People's Assumptions about Robots: Investigation of Their Relationships with Attitudes and Emotions toward Robots *

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***Abstract*— People's assumptions about robots are an important factor affecting their construction and change of attitudes and emotions toward robots. The assumptions should be measured not only to investigate psychological factors determining reactions toward robots but also to study cross–cultural attitudes toward robots. As far as measurement of people's attitudes and emotions can contribute to the design of human–robot interaction, questionnaire items measuring assumptions of robots should be prepared. To develop these items measuring individuals' assumptions about robots, a pilot research was administered in Japan. The results implied the possibility that Japanese people assume "humanoids" as a representative robots, though this assumption still remaines unconnected to realistic assumptions about situations where and tasks that these robots perform; the classical views of robots that physically act for humans remains. These implications present some problems for the administration of the survey. This paper reports detailed results of the pilot survey, discusses implications of the results and problems with them, and suggests possible future works based on the results.**

I. Introduction

Exploration of people's relationships with robots is an important subject in the development of human–robot interaction, including the design of robots' appearance and behaviors, the social influence of robotics applications, and so on. For example, Friedman and her colleagues investigated people's relationships with AIBO by analyzing more than 6,000 postings in online AIBO discussion forums [1]. Furthermore, Woods and Dautenhahn invetigated the difference on relations of robots' appearances to emotions toward them between children and adults, using a questionnaire–based method [2].

In order to explore people's attitudes and emotions toward robots more widely and exactly, psychological scales for measurement of them need to be developed as standard tools in human–robot interaction research. For this aim, we have developed and been developing some psychological scales that measure negative attitudes and anxiety toward robots [3], [4], [5]. The previous research implied possibilities of gender difference and influence of experiences of real–acting robots in individuals' construction of attitudes toward robots. Moreover, a cross–cultural research based on the scale implied the possibility of differences in negative attitudes toward robots between some nations [6].

However, there is one problem to be solved with respect to interpreting measured attitudes toward robots, particularly in interpreting cultural differences. When individuals are asked to answer questionnaires related to robots, which type of robot do they assume, which task do they assume robots perform, or which place do they assume robots work?

Humans' images of computers have already been established as those consisting of keyboards, mouses, displays, and so on. Thus, measuring attitudes and emotions toward computers may not have to take into account individuals' assumptions about them. In comparison, humans' images of robots vary from industrial arm–manipulators to pet–type and humanoid robots. Thus, differences between individuals' assumptions about robots may affect differences between their construction and a change of attitudes toward robots.

Such a possibility suggests that not only attitudes and emotions themselves but also assumptions should be measured as a controlled variable in the administration of questionnaires related to robots. Thus, it is necessary to prepare questionnaire items measuring individuals' assumptions about robots and clarify relations between these assumptions, attitudes, and emotions toward robots. In addition, from a perspective of a cross–cultural study on robots, it is important to clarify cultural differences of assumptions

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about robots themselves.

This paper reports results of our pilot research in which we have been developing questionnaire items that measure individuals' assumptions about robots. Moreover, it discusses future works based on these items.

II. PILOT SURVEY

This section reports contents and analytical results of our pilot survey administered in Japan.

A. Items and Choices

The aim of the pilot survey was to collect more assumptions about robots existing in the current stage rather than to validate items assumed in advance. For the first step, a discussion was conducted between two engineering researchers and two psychologists. It focused on three factors: assumptions about types of robots, assumptions about how robots behave in certain situations, and assumptions about tasks that robots perform. Moreover, choices necessary for each factor were discussed, considering aims and types of current robotics research.

The items and choices for pilot survey were made based on results of the discussion. The survey consists of the following assumptions:

Assumptions about Types:

Objects that respondents first recall when they hear the word "robots":

Choices:

- Humanoid
- Pets such as dogs and cats
- Animals except for pets
- Computers
- Factory Robots
- Others

Assumptions about Situations:

Situations where respondents first think "robots" exist:

Choices:

- Houses
- Offices
- Schools
- Hospitals
- Factories
- Workshops
- Hazardous locations (stricken areas, battlefields, etc.)
- Locations where humans find it difficult to go (deep sea, space, etc.)
- Others

Assumptions of Tasks:

Tasks which respondents first think "robots" perform:

Choices:

- Housework
- Office work
- Physical tasks
- Service tasks for humans
- Others

In order to assemble a variety of assumptions, respondents were allowed to check more than one choice among those mentioned above. Moreover, items classified as "Others" have space for free description of respondents' opinions about the corresponding items.

B. Administration

The pilot survey, including a pre–test of the above items, was administered for university students in the Kansai (western) area, and students and adults in the Kanto (eastern) area of Japan in December 2004. The respondents were instructed only to provide opinions about robots according to the items mentioned in II-A. Their participation was voluntary in all cases.

As a result, data samples consisting of a total of 106 respondents (male: 47, female: 33, unknown: 26) were assembled. The data from the Kansai area did not include age[1]; the average age of respondents in the Kanto area was 22.9.

C. Analysis

First, we calculated how many respondents selected each object, situation, and task in the assumptions about robots. Table I shows the numbers of respondents who checked each choice among the items, and the percentages of those items.

Regarding assumptions about types of robots, more than 80% of the respondents checked the choice "humanoid." Furthermore, about 20% of them checked the choices "pets such as dogs and cats," "computers," and "factory robots." Few respondents checked the choice "animals except for pets." Some respondents who checked the choice "Others" mentioned fighting robots appearing in TV animation programs.

Regarding assumptions about how robots behave in certain situations, the choices "houses" and "factories" were checked by 33% and 37% of respondents, respectively. The selection rates of all the other choices were less than 30%. In particular, the selection rates of the choices "schools" and "hospitals" were checked by only 1% and 10% of respondents, respectively. Some respondents who checked the choice "Others" mentioned "laboratories" and "exhibitions."

Regarding assumptions about tasks that robots perform, 66% of respondents checked the choice "physical tasks," while about 20% of them checked the choices "housework," "office work," and "service tasks for humans." Some respondents who checked the choice "Others" mentioned "tasks difficult for humans to perform, such as "fire–fighting," "wars," and "guard duty".

Second, to find relations between specific assumptions about types, situations, and tasks, ϕ–coefficients were calculated to show the extent of relationships between the assumption choices. In addition, we performed χ^2–tests on selection for pairs of choices to investigate the statistical

[1]All the respondents were university students.

TABLE I

THE NUMBER OF RESPONDENTS WHO CHECKED EACH CHOICE FROM AMONG THE ITEMS OF THE PILOT SURVEY, AND THEIR PERCENTAGES ($N = 106$)

Assumption about Types						
	Humanoid	Pets such as dogs and cats	Animals except for pets	Computers	Factory Robots	Others
N (rate)	83 (78%)	25 (24%)	2 (2%)	19 (18%)	25 (24%)	6 (6%)
Assumption about Situations						
	Houses	Offices	Schools	Hospitals	Factories	
N (rate)	35 (33%)	28 (26%)	1 (1%)	10 (9%)	39 (37%)	
	Workshops	Hazardous Locations	Locations where humans find it difficult to go		Others	
N (rate)	26 (25%)	16 (15%)	26 (25%)		10 (9%)	
Assumption about Tasks						
	Housework	Office work	Physical tasks	Service tasks for humans	Others	
N (rate)	20 (19%)	20 (19%)	70 (66%)	24 (23%)	11 (10%)	

significance of these ϕ–coefficients based on independence among these choices. [2]

Table II shows the ϕ–coefficients and results of the χ^2–tests between choices of assumptions about types and situations. The choice "humanoid" had a dependent relation only with "offices," and the ϕ–coefficient showed a low level of positive correlation between them. The choice "pets such as dots and cats" had dependent relations only with "houses" and "locations where humans find it difficult to go." The ϕ–coefficients showed a medium level of positive correlation between them. The choice "computers" had a dependent relation only with "locations where humans find it difficult to go," and the ϕ–coefficient showed a medium level of positive correlation between them. The choice "factory robots" had dependent relations only with "factories" and "workshops." The ϕ–coefficients here showed a medium level of positive correlation between them.

Table III shows the ϕ–coefficients and results of the χ^2–tests between choices of assumptions about types and tasks. In this case, there were no dependent relations between the choices, except for the relation between "computers" and "office work," that between "factory robots" and "factories," and that between "Others" and "Others." The ϕ–coefficients in these relations showed a medium level of positive correlation.

Table IV shows the ϕ–coefficients and results of the χ^2–tests between choices in assumptions about tasks and situations. The choice "house" had dependent relations with "housework," "physical tasks," and "service tasks for humans." The ϕ'–coefficient between "house" and "housework" showed a medium level of positive correlation, where as the ϕ'–coefficient between "houses" and "physical tasks," and that between "houses" and "service tasks for humans," showed a low level of negative and positive correlation, respectively. The choice "offices" had a dependent relation only with "office work," and the ϕ–coefficient showed a medium level of positive correlation. The choice "hospitals" had a dependent relation only with "service tasks for humans," and the ϕ–coefficient for it showed a low level of positive correlation. "Factories" and "locations where humans find it difficult to go" had a dependent relation with "physical tasks," with a medium level of positive correlation to it. "Workshops" also had a dependent relation with "physical tasks" but with a low level of positive correlation to it. In addition, "factories" had a dependent relation with "service tasks for humans," with a low level of negative correlation to it.

D. Discussion

We should be careful about generalizing the results of the pilot survey on assumptions about robots to a common trend in Japan because of the small number of samples and rough design of the questionnaire's administration. Nevertheless, we can try to estimate some trends to a certain extent.

First, although there were some correlations between assumptions about types, situations, and tasks of robots, they were not sufficiently high. Of course, there may be a trend that specific assumptions about situations where robots behave are connected with specific assumptions about types and tasks (e.g., "pets such as dogs and cats"–"houses," "computers"–"office work," 'factory robots"–'factories," "offices"–"office work," "factories"–"physical tasks"). However, the results of the pilot survey imply that this trend is not strong.

This implication leads to a possibility that individuals assume types, situations, and tasks of robots independently. It should be noted, however, that there is another possibiity that the respondents' assumptions about robots changed when they moved from some items to others, due to the specific way of responding to the item such as permitted selection of more than one choice. This can cause the trend

[2] Fisher's method was used in cases in which the expected value of a cell was less than 5 on the 2× 2 cross table.

TABLE II

ϕ–COEFFICIENTS AND RESULTS OF χ^2–TESTS BETWEEN CHOICES IN ASSUMPTIONS ABOUT TYPES AND SITUATIONS ($df = 1$, $N = 106$)

	Humanoid	Pets such as dogs and cats	Animals except for pets	Computers	Factory Robots	Others
Houses	$\phi = -0.020$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.319$ $\chi^2 = 9.231$ $p < .01$	$\phi = 0.050$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.038$ $\chi^2 = 0.015$ $n.s.$	$\phi = -0.012$ $\chi^2 = 0.000$ $n.s.$	$\phi = -0.172$ $\chi^2 = 1.752$ $n.s.$
Offices	$\phi = 0.212$ $\chi^2 = 3.652$ $p < .05$	$\phi = 0.020$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.074$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.166$ $\chi^2 = 2.031$ $n.s.$	$\phi = -0.030$ $\chi^2 = 0.003$ $n.s.$	$\phi = -0.147$ $\chi^2 = 1.070$ $n.s.$
Schools	$\phi = -0.185$ $\chi^2 = 0.476$ $n.s.$	$\phi = -0.054$ $\chi^2 = 0.000$ $n.s.$	$\phi = -0.014$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.209$ $\chi^2 = 0.706$ $n.s.$	$\phi = -0.054$ $\chi^2 = 0.000$ $n.s.$	$\phi = -0.024$ $\chi^2 = 0.000$ $n.s.$
Hospitals	$\phi = -0.065$ $\chi^2 = 0.071$ $n.s.$	$\phi = 0.125$ $\chi^2 = 0.798$ $n.s.$	$\phi = 0.192$ $\chi^2 = 0.578$ $n.s.$	$\phi = -0.067$ $\chi^2 = 0.064$ $n.s.$	$\phi = 0.049$ $\chi^2 = 0.012$ $n.s.$	$\phi = 0.061$ $\chi^2 = 0.000$ $n.s.$
Factories	$\phi = -0.120$ $\chi^2 = 0.991$ $n.s.$	$\phi = -0.009$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.038$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.000$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.590$ $\chi^2 = 34.064$ $p < .001$	$\phi = -0.102$ $\chi^2 = 0.380$ $n.s.$
Workshops	$\phi = -0.019$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.096$ $\chi^2 = 0.529$ $n.s.$	$\phi = 0.082$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.019$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.303$ $\chi^2 = 8.148$ $p < .01$	$\phi = 0.050$ $\chi^2 = 0.001$ $n.s.$
Hazardous Locations	$\phi = 0.094$ $\chi^2 = 0.409$ $n.s.$	$\phi = 0.076$ $\chi^2 = 0.216$ $n.s.$	$\phi = -0.058$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.146$ $\chi^2 = 1.333$ $n.s.$	$\phi = 0.138$ $\chi^2 = 1.217$ $n.s.$	$\phi = -0.103$ $\chi^2 = 0.227$ $n.s.$
Locations where humans find it difficult to go	$\phi = 0.034$ $\chi^2 = 0.006$ $n.s.$	$\phi = 0.251$ $\chi^2 = 5.395$ $p < .05$	$\phi = 0.082$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.362$ $\chi^2 = 11.813$ $p < .01$	$\phi = -0.007$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.145$ $\chi^2 = 1.009$ $n.s.$
Others	$\phi = -0.065$ $\chi^2 = 0.071$ $n.s.$	$\phi = -0.027$ $\chi^2 = 0.000$ $n.s.$	$\phi = -0.045$ $\chi^2 = 0.000$ $n.s.$	$\phi = -0.067$ $\chi^2 = 0.064$ $n.s.$	$\phi = -0.103$ $\chi^2 = 0.452$ $n.s.$	$\phi = 0.340$ $\chi^2 = 7.734$ $p < .05$

TABLE III

ϕ–COEFFICIENTS AND RESULTS OF χ^2–TESTS BETWEEN CHOICES IN ASSUMPTIONS ABOUT TYPES AND TASKS ($df = 1$, $N = 106$)

	Humanoid	Pets such as dogs and cats	Animals except for pets	Computers	Factory Robots	Others
Housework	$\phi = 0.137$ $\chi^2 = 1.228$ $n.s.$	$\phi = 0.016$ $\chi^2 = 0.000$ $n.s.$	$\phi = -0.067$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.026$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.073$ $\chi^2 = 0.210$ $n.s.$	$\phi = -0.014$ $\chi^2 = 0.000$ $n.s.$
Office work	$\phi = 0.078$ $\chi^2 = 0.256$ $n.s.$	$\phi = 0.186$ $\chi^2 = 2.648$ $n.s.$	$\phi = 0.110$ $\chi^2 = 0.050$ $n.s.$	$\phi = 0.403$ $\chi^2 = 14.657$ $p < .001$	$\phi = -0.098$ $\chi^2 = 0.506$ $n.s.$	$\phi = -0.118$ $\chi^2 = 0.461$ $n.s.$
Physical tasks	$\phi = 0.009$ $\chi^2 = 0.000$ $n.s.$	$\phi = -0.024$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.099$ $\chi^2 = 0.073$ $n.s.$	$\phi = 0.127$ $\chi^2 = 1.090$ $n.s.$	$\phi = 0.351$ $\chi^2 = 11.406$ $p < .001$	$\phi = -0.083$ $\chi^2 = 0.168$ $n.s.$
Service tasks for humans	$\phi = 0.011$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.124$ $\chi^2 = 1.011$ $n.s.$	$\phi = -0.075$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.041$ $\chi^2 = 0.014$ $n.s.$	$\phi = -0.141$ $\chi^2 = 1.395$ $n.s.$	$\phi = -0.133$ $\chi^2 = 0.743$ $n.s.$
Others	$\phi = -0.046$ $\chi^2 = 0.008$ $n.s.$	$\phi = -0.116$ $\chi^2 = 0.674$ $n.s.$	$\phi = -0.047$ $\chi^2 = 0.000$ $n.s.$	$\phi = -0.078$ $\chi^2 = 0.153$ $n.s.$	$\phi = -0.116$ $\chi^2 = 0.674$ $n.s.$	$\phi = 0.452$ $\chi^2 = 15.727$ $p < .01$

of weak relations between the choices.

Second, the fact that "humanoid" was assumed as a robot type by many respondents implies that the image of humanoid robots has spread in Japan. As mentioned

TABLE IV

ϕ–COEFFICIENTS AND RESULTS OF χ^2–TESTS BETWEEN CHOICES IN ASSUMPTIONS ABOUT TASKS AND SITUATIONS ($df = 1$, $N = 106$)

	Housework	Office work	Physical tasks	Service tasks for humans	Others
Houses	$\phi = 0.328$ $\chi^2 = 9.687$ $p < .01$	$\phi = 0.072$ $\chi^2 = 0.224$ $n.s.$	$\phi = -0.217$ $\chi^2 = 4.048$ $p < .05$	$\phi = 0.243$ $\chi^2 = 5.098$ $p < .05$	$\phi = -0.173$ $\chi^2 = 2.085$ $n.s.$
Offices	$\phi = -0.070$ $\chi^2 = 0.194$ $n.s.$	$\phi = 0.477$ $\chi^2 = 21.407$ $p < .001$	$\phi = -0.067$ $\chi^2 = 0.212$ $n.s.$	$\phi = -0.068$ $\chi^2 = 0.195$ $n.s.$	$\phi = -0.064$ $\chi^2 = 0.086$ $n.s.$
Schools	$\phi = -0.047$ $\chi^2 = 0.000$ $n.s.$	$\phi = -0.047$ $\chi^2 = 0.000$ $n.s.$	$\phi = -0.136$ $\chi^2 = 0.116$ $n.s.$	$\phi = 0.180$ $\chi^2 = 0.431$ $n.s.$	$\phi = -0.033$ $\chi^2 = 0.000$ $n.s.$
Hospitals	$\phi = -0.156$ $\chi^2 = 1.387$ $n.s.$	$\phi = 0.009$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.095$ $\chi^2 = 0.395$ $n.s.$	$\phi = 0.211$ $\chi^2 = 3.151$ $p < .1$	$\phi = 0.102$ $\chi^2 = 0.254$ $n.s.$
Factories	$\phi = -0.018$ $\chi^2 = 0.000$ $n.s.$	$\phi = -0.068$ $\chi^2 = 0.195$ $n.s.$	$\phi = 0.382$ $\chi = 13.833$ $p < .001$	$\phi = -0.226$ $\chi^2 = 4.343$ $p < .05$	$\phi = -0.067$ $\chi^2 = 0.131$ $n.s.$
Workshops	$\phi = 0.061$ $\chi^2 = 0.118$ $n.s.$	$\phi = -0.051$ $\chi^2 = 0.055$ $n.s.$	$\phi = 0.224$ $\chi^2 = 4.261$ $p < .05$	$\phi = -0.099$ $\chi^2 = 0.560$ $n.s.$	$\phi = 0.094$ $\chi^2 = 0.352$ $n.s.$
Hazardous Locations	$\phi = -0.001$ $\chi^2 = 0.000$ $n.s.$	$\phi = 0.133$ $\chi^2 = 1.055$ $n.s.$	$\phi = 0.135$ $\chi^2 = 1.228$ $n.s.$	$\phi = 0.087$ $\chi^2 = 0.324$ $n.s.$	$\phi = 0.029$ $\chi^2 = 0.000$ $n.s.$
Locations where humans find it difficult to go	$\phi = 0.061$ $\chi^2 = 0.118$ $n.s.$	$\phi = 0.173$ $\chi^2 = 2.241$ $n.s.$	$\phi = 0.363$ $\chi^2 = 12.209$ $p < .001$	$\phi = 0.058$ $\chi^2 = 0.109$ $n.s.$	$\phi = -0.122$ $\chi^2 = 0.787$ $n.s.$
Others	$\phi = 0.092$ $\chi^2 = 0.271$ $n.s.$	$\phi = -0.073$ $\chi^2 = 0.108$ $n.s.$	$\phi = -0.177$ $\chi^2 = 2.179$ $n.s.$	$\phi =^{0} .175$ $\chi^2 = 1.962$ $n.s.$	$\phi = 0.313$ $\chi^2 = 7.198$ $p < .05$

in the free descriptions of some respondents, we estimate that information gained through TV programs such as animation influence this fact. On the other hand, "animals except for pets" was hardly assumed at all, although one robot resembling a seal has recently been reported [7], [8]. [3] This implies that in Japan the image of humanoid robots has been constructed and maintained for a historically long period.

On the other hand, there was no trend that the assumption of "humanoid" was related to specific situations and tasks. This implies the possibility that humanoid robots have no realistic meanings related to concrete situations and tasks as yet, although individuals do assume it. This implication is supported by the facts that few respondents assumed "schools" and "hospitals" as places where robots work. As mentioned above, however, it should be noted that there is another possibility that the weak relation of the "humanoid" assumption to concrete situations and tasks may be caused by a change of assumptions from some items to others.

Third, many of the respondents assumed "physical tasks" to be tasks that robots perform, and this assumption had a medium level of correlation with the assumptions of "factory robots," "factories," and "locations where humans find it difficult to go". In addition, the assumption of "factory robots" also had a medium level of correlation with the assumptions of "factories" and "workshops." These facts imply a trend that a classical view of robots, which physically act for humans, remains in individuals. As mentioned above, the results imply that robots still do not realistically appear to communicate with humans in daily life, even in Japan where it is said that there is a trend of preference to robots in comparison with other nations. However, it is also just a hypothesis to be investigated by further surveys.

[3] e.g., http://edition.cnn.com/2003/TECH/ptech/11/20/comdex.bestof/, http://www.japantimes.co.jp/cgi-bin/getarticle.pl5?nn 20031028b7.htm

III. Future Works to be Performed

This section presents future works to be performed based on measurement of assumptions about robots.

A. Relations to Attitudes and Emotions toward Robots

As mentioned in Section I, we developed a psychological scale that measures negative attitudes toward robots, the Negative Attitude toward Robots Scale (NARS) [4], [5]. Through development of this scale, it was found that individuals' experiences of seeing actually acting robots influence their negative attitudes toward robots. However, this analysis did not take into account which types of robots respondents experienced.

We estimate that the types of robots individuals experience are related to assumptions about robots, and as a result, their assumptions influence their construction of attitudes toward robots. Thus, it is important to administer NARS with measurements of assumptions about robots to clarify relations between negative attitudes toward and assumptions about robots in individuals.

Moreover, assumptions about robots may be useful as controlled variables in the measurement of anxiety toward robots [4]. For example, when individuals face a robot in a given situation, there may be differences in their state anxiety between a case that their assumptions about robots corresond to the given robot and situation, and another case that they do not. Thus, our research on development of an anxiety scale about robots should take into account individuals' assumptions of them.

B. Cross–Cultural Studies

As mentioned in Section II-D, it is generally said that Japanese people like robots more than do people of other nations. Yamamoto argues that its source is the religious influence of Confucianism in modern times [9]. To verify this type of discourse, an international comparison of negative attitudes toward robots was undertaken that used NARS [6]. This international comparison had one important implication: the result of the analysis for a small data sample size in the early stage of the investigation inconsistent with the above popular discourse on Japanese people. Concretely, it was shown that the Japanese respondents ($N = 53$) had more negative attitudes toward the social influences of robots than the Chinese ($N = 19$) and Dutch ($N = 24$) respondents. This fact implies that mental images of robots in a specific nation cannot be compared only by measuring people's attitudes toward robots. To solve this problem, assumptions about robots in each nation should be measured and analyzed in combination with NARS.

This cultural study based on an international comparison addresses three research topis: differences in negative attitudes toward robots, those in assumptions about robots, and those in relations between attitudes toward and assumptions about robots. In particular, the second and third topics are absolutely necessary for evaluating the results of the first topic.

Even if people in one nation have lower negative attitudes toward robots than those in another nation, there may be several reasons for it. For example, the pilot survey reported in this paper presented the assumption of "humanoid" in Japan. This trend may be different in other nations. If "humanoid" robots display a common trend of evoking negative emotions in some nations, it may effect a difference in negative attitudes toward robots between nations. Furthermore, if many people in a nation assume that robots can help humans in hazardous situations, they might be well harbor positive attitudes toward robots. This falls within the second topic mentioned above.

No difference in assumptions about robots between some nations may suggest differences in relations of assumptions about attitudes between those nations. Thus, even if "humanoid" robots are commonly assumed in those nations, different emotions may be evoked due to cultural differences, and as a result, it may influence attitudes toward robots. This falls within the third topic mentioned above.

IV. Summary

This paper reported a pilot study on measurement of assumptions about robots in individuals. Such assumptions may influence people's construction and change of attitudes and emotions toward robots. Moreover, we discussed possible future work: clarification of relations to attitudes and emotions toward robots, and cross–cultural studies.

It should be noted that the administration of the quesionnaire in the paper was quite roughly designed since it was just a pilot survey. We plan to expand the list of items of assumptions about robots based on a more strictly designed administration. Furthermore, we are going to apply them to psychological experiments on human–robot interaction to develop a robot anxiety scale, and make multi–lingual versions of them to perform cross–cultural studies on attitudes toward robots.

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