Cultural Differences in Social Acceptance of Robots*

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Abstract— The paper summarizes the results of the questionnaire surveys conducted by the author's research group, along 1) attitudes toward robots, 2) assumptions and images about robots, 3) anxiety and expectation toward humanoid robots based on the concept of "Frankenstein Syndrome", and 4) ethical problems related to robots. Then, the paper discusses about the future direction of the research on cultural differences on social acceptance of robots.

I. INTRODUCTION

In recent years, several studies have revealed the influences of human cultures into feelings and behaviors toward robots, and some of them focused on social acceptance of robots. For example, Evers, et al. [1] revealed differences between the US and Chinese people on their attitudes toward and the extent to which they accepted choices made by a robot. Li, et al. [2] found an interaction effect between human cultures (Chinese, Korean and German) and robots' tasks (teaching, guide, entertainment and security guard) on their engagement with the robots. Yueh and Lin [3] showed differences on preferences of home service robots between Taiwanese and Japanese people.

The author and several research collaborators have also conducted some questionnaire surveys for the aim at exploring people's acceptance of robots comparing between some nations. The paper summarizes the results of these surveys consisting of international comparison on 1) attitudes toward robots, 2) assumptions and images about robots, 3) anxiety and expectation toward humanoid robots based on the concept of "Frankenstein Syndrome", and 4) ethical problems related to robots (roboethics). Then, the paper discusses about the future direction of the research on cultural differences on social acceptance of robots.

II. ATTITUDES TOWARD ROBOTS

In psychology, an attitude is defined as a relatively stable and enduring predisposition to behave or react in a certain way toward persons, objects, institutions, or issues; its source is cultural, familial, and personal. [4]. On the other hand, the research on technophobia [5] suggested that anxiety and negative attitudes toward computers influenced social acceptance of this technology. Then, it is estimated that negative attitudes toward robots are related to people's feelings about the impact of robots on society and the quality of life, and their understanding of robots. To measure this psychological construct influential into people's social acceptance of robots, the author's research group developed a psychological scale named "Negative Attitudes toward Robots Scale" (NARS) [6].

NARS consists of 14 items classified into three subscales. The first subscale (S1, six items) measures negative attitude toward interaction with robots (e.g., "I would feel paranoid talking with a robot."). The second subscale (S2, 5 items) measures negative attitude toward the social influence of robots (e.g., "Something bad might happen if robots developed into living beings."). The third subscale (S3, 3 items) measures negative attitude toward emotional interaction with robots (e.g., "I feel comforted being with robots that have emotions."). Each item is scored on a five-point scale: 1) strongly disagree; 2) disagree; 3) undecided; 4) agree; 5) strongly agree, and an individual's score on each subscale is calculated by adding the scores of all items included in the subscale, with some items reverse coded. The validity and reliability of the scale was confirmed through a psychological experiment and survey [6]. Table 1 shows the items of the NARS.

Since the development of this scale, some research works have found influences of negative attitudes into human perception and behaviors toward robots, and factors affecting these attitudes. Moreover, some of them used this scale to explore cultural differences on attitudes toward robots. Bartneck, et al., [7] suggested cultural differences on the NARS scores through an international comparative survey among seven different countries. Wang, et al., [8] found in their experiment of human-robot interaction that Chinese participants had more negative attitudes toward robots than did the USA, and relied less on the robot's advice.

The survey conducted via the Internet by the author ($N = 200$) suggested some results different from the existing studies [9]. The survey explored differences on not only negative attitudes toward robots but also correlations between the attitudes and other factors such as perceptions of the relation to the family and commitment to religions, while taking into account age factor. It was revealed that:

1. The UK people had more negative attitudes toward interaction with robots than did the Japanese people.

2. The elder people perceiving weaker relation to their family members had more negative attitude toward interaction with robots in both the nations.

3. The elder UK people perceiving weaker relation to their family members also had more negative attitude toward social influences of robots.

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4. The elder Japanese people having stronger commitment to religions had more negative attitude toward social influences.

These results suggest that not only negative attitudes toward robots but also factors influencing them may differ dependent on cultures and age.

III. ASSUMPTIONS AND IMAGES ABOUT ROBOTS

It is known that the concept of "robot" itself is very old. However, it is only recently that humanoid and pet-type robots have appeared as commercial products in daily life, even in Japan which is regarded as one of the most advanced nations in the development of robotics. Moreover, compared with computers, toward which people have a rather fixed set of images and related assumptions, images of robots and assumptions about them may vary widely, depending on the nature of the robot, e.g. whether it is of humanoid or pet-type, or its purpose, e.g. if it functions as a vacuum cleaner.

In this stage, it is important to compare between the different cultures what people assume and image when they encounter the word "robots" while discussing the differences in concrete feelings and attitudes toward robots. To explore cultural differences on these assumptions and images about robots, the author's research group administered the Robot Assumptions Questionnaire (RAQ) to the university students in Japan, Korea, and the United States, focusing on five factors relating to humanoid and animal-type robots: relative autonomy, social relationship with humans, emotional aspects, roles assumed, and images held [10].

Based on a pilot test and discussion between the researchers from the three countries, RAQ consists of one item for the assumption on relative autonomy of robots (3 choices: complete autonomy, partially controlled by humans, and completely controlled by humans), one item for the assumption on social relationship with humans (3 choices: equal to humans, similar to pet animals, and similar to tools), one item for the assumption on emotional aspects of robots (3 choices: equal to human emotions, not as much as humans, and no emotion), ten items for roles of robots, and seven items for images of robots (seven-graded scales).

The results of the survey ($N = 796$) are summarized as follows:

1. Students in Japan, Korea, and the United States tend to assume that humanoid robots perform concrete tasks in society, and that animal-type robots play a pet- or toy-like role.

2. Japanese students tend to more strongly assume that humanoid robots have somewhat human characteristics and that their roles are related to social activities including communication, than do the Korean and the US students.

3. Korean students tend to have more negative attitudes toward the social influences of robots, in particular, humanoid robots, than do the Japanese students, while more strongly assuming that robots' roles are related to medical fields than do the Japanese students.

4. Students in the USA tend to have both more positive and more negative images of robots than do Japanese students, while more weakly assuming robots as blasphemous of nature than do Japanese and Korean students.

Table I. The Questionnaire Items in NARS

Item No.	Questionnaire Items	Sub Scale
1	I would feel uneasy if robots really had emotions.	S2
2	Something bad might happen if robots developed into living beings.	S2
3	I would feel relaxed talking with robots. *	S3
4	I would feel uneasy if I was given a job where I had to use robots.	S1
5	If robots had emotions, I would be able to make friends with them. *	S3
6	I feel comforted being with robots that have emotions. *	S3
7	The word "robot" means nothing to me.	S1
8	I would feel nervous operating a robot in front of other people.	S1
9	I would hate the idea that robots or artificial intelligences were making judgments about things.	S1
10	I would feel very nervous just standing in front of a robot.	S1
11	I feel that if I depend on robots too much, something bad might happen.	S2
12	I would feel paranoid talking with a robot.	S1
13	I am concerned that robots would be a bad influence on children.	S2
14	I feel that in the future society will be dominated by robots.	S2

* Reversed Item
S1: Negative Attitude toward Situations of Interaction with Robots
S2: Negative Attitude toward Social Influence of Robots
S3: Negative Attitude toward Emotions in Interaction with Robots

These results suggest that the word "robots" evoke different images of entities having different roles, and different feelings between nations.

IV. FRANKENSTEIN SYNDROME

The term "Frankenstein Syndrome" was originally used when referring to controversies in the life sciences, in particular, genetic engineering [11], and suggests that the creation of human-like artifacts is an act of potential transgression. Kaplan [12] made use of this concept to explain why the Japanese can accept humanoid robots more naturally than do the Westerners.

Along this concept of "Frankenstein Syndrome", the author's research group developed a questionnaire to measure the acceptance of humanoid robots in humans, mainly for clarification of the difference between the UK and Japan [13, 14]. The questionnaire consists of thirty items for measuring acceptance of humanoid robots including expectations and anxieties toward this technology in the general public. Each questionnaire item is assigned with a seven-choice answer (1: "Strongly disagree", 2: "Disagree", 3: "Disagree a little", 4: "Not decidable", 5: "Agree a little", 6: "Agree", 7: "Strongly agree".). Table 2 shows the factors of the FSQ and representative items.

The results of the survey ($N = 200$) including the FSQ and NARS, and comparison between people in their 20s and those in their 50s [14] suggested some differences on social acceptance of humanoid robots between the two countries, as follows:

1. The UK participants felt more negative towards humanoid robots than their Japanese counterparts.

2. The UK participants in their 20s had more positive expectations for humanoid robots than any other group.

3. The correlation between negative attitudes toward emotional interaction with robots and negative feelings toward humanoids was at a moderate level only in 50s people.

4. The correlation between negative attitude toward social influences of robots and expectation for humanoids also had the similar trend.

5. The correlation between negative attitude toward emotional interaction with robots and root anxiety toward humanoids was at a moderate level only in UK participants in their 50s.

These results suggest differences between the two nations on both acceptance of specific type of robot and relationships between this acceptance and attitudes toward robots in more general.

V. ROBOETHICS

The recent development of robots aiming at acting in daily-life fields including home, schools, and hospitals has been encouraging for philosophers and scientists to discuss about robot ethics. For example, Asaro [15] argued that robot ethics should discuss the following three things: the ethical systems to be built into robots, the ethics of people who design and use robots, and ethical relationships between humans and robots. Lin [16] proposed the following three broad (and interrelated) areas of ethical and social concerns about robotics: safety and errors, law and ethics, and social impacts.

As shown in the previous sections, however, general publics' conceptualizations of and feelings toward robots differ among nations, due to different situations with respect to mass media and historical influences of technologies. Moreover, interpretations of the word "ethics" differ between countries because of different social norms. Thus, we should compare the opinions of the general publics of several countries when they face the words "robots" and "ethics" at the same time, in order to prepare discussion on the international consensus of robotics applications.

The author conducted a questionnaire survey ($N = 400$) based on open-ended questions in Japan, the USA, and Europe, for exploring differences on opinions for roboethics [17]. To take into account the historical influences of wars into the ethical perspectives of military robotics, the survey in Europe was conducted in Germany and France, which were a defeated country and a victorious country in World War II, respectively. The open-ended questions in the survey were as follows:

1. What would you image when hearing "robots" and "ethics" at the same time?

2. What sort of ethical problems would happen when robots widespread in society?

Table II. Factors of the FSQ and Representative Items

Factors	Representative items
I. Negative Feelings toward Humanoid Robots	"Widespread use of humanoid robots would take away jobs from people." "Humanoid robots may make us even lazier."
II. Expectation for Humanoid Robots	"I can trust persons and organizations related to development of humanoid robots." "Humanoid robots can be very useful for teaching young kids."
III. Root Anxiety toward Humanoid Robots	"The development of humanoid robots is blasphemous." "I don't know why, but humanoid robots scare me."

3. How should we solve the problems mentioned in item 2?

The results based on qualitative analysis for open-ended texts suggested some characteristics of Japan, the USA, Germany, and France when the general public of each country faces the issues regarding robot ethics, as follows:

1. People in Japan tended to react to ethical issues of robotics more seriously than those in the USA, Germany, and France, while they were more influenced by virtual contents such as science fiction movies.

2. People in Germany were least likely to connect robotics to ethics.

3. People in France, despite also being in the EU, expressed more apprehension toward robotics.

4. Japan and France had opposite trends with respect to unemployment that may be caused by the widespread of robots.

5. Although a minority of people mentioned this issue as overall, more people tended to specify the issue in Japan and in the USA than in the two European countries.

6. Unlike the people in France, the people in Japan tended to argue for restricting the use and development of robots as a solution to ethical problems.

As a result, it was suggested that people in different counties focus on different issues on robots and ethics, and try to find different solutions for the issues.

VI. DISCUSSION

As mentioned in the previous sections, our survey studies partly and independently focused on assumptions and images about robots, attitudes and feelings toward robots, and opinions on social acceptance of robots in different nations. Here, the relationship between the four studies should be clarified from the perspective of their measures to investigate what factor was lacked in the studies. Figure 1 shows the relationship between the four studies.

The presupposition in this figure is that assumptions and images about robots, attitudes and feelings toward robots, and opinions on social acceptance of robots influence each other. That is, what people assume and image on robotics applications in society may affect their feelings toward the robots, and as a result their acceptance of the robots may be influenced. On the contrary, ethics related to robots, which can reflect the historical aspect in a specific culture, may construct images of robots in people and specify their attitudes toward the robots. If the presupposition is valid, however, we should not separately measure assumptions and images about, attitudes and feelings toward, and opinions on social acceptance of robots. To investigate cultural differences on social acceptance of robots in more details, not only differences on each psychological reaction but also differences on relations between them should be taken into account.

In fact, our study using the FSQ mentioned in section IV suggest the necessity to measure more than two different psychological constructs and investigate differences on relationships between them in cultural studies on robots. Both negative attitudes toward robots in general and expectation/anxiety toward a specific type of robot (humanoid) were measured in the study, and it was found that only a specific generation in one nation showed the correlation
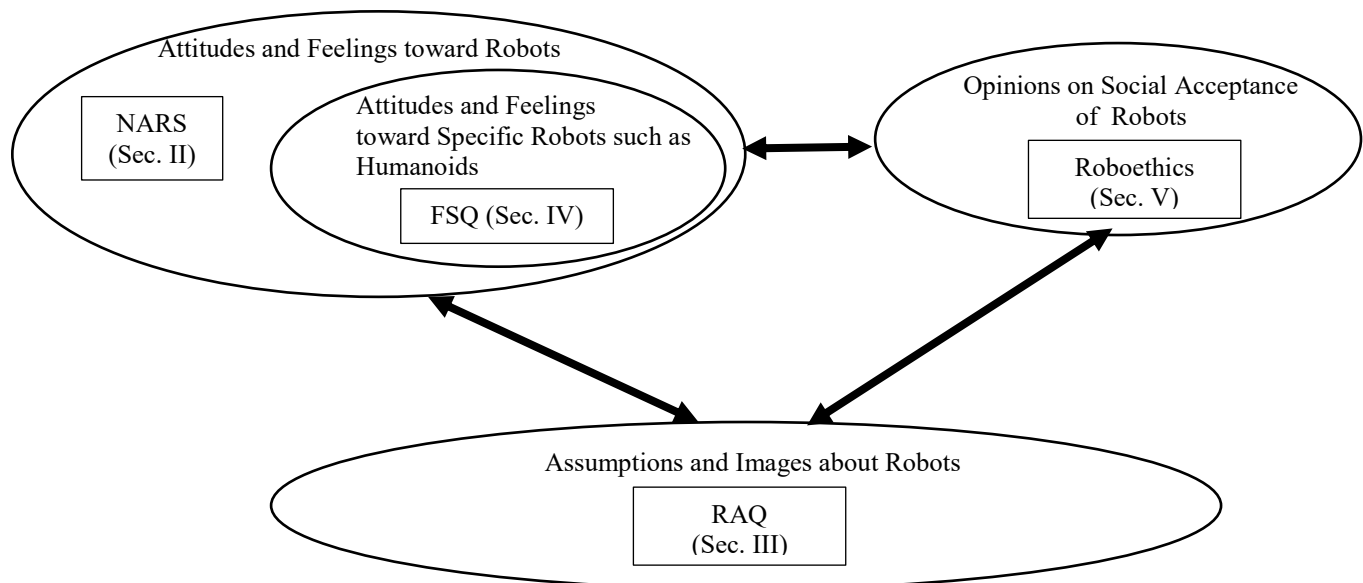

Figure 1. Relationship between Measures in Cross-Cultural Research on Robots

between them. In other words, it is suggested that general attitudes toward robots do not necessarily influence acceptance of a specific type or robotics application dependent on cultures.

On the other hand, more measures lead to the difficulty of analyses and weak implications. To avoid them, we should focus on specific applications of robots, types of robots to be assumed for the applications, attitudes and feelings toward these robots, and then consider ethical problems on these applications. For example, the following research questions will be efficient:

- What type and role of robot people assume in the application in each nation.

- What attitude and feeling people have for types and roles of robots assumed in the nations.

- How people's apprehensions about the robotics application are related to their assumptions about and attitudes toward the robots?

If the presuppositions in the applications about robot types and roles are not shared in different cultures, we will not be able to discuss the usefulness and validity of the robots, and not lead to any conclusion.

Our studies have another problem. In the four surveys, any concrete definition of "culture" was not provided, and differences in the measures between nations were straightforwardly interpreted as cultural differences. This confusion should be avoided in future studies to clarify what characteristics in the concept of "culture" can influence people's perception and behaviors of accepting robots.

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