Social Snacking with a Virtual Agent – On the Interrelation of Need to Belong and Effects of Social Responsiveness When Interacting with Artificial Entities

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Abstract. Based on considerations that people´s need to belong can be temporarily satisfied by "social snacking" (Gardner et al., 2005) in the sense that in absence of social interactions which adequately satisfy belongingness needs surrogates can bridge lonely times, it was tested whether the interaction with a virtual agent can serve to ease the need for social contact. In a between subjects experimental setting, 79 participants interacted with a virtual agent who either displayed socially responsive nonverbal behavior or not. Results demonstrate that although there was no main effect of socially responsive behavior on participants´ subjective experience of rapport and on connectedness with the agent, those people with a high need to belong reported less willingness to engage in social activities after the interaction with a virtual agent – but only if the agent displayed socially responsive behavior.

Keywords: Virtual agents; social snacking; need to belong; socially responsive nonverbal behavior; rapport.

1. Introduction

In our daily lives, we interact more and more with all kinds of technology. In order to render these interactions with machines more intuitive and usable, research groups engage in developing autonomous virtual agents which are able to interact with the human user by means of verbal and nonverbal cues (Kopp et al., 2007; Bickmore, 2004). This development incorporates human-like cues into the interface, and with this new social dimensions enter human-technology interaction. Previous research demonstrated that people already act socially towards computers which interact with human-like cues such as speech (Nass et al., 1994; Reeves & Nass, 1996). These social reactions, for example, showing politeness or reciprocity towards the agent, become even more pronounced when an interface agent (such as a face) is presented on the screen (Gratch, Wang, Gerten, Fast, & Duffy, 2007; Hoffmann et al., 2009; Krämer et al., 2013b).

While social effects of virtual agents have been well documented (Krämer, 2005) and potential reasons for users' social reactions have been discussed in depth (Nass & Moon, 2000; Shechtman & Horowitz, 2003), there is considerably less research on the question of whether the social interaction with artificial entities is experienced as socially rewarding and can fulfill social needs in a way similar to human-human-interaction. These questions, however, become increasingly important as agents are foreseen to not only serve as interface technology in service realms (information kiosks), as navigation support (on websites or in automatic teller machines) but will most likely also be employed as companions (to provide the opportunity for basic social interaction for senior citizens

deprived of social contact). It therefore becomes important to analyze whether conversations with virtual agents are capable of fulfilling social needs in the sense of satisfying people's need for contact. Although it will not be assumed that the conversation with virtual agents might be able to substitute for social contact with fellow humans, it can be argued that virtual humans might serve as "social snacks" as described by Gardner et al. (2005). This would mean that – when social interaction with fellow humans is not available - people might temporarily satisfy their social needs by settling for a snack which helps them to wait for the more adequate need satisfaction. That humans have a fundamental need for contact and belonging has aptly been described in a seminal paper by Baumeister and Leary (1995). Additionally, it has been demonstrated that regular and meaningful social contact is important for people's health (Cacioppo & Patrick, 2008). Although the need to belong as a fundamental need is characteristic for all humans, there are idiosyncratic differences (Kelly, 2001). Also, Leary et al. (2005) have suggested that there are individual differences in need to belong and provide a scale to assess the individual need to belong.

The goal of the present study is to explore to what extent conversations with virtual agents can satisfy social needs and to what degree this is dependent on people's individual need to belong. As a crucial factor which might affect the social satisfaction resulting from a conversation with a virtual human, we analyze the influence of the quality of the interaction in terms of socially responsive nonverbal behavior (smiling, nodding) provided by the agent (Gratch et al., 2007b). This work is intended to provide support for the idea that virtual characters under specific circumstances can be considered as real conversation partners and, therefore, can alleviate people's need for social contact. In order to test the presented assumptions, the participants interacted with a virtual character, the so-called Rapport Agent who shows socially responsive behavior (Huang et al., 2011).

2. Social effect of virtual agents

Cassell, Bickmore, Campbell, Vilhjálmsson, and Yan (2000) coined the term Embodied Conversational Agents (ECA) to describe computer generated anthropomorphic interface agents that employ humanlike behavior within a dyadic conversation with a human user. ECAs "may [therefore] be defined as those that have the same properties as humans in face-to-face conversations" (Cassell et al., 2000, p. 1) and as such, ECAs are capable of perceiving verbal and nonverbal cues and subsequently reacting on the given input. They are equipped with feedback and turn-taking features. Moreover, they are able to engage the user in a relevant conversation using social cues such as speech, gestures and gaze (Bickmore & Cassell, 2005).

Several researchers assume that people accept virtual characters as fellow conversation partners (Ryokai et al., 2003; Miller et al., 2011). Indeed, numerous studies have shown that people exhibit social behavior towards virtual characters and that their communication strategies resemble those used in human-human interaction (Nass & Moon, 2000; Krämer, 2005; Krämer et al., 2013b). Even though a conversation with a virtual character does not come close to a natural conversation between two individuals, it was demonstrated that numerous forms of social effects occur while interacting with a machine. Social effects in this context are commonly understood as people's display of emotional, cognitive and behavioral manners when a machine is present. These manners are similar to those people display when talking to another individual and range from showing impression management tendencies (Kiesler et al., 1996) to using more natural speech instead of other input modalities (Krämer, 2005) when reciprocating to an agent's smile (Krämer et al., 2013b). While these tendencies have been shown for the interaction with (talking) computers (see studies within the Media Equation and Computers as social actors paradigm, Nass et al., 1997; Fogg & Nass, 1997), current studies indicate that effects might even be more pronounced when humans are confronted with more realistic social cues in terms of an agent's human-like appearance and nonverbal cues (Hoffmann et al., 2009; von der Pütten, Krämer, Kang, & Gratch, 2010).

The reasons for these social reactions have already been discussed widely: while Kiesler et al. (1996) assume that these behaviors are merely triggered by demand characteristics of the (laboratory) situation and can be interpreted as superficial "as though" reactions, Nass and Moon (2000) argue

that the behavior is profoundly social (termed ethopoeia). They assume that although all users consciously know that the computer does not warrant human treatment, they cannot help acting socially due to humans' social nature. People mindlessly display social behavior as soon as they perceive a potential interaction partner – as long as he/she/it displays basic social cues. The computer or agent triggers a set of behavioral scripts that makes it unlikely for the user to actively process and reflect information (von der Puetten et al., 2010). Kappas (2005) emphasized that humans have a basic need to react socially towards potential interaction partners as they feel incomplete when they are alone and therefore are in persistent search for dyadic interaction and in this sense are "free monadic radicals".

In summary, previous research supports the idea that people unconsciously act socially towards computers even though they know that it is a computer that does not warrant social treatment. Further, it has been demonstrated that a minimal set of human-like cues are sufficient to encourage people to engage in social dialogue with computers. While only a minimal set of cues is required to elicit social manners, however even stronger social reactions occur when humans are presented with more human like cues.

It seems that people are eager to conduct social dialogue with computer agents and that social effects can be generated automatically. The occurrence of social effects and the readiness to interact with virtual characters are of particular interest for this work as this paper explores the potential satisfaction people can get through human-machine interaction. Bickmore (2004) not only presumed a human readiness but even a need to engage in more profound human-machine dialogue.

2.1. Need to belong

Both the ethopoeia assumption and the notion that humans feel incomplete when they are alone demonstrate that the human need to belong is an integral part and prerequisite of people's willingness to converse with virtual interaction. Most personality theories include the idea that people have a natural drive to affiliate with others. Baumeister and Leary (1995) complemented this idea by claiming that this drive is more than an affiliation desire, it is an actual human need and a fundamental human motivation. Due to this natural need people establish new interpersonal relationships and, at the same time, maintain a certain amount of already existing significant social bonds. People's need to belong is a powerful, universal, and influential human drive that accounts for emotion, cognition and behavior. Social satisfaction can be achieved through social interactions that have to meet certain requirements: on the one hand, the interactions have to take place repeatedly and on a regular basis. Ideally, social bonding is featured with positive or pleasant experiences or should at least be free of negative sensations.

On the other hand, the interaction should bear certain stability and also give both interaction partners the feeling of mutual affective concern (Baumeister & Leary, 1995). There are two ways of satisfying belonging needs: forming bonds and not breaking bonds. Forming new social bonds should happen easily without requiring much effort and has been associated with positive emotions such as joy and happiness (Baumeister & Leary, 1995). People usually refrain from breaking social bonds as it is always related to distress (Cacioppo & Hawkley, 2009; House et al., 1988). Deprivation of social contact is linked to decreasing health and happiness. The effects of social desertion can have impacts on the immune system and can even reach a level where even the human DNA is altered (Cacioppo & Patrick, 2009).

While the need to belong has been described as a fundamental human need, interindividual differences have also been taken into account. People differ with regard to the extent of their need and motivation to engage in social interaction and bonding (Leary et al., 2005). Based on this notion, instruments to assess the individual need to belong in the sense of a trait have been presented (Krämer et al., 2013a; Leary et al., 2005 – the latter scale being especially developed as a predictor for media usage). From this research, we assume that the need to belong helps us to understand people's motives behind social behaviors in human-human interaction and can also be applied to human-computer interaction.

2.2. Satiation and social snacking

Belonging needs are a natural human phenomenon and people constantly reach out to others in order to socialize. However, is this need insatiable? Numerous researchers have shown that individuals only form and maintain a certain number of relationships and when that number is exceeded, the drive to socialize declines (Baumeister & Leary, 1995). Those who are well integrated in a stable social network should hold fewer desires to create new bonds than those who are socially depleted. Figuratively speaking, socializing can be referred to as having a meal. When people's need for social contact is satiated, their social seeking behavior decreases. But when individuals are socially starving – because they feel lonely – they want a meal (Gardner et al., 2005). At times a meal is not readily accessible and people have to be satisfied with a simple snack. Gardner et al. (2005) proposed "that there may be 'social snacks' that provide temporary stopgaps for social hunger when a 'social meal' (e.g. interaction with an accepting other) is unavailable" (p. 232). Those "social snacks" can satisfy an individual's need at short notice but are not fulfilling, which is plausible: people are hungry, but instead of getting a Lasagna, they have to settle for a Snickers.

Social snacks may work as a surrogate when relevant interaction partners are not available (e.g. in distance relationships, people look at photos or re-read emails) or when people feel lonely due to lack of potential interaction partners. In this context, Gardner et al. (2005) describe social shielding with non-reciprocal parasocial attachments. "Parasocial attachments are defined as attachments to television personae, such as news anchors or fictional characters on sitcoms or soap operas" (Gardner et al., 2005, p. 237). People get attached to surrogates in order to shield from a lack of social contact, and for those high in need of social contacts, it is even possible to bond with completely unrealistic artificial characters (Gardner et al., 2005). Consequently, this raises the question of whether a virtual human can serve as a surrogate and generate the same effects. Specifically, it is not known whether those who have a high need to socially belong can also affiliate with a virtual human and use the interaction as a social snack.

Additionally, Pickett et al. (2004) argued that for individuals high in need to belong, it is especially important to stay socially connected, as their findings depict a relationship between belonging needs and social sensitivity. They found that those who feel a high need to socialize can sense and decode verbal and nonverbal social cues more easily than those who have comparatively low belonging needs. Advanced technologies are often featured with social cues. For instance, a virtual character uses facial expressions and language which are very common sources of social information (Pickett et al., 2004). Therefore, people who are particularly attuned to social cues due to their high level of need to belong may display a readiness to gain social satisfaction via advanced technology – if this technology is able to provide believable social cues.

2.3. Virtual rapport and the role of nonverbal behavior

Having a good conversation satisfies people's belonging needs. But how exactly do people define a good conversation? A flowing interaction is marked by harmony and synchrony; in social psychology this is often referred to as rapport. Rapport is said to have positive influences in "negotiations, management, psychotherapy, teaching and caregiving" (Gratch et al., 2007a, p.1; also see Drolet & Morris, 2000). Tickle-Degnen and Rosenthal (1990) described three major components when defining rapport: mutual attention, positivity and coordination. According to that, rapport occurs on three levels. On the behavioral level, both interaction partners align their body movements (e.g. posture shifts, nods), on the emotional level, both conversation partners feel comfortable and perceive the interaction as rewarding. Finally, on the cognitive level there is a shared understanding (Tickle-Degnen & Rosenthal, 1990; Gratch, et al., 2007a). Rapport is a sign of quality within an interaction and does not arise in every interpersonal conversation. When rapport occurs, people are more responsive to what the counterpart is saying, broaden their variety of topics, keep more eye-contact, smile more frequently and increase proximity (Grahe & Bernieri, 1999; Cassell, Gill, & Tepper, 2007), showing that rapport happens both on a verbal and on a nonverbal level. However, some researchers (Grahe & Bernieri, 1999; Tickle-Degnen & Rosenthal, 1990) argue that nonverbal cues are more essential indicators (and drivers) for rapport. For example, Grahe and Bernieri (1999) found that people assessed rapport (operationalized as mutual liking) more accurately when nonverbal cues were accessible. Overall, rapport can be viewed as a phenomenon with two different

characteristics: instant liking and responsiveness, as well as an increasing interdependence over time (Cassell et al., 2007). Therefore, Cassell and colleagues (2007) distinguished between short-term and long-term rapport. Whereas short-term rapport demands all three components (mutual attention, positivity and coordination) to the same extent, long-term rapport differs. They proposed that when a relationship deepens, positivity becomes less important, coordination increases while mutual attention remains at the same level (Cassell et al., 2007). This study focuses on short-term rapport, instant liking and responsiveness.

Research on Embodied Conversational Agents (ECAs) has shown that virtual humans can be a useful tool to establish rapport within a conversation (Maatman et al., 2005; Gratch et al., 2006; Huang et al., 2011). The Rapport Agent, developed by Gratch et al. (2006), can produce listening behaviors and has been shown to have an effect on human's social behaviors. In order to encourage the human story teller to continue talking, the Rapport Agent is – amongst other features - equipped with so called backchannel continuers (e.g. head nods) (Gratch et al., 2007a). The agent perceives the speaker's upper body movements and therefore generates appropriate head nods as a response to what the speaker is saying. Additionally, the agent displays a broad set of nonverbal behaviors such as eye-blinking, different posture shifts and smiling. Empirical research has shown that these are the most important cues which help to establish rapport between two interaction partners (Grahe & Bernieri, 1999; Huang et al., 2011). By analyzing the human user's body movements in real time (disfluency of speech, smiles, head nods), the behavior of the virtual human can be produced as contingent responsive behavior (Gratch et al., 2007a). The Rapport Agent therefore not only displays evident social cues such as vocal tone and facial expressions but also provides interaction abilities which might render it a rewarding conversation partner. Thus, social responsive behaviors and subsequent rapport within a human-machine dialogue may help to increase social satisfaction, which is an integral part of the current research.

2.4. The present research and hypotheses

The goal of the present study is to explore to what extent conversations with virtual agents can satisfy social needs in the sense of "social snacks" described by Gardner et al. (2005). As crucial influencing factors, we have described people's individual need to belong as well as the quality of the interaction in the sense of the socially responsive behavior shown. Therefore, we aim at contributing to a more complete understanding of whether a human-computer interaction can provide rapport that satisfies one's need for social contact and to what degree this is dependent on one's individual need to belong.

The Rapport Agent is designed to establish rapport in the sense of mutual liking, increased responsiveness and positivity between itself and the user by displaying contingent nonverbal behaviors. Subsequently, when the virtual counterpart displays social responsive behavior, it should be perceived as conveying more rapport and should be rated as closer (e.g, mutual liking). Therefore, the following hypotheses can be formulated:

Hypothesis 1: The agent in the socially responsive condition is perceived to convey greater rapport than the agent in the control condition.

Hypothesis 2: The agent in the socially responsive condition leads to more perceived connectedness than the agent in the control condition.

Since the quality of interactions in terms of responsiveness and positivity have been described to be associated with satisfying one's need for social contact (Baumeister & Leary, 1995), it can be assumed that only when the agent conveys rapport, there is the possibility to contribute to the satisfaction of the momentary need for social contact.

Hypothesis 3: After interacting with the agent in the socially responsive condition, participants feel less willingness to engage in further interaction compared to after interacting with the agent in the control condition.

Likewise, based on the fundamental attributes of the need to belong described by Baumeister and Leary (1995) as well as of the description of the need to belong as an individual trait (Leary et al.,

2005) it can be assumed that the higher people's need to belong is, the more will they strive for any kind of further social interaction.

> Hypothesis 4: Participants with more individual need to belong will have more willingness to engage in further interaction after talking to the virtual agent compared to those with lower need to belong.

As described above, people with a high need to belong have an increased willingness to socialize with others. But especially because of their increased need for interaction, they might also be open for satisfying their need by a "social snack" (Gardner et al., 2005). However, at the same time, not every social cue might be able to provide a "social snack" – for example, merely showing a picture of a virtual agent or merely providing a non-responsive agent may not be sufficient. People will only reach satisfaction with the interaction and consider the agent as a "social snack" if a minimum of reciprocity and positivity is given (if the agent displays socially responsive behavior). Therefore, we assume that – for people high in need to belong - the interaction with the virtual agent can only satisfy social needs (and serve as social snack) when the agent is responsive.

> Hypothesis 5: There is an interaction of need to belong and the socially responsive behavior of the agent: Only when the agent is socially responsive, people with high need to belong will experience a decrease in willingness to engage in further social activities.

Finally, the satisfaction with the interaction with the agent might be assessed by inquiring for behavioral intentions, namely the willingness for further interactions with the virtual agent. Accordingly, we ask:

> RQ: Which interaction partner (virtual agent, fellow human, alone) is preferred for a follow-up task and to what extent is the decision dependent on people's individual need to belong and the agent's socially responsive behavior?

3. Method

3.1. Participants

A total of 79 participants (men = 38, women = 41) were recruited from the Greater Los Angeles Area. The recruitment was conducted via the online platform Craigslist.com and appointments were administered by the scheduling tool Acuityscheduling.com. People aged 18 to 70 were eligible; the age range was from 18 to 66 (M = 35.26, SD = 12.38). All participants signed a consent form in order to take part in the study. Exclusion criteria were subjective impaired vision and non-English speakers.

3.2. Design

The participants were randomly assigned either to the experimental or control condition. 40 people interacted with the virtual human in the socially responsive behavior condition in which the agent displayed nonverbal feedback such as head nods and smiles. The remaining number of participants (N = 39) was assigned to the control group using the virtual human that did not show any kind of feedback but merely slight and randomized posture shifts and eye blinking in order to appear alive (idle behavior).

3.3. Procedure

Upon entering the lab, participants were instructed and asked to sign a consent form. All participants had to fill out several questionnaires about their personality before the interaction with the Rapport Agent started. They were informed that they would interact with an autonomous virtual human. However in fact, the agent only partly acted autonomously. The questions it posed were triggered by a Wizard-of-Oz procedure in which the agent was controlled by a human who started the next question at the appropriate time (Dahlbäck et al., 1993). Participants used a 30 inch screen to complete the online survey and interact with the virtual human, they were also provided with a headset in order to talk to the virtual agent and a keyboard and a computer mouse to answer the questionnaires. There were two webcams and one HD-camera installed facing the participants.

Participants were randomly assigned to one of the two conditions. During the interaction, the virtual human asked the participant five questions of increasing intimacy. In order to facilitate the

answers, the agent started out by telling something about itself (see Nass & Moon, 2000; von der Pütten et al., 2010). The questions were:

1) I was designed and built by ICT researchers here in Marina del Rey. What is your hometown?
2) When I don't interact with people, I usually study them so I can better communicate with them. What are your favorite things to do in your free time?
3) I like to listen to what people say. I have lots of patience for listening, even if you have a lot to say. What characteristics of yourself are you most proud of?
4) I feel furious when people treat me as if I was just a machine without any thinking or feeling. What are some of the things that make you furious?
5) My abilities are somewhat limited. For example, I can speak and listen to what you say, but I can't walk down a street in your world. What are some of the things you hate about yourself?

Afterwards, all participants filled out post-questionnaires, which comprised the evaluation of the agent and the interaction and an assessment of people's need to reach out to others. During the experiment the instructor remained in an adjacent room monitoring the participants via video camera. After completing the questionnaires, the instructor re- entered the room and posed one last question (who to play a follow-up game with). Each session lasted approximately 35 minutes. Afterwards, participants were fully debriefed and then they received $25 as compensation.

3.4. The agent

The agent was used as a listener in the dyadic conversation set-up. The agent attempts to establish rapport during the conversation by dis- playing continuous nonverbal feedback (see Gratch et al., 2007b). For the purpose of this study and in order to be able to generalize the results to different appearances, two (female) representations of the agent were used. Both agents were used in both conditions (see Fig. 1).

Fig. 1. Appearance of the virtual agents employed in the study.

The version used for this study was the second – modified – version of the agent. In the first version, the agent acted as a silent but attentive agent. It was later extended to an interview-like setting where the agent used pre-recorded questions to establish a conversation, similar to the setting at hand (Huang et al., 2011). In order to create rapport within a dyadic conversation, attention and coordination of nonverbal cues are crucial. Head nods, smiling and posture shifts represent indicators for rapport during the conversation. The agent is able to detect these indicators and then tries to replicate the participants' behavior by giving contingent nonverbal feedback (Wang & Gratch, 2009). By doing so, the agent follows a set of rules derived from social science literature. Huang et al. (2011) enhanced the agent's accuracy in giving feedback and developed a modified version of the agent

(Huang et al., 2011). The modified system architecture consists of three main components: 1) perception, 2) response and 3) visualization..

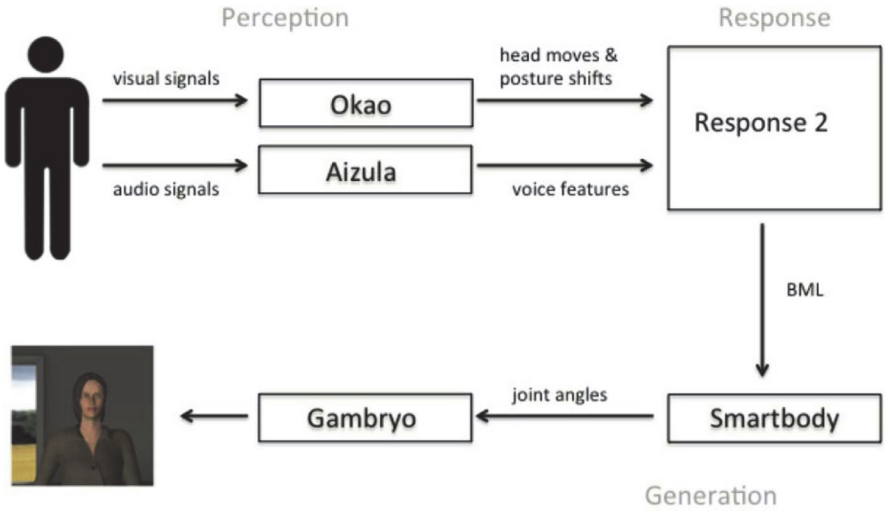

Fig. 2. Architecture of the rapport agent.

The perception component collects and analyzes audiovisual data - the participants' upper-body movement and voice - in real-time. In order to detect all audiovisual features the agent uses two different software packages: Okao and Aizula. Okao detects visual features such as head nods, the position and orientation of the participants' head, eye-gaze (gaze drifts away or not) and the smile level (Huang et al., 2011). The software monitors the interviewees' upper-body movements and posture shifts. Aizula captures audio signal (speech and silence) and analyzes the pitch and intensity of the participants' speech. The recognized audiovisual signals are then sent to the response component (Kulms et al., 2011; Huang et al., 2011).

In the response component, the captured features are run through a set of feedback rules, which determine the agent's nonverbal reaction to what the participant is saying. The software recognizes speech, silence, smile and eye-gaze and then provides the appropriate backchannel feed- back.

As a next step, the output from the response component is transferred to an animation system using Behavioral Markup Language (BML). The output determines the virtual human's reaction. The animation system, Smartbody (Thiebaux et al., 2008), guarantees a coherent dyadic conversation by alternating active and passive behavior. After that, the animated feedback is rendered by Gamebryo, a commercial game engine, and displayed on the screen (Gratch et al., 2006; Huang et al., 2011) (see Fig. 3). In the interactions during the experiment, the agent in the so- cially responsive condition on average smiled 17.25 (SD = 18.93) times and nodded 14.43 (SD = 8.97) times.

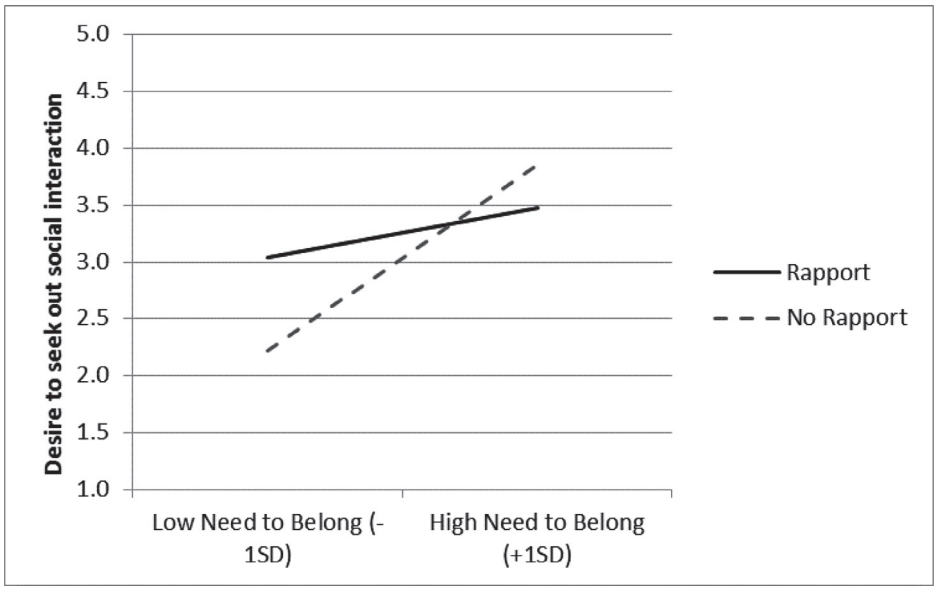

Fig. 3. Simple slopes of the interaction of need to belong and rapport condition.

4. Measures

4.1. Dependent variables

Perception of the agent. In order to measure people's perception of the agent, the participants were asked to fill in two post-questionnaires. First, the Rapport Scale (Kang & Gratch, 2012) with 23 items was used in order to assess how participants perceived the interaction and the Rap- port Agent per se (e.g., "I felt I had a connection with the listener"; "The interaction was frustrating" ; "The listener's body language encouraged me to continue talking"). People were asked to evaluate the interaction on a 7-point Likert scale (very strongly disagree – very strongly agree). In order to conduct further analysis the 23 items were all combined into one variable (Cronbach's α = .92, M = 4.24, SD = .855).

Secondly, parts of the Social Connectedness questionnaire (van Bel et al., 2009) were employed. The questionnaire developed by van Bel et al. (2009) consists of two parts: the Specific Connectedness Dimension and the Overall Connectedness Dimension. For this study 14 of 18 items from the Specific Connectedness Dimension (2. Dissatisfaction with contact quality, 3. Shared understandings, 4. Knowing each other's experiences, 5. Feeling of closeness) were used with a 5-point Likert scale (strongly disagree – strongly agree). Relationship salience was excluded since the participants did not interact with the Rapport Agent before. The items were slightly rephrased to adjust the measurement to human-machine interaction ("I derive little satisfaction from the contact with X" – "I derive little satisfaction from the contact with the virtual human"). The 14 items were all combined into one variable (Cronbach's α = .91, M = 2.53, SD = .696).

Willingness to engage in social activities. The study aims at demonstrating that virtual humans can satisfy people's need for social contact and therefore alleviate the need to engage in social activities. 18 items in total were developed in order to measure people's willingness to socialize after the interaction with the virtual human. The participants were asked to answer the items using a 5-point Likert scale (1 = very likely, 5 = very unlikely). A factor analysis was con- ducted on the 18 items with orthogonal rotation (varimax). The Kaiser- Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = .72. Bartlett's test of sphericity χ 2 (153) = 836.82, p < .001 indicating that the correlations were sufficiently large for Principle Components Analysis. An initial analysis was run to obtain eigenvalues for each component in the data. In total there were five components over Kaiser's criterion of 1. However, only the first two factors had good re- liabilities and were retained in the final analysis explaining 48.38% of variance in combination. Table 1 shows the factor loading after rotation. The items that cluster on factor1 all describe the desire to engage in so- cial activities with friends and family and can therefore be summarized as "desire". Due to

incompatibility in regards to the content, the item "I am going to call my friends today" was excluded from factor 1. Factor 2 represents people's actual plans to socialize after the interaction and can be termed "plan".

Table 1. Factor analysis of the items measuring willingness to socialize.

Item	desire	action
	Desire	Plan
Now I would like to meet my friends.	**.862**	-.177
Now I feel like calling my friends.	**.807**	
Now I feel like socializing.	**.781**	-.145
Now I would like to meet my family.	**.759**	-.230
Now I want to feel close to my friends.	**.750**	-.352
Now I want to feel close to my family.	**.745**	-.379
Now I feel like calling my family.	**.724**	
Now I feel like texting my friends.	**.662**	.196
Now I feel like texting my family.	**.607**	.142
I am going to meet my family today.		**.701**
I am going to text my family today.	.244	**.688**
I am going to text my friends today.	.384	**.642**
I am going to call my family today.	.439	**.552**
Eigenvalues	6.09	2.62
% of variance	33.85	14.53
α	.91	.72

Behavioral intention. In addition to the ad hoc items, a behavioral measurement was used in order to assess the participants' need for social contact. People were asked to join a follow-up game and had three options concerning the interaction partner to choose from. They could either chose to play (1) by themselves, (2) with the same virtual human they had already encountered, or (3) with another participant. The follow-up task offered the opportunity to incorporate a behavioral measurement in the study and thus broaden the variety of response options regarding the subjects' need for social contact.

4.2. Moderating variables

Need to belong. Personality traits might influence the effect that in- dependent variables have on the dependent variable. Therefore people's individual need to belong was measured. In order to assess the participants' urge to socially belong, a Need to Belong Scale comprising 10 items was used (e.g., "Social bonds are important to me"; "I do not like being alone") (Krämer et al., 2013a). The participants were asked to fill out the questionnaire on a 5-point Likert scale (from 1 = strongly dis-agree to 5 = strongly agree). In order to conduct further analysis, the 10 items were all combined into one variable (Cronbach's α = .69, M = 3.47, SD = .489).

5. Results

Before testing the hypothesis we explored the descriptive values of need to belong scale in the two conditions. A t-test revealed there was a significant difference in need to belong between control (M = 15.90, SD = 1.77) and socially responsive (M = 14.55, SD = 2.93) conditions (t(77) = 2.47, p = .02). While one might argue that the lower need to belong observed in the socially responsive condition indicates range restriction (e.g., floor effect), which could lead to a lack of an effect of need to belong (on plans to seek out others), the fact that there is actually a ∗larger∗ standard deviation for need to belong in that condition rules out that possibility.

Although it was expected in H1 that participants would report experiencing greater rapport with the socially responsive agent in comparison to the agent without socially responsive behavior, there was no difference between these conditions (M = 4.20, SD = .89 vs M = 4.27, SD = .82, t(77) = .34, p

= .74). Likewise, participants did not report greater connectedness with the agent in the socially responsive condition than in the socially non-responsive condition (M = 2.51, SD = .72 vs M = 2.54, SD = .68, t(77) = .21, p = .83). Therefore, hypotheses 1 and 2 were not supported. Additionally, t-tests did not reveal significant differences between the socially responsive condition and the socially non-responsive condition in "desire" (M = 3.24, SD = .83 vs M = 3.36, SD = .83, t(77) = .66, p = .51) nor in "plan" (M = 3.20, SD = .95 vs M = 3.26, SD = 1.05, t(77) = .25, p = .80). Thus, there is no evidence that the quality of the interaction affects people's willingness to engage in further social contact. Therefore, H3 was not supported.

In order to demonstrate that virtual agents who engage in rapport- building behaviors can serve as social snacks, reducing the willingness to engage in social activities among those who have a strong need to belong, moderated regression analyses were performed on both the "de- sire" and "plan" variables.

First, to analyze "desire", we conducted a regression analysis predicting state levels of desire to seek out social interaction by entering trait need to belong (centered) in first step, adding condition (dummy-coded: 0 = socially non-responsive agent, 1 = socially responsive agent) in a second step, followed by adding the need to belong × condition interaction term in a third step. As expected, chronic need to belong predicted immediate desire to seek out social interaction (ß = .38, t(76) = 3.61, p = .001), and there was no need to belong by condition interaction (ß = −.05, t(75) = −.49, p = .63).

To analyze "plan", we conducted another regression analysis predicting state levels of plan to seek out social interaction by entering trait need to belong (centered) in a first step, adding condition (dummy- coded: 0 = socially non-responsive agent, 1 = socially responsive agent) in a second step, followed by adding the need to belong × condition interaction term in a third step. While chronic need to belong predicted the plan to seek out social interaction as expected (ß = .36, t(76) = 3.36, p = .001), there was a need to belong by condition interaction (ß = −.51, t(75) = −2.49, p = .02). Likewise, a 95% confidence interval for ß includes 0, as it ranges from −.004 to .436. As can be seen in Fig. 3, follow-up simple slope analyses within each condition revealed that, after interacting with an agent that was not designed to display socially responsive behavior, participants with a heightened need to be- long have a much stronger plan to reach out to others eminently (ß = .82, t(75) = 3.94, p < .001). However, interacting with an agent that engages in socially responsive behaviors provided a social snack, as those with a stronger need to belong were less planning to seek out social interaction after interacting with the socially responsive agent (ß = .22, t(76) = 1.73, p = .09). Therefore, in sum, H4 was supported since our data show that people with increased need to belong had an increased need to seek out further interaction after the conversation with the virtual agent (independent of the condition). Also, we find support for H5 since people with a high need to belong were less planning for further social contact after the interaction with the agent that displays socially responsive behavior compared to an interaction with an agent not showing socially responsive behavior.

With regard to the decision with whom to play an alleged game, descriptive data show that 57% of all participants chose to play the follow- up game with the virtual human as a partner. 29.1% opted for another participant and only 13.9% decided to play by themselves. People's decision was regardless of the condition in which they were interacting with the agent. A regression analysis shows that need to belong also did not influence the decision with whom to play. Therefore, it can be summarized that people in general valued the interaction with the virtual agent so that more than half of the participants opted to continue the interaction. However, this was neither affected by condition (thus, the socially responsive agent was not chosen more frequently) nor by people's individual need to belong.

6. Discussion

The present study aimed at investigating whether virtual humans can satisfy one's need for social contact. As previous findings indicated, a minimal set of human-like cues is sufficient to encourage people to engage in social dialog and can also be found in human-machine inter- action (Pickett et al., 2004). For instance, if virtual characters feature social cues such as language or facial expressions and

have basic dialogue abilities, it was assumed that they can serve as means for social satisfaction – at least in the sense of providing a "social snack" as defined by Gardner et al. (2005). Hence, this study explored whether a virtual human, specifically the Rapport Agent when showing socially responsive behavior, is capable of satisfying people's need for social contact depending on their individual need to belong. Therefore, two different versions of the Rapport Agent were employed: one that displayed socially responsive, contingent nonverbal behavior (smiling and nodding), which is assumed to enhance social effects during a dialog, and one version that exhibited only verbal cues and basic idle nonverbal behavior. With regard to people's perception of the agent, the results showed that the evaluation in terms of rapport and perceived connectedness to the agent did not depend on the condition (socially responsive condition vs. control condition) that the participants were assigned to. The participants rated the agent's performance and connectedness irrespectively of the nonverbal behavior display. The results did not confirm Gratch et al.'s (2007b) findings that nonverbal behavior of a virtual character influences people's perception and experience.

Usually, rapport within a dialog is seen as an indicator for good conversation quality and is associated with increased mutual liking (Tickle- Degnen & Rosenthal, 1990). As Grahe and Bernieri (1999) pointed out, the nonverbal component is crucial when establishing rapport among the conversation partners. The Rapport Agent does feature a wide range of nonverbal feedback such as diverse head nods, eye blinking, posture shifts and smiling, which has been shown to be sufficient to produce increased evaluation and social behaviors (Gratch et al., 2006; Huang et al., 2011; von der Pütten et al., 2010). A lot of research regarding the establishment of rapport during human-agent interaction focuses on short-term rapport (instant liking) (Maatman et al., 2005; Gratch et al., 2006). While it is not clear whether long-term rapport can be established by technology, the perception of short-term rapport has been demonstrated and therefore was expected to emerge in this study. Since other studies have already shown effects of socially responsive behavior of the agent, it is difficult to explain why there was no main effect on perception of rapport and of connectedness here.

One potential explanation to be considered is that other studies tended to show more pronounced effects on participants' behavior in- stead of participants' perception and subjective experiences (Gratch et al., 2006; Huang et al., 2011; von der Pütten et al., 2010). Therefore, socially responsive behavior seems to have the potential to be influential even without people consciously noticing it – and this was also true in our study: with regard to the factor "plan", socially responsive behavior impacted future behavioral plans (moderated by the need to belong trait) although these same participants do not describe rapport and an increased connection. Although there was no main effect of the socially responsive condition on the willingness to engage in social contact, it became evident that especially for people with a high need to belong, the plan for future social contact on the same day is diminished only after having had a high-quality, socially responsive interaction with a virtual agent.

Another plausible explanation might be that in the specific interview and conversation situation in our study, there was little opportunity for the agent to display rapport behavior. Since the agent's behavior is contingent to the participant's behavior the agent would not show a lot of rapport behavior if the participant did not display much nonverbal behavior. However, the fact that the agent showed on average 17 smiles per interaction would speak against this assumption.

Additionally, the Rapport Agent produces its nonverbal feedback without attending to the verbal content of the participant's comments, which can lead to faulty feedback (Gratch et al., 2007a). In order to propel mutual understanding, it is crucial to give specific responses to what the counterpart is saying. Faulty nonverbal responses that the agent dis- plays can be highly inappropriate in some cases. For instance, in the present study one of the questions asked by the Rapport Agent broached the issue of what makes the participant furious. Smiling as a response can be detrimental in this case – even if the smiling is a reaction to the participants' smiling. Summing up, therefore, the present context- free feedback could have led to frustration with the agent, as the user might have felt misunderstood. However, the follow-up questions show that there is no general disappointment or frustration with the agent since more than half of the participants chose to continue their conversation with the agent.

With regard to main effects of personality traits, it was tested whether people's individual need to belong (Leary et al., 2005; Kelly, 2001; Krämer et al., 2013a) would affect the willingness to engage in future social interaction. Here, it was indeed shown that need to belong predicts whether people wish to engage in social contact after the interaction with the virtual agent and whether they would initiate actual social meetings (e.g. phoning friends, meeting family). Given the definition and measure of the need to belong trait which includes the tendency to affiliate with others (Baumeister & Leary, 1995; Krämer et al., 2013a), this finding is not surprising.

More astonishing and the most important finding of our study is that for people with a high need to belong, the interaction with a virtual agent can indeed diminish their plan to engage in social contact, but this is true only when the agent displays socially responsive behavior. In sum, when people interact with a virtual agent, a higher need to belong is associated with more plans to talk with other people, but not if the virtual agent itself provides social "treats" by smiling and nodding. Therefore, a minimum of reciprocity and positivity (Tickle-Degnen & Rosenthal, 1990) is necessary in order to reach sufficient satisfaction with the situation so that further social interaction is rendered less important. An explanation for why people with a high need to belong respond to agent's socially responsive behavior can be derived from previous results: according to Appel et al. (2012) people who have a high need to belong have a higher disposition to decode social cues in or- der to satisfy their social needs. As outlined earlier, socially responsive behavior within a dialog enhances mutual liking and is assumed to be an indicator for conversation quality. Hence, the occurrence of socially responsive behavior is proposed to deliver a higher social satisfaction caused by the Rapport Agent's performance. A high number of social cues are expected to elicit more social behavior leading to rapport and consequently lead to a more fertile dialog (Appel et al., 2012). The Rap- port Agent displays a variety of social cues, however, human-human conversation is a complex matter that cannot be itemized in a specific amount of behavioral actions that easily – which might be a reason for why the socially responsive behavior did not yield a main effect (see above).

At the same time it needs to be acknowledged that people with lower need to belong (who do not seem to be too keen on contact anyway) are more stimulated to seek our social contact when the agent shows rapport.

Another aspect that needs to be discussed is why the effect is only significant for the factor "plan" which is just one of the factors of the willingness to engage in social activities. As the plans to engage in social activities include activities which might not easily be susceptible to influences by social interactions with agents (such as "meeting with family"), this is even a more demanding test.

In sum, we conclude that for a specific group of users and when a minimum quality of the conversation is given, people indeed can benefit from virtual agents in the sense that they experience "social snacking" in terms of a decrease of their momentary plan to engage in social contact. Does this mean, that in 50 years, people will engage not only in social snacking but will satisfy their belongingness needs by conversing with their virtual companions instead of real world human friends and acquaintances? The history of media psychology suggests that this will not be the case: so far, neither cinema, TV, computer games or the Inter- net's social networking sites have led to what was feared: the destruction of human relations and the end of meeting friends face-to-face. There- fore, this should not be expected to occur with regard to interactions with artificial entities. In line with this, socially responsive agents will probably also never be a means to resolve loneliness. Still, such interactions with socially responsive agents could – like other social snacking (looking at photographs of loved ones) – be helpful in bridging the time until human social contact will be possible. With regard to the future design of virtual agents, designers might derive from the present results that agents need to be socially responsive at least to a minimum extent so that people with a high need to belong trait can benefit from interactions with them.

6.1. Limitations and future research

Several methodical aspects concerning the measurement and scenarios used in the present study have to be reviewed critically, in order to better understand the findings obtained in the hypotheses testing.

As already alluded to above, there could have been too little opportunity in the short conversation to display rapport behavior. Especially as the agent's behavior is contingent to the participant's behavior, there might have been dyads in which only a small amount of smiling and nodding became visible. Future studies should therefore take care that the socially responsive and socially not-responsive condition differ considerably.

Another concern is the fact that standardized scales could not be used comprehensively. While for need to belong trait (Krämer et al., 2013a), rapport (Gratch et al., 2007) and social connectedness state (van Bel et al., 2009), instruments whose reliability, validity and usefulness have been demonstrated, were used, there was no measure for assessing the momentary willingness to engage in social contact. There- fore, we were only able to use items which we specifically developed for the study. These items obtained solid reliability but nevertheless one might argue that the measure has not yet been tested extensively for reliability and validity.

The conducted study was limited to rather short conversations. It can be derived from the questionnaires and debriefings, that the participants experienced the interaction to be too short and the majority expressed disappointment regarding the length of conversation. Specifically, the conversation with the Rapport Agent entailed only five questions in total; many participants reported that the conversation ended, just in that moment they opened up to the virtual human. Therefore, it could be argued that five questions are not sufficient in order to encourage people in social dialog and further questions should be added. This observation suggests that a long-term interaction with the Rapport Agent can eventually advance social satisfaction.

Moreover, according to Baumeister and Leary (1995) social satisfaction can be achieved through social dialog that implies positivity, mutual affection, and occurs repeatedly. As the study set-up entailed only one interaction session, not all requirements of potential social satisfaction were met. There are findings that suggest that repeated human- agent interaction can elicit pleasant anticipation to the next interaction and concomitantly positive emotions (Bickmore, 2004). Therefore, future studies should employ a long-term design.

With regard to the appearance of the agents, several aspects re- quire critique. First, virtual characters that resemble the user are assessed more positive (Iacobelli & Cassell, 2007), and as an "in-group" member, the agent is perceived as more intelligent and competent – even when it has the same narratives as a virtual character that does not resemble the user (Nass et al., 2000). The participants of the current study were of different ethnic groups, however not all ethnicities were considered in the current research design. Additionally, only female characters were employed, which also could influence the participant's evaluation, as half of the sample was male. It could be helpful for future studies to employ diverse virtual characters matching participants' ethnicity and gender.

Although the current research showed some effects, it is not clear yet, how valuable the interaction with a socially responsive agent as a social snack is, compared to other potential social snacks such as watching a TV-series featuring a favorite protagonist or reading one's Facebook feed. Therefore, future studies should employ similar experimental procedures in which a socially responsive agent is compared with other sorts of potential social snacks.

7. Conclusion

In conclusion, although there was no main effect of the agent's socially responsive behavior on participants' experiences of rapport and connectedness, it is all the more important that the interaction between need to belong trait and socially responsive behavior yielded significant results. While it seems obvious that the need to belong is directly related to the willingness to engage in social contact, it is important to note that this need cannot be satisfied by presenting a human-computer interaction with any kind of social cues. For despite social cues such as human-like appearance, verbal cues (speech) and basic nonverbal idle behaviors, the plan to engage in social interaction after the conversation with the virtual agent was only significantly smaller when the agent showed social qualities like socially responsive behavior - in the sense of smiling and nodding while listening.

Therefore, the reciprocity and positivity which are conveyed by socially responsive behaviors are essential when trying to provide people with "social snacks".

Acknowledgments

The work depicted here is sponsored by the U.S. Army Research Laboratory (ARL) and DARPA under contract numbers W911NF-04-D- 0005 and W911NF14-D-0005, respectively. Statements and opinions ex- pressed and content included do not necessarily reect the position or the policy of the Government, and no official endorsement should be inferred.

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DATES
Received: 3 Jan. 2017
Revised: 4 July 2017
Accepted: 20 Aug. 2017

FUNDING
The U.S. Army Research Laboratory (ARL) and DARPA under contract numbers W911NF-04-D- 0005 and W911NF14-D-0005

CONFLICT OF INTEREST STATEMENT
NO