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To cite this version:

Céline Clavel, Faur Caroline, Jean-Claude Martin, Sylvie Pesty, Dominique Duhaut. Artificial Companions with Personality and Social Role. CICAC 2013 - Symposium on Computational Intelligence for Creativity and Affective Computing, Apr 2013, Singapore, Singapore. pp.87-95, 10.1109/CICAC.2013.6595225 . hal-00872149

HAL Id: hal-00872149

https://hal.science/hal-00872149v1

Submitted on 14 Dec 2013

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Artificial Companions with Personality and Social Role

Expectations from Users and Impact on the Design of Groups of Companions

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Abstract—**Robots and virtual characters are becoming increasingly used in our everyday life. Yet, they are still far from being able to maintain long-term social relationships with users. It also remains unclear what future users will expect from these so-called "artificial companions" in terms of social roles and personality. These questions are of importance because users will be surrounded with multiple artificial companions. These issues of social roles and personality among a group of companions are seldom tackled in user studies. In this paper, we describe a study in which 94 participants reported the social roles and personalities they would expect from groups of companions. We explain how the results give insights for the design of future groups of companions endowed with social intelligence.**

Keywords— affective computing ; companions ; robots ; virtual charactesr ; social role ; personality

I. INTRODUCTION

One of the trends of the last twenty years is the increasing number of digital devices and services used in our daily life such as virtual assistants on web sites, personal assistants on smartphones and robotic vacuum cleaners. These systems are becoming more and more interactive, intelligent and autonomous. Several recent research projects have shown that artificial companions (hereafter "companions") should not only offer various services, but should also create and maintain a long-term social relationship with users. Yet, it remains unclear what future users will expect from these companions in terms of social roles and personality. These questions are of importance because users will be surrounded with multiple companions. Such companions will feature various embodiments (e.g. virtual characters on a computer screen, robots at home, or handheld applications).

Existing studies focus on individual companions rather than on groups of multiple companions with various embodiments. These issues of social roles and personality among a group of several companions are seldom tackled in user studies. Several studies based on questionnaires analyze the expectations of the users of robots. In the Eurobarometer study on attitudes towards robots [22], 70% of the participants have a positive view of robots. Yet, more than 80% of them reported to feel uncomfortable with the idea of a robot caring for children or elderly people. Tsui et al. [65] observe that attitudes towards presence robots are influenced by culture, gender and prior robot experiences. Results of an online questionnaire [21] indicate that the negativity expressed about social robots is associated with the social role of the companion and some characteristics of the participants.

If these studies raise the issue of social role for a companion, they do not tackle the possibility to have a group composed of multiple companions. Is a group of companions more desirable than a single companion? Can the group help clarifying the social role of each companion, and thus making these companions more acceptable? Furthermore, previous studies do not address the issue of personality. Do users want companions with personality? Can personality make social roles like caring more foreseeable for users? Inside a group of companions, should individual companions have similar or complementary personalities? Do users expect companions with different roles in the group to display different personalities? The study presented in this paper aims at providing some answers to these questions.

The first part of this paper addresses requirements on social skills and personality for the design of companions. The second part presents our user-centered study about users' expectations about companions. We explore the relations that users make between the social roles of companions and the personality of the companions. We also raise the issue of a group of companions and the role of companions' personality in this group. The paper concludes by discussing the means of using the results of this study for informing the design of groups of different companions.

II. RELATED WORK

A. Robotic and virtual companions

Robots and virtual characters are becoming increasingly prominent in everyday life, taking on a variety of roles, including household robots, user interfaces to smart homes, coaches or affective supporters. They have to interact with users in a complex social world, and need to be able to develop and maintain long-term, trusting and engaging relationships.

It is in the field of robotics that the notion of companion is the most visible. The project *Robot Companions for Citizens* is one of the six pilot projects selected in the great challenges European program FET Flagship in 2011.This project aims at putting robot companions in our societies. There are multiple companions developed in the robotics community.

To be more appealing, some of these robot companions are shaped as stuffed toys. *Paro* [61] is a furry baby harp seal robot. Paro is used to enhance health and psychological well-being of elderly users [62][67]. It has five kinds of sensors: tactile, light, audition, temperature, and posture sensors, with which it can perceive people and its environment. It feels being stroked and beaten by tactile sensor, or being held by the posture sensor. Paro can also recognize the direction of voice and words such as its name, greetings, and praise with its audio sensor. Paro can learn to respond to its new name and to behave according to user's preferences.

Emotirob is a teddy bear robot built for bringing some comfort to children in hospital. This stuffed robot identifies the child's emotional state in order to react accordingly. Emotirob can express joy, sadness and surprise by moving its eyebrows and mouth [59].

Nao[1] is a humanoid robot. The ALIZ-E[2] project aims at designing and developing long-term, adaptive social interactions between Nao robots and child users in real-world settings [5]. Henkemans et al. [26] studied how social robots can support children with their self-management of diabete.

The *iCat* [10] is able to display facial expressions by moving its neck, eyes, eyebrows, lids and lips. The iCat is used by Castellano et al. [13] in the LIREC[3] project (Living with robots and interactive companions). The iCat acts as an empathic game companion, which plays chess using an electronic chessboard. While playing with the iCat, children receive feedback about their moves through the robot's facial expressions. These expressions are generated by an affective system influenced by the state of the game. A higher level of user's engagement is observed when the iCat displays facial expressions compared to when the iCat does not display any facial expressions.

Virtual characters cannot interact directly with the user in a physical meaning but the subtleties and the dynamics of their virtual facial expressions are potentially higher than the ones of a physical robot. In the LIREC project, Lim et al. [35] propose a virtual companion that is socially-aware [57]. This companion can exploit information from prior interactions with the user to adapt its behavior. In addition, the companion can tag its memory about sensitive information in regards to a particular user (e.g. "don't tell this to Luke").

The Companions[4] project focuses on virtual character companions. Cavazza et al. [14] designed the "How was your day?" companion. This embodied conversational agent listens to a user and provides verbal and non-verbal feedback. The companion constructs a representation of the discussed events, occasionally asks questions and gives advices. Pinto et al. [49] describe a conversational companion for elderly users. The primary ability of this companion is to comment photographs with the user. It remembers people and dates and can make deductions about them (e.g. if the companion knows that Lisa and Laura are Mary's daughter, it can tell that Lisa and Laura are sisters).

Bickmore and Picard [8] describe a longitudinal study to evaluate the impact of an exercise advisor agent over a six weeks period of time. Laura, the companion agent, acts as a sport coach to motivate students to do physical activity. She can remember information about the user and use them in later dialogues. Results indicate that users are prone to have relational conversations with Laura and that this leads to a more positive user's perception of the relationship between him and the virtual companion.

Few studies explore the impact of a group of virtual characters on the interaction. Baylor and Kim [6] investigate the use of multiple pedagogical agents with different roles (Expert, Motivator and Mentor). Each role has its own benefits for the user. The authors observe that multiple distinct agents offer an advantage over a single virtual agent featuring all the roles in a single embodiment. Finally, the MARC framework (for Multimodal Affective Reactive Characters) is developed for addressing the design and the real-time interaction with visually realistic expressive virtual agents. MARC is used to model social re-appraisal mechanism between several virtual characters [55]. During a user study, it was observed that participants are able to perceive this social interaction between the two characters.

B. Towards acceptable companions

Pérez-Espinosa et al. [48] emphasize the importance for naturalistic social interactions in the maintenance of engagement with users. Becker-Asano [28] explains the importance of the perceived normative structures of interaction for users and their interactions with social companions. Research in conversation analysis shows that users of companions display and expect turn-taking behaviors in a similar way as in human-human interaction [68][29]. Based on the study of a companion's conversational behavior, the SERA [5] project (Social Engagement with Robots and Agents) studies on the development of human-robot relationships over time and the integration of companion technologies in everyday life.

Current research in virtual agents considers emotional communication as one of the primary ways to achieve

[1] http://www.aldebaran-robotics.com
[2] http://www.aliz-e.org/
[3] http://lirec.eu
[4] http://www.companions-project.org/
[5] http://project-sera.eu/

believability. Emotional capabilities help characters to be and appear aware about what happens in the world. Virtual agents are usually able to display facial expressions of emotions. Some virtual agents include blends of several emotions using a decomposition of the face in several areas [1][45]. Expressive robots have also been successfully created. For instance the face of Kismet [9] conveys emotions based on nine prototypical facial expressions that are blended along three axes: Arousal, Valence and Stance. Arousal defines the level of energy. Valence specifies how positive or negative the stimulus is. Stance defines how approachable the stimulus is. This dimensional approach, based on the Circumplex model of emotions [58], defines an Affect Space in which expressive behaviors span continuously across these three dimensions, creating a rich variety of expressions.

Whereas some robots use their face to display emotional expressions, other robots such as Nao need to use their body [7]. Bodily expression of emotions that can be interpreted whilst interacting with the robot might improve the naturalness of the interaction. Postural expressivity is considered to enable virtual characters to display interpersonal attitudes [4]. Models of bodily expressions of action tendencies are proposed [63]. Models of gesture expressivity have also been proposed for the Nao robot focusing on movement quality [47].

However, there are considerable interpersonal differences between users of robots. While some users deal with the robot as a social actor [40][41], others refuse to do so even if the robot offers social communication [23].

C. Personality of companions

There are several studies about users' perceptions of their computers showing that users apply to their computer some stereotypes of daily life. Gender stereotypes were observed: users trust more a machine endowed with a male voice and estimate that a machine having a female voice has higher relational skills [43]. Nass et al. [44] observe that standards of social utility and social desirability also applied to HCI. The performances of computers are judged as being superior when they are valorized by other computers that when it is the computer that praises itself. A computer which congratulates itself or which criticizes other computers is perceived as being less friendly than a computer which admires the others and which displays self-criticism. Computers that criticize are perceived as being smarter than computers that praise. Other researchers study the impact of users' personality on their representation of their computer. Nass et al. [42] propose a circumplex model of inter-personal behavior based on two "factors": Extraversion (dominant vs. submissive) and Agreeableness (cordial vs. hostile). They observe that subjects prefer a computer which looks like them and has similar skills.

Tapus et al. [64] design and evaluate an assistive robot for post-stroke rehabilitation therapy. The robot monitors therapy exercises and encourages patients with verbal utterance. The robot can exhibit an "extravert" behavior, revealed by a challenging therapy style or an "introvert" behavior, revealed by a nurturing therapy style. Contents of verbal interactions and para-verbal cues are also set by the personality of the robot. Extrovert participants tend to prefer the extrovert robot, while introvert participants tend to prefer the introvert robot.

Lee et al. [33] suggest that the personality of companion transforms a simple interaction into a relationship and introduces an emotional investment. Using AIBO, a social robotic pet developed by Sony, they examine the issue of personality in human-robot interaction. They compare the impact of AIBO's personality (introvert vs. extrovert) and the participant's personality (introvert vs. extrovert). They test if participants recognize the robot's personality based on its verbal and nonverbal behaviors. The authors observe that participants enjoy interacting with a robot more when the robot's personality was complementary to their own personality than when the robot's personality was similar to their own personality. Participants' feeling of social presence during the interaction is a significant mediator for the complementarity attraction effects observed.

Most models of virtual agents with personality are inspired by the lexical approach, and more precisely, by the Big Five model [19][20][27]. However, most systems focus on a few traits (extraversion, agreeableness and neuroticism, [2]; neuroticism, [27]). For example, Van den Bosch et al. [66] selected only extraversion and agreeableness to impact the conversational behavior of a virtual house buyer. Nass et al. [44][42] propose models of virtual agents based on the social context and intra individual differences. A few other authors base their models on a socio-cognitive approach, which focuses on understanding the cognitive, emotional, and social processes that characterizes individuals. Moffat [39] developed a model to create personalities of virtual agents based on Mischel's work. Sandercock [60] focus on intra-individual variability of agents. Their goal is to produce agents the conduct of which depends on the situation while remaining consistent. Several studies combine different approaches to personality [25][53][54]. Poznanski & Thagards [51] develop the SPOT model (Simulating Personality Over Time) based on the lexical approach and the socio-cognitive approach. For a given trait, the model specifies a type of behavior but also takes into account the possible influence of the situation on the emergence of behavior. Few computational models feature emotional expressiveness that depends on a personality profile. According to Arya [3], it is essential to have facial expressions of virtual characters to be related to a personality profile in order to improve the credibility of the characters. They propose a model of personality based on Wiggins's model of affiliation / dominance that activates facial actions. The importance of expressiveness is supported by the results of Cafaro et al. [11]. The authors observe that subjects, in zero-acquaintance situations, use non-verbal behavior (such as gaze and smile) as a basis for personality judgment of virtual agents as they do in real life, according to social psychology research.

D. The lexical approach of personnality in psychology

Personality is "a set of organized, stable and individualized behaviors" [38]. The goal of personality research is to try to describe, to explain and to predict this set. Today an integrative approach of personality is recommended [38]. Six levels of analysis are proposed to provide a global overview of human personality: the trait-dispositional level, the psychodynamic-

motivational level, the phenomenological level, the behavioral-conditioning level, the social cognitive level and the biological level. Each level provides a specific contribution to the general understanding of personality and behavior. These levels are partly addressed by several major historical approaches that we describe below.

In psychology, three types of approaches study personality. The lexical approach is the most developed. It proposes to classify the terms of natural language that are used to describe and understand human qualities. It enables to define constructs that have a relative temporal stability, a good predictive value, that are applicable to different cultures and that are socially important. These constructs correspond to "personality traits". Rolland [56] defines traits as "coherent sets of cognitions, emotions and behaviors that demonstrate a temporal stability and cross situational consistency". Such traits result from inferences and not from a directly observable reality. Different models and psychometric tools based on the lexical approach are developed: the Eysenck Personality Inventory, 16PF, and the Revised NEO Personality Inventory (NEO PI-R). NEO PI-R is currently the most frequently used tool. It is based on the five factor model. This model proposed by Costa and McCrae [15] describes personality with two levels. The facets propose a fine and accurate description of personality. A domain corresponds to a group of facets. The big five model identifies five basic dimensions through factorial analysis.

Neuroticism is defined as a system regulating avoidance behaviors. Its role is to preserve the organism of pain by anticipating and by activating monitoring behaviors. A subject with a high neuroticism score has a very critical vision of himself. He also has the tendency to feel frequently and intensively a wide range of negative emotions. The facets of neuroticism are: Anxiety, Angry, Hostility, Depression, Self-Consciousness, Impulsiveness, and Vulnerability.

Extraversion is characterized as a system of regulation of approach behaviors. A high score on this trait reveals a strong sensitivity to pleasant stimuli and a tendency to feel frequently and intensively positive emotions. The facets of Extraversion are: Warmth, Gregariousness, Assertiveness, Activity, Excitement-Seeking, and Positive Emotions.

Openness to Experience results in broad and varied interests, a capacity to search for and to live new and unusual experiences. It is a system of regulation of reactions to novelty. The facets of Openness to Experience are: Fantasy, Aesthetics, Feelings, Actions, Ideas, and Values.

Agreeableness refers to interactions with others and especially to the tone of relationship with others. The facets of Agreeableness are: Trust, Straightforwardness, Altruism, Compliance, Modesty, and Tender-Mindedness.

Conscientiousness relates to motivation, organization and perseverance in the conducts oriented towards a goal. A high score corresponds to a person who tends to set long-term goals, to organize her action and accepts the constraints bound to the satisfaction of needs and desires. The facets of Conscientiousness are: Competence, Order, Dutifulness, Achievement Striving, Self-Discipline, and Deliberation.

E. Evaluation and prospective studies

Jacobsson and Nylander [30] describe an approach for conducting long term studies of companions. They draw from their work of conducting several qualitative long-term user studies of people's relationship with robotic companions, virtual agents and mobile devices in order to develop a methodology where the initial bond with the artifact is based on a more intense experience. After this initial phase referred to as Always On the relationship will fade over to the adoption phase where the more traditional long-term use can be studied.

Dehn and Van Mulken [18] present a review of empirical research on the impact of animated interface agents. They recall the use of questionnaires appears to be the predominant approach to quantifying the effects of anthropomorphism [31][34][12]. Researchers usually provide participants with a questionnaire that includes questions about some features of the system to measure their attitudes. Participants' answers are usually measured as ratings on a 5- or 7-point scale ranging from "feature is fully present" to "feature is fully absent". The dimensions addressed in those questionnaires commonly pertain to the perceived intelligence, likeability and usefulness of the system.

Lexical approaches to personality provide descriptive models to classify individuals according to their abstract dispositional trends. These approaches do not aim at explaining the behaviors of individuals but only to describe these individuals. These lexical approaches are thus relevant for questionnaire based studies in which participants are asked to rate someone else's (or a companion's) personality.

III. A USER-CENTERED STUDY

A. Goals

The goal of our study is to explore the attitudes that future users have towards future companions in terms of capacities, social role, personality and groups of several companions. In order to reach this goal, we conducted a study at a robotics event. To support prospective design, we examined participants' expectations about companions. In addition, we studied their interest for using a group of several companions. Finally we assessed if the personality profiles assigned to companions depended on the social role of these companions.

B. Questionnaire

We designed an online questionnaire to evaluate 1) *users' expectations about the capacities and application domains of companions*. We proposed several items concerning usual applications areas: domestic activities, surveillance, entertainment, affective and reflexive assistance.

We also provided items concerning 2) *the relationship that participants would like to have with companions*. We based our questions on interpersonal attitudes studies. Statistical studies based on factor analyses suggest the existence of several attitudes in interaction [24][36][37]. Two bipolar factors are generally considered: Dominance / Submission and Friendliness / Hostility. Dominance involves behaviors associated with attempts to completely control others, to

impose one's needs, desires, and expectations to others. Conversely, a submissive attitude is the tendency to satisfy the needs, the expectations and the desires of others. A hostile attitude refers to the tendency to be aggressive, angry, to show a degree of animosity. Conversely, a friendly attitude reflects the desire to please and construct links with others [50].

Some other items concern 3) *users' expectations about the social interaction with companions*. Eight items were extracted from the NEO PI-R personality inventory. Two personality factors are of quite relevant for studying the perception of social interaction: extraversion and agreeableness. The first factor characterizes the sociability of individuals. The second factor relates to interpersonal tendencies.

We also included in the questionnaire a list of items concerning groups of companions. The goal of this section of the questionnaire is to better understand the inter-individual differences that participants expect from individual companions in a group. Six items deal with these aspects and particularly the question of similarity between the companions that belong to the same group. Picturing a robot and a virtual agent belonging to the same user, should these two companions have similar behaviors in terms of social interaction?

Finally, we proposed several questions to help participants define the personality profile of their companions and the possible relations between this personality and the social roles of these companions. These items were also extracted from the NEO PI-R personality inventory. They relate to the *Warmth facet* of the extraversion factor and the *Compliance facet* of the agreeableness factor. Warmth is the tendency towards affection. People who score high on this facet tend to be friendly. They like people and have a relatively easy time forming close interpersonal attachments. People who score low on this facet tend to be more formal, distant and reserved in their relationships with others. The compliance facet concerns one's typical response to conflict. High scorers tend to use withdrawal and smoothing techniques. Low scorers are more likely to be aggressive and assertive. The items of the inventory were adapted so that they were not self-attributions but related instead to hetero-attributions. Our goal was to evaluate if participants would find these facets of personality consistent with social roles of companions. Inspiring from the studies and prototypes described in the related work section above, we selected three usual *social roles* of companions:

- *Personal Assistant*: manages your calendar, dates ; helps in everyday life
- *Intimate Friend*: knows your friends, listens to your problems, helps you find solutions
- *Guardian:* ensures your safety, protects you, reprimands you if necessary

C. Participants

We recruited 94 voluntary participants at a robotics fair (Robofesta). 14 of them were female and 80 male. Participants' age ranged from 12 to 59 years old, with a median age of 19.

D. Results: companions' capacities and application domains

Participants judged as very important the use of companions in the domestic domain. But this judgment of interest varies according to the level of autonomy of the companion. Participants judged that the use of a companion that is slightly autonomous is more important than the use of a companion who is strongly autonomous. They prefer an artificial companion which acts under the participants' orders than a companion which acts by its own initiative. The same result is observed for surveillance and security activities. Participants considered that managing email (strongly autonomous) is not a relevant use for an artificial companion, whereas the ability to simply alert users of incoming mail (moderately autonomous) is a relevant use of a companion. They indicated that they would like the companion to do sport with them. Participants did not give a strong opinion about some of the suggested uses of companions. For example, they showed neither interest nor disinterest towards an affective or reflexive assistant. Table I presents these results.

TABLE I. CAPACITIES AND APPLICATION DOMAINS OF COMPANIONS (MIN=1, MAX=5)

Capacity of my companion	Application domain	Means	SD
It should move objects that I ask for	Domestic	3.78	0.62
It should decide which objects to move	Domestic	1.96	1.58
It should supervise my house (e.g. temperature)	Domestic	2.65	1.51
It should help me at home (e.g. cooking)	Domestic	3.43	1.07
It should manage my emails	Surveillance	0.81	1.24
It should alert me when I receive an important email	Surveillance	2.99	1.27
It should assess when it is appropriate to interrupt me in case of an important email	Surveillance	1.91	1.44
It should play reflexive games with me	Entertainment	2.83	1.38
It should do sport with me	Entertainment	3.03	1.40
It should play music with me	Entertainment	2.52	1.42
It should illustrate my ideas	Affective or reflexive assistance	2.44	1.61
It should boost my mood	Affective or reflexive assistance	2.75	1.43
It should inform me about my psychological data	Affective or reflexive assistance	2.59	1.49

E. Results: attitudes of companions

Several items of the questionnaire concern the interpersonal attitudes that an artificial companion should display when it interacts with users. Table II presents the results. Participants do not want to be dominated by artificial companions. They reported that they would not accept a companion which gives orders. When the companion is used to signal a mistake, participants are neutral (they neither agree nor disagree with such an attitude from the companion).

TABLE II. PARTICIPANTS' EXPECTATIONS ABOUT THE ATTITUDES OF THE COMPANIONS (MIN=1, MAX=5)

Expectation about the attitude of my companion	Means	SD
I accept that my companion gives me orders	0.52	0.84
I would like to be able to discuss the orders given by my companion	1.62	1.69
I would execute the orders given by my companion	0.62	0.95
I would accept that my companion gets me back on trail when I get lost in my activities	1.16	1.35
I would accept that my companion tells me when I am wrong	2.81	1.27
I would like that my companion gives me a solution when I face a difficult situation	2.80	1.35
I would not like my companion to interrupt me when I speak	2.20	1.74

F. *Results: participants' expectations about the social interaction with companions*

We analyzed the participants' answers to the questions extracted from the NEO PI-R personality inventory which concern the type of social interaction that participants would like to have with companions. Table III presents the results. They show that participants would like their companion to be cooperative, not hostile, not distrustful and not cynical. Participants would also like their companions to be slightly assertive (i.e. the companion should pay attention to the users and should avoid making use of authority). Overall, participants would like the companion to be relatively warm and hedonistic in its relations with the user.

TABLE III. PARTICIPANTS' EXPECTATIONS ABOUT SOCIAL INTERACTION WITH COMPANIONS (MIN=1, MAX=5)

	Expectation about social interaction with companions	Means	SD
Compliance	It should prefer to cooperate with me rather than competing with me	3.33	1.08
	It should often argue with me	0.68	1.11
Trust	It can be cynical and skeptical about my intentions	0.94	1.25
	It does not trust me when I am friendly to it	0.58	1.00
Assertivity	During conversations, it usually let me speak	2.88	1.19
	During conversations, it usually speaks more often than me	1.22	1.05
Warmth	It has strong affective connections with me	2.20	1.57
	It enjoys talking to me	2.68	1.45

G. *Results: participants' expectations about groups of companions*

Participants considered collaboration to be the most important feature for characterizing a *group of companions* (Table IV). Participants also judged the interoperability of the companions as an important aspect. They considered as important the capability of a companion to migrate between a robot and a virtual agent. Finally, they judged that the consistency of the social group of companions was important. Participants expressed the desire that all companions of the same group behave similarly.

TABLE IV. PARTICIPANTS' EXPECTATIONS ABOUT A GROUP OF COMPANIONS (MIN=1, MAX=5)

Individual companions in my group of companions should …	Means	SD
communicate with me in the same way	2.11	1.33
collaborate together	3.32	1.04
share several common features	1.49	1.25
display a family resemblance	1.90	1.27
be the same companion with different embodiments	2.92	1.38
behave differently	1.90	1.41

H. *Results: personality profile for companions according to their social role*

Participants assigned different personality profiles to different social roles of companions. Figure 1 provides the details of the two facets that we studied for the three companion's roles: warmth and compliance. For an *Intimate Friend,* participants considered that warmth was important. The score is higher than the score of the general population. In contrast, the score of warmth for a *Guardian* is weaker than the score of the general population. Participants considered that a companion who is a *Guardian* needs to display a weak level of warmth. Finally, the score of warmth attributed by participants to *Personal Assistants* corresponds to the means of the general population. In conclusion, the warmth facet seems preferable for the friend (high) and the guardian (low) roles but not for the personal assistant role.

With respect to the compliance facet, participants distinguished the guardian role from the other social roles. They considered that guardian companions should not be compliant. The score of compliance for a *Guardian* companion is lower than the score of the general population.

I. *Results: influence of personality on the expected capacities of the companion as a function of its social role*

With respect to the expected personality of the companion, the dataset was analyzed by means of analyses of variances (ANOVA) with the Condition (very high / high / medium / low / very low score for personality facets) as the within-subject factor. Fisher's Least Significant Difference was used for post-hoc tests. All the analyses were performed with Statistica.

With regards to the *Warmth facet*, results are the following. Whatever the social role of the companion, participants who attributed a very high score to the warmth facet judged more important that the companion is able to illustrate ideas than the participants who attributed lower scores for the warmth facet. However, the participants' expectations with respect to this facet varied as a function of the social role of the companion:

- *Personal Assistant*: participants who attributed a very high score to the warmth facet reported as more important the moral and reflexive support from a companion than participants who did not attributed a very high score to the warmth facet ($F(4, 82)=5{,}84$; $p={,}00034$).

- These results are similar to the results observed for the *Intimate Friend*. Participants who attributed a very high score to the warmth facet reported as more important the capacity to express emotions than participants who did not attributed a very high score for the warmth facet ($F(4, 81)=3{,}31$, $p={,}015$).
- *Guardian:* participants who attributed a high score to the warmth facet reported as less important the capacity to provide support for sport activities ($F(4, 82)=3{,}26$; $p={,}016$) or to provide reflexive help to users ($F(4, 81)=2{,}76$; $p={,}033$) than participants who did not attribute a very high score for the warmth facet.

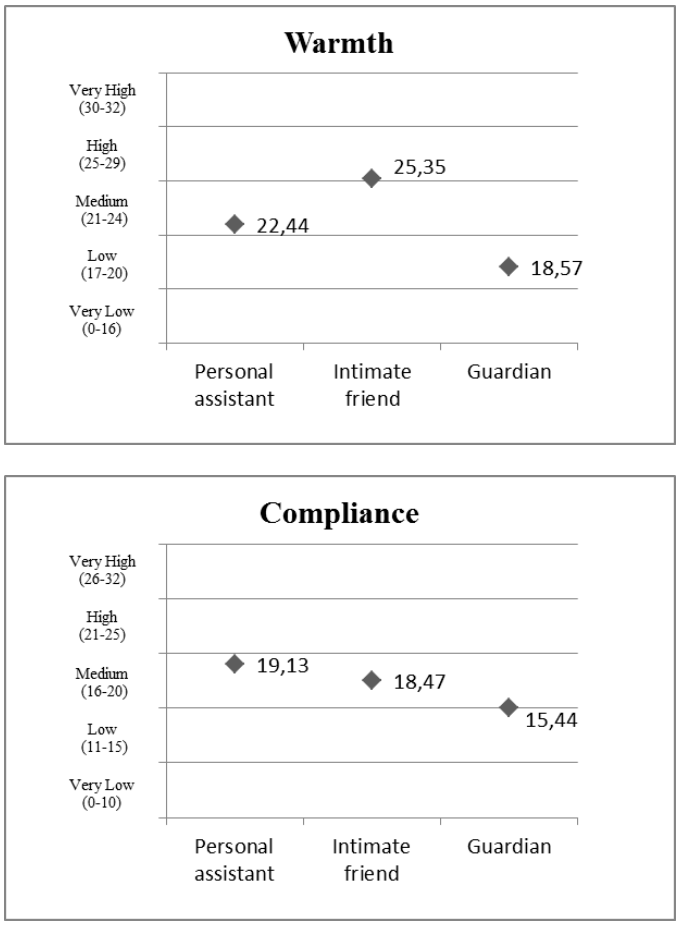

Fig. 1. Expected personality profile for a companion as a function of its social role

Similarly, for the *Compliance facet*, results showed that participants' expectations varied as a function of the social role of the companion. For the *Intimate Friend* role, participants who attributed a very low score to the compliance facet reported as more important the moral and reflexive support from the companion than participants who attributed a high or very high score for the compliance facet ($F(4, 82)=8{,}12$; $p={,}00001$). In addition, participants who attributed a very low score to the compliance facet considered that the companion could be more cynical and aggressive than participants who attributed a high or very high score for the compliance facet ($F(4, 78)=2{,}44$; $p={,}054$). For the *Guardian companion,* participants who attributed a very low score to the compliance facet reported as more important the domestic functions ($F(4, 82)=3{,}15$; $p={,}018$) and the moral and reflexive supports ($F(4, 82)=3{,}07$; $p={,}021$) than participants who attributed a high or very high score for the compliance facet.

IV. Conclusions

We reported in this paper a questionnaire study about the expectations that people have about future companions and groups of companions.

The main results are the following. Participants reported that companions would be mostly useful in the domestic domain. They prefer companions to have only a small level of autonomy and they do not want companions to be dominant. Furthermore, participants expect the following features of social interaction with companions: cooperative, not hostile, not distrustful and not cynical. When thinking about having a whole group of companions, participants reported the following features to be of importance: the capacity of the companions of the group to collaborate, to be interoperable, and to migrate between various embodiments. In addition, the individual companions should behave similarly. Finally, people expect companions to display different personalities for different roles.

In regards to users' expectations in terms of capacities of a companion, our results are in line with the results observed by Dautenhahn [17] and Ray et al. [52]. Users still prefer companions to help in the domestic domain. A companion is seen by future users rather as an intelligent tool than as a potential friend. Perhaps technologies have to evolve first in order to trigger users' desire.

The results of this study will help us to inform the design of social companions that display personality among groups of companions. We intend to extend the MARC platform with modules dedicated to the management of social roles and personality. Expected links between roles and personality that were observed in this study will be specified in the system. We will model the two facets Warmth and Compliance and their impact on the behavior of the virtual character. We will test users' perception of those traits when interacting with the virtual companion. Would the personality of the agent be well recognized, we will test user's attribution of social role to the agent, in order to see if we find the same pattern than in this study.

We intend to proceed to a similar study next year with other participants. We will add new questions about the personality of the users to study how it impacts the social role and the personality that participants expect the companions to display. These additional questions will also consider if the following concepts are relevant for groups of companions: social group and social norms.

Finally, we used a lexical approach to personality. This approach pays little importance to the role of the environment in the implementation processes of personality. The lexical approach of personality only focuses on interpersonal differences and not on intra-individual differences. In next year's study, we intend to investigate other approaches to

personality (psychosocial and socio-cognitive approaches) which might be more relevant for groups of social companions.

ACKNOWLEDGMENT

Part of the work described in this study was funded by the project MOCA ANR-2012-CORD-019-02.

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