

A Synthetic Character Application for Informed Consent

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Abstract

We developed an application using synthetic character technology to allow users to practice administering informed consent. The target audience for this application is health communications researchers, field interviewers, and others who administer informed consent to research participants. The synthetic character was designed to simulate a potential participant/respondent in a study who has questions about the study, including many of the queries researchers typically get from research participants. These queries include questions about the sponsor, the content of the study, how respondents were selected, confidentiality, how much time the study is expected to take, benefits and risks, and who to contact for further information. The synthetic character appears on the monitor and asks the questions audibly. The users must respond to these queries correctly, using natural spoken language. The application was developed to be easily adaptable to different projects since each project will have different specific information to impart to participants during informed consent. We describe a brief test of the application and plans for further evaluation.

Introduction

With funding provided by the National Institutes of Health Human Subjects Research Enhancements Program, we developed a synthetic character application for assessing skills in providing informed consent demonstrated by health communications researchers and field interviewers.

The application was developed by individuals from RTI's Office of Research Protection and Ethics, IRB administrative staff, and Technology Assisted Learning division, building on past work both on enhancing the protection of research participants and on applying synthetic character technology to improve the learning of interaction skills. A test of one version of the application will be conducted with help from colleagues in the Psychology: Social and Health Sciences department at Duke University.

Synthetic Character Technology. Our synthetic character technology is characterized by highly detailed syn-

thetic characters who respond and react realistically to user input. The technology involves visualization software, a language processor, and a behavior engine (see Figure 1). Users generally converse with synthetic characters using natural language (i.e., via a microphone, not by typing text nor selecting from a menu, though the choice is application-specific). Synthetic characters respond using gestures, body movement, facial expression, intonation, and speech, with confusion, anger, pain, or any emotion, as appropriate. Synthetic character behavior is based on cognitive, emotional, semantic, social, and/or physiological models. Our synthetic character applications run on standard multimedia personal computers running Windows, requiring only a good microphone as an accessory. For a fuller description of the technology, including detailed references to work that we've built on, see (Hubal and Guinn 2003).

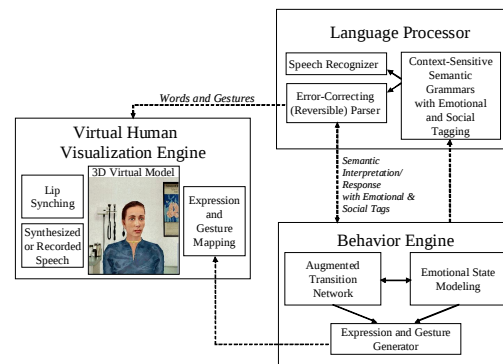


Figure 1. Synthetic Character Technology

In synthetic character applications, users are able to practice with numerous case-based scenarios in a reproducible, objective learning environment. Each scenario establishes initial conditions, but the user's responses to the synthetic character, as well as intended flexibility in how the synthetic character is allowed to react, cause the conversational flow to vary from interaction to interaction. Hence, the user must learn to handle each interaction individually.

For visualization, a full-body, animated synthetic character was developed to appeal to the target population, and a simple kitchen scene was created. We used FaceGen to

generate a base head model for the desired age and ethnicity as well as morph targets for expression and lip synching, Character Studio to animate and apply motion capture data to the character, 3DS Max to generate content for the character and virtual environment, and various applications and plug-ins (Photoshop, Deep Paint 3D, Deep UV) to generate and apply textures and mapping coordinates for the character and virtual environment. The real-time rendering is being handled by NDL's Gamebryo engine.

For language input processing the architecture in general uses the following components (Guinn and Montoya 1998): an off-the-shelf speech recognizer; a minimum distance translator that parses the recognizer output, matching to the closest grammatical sentence; dynamically selected grammar files that feed into the speech recognizer and also the parser, categorizing syntactic elements into semantic (i.e., meaningful) categories; and emotional and social tagging that carry information related to emotional or social state variables maintained by the behavior engine. Language output is achieved either by text-to-speech generation or by using pre-recorded files (as was the case in this study).

The remainder of this paper describes the behavior modeling. In the current application, the synthetic character portrays many of the typical questions and concerns related to informed consent, involving comprehension, ability to make an informed decision, and voluntariness. The application captured data on how questions were answered by the user, on how the synthetic character's concerns were addressed, and on the consistency and relevance of provided information.

This application is one of many that RTI has created using synthetic characters. Others include applications for training police officers handling mentally disturbed individuals (Frank et al. 2002), clinicians interviewing patients exposed to bioterrorist agents (Kizakevich et al. 2003) or pediatric patients (Hubal et al. 2003), emergency response personnel encountering trauma patients (Kizakevich et al. 1998), field and telephone interviewers learning to minimize nonresponse on federally-funded health, economic, and other surveys (Link et al. 2002), and at-risk adolescents dealing with anger management (Paschall et al. in press).

Implementation

In implementing the application we considered (i) what the virtual environment needed to look like, (ii) how to structure the dialog, (iii) how to track user input, and (iv) how to provide feedback.

Virtual Environment. As in all of our applications, the appearance of the synthetic character in the virtual environment is important. We decided to make the scene a kitchen, and the character more average-looking than the

avatar models on which she was based. (See the screenshot in Figure 3 below.) We opted for a country-style kitchen where an interview would be likely to take place (e.g., for a survey of household drug use, which is one of many field studies that RTI performs). We also opted for a 30-something woman of average build, somewhat typical of whom a researcher might encounter at her home. Unlike other of our synthetic character applications, in this application we did not require many movements (animations) beyond seated gestures, and also did not require selection maps for our 'picking' technology (Zimmer et al. 2003) that allows for application of tools to the character.

Scripts. We developed scripts for seven components of informed consent: research issues, confidentiality, voluntariness, selection procedures, duration, who to contact, and benefits or compensation. The research issues script is diagrammed in Figure 2. In that figure, the ovals represent utterances made by the synthetic character (a potential participant in the research) and boxes responses made by the user. There are other components of informed consent that often occur, such as rescheduling or challenging, that we considered but dropped for this application, feeling that if the researcher were already sitting in the participant's kitchen, these components made little sense. We expect in the future to alter the scenario and add components such as rescheduling.

There are a few items of interest shown in the figure. First, since it is natural dialog that the user engages in, there are many ways a user may express a given response. What is shown in the boxes are the semantically different responses. We enabled – through many iterations of testing – numerous variants for giving each semantic response. Second, what boxes are shown are the only semantically different responses we allowed for this component. That is, we analyzed the scripts carefully and determined that, according to standard practices, these would be the only responses we cared to understand at this point, after the synthetic character had just uttered a particular question. Third, we decided to end the simulation as soon as we detected a wrong or hesitant answer from the user or one that was not complete enough. At that point we brought up a hint and required the user to restart the scenario. The user's objective was to complete an entire conversation.

Overall, there were 28 different questions the synthetic character could ask (each with several variants) and some 42 semantically different responses (as just discussed, each with many variants) the user could give.

Tracking User Input. For the feedback that the application provided the user, it was necessary that we tracked how well the user's responses matched the synthetic character's queries. For instance, if the character asked "Do I have to participate?", an answer of *Yes*. is responsive but false, an answer of *No*. is responsive and truthful but vague or incomplete, an answer of *Your participation is*

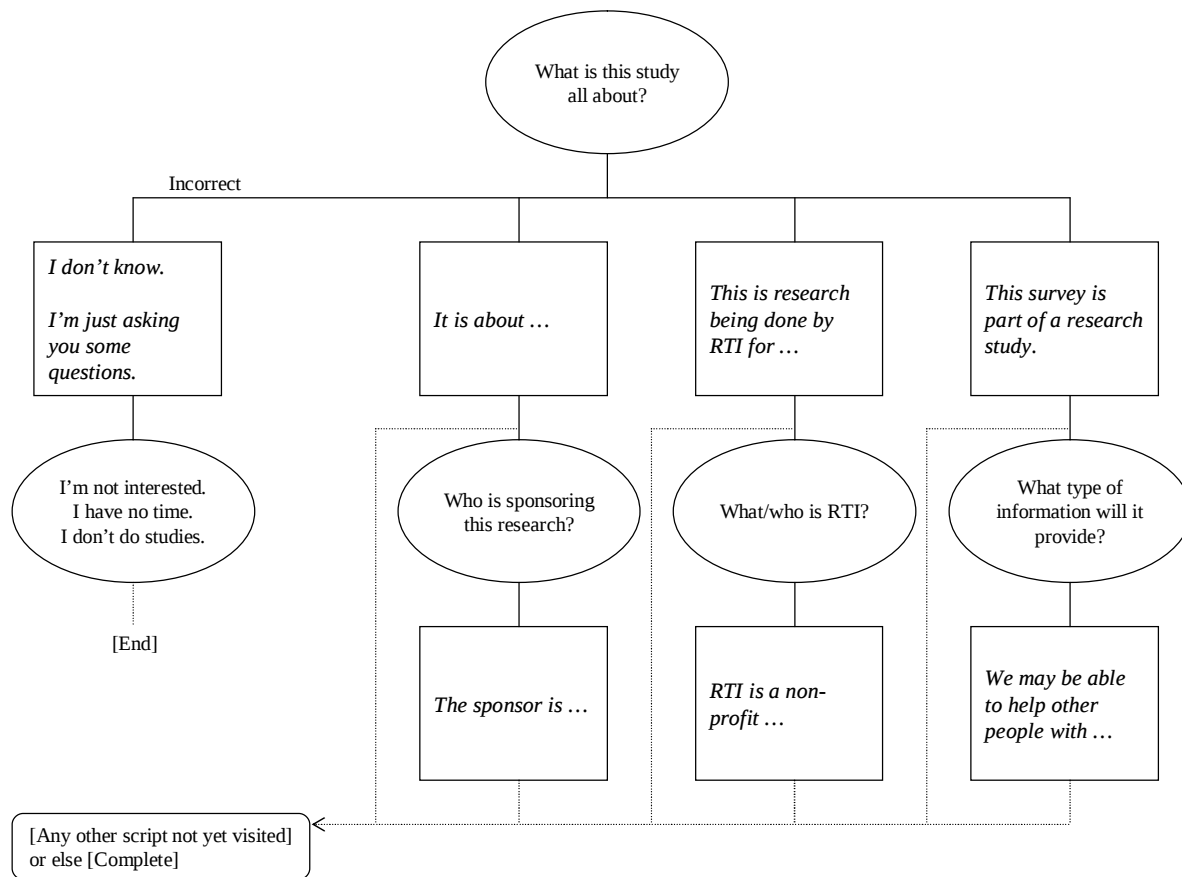


Figure 2. Research Script

completely voluntary. is responsive and truthful and complete and reassuring, and an answer of *I only have a few questions to ask you*. is not responsive, vague, and not particularly reassuring.

In other applications, we variously cared about how polite was the user, how agreeable, how well the user sought information regarding the concern, and how detached the user was from the scenario (Frank et al. 2002; Paschall et al. in press). In this application we focused on the following:

- **Responsiveness.** Did the user answer the question that was asked?
- **Truthfulness.** Was the response accurate?
- **Completeness.** Was full information given in the response?
- **Complexity.** Was the response full of long sentences, difficult words, or jargon (hence not very reassuring)?

Hints. As a hook into what would be needed for a stand-alone training system, we added a hinting capability that offered advice to the user when it perceived that the user

violated responsiveness, truthfulness, completeness, or complexity. Table 1 shows the hints associated with the dialog in Figure 2.

Our language processor computes a reliability score that takes into account the speech recognizer score and the parser score, among other factors (Guinn and Montoya 1998). Depending on a threshold set dynamically for the reliability score, we had the synthetic character ask the user to repeat himself/herself, paraphrase what was interpreted and/or ask for confirmation or elaboration, or accept the interpretation and continue.

We set the interview to halt as soon as the application determined that the user had not handled the participant's concern appropriately. At that point, a hint was displayed and the user was required to restart and try again. The interview ended successfully when the user responded appropriately to all of the participant's questions.

Sample Dialog. Since the scenario is meant to begin from the initial point of obtaining consent, we decided to skip the greeting, even though the greeting sub-dialog is well-

defined and one we have implemented in other applications. We also specifically avoided topics such as rescheduling or dealing with a difficult respondent that could be part of a normal research survey interview. A typical scenario for this application would proceed as follows (the synthetic character's questions are shown in quotes, the user's responses are shown in italics):

"Who's the sponsor?"

The sponsor is the New York City Department of Health and Mental Hygiene.

"What is this study all about?"

The work is focused on long and short term health effects for people near the World Trade Center tragedy.

"Do I have to participate?"

No.

"I'm not convinced."

Your participation is completely voluntary.

"Who is conducting this research?"

The research is being conducted by RTI.

"Who is RTI?"

RTI is a non-profit research institute dedicated to improving the human condition.

"How much time will this take?"

It depends on your responses, but the interview will typically take less than an hour.

"Will my responses be kept private?"

Yes, only the project team will be able to access your specific information.

"I'm still not convinced."

Ma'am, your answers are very important to the study.

"Let's go."



Table 1. Portion of Hint Table

Expected Reply\User Reply	<i>I don't know.</i>	<i>I'm just asking questions.</i>	<i>The research is being conducted by RTI.</i>	<i>The research is part of a larger study.</i>	<i>The research is about ...</i>	<i>The research sponsor is ...</i>	<i>RTI is a non-profit ...</i>	<i>Your information may help others.</i>
Reply to "Tell me about the study."	Tell the person what the study is about and how responses fit in, how they will be aggregated, and how they will be used.	You may only be asking a few questions, but this does not answer the question of what the study is about.		Talking about the larger context of the study is a good strategy when asked about the study.	Good, giving an understanding of what this study is about is likely to turn around the skeptical person.		The person is more interested in the study itself than what organization is conducting the research.	The question regards the study itself, not whether or not there are potential benefits to others.
Reply to "What information will the research provide?"	You should know how the responses will be collected, aggregated, analyzed, and used.			Good, giving the big picture and how this study fits in is likely to make the skeptical person a little less so.	Good, giving an understanding of what this study is about is likely to turn around the skeptical person.		The person is more interested in the study itself than what organization is conducting the research.	The question regards the study itself, not whether or not there are potential benefits to others.
Reply to "Who is RTI?"	Tell the person that RTI is a nonprofit, independent research institution.		The person was curious about who is conducting the research, good answer.			The person was curious about who is conducting the research, not who is funding it.	Good job talking about RTI when the person was curious about the Institute.	
Reply to "Who is the sponsor?"	Tell the person who is the sponsor of the study, the person has a right to know.		The person was curious about who is funding the research, not who is conducting it.	Talking about the larger context of the study is okay when asked about the sponsor, but not the best response.	Talking about the study is okay when asked about the sponsor, but not the best response.	The person was curious about who is sponsoring the research, good answer.		The question regards the sponsor, not whether or not there are potential benefits to others.

Evaluation

The application has not yet been formally evaluated. We are assured of our construct and criterion validity, as the application was developed with continuous subject-matter expert input (logging their tests of the application, revising language grammars to incorporate their input and ensure the synthetic character responded appropriately, and re-testing) and follows the type of assessment actually used at RTI for informed consent skills. To date, though, we have only assessed its use in the field in a limited setting.

We conducted a preliminary assessment as part of a study being conducted by RTI on the health effects of those living and working around the World Trade Center during 9/11. Five trained interviewers for that study practiced responding to informed consent questions using the application. The interviewers interacted with the synthetic character – we named her Clarisse (see Figure 3) – for 3-6 conversations each. After completing the conversations, they filled out a short instrument on their familiarity with computers and their impressions of the application. These instruments have been used in other of our studies (Frank et al. 2002; Paschall et al. in press).

We asked questions about the application regarding how realistic was the character's behavior, how effective the application could be in preparing someone to provide informed consent, how easy was the application to use, and how enjoyable was the application. The average rating for all of the questions fell between "moderately" and "very".

In addition to the survey filled out by the interviewers, an observer rated how they interacted, their level of engagement, emotional tone, body language, comprehension, and verbalizations. The interviewers were moderately to highly engaged, relaxed and even amused by the synthetic character, and moderately to highly talkative with the character. Other measures of interaction were less informative, such as the interviewers' low use of body language, negotiation, and information seeking, but this was to be expected given the relatively few body movements and facial gestures made by the character, and the question-answering rather than information-gathering nature of the conversation.

We are planning further, formal studies of the application. The methods will involve typical study, experimental, and test phases. Participants will be asked to take on the role of a research interviewer and obtain informed consent from a potential research participant.

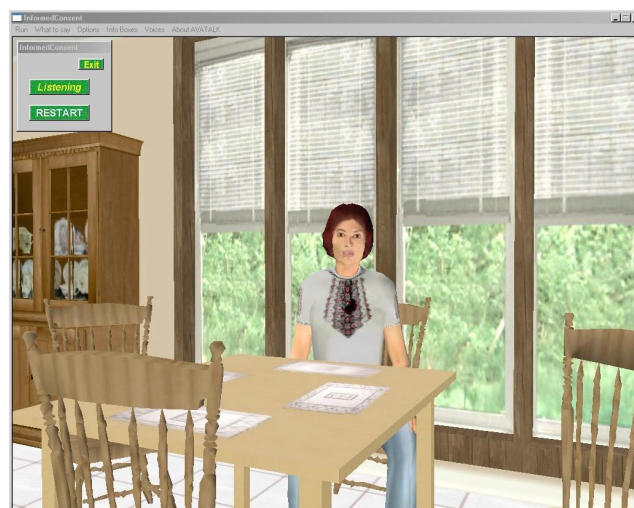


Figure 3. Screenshot of Application.

In the study phase all participants will be able to learn the basics of research interviewing as well as specifics of the putative research. That is, we will give them all the information they would need to appropriately answer the questions posed by a typical potential research participant. In the experimental phase half of our participants will continue to study the materials while the other half will practice with the synthetic character application. In the test phase we will hire an actor to play the role of a potential research participant and pose those informed consent questions, and then we will analyze our participants' responses (in terms of responsiveness, truthfulness, completeness, or complexity).

We have argued elsewhere (e.g., Hubal and Guinn 2003) that synthetic character simulations can improve interaction skills training and assessment by providing students with more practice time and consistent interaction experiences. This is true of simulations in general, where students can acquire and practice skills in a safe, reliable, modifiable environment. We expect results from our formal studies to lend support for the use of synthetic character simulations to train and assess informed consent skills.

Acknowledgements

We wish to thank Connie Hobbs, Henry Schwetzke, Colleen Waters, and Harvey Zelon for their assistance during development. This work was funded by the National Institutes of Health (NIH) under Grant Number 2 S07 RR018257-02 and the National Science Foundation (NSF) under Grant Number EIA-0121211. Opinions expressed in this paper are those of the authors, and do not necessarily represent the official positions of NIH or NSF.

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