An International Comparative Analysis for Autonomous Vehicles and Their Effects

Ryosuke Ando[1(✉)], Wei Liu[2], Jia Yang[1], and Yasuhide Nishihori[1]

[1] TTRI (Toyota Transportation Research Institute), Toyota 471-0024, Japan
ando@ttri.or.jp
[2] Chongqing Jiaotong University, Chongqing, China

Abstract. Recently, autonomous vehicles have been one of the hottest issues in the world. In the pasted century, automobile vehicles have changed human lives and social society. From now, autonomous vehicles will change the world for the second time. Therefore, the issue of autonomous vehicles calls us to focus its effects on the related social respects. In order to investigate the effects of these innovative technologies, an international comparative study between Japan and China, No. 2 and No. 3 largest economic countries in the world, were conducted during 2016 and 2018, respectively. In this paper, we report on the results of two questionnaire surveys. Through this comparative study, we can understand the similarity and difference between these two countries and reconsider what we should do in the coming years. The major findings indicated that the Japanese are more conservative than the Chinese. In terms of the comparative results, we proposed that it was crucial for Japanese society to change this situation to promote autonomous vehicles.

Keywords: Autonomous vehicles · Innovative technology · International comparison · Japan · China

1 Introduction

Autonomous vehicles have been one of the hottest issues in the world. In the pasted century, automobile vehicles have changed human lives and social society. From now, autonomous vehicles will change the world for the second time. Therefore, the issue of autonomous vehicles calls us to focus its effects on the related social respects.

Regarding international comparison on autonomous vehicles, these has been some studies such as (References [3, 4, 6, 7, 12]) by the researchers in Japan and other countries. However, the study targeted on China is very limited since Chinese government set forth a very strict limitation on the personal information. Therefore, in this paper, we report on the results of two questionnaire surveys implemented in China and Japan (Reference [1]), respectively. They are ranked as the second and third economic countries worldwide. Through the comparative analysis, we can understand the similarity and difference between them, and reconsider what we should do in the coming years.

The methodologies to discuss competences and its uncertainty of science and technology have been made in many existed studies (References [2, 5, 8–11]) by

N. Agarwal et al. (Eds.): MSBC 2019, CCIS 1079, pp. 55–67, 2019.
https://doi.org/10.1007/978-3-030-29862-3_5

Ayse Ozmen, Gerhard-Wilhelm Weber, Pakize Taylan, Silja Meyer-Nieberg and Erik Kropat et al. What we are reporting in this paper is not the deep methodology but the useful information for further analysis.

2 Outline of the Surveys

An internet-based survey in Japan was conducted in October 2016 through Rakuten Research. This corporation (currently renamed as Rakuten Insight) is one of the largest websites for market research in Japan. There were 2,200,000 registered monitors. 1,480 respondents owning and driving cars were randomly selected to answer our survey.

On the other hand, the survey in China was conducted during December 2017 and January 2018. Considering the people in China are more likely to use SNS such as Weibo and WeChat. So both Weibo and WeChat were used with the website together. 1,500 respondents driving cars took part in this survey.

The question sheets have been treated almost the same in both Japan and China. However, a few of contents, such as annual income and year of using cars, had been adjusted by considering the different present states and the difference of survey implementation.

The basic statistic approaches used here are F-test as shown in Eq. (1) and t-test as shown in Eq. (2).

$$F = S_1^2 / S_2^2 \tag{1}$$

where S_i^2 is the variance of sample i (i means Japan or China).

$$t = d/(\sqrt{s_d^2}/n) \tag{2}$$

where d is the difference and n is the sample number.

The result of purchased cars is using as shown in Fig. 1, almost 50% of respondents in Japan purchased in the past three years and more than 10% of people purchased 10 years before. In China, more than 80% of people purchased in the past five years and only 33% of respondents purchased cars in 2005 or before.

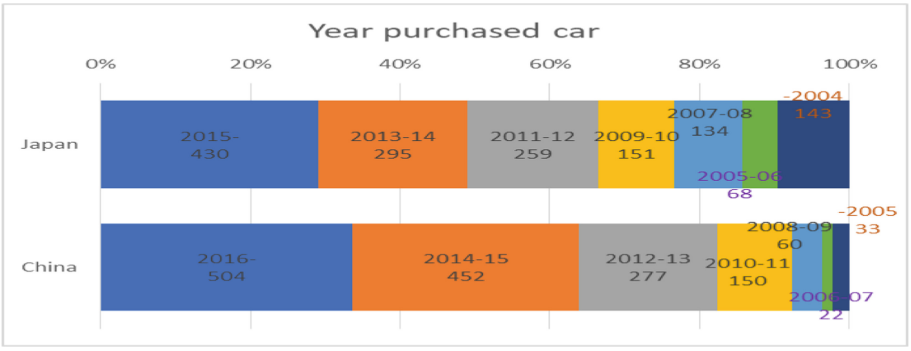
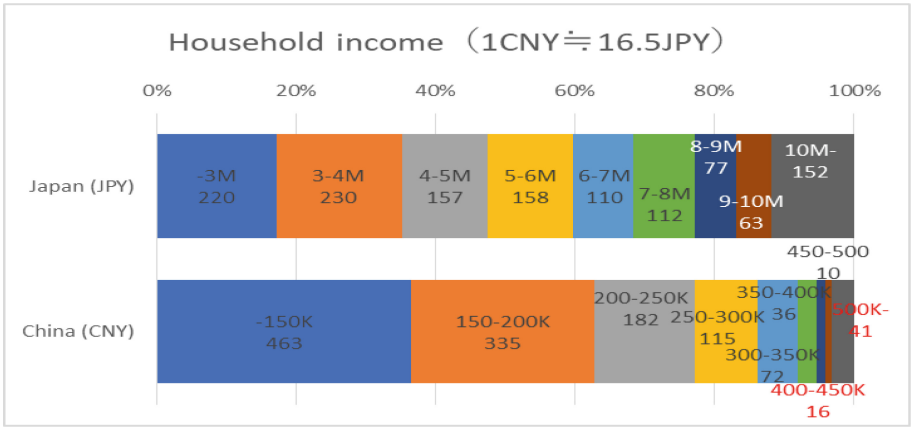


Fig. 1. When did you purchase your car?

As given in Fig. 2, the household incomes in China are generally lower than that in Japan. Furthermore, the percentages of the relatively low-income class are larger than that in Japan. The household income distributes more evenly in Japan, compared to China.

Household classification makes the car using different. Figure 3 shows us that "couple only" families and "two generations with children" families in Japan shows more than that in China. Comparatively, "single" and "three generations with parent" families in China show larger shares than that in Japan. The F-value is 4.284 and greater than 4.28 (with the degrees of freedom as 6 for both Japan sample and China sample).



(where M=million, K=thousand, CNY=Chinese yuan, JPY=Japanese yen)

Fig. 2. How much is your household annual income?

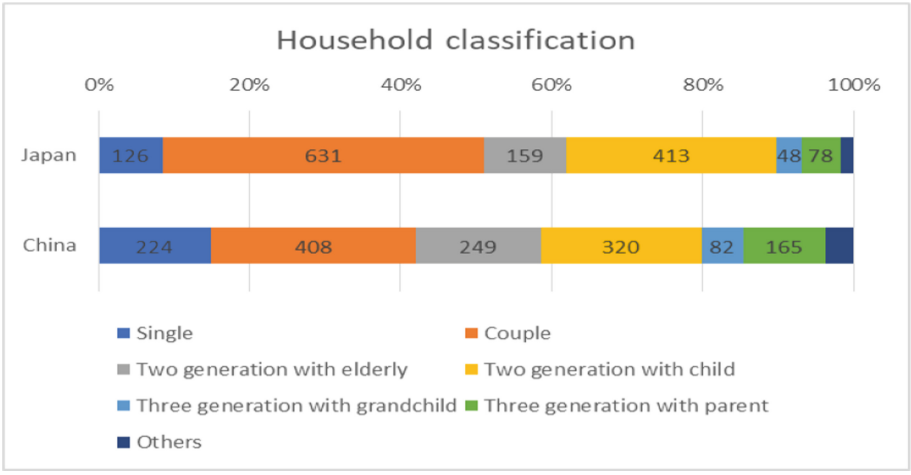


Fig. 3. Household classification comparison

In daily life, Japanese people make use of cars more frequently than Chinese people as Fig. 4. Nearly 20% of Chinese people drive their cars for less than one day per month. This may be because owing cars is not only for mobility needs but also for showing the economic status of the car owner. The F-value is 5.0503 and greater than 5.05 (with the degrees of freedom as 5 for both Japan sample and China sample).

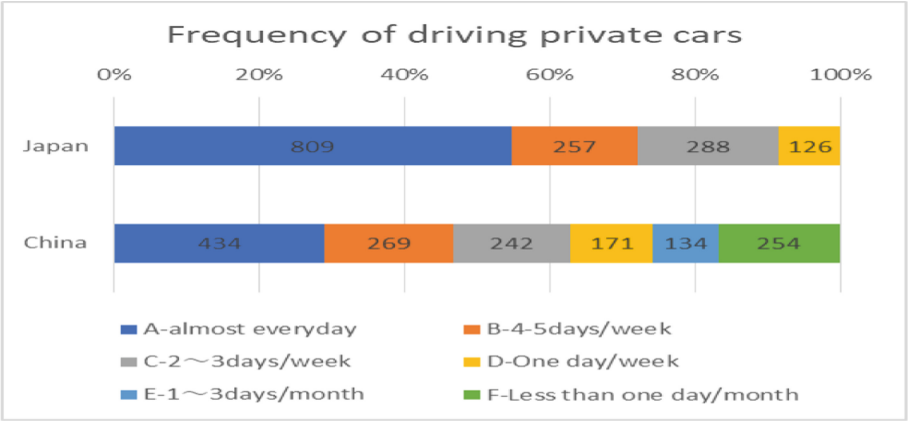


Fig. 4. How often do you drive your cars?

3 Comparative Results of Consciousness

At first, some questions on how people want to make use the autonomous vehicles (AVs) are compared and shown from Figs. 5, 6, 7, 8, 9, 10 and 11.

We can know from Fig. 5 that more than 40% of people in China answered that "absolutely yes" when we asked if they make use of AVs for a long-distance move, but this percentage is about half in Japan.

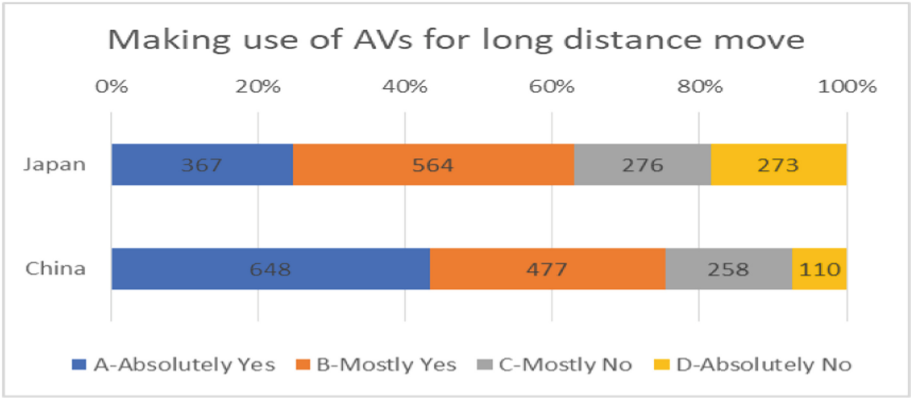


Fig. 5. Do you want to make use of AVs for a long-distance move? (p-value = 0.975)

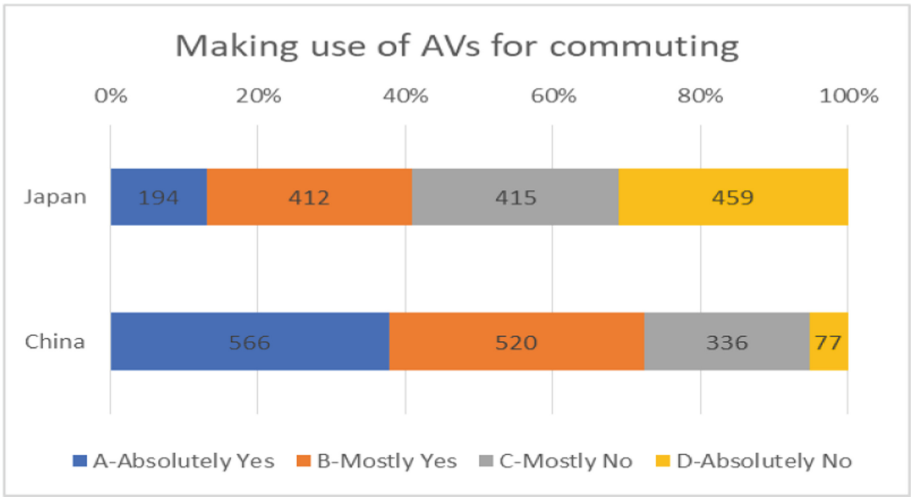


Fig. 6. Do you want to make use of AVs for commuting? (p-value = 0.978)

Regarding whether people make use of AVs for commuting, in both China and Japan, as depicted in Fig. 6, the percentages of "absolutely yes" have been decreased. However, the difference between the two countries became larger. That in Japan is less than half of that in China.

As for the daily life activities such as shopping, seeing doctors and amusement activities, the situations shown in Fig. 7 in both countries are almost the same as what in Fig. 6. Furthermore, on transporting people given in Fig. 8, quite similar results can be obtained.

Meanwhile, given by Fig. 9, about access transport which means that short trips as the first one mile or the last one mile, the percentages of both "absolutely yes" and "mostly yes" decrease in both countries although there are still more than 50% of people answered positively in China.

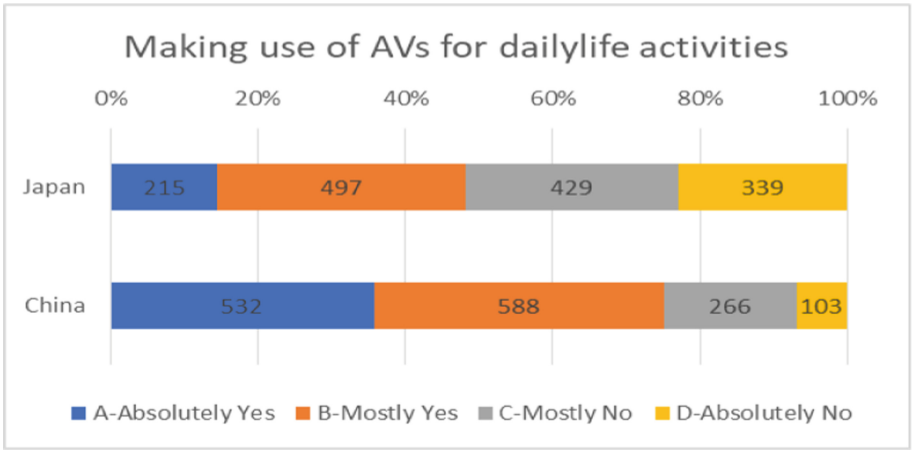


Fig. 7. Do you want to make use of AVs for daily life activities? (p-value = 0.987)

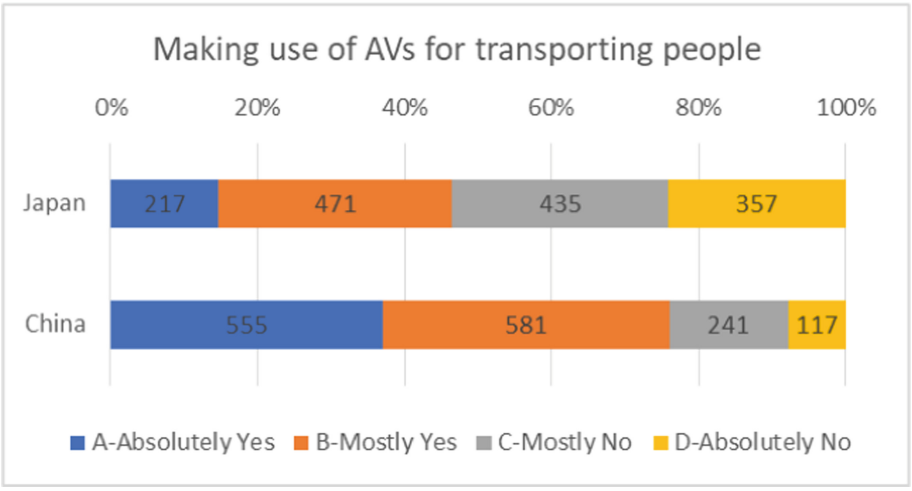


Fig. 8. Do you want to make use of AVs for transporting people? (p-value = 0.981)

In China, people gave the highest expecting business activities (almost 80% answered "yes" as shown in Fig. 10) and automated parking (80% answered "yes" as Fig. 11 shows). However, in Japan, people told us quite different results on these two questions: higher expecting for automated parking but lower expecting for business activities.

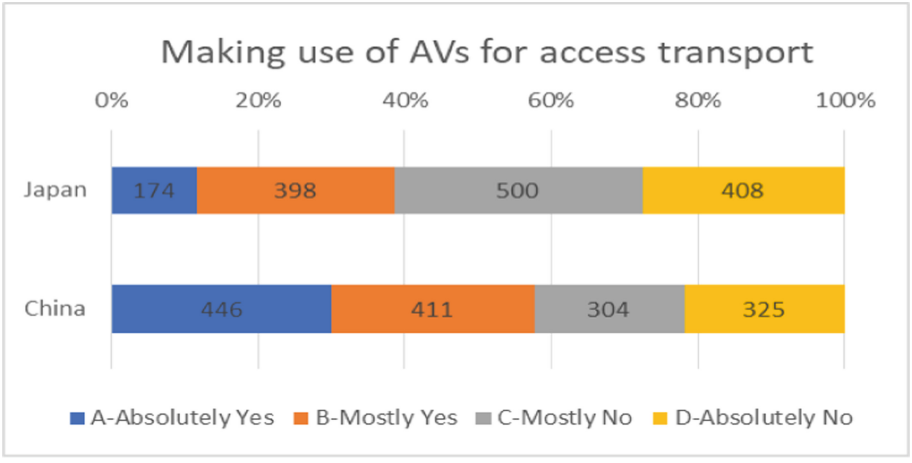


Fig. 9. Do you want to make use of AVs for access transport? (p-value = 0.989)

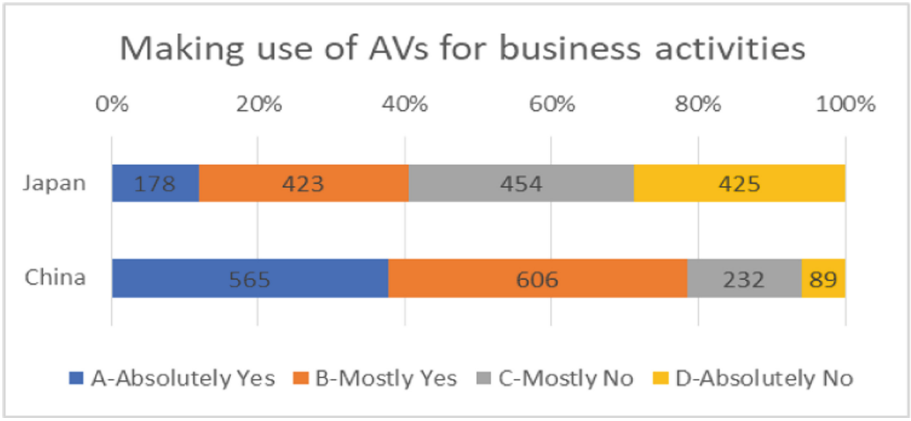


Fig. 10. Do you want to make use of AVs for business activities? (p-value = 0.988)

Making a short summary, we can know that Chinese people higher expected AVs for all usage situation than Japanese people.

Traffic jam, traffic accidents, and traffic environmental issues are normally considered as three negative outputs that automobile vehicles have brought into our society. In our surveys, we set some questions to understand people's expecting for AVs to solve or contribute these three negative outputs.

The questions are summarized in Figs. 12, 13 and 14. Both Chinese people and Japanese people have a higher expectation that AVs will solve/contribute to the three negative outputs. Of these three issues, to reduce traffic accidents is the most expected in both countries: more than 80% are expecting. Furthermore, the distributions are also very similar, that made t-test be with a low p-value ($0.875 < 0.9$). Regarding the traffic jam and environmental issues, the results are similar, too although the distributions are statistically different. Moreover, what expected by Chinese people are higher than what by Japanese people.

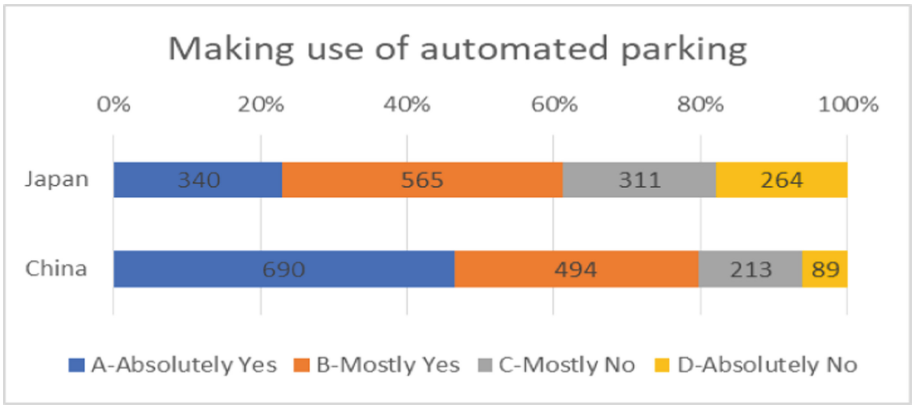


Fig. 11. Do you want to make use of AVs for automated parking? (p-value = 0.991)

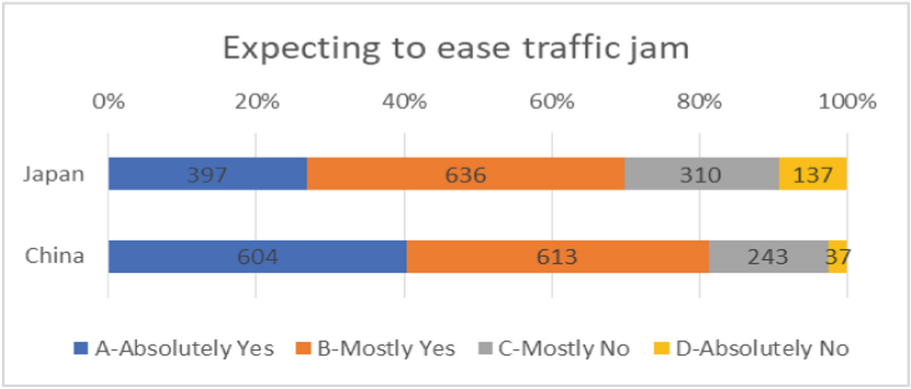


Fig. 12. Do you expect AVs being able to ease traffic jam? (p-value = 0.955)

In Japan, the aging issue has been a very serious social issue. On the other hand, China's aging increases very quickly and will be No. 1 in the near future. Therefore, the contribution of AVs to support elderly's transport has been higher expected in both countries (Fig. 15). In Japan, this issue is the highest expected issue.

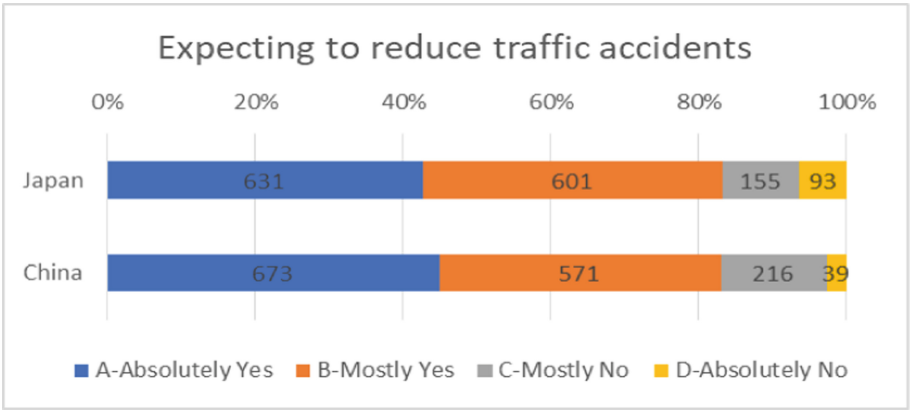


Fig. 13. Do you expect AVs being able to reduce traffic accidents? (p-value = 0.875)

As AVs means self-driving, the current drivers will be free so that they may work or rest when they are in AVs. On this issue, Fig. 16 tells us that Chinese people gave the highest percentage of positive answers. Comparatively, the percentages of Japanese people were lower by 20 points.

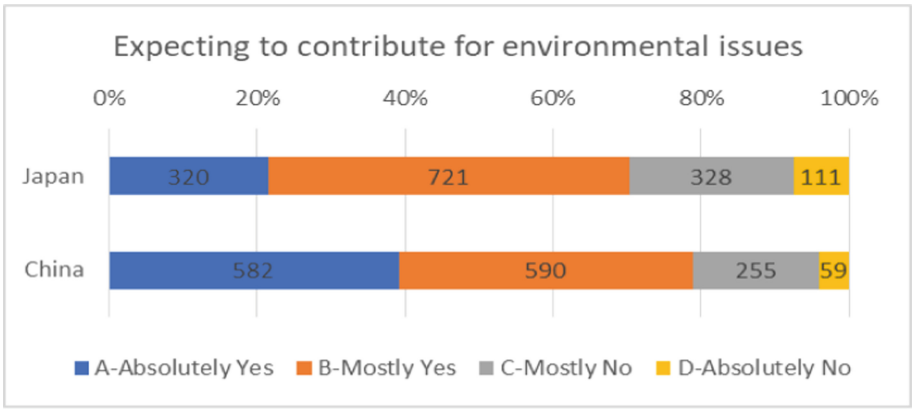


Fig. 14. Do you expect AVs being able to contribute to environmental issues? (p-value = 0.988)

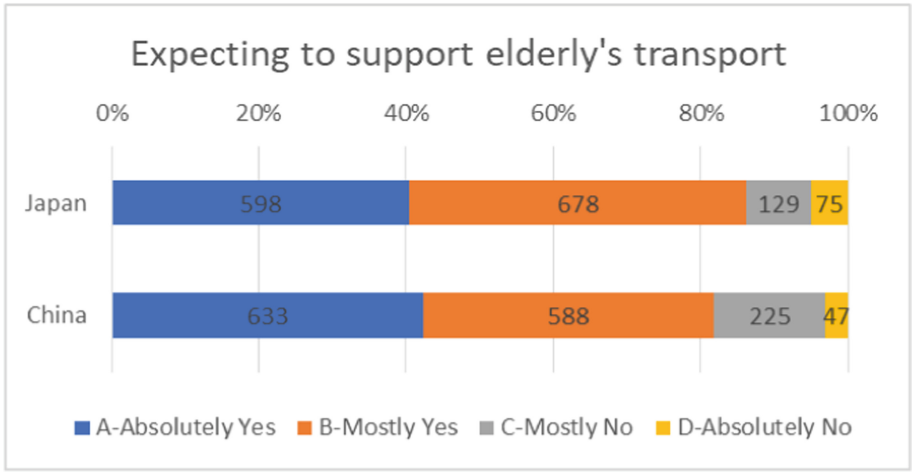


Fig. 15. Do you expect AVs being able to support elder's transport? (p-value = 0.940)

Summarizing the above, we can know that Chinese people have almost the same percentage to make use of AVs and expect AVs positively contributing to the solution of the automobile traffic problems and the related social issues. On the other hand, Japanese people show the higher expecting for AVs to contribute to the solution of the automobile traffic problems and the related social issues, but the percentages of making use of AVs are quite lower. Japanese people seemed not being imaging themselves in the coming AVs society.

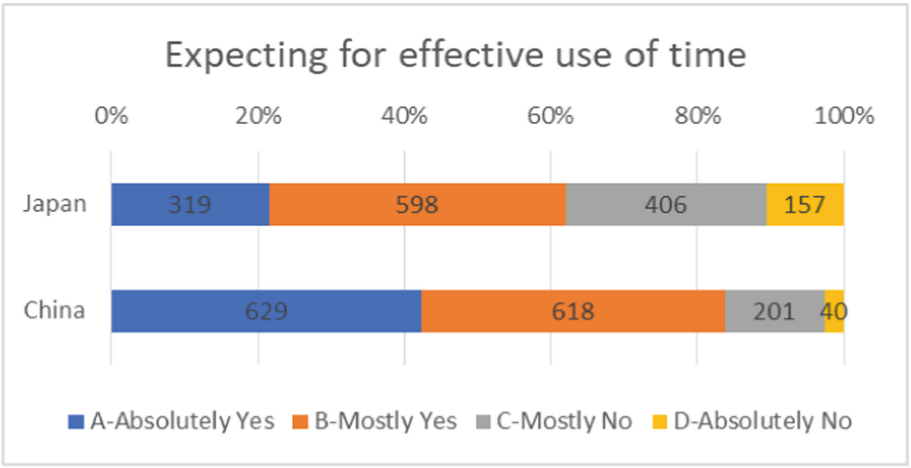


Fig. 16. Do you expect AVs being able to contribute for effective use of time? (p-value = 0.987)

4 Effects of Autonomous Vehicles

Extendedly, some questions on the effects of AVs were also inquired. Some interesting results can be known from Figs. 17, 18, 19, 20 and 21. Regarding affirmative effects of AVs in Figs. 17 and 21, a higher percentage in China than that in Japan is obtained. In contrast, Japanese people gave higher percentage than Chinese people for the anxiety as shown in Figs. 18 and 20.

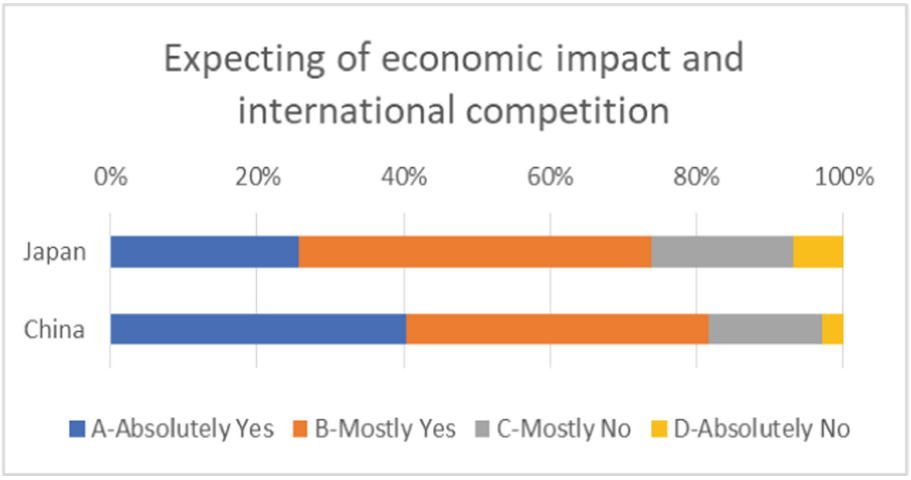


Fig. 17. Do you expect AVs being able to contribute to economics and international competition? (p-value = 0.985)

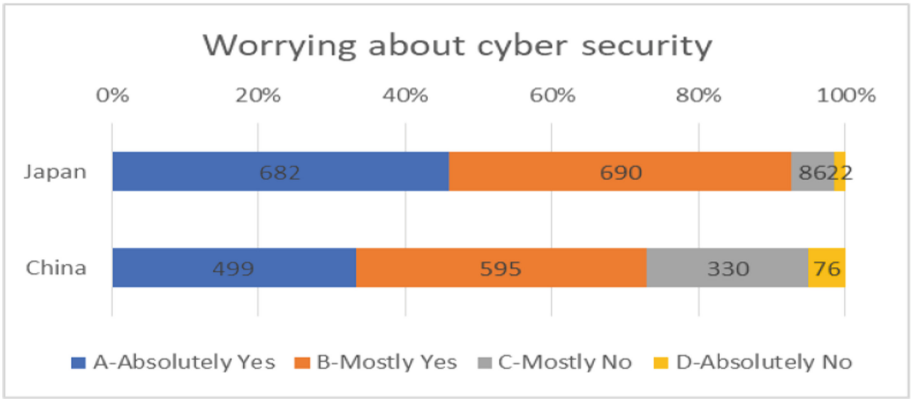


Fig. 18. Do you worry AVs about cybersecurity? (p-value = 0.961)

Extremely, on "worrying about cybersecurity" and "worrying about responsibilities of traffic accidents", more than 90% of Japanese people answered "yes". How to let Japanese people get rid of their anxiety on AVs seems to be an important task for the people to promote the AVs.

More than 70% of Japanese people and more than 80% of Chinese people expect the economic impact of AVs (Fig. 17) and thought AVs contribute to international competition of their countries.

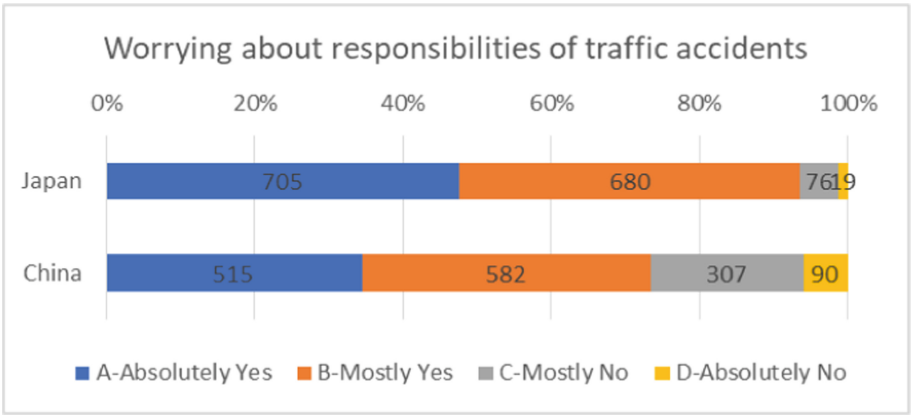


Fig. 19. Do you worry AVs about the responsibility of traffic accidents? (p-value = 0.972)

These also brought that more than 50% of people in both countries (Fig. 21) approve on AVs society totally. These results are a strong power to promote AVs into the real society in both two countries.

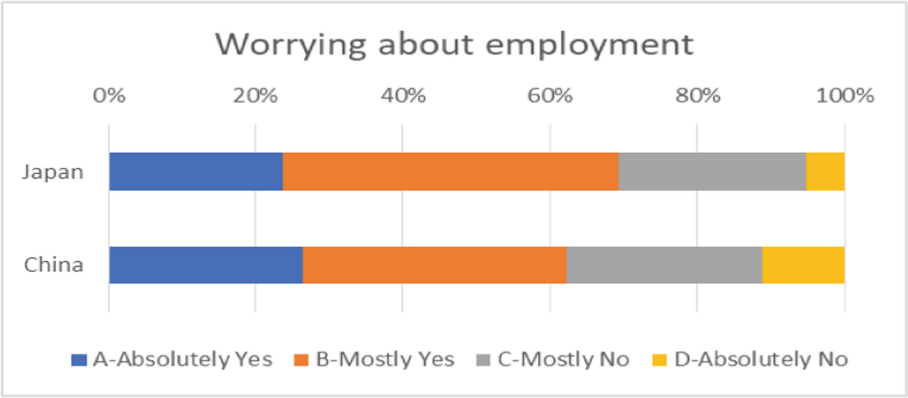


Fig. 20. Do you worry AVs about employment? (p-value = 0.960)

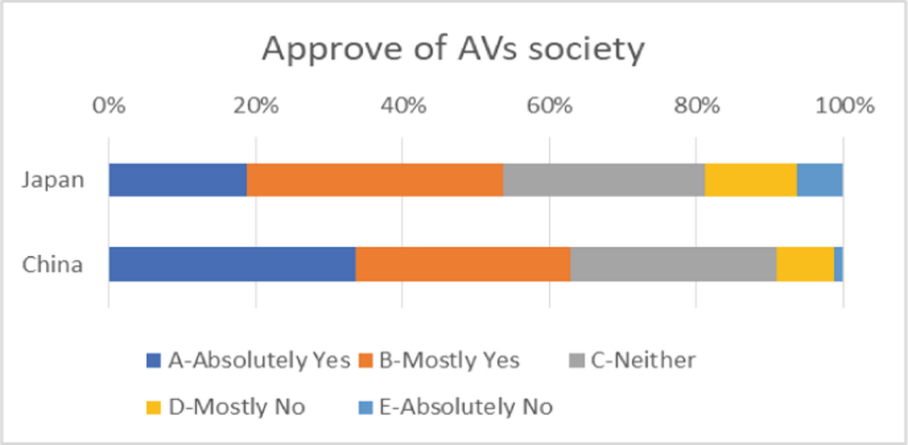


Fig. 21. Yours approves on AVs society totally? (p-value = 0.946)

5 Conclusions

AVs has been one of the hottest research topics worldwide. Some social issues are found to be the main obstacles impeding the diffusion of AVs. This study aimed to indicate crucial measures implemented for social environment in Japan and China, two top leader countries in the world, to welcome future society with AVs. To realize this goal, we have conducted an international comparative study between Japan and China. Here, the present state in China was investigated in 2018 based on the previous study in Japan in 2017.

The comparative results told us that Chinese people are more positive to affirm the AVs generally than Japanese people. Japanese people are more prudent when promoting AVs into real society. Although all people in both countries show the same

result on expecting to reduce the traffic accidents by AVs and to contribute to support the elderly people's mobility, most results are in contrast.

When we are positive to rethink these results, the solutions in these two countries can tell the world how to overcome all kinds of obstacles in the process of promoting the AVs.

Acknowledgment. This study was partly supported by JSPS KAKENHI Grant Number JP17K06612.

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