

Motivating Health Behavior Change with Humorous Virtual Agents

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ABSTRACT

Research on the psychology of humor indicates that humor can increase the impact of persuasive messages in certain circumstances, suggesting that virtual agents could use humor to improve the effectiveness of motivational counseling with users. To explore this idea, we developed two virtual agents that attempt to motivate users to perform healthy behaviors – either to increase exercise or fruit and vegetable consumption – and systematically vary whether they use humor or not in their counseling conversations. Human-authored jokes were selected from a large corpus based on the nature of the humor (empathetic affiliative humor that serves to build relational closeness), health topic relevance, and subjective ratings of funniness, as well as relevance to user stage of behavior change. We evaluated our agents in a two-treatment counterbalanced within-subjects experiment, where participants interacted with a humorous and non-humorous agent motivating either exercise or healthy diet. We found the interaction with the humorous agent led to a significantly greater change in motivation to engage in the target behavior than interacting with the non-humorous agent.

KEYWORDS

embodied conversational agents; user study; humor; motivational interviewing

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1 INTRODUCTION

Adopting and maintaining healthy behaviors related to fitness and diet is challenging. Health and wellness promotion professionals use a variety of methods to help their clients believe in themselves, make commitments, overcome barriers, manage expectations, and ultimately maintain their behavior.

Building rapport with and showing empathy towards a client is an important facet of health counseling [40]. One of the ways health care providers do this is through the use of humor, the use of amusing or comical anecdotes or stories that can result in positive affect in the client. In the context of health counseling, humor has been found to increase the persuasiveness of health messages [5], build rapport, increase satisfaction with the relationship between patients and providers, and increase trust between them [2]. Humor has also been shown to be important in establishing therapeutic alliance, which is the trust and belief that a client has in working with a counselor to achieve their goals [21].

It is crucial that the topics of humorous remarks and the type of humor used in professional counseling are carefully considered [48]. For example, affiliative humor that uses jokes, witty banter, or humorous asides are positively correlated with empathic concern, suggesting that clinical use of affiliative humor could improve the therapeutic alliance and trust. Offensive and argumentative humor styles or humor that targets patients directly are inappropriate in the context of patient-provider interactions [17].

Access to healthcare professionals who have specialized training, such as health counseling, is limited, and the cost of therapy can be substantial. Software solutions have the potential to address some of the barriers to treatment. For example, Embodied Conversational Agents (ECAs) are interfaces that simulate face-to-face interactions by displaying a humanoid agent that exhibits the non-verbal behaviors that accompany speech. The use of ECAs for health behavior promotion has been researched in a variety of contexts, including exercise promotion[4], medication adherence promotion [26], and smoking cessation[13].

One of the most widely used counseling techniques for enhancing people’s motivation towards behavior change is Motivational Interviewing (MI) [34]. This technique uses particular strategies, such as reflective listening, to understand clients’ readiness to change. Additionally, MI is often used in conjunction with the Transtheoretical Model of behavior change, that states that tailoring interventions to people’s stage of change leads to more successful interventions, for example, a person who is merely thinking about going out for a run sometime soon needs a very different motivational message than someone who runs 5k once a week but would like to increase that to 10k [44].

We aim to build ECA systems capable of conducting effective health counseling interventions, using MI, building rapport and therapeutic alliance, and showing empathy through the use of tailored, relational behavior, like humor.

The purpose of the current study is to assess whether users would find humor acceptable when used by an ECA in the context of health counseling conversations, and to determine whether its

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use would be beneficial in establishing a therapeutic alliance with the agent and positively impacting user attitudes towards the health behaviors of interest.

To answer these questions, we designed a lab experiment that systematically varies the use of humor and also the tailoring of humor to participants' level of readiness for behavior change. We evaluated the following hypotheses:

H1: Participants will accept an ECA that uses techniques from MI to promote physical activity and eating the recommended amount of fruits and vegetables.

H2: Participants will be more accepting of the ECA that uses stage- and topic-appropriate affiliative humor than the one that does not.

H3: The conversation with the ECA that uses stage- and topic-appropriate affiliative humor will have a greater positive impact on participants' attitudes towards engaging in the target behavior than with the ECA that does not.

Few studies have systematically investigated the manipulation of humor type, or compare humorous to non-humorous patient-provider interactions, and none have evaluated these effects in the context of health counseling by virtual agents.

2 RELATED WORK

Our work draws on previous research on the use of humor in healthcare settings, ECA-driven MI systems, and the use of humor in human-agent interactions.

2.1 Humor in Healthcare

Humor provides healthcare practitioners with an alternative strategy for helping patients make decisions, thereby promoting therapeutic goals [30]. Integrating humor into therapy, offers clinicians alternative ways to correct irrational thoughts, motivate clients, change client attitudes towards healthy behaviors, and express genuine concern [48]. The result of successfully implementing humor into therapeutic practice is the creation of a "positive emotional experience" shared by both provider and client that could potentially change the client's perspective and simultaneously modify the client's willingness to engage in healthy behaviors [48].

Clinicians have been encouraged in the use of humor in clinical practice to increase patient satisfaction [30] [48]. While some methods of manualized humor treatment techniques exist [9], therapists are urged to use clinical discretion to assess the client's acceptance of humor and use affiliative humor during clinically acceptable moments.

The type of humor a clinician chooses to use during a therapeutic interaction is extremely important. A survey administered to 103 undergraduates at a community college found that affiliative humor that uses jokes, 'witty banter', or 'humorous asides' to put a patient at ease was positively correlated with empathic concern. This suggests that clinical use of affiliative humor could improve the therapeutic alliance by potentially increasing trust between clinician and patient [17].

Research indicates that nurses utilize humor in healthcare settings to alleviate patient discomfort [2]. A qualitative study identified that humor can be an effective tool for establishing trust in the clinical relationship. However, interactions tended to be initiated using non-humorous communication, which allowed the providers

to validate the patients experience, acknowledge the importance of the health topic at hand, and then use humor to reduce patient anxiety [12].

2.2 Motivational Interviewing & Virtual Agents

Research has shown that conversational agents can conduct MI sessions both using constrained and unconstrained user input. Participants in a longitudinal study evaluating a constrained-input agent system that used MI as part of its therapeutic agenda, received high ratings of user satisfaction, MI fidelity, and relational closeness [3].

An ECA using MI in a screening and brief intervention for alcohol use had high therapeutic alliance and participants' quantity and frequency of drinking was reduced post-intervention compared to baseline [53]. In a feasibility study evaluating a similar system for opioid use disorder patients, participants were satisfied with the agent, wanted to interact with her again, liked her, trusted her, found her interesting, and felt that they understood one another [41].

An unconstrained dialog input agent system that used MI as part of its intervention design, showed that participants rated an empathetic agent higher than a non-empathetic one on a number of measures of usability and social dimensions, such as trust, perceived intelligence, and likability [28].

2.3 Humor & Agents

A survey of the embodied agent literature investigated whether integrating humor capabilities into the internal model of conversational agents would be useful. The research on 'computers as social actors' paradigm [45] has revealed that people will interact with computers as if they are social agents. Therefore, since affective displays (e.g., smiling) and humor appreciation are important in human interactions where humor is used, ECAs should have the ability to understand and exhibit these contextual cues [38].

Humorous agents have been found to have an effect on users beyond simply making them smile. For example, humorous agents make interactions more enjoyable and help build rapport, as well as impacting how users perceived their cooperativeness [27]. Similarly, virtual agents that simulate laughter appropriately can use that to communicate their intentions and influence the relations between them and their conversational partners [37].

Humorous agents in general seem to induce more positive emotions in users than ones that do not [43] and can, for example, help chatbot agents recover from dialog errors [36]. Even social robots that express humor, empathy, and appropriate voice pitch, can improve users' perception of task enjoyment, the robot's personality, and speaking style [35]. Additionally, a social robot's timing of humor delivery impacts how funny they seem [50].

This effect seems to go beyond positive affect. In a user study of a humorous agent, participants who rated the agent as unfunny were less likely to be persuaded by the agent's suggestions in a problem solving task [25].

3 DESIGNING HUMOROUS MOTIVATIONAL AGENTS

In this work, we designed ECA counselors that use techniques from MI to promote health behavior, in order to study their impact on



Figure 1: The agents we used in our study. Emily (left) just asked the participant how important the target behavior is to them. Katherine (right) just told a joke so she pauses, wears a smile, raises her eyebrows, and the camera zooms in slightly.

user attitudes towards health behavior change when using topically relevant affiliative humor.

We created two virtual agent interventions that use principles from MI and affiliative humor to increase motivation to engage in physical activity and eating fruits and vegetables. Significant literature in medicine and public health supports the many benefits of changing attitudes towards increasing both of these behaviors [24] [18].

Our primary purpose in these virtual counselor interventions is to increase motivation and confidence to change. While motivation and confidence are not guarantees of actual behavior change, they are prerequisites for intention to change, which itself is a prerequisite for actual change [10]. Motivational Interviewing is typically used for individuals who are at the very early stages of their behavior change journey and lack motivation to get started [34]. Our focus in the interventions described is on individuals in these early stages, thus motivation and self-efficacy (confidence), are the key outcomes of interest. Several ECAs have now been developed that have demonstrated long-term health behavior change (e.g., [4]); our objective here is to demonstrate new counseling techniques that can be used by such agents to increase their efficacy and improve user retention in longitudinal interventions.

3.1 Humor Selection and Conversation Design

We collected humorous material for our agent interactions from a dataset of 231,657 short jokes gathered from various subforums on Reddit¹ and has been used for a variety of tasks, such as for humor generation².

First, we filtered the dataset by the most popular keywords³ related to our two topics (i.e., ‘exercise’, ‘gym’, ‘workout’, ‘weight’, ‘nutrition’, and ‘diet’), resulting in 1874 jokes. Second, we removed inappropriate jokes, both with respect to the topic (e.g., physical exercise as opposed to a military exercise) and chose the ones fit for use in a counseling setting, specifically those considered affiliative humor (creating a sense of fellowship, happiness, and well-being), bringing the number of jokes down to 209. Third, we categorized the jokes into three groups. Two groups had to do with users’ stage of behavior change (those actively engaged in the behavior and those that are not), and the third group included jokes that convey

a general sense of empathy, resulting in 104 jokes. Fourth, we asked 9 independent raters to indicate how funny they thought each joke was on a single Likert-scale item, from 1 to 7. Fifth, we selected the top 7 jokes for each of the two topics (exercise and nutrition), which were included in the final dialog scripts used in our study.

3.2 ECA Implementation

Our ECA system has a 3D animated character that converses with users using synthetic speech output and multiple-choice menu inputs for user responses, with allowed user responses updated at each turn of the conversation. The system generates synchronized non-verbal conversational behavior for the agent using BEAT [7], including hand gestures, head nods, eyebrow raises, posture shifts, and gaze behavior. Agent utterances and menu options are generated using template-based text generation. We built a standalone Windows application using the Unity3D game engine that ran on an HP touch-screen tablet and a speech synthesizer from IVONA was used to generate the agent’s speech. Figure 2 shows a diagram of our system components. We used two different agent models for each topic: exercise and nutrition (Figure 1).

The dialogue is managed by a hierarchical transition network (HTN) and a script interpreter that functions according to a theory of discourse structure [14]. The theory asserts that discourse is arranged into segments that have a distinct purpose and that new segments can be introduced within ongoing segments, often marked by cues like ‘Anyway’ and ‘Speaking of’, such as the jokes in our dialogue. Figure 3 shows an example dialog script used in our system, split into discourse segments.

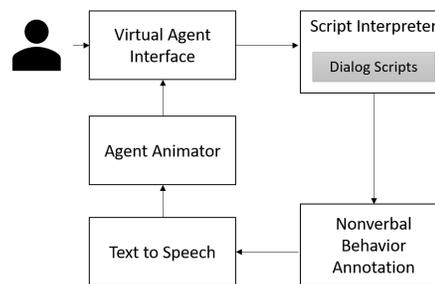


Figure 2: Virtual agent system diagram.

¹<https://github.com/amoudgl/short-jokes-dataset>

²<https://www.kaggle.com/abhinavmoudgil95/short-jokes>

³<https://www.wordstream.com/>

DS1	<p>Agent: So, how is the weather out there today? User: It’s fine Agent: I see, well that’s good.</p>
DS2	<p>Agent: You know what they say about the weather in Boston? If you don’t like it, just wait five minutes. User: Haha</p>
DS3	<p>Agent: Alright, about how many half cup servings do you eat on a typical day? User: 2 Agent: Okay, I am glad to hear that you are eating some fruits and vegetables. I would like to help change your diet, so that you can reach the weekly recommendation of five servings per day, five days per week. User: Okay</p>
DS4	<p>Agent: One time, my friend suggested I go on a diet where I would only eat almonds. But I thought, that’s just nuts. User: Haha Agent: All kidding aside, on a scale of 1 to 10, where 1 means a healthy diet is not at all important, and 10 means health eating is very important, how important is healthy eating to you? User: 4 Agent: Alright, that’s good. You could have chosen a lower number, but you didn’t. You chose a 4 and not a lower number. Why is it important for you to eat fruits and vegetables? User: To be healthy and live longer Agent: Alright, so I hear that you would eat more fruit and vegetables to be healthy and live longer. That’s a really good reason.</p>
DS5	<p>Agent: You know, there are a lot of little things people can do to get more fruits and vegetables into their life. For example, making sure you always walk through the produce section when you go grocery shopping. User: I might give that a try</p>
DS6	<p>Agent: Speaking of diets, I know people who are on the seafood diet. Every time they see food, they eat it. User: Haha</p>
DS7	<p>Agent: I think that’s all the time we have for now. I appreciate you sharing your thoughts with me today. Have a great day. User: Goodbye</p>

Figure 3: Example dialog from the nutrition script split into discourse segments (DS). The nested segments have a distinct purpose, to add humor, but are relevant within the scope of their encompassing DS.

3.3 Humor Implementation

In the counseling conversations, we treated joke telling as a form of conversational storytelling and provided “contextualization cues” [15] to cue the shift in framing, using discourse markers such as “This one time” and “Speaking of”. Likewise, the end of a humorous remark is often marked in certain ways, for example, with pauses where the listener thinks about how to respond [23]. In our case,

the virtual camera in the agent’s virtual environment zoomed in slightly closer to the agent’s face at the beginning of the humorous remark to indicate a more intimate proximity and stayed close until the user responded to the agent’s joke, allowing them time to think and react. Furthermore, since the jokes are within a conversational frame, the agent displays additional contextualization behaviors while telling the jokes, such as smiling and eyebrow raises (e.g., right side of Figure 1) [16].

3.4 Designing for Motivation

MI is a cognitive behavioral counseling approach that is effective for changing attitudes after a single brief session for topics about diet and exercise [33]. We therefore structured the conversations using elements of MI that human counselors most often use in brief initial sessions.

The two health counseling ECA conversations had different topics but the same structure. They start with a greeting, brief small-talk, and stating the standard public health guidelines for either of the two topics. The ECA then asks participants for permission to continue discussing the target health behavior, a key aspect of MI. If the participant wishes to continue, the agent attempts to build trust and rapport by reflecting back their wish to continue the conversation using positive affirmation statements. The agent then presents herself as a collaborator, rather than an expert, who wants to help participants explore their motivations towards changing or maintaining the target behavior.

Following agreement to continue, the agent gauges their level of adherence to the recommended guidelines. For those who don’t adhere, the ECA highlights the inconsistency between the target behavior guidelines and the behavior they currently engage in. For participants who follow the recommendations, the conversation is continued, concentrating on maintaining their current behavior.

The agent then asks the participants how important the target behavior is to them. This gives the agent an idea of their ‘readiness to change’ and gives them the chance to communicate levels of anxiety or ambivalent thoughts (Figure 1). The agent then draws attention to what the participant is particularly concerned about by verbally rephrasing their response, an MI technique called ‘simple reflection’, which gives the participants to hear their response spoken out loud.

Next, the agent enhances the participants’ motivation by asking them why the target behavior might be important to them. This is important for making clients’ commitment to change stronger. This technique was included in our design to allow participants to talk about reasons for change with the agent and increase their motivation.

The agent then focuses on the mismatch between the participants’ reasons for change and a low readiness score. Doing this is in line with developing discrepancy, an important aspect of MI in early sessions [33, 34]. Following this, participants choose a suggestion on how to realize that change in their lives. The agent confirms their choice after allowing them to choose what is in accordance with their wishes. Towards the end of the conversation, participants are asked how committed, confident, and motivated they are to change. The agent uses a simple reflection to convey support, which increases their likelihood of moving participants towards a path for change and an effective result.

Simple reflections are used throughout the session to show empathy and highlight the positive sides of the participant’s mindset. Praising and reflecting, along with recommending the use of clinically approved guidelines, shows the agent playing a supportive role and her use of empathic patient-centric language makes her a partner in the participants’ journey towards change.

The conversation ends with the ECA summarizing the participants’ goals, reasons for change, level of commitment, and motivation, deliberately highlighting the constructive parts of the conversation. This further promotes the participants’ motivation to change.

In this design, we identified five key moments in the dialog to use conversational humor: (1) during the greeting phase, (2) following the staging question, (3) following choosing why the target behavior might be important to them, (4) while getting tips regarding doing the target behavior, and (5) while saying farewell. Figure 3 shows a sample conversation with jokes at three of these key moments, i.e., (1), (2), and (4).

4 USER STUDY

We conducted an experiment to evaluate the effect of affiliative humor on people’s attitudes towards behavior change. The experiment was a within-subjects design to eliminate inter-subject variation to boost the power of our study, and we used two different health behavior change topics to eliminate carryover effects. The study was counter-balanced, i.e., we randomized character designs across treatments so the effects of any differences should wash out. Subjects had a conversation with each agent during the course of the experiment.

The within-subjects manipulation had two conditions. In one condition, the ECA told four jokes during the brief counseling session that were relevant to the topic and whether they regularly engaged in the target behavior (e.g., exercise regularly or eat a healthy diet) or not (HUMOUR). The other condition contained no humor in a similar brief counseling session (NoHUMOUR). Treatment order (HUMOUR vs. NoHUMOUR), ECA appearance, and health topic (exercise or nutrition) were counterbalanced.

4.1 Participants, Measures & Procedure

Research participants were recruited using an online advertisement, were required to be 21 years or older, able to speak and read english, and self report as being in one of the first three stages of change with respect to the target behaviors. The study was approved by our institution’s IRB and participants were compensated for their time.

Participants were randomly assigned to one of 8 configurations of topics (Nutrition or Exercise), treatments (HUMOUR vs. NoHUMOUR), and virtual agent models (Katherine or Emily). Following randomization, participants were verbally consented by a trained research assistant and invited to fill out an informed consent document and well consent to audio recording.

Prior to interacting with the agents, we collected the following measures: Socio-demographics, Situational Humor Response Questionnaire [31], Humor Styles Questionnaire [32], Sense of Humor Questionnaire [49], Need for Cognition Scale [6], and the Big-Five personality traits questionnaire [11].

The next set of measures were taken for each of the two topics (exercise and nutrition) before the interaction with the agents and

after: Decisional Balance [19, 29], Self-Efficacy [1, 29], Motivation, Confidence, and Stage of Change. The final set of measures were collected following each of the agent conversations: General agent ratings and funniness (Table 1), Interpersonal Trust [52], and Bond-subscale of the Working Alliance Inventory [20].

Following the second agent conversation, we told participants that they were going to have a third and final conversation and that they could choose which agent they wanted to talk to. Finally, we conducted a semi-structured interview asking participants about their experience interacting with the agents.

5 RESULTS

A total of 15 participants successfully complete the study, which a retrospective power analysis indicated was the number we needed [8]. Participants were 36.73 (12.65) years old, 40% female, 73% white, 91% single, and all had either some college experience or a college degree. Participant occupations varied, and all used computers on a regular basis. Ratings of the Humor Styles Questionnaire, which measures how much people appreciate particular styles of humor

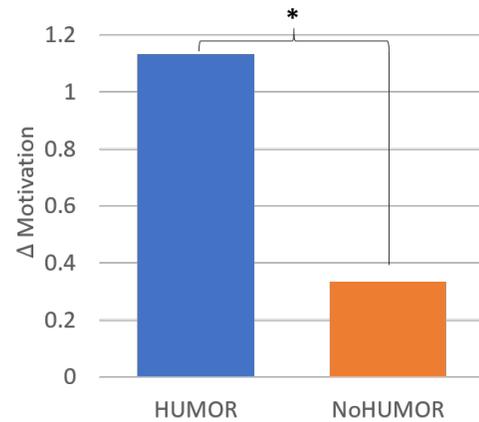


Figure 4: Participants had a significantly greater change in motivation following the conversation with the HUMOUR agent. * $p < .05$

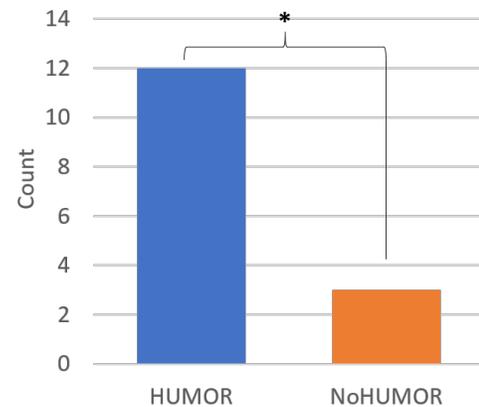


Figure 5: 12 participants chose to speak with the HUMOUR agent for a subsequent conversation, while 3 participants chose the NoHUMOUR agent. * $p < .05$

Item	Anchor 1	Anchor 2	Median (IQR) - Wilcoxon Signed-Rank
How satisfied are you with the agent?	Not at all	Very satisfied	Nutrition: 6 (2) W=102 p<.05 Exercise: 6 (2.5) W=83.5 p<.05
How much would you like to continue working with the agent?	Not at all	Very much	Nutrition: 6 (1) W=95.5 p<.05 Exercise: 6 (1.5) W=109.5 p<.05
How much do you trust the agent?	Not at all	Very much	Nutrition: 6 (2) W=98.5 p<.05 Exercise: 6 (1.5) W=116.5 p<.05
How much did you like the agent?	Not at all	Very much	Nutrition: 6 (1.5) W=89 p<.05 Exercise: 6 (1.5) W=101.5 p<.05
How knowledgeable was the agent?	Not at all	Very knowledgeable	Nutrition: 6 (1.5) W=112 p<.05 Exercise: 6 (1) W=102 p<.05
How natural was your conversation with the agent?	Not at all	Very natural	Nutrition: 5 (2) n.s. Exercise: 5 (2.5) n.s.
How would you characterize your relationship with the agent?	Complete stranger	Close friend	Nutrition: 4 (3) n.s. Exercise: 4 (2) n.s.
How similar do you feel that you are to the agent?	Very different	Very similar	Nutrition: 4 (2.5) n.s. Exercise: 4 (3) n.s.
The agent was funny	Strongly disagree	Strongly agree	NA

Table 1: Single scale items participants were asked regarding the two agents. The last column shows which items were significantly greater than a neutral score of 4.

(e.g., self-defeating, affiliative, and sarcastic), showed that affiliative humor was the highest scoring humor style for our participant group, $M=44.73$ (7.53).

5.1 Quantitative

The agent in the HUMOUR condition was rated funnier than the agent in the NoHUMOUR condition, $M=5$ vs. $M=2$ ($W=40$, $p<.05$), confirming our manipulation check.

Participants had a significantly greater change in their motivation to engage in the target behavior following the conversation with the HUMOUR agent, compared to the NoHUMOUR agent, $M=1.13$ (1.55) vs. $M=0.33$ (0.62) ($W=21$, $p<.05$), with an effect size of $d=0.58$ (Figure 4). When asked which agent they would like to interact with for a third conversation, a significantly greater number of participants chose the HUMOUR agent over the NoHUMOUR agent (12 vs. 3), $X^2(1)=5.4$, $p<.05$ (Figure 5). An ANOVA test for order effects with respect to the change in motivation was not significant.

We found significant correlations between several individual variables, such as personality traits, age, and humor styles. Being neurotic was positively correlated with liking self-defeating humor ($r=0.4$, $p<.05$), while being conscientious and agreeable were negatively correlated with liking self-defeating humor ($r=-0.67$, $p<.05$ and $r=-0.55$, $p<.05$). Extraversion and age were each positively correlated with liking self-enhancing humor ($r=5.8$, $p<.05$ and $r=0.61$, $p<.05$). Age was also positively correlated with liking aggressive humor ($r=0.54$, $p<.05$). In general, participants were satisfied with the agents. They indicated that they were knowledgeable, they wanted to continue working with them, they trusted, and liked them. These measures were significantly greater than neutral (Table 1). None

of the other measures collected were significantly different among our treatment groups.

5.2 Qualitative

Semi-structured interviews were conducted with all participants and analyzed using elements of grounded theory and selective coding practices [47]. The Nvivo 12.5.0 data analysis software was used to inductively code transcripts and identify emergent themes.

5.2.1 Participant Reactions to Humor. Nearly all participants stated that the only difference between the agents was the use of humor in one of the conversations. They described the humorous agent as funny, found the humor to be more subtle and light-hearted and came away from the interaction with a sense of validation about their own health concerns. P4 explains, “*I think it [the humor] was good that they [the jokes] were subtle, not over the top, and they felt natural.*” The agent’s humor style was perceived as affiliative, making some participants feel comfortable during the conversation. P2 states, “*[the joke] was nice because it was, like...she’s concerned about something, too. So, it just kind of felt she was more on your side and...she wasn’t this perfect, like, I don’t know, robot person.*”

Many described the humor as ‘humorous attempts’. They felt that imperfect attempts at humor are welcomed and sometimes funnier when delivered by an agent. P12 characterizes the agent’s humor by stating, “*it was entertaining and it made me chuckle how dumb it was, not that it was funny funny, but at least she tried!*”

The humorous agent was described as more likeable than the other by almost all participants and they assigned personal characteristics to her: ‘she was friendly’, ‘authentic’, and ‘knowledgeable.’

They provided examples of the function of humor in their interaction with her, for example, “*I guess the joking put me more at ease.*” (P12). Participants explored how they could more easily relate to the humorous agent, e.g., “*the jokes made her seem more relatable...she felt more of, like, an ally or friend or something.*” (P2), showing the power of humor in establishing the role of the agent as a trusted resource.

5.2.2 Humor and its Impact on a Health Conversation. Overall, participants accepted and endorsed the use of humor during the health counseling conversations with an agent and highlighted benefits of affiliative humor. Most of these benefits focused on how humor aided in human-agent interaction by making the intervention more engaging. Participants referred to health-related conversations that are normally ‘boring’ as ‘entertaining’ and, as a result, more memorable. This emphasizes how humor can be an important tool during health-related conversations, especially if it assists in memory. P8 encapsulates this idea by stating, “*...You know it lightens the mood... it easier to relate to the person and I mean, it makes you laugh and I think when you laugh, you can remember the conversation better.*”

Importantly, the effects of humor during the health conversation with an agent reflected similar benefits found in patient-provider communication, e.g., “*It immensely helped... when you’re trying to connect with another human being, humor goes a long way ... you can laugh with somebody, it usually tends to put guards down.*” (P10).

Similarly, participants explored the emotional benefits they experienced when reporting information they might otherwise feel embarrassed about to the joking agent. P5 states, “*So, I think, maybe some people feel bad...when they have those ranking from one to ten...you probably feel uncomfortable, hitting 1 or 2...these jokes in that kind of situation...keep your mood up.*” P5 highlights that humor can lighten the mood around topics that a participant may be reluctant to discuss. By creating an environment where participants feel comfortable reporting information accurately during the health conversation with the agent, participants in turn receive more useful and actionable advice from the agent. Participants identified an additional benefit of humor, stating that the use of humor made them more likely to re-initiate the conversation about the health topic with the humorous agent, indicating that humor may be a useful tool for increasing user engagement, e.g., “*the light-hearted nature is something that would make me...slightly more motivated to come back.*” (P4).

5.2.3 When Humor Hurts. Participants who reported health-related difficulties, where self-identified lack of exercise and poor nutrition were directly impacting their quality-of-life, perceived the humorous agent as less kind, as P3 described, “*I didn’t like the second one, because it was real jokey. I’m here to gather information about improving my life. I need it to be serious.*” This sentiment was echoed by two other participants who did not pick the humorous agent when given the choice. Thus, targeted communication styles based on how sensitive the topic is to the participant may be important to consider when designing humorous health-counseling agents.

6 CONCLUSION

Our results show that an agent that uses affiliative and topically-appropriate humor in a brief motivational interview can increase people’s motivation towards exercising and healthy eating, and that humor can promote engagement with a virtual agent.

Our hypotheses were supported. Participants’ change in motivation was significantly greater following the conversation with the humorous agent compared to the non-humorous one. Since changes in attitude towards a particular behavior are predictive of actual behavior change [22, 42, 46, 51], these results indicate that people who are counseled by an agent that uses affiliative humor are more likely to change their behavior than those who interact with a non-humorous agent. Additionally, a significantly greater number of participants chose to talk to the humorous agent again, regardless of topics, indicating that humor can increase engagement with virtual agents. More specifically, an agent that uses topic-appropriate and relational (affiliative) humor precipitates engagement with that agent. Furthermore, participants were accepting of an agent that uses MI counseling techniques while promoting exercise and healthy eating, regardless of whether she used humor or not.

Our qualitative results added context to the benefits that participants had identified of incorporating humor into agent interactions, while also identifying individual-based contextual factors that possibly lessen the effectiveness of humor in health conversations with an agent. For example, the sensitivity of the health topic was an unexpected finding that warrants further investigation; however, the number of possible health problems, user attitudes towards those problems, and types and topics of jokes, comprises a vast combinatoric space that is beyond our current scope.

6.1 Limitations

There are several limitations to our study beyond the small convenience sample used. Humor can be personally relevant to a particular user in many ways, making it especially funny or offensive. A thorough analysis of these discriminating factors should be performed to allow anecdotes to be more effectively targeted. In comedy, timing is everything, and robots and agents are no exception [50]. The timing of the delivery of our agent’s jokes needs improvement and more research is needed to explore the subtle nonverbal behavior and prosody required for an ECA to tell jokes more effectively. Most importantly, health behavior change can take weeks or months to achieve, and we cannot yet tell whether the effects of humor will serve to further engage users and retain them in a longitudinal intervention.

6.2 Future Work

Our findings call for further research into the effects of humor in human-agent interactions and that there should be humor support in designs of conversational agents [39]. We found correlations between personality traits (and other factors) and liking particular kinds of humor. These relationships can be modeled and leveraged to tailor virtual agent interactions to the user. We are interested in studying the effect of tailoring humor to both the topic and people’s readiness to change, as well as how MI coupled with humor impacts long-term behavior change. Finally, we are interested in developing systems that can automatically generate humor with appropriate placement, delivery, and behaviors for reacting to humor [37].

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