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Individual Differences and Biohybrid Societies

Emily C. Collins and Tony J. Prescott

Department of Psychology, The University of Sheffield, UK
{e.c.collins,t.j.prescott}@sheffield.ac.uk

Abstract. Contemporary robot design is influenced both by task domain (e.g., industrial manipulation versus social interaction) as well as by classification differences in humans (e.g., therapy patients versus museum visitors). As the breadth of robot use increases, we ask how will people respond to the ever increasing number of intelligent artefacts in their environment. Using the Paro robot as our case study we propose an analysis of individual differences in HRI to highlight the consequences individual characteristics have on robot performance. We discuss to what extent human-human interactions are a useful model of HRI.

Keywords: individual differences, biohybrid, HRI, attachment, design.

1 Background

As a broad, multidisciplinary field it can be difficult to concisely define Human-Robot Interaction (HRI), but it maybe useful to consider HRI as being to robotics, as ergonomics is to design. Contemporary robot design is influenced both by the task domain (e.g., industrial manipulation versus social interaction) as well as by discrete classifications of the humans with which the robot will interact. For instance, robots designed for autism therapy behave quite differently from robots designed to interact with office workers or groups of people in crowded spaces such as airports [1]. The diversity of robot design reflects the considerable increase over the past few decades in the breadth of robot use.

Given the ongoing integration of intelligent machines into human life, we ask: how will people respond to these new *biohybrid societies*? Perhaps robot designers and engineers should be tackling how to make robots do the intricate things we wish of them before addressing the question of how we finesse a robot's social behaviour, but the speed with which robotics is advancing indicates that the time for thinking about the consequences of technology capable of eliciting complex, lasting emotions from humans is now [2]. This study investigates to what extent theories of human-human interaction are useful to an understanding of HRI as a contributing factor in the development of tools for robot design.

2 Paro and Individual Differences

Paro is a therapeutic device modelled on a baby harp seal (Fig. 1). Its primary use is in dementia-care as a robotic replacement for pets otherwise used in animal-therapy. Already it has become apparent that one size does not fit all even for this

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Fig. 1. Paro's *cute* design is intended to elicit positive responses from humans

early example. Whilst some patients take to Paro, and benefit from its use, some do not [3]. Despite patients' shared condition - dementia - the characteristics of the individual remain highly influential over the robot's performance.

In psychology, the study of these intra-class differences is referred to as *individual differences*. Whilst psychology is ostensibly the study of individuals, modern psychology more generally studies groups defined by shared biology or cognition. The statistical controls upon which empirical work relies are often defined in terms of a comparison between and within these groups, with individual differences treated as deviations from the main dimensions of study.

In order to design robots that will be effective for all people, rather than just some, we propose that within HRI whilst studying groups we also seek to understand dimensions of behaviour upon which individuals differ. This risks leading to a very complex design process - how are we even to begin to understand how humans will vary in their individual responses to robots in particular situations?

One way is to consider human-human interactions as a model of HRI. Robots with some autonomy and a physical presence that are capable of social interaction can be expected to elicit significant emotional responses. Considering the importance of emotions to the development of relationships one possible way to tackle the question of individual human reactions to robots is to consider to what extent human-human (or human-animal) interactions are a useful model of human-robot interactions [4]. To explore this we have chosen to analyse interaction with Paro using the human-human bonding theory of attachment.

3 Attachment Theory and Experiment

Attachments are thought to be driven by an evolutionarily programmed behavioural system which keeps infants close to their caregivers and safe from harm. A list of specific features are required for a relationship to be considered an attachment (in the psychological sense) [5], and attachment styles themselves are well defined in the literature as individual personality traits, that strongly influence emotional bonds and reactions to social partners [6].

The aim of the experiment is to measure whether individuals with attachment avoidance type personalities tend towards deactivating their emotional response towards Paro, in contrast to those with attachment anxiety personalities from whom we expect a hyperactivated emotional response.

Before arrival participants complete an online questionnaire measuring attachment style. Upon arrival a baseline measure of emotional receptiveness is

taken. Participants are then led to a room and asked to explore the interactive features of Paro before being let into the room alone. During the interaction participants are covertly video recorded. After five minutes have elapsed the experimenter returns and a measure of emotional receptiveness is taken again. Finally the experimenter conducts a short interview with the participant about their interaction with Paro, and the expectations they had before the interaction.

The questionnaire and interview data is used to cross reference the recorded behavioural data. The video is coded for robot directed displays of affection and interactivity: frequency/duration of touches, type of touch, e.g., stroking, cuddling, etc. As a robot designed to elicit caregiving behaviour in its users, Paro should tap into the caregiving structures of our participants. Thus participants measuring high in attachment avoidance should display less of these affectionate behaviours than those high in attachment anxiety. If Paro's design is effective our hypothesis may well be confirmed. If our hypothesis is not confirmed it is possible that this is due to Paro's design being less efficient at eliciting emotion than it could be. Alternatively it may indicate that a human-human interaction model cannot be directly applied to a human-robot interaction scenario.

However, as our focus here is on variation amongst individuals, and personal attachment style, we expect to obtain some data which will feed into our ideas about the potential for robot customisation. Future robots may, for example, measure an individual's personal attachment style, and then adapt its behaviour appropriately, allowing the achievement of personalised human-robot interactions without a requirement for personalised configuration, an idea which in turn may lend itself to greater advancements in our developing biohybrid societies.

References

1. Goodrich, M.A., Schultz, A.C.: Human-robot interaction: a survey. Foundations and trends in human-computer interaction 1(3), 203–275 (2007)
2. Watanabe, M., Ogawa, K., Ishiguro, H.: Field study: can androids be a social entity in the real world? In: Proceedings of the 2014 ACM/IEEE International Conference on Human-Robot Interaction, pp. 316–317. ACM (2014)
3. Chang, S., Sung, H.: The effectiveness of paro robot therapy on mood of older adults: a systematic review. International Journal of Evidence-Based Healthcare 11(3), 216 (2013)
4. Collins, E.C., Millings, A., Prescott, T.J.: Attachment to Assistive Technology: A New Conceptualisation. In: Proceedings of the 12th European AAATE Conference (Association for the Advancement of Assistive Technology in Europe) (2013)
5. Hazan, C., Zeifman, D.: Pair bonds as attachments: Evaluating the evidence. Guilford Press (1999)
6. Vrtička, P., Andersson, F., Grandjean, D., Sander, D., Vuilleumier, P.: Individual attachment style modulates human amygdala and striatum activation during social appraisal. PLoS One 3(8), e2868 (2008)