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Ohno, Shiroh

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AI/Robot City Expectation and AI Education Aspiration: A Survey of Four Countries - Japan, United States, China, and Australia

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AI/Robot City Expectation and AI Education Aspiration: A Survey of Four Countries – Japan, United States, China, and Australia

Shiroh OHNO the University of Tokyo

Keywords: Artificial Intelligence, Smart City, International Comparison, Informatized Area

Introduction

According to the United Nations, approximately 56% of the world's population is currently concentrated in urban areas, and this proportion is estimated to increase to 70% by 2050 (World Bank, 2023). As more countries around the world recognize the need to avoid problems caused by the informatization of cities, they are rapidly focusing their efforts on smart city development, ushering in a period of rapid growth referred to as Smart City 3.0. However, the "ideal community" for people living in cities with diverse circumstances and sources of information is not uniform, and consensus-building comes with its difficulties. The need for a human-centric approach has been emphasized as an important element in linking rational and sustainable urban planning that uses information technology to citizen well-being (e.g., Cardullo & Kitchin, 2019). It is important to understand the values that lead to the acceptance of artificial intelligence (AI) and robots, and to what extent anxiety and fear towards AI and information technology hinder its utilization.

To improve the well-being of citizens, urban planning should be defined through feedback from "smart citizens" who participate in city management that utilizes information technology. It has been shown that human capital, such as the attainment of higher education, is linked to the prosperity of smart cities (Caragliu et al., 2011). Therefore, there is a benefit to providing residents with opportunities for critical and creative learning (Manchester & Cope, 2019). In the context of smart cities, it is essential to provide efficient educational opportunities for everyone, from current students to the elderly, in the long term. This is also consistent with the SDG 4 goal of "ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all." According to the OECD (2021) report, AI has the potential to improve educational processes and outcomes and contribute to achieving SDG 4. However, the introduction of AI in education remains limited at the institutional level (e.g., in schools). The recent COVID-19 pandemic response has provided an opportunity for educational systems to rapidly progress and achieve elements of learning that were previously dismissed as futuristic (World Bank, 2021). However, evidence regarding the effectiveness and acceptance of AI in education is still insufficient. According to a large-scale quantitative survey of 17 countries worldwide by Gillespie et al. (2023), trust in AI varies significantly across countries. The "willingness to trust" AI was high in India (75%) and China (67%) and moderate in the United States (40%), Australia (34%), and South Korea (32%), while Japan ranked 16th out of 17 countries (23%). Similarly, the "willingness to accept" AI was high in India (67%) and China (66%) and moderate in the United States (24%), Australia (23%), and South Korea (32%), while Japan ranked 15th out of 17 countries (19%). Four main factors contributing to trust in AI were identified: whether institutions ensure safe use, the motivation based on the benefits of AI use, a reduction of AI risks, and knowledge of the effectiveness of AI and digital technologies.

This study aimed to accumulate data for a human-centric approach by conducting a survey of the awareness of the desire for AI technology. We surveyed people in Japan nationwide, as well as regions in the United States, China, and Australia, to investigate the idealization of the introduction of AI and robotic technologies. We also included questions on the place of AI in future living environments and whether it should be utilized in

education. We analyzed the values participants emphasized and the relationship between information anxiety and fear of AI.

Methods

Sample

An online survey was conducted across Japan on March 26 and March 27 in 2024. Respondents between the ages of 15 and 79 were recruited across Japan. Along with registered monitors from the research firm Cross Marketing Inc., we collected responses equally from men and women in five-year age brackets. Data inappropriate for analysis were excluded, resulting in a final sample size of 1,040.

As a comparison, we conducted online surveys in three countries between March 27 and March 31, 2024, with registered monitors from the research firm Cross Marketing Inc. Respondents between the ages of 16 and 79 were recruited across the United States (Los Angeles), China (Shenzhen), and Australia. We collected responses from men and women in five-year age brackets as equally as possible within the distribution range of the monitors; however, biases existed in the respective distributions. Data inappropriate for analysis were excluded, resulting in a final sample size of 362(Los Angeles), 348(Shenzhen), 277(Australia).

Instruments

AI/Robot City Expectation, AI Education Aspiration, Emphasized Values, Information Technology Anxiety and AI Phobia, Informatization of Residential Area, and Media Usage Time were measured and scored as subjective assessment scores.

AI/Robot City Expectation: To measure the desire for an ideal living environment utilizing AI and robots, we scored the mean values of the following items (α= 0.86)[1]. The five items were "People can travel in autonomous vehicles," "Traffic lights are managed and optimized by AI," "Life is supported by robots or drones," "Robots or drones patrol the area for security," and "Health management is mandated through AI." The items were rated on a four-point Likert scale (1 = "Not at all ideal," 2 = "Not very ideal," 3 = "Somewhat ideal," and 4 = "Very ideal").

AI Education Aspiration: To measure the desire for utilizing AI in education, we scored the mean values of the following items. (α= 0.78) The three items were "We should adopt free-paced learning according to children's understanding levels with AI 's support," "We should enhance our ability to address children's questions and identify their challenges with the support of AI," and "We should introduce the automatic grading of homework and tests by AI." The items were rated on a four-point Likert scale (1 = "Don't agree at all," 2 = "Don't agree much," 3 = "Somewhat agree," and 4 = "Agree").

Things Considered Important: Regarding the values they emphasize, we scored the responses to the question "How important are the following to you?" for each of the following items. The six items were "Stability of current society," "Stability of society in 30 years," "Children's living and learning environments," "Sustainable global environment," "Reduction in daily travel times," and "Protecting your privacy." The items were rated on a four-point Likert scale (1 = "Not at all important," 2 = "Not very important," 3 = "Somewhat important," and 4 = "Very important").

Information Technology Anxiety: To measure the general anxiety towards information technology, we scored the mean values of the following items (α= 0.63). The three items were "I am afraid that digital technology will widen the gap," "I am worried that digital technology might invade my privacy," and "I am concerned about being able to effectively use digital technologies." The items were rated on a four-point Likert scale (1 = "Don't agree at all," 2 = "Don't agree much," 3 = "Somewhat agree," and 4 = "Agree").

AI Phobia: We scored AI phobia using three items extracted from the AI Phobia Measuring

[1] Cronbach's alpha coefficient was calculated for the Japanese group.

Items (Kim., 2019)[2] and one newly added item, totaling four items. The four items were “I am scared by the recent intelligence of AI,” “I am afraid that humans will be dominated by AI,” “I am afraid that AI will attack and harm humans,” and “I am afraid that AI will bring about a catastrophe like the extinction of humanity.” The items were rated on a four-point Likert scale (1 = “Don't agree at all,” 2 = “Don't agree much,” 3 = “Somewhat agree,” and 4 = “Agree”).

Living in an Informatized Area: We scored the informatization of the respondent's residential area based on the responses to the following items. The one item was “Digital technologies are advancing rapidly.” The item was rated on a four-point Likert scale (1 = “Not at all applicable,” 2 = “Not very applicable,” 3 = “Somewhat applicable,” and 4 = “Very applicable”).

Media Usage Time: For media usage time, we scored the time spent watching television and using social media as follows: 6 for more than 5 hours, 4 for three hours or more but less than five hours, 2.25 for 1.5 hours or more but less than three hours, 1 for 30 minutes or more but less than 1.5 hours, 0.25 for one minute or more but less than 30 minutes, and 0 for 0 minutes (not used).

Age, Gender: We used the numerical value entered for age. For gender, we created a dummy variable with 1 for female and 2 for male and used it in the analysis. "Other/No response" (33 in Japan, 5 in China) was treated as a missing value in this analysis.

Design

A multiple-group path analysis for structural equation modeling was conducted using the Mplus Version 8.8. The significance level was set at 5% for all analyses.

Results

The distributions of gender and age groups for each region are shown in Table 1.

The distributions of the variables used in the analysis are shown in Table 2.

Table 1 The distributions of gender and age

	JP	US	CH	AU
n	1040	362	348	277
women	48.7%	51.4%	51.1%	52.7%
men	48.2%	48.6%	47.4%	47.3%
10's	13.8%	12.7%	4.3%	8.3%
20's	13.4%	15.2%	28.4%	16.2%
30's	14.0%	13.8%	39.9%	15.9%
40's	14.8%	14.4%	12.6%	15.2%
50's	15.0%	13.3%	9.8%	15.2%
60's	15.0%	15.5%	3.7%	17.7%
70's	14.0%	15.2%	1.1%	11.6%

Table 2 The distributions of the variables

	JP		US		CH		AU	
	M	SD	M	SD	M	SD	M	SD
AI/Robot city expectation	2.41	.70	2.29	.72	3.05	.54	2.30	.68
AI education aspiration	2.57	.66	2.49	.79	3.13	.55	2.46	.76
Stability of current society	3.25	.82	3.57	.68	3.16	.68	3.59	.60
Stability of society in 30 years	3.18	.86	3.54	.70	3.25	.76	3.52	.66
Children's living and learning environments	3.07	.86	3.57	.66	3.28	.67	3.52	.66
Sustainable global environment	3.22	.81	3.44	.77	3.24	.73	3.46	.75
Reduction in daily travel times	2.93	.78	3.03	.83	3.20	.68	3.17	.72
Protecting your privacy	3.27	.81	3.69	.59	3.26	.72	3.67	.57
Information technology anxiety	2.88	.65	2.84	.68	2.91	.63	2.97	.60
AI Phobia	2.61	.74	2.55	.84	2.68	.75	2.69	.78
Living in an informatized area	2.28	.80	3.08	.88	2.28	.80	3.06	.77
TV watching time	2.27	1.95	3.13	2.12	1.76	1.38	2.59	1.90
Social media usage time	1.49	1.73	2.42	2.15	2.61	1.70	1.95	1.96

We then conducted a correlation analysis between the desire for AI utilization, AI education aspiration, and the explanatory variables (Table 3, 4).

Next, we performed a multi-group path analysis. Paths were drawn from all other observed variables to AI/Robot City Expectation and AI Education Aspiration. In this study, the standardized coefficients for all paths are presented. Note that covariances were specified between the error terms of AI/Robot City Expectation and AI Education Aspiration, as well as among all other observed variables. The groups were: JP: Japan, US: United States, CH: China, and AU: Australia.

[2] The English expressions have been modified to conform to the Japanese version.

Table 3 Correlation analysis: AI/Robot city expectation

	JP	US	CH	AU
Stability of current society	.17 ***	-.15 **	.32 ***	-.09 ns
Stability of society in 30 years	.19 ***	-.08 ns	.41 ***	-.10 ns
Children's living and learning environments	.22 ***	-.08 ns	.30 ***	-.21 ***
Sustainable global environment	.19 **	.01 ns	.31 **	-.01 ns
Reduction in daily travel times	.26 ***	.12 *	.35 ***	.06 ns
Protecting your privacy	.14 ***	-.11 *	.31 ***	-.21 **
Information technology anxiety	.21 ***	-.11 *	.29 ***	-.18 **
AI Phobia	.17 ***	-.15 **	.28 ***	-.34 ***
Living in an informatized area	.25 ***	.21 ***	.34 ***	.09 ns
TV watching time	.05 ns	-.01 ns	.14 **	-.05 ns
Social media usage time	.19 ***	.24 ***	.09 ns	.28 ***
Gender（Woman:1/Man:2）	-.03 ns	.18 **	.05 ns	.10 ns
Age	-.14 ***	-.28 ***	-.08 ns	-.25 ***

Note. Spearman, *p<.05, **p<.01, ***p<.001, n.s. not significant.

Table 4 Correlation analysis: AI education aspiration

	JP	US	CH	AU
Stability of current society	.25 ***	-.09 ns	.34 ***	-.03 ns
Stability of society in 30 years	.27 ***	-.06 ns	.45 ***	-.04 ns
Children's living and learning environments	.28 ***	-.07 ns	.33 ***	-.08 ns
Sustainable global environment	.30 **	.11 *	.34 **	.02 ns
Reduction in daily travel times	.32 ***	.18 **	.33 ***	.12 *
Protecting your privacy	.23 ***	-.10 ns	.37 ***	-.15 *
Information technology anxiety	.26 ***	-.14 **	.30 ***	-.06 ns
AI Phobia	.21 ***	-.20 ***	.22 ***	-.20 **
Living in an informatized area	.24 ***	.15 **	.35 ***	.12 *
TV watching time	.06 *	-.03 ns	.12 *	-.04 ns
Social media usage time	.20 ***	.30 ***	.11 *	.25 ***
Gender（Woman:1/Man:2）	-.03 ns	.21 ***	.12 *	.13 *
Age	-.10 **	-.28 ***	.02 ns	-.25 ***

Note. Spearman, *p<.05, **p<.01, ***p<.001, n.s. not significant.

In Model 1, we set equality constraints on all paths. In Model 2, referring to the path coefficients of the saturated model, we set equality constraints on 10 paths[3] where the presence of significant relationships and the degree of coefficients were similar across regions. In Model 3, referring to the path coefficients of the saturated model, we set equality constraints on six paths where the presence of significant relationships and the degree of coefficients were similar across regions. After examining the fit indices (Table 5), we adopted Model 2.

Table 5 The fit indices

	AIC	Adj.BIC	RMSEA	CFI	SRMR
Model 1	6995.46	7106.70	0.07	0.86	0.091
Model 2	6835.65	7062.97	0.00	1.00	0.015
Model 3	6852.19	7108.53	0.00	1.00	0.012

The results for the Japanese group are shown in Table 6. Emphasizing children's living and learning environments, a sustainable global environment, and a reduction in daily travel times was associated with higher AI/Robot city expectation and AI education aspiration. Among other variables, a younger age and residence in an informatized area were associated with higher AI/Robot city expectation and AI education aspiration. No significant associations were found for AI phobia, television or social media usage time, or gender.

Table 6 Standardized coefficients for the Japanese group

Japan（n=1007）	AI/Robot city expectation		AI education aspiration	
Stability of current society	-.01	ns	.02	ns
Stability of society in 30 years	.03	ns	.00	ns
Children's living and learning environments	**.12**	**	**.12**	**
Sustainable global environment	**.06**	*	**.16**	***
Reduction in daily travel times	**.13**	***	**.14**	***
Protecting your privacy	.00	ns	.01	ns
Information technology anxiety	**.11**	**	**.12**	**
AI Phobia	-.02	ns	-.01	ns
Living in an informatized area	**.16**	***	**.14**	***
TV watching time	.02	ns	.02	ns
Social media usage time	.03	ns	.04	ns
Gender（Woman:1/Man:2）	.01	ns	.03	ns
Age	**-.22**	***	**-.20**	***
R^2	.18		.23	

Note. *p < .05, **p < .01, ***p < .001, n.s. not significant. The covariance between AI/Robot city expectation and AI education aspiration is 0.38***.

[3] The paths for AI education aspiration and AI/Robot city expectation, including sustainable global environment, reduction in daily travel times, protecting one's privacy, informatization of the residential area, and television watching time.

The results for the Los Angeles group are shown in Table 7. Emphasizing a sustainable global environment and reduction in daily travel times was associated with higher AI/Robot city expectation and AI education aspiration.

Among other variables, lower AI phobia, living in an informatized area, longer social media usage time, being male, and being younger were associated with higher AI/Robot city expectation and AI education aspiration. No significant associations were found for information technology anxiety or television watching time. The variables most strongly associated with AI/Robot city expectation were age, AI phobia, and informatization of the residential area.

Table 7 Standardized coefficients for the Los Angeles group

Los Angeles（n=362）	AI/Robot city expectation		AI education aspiration	
Stability of current society	-.09	ns	-.04	ns
Stability of society in 30 years	-.04	ns	-.05	ns
Children's living and learning environments	-.01	ns	-.06	ns
Sustainable global environment	**.05**	*	**.13**	***
Reduction in daily travel times	**.14**	***	**.13**	***
Protecting your privacy	.00	ns	.01	ns
Information technology anxiety	.02	ns	.02	ns
AI Phobia	**-.18**	**	**-.26**	***
Living in an informatized area	**.17**	***	**.13**	***
TV watching time	.02	ns	.02	ns
Social media usage time	**.15**	**	**.20**	***
Gender （Woman:1/Man:2）	**.13**	**	**.16**	***
Age	**-.19**	***	**-.20**	***
R^2	.21		.27	

Note. $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$, n.s. not significant. The covariance between AI/Robot city expectation and AI education aspiration is 0.49^{***}.

The results for the Shenzhen group are shown in Table 8. Emphasizing the stability of present society, the stability of society in 30 years, sustainable global environment, and reduction in daily travel times were associated with higher AI/Robot city expectation and AI education aspiration. Among other variables, informatization of the residential area was associated with higher AI/Robot city expectation and AI education aspiration. Higher AI phobia was associated only with AI/Robot city expectation. Higher information technology anxiety was associated only with higher AI education aspiration. No significant associations were found for television watching time, social media usage time, age, or gender. The variable most strongly associated with AI/Robot city expectation was AI phobia.

Table 8 Standardized coefficients for the Shenzhen group

Shenzhen（n=343）	AI/Robot city expectation		AI education aspiration	
Stability of current society	**.20**	***	**.15**	**
Stability of society in 30 years	**.18**	***	**.14**	**
Children's living and learning environments	.01	ns	.01	ns
Sustainable global environment	**.07**	*	**.17**	***
Reduction in daily travel times	**.15**	***	**.15**	***
Protecting your privacy	.00	ns	.01	ns
Information technology anxiety	-.02	ns	**.15**	*
AI Phobia	**.27**	***	.10	ns
Living in an informatized area	**.18**	***	**.14**	***
TV watching time	.02	ns	.02	ns
Social media usage time	-.03	ns	-.03	ns
Gender （Woman:1/Man:2）	.04	ns	.09	ns
Age	-.06	ns	.01	ns
R^2	.36		.37	

Note. $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$, n.s. not significant. The covariance between AI/Robot city expectation and AI education aspiration is 0.23^{***}.

The results for the Australian group are shown in Table 9. Emphasizing a sustainable global environment and reduction in daily travel times was associated with higher AI/Robot city expectation and AI education aspiration. Not emphasizing the children's living and learning environments was associated only with higher AI education aspiration. Lower AI phobia, living in an informatized area, longer social media usage time, and being younger were associated with higher AI/Robot city expectation and AI education aspiration. Additionally, being male was associated with higher AI education aspiration. No significant associations were found for information technology anxiety or television watching time.

The variable most strongly associated with AI/Robot city expectation was AI phobia.

Table 9 Standardized coefficients for the Australian group

Australia（n=277）	AI/Robot city expectation		AI education aspiration	
Stability of current society	.06	ns	.02	ns
Stability of society in 30 years	-.02	ns	-.04	ns
Children's living and learning environments	**-.15**	*	-.05	ns
Sustainable global environment	**.06**	*	**.13**	***
Reduction in daily travel times	**.12**	***	**.11**	***
Protecting your privacy	.00	ns	.01	ns
Information technology anxiety	.04	ns	.11	ns
AI Phobia	**-.40**	***	**-.31**	***
Living in an informatized area	**.16**	***	**.12**	***
TV watching time	.02	ns	.02	ns
Social media usage time	**.20**	***	**.18**	**
Gender（Woman:1/Man:2）	.06	ns	**.16**	**
Age	**-.17**	**	**-.20**	**
R^2	.30		.22	

Note. $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$, n.s. not significant. The covariance between AI/Robot city expectation and AI education aspiration is 0.44^{***}.

Regarding factors considered important, emphasizing the stability of present society and the stability of society in 30 years was associated with higher AI/Robot city expectation and AI education aspiration only in Shenzhen. Emphasizing a sustainable global environment and reduction in daily travel times was associated with higher AI/Robot city expectation and AI education aspiration across all four regions. No significant associations were found between protecting one's privacy and AI/Robot city expectation or AI education aspiration.

The informatization of the residential area was associated with higher AI/Robot city expectation and AI education aspiration across all four regions. In Los Angeles and Australia, lower AI phobia was strongly associated with higher AI/Robot city expectation and AI education aspiration. In Shenzhen, conversely, higher AI phobia was associated with higher AI/Robot city expectation. Higher information technology anxiety was associated with higher AI/Robot city expectation and AI education aspiration in Japan, but there was very little association in other countries, except for a similar association with higher AI education aspiration in Shenzhen. Regarding media usage time, no associations were found for television watching time. Longer social media usage time was associated with higher AI/Robot city expectation and AI education aspiration in Los Angeles and Australia. Regarding gender, being male was associated with higher AI/Robot city expectation and AI education aspiration in Los Angeles and higher AI education aspiration in Australia. A younger age was associated with higher AI/Robot city expectation and AI education aspiration in Japan, Los Angeles, and Australia, with relatively large coefficients.

Discussion

Focusing on the items that showed relatively large coefficients and were somewhat common across the four countries, the emphasis on a sustainable global environment, a reduction in daily travel times, and living in an informatized area were associated with higher AI/Robot city expectation. To promote a wider acceptance of AI technology, it may be useful to persuasively demonstrate the reduction in daily travel times and to advance the informatization of residential areas. A survey by Gillespie et al. (2023) showed that only half of the respondents believe that the benefits of AI outweigh the risks. Furthermore, half are unaware of when and how AI is being used, and 82% want to learn more about AI. However, participants in Australia and Japan had significantly lower interest in learning about AI. A generation gap in trust in AI has also been noted. In the present study, age was the variable with the largest coefficient in Japan, indicating a difference in AI utilization awareness between younger and older generations.

AI technology is not always clearly presented to the general population, and it is difficult to say whether all individuals share the same vision of an "AI-utilized society." To encourage acceptance of AI technology, it may be

necessary to build an "imagined community" across generations by advancing informatization or sharing successful examples from other regions. The emphasis on a sustainable global environment was relatively strongly associated with AI education aspiration, suggesting a high affinity between liberal values and AI education. Additionally, Gillespie et al. (2023) demonstrated the existence of an educational gap in trust in AI, which may be related to the association between concerns about social issues, such as maintaining the global environment, and educational attainment. In Japan, raising awareness of the living and learning environments of children may also influence the utilization of AI. Regarding information technology anxiety in Japan, higher anxiety was associated with higher AI/Robot city expectation, which may be because AI technology is perceived as overcoming the shortcomings of conventional information technology. It may also be that those who are more familiar with information technology tend to be more anxious.

As an outcome of this study, we were able to quantitatively identify factors associated with the desire for AI utilization in Japan and other countries or cities, both common and unique to each region. Future tasks include more precise measurements of AI acceptance attitudes, examinations of causal relationships, and analyses of narrower regional scopes. AI technology is expected to increasingly permeate all of society in the future. When people encounter AI technology, understand it sufficiently, and imagine its utilization as a realistic judgment rather than a preconception, discussions can progress on how to accept and utilize it. The accumulation of empirical research is needed for this purpose.

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