

Interacting with Personality-Rich Characters

by

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ABSTRACT

Whether reading a novel, watching TV, or enjoying a film, people are captivated by personality-rich interactive characters. They willingly suspend disbelief in order to immerse themselves in vicarious experiences with these characters. More recently, efforts have begun to create interactive characters in computer media. Several interesting questions arise. How can we create personality-rich characters in these new media? Will we be able to create characters that have distinct and recognizable personality types? What sorts of dramatic forms will support person-character interaction? Will people willingly suspend disbelief in order to immerse themselves in interactive experiences with these characters? How will people respond to dramatic interactions with characters? Will they like or dislike particular characters? Will they enjoy the interactive experience? In this paper, we report an initial exploratory study of these issues.

Keywords

Synthetic actors, personality, user experiments, believability, entertainment.

INTRODUCTION

People attending a movie or a play appreciate characters with strong personalities that are believable and display a wide range of emotions. They enjoy empathizing with the hero or hating the bad guy. They temporarily forget that those characters exist only in the author's imagination. The author defines his or her characters' personalities with care to elicit an emotional response from an audience [10]. Poorly-defined personalities simply cause indifference or boredom. On the other hand, actors are responsible to play roles according to the directions they receive and to communicate consistent, compelling, and believable personalities through the performances they give [5].

Starting from that point, we have elaborated the concept of "synthetic actors" able to improvise their behavior in an interactive environment. Such actors can portray characters having different personality traits, moods and attitudes. We claim that users can forget such actors are not real characters but only fictional, just as spectators forget that characters in a movie, a play or a novel are not real. The more the actors react in a believable way, the more the users will react as if in a human-human interaction.

Other researchers working on believable agents in interactive environments agree that such agents must have personalities and emotions, because people naturally attribute them to those agents, although they know they are not real [3, 9, 12]. People react to them as if they were human. The style of interaction is especially important, because personality and emotions can be expressed through that style.

Such phenomena have been noticed on television and computer screens by the social scientists Reeves and Nass [15]. They have shown that people treat those media in the same way they treat other people. For instance, the same kinds of behavior that upset people when they talk, like being interrupted, make them angry when they interact with a computer. Experiments were run in which users socially interacted with computers that were attributed personalities using a minimal set of cues, such as politeness and rudeness [13, 14]. Those experiments showed that it is not necessary to have very sophisticated agents to trigger social responses from users.

By using synthetic actors exploiting a social-psychological model to portray characters, we have different goals from the social scientists'. We want our actors available in interactive environments, such as interactive story applications [8] and intelligent user interfaces [11] not only to obtain social responses from users, but also to give performances that are believable, engaging, and entertaining. We believe that such characteristics are especially important in systems that need to sustain the interest of the users, as movies and plays do. To this end we have built characters with personalities, moods and relationships, and we have run user tests to verify whether

they could recognize the character personalities we built and whether they found those characters believable and entertaining.

The remainder of the paper is structured as follows. We describe our social-psychological model and the synthetic actors that exploit it. We present the application we used to run our user experiments, and we give a few examples of personalities and interactions. Lastly, we describe our user tests and discuss the results.

A SOCIAL-PSYCHOLOGICAL MODEL FOR SYNTHETIC ACTORS

We have proposed a social-psychological model for synthetic actors, autonomous or avatars, able to improvise their behavior in an interactive environment [16]. In our model, we distinguish *personality traits*, *moods* and *attitudes*.

Personality traits

Personality traits correspond to patterns of behavior and modes of thinking that determine a person's adjustment to the environment [1]. They change little and slowly over time, and can be recognized through an individual's behavior, because those traits are what makes this character different from the others. Examples of personality traits are self-confidence, friendliness, and greed.

We base our personality model on two types of psychological theories: the trait theories [4] and the social learning theories [2]. Both theories describe an individual personality profile in terms of a set of traits quantified on a continuous dimension such as the introverted/extroverted scale, and use that profile to predict future behaviors. In trait theories, we assume that people behave consistently, no matter the context. In social learning theories, a person's behavior varies depending on the characteristics of the context and her past experiences with similar situations. For example, a waiter may be shy with women, but self-confident with men.

In our model, the quantification of a trait is numerical, the value being an integer on the interval $[-10,10]$. For instance, if we consider the scale of friendliness, -10 would mean that a character is very hostile, 0 that he or she is neither hostile nor friendly, and 10 that he or she is very friendly. We can attribute a default value to a personality trait. Such a value is fixed, as prescribed by trait theories. But, as an alternative, we can define a flexible value correlated to the value of another trait, mood, or attitude. For instance, we can say that a character has a confidence level of 6 (fixed value), and a friendliness level depending on how much he or she likes the characters he or she is interacting with (correlated value). Finally, we can specify situations when the character has a value different from the default of correlated value, with respect to social learning theories. Those situations apply on

values of personality traits, moods, or attitudes. For instance, although a character has a level of friendliness of 5 by default, we could say that this level lowers to -7 if he or she gets very angry.

Moods

Moods are emotions such as happiness and anger, or sensations from physical needs such as fatigue, hunger, and thirst. Emotions are triggered by events; sensations are event-independent. We divide the moods into two categories: the *self-oriented* moods, and the *agent-oriented* moods. The self-directed moods, such as happiness, pride, and thirst, are not directed toward other characters. The agent-oriented moods, such as anger and reproach, are directed toward other individuals. The distinction between the two kinds of moods is significant, because an individual may have very different feelings for someone from the ones he or she has in general. For instance, one character may be rather happy, but remain angry at another character because of what that character did to him.

Attitudes

Attitudes, such as status, degree of sympathy, and trust, correspond to the essence of an interpersonal relationship. They are different from agent-oriented moods, which are very variable. Attitudes vary slowly over time or remain quite stable, depending on the nature of the relationship.

Design and use of a personality profile

A designer, or author, can choose the personality traits, moods and attitudes he or she wants to define the psychological and social profiles of his or her characters. We do not claim that a given set is better than another. It is not important what a designer uses to define his or her characters, but how he or she exploits and connects the components to make his or her character interesting and believable.

We have built our synthetic actors and introduced the personality, moods and attitude elements using BB1 agent architecture [6] and the method of directed improvisation [7]. Synthetic actors own a repertoire of actions. Each action has a personality profile. The personality profile of an action indicates for each relevant personality trait the ideal numeric value in $[-10,10]$ the character should have in the current context. For instance, "speaking politely" and "speaking nastily" would be rated differently with respect to the degree of friendliness. If the character portrayed by an actor is quite friendly, then the actor would probably choose to speak politely. The degree of friendliness can change over time, and the actor can decide to speak nastily if his or her character gets very angry.

The current value of a personality trait, mood or attitude is recalculated each time an action performed by self or others modifies that value, or the value of a component to which it is correlated or figuring in a situation has

changed. It is therefore natural that an actor's behavior varies over time based upon those values.

PERSONALITIES IN THE CYBERCAFÉ

We have tested our social-psychological model using an application called the Cybercafé. The Cybercafé provides two autonomous actors and an avatar. One autonomous actor portrays a waiter called Otto, and the other a customer called Jim. The avatar allows the user to play the role of a customer called Gaby. The user can direct the avatar by selecting buttons corresponding to actions that can be performed by Gaby in a given context. Actions performed by any actor are displayed in a window presenting the textual description of the interaction.

The scenario that we explore is the following. Gaby sits at a table. Otto is behind the bar. Jim enters the café and asks Gaby if he could sit with her. After Jim sits down, Gaby wants to know what Jim wants. Jim calls the waiter to order a drink. Otto comes, takes the order and goes to get the drinks. There is a short interaction between Gaby and Jim, before Otto comes back with the drinks. Afterward, Gaby asks Jim again about what he wants. Jim's answer is the end of the scenario.

For our experiments, we have chosen three traits to define a character's personality:

- *self-confidence*, which specifies whether an individual is usually dominant and assertive, or nervous and insecure;
- *activity*, which indicates whether a character is usually energetic or lazy;
- *friendliness*, which shows whether an individual is naturally nice or hostile with others.

We have also used the following components on which the value of the personality traits can be dependent:

- the self-oriented mood of happiness (negative value denotes *sadness*);
- the agent-oriented mood of *anger* (positive value denotes gratitude);
- the attitudes of *attraction* (like or hate) and *status*.

Using those components, we have defined ten experimental personalities that we could apply to any of the characters of the Cybercafé. We textually described those personalities before defining them with our social-psychological model. In some of those personalities, the value of the traits does not depend on other components. For instance, we can say that someone who is rude and nasty has a level of friendliness very low, no matter the situation. In other cases, the value of a trait can depend on other components. For instance, a choleric character, who is usually calm, can become hostile very quickly if its threshold for anger, very low, has been reached.

The personalities that we used for our experiments are:

- *nasty*: very rude with everyone;
- *friendly*: very nice with other characters;
- *phlegmatic*: does not show emotions, neither friendly nor aggressive;
- *shy*: not confident at all, very nervous;
- *confident*: shows high self-confidence;
- *dynamic*: has a high level of energy;
- *lazy*: has a low level of energy;
- *choleric*: changing mood, gets aggressive very easily;
- *selective*: friendly with people she likes, nasty with people she hates;
- *reactive*: reacts strongly if she is verbally attacked or flattered.

As an illustration, Figure 1 shows an example of interaction where Jim (the autonomous customer) is nasty, Gaby (the avatar) is shy, and Otto (the waiter) is friendly. Figure 2 shows a very different interaction where Jim is confident, Gaby is dynamic and Otto is lazy.

We describe our user experiments in the next section.

EXPERIMENTS WITH USERS

In order to test our social-psychological model, we asked people to visit the Cybercafé as the customer Gaby and to answer a few questions. We prepared our experiments by building three sets of characters for the Cybercafé. In each set, we assigned one of the experimental personalities described in the previous section to each character: Gaby (avatar), Otto (waiter) and Jim (autonomous customer). The sets are:

- Set 1: Gaby is nervous, Otto is friendly, and Jim is nasty.
- Set 2: Gaby is dynamic, Otto is lazy, and Jim is confident.
- Set 3: Gaby is reactive and angry at Otto; Otto is choleric and angry at Gaby; Jim is selective, hates Otto but likes Gaby.

Eight users visited the Cybercafé as Gaby with each set of characters. The users were two women and six men in their twenties or thirties. Before using the system, they were told how to use the Cybercafé and the role of each character. We asked them to identify the personality of each character and to describe it at the end of a session. They were also asked several questions regarding their perceptions of the experience.

In the rest of this section, we present the questions we asked and we qualitatively analyze the answers provided by the users.

Otto clicks his tongue.
 Jim gracefully goes into the café.
 He confidently goes to a table.
 Jim (to Gaby): Lady, I want to sit with you.
 Gaby (to Jim): No...Oh, I suppose it's OK.
 Jim sits down gracefully.
 Gaby (to Jim): What should we do? I mean, could you tell me what to say? I mean, what do you want?
 Jim stares furiously at Otto.
 Jim (to Otto): Waiter!
 Otto moves to the table, singing a happy song.
 He smiles at Gaby politely.
 He says: Could I take your order?
 Jim (to Otto): Bring me a beer and leave us alone!
 Gaby (to Otto): I'm not sure... Bring me the same thing.
 Otto says: I'll come back with your order.
 He walks to the bar with a smile on his face.
 Gaby (to Jim): I'm...uh...Gaby.
 Jim (to Gaby): I'm Jim.
 Gaby (to Jim): Nice to be with you...uh...
 Otto goes to the table with a smile on his face.
 He gracefully puts two glasses on the table.
 He says: Have a very nice time!
 Gaby (to Jim): Uh...thanks!
 Otto says: Sure!
 He moves to the bar with a pleasant gait.
 Gaby (to Jim): May I want what you know? I mean, know what you want?
 Jim (to Gaby): Thank you for the drink, baby! It's just what I needed.

Figure 1: Interaction involving nasty Jim, shy Gaby and friendly Otto

We have grouped the questions around the following themes:

- identification of a personality;
- believability of the characters;
- personification by the user;
- reaction to the characters;
- potential for entertainment.

Each question was asked to a user at the end of each session of the Cybercafé, except the group of questions regarding entertainment, which was asked after the three experimental sessions were completed.

Otto waits.
 Jim quickly walks into the café.
 He dashes to a table.
 Jim (to Gaby): Madam, may I share the table with you?
 Gaby (to Jim): Please!
 Jim sits down.
 Gaby (to Jim): Don't make me wait too long, tell me what you want.
 Jim winks at Otto.
 Jim (to Otto): Waiter, we need service.
 Otto leisurely strolls over to the table.
 He looks at Gaby with red eyes.
 He says: What?
 Jim (to Otto): Bring me a cup of coffee.
 Gaby (to Otto): I need the same thing. I'm so thirsty.
 Otto says: I'm pretty busy. I'll be back at some point.
 He saunters over to the bar.
 Gaby (to Jim): I'm Gaby, and I can't wait to know your name.
 Jim (to Gaby): My name is Jim.
 Gaby (to Jim): I'm happy to meet you, Jim.
 Otto saunters over to the table.
 He holds two glasses and lazily puts them on the table.
 He says: Don't call me too soon. I need to rest.
 Gaby (to Otto): Thank you.
 Otto says: I just want to rest right now.
 He moves over to the bar with a sluggish gait.
 Gaby (to Jim): My boyfriend will arrive pretty soon, so please, tell me what you want.
 Jim crosses his arms in front of himself.
 Jim (to Gaby): Well, I'm a police officer and I have a few questions to ask you about your husband.

Figure 2: Interaction involving confident Jim, dynamic Gaby and lazy Otto

Identification of a personality

Question: Describe the personality of each character.

We decided to ask a question that allowed users to describe the different personalities in their own terms, in order not to influence their perceptions of the characters.

Session 1: Nasty Jim, nervous Gaby and friendly Otto

All the users identified Jim as nasty, using adjectives like rude, pushy, obnoxious, and mean. Gaby was described as nervous by seven people who said that she was unsure of herself, shy and hesitant. The other user found her cool and cooperative. Everyone considered Otto as friendly, using adjectives like cool, cheerful and happy-go-lucky to describe his personality.

Session 2: Confident Jim, dynamic Gaby and lazy Otto

Seven people estimated that Jim was confident and polite, using terms like relaxed and professional. The other person found that Jim was rather bold and impatient. Opinions regarding Gaby's personality were much more divided. Four users characterized Gaby as dynamic, using terms such as energetic and hurried. Two people described her as calm and assertive. One person said she was nervous, and another said she was pleasant. Otto was considered lazy by six users, who used adjectives such as sluggish and rude. One person said he was unprofessional and inconsiderate, and another that he was stand-offish.

Session 3: Selective Jim, reactive Gaby and choleric Otto

The identification of Jim's and Gaby's personalities was quite divided. Two people perceived that Jim was selective, mentioning that he was polite to Gaby but rude to Otto. Two mentioned that he was hurried. Two others said that he was playful and friendly, and two others that he was odd and strange. Four people perceived Gaby as reactive, using terms like impatient and pushy but polite. Two users found she was pleasant and friendly, one that she was nervous and uncomfortable, and one that she was rushed. Otto was considered rude by seven people who used adjectives such as impolite, bold, and mean. One person found Otto nondescript.

If we summarize the results, five personalities out of nine were identified correctly by at least six users over the three sessions. The choleric personality, which is mood-dependent, was confused with the rude one by seven people, which makes sense considering the scenario they used, Otto being initially angry at Gaby and saying very little to Jim. So, we can say that six personalities out of nine were identified by most of the users. We will look at the three other cases.

In session 2, dynamism was identified by only four people, but other users utilized terms such as pleasant, confident, and assertive, which could be associated with dynamism. We do not know for sure, because of the imprecision given by the free-form description.

In session 3, selective and reactive personalities were identified by only a few people. Such personalities were much more difficult to recognize given the length of our scenario, although a few users were able to recognize them correctly. A longer scenario where the difference of behavior resulting from a change in the values of moods and attitudes would be more perceptible would be necessary.

As a conclusion, we can say that mood- and attitude-independent personalities are usually recognized by users. Mood- and attitude-dependent personalities are more difficult to recognize if the scenario is too short. Additional user experiments with longer scenarios would be necessary to clarify this issue.

Believability of the characters

We tested believability of the characters using two indirect questions: one comparing the characters' behavior to human behavior, and one regarding the consistency of the characters. We avoided a question like "Do you think that the characters were believable?" because the term "believable" is open to a wide variety of interpretations.

Question: Do you think human beings could act as the three characters did? Why or why not?

Six people out of eight found that the characters were believable in the first and the third sessions, and seven out of eight in the second session. Users who did not consider the characters believable found them too extreme, or caricatured, especially the rude characters in sessions 1 and 3.

Question: Do you think the characters had a consistent behavior? Why or why not?

All the users found that the characters behaved consistently with their personality in the first session. In the second session, one person said that Jim was too strange in his behavior, and another affirmed that Gaby's behavior changed with time. In the last session, five people found the characters consistent. The three others found a problem with Jim, characterizing him as strange, having no personality or sensitive at first and loony at the end.

From those results, we can say that people usually believe in characters who have a consistent behavior and are not too extreme. They have more problem when a character's behavior changes over time, as Jim's does in the third session. Similar user experiments with longer scenarios would be interesting to run to see if such a problem would still exist.

Personification by the user

We wanted to know if users do take on the roles of their characters and forget their own personalities when they interact via their avatars with synthetic actors. We evaluated this aspect at two different levels: the influence of the characters' personalities on their selections of actions, and their reaction at the end of the scenario.

Question: Were the actions you selected for Gaby influenced by the characters' personalities?

Seven people said that their selections of actions for Gaby were influenced by the characters' personalities in the first session. Six gave similar answer after session 2, and all the users after session 3. About half of the users gave details about how they selected the actions. Most of them said they could not stay indifferent to rude or bold behaviors, and felt like reacting strongly or negatively to rude requests. Users who did not take into account the characters' personalities when they chose actions for Gaby said it was the case because they had a hard time

determining the characters' personalities, especially at the beginning of the scenario.

Questions: If you were Gaby, how would you feel after Jim's last answer? What would you do or say?

After each session, people were very creative about what they would do or say. All the answers would have been a very good continuation of the scenario, with respect to the emotions the users described for their character Gaby. For instance, in the first scenario, one of the last responses from Jim was: "Thanks for the drink, baby. It's just what I needed." Four replies we received from people who would have been upset if they were Gaby were:

- "Pay your own way cheapskate."
- "How dare you talk to me that way!"
- "But I didn't buy it for you."
- I would leave right away.

People seemed to have very emotional responses in general. We will look at the details of those emotions and compare them to Gaby's personality in each scene, to verify if those emotions could have been Gaby's in the context.

Session1: Nasty Jim, nervous Gaby and friendly Otto

The last response from Jim was upsetting or insulting, as the example we presented before. Five people said that they would be offended, insulted, taken advantage of, upset, or angry to such a reply. One user said that she would have been scared, another would have been bored, and the last one would have been confused. Considering Gaby's personality, she would probably have been more scared or confused than insulted.

Session 2: Confident Jim, dynamic Gaby and lazy Otto

Jim's last answer, such as "I'm a police officer and I have a few questions to ask you about your husband," was supposed to annoy Gaby or take her by surprise, according to her personality. Three people said they would have been annoyed, three scared, one surprised and one upset.

Session 3: Selective Jim, reactive Gaby and choleric Otto

One of Jim's last answers for this scenario was: "It's nice to spend time with a nice woman." It was a little mysterious in the context, and could annoy, surprise or flatter Gaby, with respect to her personality. A wide range of feelings were triggered in users: irritation and impatience (two users), surprise (two users), harassment (one user), flattery (one user), fright (one user), relief (one person).

According to our user experiments, we can say that people consider the characters' personalities when they select actions for their avatar, but usually forget the personality of their own avatar, rather reacting with their own personalities. Two people mentioned that they would have preferred to do something else at a given point in the

scenario. It just shows that people never forget their own personality while directing an avatar. Assuming that, it is not surprising that our users mentioned such a big variation in the emotions they would have experienced if they were in the shoes of the character portrayed by their avatar.

Reaction to the characters

Another hypothesis we wanted to verify is whether users react to fictive characters in the same way they react to human beings displaying the same kind of personality. We asked questions about which characters they would most or least like to spend time with.

Questions: Which character would you most like to spend time with? Why?

Which character would you least like to spend time with? Why?

Before the user experiments, for each set of characters, we picked ourselves the characters we would most or least like to spend time with, knowing the personality of each. We compare our picks with the users' answers.

Session1: Nasty Jim, nervous Gaby and friendly Otto

We thought that people would prefer to be with Otto because he was more likable, and would want to avoid Jim because of his rude manners.

Six people preferred Otto, saying that he was cool, a good waiter, friendly and polite. Two people said they would prefer spend time with Gaby, saying that she seemed easy to get along with. Everyone said they would prefer not to spend time with Jim, considering him as a jerk, too pushy, rude, coarse, and obnoxious. Our prognostics were right.

Session 2: Confident Jim, dynamic Gaby and lazy Otto

We predicted that most people would prefer to be with Gaby because of her energy and her dynamism, and they would like to avoid Otto because of his lack of enthusiasm.

Six people said they would prefer to spend time with Gaby, considering her enthusiastic and friendly. Two people would most like to spend time with Jim because he was polite and very likable. On the other hand, five users would prefer to avoid Otto because they found him lazy, depressing, boring, and rude. One person would avoid Otto and Gaby because she found them both impolite and hostile. Jim provoked suspicion in one of the users who would prefer not to be with him. Finally, one person said she would not like to be with Otto because he was a bore, and Jim because he was a macho. Our prognostics were right again.

Session 3: Selective Jim, reactive Gaby and choleric Otto

We predicted that most of the people would prefer to be with Jim or Gaby, because of their natural confidence without being rude if they have no reason to be upset. On the other hand, we thought that most people would least

like to be with Otto, because of his disturbing, choleric nature.

Seven users picked Gaby as their first choice to spend time with, saying she was a nice person, confident, friendly, and not too rude. One of those person added that Gaby was most like her. Jim would have been preferred by just one person, because of his politeness. On the other hand, Otto would have been avoided by six people who said that he was rude and unpleasant. One person found Jim manipulative and would not have liked to spend time with him. Finally, one person found Otto and Jim not interesting to spend time with. In that case, the clear choice by the users regarding spending time with Gaby was a little surprising.

Comparing the users' picks with our prognostics, it seems like users forget that fictive characters played by synthetic actors are not human beings, and have the same kind of reactions they would have with people possessing similar personalities.

Potential for entertainment

We assume that the evocation of emotion is a necessary condition for user to be entertained by a system such as the Cybercafé. So, at the end of all the experiments, we asked the users whether they felt any emotions and we also added a direct question about entertainment.

Question: Did you feel any emotions while using the Cybercafé?

We first let the users describe the emotions they felt, if any, during the interaction with the Cybercafé. All the people said they experienced emotions while using the Cybercafé, such as surprise, anger, humor, curiosity, and confusion. Two of them went further by saying that they identified with Gaby's emotions during the scenario. One person mentioned that she had a mild curiosity trying to understand the motive behind each character's behavior.

Question: Did you laugh?

We expected users to laugh using the Cybercafé, because laughs from the users, like laughs from the audience of a movie or a play, show that people are entertained. Five people affirmed that they laughed, from slightly to quite often. One person said she smiled, and two other users did not laugh at all.

Question: Are you surprised by Jim's last answer? Why?

Surprise is another ingredient that contributes to entertain people. When there is suspense in a scenario, people get tense and want to know the end. We asked that question regarding Jim's last answer at the end of each session to verify if surprise was experienced by the users.

Session1: Nasty Jim, nervous Gaby and friendly Otto

Seven people were surprised by the end of the scenario. Among those persons, five said that Jim's behavior was highly impolite or bold. The two other users thought that

Jim's response was totally unexpected given what was said before, and not stereotyped. The person who said that she was not surprised added that Jim just acted in accordance with his personality.

Session 2: Confident Jim, dynamic Gaby and lazy Otto

Six people experienced surprise with Jim's last action. Three of them mentioned that the motive given by Jim to be with Gaby was very unexpected. Two people considered Jim highly bold and impetuous at the end. The last user thought that Jim was just avoiding Gaby's question, "What do you want?". The two users who did not experience surprise thought that Jim was very consistent with what he said before, and being bold and impetuous at the end was a normal behavior, considering that he forced his presence with Gaby.

Session 3: Selective Jim, reactive Gaby and choleric Otto

Five users were surprised by the end of the scenario by Jim. Two of them estimated that Jim's last action was very unexpected with what was said before, and very emotional. Two others expected something big, a punch, at the end, and it did not come. Another, finally, said that Jim did not answer the question. The three users who were not surprised by Jim's reaction said that it was consistent with his personality, too stereotyped and too similar to his reaction in the first session, when he was nasty.

So, most of the users were surprised while interacting with the Cybercafé. Some of them mentioned that there was suspense during the scenario, and they could not wait to know Jim's motive for being with Gaby.

Question: Did you find the Cybercafé entertaining?

Finally, we directly asked a question regarding whether people found the Cybercafé entertaining. Everyone said that the system was entertaining, and they enjoyed the experience. Trying to find out the motive behind each action of a character was part of the fun.

From our user experiments, we can say that people interacting with a system like the Cybercafé find the experience entertaining for different reasons. Emotions, such as joy (expressed by laughs and smiles) and surprise are often experienced by users, as well as curiosity. The user taking part in the story through his or her avatar is probably another factor that contributes to making the Cybercafé entertaining, though we did not ask such a question in our experiments.

CONCLUSION

After describing a social-psychological model for synthetic actors able to portray characters with personality in an interactive environment, we presented the results of a first series of user experiments with the Cybercafé. By those experiments, we showed that:

- People are usually able to recognize correctly personalities built with our social-psychological model through a synthetic actors performance if the personality traits are not dependent of moods or attitudes. Mood- and attitude-dependent traits are more difficult to recognize if the scenario in which the actors play is too short to notice the change of moods and attitudes.
- Users usually believe in characters who have a consistent behavior and are not too extreme. Behavior that changes over time because of a change of moods or attitudes are more difficult to believe in if the scenario is short.
- People take into account the characters' personalities when they select actions for their avatars, but usually neglect the personalities of their own avatars. In fact, people prefer to shape the personality of their avatar rather than getting a predefined one for their character.
- Users socially and emotionally react to synthetic actors as if they were human beings.
- Applications involving users and synthetic actors are entertaining because of the emotions they trigger and the active participation required from the users.

A next series of user experiments should exploit a longer scenario that enables users to observe changes of moods and attitudes more easily and will hopefully confirm the results presented in this paper. Experiments with designers of characters using our social-psychological model will also be necessary to show that our model can provide desired personalities easily and accurately.

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REFERENCES

1. Atkinson, R. L., Atkinson, R. C., and Hilgard, E. R. *Introduction to Psychology*. Harcourt Brace Jovanovich, Inc., 1983.
2. Bandura, A. *Social Learning Theory*. Englewood Cliffs, Prentice-Hall, 1977.
3. Bates, J., Loyall, A. B., and Reilly, W. S. *An Architecture for Action, Emotion, and Social Behavior*. Technical Report CMU-CS-92-144, School of Computer Science, Carnegie Mellon University, 1992.
4. Briggs-Meyers, I., and Myers, P. *Gifts Differing*. Consulting Psychologists Press, 1980.
5. Guthrie, T. *Tyrone Guthrie on Acting*. The Viking Press, New York, 1971.
6. Hayes-Roth, B. An Architecture for Adaptive Intelligent Systems. *Artificial Intelligence* 72 (1995), 329-365.
7. Hayes-Roth, B., Brownston, L., and Sincoff, E. *Directed Improvisation by Computer Characters*. Technical Report KSL-95-04, Knowledge Systems Laboratory, Stanford University, 1995.
8. Hayes-Roth, B., and van Gent, R. *Story-Making with Improvisational Puppets and Actors*. Technical Report KSL-96-05, Knowledge Systems Laboratory, Stanford University, 1996.
9. Hayes-Roth, B., van Gent, R., and Huber, D. Acting in Character. To appear in *Creating Personalities for Synthetic Actors*. Trappl, R., and Petta, P. (eds.). Also Technical Report KSL-96-13, Knowledge Systems Laboratory, Stanford University, 1996.
10. Hogrefe, P. Bringing your Characters to Life. *Handbook of Short Story Writing*. Writer's Digest, 1970, 37-46.
11. Laurel, B. Interface Agents: Metaphors with Character. *The Art of Human-Computer Interface Design*. Addison-Wesley, Reading, MA, 1995, 355-365.
12. Maes, P. Artificial Life meets Entertainment: Lifelike Autonomous Agents. *Communications of the ACM*, 38:11 (1995), 108-114.
13. Nass, C., Moon, Y., Fogg, B. J., Reeves, B., and Dryer, D. C. Can computer Personalities be Human Personalities? *International Journal of Human-Computer Studies* 43 (1995), 223-239.
14. Nass, C., Steuerer, J., and Tauber, E. R. Computers are Social Actors. *Proceedings of CHI '94*, Boston, MA, April 1994, 72-78.
15. Reeves, B., and Nass, C. *The Media Equation: How People Treat Computers, Television and New Media Like Real People and Places*. Cambridge University Press, 1996.
16. Rousseau, D., Hayes-Roth, B. *A Social-Psychological Model for Synthetic Actors*. Technical Report KSL-97-07, Knowledge Systems Laboratory, Stanford University, 1997.