

Toward Conducting Motivational Interviewing with an On-Demand Clinician Avatar for Tailored Health Behavior Change Interventions

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Abstract—We describe work-in-progress about the development of avatar-based personalized assistants that can deliver motivational interviewing health behavior change interventions which are tailored to the needs of its specific user. Our approach combines the latest progress in Embodied Conversational Agents (ECAs), believable agents, and dialog systems. We discuss how we use different platforms to aim at providing accessibility of personalized health assistant, anytime anywhere.

I. INTRODUCTION

We discuss our work-in-progress on the development of an intelligent Embodied Conversational Agent (ECA) or avatar that (1) generates multimedia, multilingual and multicultural specific tele-health messages, (2) tailors them to the diverse preferences of at-high-risk youth (e.g. gender, ethnicity, language), and (3) delivers them to youth seamlessly on personal computers, web-based systems, and/or mobile phones.

In particular, we are working on an intelligent agent architecture that integrates artificial intelligence techniques with various forms of multimedia technologies to connect at-risk youth to the healthcare system. The intelligent agent communicates with the at-risk youth via an interface with digital avatars or Embodied Conversational Agents (ECAs) [1], [2] who can engage the at-risk youth via innovative multilingual, multicultural, and multimodal messages promoting healthy behaviors.

To build on avatar acceptance, the health-promoting digital avatars are specifically tailored to the youth preferences (e.g. gender, ethnicity, language) and adaptable to the youth behaviors (e.g. specific risky behaviors). In addition, the need for dynamic and timely message delivery in the specific context of at-risk youth behaviors (sexual activity, alcohol/drug use) is being addressed by working on the design of avatars that youth can interact with it seamlessly depending upon the time of day, on a personal computer, on a web-based portal, or on a mobile smart phone.

Latest findings have already shown that health promotion interventions tailored to the individual are an improvement

over one-size-fits-all interventions [3]. Efficient individually tailored health promotion interventions became feasible with the advent of computer delivered interventions (CDI).

We posit that ECAs might be ideal to assist in delivering tailored health information to at-risk populations because they can be designed to (1) be personalized to a user with a user-model, (2) be highly adaptive in terms of characteristics (e.g. gender, race, culture, language), (3) gather and remember information provided voluntarily by a user, (4) have deep knowledge of a domain with specific expert-systems, and (5) be able to engage in meaningful dialog.

In addition, the possibility to run ECAs on a variety of communication technologies (e.g. internet-based platforms, PCs, mobile phones), so that their accessibility and availability improves, augments considerably their potential impact for at-risk populations, in a window of opportunity situation during which motivation to change may be especially malleable (e.g. being talked to by an understanding counselor when just arrested in a police station for substance use might help in making a quantum leap in readiness to change the destructive habit).

The concept of avatar-based interactive mobile interventions to promote health behavior has many applications in telemedicine and public health and promises to have major potential impact for future tele-health interventions (e.g. drug and alcohol users, over-eaters, chronic conditions).

Whereas the use of conversational agents online and on mobile devices has been a topic of on-going research over the past few years (see [4] for a review), the use of avatar-based systems to help at risk-youth has not received much attention.

Furthermore, although the recently developed motivational interviewing counseling style (described below) has shown powerful for delivering successful health behavior change interventions [5], it was only in the last couple of years that it was first identified particularly useful for health dialog systems [6], [7]. Since then a few other attempts have been explored with the use of 2-D cartoon or comic-like characters [8], [9].

Our current work introduces MI interventions led by an animated and emotionally expressive 3D character, able to speak, emote, and engage in dialog-based interactions on a specific topic of health behavior change - on-demand, i.e. at any point the person needs that counseling. The system is modularized to enable the addition of interventions for various behaviors, and the current implementation discusses motivational interviewing for alcohol use behavior change. Similarly, the systems is conceived to enable tailoring of interventions to a specific target population and to a specific user, and the current work discusses interventions for youth-at-risk (e.g. college students).

II. OVERALL SYSTEM COMPONENTS

A. Motivational Interviewing

Our personalized assistants deliver behavior change health interventions adapted from motivational interviewing (MI) [10], [5], [11]. MI is a directive, client-centered counseling style whose main goal is to *magnify discrepancies that exist between client goals and current behavior*. Rollnick and Miller [11] describe MI as helping clients to *explore and resolve ambivalence* [about reducing substance involvement], and enumerate the spirit of MI as:

- 1) Motivation to change is elicited from the client, and not imposed from without.
- 2) It is the clients task, not the counselors, to articulate and resolve his or her ambivalence.
- 3) Direct persuasion is *not* an effective method for resolving ambivalence.
- 4) The counseling style is generally quiet and eliciting.
- 5) The counselor is directive in helping the client to examine and resolve ambivalence.
- 6) Readiness to change is not a client trait, but a fluctuating product of interpersonal interaction.
- 7) The therapeutic relationship is more like a partnership or companionship than expert/recipient roles.

MI typically involves a *brief assessment* followed by *feedback* about the assessment results. Assessment data compiled from an individual are used to provide individualized, age- and gender-graded feedback about drinking and related behaviors. Throughout the MI interaction, a client-centered counseling style is used (vs. a traditional 'medical expert paternalistic authoritarian' style).

The inspiration of our avatar-based MI intervention described earlier in [7] follows most closely the MI-related intervention developed for college students with alcohol use issues by Marlatt [12].

In our motivational interviewing intervention, participants are provided with personalized feedback as is done in many brief interventions [13].

Specifically, topics covered in the feedback session include *personalized feedback* in the areas of:

- self-reported drinking,
- perceived current and future risks of drinking,
- negative consequences of current consumption patterns,



Fig. 1. Avatar provides tailored feedback based on previous assessment

- personal goals and their relation to alcohol use,
- social supports and their beliefs about drinking, and
- intentions and self-efficacy in regard to personal drinking goals.

We provide students with written, and empathetic verbal feedback about their own substance use vis-à-vis age- and gender-specific national norms. The belief that "everyone does it" is challenged via this feedback [14] because it raises awareness to the problem, and change does not usually happen without awareness.

B. Case Scenario

The advantages of our avatar-based approach is to enable (relatively) easy authoring of intervention variations (discussed in the next Section).

Our current intervention is intended for use by students who qualify as drinkers (e.g. 6 or more drinking occasions in the past year). Once identified, who have drinking issues are invited to participate in computerized health evaluation and feedback. The *On-Demand Avatar Clinician* features a 3-D emotionally expressive animated narrator (shown in Figure 1 who reads all material (so that no reading literacy is required). The repeatable intervention is conducted with the following primary MI components:

- 1) *self-monitoring* about drinking patterns and associated problem behavior(s);
- 2) feedback regarding the *negative consequences* of alcohol use that the participant reported, on self-reported readiness to change, and on alcohol use as compared to that of same age and gender peers; these are collected and available as reminders;
- 3) *pros and cons* of alcohol use and related change, in which the participant chooses from lists of positive and negative aspects of alcohol use from their perspective; collected and available as reminders;

- 4) *summary* of overall exchange, with learned facts and current stage of change; also collected and available;
- 5) *question* regarding the participants interest in change. Depending upon that answer, an *optional goal-setting* sub-session regarding alcohol use reduction is initiated.

C. System Components

The system involves the following main components.

The *User-Model* is used to build and maintain the profile of each user as it changes over time and the various stages of change the students is [15]. It includes the preferred users avatar identified either directly by the user or inferred by the system based on the users ethnicity (implementing patients' concordance) as shown in Figure 2. The user-model also enables tailoring the intervention to that specific student user. Tailoring is achieved by using the user's name or *personalization*, using known characteristics of the user such as gender or *adaptiveness*, and by using self-identified needs of the user or *feedback-provision*. Tailoring can also be dialog-based in that it is enabled by asking the user about their goals and by recommending choices about how to best achieve these goals. The key is that the personalized, adaptive, or feedback based tailored messages are more effective in promoting attitude and behavior change than the generic one size fits all content delivered by print or to groups (as is currently done with many interventions) [16].

The *MI intervention* is currently implemented with menu-based decision-tree navigation. Categories of sub-interventions are created for tailoring to specific students. For example, if the student is ready to move to a different stage in the wheel of change, then a sub-intervention appropriate for that stage is activated [15].

The *normative statistical databases* are accessed to calculate meaningful information about the student's specific drinking patterns as opposed to the norm (the belief that everyone does it is dispelled that way) (see Figure 1).

Accessible Platforms: The ECA architecture is integrated with a web-based interface so that interventions are available wherever internet is available. New uses of mobile technologies indicate that mobile phones can be useful in the context of psychotherapy and counseling [17]. Although at a very experimental state, our current mobile avatar software package allows for both male and female avatars, different ethnicities, and universal facial expression animation [19].

D. The Avatar Itself

We have already identified *specific features of ECAs* that are important - if not necessary - to include in the design of computer-based interventions for health promotion behavior [20]. We integrated these features in our current prototype: 3-dimensional (3D) graphical avatar (facial and/or half/body) [21]; a set of features to portray different ethnicity features on the 3D avatar (e.g. skin color, facial proportions); a set of custom-made facial expressions capable of animating the 3D avatar with dynamical believable facial expressions (e.g. pleased, sad, annoyed); text-to-speech (TTS) engine to be



Fig. 2. Web Interface gives choice of avatars



Fig. 3. Dynamic Facial Expression Animations

able to read text with a natural voice; set of different natural languages to enable the avatar to be multilingual (English first, and Spanish will follow); the possibility to manipulate vocal intonation in order to add to the agents believability.

Empathy: Empathy is considered the most important core condition in terms of promoting positive outcomes in psychotherapeutic contexts [22]. Considerable progress in animating virtual characters via mark-up language have been made such that it is feasible to have text-to-speech scripted interventions with non-verbal cues [23]. We are interested in modeling some meaningful empathetic communication in the context of MI. Our expressive avatar is programmed with believable facial expressions (see Figure 3) developed in an earlier study [24] and vocal intonation synthesis to make believable and congruent with the dialog content during the interaction with the youth.

Dialog Abilities and Spoken Language Generation: A number of studies have pointed out that one of the main limits of computers for psychotherapy lies in their partial ability to adequately interpret natural language inputs [25]. Latest progress in natural language processing in general, in social dialog abilities of ECAs in particular [26], and in modeling expression of emotion [27] have been increasing ECAs dialog

abilities steadily. Full natural language understanding is still not within reach however and will necessitate many more years (or decades) of research in natural language processing in order to make sense of the complexity, ambiguity and richness of natural languages. However, we argue that given the domain-specific nature of our motivational interviewing avatar-based health interventions, which follow semi pre-determined scripts, we can design meaningful interventions without full natural language processing abilities.

Whereas this work-in-progress demonstrates how meaningful MI interventions can be designed with menu-based navigation, we are currently identifying restricted specific dialog scripts that will be used by our on-demand avatar clinician to conduct real dialog.

III. CONCLUSION

In this article we have described work-in-progress on the development of an on-demand avatar clinician to deliver and conduct motivational interviewing behavior change interventions. The demand for health promotion interventions that are tailored to an individual's specific needs is real, and the technological advance that are describing is an attempt to address that need.

Our next step will be to program some relevant parts of the MI intervention using a dialog engine and natural language processing (vs. the dialog being conducted via menu-based navigation). We also plan to focus on modeling empathy in way that is believable (i.e. gives the illusion that the avatar character is a supportive being who can be counted on), promotes engagement with the health intervention program, and, ideally, increases positive outcomes.

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