening instrument. *Family medicine* 25, 6 (1993), 391–395.
- [7] David DeVault, Ron Artstein, Grace Benn, Teresa Dey, Ed Fast, Alesia Gainer, Kallirroi Georgila, Jon Gratch, Arno Hartholt, Margaux Lhommet, et al. 2014. SimSensei Kiosk: A virtual human interviewer for healthcare decision support. In *Proceedings of the 2014 international conference on Autonomous agents and multiagent systems*. International Foundation for Autonomous Agents and Multiagent Systems, 1061–1068.
- [8] Birgit Endrass, Elisabeth André, Lixing Huang, and Jonathan Gratch. 2010. A data-driven approach to model Culture-specific Communication Management Styles for Virtual Agents. In *Proceedings of the 9th International Conference on Autonomous Agents and Multiagent Systems: volume 1-Volume 1*. International Foundation for Autonomous Agents and Multiagent Systems, 99–108.
- [9] Birgit Endrass, Matthias Rehm, and Elisabeth André. 2009. Culture-specific communication management for virtual agents. In *Proceedings of The 8th International Conference on Autonomous Agents and Multiagent Systems-VOLUME 1*. International Foundation for Autonomous Agents and Multiagent Systems, 281–287.
- [10] Budd Hall. 1975. Participatory research: An approach for change. *Convergence* 8, 2 (1975), 24.
- [11] Bruce Hanington and Bella Martin. 2019. *Universal Methods of Design Expanded and Revised: 125 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions*. Rockport Publishers.
- [12] Brian Jack, Timothy Bickmore, Megan Hempstead, Leanne Yinusa-Nyahkoon, Ekaterina Sadikova, Suzanne Mitchell, Paula Gardiner, Fatima Adigun, Brian Penti, Daniel Schulman, et al. 2015. Reducing preconception risks among African American women with conversational agent technology. *J Am Board Fam Med* 28, 4 (2015), 441–451.
- [13] Dušan Jan, David Herrera, Bilyana Martinovski, David Novick, and David Traum. 2007. A computational model of culture-specific conversational behavior. In *International Workshop on Intelligent Virtual Agents*. Springer, 45–56.
- [14] Abby C King, Timothy W Bickmore, Maria Ines Campero, Leslie A Pruitt, and James Langxuan Yin. 2013. Employing virtual advisors in preventive care for underserved communities results from the COMPASS study. *Journal of health communication* 18, 12 (2013), 1449–1464.
- [15] Jared W Magnani, Courtney L Schlusser, Everlyne Kimani, Bruce L Rollman, Michael K Paasche-Orlow, and Timothy W Bickmore. 2017. The atrial fibrillation health literacy information technology system: pilot assessment. *JMIR cardio* 1, 2 (2017), e7.
- [16] Enid Montague and Jennifer Perchonok. 2012. Health and wellness technology use by historically underserved health consumers: systematic review. *Journal of medical Internet research* 14, 3 (2012), e78.
- [17] Fred Nash. 1993. Church-based organizing as participatory research: The northwest community organization and the pilson resurrection project. *The American Sociologist* 24, 1 (1993), 38–55.
- [18] Seth M Noar, Christina N Benac, and Melissa S Harris. 2007. Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. *Psychological bulletin* 133, 4 (2007), 673.
- [19] Douglas Oman and Dwayne Reed. 1998. Religion and mortality among the community-dwelling elderly. *American Journal of Public Health* 88, 10 (1998), 1469–1475.
- [20] Jean A Pratt, Karina Hauser, Zsolt Ugray, and Olga Patterson. 2007. Looking at human-computer interface design: Effects of ethnicity in computer agents. *Interacting with Computers* 19, 4 (2007), 512–523.
- [21] Albert Rizzo, Belinda Lange, John G Buckwalter, Eric Forbell, Julia Kim, Kenji Sagae, Josh Williams, JoAnn Difede, Barbara O Rothbaum, Greg Reger, et al. 2011. SimCoach: an intelligent virtual human system for providing healthcare information and support. *International Journal on Disability and Human Development* 10, 4 (2011), 277–281.
- [22] Brent Rossen, Kyle Johnsen, Adeline Deladisma, Scott Lind, and Benjamin Lok. 2008. Virtual humans elicit skin-tone bias consistent with real-world skin-tone biases. In *International Workshop on Intelligent Virtual Agents*. Springer, 237–244.
- [23] Patrie R Spence, Kenneth A Lachlan, Stephen A Spates, and Xialing Lin. 2013. Intercultural differences in responses to health messages on social media from spokespeople with varying levels of ethnic identity. *Computers in Human Behavior* 29, 3 (2013), 1255–1259.
- [24] Randy Stoecker and Edna Bonacich. 1992. Why participatory research? Guest editors’ introduction. *The American Sociologist* 23, 4 (1992), 5–14.
- [25] Anselm Strauss and Juliet Corbin. 1990. *Basics of qualitative research*. Sage publications.
- [26] Jan Svennevig. 2000. The establishment of interpersonal relations in conversation. In *Getting acquainted in conversation: A study of initial interactions*. Vol. 64. John Benjamins Publishing, 7–62.
- [27] Kim M Unertl, Chris L Schaefbauer, Terrance R Campbell, Charles Senteio, Katie A Siele, Suzanne Bakken, and Tiffany C Veinot. 2015. Integrating community-based participatory research and informatics approaches to improve the engagement and health of underserved populations. *Journal of the American Medical Informatics Association* 23, 1 (2015), 60–73.
- [28] Langxuan Yin, Timothy Bickmore, and Dharma E Cortés. 2010. The impact of linguistic and cultural congruity on persuasion by conversational agents. In *International Conference on Intelligent Virtual Agents*. Springer, 343–349.