

A Study on Strategies to Make Good Use of Android Science

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Introduction

Humanoid robots (*humanoids* hereafter) developed by Japanese researchers have recently begun to serve as platforms for the study of cognitive mechanisms both domestically and abroad. In the European Union, humanoid and especially very humanlike *android* robots are not generally accepted as human companions and are developed only for scientific purposes. The US focus on the practical use of humanoids for security and space does not require of them near human appearance and behaviors. In Japan, the general public is interested in humanoids and, for the moment, seems eager to accept them as companions. Both the general public and developers are concerned about the extent to which their behavior, cognition, and attitudes should be humanlike, how humanlike qualities are to be achieved, and how human-friendly androids will eventually be. Japan may be the first country to foster widespread interaction between the general public and humanoids, and indeed androids, in everyday life.

Now the Japanese government is required to set up comprehensive strategies 1) to make effective use of androids to advance our understanding of brain functions and the human mind (i.e., *cognitively-oriented android science*, see MacDorman and Ishiguro, 2006a, 2006b), 2) to promote studies and discussion on the social implications of knowledge obtained from cognitively-oriented android science, and 3) to predict and examine the likely influence of androids when they are integrated into society at large (Ishii, 2006).

Android Science in Japan

When the Japanese government set up strategic targets for brain science research in the 1990's, "creating a brain" was launched as one of its categories. This soon evolved into a conceptual framework to elucidate brain functions by creating algorithms of the brain and evaluating them in a robot, which can interact with the environment through its body. The Japanese have not had a tradition emphasizing a brain-versus-body duality but rather accept the view that the mind, body, other persons, and the environment all mutually influence each other. A scientific paradigm shift from a brain-body duality to a brain-body continuum occurred largely without debates (Tani, 1998). Thus, humanoid sciences were devoid of such philosophical considerations in Japan.

Japan's history is unique in that the animistic view typical of hunter-gatherer societies was not expunged after the transition to an agriculture society, or later an industrial society, despite the incorporation of Buddhism and other beliefs from the continent of Asia and the West (Umehara

and Fujimura, 1994; Yamaori, 2005). Even today, it is not difficult for the Japanese to accept that a non-human might have some kind of soul (Takanishi, 2005). A Japanese philosopher explains that, because 'we' try naturally to give everything meaning; we put the writer's emotion into even a computer-generated Haiku poem; and cast 'our' mind into robots that lack their own mind (Kurosaki, 2001). This is one reason why the Japanese accept androids and robots pets easily. Most of them have no habit of profound precautionary considerations about androids.

The situation differs from Western societies whose animistic ideas have been uprooted by monotheism since the Old Testament, and who have been concerned about the controllability of androids (the 'Frankenstein complex'). Because of a prevailing belief that humankind was created in the image of an omnipotent Creator and that all other creatures were created for human use, people may think the "creation of androids is disobedience to God," "androids can be harmful and dangerous to human beings," or "androids can never have a soul because they are not created by God" (Dario, 2005).

However, the Japanese are reluctant to introduce new concepts and technologies that are directly related to their natural body. For example, seldom are declarations of brain death or requests for organ implants approved (Ida, 2003). Ironically, administrators tend to oppose the application of robots in the medical services. It is still not clear whether the Japanese will realize human-android symbiosis in a mature form or fall into android-phobia when they find androids are penetrating too deeply into their daily lives. It is necessary to carry out psychological and sociological studies to seek desirable human-android relationships.

The Future of Android Science

Android science will help elucidate mechanisms of human cognition and behavior including autonomy as described below while influencing society and stimulating debate. Thus, the social sciences and such humanities subjects as philosophy will have to take part in android science from the beginning, to interpret the results of research in engineering and the natural sciences in a social context.

Mechanisms of autonomy. One of Japanese future challenges is to make a society where elderly and disabled people can live as autonomously as possible in an ordinary environment together with other people. As for androids, they are expected to act autonomously in human society without depending exclusively on human-made programs. When people walk along a familiar path or engage in a well-practiced task, they are acting autonomously but largely subconsciously. Recent advances in neuropsychological and

psychophysical methodology and behavioral measurement methods, combined with the development of noninvasive brain activity measurement technology, disclose that major aspects of autonomous behaviors and decision making are implicit (Shimojo, 1999). Because subconscious processes are directly connected to physical states and environmental contexts, and are relatively passive and mechanical, it is expected to be relatively easier to scientifically elucidate these processes. In combination with those studies described above, android science will disclose mechanisms of autonomy (Maeno, 2005).

Modern law is based on the concept of the free will of each individual and of responsibility for conduct performed by free will. The scientific paradigm about mechanisms of autonomy will elicit debate on the rights and responsibility of autonomous humanoids and a reconsideration of the responsibility of human beings (Caverley, 2006).

Human perception has been changing through interaction with new technologies (McLuhan, 1962). These days, young generations are easily exposed to and most susceptible to new technologies. When androids become available at home, infants and children will be the most intensely attracted to and influenced by them (Turkle et al., 2006). Some parents may try to make androids take care of their children in their stead. Indeed, there is already a project to develop childcare robots in Japan. A theory of mind and concept of self have been normally developed through interactions with conspecifics so far. Recently, the influence of caregivers' attitudes on the cognitive development of infants has been found to be much more critical than previously thought (Kozima & Takada, 2001). It is necessary to foresee the capability of androids as caregivers and their potential influence on the growth and communication of children. Also cohort studies have to be carried out while the majority of people have still grown up without frequent contacts with robots. In this context, it is required to make ethical considerations on what kind of androids should be developed and distributed.

Conclusion

As android science explores the fundamental nature of the human mind, questions such as "to whom does the knowledge of a human mind belong?" or "can it belong to anyone at all?" will foster wide scale debate. Each government and international organization has to make efforts so that everyone in the world can share knowledge about the human mind. In the 21st century, technologies "to exploit the brain" will be developed and used in various domains, such as the economy, production, labor, and amusement. It is indispensable to promote in advance scientific research "to explore the brain" profoundly. Android sciences should be promoted as a part of comprehensive studies of the mind. Recent advances in genetics, primatology, anthropology, archeology, history, cognitive science, and social science make it possible to explore changes in human cognition and behavior in a long and continuous time span. This will help to foresee future

changes by new technologies and social and environmental conditions. It is useful to ponder what are equilibrating states of mind and what are suitable way to let our mental mechanisms function in good interaction with our conspecifics and outer environments. We can manage to use androids as a good platform for researchers from different domains and the general public to discuss issues together.

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