The Frankenstein Syndrome Questionnaire – Results from a Quantitative Cross-cultural Survey.

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This paper describes the results from a cross-cultural survey of attitudes towards humanoid robots conducted in Japan and with a Western sampe. The survey used the tentatively titled "Frankenstein Syndrome Questionnaire" and combined responses both from a Japanese and Western sample in order to explore common, cross-cultural factor structures in these responses. In addition, the differences between samples in terms of relationships between factors as well as other intra-sample relationships were examined. Findings suggest that the Western sample's interfactor relationships were more structured than the Japanese sample, and that intra-sample characteristics such as age and gender were more prevalent in the Western sample than the Japanese sample. The results are discussed in relation to the notion of the Frankenstein Syndrome advanced by Kaplan [1].

1 Introduction

This paper reports recent findings from our continued work in developing a tool for examining attitudes towards humanoid robots that is valid across Western and Japanese Cultures. As described in Syrdal et al.[2] and Nomura et al.[3], these findings inform our investigation into how members of society may respond to the possibility of humanoid robots being used and encountered in their everyday lives.

Previous cross-cultural studies have found conflicting results and [4,5], particularly when considering comparisons between absolute scores on scales intended to measure specific constructs related to participants' attitudes towards robots. In order to further investigate cross cultural differences and similarities along such attitudes, we conducted an open-ended survey of attitudes towards humanoid robots both in Japan and in the UK [2] from which statements representative of different categories from each sample were selected and made into the Frankenstein Syndrome Questionnaire (FSQ) [3].We have based our theoretical approach in terms of cultural differences on that of Kaplan's [1] description of the "Frankenstein Syndrome". This approach

Table 1 Factor Loadings on the FSQ (*item removed from Subscale)

F1	F2	F3	F4	F5	Variable
.692	-.042	-.105	.080	.121	I would feel uneasy if humanoid robots really had emotions or independent thoughts.
.491	.005	-.007	.337	-.126	If humanoid robots cause accidents or trouble, I believe that the people and organizations developing of them will provide sufficient compensation to the victims.
.417	.017	.108	-.004	-.162	Widespread use of humanoid robots would lead to high maintenance-costs for them.
.380	-.182	.210	.111	.250	I am concerned that humanoid robots would be a bad influence on children.
.447	-.070	.098	.059	.158	I would hate the idea of robots or artificial intelligences making judgements about things.
.832	.093	-.166	-.094	-.008	I feel that if we depend on humanoid robots too much, something bad might happen.
.570	-.069	.310	-.120	-.080	I don't know why, but humanoid robots scare me.
.574	-.078	.209	.093	-.022	Many humanoid robots in society will make it less warm.
.545	.083	.054	-.011	.113	Something bad might happen if humanoid robots developed into human beings.
.371	.216	.011	-.088	.238	Widespread use of humanoid robots would take away jobs from people.
-.141	**.539**	-.021	.199	.320	Humanoid robots can create new forms of interactions both between humans and between humans and machines.
.277	**.414**	.131	-.194	.285	Humanoid robots may make us even lazier.*
.154	**.466**	-.125	-.024	.059	Humanoid robots can be very useful for caring the elderly and disabled.
-.110	**.493**	.112	.050	.125	Humanoid robots should perform repetitive and boring routine tasks instead of people.
-.055	**.573**	.011	.149	-.175	I don't know why, but I like the idea of humanoid robots.
-.219	**.537**	.363	-.010	-.327	Humanoid robots can be very useful for teaching young kids.
-.129	**.389**	-.069	.025	-.138	Humanoid robots are a natural product of our civilization.
.119	**.723**	-.113	.051	-.021	Humanoid robots can make our life easier.
.307	**.499**	-.214	.039	-.013	Humanoid robots should perform dangerous tasks, for example in disaster areas, deep sea, and space.
.002	.000	**.511**	-.090	.318	I am afraid that humanoid robots make us forget what it is like to be human.
-.071	-.196	**.759**	.111	.165	The development of humanoid robots is a blasphemy against nature.
.023	.139	**.640**	-.107	.027	I feel that in the future, society will be dominated by humanoid robots.
.351	-.073	**.524**	.076	-.047	The technologies needed for developing humanoid robots are amongst those fields that humans should not advance too far in.
.095	-.131	**.731**	.063	.007	The development of humanoid robots is blasphemous.
-.040	.081	-.172	**.656**	.122	The people and organizations that develop humanoid robots can be trusted.
-.079	.280	.033	**.603**	.065	The people and organizations that develop humanoid robots seem sincere.
-.001	.077	.241	**.569**	-.256	I trust the people and organizations that develop humanoid robots to disclose sufficient information to the public, including negative information.
.196	.214	-.126	**.411**	-.053	Persons and organizations related to development of humanoid robots will consider the needs, thoughts and feelings of their users.
.053	.107	.203	-.009	**.606**	Interacting with humanoid robots could sometimes lead to problems in relationships between people.
.180	.113	.298	-.052	**.457**	I am afraid that humanoid robots will encourage less interaction between humans.

posits that the act of creation, particularly innovative creation is seen as a taboo in Western cultures. In these cultures, the use of novel technologies is often seen as potentially problematic in itself, while other cultures, such as that of Japan, may have a more pragmatic view, judging innovations on their own merits. This phenomenon could manifest as an underlying factor in attitudes towards humanoid robots in a much greater extent in Western cultures than one would see in a Japanese population.

The presence of such a factor, in addition to differences in how demographic factors interact with culture on the impact scores from the different factors formed from the questionnaire that we are using, will form a foundation for our further effort in examining the role of the Frankenstein syndrome in cross-cultural studies in social robotics.

2 Methodology

2.1 Sampling

The Japanese sample consisted of 1000 persons recruited through a professional survey company. The Western sample consisted of 146 participants(61 male and 85 females; age range 20-64, Mean age 28, Median age 25) , recruited through adverts in social media and through the University of Hertfordshire intranet. Exclusion criteria for the Western sample was (a) not having a European or Middle Eastern native language, and not living in Europe, the Middle East, The Americas or Australia/New Zealand. Due to the disparity in size between the Western sample and Japanese sample, a subsample was extracted from the Japanese sample using a stratified random sampling technique, where the strata were based on gender and age-category. This random sample was combined with the Western sample in order to create a joint sample for analysis. A second random sample was also taken from the Japanese sample to assess the generalizability of the findings from the Japanese subsample.

2.2 Survey

The survey was presented as a series of webpages, with a cover page displaying images of a wide range of humanoid robots. The survey itself consisted of the statements presented in Table 1, inviting the participants to indicate their agreement with each on a 7-point likert scale. See [3] for a more in-depth description of the survey, including the pictures used.

3 Results

3.1 Factor Analysis

The joint sample data was assessed using a maximum likelihood, exploratory factor analysis, which found 5 factors using the Cattell extraction criteria[6], explaining

54.32% of the variance in the sample. The promax rotation Factor Loading Matrix can be found in Table 1. The items loading into the different factors were combined into scales.

The items in Factor 1 had a Cronbach's α of .84 for the sample as a whole, .84 for the Western sample and .85 for the Japanese sample. This factor was tentatively named **General Negative Attitudes towards Robots**.

The items in Factor 2 had a Cronbach's α of .75 for the sample as a whole, .65 for the Western sample and .77 for the Japanese sample. Due to the low reliability the western sample, subsequent investigation of Item-Scale correlation found that this was caused by the item: "***Humanoid robots may make us even lazier***", loading negatively on this subscale for the western sample while it was positively correlated with the subscale for the Japanese sample. After this item was removed, the sample as a whole had a Cronbach's α of .75, with .73 for the Western sample and .78 for the Japanese sample It was tentatively named **General Positive Attitudes towards robots**.

The items in Factor 3 had a Cronbach's α of .83 , with .81 for the Western sample and .85 for the Japanese sample. It was tentatively named **Principal Objections to Humanoid Robots.**

Table 2 Differences in Subscale Correlations according to Sample

Factor	General Negative	General Positive	Principal Objections	Trust in Creator
General Negative	1			
General Positive	r= .21 r_w=-.39, r_j=.01 z=3.63,p<.01**	1		
Principal Objections	r=.59 r_w=.65, r_j=.53 z=1.55,p=.06	r=-.39 r_w=-.41, r_j=-.22 z=1.71,p<.05*	1	
Trust in Creators	r=-.13 r_w=-.20, r_j=.01 z=1.67,p<.05*	r=.54 r_w=.45, r_j=.51 z=0.67,p=.25	r=-.25 r_w=-.34, r_j=.05 z=3.39,p<.01**	1
Interpersonal Fears	r=.56 r_w=.58, r=.52 z=0.75,p=.23	r=-.18 r_w=-.36, r_j=.05 z=3.59,p<.01	r=.53` r_w=.57, r_j=.52 z=0.6,p=.27	r=-.22 r_w=-.34, r_j=.05 z=2.63,p<.01

The items in Factor 4 had a Cronabch's α of .73 for the sample as a whole, 68 for the Western sample and .75 for the Japanese sample. Subsequent Item-Scale correlations suggested that this was caused by overall lower reliability along this scale for the Western sample. It was tentatively titled **Trust in Robot Creators**.

The items in factor 5 had a Cronbach's α .68, with an α of .64 for the Western sample and .75 for the Japanese sample. This subscale was tentatively named **Interpersonal Fears** .

3.2 Intra-sample correlation between the subscales.

In order to further investigate the relationship between culture and subscale scores, intra-sample relationships between the subscales were investigated using correlations.

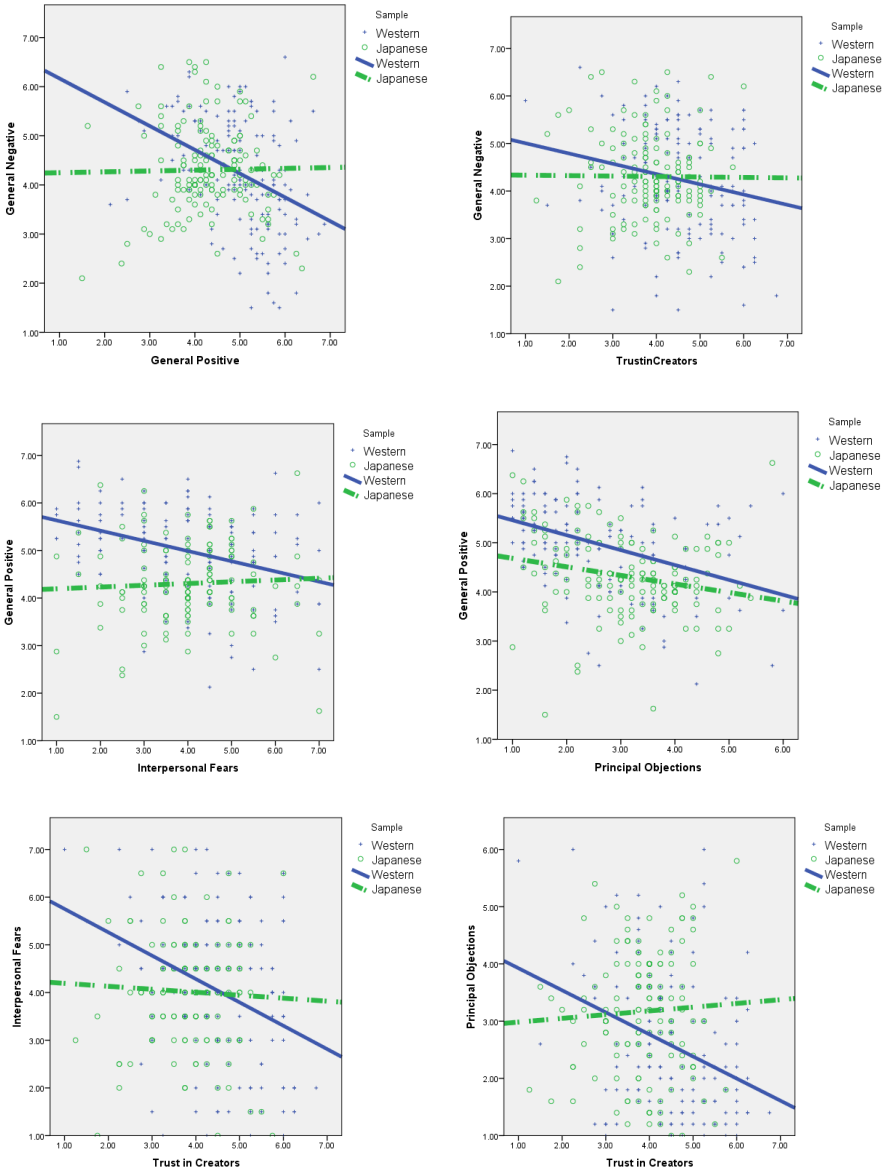

Fig. 1 Differences in Subcale Correlations according to sample**.**

The correlations between the subscales for the sample as a whole can be found in Table 2, which shows which suggests a high degree of inter-correlation between all

the subscales in the sample as a whole (r), but as Fig. 1, illustrates, this relationship is more complicated, however, as there are significant differences between the samples in terms of subscale correlations. These differences all manifest as stronger correlations between the subscales in the Western sample (r_w), suggesting that scores on one subscale predict scores on the other subscales well in this sample, while this is not the case for the Japanese sample(r_j). This would in turn suggest that the Western sample's attitudes is to a much larger extent dependent on one underlying factor that impacts overall attitudes towards robots

3.3 Subscale Score ANOVAs

A series of 2x2x3 ANOVAs were run for each subscale, in order to investigate the relationship between Sample (Western or Japanese), Gender (Male or Female), Age Category (Participants in their twenties, thirties or above 40) and subscale scores. The overall mean for each subscale score by each variable is presented visually in XXX and when responsible for a significant main effect, is described under the description of each subscale.

General Negative Attitudes towards Humanoid Robots

There were significant main effects for Sample ($F(1,278)=7.48$, $p<.01,\eta^2=.03$), Gender ($F(1,278)=19.60$, $p<.01,\eta^2=.07$) and Age Category ($F(2,278)=5.86$,

Table 3 Subscale Means by Sample

Subscale	Western Mean(SD)	Japanese Mean (SD)
General Negative	**4.23(1.14)**	**4.31(0.88)**
General Positive	**4.97(.081)**	**4.29(0.78)**
Principal Objections	**2.55(1.09)**	**3.06(0.88)**
Trust in Creators	**4.56(1.07)**	**3.88(0.90)**
Interpersonal Fears	4.01(1.54)	4.01(1.16)

(Bold scores represent significant main effects)

$p<.01,\eta^2=.04$). There was also an interaction effect for Sample and Age Category ($F(2,278)=8.00$, $p<.01,\eta^2=.05$)

The Descriptive Statistics in Table 3 suggest that overall, the Japanese sample scored higher in this subscale. Table 4 suggest females scored higher than males and according to Table 5, participants in their 20s scored higher than the other two age categories ($t>2.29,p<.05$). The descriptive statistics for the Age Category and Sample interaction effect can be found in

Table 6A which suggest that the main effect observed was caused by the differences between the participants in their 20s in the Western sample scoring higher in this subscale than the other two categories ($t>3.16,p<.05$) while this effect is not observed in the Japanese sample, which was more uniform across the different age categories ($t<.49,p>.6$).

General Positive Attitudes towards Humanoid Robots.

There was a main effect for Sample ($F(1,278)=35.12$, $p<.01$,$\eta^2=.11$) and Gender ($F(1,278)=9.01$, $p<.01$,$\eta^2=.03$). There was also a significant interaction effect for Sample and Gender ($F(1,278)=6.72$, $p<.01$,$\eta^2=.02$).

The Descriptive Statistics for the Main Effects can be found in Table 3-5 and **Error! Reference source not found.** and suggest that overall, Western participants scored higher on this subscale than the Japanese, and that male participants scored higher than female.

Table 6B describes the interaction effect for General Positive Attitudes, and suggest that in the Western Sample, male participants score higher along this subscale($t=3.96$,$p<.01$), while in the Japanese sample, this effect is not evident($t=.29$,$p=77$).

Table 4 Subscale Means by Gender

Subscale	Male Mean(SD)	Female Mean(SD)
General Negative	**3.91(0.98)**	**4.53(0.96)**
General Positive	**4.88(0.94)**	**4.48(0.90)**
Principal Objections	**2.58(1.17)**	**3.07(1.16)**
Trust in Creators	4.25(0.93)	4.19(1.08)
Interpersonal Fears	3.85(1.20)	4.13(1.46)

(Bold scores represent significant main effects)

Table 5 Subscale Means by Age Category

Subscale	20s Mean (SD)	30s Mean (SD)	40+ Mean (SD)
General Negative	**4.43(0.98)**	**3.94(1.10)**	**3.96(0.85)**
General Positive	4.58(0.99)	4.72(0.85)	4.92(0.74)
Principal Objections	**3.06(1.19)**	**2.45(1.08)**	**2.45(1.11)**
Trust in Creators	4.22(1.05)	4.16(0.97)	4.29(0.97)
Interpersonal Fears	**4.22(1.38)**	**3.53(1.17)**	**3.66(1.34)**

(Bold scores represent significant main effects)

Principal Objections.

There were significant main effects for Sample ($F(1,278)=24.66$, $p<.01$,$\eta^2=.08$), Gender ($F(1,278)=5.17$, $p<.05$,$\eta^2=.02$), and Age Category ($F(1,278)=7.89$, $p<.01$,$\eta^2=.05$). These effects are described in Table 3-5 and suggest that the Japanese sample scored higher on this subscale than the Western sample, the Female sample higher than the Male sample, and participants in their 20s scored higher than the other two age categories.

Trust in Creators

There was a significant main effect for Sample ($F(1,278)=13.59$, $p<.01$,$\eta^2=.05$) and an interaction effect for Sample and Age Category ($F(2,278)=4.06$, $p<.05$,$\eta^2=.02$). The main effect is described in Table 3-5 and suggests that participants in the Western

sample scored higher than participants in the Japanese sample on this subscale while the interaction effect described in
Table 6C suggests that this was caused by participants in the the 40+ category scored significantly higher than the other categories on this subscale in the Japanese sample ($t>2.17$, $p<.05$), but that this was not the case in the Western sample($t<1.15$,$p>.25$). In fact the trend in the Western sample was in the opposite direction.

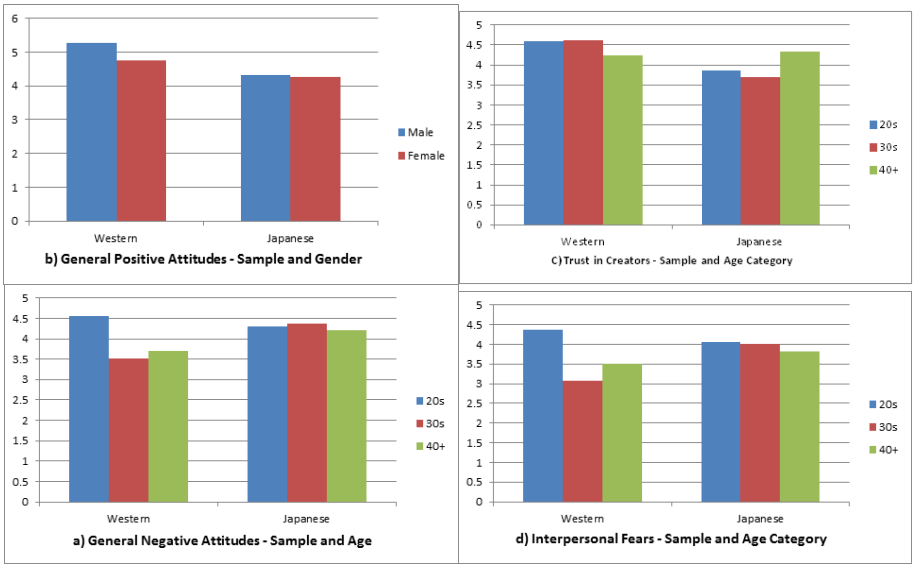

Fig. 2 Interaction Effects for Subscale Scores

Interpersonal Fears.
There was a significant main effect for Age Category ($F(2,278)=6.02$, $p<.01$,$\eta^2=.04$) and an interaction effect for Sample and Age Category ($F(2,278)=4.72$, $p<.01$,$\eta^2=.03$). The interaction effect was is described in
Table 6D and suggest that in the Western sample, participants in their 20s scored higher along this subscale than other age categories, while this was not the case for the Japanese sample.

4 Discussion

4.1 Summary of Findings

The findings from the Factor Analysis using both samples found 5 factors that had a reasonably high degree of reliability, which were consistently higher for the Japanese sample than the Western sample. As discussed in Syrdal et al. [7], differences in absolute scores between the two populations are not as meaningful as exploring differences in the relationships between measures across the cultures, both in terms of

the scales relate to each other as well as how they relate to demographic characteristics.

Subscale Correlations

Correlation between subscales suggested that overall, the relationship between subscales were more structured in the Western Sample than in the Japanese, with a

Table 6 Interaction Effect for Subscale Scores

A)Interaction effect for General Negative Attitudes towards Humanoid Robots

Age Category	Sample	Mean (SD)
20s	Western	4.55(1.02)
	Japanese	4.31(0.94)
30s	Western	3.51(1.21)
	Japanese	4.37(0.80)
40+	Western	3.69(0.93)
	Japanese	4.20(0.71)

B) Interaction Effect For General Positive Attitudes towards Humanoid Robots

Gender	Sample	Mean (SD)
Male	Western	5.28(0.67)
	Japanese	4.31(0.82)
Female	Western	4.76(0.84)
	Japanese	4.27(0.75)

C) Interaction Effect for Trust in Creators of Humanoid Robots

Age Category	Sample	Mean (SD)
20s	Western	4.60(1.01)
	Japanese	3.85(0.92)
30s	Western	4.62(1.04)
	Japanese	3.70(0.61)
40+	Western	4.25(1.00)
	Japanese	4.33 (0.84)

D) Interaction Effect for Interpersonal Fears

Age Category	Sample	Mean (SD)
20s	Western	4.37(1.58)
	Japanese	4.06(1.19)
30s	Western	3.07(1.24)
	Japanese	4.00(0.89)
40+	Western	3.50(1.26)
	Japanese	3.81(1.43)

higher degree of interfactor correlation. This can be taken as supporting the idea and construct of a culturally dependent Frankenstein Syndrome as advanced by Kaplan [1]. The Western sample tend to respond to the different subscales in a manner consistent with their responses being towards humanoid robots in and of themselves, rather than for specific issues related to their creation and adoption. This is in line with Kaplan's thesis of the Frankenstein Syndrome being an expression of a Western Taboo regarding the act of creation itself.

Intersample Differences.

The results from this analysis replicates the emphasis of age from Nomura et al.[3] in that age seems important in Western Cultures as well, with the youngest group of participants being the most skeptical of humanoid robots both in terms of General Attitudes as well as Interpersonal Fears when compared to the older groups, however

this effect was most pronounced in the Western sample with this particular factor structure. A similar effect for Trust in Creators was observed, but here age differences were most pronounced in the Japanese sample, where the 40+ group scored higher than the other age categories along this dimension. This suggests that these age differences are more closely related to changing views of technology in the Western sample, but while in the Japanese sample may be related to changes in how scientific and industrial authorities are viewed.

Finally, there were gender differences between the two samples terms of Positive Attitudes, in the Western sample, male respondents scored higher along this subscale than females, but this was not the case for the Japanese sample.

4.2 Conclusions and Future Work

As a first, cross-cultural use of the FSQ, the results are encouraging. The current structure of the FSQ has a high degree of reliability across both Japanese and Western samples and reveal interesting differences between the two groups in terms of intra-sample characteristics as well as in terms of subscale correlations. However, as previously pointed out, these now need to be supplemented by examining the role of FSQ Subscale scores and how they interact with related scales and behaviour within human-robot interactions. This will allow for a deeper validation of the FSQ and greater understanding of attitudes towards humanoid robots .

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