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SOCIAL ROBOTICS IN EASTERN AND WESTERN NEWSPAPERS: CHINA AND (EVEN) JAPAN ARE OPTIMISTIC

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To look into the assumed difference between East and West in acceptance and use of robots, we performed a content analysis on 120 articles about social robots in two Asian-English (China Daily and The Japan Times) and two Western-English newspapers (The Guardian and New York Times) written between 2009 and 2018. From these articles, we drew a number of statements ($N = 118$). We analyzed tone of voice as well as the positive or negative framing of the consequences of the implementation of social robots in society, economy, health, and safety. Intercoder reliability was > .7, according Krippendorff's α-reliability. Western newspapers presented significantly more *negative* social frames, *negative* fairness-and-equality frames, and *negative* safety-and-health frames than did Eastern papers, which presented significantly more *positive* economic frames than did Western papers. Western newspapers expected more negative social, health, safety, and equality issues than did the East. The West anticipated little economic benefit. The East expected little harm to society, safety, health, and equality but rather foresaw beneficial economic outcomes.

Keywords: Social robots; newspapers; attitude; framing; culture; content analysis.

1. Introduction

There is a common understanding that the Asian countries are more positive about robotics and artificial intelligence (AI) than Western nations are. Western society would mainly express moral objections, being afraid of job loss, and being subdued by robots. Scientific articles repeatedly report the ease of adoption of robots in Asia relative to the US and Europe [Broadbent *et al.*(2009); Kaplan (2004); Rau *et al.*(2009)].

Perhaps a philosophical difference makes Eastern cultures look differently upon the world of nonliving things such as robots. In his seminal work, [Imanishi (1941/2002, p. 7)]offers an Eastern perspective on the natural world, stating that: "I do not think that the life that we know exists in the same way in nonliving things. However, there is no problem to admit that nonliving things may have their own kind of life." He counters the verdict that an anthropomorphic view of objects (i.e. the widespread Eastern view) is subjective and unscientific by arguing that a mechanistic view on organic life (the Western perspective) is just as subjective and unscientific. It is all a matter of perspective.

According to [Yamamoto (1983), also Bartneck *et al*. (2005)], Confucianism might have had a positive effect on robot culture in Japan. In Japanese Manga movies, good fights evil but different from the West, the good guys are not necessarily human whereas the bad guys are not necessarily robotic: Good robots may be fighting human evil.

[Homburg *et al*. (2019)] looked into German, American, and Indian attitudes towards social robots, posing questions about empathy, expertise, reliability, and trust to find that Indian participants scored higher on all of these dimensions. [Shahid *et al*. (2011)] found

that Pakistani children were more expressive during robot interaction than their Dutch counterparts.

[Li *et al*. (2019)] explored the requirements on a domestic robot with Chinese and US participants. One of their results was that Chinese participants regarded robots as more autonomous, allowing them to make decisions. Americans, however, saw the robot more as a machine, which should obey their orders and comply with pre-set rules.

Yet, the image seems more nuanced. On the one hand, [Nomura *et al.*(2015)] found in an online survey that indeed UK citizens felt more negative toward humanoid robots than did Japanese (irrespective of family relationships or religion). On the other hand, [Bartneck *et al*. (2005)] found in their survey that compared to Dutch and Chinese participants, the Japanese had significantly more concerns about how robots negatively affected society. These authors suggest that owing to high exposure, Japanese people may have a better understanding of a robot's capabilities or indeed,the lack thereof.

[Kamide *et al.* (2017)] also found that Japanese are not necessarily comfortable with robots. Their questionnaire study revealed that US participants welcomed social robots more than Japanese even when the negative features of those machines were more numerous than the positive.

The Japanese may not be the "robot maniacs/lovers" public opinion believes they are. From their questionnaire study, [Haring *et al.* (2014a)] report that compared to Europeans, Japanese did not have a more positive attitude towards robots but they were (cf. [Bartneck *et al*. (2005)]) more exposed to them via the media. In a follow up, [Haring *et al.* (2014b)] administered two experiments in Japan and Australia and found that Australians perceived an android robot as more positive than did Japanese people.

In 2018, the *Digital Society Index* compiled by Dentsu Aegis Network together with Oxford Economics ranked countries across a number of dimensions of the digital economy.[a] For example, in speed of digital growth, the US was leading. Yet, China was leading with 65% of the population believing that AI and robotics would create more job opportunities with the US occupying a mid-position of 23% just like Japan (22%). This seems quite unexpected because Japan is seen as one of the preeminent robot-developing countries. China also was leading with 71% of the population believing that digital technology would have strong societal impact with again the US in mid position (38%) and Japan following with 22%. Trust in data use was highest again in China (47%) with the US in mid position (23%) and Japan being most pessimistic (14%). In other words, China may live up to the image of Asia being very receptive of new technology (i.e. AI and robotics). For instance, Chinese older adults seem to accept domestic robots based on the prospects of their utility (rather than pleasure or fun) [Chen (2018)]. Japan, however, a top robot developer, seems to entertain a fairly ambiguous attitude.

According to [MacDorman *et al.*(2009)], we should not look too much into different people's attitudes. In a comparison between the US and Japan, these authors found comparable responses toward robots and proposed to explain the societal acceptance of robots from differences in history, religion (this is different from [Nomura *et al.*(2015)]), identity, economics, occupation, and government policy.

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[a] https://us.dentsuaegisnetwork.com/perspective/the-digital-society-index/

There is consensus that adoption of social robots is higher in Asia than in the West. Then again, the Japanese unexpectedly seem quite reluctant towards AI, robots, and other digital innovations. The reasons why are rather diffuse. The inclination is to believe that individual attitudes in East and West are overlapping and that differences should be explained from more social variables such as culture, economic structure, and policy.

1.1. *Developing the hypotheses*

East and West seem to have different referential frameworks. Philosophically [Imanishi (1941/2002, p. 7)], nonliving things such as robots are accepted in the East to lead their own kind of life, whereas in the West, even organisms are conceptualized as mere machinery. That would explain why the Chinese in [Li *et al.* (2019)] allowed robots to make decisions, whereas in the West, machines should merely execute orders.

From an ethical viewpoint, Confucianism recognizes good and bad as entangled dimensions [Yamamoto (1983)] and so robots are not merely evil. Moreover, Eastern cultures seem more trusting [Homburg*et al.* (2019)]. This in contrast to the Christendom-based West, making a clearer division between good and bad.

Societally, Confucianism is group-oriented and compliant with government policy [MacDorman*et al.* (2009)]. Instead, the West is more individualistic and disobedience is not necessarily objected against. In other words, if Eastern governments envision economic benefits [Dentsu Aegis, MacDorman *et al.* (2009)], society will lightly embrace AI and robotics. In the West, people follow their own ideas, which as we saw, are more negative about machines that do not take orders but decide for themselves.

What runs counter to these tendencies is experience, high exposure, or 'accustomization.' As [Bartneck*et al.* (2005)] indicated, the Japanese experienced the negative side of robotics as well, however, they stayed with the policies of their government.

Our research question, then, is whether different referential frameworks are in operation when Eastern or Western newspapers report about society's take on social, economic, moral, fairness, and health-and-safety issues of robotics. From a Confucian and more animistic viewpoint, we hypothesized (Hypothesis 1)that Eastern newspapers would maintain a more positive tone of voice in their writings about robotics than would Western newspapers. With [Bartneck*et al.* (2005)], we also expected that over time, experiencing the things that robots do not do well, people would become less positive about robots, also in the East. Hypothesis 2, then, assumed the later period of our investigations (2014-2018) to be more negative about robots than the earlier period (2009-2013). Again from a Confucian state of mind, Hypothesis 3 supposed that in line with government policies, the framing of consequences of robot implementation to society and economics would be more positive in the Eastern news than in the West.

1.2. *Our study in brief*

To see how a country may build up a shared 'frame of reference' towards social robots, we did a content analysis of articles about social robots in China Daily and The Japan Times versus The Guardian and New York Times. These specific papers were chosen because they are prominent Western and Eastern newspapers. The New York Times is an

American, English written newspaper and one of the most circulated papers in the world. The Guardian is a British daily newspaper that reaches more than 23 million UK readers a month. With a circulation of 900.000 copies, China Daily is one of the most circulated English written papers in Asia. The Japan Times is the largest and oldest English-language daily newspaper in Japan and is distributed in partnership with The International New York Times.Per paper, we analyzed 30 articles written between 2009 and 2018 for tone of voice and for the positive or negative framing of the consequences of social robots for society, economy, health, and safety.

2. Methods

2.1. *Materials and design*

To find relevant articles, we entered the following keywords in the databases of the respective journals: "social robot*"; "social AND robot*"; and "social robots". In using a randomizer, we selected 30 English-written articles for each newspaper: two from the East (China Daily and The Japan Times) versus two from the West (The Guardian and New York Times) (Fig. 1).[b]We chose these newspapers because all four have a long-standing English tradition with a broad readership and high prestige.

2.2. *Measurements*

Five coders analyzed the headings and body text without the images of the news articles concerning social robots, using the variables from the following coding scheme:

Is the article written in a…
 (1) positive tone of voice?
 (2) negative tone of voice?
 (3) neutral tone of voice?

Does the article contain text about consequences written in…
 (4) a negative social frame?
 (5) a negative economic frame?
 (6) a negative moral frame?
 (7) a negative fairness-and-equality frame?
 (8) a negative health-and-safety frame?
 (9) another type of negative frame?
(10) a positive social frame?
(11) a positive economic frame?
(12) a positive moral frame?
(13) a positive fairness-and-equality frame?
(14) a positive health-and-safety frame?
(15) another type of positive frame?

[b]https://www.japantimes.co.jp/news/2014/07/15/business/corporate-business/robots-can-solve-labor-woes-son/#.XEBRBC1x_BJ; https://www.theguardian.com/technology/2016/sep/29/ipal-robot-childcare-robobusiness-san-jose

Fig. 1. Sample of newspaper articles on social robots. Top: The Japan Times. Bottom: The Guardian.

6   *Authors*

We analyzed 4×30 = 120 articles in total.Based on a randomized selection of20% of the total number of articles, intercoder reliability was established on 24 articles (Krippendorff's α-reliability). This procedure indicated that the codebook had to be revised (Table 1). The coders discussed the differences in coding the variables and we revised the codebook's description, discussed in the next section.All coders had an academic background in communication and a comparable English-language proficiency, ranging from one coder atB1 level to four coders at C1, according to the Common European Framework of Reference.

Table 1. Initial and post reliabilities.

Variable	Initial reliability*	Post reliability*
About social robots	.69	1.0
Positive tone of voice	.75	.93
Negative tone of voice	.90	1.0
Neutral tone of voice	.83	.93
Negative social frame	.55	.90
Negative economic frame	.47	.80
Negative moral frame	.57	1.0
Negative equality/fairness frame	.38	.77
Negative health/safety frame	.35	.86
Negative other frame	.59	.83
Positive social frame	.68	.97
Positive economic frame	.60	.89
Positive moral frame	.10	1.0
Positive equality/fairness frame	.20	.70
Positive health/safety frame	.70	.95
Positive other frame	.17	1.0

*According to Krippendorff's α-reliability

About social robots

Initially, the coders classified articles about general robotics or AI as 'social robots.' After focusing on the explicit mentioning of social robots, interrater reliability increased to 1 (100%). All coders agreed on every article that was about social robots.

Positive/negative/neutral tone of voice

Initially, certain coders based the tone of voice about robots on the overall tone of voice of the article. Tone of voice (TOV) then was limited to social robots and if social robots were not mentioned, TOV was regarded as neutral. Interrater reliability increased (Krippendorff's α> .70) for positive TOV, negative TOV, and neutral TOV.

Positive/Negative Social Frame

One of the coders did not classify societal trends as social frame. After discussion of the definition, all coders agreed that articles including text about trends in society related to social robots should be coded as social frame. After recoding the articles, the reliability

changed for positive social frame to Krippendorff's $\alpha = .90$ and for negative social frame to Krippendorff's $\alpha = .97$.

Economic Frame

Coders classified certain articles for economic consequences that were not the effect of social robots per se. We then decided that economic consequences specifically should be the result of applying social robots such as an increase in productivity or a cost reduction. With this adjustment to the codebook, the interrater reliability increased for both positive economic frame and negative economic frame to Krippendorff's $\alpha > .70$.

Morality frame

Coders did not agree on what should be identified as a morality frame. After initial coding, we decided that for a 'morality frame' the article should address consequences of social robots for a country's or a community's religion or policy. After the recode, interrater reliability went to 100% for both negative and positive moral frames.

Fairness and equality frames

At first, texts about legal problems, ethics, and equality were not coded as 'fairness-and-equality frame.' The coders then discussed that these should be the focal points for this frame and after recoding, interrater reliability for positive fairness-and-equality frames as well as negative fairness-and-equality frames achieved Krippendorff's $\alpha > .70$.

Security, health, and safety frames

Security, health, and safety frames achieved a Krippendorff's α of .70 right away. Yet, certain coders included security, health, or safety issues that were unrelated to social robots. After discussion and recoding, Krippendorff's α became .95 for the positive health-and-safety frame and .86 for the negative health-and-safety frame.

Other consequences related to social robots frame

For many coders, it was unclear when to use the 'other' frame. In some cases, coders used it when in doubt about which frame to use or when they believed that more frames occurred in the same article. After discussion, we decided that 'other' should be used only when a frame occurs that is completely unrelated to the other frames in the codebook. After recoding, the reliability changed to Krippendorff's $\alpha = .83$ for the negative other frame and 100% for the positive other frame.

3. Analysis and Results

From the 120 newspaper articles, we drew $N = 118$ statements about robotics, which we used in our analyses.We did a frequency count on our nominal measures ('yes' or 'no', 'present' or 'not present') and used Chi-square and crosstabs to inspect the (in)dependency of categorical variables (e.g., Eastern newspapers have a positive TOV). When the Chi-square value was significantly large (the max usually lies around22), we concluded for dependency. If not significantly large, we concluded there was no

8　*Authors*

relationship. On those frequencies, we then performed independent samples t-tests to analyze the direction of a potential difference, for instance, Eastern newspapers have a more positive TOV than do Western newspapers.

This way, we analyzed whether Eastern newspapers had a more positive tone of voice than Western newspapers (Hypothesis 1), whether the earlier period (2009-2013) would be more positive than the later period (2014-2018) (Hypothesis 2), and whether the framing of consequences of applying social robots would be more positive in the Eastern than in the Western news (Hypothesis 3).

With respect to Hypothesis 1 (Table 2), Chi-square crosstabs revealed that different TOV and location of the newspapers (East-West) depended on each other ($X^2_{(1)} = 18.28$, $p < .001$). An independent samples t-test revealed that TOV was more positive in the Eastern newspapers than in the Western newspapers ($t_{(116)} = 4.71$, $p < .001$), confirming Hypothesis 1.

Note that Table 2 (and Table 3) should be read as three separate sub tables. If the observant reader summates the frequencies across sub tables, the paradox occurs that, for instance, the West has 35 statements 'not positive,' which at face value should be the 17 neutral ones + 40 negative ones = 57, which is not 35. However, not all statements were part of a category in a discrete either-or way: Certain statements were not positive but upon reshuffling, they did not become neutral or negative but went into the 'not present' category again: not positive, not neutral, and not negative. They were doubtful cases that had something of everything or nothing of it at all.

Table 2. Frequencies of occurrence of statements ($N = 118$) with positive/neutral/negative tone of voice.

Variable	Positive tone of voice present	Positive tone of voice not present	Total
East	47	13	60
West	23	35	58
Total	70	48	118
Variable	Neutral tone of voice present	Neutral tone of voice not present	Total
East	9	51	60
West	17	41	58
Total	26	92	118
Variable	Negative tone of voice present	Negative tone of voice not present	Total
East	4	56	60
West	40	18	58
Total	44	74	118

In view of Hypothesis 2 (Table 3), Chi-square crosstabs revealed that no significant relation was established between period and positive TOV ($X^2_{(1)} = .41$, $p = .52$; $t_{(116)} = -.65$, $p = .52$). Publication time and positive TOV of the article were unrelated. When these data were split into Eastern and Western newspapers, the results weresignificant neither for Eastern ($X^2_{(1)} = .49$, $p = .05$; $t_{(58)} = -.21$, $p = .84$) nor forWestern newspapers ($X^2_{(1)} = .15$, $p = .05$; $t_{(56)} = .02$, $p = .98$). Between the two periods, the number of articles with positive TOV was not dependent on Eastern or Western newspapers.

Table 3. Frequencies of occurrence of statements ($N = 118$) with positive/neutral/negative tone of voice in two periods.

Variable	Positive tone of voice present	Positive tone of voice not present	Total
2009 – 2013	14	12	26
2014 – 2018	56	36	92
Total	70	48	118
Variable	Neutral tone of voice present	Neutral tone of voice not present	Total
2009 – 2013	6	20	26
2014 – 2018	20	72	92
Total	26	92	118
Variable	Negative tone of voice present	Negative tone of voice not present	Total
2009 – 2013	5	21	26
2014 – 2018	17	75	92
Total	22	96	118

The same pattern was found for neutral and negative TOV. No significant relation was established between period and neutral TOV ($X^2_{(1)} = .02$, $p = .88$). When split, results remained not-significant for Eastern ($X^2_{(1)} = 2.12$, $p = .15$) and Western papers ($X^2_{(1)} = 1.19$, $p = .28$). For negative TOV, again no dependency was found with period ($X^2_{(1)} = .01$, $p = .94$) and when split, no significant relation between negative TOV and Eastern newspapers ($X^2_{(1)} = .86$, $p = .36$) was established, nor with Western newspapers ($X^2_{(1)} = .00$, $p = .98$).

The number of negative, positive, and neutral articles remained undifferentiated over the two periods. Thus, none of the variables for tone of voice significantly differed in the two periods, rejecting Hypothesis 2.

With regard to Hypothesis 3 (Table 4, Figure 2), Chi-square crosstabs and independent samples t-test indicated that Western newspapers presented significantly more *negative* social frames (cf. Figure 1, bottom) than did Eastern papers ($X^2_{(1)} = 6.75$, $p = .01$; $t_{(106.93)} = 2.64$, $p < .01$). For positive social frames, however, the difference between regions was not significant ($X^2_{(1)} = .21$, $p = .65$; $t_{(116)} = .45$, $p = .65$).

Table 4. Frequencies of occurrence of positive/negative frames on several robot-relevant dimensions.

Variable	Addressed	Not addressed	% Addressed	% Not addressed
Negative social frame	32	86	27.1%	72.9%
Negative economic frame	19	99	16.1%	83.9%
Negative moral frame	2	116	1.3%	98.7%
Negative equality/fairness frame	13	105	11.0%	89.0%
Negative health/safety frame	25	93	21.2%	78.8%
Negative other frame	1	117	0.8%	99.2%
Positive social frame	79	39	66.9%	33.1%
Positive economic frame	40	78	33.9%	66.1%
Positive moral frame	0	118	0.0%	100%
Positive equality/fairness frame	18	100	15.3%	84.7%
Positive health/safety frame	58	60	49.2%	50.8%
Positive other frame	1	117	0.8%	99.2%
Variable	Addressed East	Not addressed East	Addressed West	Not addressed West

|				
Negative social frame	10	50	22	36
Negative economic frame	10	50	9	49
Negative moral frame	1	59	1	57
Negative equality/fairness frame	2	58	11	47
Negative health/safety frame	5	55	20	38
Negative other frame		60	1	57
Positive social frame	39	21	40	18
Positive economic frame	28	32	12	46
Positive moral frame		60		58
Positive equality/fairness frame	10	50	8	50
Positive health/safety frame	28	32	30	28
Positive other frame	1	59		58
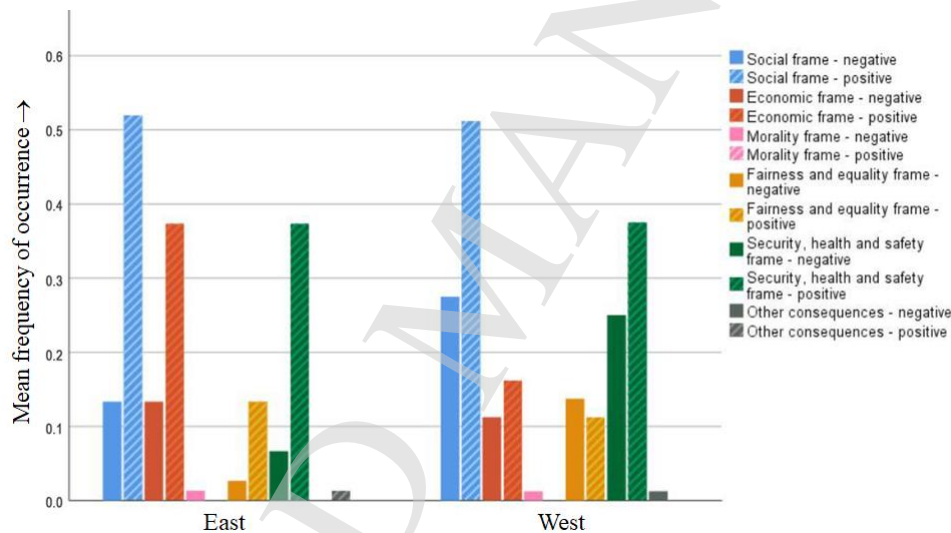
Fig. 2. Mean number of frames in robot articles from two Western and two Eastern newspapers.

Reversely, Chi-square crosstabs and independent samples t-test showed that the presence of *positive* economic frames was significantly higher in Eastern than in Western newspapers ($X^2_{(1)} = 8.88$, $p = .003$; $t_{(112.68)} = 3.01$, $p < .01$) but for negative economic frames this was not so ($X^2_{(1)} = .03$, $p = .87$; $t_{(116)} = -.17$, $p = .87$). In the East, the economic benefits of social robots were mentioned more often than in the West.

There were no significant differences for the negative morality frames ($X^2_{(1)} = .01$, $p = .98$; $t_{(116)} = .024$, $p = .98$).[c]

Chi-square crosstabs and t-tests also showed that presence of *negative* fairness-and-equality frames were used significantly more frequent in Western newspapers than in the East ($X^2_{(1)} = 7.35$, $p = .01$; $t_{(79.28)} = 2.75$, $p < .01$). For positive fairness-and-equality frames, the difference was not significant ($X^2_{(1)} = .19$, $p = .66$; $t_{(116)} = -.43$, $p = .67$).

[c] Chi-square crosstabs could not be conducted for positive morality frames because this variable was a constant.

Western newspapers used significantly more *negative* safety-and-health frames than did Eastern newspapers ($X^2_{(1)} = 12.08$, $p = .001$; $t_{(90.95)} = 3.61$, $p < .001$) but for positive safety-and-health frames, the difference was insignificant ($X^2_{(1)} = .30$, $p = .58$; $t_{(116)} = .54$, $p = .59$).

Regarding 'other' frames, we found no significant differences, neither for positive frames ($X^2_{(1)} = 1.04$, $p = .31$) nor for negative ones ($X^2_{(1)} = .98$, $p = .32$), and not between East and West ($t_{(59)} = 1.00$, $p = .32$).

Hence, Hypothesis 3 is accepted for negative social, negative fairness-equality, and negative safety-health frames as well as for positive economic frames. However, we should reject Hypothesis 3 for all other frames (e.g., morality).

4. Conclusion/Discussion

Figure 2 shows that the main newspaper items related to robotics were rather pragmatic. In East and West, articles discussed social, economic, and security-safety-health issues rather than idealistic matters: There was not much on morality, fairness-and-equality, or any other issues. Yet, Eastern newspapers (Japan included) maintained a significantly more positive tone of voice in writing on these matters than did Western newspapers. Therefore, we regard Hypothesis 1 as accepted.

As far as we could observe, this did not change over time: Hypothesis 2 was rejected because the earlier period (2009-2013) was not significantly more positive and the later period (2014-2018) not more negative than its counterpart was. Perhaps that with a larger sample, differences between the two periods may surface that currently remained uncovered. Because the random sampling created a considerate difference in the number of articles used for the first and second period, differentiation between periods perhaps remained undetected.

What we did find is that Western newspapers presented significantly more *negative* social frames, *negative* fairness-and-equality frames, and *negative* safety-and-health frames than did Eastern papers, which presented significantly more *positive* economic frames than did Western papers. These findings corroborate Hypothesis 3. Note, however, that for this study, we analyzed English-written Asian newspapers only, so that the way in which these articles frame social robots may be different from Asian newspapers in Asian languages.

Obviously, it is hard to tell to what degree journalists represent a people's view (see the *Digital Society Index* of 2018) or to what degree they are influential for it. Nonetheless, our results fall in line with the repeatedly observed finding that Eastern cultures have less of a problem with robots and AI than do Western societies.

Thus, if newspapers reflect a general attitude towards social robots, the East being more positive, the West being more negative about them, then according to [MacDorman *et al.*(2009)], we should not explain different acceptance from different people's attitudes (such as those in Japan). These authors emphasize the influence of history, religion, identity, economics, occupation, and government policy.

This is not the place to go deeply into each of these aspects, which would require a monograph of their own. However, there is something to say about MacDorman's et al. array, given that ancient China and somewhat later Japan invented numerous social

12   *Authors*

robots thousands of years before Leonardo invented his [Needham(1991)]. Religion too may play a role as Asian cultures (e.g., Tao, Shinto, Buddhism) assign 'anime' to what the Westregards as non-living objects [Plumwood(2014) p. 453]. Confucianism is group-oriented and emphasizes maintaining the governmental order. In general, Westerners feel more detached as an individual from their surroundings ('dualism') than do Eastern cultures who operate more as a community [Hwang (2015)], robots included we dare say. Moreover, governmental policy in China is to focus on AI and robots as a core technology [Larson, (2018); Church (2018)]: The Chinese Mainland Affairs Office rewards projects in robot basic research with approximately 10-15M Yuan = 12-20M€ each. The Tokyo Times reported in 2013 that the government injected 25.3 million dollars into robotics for care purposes alone.[d] Such programs on AI and robotics are unprecedented in the West.

Overall, it seems that indeed Eastern societies accept social robots more easily than do Western societies, China being the most optimistic and welcoming. Japan seems to accept their arrival as well, following government policy, although individually people may feel disenfranchised. Westerners fear the social repercussions, their health and safety, that the introduction of robots may be unfair to some and may increase the digital divide. China and Japan see the economic benefits regardless of their population's feelings.

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