The RoPE Scale: a Measure of How Empathic a Robot is Perceived

Conference Paper · March 2019

DOI: 10.1109/HRI.2019.8673082

6 authors, including:

Laurianne Charrier
Université Lumiere Lyon 1
3 PUBLICATIONS **63** CITATIONS
SEE PROFILE

Alexandre Galdeano
Albstract
3 PUBLICATIONS **31** CITATIONS
SEE PROFILE

Amélie Cordier
University of Lyon
73 PUBLICATIONS **551** CITATIONS
SEE PROFILE

The RoPE Scale: a Measure of How Empathic a Robot is Perceived

Laurianne Charrier*†, Alisa Rieger*†, Alexandre Galdeano*†, Amélie Cordier†, Mathieu Lefort*, and Salima Hassas*
*Univ Lyon, Université Lyon 1, CNRS, LIRIS, F-69621, Villeurbanne, France
Email: [lcharrier, agaldean, mlefort, shassas]@liris.cnrs.fr
†20 Boulevard Eugène Deruelle, 69003 Lyon
Email: [laurianne.charrier, alisa.rieger, alexandre.galdeano, amelie.cordier]@hoomano.com

***Abstract*—To be accepted in our everyday life and to be valuable interaction partners, robots should be able to display emotional and empathic behaviors. That is why there has been a great focus on developing empathy in robots in recent years. However, there is no consensus on how to measure how much a robot is considered to be empathic. In this context, we decided to construct a questionnaire which specifically measures the perception of a robot's empathy in human-robot interaction (HRI). Therefore we conducted pretests to generate items. These were validated by experts and will be further validated in an experimental setting.**

***Keywords*—Human-Robot Interaction; Social Robots; Perceived Empathy; Psychometrics.**

I. Introduction

According to [7], empathy "might have a crucial role in human communication" and "might serve as the origin of the motivation for altruistic behavior and cooperation". Empathy—as defined in the cognitive psychology and HRI literature—is "a complex process whereby one understands and/or shares an entity's frame of reference, and/or reacts appropriately without having doubts about which frame of reference belongs to whom" [4], and an essential component of interaction. Empathic capabilities can be separated into two analytic categories: (1) the capabilities that are emotional, with the ability to share the affective experience of someone else; (2) the capabilities that are cognitive, with the ability to represent and understand the mental states of someone else and their perspective [4]. Cognitive empathy has many subcategories, including empathic comprehension and empathic response. Empathic comprehension, sometimes called empathic understanding, describes the ability to become aware of and to understand another person's unique experience and feelings [14]. Empathic response describes how one communicates their attempts at understanding someone else's frame of reference, including their feelings and motives [2].

Being empathic seems to be a component of human interaction which is greatly linked to how positive we are perceived by our interlocutor. In order for social robots to accomplish what they are made for, i.e. to "perform social interactions in a Human-like way" [4], they need to know what humans feel and what their mental states are, so that they can adapt their behavior [12]. As said by [12], there is a need for means to assess how empathic a robot is perceived.

II. Related Work

There are various ways of measuring human-human empathy in the literature. The Barrett-Lennart Relationship Inventory (BLRI) [1] is one of the "most widely used client-rated measure of empathy" [8]. It can also be a self-rated measure of empathic understanding. An other widely used self-rated measure of empathic concern and perspective taking is the Interpersonal Reactivity Index (IRI) [6]. Other questionnaires that measure the empathy quotient of a person can be found [11], [9].

Perceived empathy in human-human interaction can be measured with the Accurate Empathy Scale (AES) [15] which is, as an observer-rated measure, commonly used in context of therapy with the evaluation of the therapist's empathy. Other questionnaires are used to measure perceived empathy [1], [13].

In search of applicable metrics for perceived empathy of robots in HRI, we found that in the HRI research community the concept of empathy in robots is measured mostly using homemade questionnaires and few self reported measures [3], [16] which have not been clearly evaluated in term of validity and reproducibility. Frequently, metrics for measuring human empathy were only slightly changed and applied without previous validation [12]. Moreover, these approaches come with various biases, as involving cognitive abilities that robots do not have (e.g., saying that it is playing a role), whereas human empathy and robot empathy are, although with similarities, still two different concepts that can not be measured in the same way [4], [12].

To promote the comparability of HRI empathy experiments and to get results as unbiased as possible, it is necessary to have standardized and validated methods of measuring the perceived empathy of robots [12]. From our literature review, we conclude that the HRI research community lacks attempts to find standardized metrics for perceived empathy in robots, and—for that reason—we propose such a metric.

III. Generation of items

The Robot's Perceived Empathy (RoPE) scale is composed of 18 items divided in two scales: empathic understanding and empathic response (see Tab. I) with four filler (i.e., catch) items. The scales are based on the results of a previous pilot study with an exploratory approach [4]. Items are based on

978-1-5386-8555-6/19/$31.00 ©2019 IEEE

id	Empathic Understanding subscale items (EU)
EU1	The robot appreciates exactly how the things I experience feel to me.
EU2	The robot knows me and my needs.
EU3	The robot cares about my feelings.
EU4	$(-)$ The robot does not understand me.
EU5	The robot perceives and accepts my individual characteristics.
EU6	The robot usually understands the whole of what I mean.
EU7	$(-)$ The robot reacts to my words but does not see the way I feel.
EU8	The robot seems to feel bad when I am sad or disappointed.

id	Empathic Response subscale items (ER)
ER1	$(-)$ Whether thoughts or feelings I express are "good" or "bad" makes no difference to the robot's actions toward me.
ER2	$(-)$ No matter what I tell about myself, the robot acts just the same.
ER3	The robot comforts me when I am upset.
ER4	The robot encourages me.
ER5	The robot praises me when I have done something well.
ER6	The robot helps me when I need it.
ER7	The robot knows when I want to talk and lets me do so.
ER8	$(-)$ The robot's response to me is so fixed and automatic that I do not get through to it.

id	Filler items (FI)
FI1	The way the robot acts feels natural.
FI2	The robot knows what it is doing.
FI3	The robot is responsible for its actions.
FI4	When I interact with the robot, I feel anxious.

Table I
THE ITEMS COMPOSING THE ROPE SCALE. TO CALCULATE THE SUBSCALES' SCORE, SUM THE VALUE OF EACH ITEMS AFTER HAVING MULTIPLIED BY -1 THE VALUE OF THE ITEMS MARKED BY $(-)$.

human empathy metrics [1], [6] adapted to robots, avoiding unexpected formulations that involve capacities that robots clearly do not have. We verified the relevance of each item of the French versionaccording to the concept of the scale it represents by the valuation of 15 experts in cognitive sciences or other social sciences, and 10 experts in robotics or artificial intelligence. According to their advice, three items have been modified to stick as close as possible to the concepts of empathic understanding, and then confirmed by another group of experts. Expert validation of the English version[??] of the questionnaire has to be done to confirm the modifications in both languages.

IV. FUTURE WORK

In a future experiment, we plan to evaluate the reliability and validity of the French version of our metric. For this experiment, we will use Anki's Cozmo robot because it can display emotions easily and without the use of speech which could induce biases [5]. We will film an interaction between Cozmo and a person, who will tell Cozmo about their vacation. This interaction will be filmed twice. During both of them, Cozmo will display its emotions through its face and its behavior in a Wizard of Oz setup. In the first video, Cozmo will react empathically and display its understanding of the person's state of mind and emotions. In the second one, Cozmo will only display neutral and emotionless reactions signalizing that it is following the conversation, merely nodding. We will select two groups of about 150 French-speaking participants within a broad age span and from diverse demographic backgrounds, following the French population quotas. This sample size has been calculated as the minimum to be sensitive to small to medium-sized effects with a great statistical power [10]. Each video will be submitted with a questionnaire to a group. Forms will be sent twice, several weeks apart, to ensure with a test-retest task that the metric is reliable. Reliability, validity and sensibility of the measure will be tested in various statistical ways to validate the quality of the French version of the scale.

V. CONCLUSION

We proposed a new measure of perceived empathy in HRI and validated the items of the French version with experts from cognitive sciences and robotics. There are obviously still many things to do to get to the point of having a valid metric, such as reliability, sensibility, and generalizability tests. The purpose of this metric is to improve the reproduciblity, validity, and comparability of robotic empathy research.

ACKNOWLEDGEMENTS

This research was supported by the French *Association Nationale de la Recherche et de la Technologie* (ANRT) contract 2017/0226 and the joint laboratory BEHAVIORS.AI funded by the French *Agence Nationale de la Recherche* (ANR) contract ANR-16-LCV2-0003-01.

REFERENCES

[1] G. Barrett-Lennard, "The relationship inventory: A technique for measuring therapeutic dimensions of an interpersonal relationship," in *Mimeographed paper read at the Annual Conference of the Southwestern Psychological Association in St. Augustine, Florida*, 1959.
[2] S. Bavolek, "Developing empathy in families," *Retrived from www. nurturing/parenting. com*, 2003.
[3] T. W. Bickmore, "Relational agents: Effecting change through human-computer relationships," Ph.D. dissertation, Massachusetts Institute of Technology, 2003.
[4] L. Charrier, A. Galdeano, A. Cordier, and M. Lefort, "Empathy display influence on human-robot interactions: a pilot study," in *Workshop on Towards Intelligent Social Robots: From Naive Robots to Robot Sapiens at the 2018 IEEE/RSJ IROS Conference*, 2018.
[5] C. R. Crowelly, M. Villanoy, M. Scheutzz, and P. Schermerhornz, "Gendered voice and robot entities: perceptions and reactions of male and female subjects," in *2009 IEEE/RSJ IROS Conference*, 2009, pp. 3735–3741.
[6] M. H. Davis, *Interpersonal reactivity index*. Edwin Mellen Press, 1980.
[7] F. De Vignemont and T. Singer, "The empathic brain: how, when and why?" *Trends in cognitive sciences*, vol. 10, no. 10, pp. 435–441, 2006.
[8] R. Elliott, A. C. Bohart, J. C. Watson, and L. S. Greenberg, "Empathy." *Psychotherapy*, vol. 48, no. 1, p. 43, 2011.
[9] D. Jolliffe and D. P. Farrington, "Development and validation of the basic empathy scale," *Journal of adolescence*, vol. 29, no. 4, pp. 589–611, 2006.
[10] D. Lakens, "Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for ttests and anovas. front psychol. 2013; 4: 863," 2013.
[11] E. J. Lawrence, P. Shaw, D. Baker, S. Baron-Cohen, and A. S. David, "Measuring empathy: reliability and validity of the empathy quotient," *Psychological medicine*, vol. 34, no. 5, pp. 911–920, 2004.
[12] T. Nomura, "Empathy as signalling feedback between humanoid robots and humans," *Humanoid Robotics: A Reference*, pp. 1–10, 2016.
[13] R. E. Plank, A. P. Minton, and D. A. Reid, "A short measure of perceived empathy," *Psychological reports*, vol. 79, no. 3, pp. 1219–1226, 1996.
[14] P. F. Schmid, "Comprehension: the art of not-knowing. dialogical and ethical perspectives on empathy as dialogue in personal and person-centred relationships," *Empathy*, pp. 53–71, 2001.
[15] C. B. Truax, "A scale for the rating of accurate empathy," *The therapeutic relationship and its impact*, pp. 555–568, 1967.
[16] A. van Ruiten, D. Haitas, P. Bingley, H. Hoonhout, B. Meerbeek, and J. Terken, "Attitude of elderly towards a robotic game-and-train-buddy: evaluation of empathy and objective control," in *Proceedings of the Doctoral consortium, in the scope of ACII2007 Conference*, 2007.