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ORIGINAL ARTICLE

User perceptions of anthropomorphic robots as monitoring devices

Stuart Moran · Khaled Bachour · Toyoaki Nishida

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Abstract The principle behind anthropomorphic robots is that the appearance and behaviours enable the pre-defined social skills that people use with each other each day to be used as a means of interaction. One of the problems with this approach is that there are many attributes of such a robot which can influence a user's behaviour, potentially causing undesirable effects. This paper aims to identify and discuss a series of the most salient behaviour influencing factors in the literature, related to a number of robot attributes. A particularly novel aspect of this work is the study of robots as monitoring or data collection devices, one of several behaviour influencing factors which has received insufficient attention. As a first step towards this, the PSA matrix is produced, which visualises the relationships between system attributes and user perceptions, grounded in empirical evidence in the literature. This matrix highlights gaps in the literature, brings together a series of salient behaviour influencing factors for the first time and gives a clear view of the state of the art.

Keywords Anthropomorphic · Data collection · Matrix · Monitoring · Pervasive · Robotics · Ubiquitous

S. Moran (✉) · K. Bachour
Mixed Reality Lab, University Nottingham, Nottingham, UK
e-mail: Stuart.Moran@nottingham.ac.uk

K. Bachour
e-mail: Khaled.Bachour@nottingham.ac.uk

T. Nishida
Nishida Lab, Department of Intelligence Science and Technology, Graduate School of Informatics, Kyoto University, Kyoto, Japan
e-mail: nishida@i.kyoto-u.ac.jp

1 Introduction

With continuous advancements in artificial intelligence and reduction in costs of hardware, the reality of a world where humans coexist with robots approaches ever closer. Through ongoing social research, most major computer technologies have a clear set of design principles and methods for introducing technology successfully into the user market. In the case of robots, one direction being explored is the approach of a humanlike appearance. Anthropomorphic robots attempt to make the use of the well-defined social abilities that people use with one another day-to-day as a means of interaction. The benefits of this are that there is ideally very little learning time required to interact with the technology, through a familiar and intuitive interface. There are many different attributes of a robot which can help increase the perceptions of anthropomorphism, including facial features, physical expressiveness, emotions and personality. One of the problems with these attributes is that slight variations can cause a change in the way a robot is perceived and interacted with, including feelings of discomfort [e.g. uncanny valley (Mori 1970)]. Such variations are not limited to human–robot interaction (HRI), but can also been found in other computer systems. For example, many such parallels exist in monitoring systems, such as CCTV and wearable computing.

We argue that anthropomorphic robots, by design, are inherently monitoring (or data collection) devices, but unlike typical monitoring systems, they have a unique embodiment and physical presence. In human–human relationships there is evidence that shows how being observed can *change behaviours*, consider social facilitation effects (Woods et al. 2005a), or the infamous, but often contested, Hawthorne effect (Wickstrom and Bendix

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