Robot Personality Design for an Appropriate Response to the Human Partner

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Abstract— **This paper discusses the importance of modeling personality for social robots. While human-liked features (such as voice, gestures, and postures) are well-studied in social robotics, developing robots with personality traits is still very much in its infancy. In this paper, we show and argue the importance of embodying personality in the robot's behavior so as to provide a more natural interaction and a more appropriate feedback to the human partner.**

I. INTRODUCTION

We define a "readable" feedback as a *feedback that is easy to be understood by the human partner during an interaction*. This can be translated as observable actions, verbal acts, and paraverbal changes that human partner can perceive from his/her interlocutor during interaction. Usually in human-human social interaction, the level of "readability" can be described as the ease of one partner to perceive his/her interlocutor's reaction to his/her act. The "readability" of an act may depend on the clearness of the communication intention, and is generally described by responding to the five WH questions: what, where, when, who, and why. Moreover, the "readability" may also depend on the familiarity of the act performed by the interlocutor, for example, people from one culture may misunderstand an action when interacting with someone from another culture.

In the context of human-robot interaction, the readability of robot's feedback can be considered as the understandability of these feedbacks towards the human partner. We consider that a robot feedback is readable, if the human partner find it easy to understand the robot's behavior and message. Research in HRI focuses a lot on methods for establishing a natural communication between a robot and a human either by developing well-defined and controlled interaction scenarios, or by modeling several communication modalities, such as voice content, gaze, actions, gestures. One of the aim of these approaches is to make the human-robot communication as close as possible to the human-human communication. We posit that the readability of the robot's feedback also depends on the clearness of the communication intention and on the familiarity of the robot's reactions (e.g., culture-based behaviors), as described in Fig. 1.

In this paper, we are interested in discussing the personality development to provide better readability for social robots. Multi-modal capabilities (e.g., voice content, gestures, movements) make the communication between human and robots more and more effective [1]. Research should thus be focused not only on finding ways for the robot to communicate with humans but also on effective new manners to express these informations. We argue that it is time to reinforce research in robotics towards the modeling of personality for a better interaction with the human counterpart.

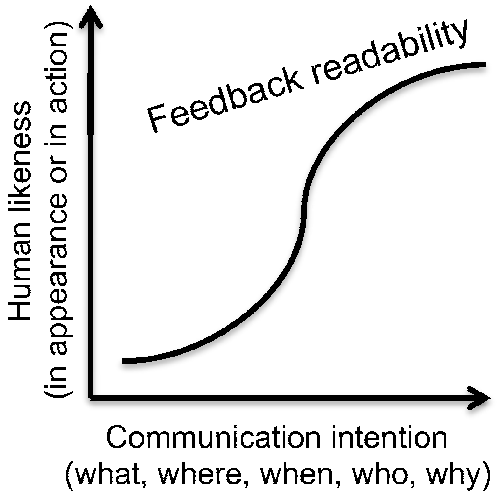

Fig. 1: Sketch of the Robot's Feedback Readability

II. WHAT ARE POTENTIAL "READABLE" FEEDBACKS TO HUMAN?

The authors in [1] describe a review about how to create natural and effective communication modalities for Human-Robot Collaboration. In their paper, robots are divided in three categories: Robots as Tools, Robots as Guides, Hosts, and Robots as Humanoids. Important ingredients for an effective communication with the human partner for each kind of robots are outlined (see Table I).

Robots as Tools are, generally, considered to act conventionally (i.e. with respect to certain rules of information exchange), and thus exposed to less demand of social ability. The other two types of robots, Robots as Guides and Robots as Humanoids, are, however, required to exhibit social capabilities so as to establish a natural interaction with the human partner. Some of the social capabilities of robots are listed by [2] as "human social" characteristics (Fig. 2).

While human-liked capabilities are widely studied in the robotics research community, we found that personality

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TABLE I: Important Elements of Effective Communication in Human-Robot Collaboration, adapted from [1]

Robot Type	Important Ingredients
Robots as Tools	Adjustable autonomy Context awareness
Robots as Guides, Hosts	Effective natural speech Multimodal communication Grounding
Robots as Humanoid	Multimodal communication Learning ability Modeling of others' intention

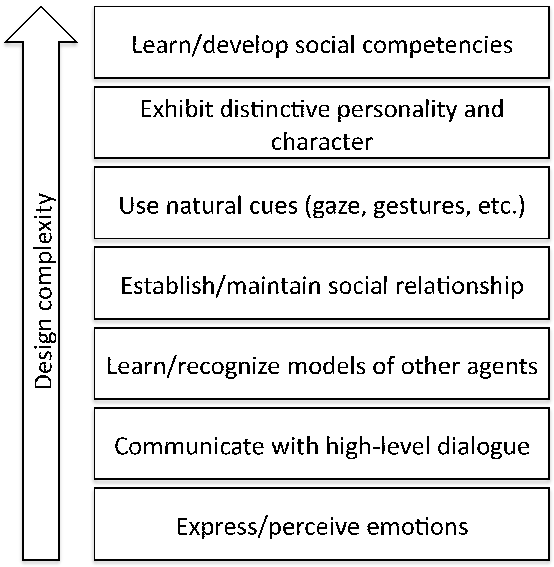

Fig. 2: Design complexity of social activities for social robots, developed by [2]

modeling is not receiving enough attention. We present in the next sections some studies on personality models for social robots and we discuss the importance of such modeling to provide a better robotic service to human.

III. PERSONALITY DIMENSIONS AND COMBINED VERBAL-NON VERBAL PRODUCTION

Personality is the fundamental dimension of variation between humans. In the literature, there are different models of personality (e.g., Big5 [5], Eysenck Model of Personality - PEN [21], Meyers-Briggs [20]). The personality has a long term effect on the generated behavior, which gives more reliability to the personality dimensions for characterizing the generated verbal and nonverbal behavior, to the contrary of other short-term characteristics like estimating human emotions through prosodic features.

Human's personality is usually expressed through all communication channels (i.e., non-verbal, para-verbal, and verbal). Personality markers in the non-verbal language have been illustrated in [7], [8], [9], where the authors focused mainly on the correlation between bodily language in both the introversion and extraversion traits. The characteristics of the generated gestures during the nonverbal communication can differ according to the personality traits. The position of the head and trunk are clear indicators of the personality traits; leaning forward communicates a relatively positive attitude to the interlocutor, which is correlated with extraversion, whereas leaning backward or turning away communicates a more negative attitude, which is correlated with introversion. Moreover, extraverted individuals tend to tilt their heads, raise their shoulders, and implement higher amplitude gestures with respect to introverted individuals. In addition, extraverted individuals maintain more eye contact, shoulder orientation, and leg orientation comparing to introverted individuals [10], [11], [8].

On the other hand, personality markers in the verbal language influence the verbal content of the human speech as illustrated in [6], [12], [13], [14], [15]. The authors stated different cues for the extraversion and introversion personality traits. They argue that extraverts talk more, louder, and more repetitively, with fewer pauses and hesitations. They have higher speech rates, shorter silences, a higher verbal output, a lower type/token ratio, and a less formal language, meanwhile introverted individuals use a broader vocabulary. Furthermore, extraverted use more positive emotion words, and show more agreements and compliments than introverted.

While most of the studies in personality focused on the extroversion trait, the authors in [14] focused in corresponding features for other personality traits. They found that neurotic people use more negative emotion words; agreeable people express more positive emotions; conscientious people avoid negations, negative emotion words and words reflecting discrepancies (e.g., should and would). And, openness-to-experience people prefer longer words and words expressing temptation (e.g., perhaps and maybe), as well as the avoidance of 1st person singular pronouns and present tense forms.

The influence of personality traits on the verbal and non verbal production constitutes a big step towards generating appropriate robot behavior matching human's personality within a human-robot interaction, aiming towards validating the similarity attraction principle [22] stating that individuals are attracted by others with the same personality traits, within human-robot interaction.

IV. PERSONALITY DESIGN - A WAY TO ENHANCE "READABILITY" OF ROBOTS' FEEDBACK

The authors in [16] show that people tend to induce emotion and personality to their PCs, TV, and other devices along the time. Given the involvement of robots in everyday activities, such tendency needs our serious attention. The modeling of personality should be considered as of central attention when it comes to create social robots. Next, we present some studies that put forward the role of different types of personality for social robots to better accomplish assigned tasks.

Tapus et al. in [17] have studied the relationship between the extroversion-introversion personality spectrum and the style of encouragement in a rehabilitation task and the role of adapting robot's behavior to the user's profile. The

three factor PEN (Psychoticism-Extroversion-Neurotisicm) Eysenck Personality model was employed in their study, with a particular focus on the extroversion dimension. The study shows that users preferred working and interacting with a robot with a similar personality as theirs during exercises: extrovert users preferred the robot that challenged them during the exercises, while introvert users preferred the robots that praised them.

Another work that studies the role of personality during Human-Robot Interaction is that of Lee et al. [18]. They presented an experiment with the AIBO robot that exhibits different personality traits. The study makes a comparison between the Introvert vs. Extrovert behaviors (based on the Myers-Briggs Type Indicator). The participants were asked to play with AIBO robot (exhibiting either introverted or extroverted behaviors) to evaluate AIBO's interaction ability without knowing that there were AIBOs with different personalities. The obtained results emphasise that participants were more joyful when interacting with AIBO that had complementary personality to theirs.

The two works presented above show interesting findings for the modeling of personality for social robots. Even though they seem contradictory, we believe that they are not. In fact, the first work [17] evaluated the robot's personality when robots were working as assistants to help users perform one or several tasks. In the second work [18], AIBO robots were involved in entertainment scenarios, where human participants were supposed to be eager to explore AIBO's capabilities. It seems that in a collaboration context, people preferred similar personality (as occurred in the first work), while complementary personality partner is preferred when it comes to an exploratory task (as found in the second work).

We suggest that social robots with personality are better received and understood by the human partners. The design of personality should be based on an existing personality model proposed in psychology (as mentioned above). Moreoever, the personality should be modeled based on the study and goal purposes.

In order to endow a robot with personality traits, we need to use the knowledge that we know of human's personality from social, cognitive, and linguistic sciences (see section III). Robots can express their personality through non-verbal, para-verbal, and/or verbal cues. These various communication and interaction elements need to be parametrized so as to fit the characteristics of specific personality traits.

Authors of [17] and [18] showed that by altering the robot's personality, one can change the result of the human-robot interaction. People seem to prefer robots with the same personality as theirs when it comes to a collaboration task. And when it comes to a task of discovery and communication, people tend to appreciate more robots with different personality traits than theirs. From these findings, we make the assumption that positive and cooperative reactions of users is resulted from a better readability of the robot's behavior. This can be the result of the use of appropriate personality on the robot.

V. CONCLUSION

In this paper, we discussed the importance of developing personality traits for social robots. This should be considered a natural step in the evolution of social robot's development (Fig. 2). We showed examples where robots with introvert/extrovert robots were evaluated while interacting with human partners. Those examples shows that robots with different personalities can elicit different reactions from human partners and thus produce better task performances when used appropriately. Further research studies with quantitative analysis are to be considered to address the influence of robot's personality in the interaction.

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REFERENCES

[1] S. A. Green, M. Billinghurst, X. Chena and J. G. Chasea, "Human-Robot Collaboration: A Literature Review and Augmented Reality Approach in Design", International Journal of Advanced Robotic Systems, vol. 5 (1), 2008, pp. 01-18.

[2] T. Fong, I. Nourbakhsh, and K. Dautenhahn, "A survey of socially interactive robots", Robotics and Autonomous Systems, vol. 42, 2003, pp. 143-166

[3] W.Norman,"Toward an adequate taxonomy of personality attributes:replicated factor structure in peer nomination personality rating",Journal of Abnormal and Social Psychology, vol. 66, pp. 574-583, 1963.

[4] R.R. McCrae and P. Costa, "Validation of the five-factor model of personality across instruments and observers", Journal of Personality and Social Psychology, vol. 52, p. 81-90, 1987.

[5] L. R.Goldberg, "An alternative description of personality: The Big-Five factor structure", Journal of Personality and Social Psychology, 59, pp. 1216-1229,1990.

[6] M. F.Mairesse, M. Walker and R. Moore, "Using linguistic cues for the automatic recognition of personality in conversation and text", Journal of Artificial Intelligence Research (JAIR), pp. 457-500, 2007.

[7] R.A.M. Neff, Y.Wang and M.Walker, "Evaluating the effect of gesture and language on personality perception in conversational agents", Proceedings of Intelligent Virtual Agents (IVA), 2010.

[8] A.Mehrabian,"Significance of posture and position in the communication of attitude and status relationships", Psychological Bulletin 71(5), pp. 359-372,1969.

[9] K.Isbister, and C.Nass, "Consistency of personality in interactive characters: Verbal cues, non-verbal cues, and user characteristics", International Journal of Human Computer Studies 53(2), pp. 251-268,2000.

[10] R.Lippa, "The nonverbal display and judgment of extraversion, masculinity, femininity, and gender diagnosticity: A lens model analysis", Journal of Research in Personality 32(1), pp. 80-107, 1998.

[11] K.Frank, "Posture and Perception in the Context of the Tonic Function Model of Structural Integration: an Introduction", IASI Yearbook 2007 pp. 27-35, 2007.

[12] K. R.Scherer, "Personality markers in speech", In Scherer, K. R., and Giles, H. (Eds.), Social markers in speech. Cambridge University Press, pp. 147-209, 1979.

[13] A. Furnham, "Language and personality", In Giles, H., and Robinson, W. (Eds.), Handbook of Language and Social Psychology, Winley, 1990.

[14] J. W.Pennebaker, and L. A. King, "Linguistic styles: Language use as an individual difference", Journal of Personality and Social Psychology, 77, pp. 1296-1312, 1999.

[15] J.-M.Dewaele, and A.Furnham, "Extraversion: the unloved variable in applied linguistic research", Language Learning, 49 (3), pp. 509-544, 1999.

[16] B. Reeves, and C. Nass, "The Media Equation", CSLI Publications, Stanford, 1996.

[17] A. Tapus, C. Tapus, and M. J. Matarić, “User-Robot Personality Matching and Robot Behavior Adaptation for Post-Stroke Rehabilitation Therapy, Intelligent Service Robotics”, Special Issue on Multidisciplinary Collaboration for Socially Assistive Robotics, April, 2008.

[18] K. Min Lee Wei Peng, S.-A Jin, and C. Yan, “Can Robots Manifest Personality?: An Empirical Test of Personality Recognition, Social Responses, and Social Presence in Human-Robot Interaction”, Journal of Communication, vol. 56, 2006, pp. 754-772.

[19] C. DiSalvo, F. Gemperle, J. Forlizzi, and S. Kiesler, “All robots are not equal: The design and perception of humanoid robot heads”, in: Proceedings of the Conference on Designing Interactive Systems, 2002.

[20] I. Myers Briggs and P. B. Myers, “Gifts Differing: Understanding Personality Type”, Davies-Black Publishing, ISBN 0-89106-074-X

[21] H.J. Eysenck, “Dimensions of personality: 16, 5 or 3? criteria for a taxonomic paradigm”, Personality and Individual Dierences 12, pp. 773790

[22] C. Nass, and M.K. Lee, “Does computer-synthesized speech manifest personality? experimental tests of recognition, similarity-attraction, and consistency attraction”, Journal of Experimental Psychology: Applied 7(3), pp. 171181