

WEBINAR SUMMARY:

Domestic AI in the UK and Japan

With Ekaterina Hertog, Nobuko Nagase and Setsuya Fukuda

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Ekaterina Hertog's Talk:

Today we would like to talk about this research that's coming out from our domestic AI research project. The project aims to explore artificial intelligence potential to transform unpaid domestic work. It's a UK-Japan collaboration in the UK. I lead the UK team, and Professor Nagase, who will be talking later, leads the Japanese team. But at the moment, I'll give a brief introduction to the project and why we think it's important, and then discuss one of the papers that we are preparing for publication and our most recent findings.

Many of you must have come across these kinds of articles in the media. They all raise alarm to the rise of digitalisation and artificial intelligence, and how it will change the paid labour market. However, of course, paid work is not the only type of work that we all do. This slide demonstrates the average times adults aged 20 and older in the UK and Japan spend doing paid work. As you can see, the blue bar is paid work, while the red is unpaid work. Perhaps unsurprisingly, working hours are particularly long in Japan, on average. In both countries, paid and unpaid work times are compatible. Of course, this ignores the fact that at certain stages in our life, for example, when we're both working and caring for young children, unpaid workload could even overshadow the paid workload, for example. I think the idea that I am trying to sort of stress here is also very nicely captured in this image on the left, which shows that societies depend on unpaid labor, which is also sometimes called reproductive labor. If no one cleans, cooks, and cares for children, societies are going to grind to a halt. Paid work will become impossible. So given the importance of unpaid work, and the experts raising alarm or stressing the fact that artificial intelligence is going to steal our jobs, we started thinking, well, if robots are going to steal our jobs, maybe they can also take out our trash and there'll be some balance there.

When we started working on this project, we noticed that there's not been much academic research or research by policymakers on the subject. However, the same cannot be said about consumers and companies. This is a simple graph compiled from the figures published annually by the International Federation of Robotics. They publish raw numbers of the number of robots sold, or in the case of industrial robots, which is the black line, the units installed globally in a given year. They categorize the robots into four very broad categories. Household service robots, and these include lawn mowers, vacuum cleaners and floor mops etc. Entertainment robots, these

particularly come up in the media from Japan. Professional service robots, like perhaps medical robots or some of the robotic units used in elder care facilities. Finally, industrial robots, the gigantic robots that are building cars, and so on.

As we can see from this graph, from 2010, household service robots outnumbered all the other types of robots in terms of sales globally. There's been a lot of appetite for them already. Moreover, this graph highlights the number of domestic robots people are buying has accelerated between 2018 and 2019. The number of household service robots sold increased by 40% year on year. We don't see such dramatic increases in the other types of robots. So, domestic robots are being produced. They're being sold. They're being adopted. What does this mean for us as individuals and for our societies?

We designed a domestic AI project. There were many team members involved to design an expert survey in which we try to assess how much domestic work could be automated in the next 5 and 10 years. What do the experts think? This is a graph showing 17 domestic tasks. These are types of unpaid work tasks. We were guided by two thoughts. First of all, we wanted to have a good variability of tasks, and we started with a list of tasks from time use service, which is a traditional way of measuring unpaid work, because this is work that's not being paid for, so it's not captured through GDP, through salaries, etc, it's captured through time. On the other hand, we have to have a limited number of tasks, because we needed experts to evaluate and think carefully about them. So we came up with this list of 15 tasks, capturing both housework and care work tasks.

First of all, experts believe that in 5 years, all the tasks will require less time to be spent on them through automation. Moreover, housework tasks, which are the blue, orange and green bars are more automatable, and in particular the blue bars stand out. These are capturing routine housework types like cooking, dishwashing, and cleaning, as well as shopping, which are the green bars in the middle. They are particularly close to 30% in terms of routine domestic tasks, and over 40% for shopping. Extra things can be automated in the next 5 years. Care work is particularly resistant to automation. Again, maybe not surprisingly, because it is an interactive task, not a manual one. Care work here is captured through the purple and dark gray bars, which is adult care. The predictions for 10 years are quite similar in terms of a pattern, but the bars go even higher, and I will show this to you later. These are the findings from the experts. These were average findings across the UK and Japan. Experts think different domestic tasks or domestic work is automatable. They expect some change in the coming 5 years in our domestic workloads.

Our second interest in the paper was: Who are these experts and other predictions influenced by anything apart from their expertise? Our starting point was literature on paid work automation, and there were lots of expert surveys, and debates about how best to capture them. One thing that unites that literature is that the core characteristics are seen as their training there. Once they've received training in machine learning, perhaps computer sciences or artificial intelligence in some way, that's what's expected to define their views and their predictions when asked about the risks of automation. We thought that that might or might not be true, because we don't just have our occupational training. Of course, all of us have other experiences that potentially influence our perceptions of how the future will be, what's necessary in the future and how we think society will

change. Here, the comparative nature of our project was a particular strength, because we didn't treat our experts as a black box. We collected the number of characteristics about them, and just to make the point clear, I am presenting the differences by two types of characteristics. Specifically, their background, where these experts lived and worked. Did they live and work in the UK or in Japan? Second is their gender. We thought that gender would be particularly interesting for domestic work, because domestic work tends to be gendered in all societies across the world. Women do more domestic work than men.

Here are the average predictions across all domestic tasks. We just bunch them all together, both housework and care work. What's the average expected proportion of automation in the next 5 years expected by UK and Japanese male and female experts. As expected, there are differences by country as well as by gender. First of all, UK experts turned out to be a lot more optimistic about domestic automation compared to the Japanese experts, especially UK male experts, but both types of groups expected more domestic automation to happen in the coming years, which was somewhat of a surprise, as we generally perceive Japan as a quite innovative, particularly as so many robots are exported from Japan. The second big difference was the gender patterns. The gender patterns were reversed in the two countries. Interestingly, in the UK, generally speaking, men tend to be more optimistic overall about technology. They are more likely to adopt it, more likely to perceive it as useful, and just generally more positive. That's not only the case for the UK. There are large Euro barometer surveys, for example, looking at 28 European countries that find this general pattern across all the countries.

In Japan, at least when it comes to domestic automation robots that would take over some of the household labor, the predictions seem to be reversed. The most pessimistic subgroup in this particular cross-section were Japanese men. They didn't expect too much unpaid work to be automated in the next 5 years. Initially, to scope out the data, most of the work was done through a survey. We did carry out a number of interviews, and we also reached out to the experts that did the most outlying research. We reached out to everyone who made the lowest and the highest predictions in different domestic tasks, and asked them to justify or explain their prediction. What informed their thinking? I think particularly in Japan there was quite a clear pattern emerging, both female and male experts had similar thinking in terms of complexity. People pointed out that domestic tasks could be particularly difficult to automate. There was a big difference in the perception of the demand. We had one quote from a female expert that said: "Domestic tasks will be difficult to automate, so whatever new technologies emerge, they will be fairly pricey. But we expect high price goods to be able to make sure that the quality of domestic work is maintained." Other Japanese experts gave quotes essentially arguing that because it will be so expensive, there will be no demand for it. Therefore it will never become mainstream.

I think in the future it would be interesting to carry out perhaps more quality of research or focus groups to better understand how personal experiences and perceptions inform expert predictions. I also want to talk about why this is important. Why do we need to be interested in expert backgrounds, and how predictions vary by backgrounds? Well, the predictions of the future have consequences in the present. Again we draw parallels with the future of work literature. The first similar seminal paper by two Oxford colleagues came out in 2013. That paper made quite an alarming and bold statement, arguing that about 47% of occupations could be automated or be at risk of automation in the near future. That attracted a lot of attention from policymakers that informs

budget allocation, and so on. If we perceive something as an important near-future change, that's likely to inform budget allocation and policymakers.

What we see here in our findings, is that these predictions could be informed to some extent by the expert's backgrounds. Imagine that we carried out a survey of domestic automation, and our expert panel disproportionately only consisted of Japanese male experts. Well, in that case, we'd have a rather dim view, and we would perceive domestic automation as not very likely to happen. As a result, maybe the government would pay less attention to the necessity of regulating smart technologies in the homes, to the risks that smart technology might present by collecting personal household data, and so on. So while we wouldn't argue that any particular group holds the truth about expert predictions, these findings highlight the fact that expert predictions are contingent, and it's important to have a diverse board of experts. Thank you very much.

Setsuya Fukuda's Talk:

I'm Setsuya Fukuda, working at the National Institute of Population Social Security Research. Thank you for joining us today. Katya explained what experts say about the future of automation of unpaid work. In my talk, I'm going to talk about the future of unpaid work, by using simple simulation. As she has just mentioned, unpaid work is so important for society because without unpaid work, society could not run. She also showed how significant time is spent doing unpaid work. Furthermore, unpaid work has a gender dimension. As this graph shows, men, both in Japan and the UK, spend significant time on paid work, while women spend significant time on unpaid work. This tendency is much more striking in Japan, as you can imagine, because gender roles are much more defined in Japan compared to the UK. Japanese men spend a lot more time on paid work than men in the UK, and Japanese women spend much more time on unpaid work than women in the UK.

In this paper, we are going to estimate how unpaid work would be automated in the future, using a kind of simulation to see how time use on unpaid work changes if future time use on unpaid work has changed. We also speculated about the consequences of this for labour market availability. If people didn't spend time on unpaid work, what would be the impact on the labour supply? So what we have done in the simulation is, first, we specified unpaid work activities into 19 activities. Those 19 activities are: cooking, dishwashing, cleaning, making textiles, laundry, gardening, pet care, shopping, home maintenance, car maintenance, service use, household management, other housework, physical care of a child, teaching a child, interacting with a child, accompanying a child, escorting a child, care for an adult, etc. We used a time-use survey, in order to find out exactly how much time people spend on each activity. Next we linked these 19 activities to market occupations.

There was a previous study which calculated automation scores for paid occupations. There are some occupations which are very similar to those 19 activities. For example, cooking can be linked with working as a chef, and dishwashing could be also linked to being a dishwasher, and cleaning could be linked to a cleaner, and so forth. For those market occupations, we already have automation scores, which have been calculated by other studies. In our study, we assume that the same automation probability can be applied to each of those unpaid

work activities. In this way, we have automation activity for each unpaid work activity that is obtained from market occupations. Once we have linked those automation scores for each activity, we can then calculate the time-use. If the automation score of cooking is 60%, we assume that 60% of cooking time will be reduced. By doing that, we can simulate how future time-use would be changed if the automation score of paid occupation were applied to each unpaid work activity.

We also compared the UK and Japan. Firstly, both of the countries are similarly developed, yet they have very different social norms, especially in regard to gender dimensions, as I have just shown. Another difference is the population structures. As you know, Japan has a more ageing population, compared to the UK. Therefore the implication of the automation of unpaid work could be slightly different in two countries.

I will show you some results, the main findings of the simulation work. Firstly, this graph shows how each 19 activities are classified across the automation scores in both countries. I did mention 19 activities, but we thought it would be too cluttered to show 19 activities on the graph, so I grouped them into 9 activities.

I mentioned the 19 activities, but these 19 activities may be too tedious to show in two countries. show on the graph. So I kind of grouped them into nine activities. For example, the cooking and dishwashing is grouped into food management, and cleaning is linked to the household upkeep. Gardening and pet care is also grouped into one category. As you can see from this graph, many of the activities are actually classified into 50 to 70 percent automation probability according to our classifications. Some activities, such as food management and laundry, are even classified as a 70 to 85 percent automation probability. Childcare is of course a difficult task to automate, even linking with its market occupation, such as a nanny or childcare teacher. As you might note, in Japan, the automation score for childcare is zero to 15%, while for the UK it is 15 to 30%. This is because in the childcare category, there are five activities: the physical care of a child, teaching a child, interacting with a child, accompanying a child and escorting a child. In both countries, the time use composition of each activity is different. For example, escorting a child has a much higher automation probability than other care activities. It seems like in the UK, people spend more time escorting a child than in Japan. The time used on each activity is weighted. Therefore the assigned automation score is different in two countries.

This graph shows our simulation results on how observed and simulated time use differ in two countries and also by sex. Firstly, this blue bar shows the observed time used on the total unpaid work time. As expected, women spend more time than men on unpaid work in both countries, but this tendency is much more severe in Japan than in the UK. The red, green and orange bar shows how time used on unpaid work will be reduced if automation takes place. In order to check the validity of our simulation work, we have used three different kinds of automation scores, which have already been published in previous studies. But our main focus is on Scenario 1 as our main findings. Although we have used three different automation scores from three different studies, the results look quite similar, I would say. For example, for Japanese women, the observed time used on unpaid work is 329, so 330 minutes per day, but this reduces to 134 minutes if automation takes place. This means 60 to 70% of time use will be reduced according to our simulation work. The same can be observed for women in the UK. Women in the UK spend nearly 300 minutes per day on unpaid work, but this will be reduced to 130 minutes if

automation takes place. It is similar for both men in the UK and in Japan. For example, men in the UK spend on average 166 minutes per day on unpaid work, but this could be reduced to 60 minutes if automation takes place. For Japanese men, they spend only 97 minutes, but it will be reduced by half. If we link the automation scores of paid occupations to unpaid work activities, our estimation shows that a significant amount of time could be reduced.

If this reduced time is fully used for paid work, how much employment could be created as a result of automation? The graph on the left shows the percentage of potential full-time workers in Japan and the UK. These graphs are separated by sex. Let's look at the blue bar, which shows the simulation based on the Frey and Osborne automation score. According to this simulation work, we expect a 2% increase in full time workers for Japanese women. This is quite significant as a percentage for the employment rate. However, the percentage for an increase in employment rate is only 0.7% for women in the UK. This is because Japanese women spend more time on unpaid work, so the reduced time in unpaid work is quite significant - some of them could have enough freed up time no longer spent on unpaid work, so they can fully make use of it for full-time employment.

The graph on the right shows the potential increase in part-time employment. This is much larger than the increase in full time employment, especially for Japanese women. In Japan, we expect a 6% increase in part-time employment if automation of unpaid work takes place. In the UK, a 4% increase in potential part-time workers if automation takes place. However, for Japanese men especially, the increase in potential part-time employment will be much lower. For men in the UK, a 2% increase will be expected in part-time employment due to the automation of unpaid work.

These are very simple simulations under the assumption that all freed up time used on unpaid work will be used for paid work, which is quite unrealistic. It's just to show that the decrease in unpaid work time use could be kind of transformed into other things. We could potentially expect this kind of a change in the labour market.

I'd also like to discuss some implications for our aging society. We might ask this kind of question: Can AI and technology help compensate for a huge care demand expected in future Japan and also slightly later in the UK? Also, can AI and technology help elderly stay healthy and independent with the help of a machine or some technology? Lastly, can AI and technology help the government avoid fiscal bankruptcy due to the increase in social security expenditure? This is also dependent on the cost of automation.

Our results could also have some implications for gender equality. We think that the automation of unpaid work may facilitate gender equality by reducing women's time use on unpaid work more than that of men. Also, by possibly increasing women's employment as more women are freed from the burden of housework and care work, especially in Japan.

In conclusion, our paper shows that unpaid work could be automatable, especially housework. I haven't shown you in much detail, but housework has a higher score for automation than care work. Also, the automation of unpaid work could increase everyone's discretionary time. However, it could also have darker consequences. For example, not everyone has access to this kind of technology. Wealthier individuals have better access to

automation technologies. This would actually create a new digital divide so that richer people can enjoy more of the benefits of the automation of unpaid work, while the poorer cannot. We could also pose some questions, whether automating everything is a good thing or not. For example, the automation of housework may lead to the loss of some human skills. We might also have some unexpected consequences for human development, particularly if care work, such as childcare, is automated. We might have to think about these things for the future of unpaid work.

Thank you very much.

Nobuko Nagase's Talk:

Hello, this is Nobuko Nagase. Thank you for the opportunity to share our thoughts. Setsuya and I were in the same group. During this research, I had the chance to carry out a small survey with our Ochanomizu University group, in the Department of Human Life and Environmental Science. I would like to show what happened during COVID-19 very briefly. Dr. Hartog shared the UK results, so I'm going to compare how homeschooling was conducted in the UK and in Japan using this survey and using the already published results about the UK.

This is the reduction of commuting seen at major stations at peak hours during pandemic. This was when the Emergency State Declaration was made from March to May last year, and about 70% of commuting was reduced. This is the number of cases for COVID. The reduction of commuting stayed around 30 to 50% throughout after the declaration of state of emergency.

Japan has been quite resistant about working from home because of our company culture. But suddenly, after the emergency declaration, the government strongly recommended to work from home. In our research, we found that, especially at full-time work, higher-educated, larger firms, and also at the places where there was a state of emergency, there was more increase in homeschooling and telework.

This is the change in the number of workers. In Japan, women were affected more than men, especially the part-time workers, because of the school closures. As many part-time workers worked on a more temporary basis, they had more leave and thus more stayed at home.

This is to give you just a picture of the gap between Japanese men and women in childcare. This is Japan, women with small children, and men, husbands with small children, the US and the UK. So you can see that in Japan, men especially spent a very small amount of time on care work, whereas females had a very large share.

This is the study we did in November 2020. We studied couples with their first child from ages 3 to 15; with the father and mother being within the age group of 25 to 59. We found that there was a substantial increase in cooking, especially for full-time housewives during the pandemic. The yellow represents wives that were formerly full-time workers, and the blue is wives that were former part time workers. This dark blue is the husbands. There was a huge increase in housework for full-time mothers but you can also see that with fathers, there was an increase in communicating with children, cleaning, and even cooking. I won't show you the result

of our econometric analysis, but what we found was that being at home had the largest impact on fathers doing more domestic work. For mothers, children staying at home had the largest impact for them to have more domestic work. Of course, when the children are smaller, the impact was also found. But, the fact that sudden teleworking made a larger percentage of fathers stay at home, increased the domestic activities of fathers. Interestingly, it increased the satisfaction of parenting of fathers when compared with pre-COVID and after COVID, especially when they had more time at home. In other words, maybe Japanese men do enjoy these domestic activities with their family, but because of their long hours, they potentially had less chances to do so before the pandemic.

Of course, the result was varied. Not everybody was able to stay at home. In total, about 30% of fathers had more time staying at home. Because of the increase of domestic activities, there was an increase in investment in home appliances. You might think that in Japan, there are large electric appliances at home. However, for example, dishwashers are not so popular in Japan. But according to our survey, after the pandemic, it increased by 7.3%, especially for full-time working mothers. Robot cleaners increased by 8% for full-time working mothers. It was a larger increase for full-time working mothers, who need to save time compared with part-time workers and housewives.

Tetsuya talked about elderly care, and we can see that 8.5% of monitoring devices increased. Especially during COVID-19, many families could not visit their elderly relatives or parents, and as a result, a device to monitor the elderly increased. There was also an increase of automated cooking machines: machines where you can download the recipe, and you just push a button to cook.

Now I will turn to how homeschooling was conducted in the UK and Japan. For the UK, I used Benzel et al. Understanding Society Briefing Note, Wave 1 COVID-19 Survey, Homeschooling April, 2020. For Japan, we used the Ochanomizu University Survey on AI, ICT and Life Change, which was conducted retrospectively in November 2020. Our school closure in Japan was much shorter than what was found in the UK. It was closed from March 2nd to May 25th. The closure depended on the region. In some prefectures there were no school closures. However, even after the state of emergency stopped, for areas around Tokyo, for example, shortened school hours continued till the summer. School returned back to normal after September.

Was the computer required for schoolwork? This is for primary schools and secondary schools in the UK. You can see that a much lower percentage of Japanese schools required computers for schoolwork. Much more schoolwork during the school closure was conducted through the use of computers in the UK.

The number of online classes was not so high in either country. Less than one class per day. So perhaps in the UK, homework must have been given through computer access. In Japan, homework was usually given on a paper basis where parents go, perhaps once a week to retrieve the homework and do it at home. I was shocked to see that in Japan, in primary school, one in five students did not have access to a tablet or computer at home. Whereas the percentage was much smaller in the UK. This was quite surprising for me because I thought most people in Japan had access to computers, but actually, computers were more popular in the early 2000s and

perhaps it has been replaced by the smartphone, especially in less educated families. So this was kind of an alarming result for me.

To conclude, the use of ICT and teleworking allowed for increased contact of fathers with children and an increased satisfaction of the parenting of fathers. Families staying at home increased domestic workload for family members, especially for full-time housewives. Homeschooling in Japan during the school closure was conducted mostly through homework sheets, but not so much so through computer devices. There was an increased demand for household labor-saving home appliances, especially for full-time working wives.

Thank you very much. This concludes my presentation.

Q&A with audience:

Jason James: I found that quite encouraging, in the sense that, obviously people in paid work are worried about robots taking their paid work away from them, but there seems to be relatively little downside in robots doing unpaid work, like taking out the trash as Ekaterina said.

There's been some discussion by the presenters, as well as in the chat about whether in some cases automation reduces the quality of what's being done, I think this is particularly the case with care work.

Could I ask a couple definitional questions? It's quite difficult to grasp the definitions as a non expert. So Ekaterina, in your presentation you were talking about the percentage that's going to be automated. Presumably that means the difference between the current level of automation, and the expected level in five years.

Ekaterina Hertog: Yes, I should have clarified that.

Jason James: Obviously a certain amount is automated already,

Ekaterina Hertog: We explicitly told the experts to keep in mind how many dishwashers or washing machines are already the norm in developed societies.

Jason James: I was also thinking about automating cooking, for instance. If you buy a ready meal, which can be just heated up in the microwave, does that count as automation?

Ekaterina Hertog: That's an excellent question. We actually had as a group massive debates about where do we draw the line of automation? In the end, we took a more practical route of where new predictive algorithms play a role like they would, for example, in automation of shopping. Amazon, I think, patented new predictive shopping, which sounds very futuristic. The model would be that Amazon predicts what you want to buy. You get random stuff sent in and you return what you don't need. They are obviously not doing it yet because their predictions are not that accurate.

For example, if I buy a sofa, they predict that I need another one, which seems a very bizarre idea. However, they do hold a patent on eventually doing that predictive shopping. That, of course, doesn't depend on a robot coming into my house and physically going to do grocery shopping for me, but rather, it's an algorithm that sits somewhere else. There could be parallels with cooking there as well, with me using an app or something and ordering ready-made food. Coming back to your question as long as there were predictive algorithms involved, we considered that as contributing to our estimate, right.

Audience member: Throughout this discussion, there seems to be emphasis on the onus of these automations to be on those within the household. Do we anticipate there'll be cross-proliferation between, for example, service providers or even shops, and those workplaces that feed directly into the domestic environment. I think a good example is over the pandemic perhaps considering what the school institutions themselves could do to feed into that home life and what kind of automations they could perhaps provide instead of the onus being entirely on parents themselves.

Ekaterina Hertog: If I understood the question correctly, there's some parallels with Jason's questions about the sort of human-robot interaction and how this could feed into domestic life. We understood automation quite broadly and we imagined these models to an extent. I mean teaching models like that already exist. I think they're just not as popular; students receive tasks and there's some algorithmic checking of their work. Going forward in the future, there is potential for this sort of hybrid model with both humans and algorithms being involved, where technology could take on more routine, less creative tasks. For example, if my child needed to learn the multiplication tables, I'm quite happy for a robot to show him the cards and evaluate responses. That leaves time to maybe read and discuss a book with him or play a board game. So I think there's potential to that. The project itself didn't scope it in great detail. This is something that I think would be going more further to future research. Does that answer your question?

Jason James: Is that what you meant, Mark? Maybe it was about the idea of schools providing the laptops for families rather than the families having to buy them themselves. Is that what you meant, Mark?

Audience member: It falls into the purview of both. There's an emphasis throughout the conversation on physical hardware as well, which I think could be a bit of a misnomer. Personally, I've seen that process automation has happened more on a software-driven basis. Perhaps if schools provide the software and control the software on their side, they themselves will be able to mark the work remotely and be that human in the loop instead of the onus being on the parent.

Jason James: A concern from one of the people in the chat is to do with poorer families being deprived or a kind of digital divide. So the suggestion is that AI might be able to support children whose parents are less interested in their education or who have fewer economic resources. But I would have thought they would equally struggle to afford AI. Does anyone have any comments on that?

Nobuko Nagase: Well, maybe the government can invest in some way, so that such a kind of instrument can be given to those families. But on the other hand, AI could also increase the gap of educational equality because richer families are able to use more resources for AI.

Ekaterina Hertog: I think there's quite a lot of research being carried out on the digital divide and that has implications for the automation of domestic tasks, including education. I think it's a very perceptive question. It's about hardware and software. It's not enough to just provide hardware for all children, although it would be a good start to help close some of the inequalities. If poorer children are given the same Chromebooks or iPads by schools, for example. There's also been some very interesting work done in the US comparing how these devices are used by private schools and state schools; how private schools with more resources are able to train their teachers, and use technology more creatively, whereas in state schools and schools in poorer areas, teachers tend to be busier, or under resourced, so they struggle to provide the same benefits. There's no extra training to help teachers set up technology as well as teach students who need help with setting up and using all the features of the provided technology.

Audience member: My question was a follow up about this divide. Some automation of certain activities are considered better left to humans, but perhaps some kind of automation could actually help bridge the divide. Is there some way to feed this information back to the people making decisions about which tasks are chosen to be automated in the future, to make sure it is more equally distributed across different classes and different genders?

Setsuya Fukuda: There has been a lot of concern about the possibility of enlarging the digital divide because the richer can afford these services created by AI and new technologies, while the poor cannot. So, I think it's very important for the government to subsidize and make sure that the benefits of those technologies are more widely spread to the public, so that the digital divide can be minimized. I don't think it's possible to prevent the digital divide, but it should be minimized. I don't think that the government currently has any policies to do with minimising the digital divide caused by the development of technology. So that is going to be a hot topic in the policy making area.

Jason James: Maybe I can just butt in with another question of my own, because I was quite interested in the differences between the UK and Japan. I mean, for instance, we heard from Nagase Sensei that Japanese households often have smartphones instead of computers, and that's made a difference to how children have been educated during lockdown. One of the other obvious differences is that Japanese houses are typically smaller than British houses. From my experience of them, they are also quite cluttered. That presumably explains why Japanese houses often don't have dishwashers, because there isn't space. Also the robot cleaners are suitable for bigger flooring spaces, which is quite unusual in Japan, and so I wonder if either of the Japanese would like to comment on that.

Nobuko Nagase: I've asked my students why more Japanese people use smartphones as opposed to computers. One of my students said, 'Because of typing.' Typing on computers is easier for me, because I know how to type quickly. But many younger Japanese people like to do it on smartphones, some even want to write their thesis on

their smartphone because they can do it faster. So there is some kind of difference. But I don't like that smartphones are used more frequently in Japan. But there are reasons for it.

Right now in Japanese families, double-income families with full-time work are increasing among the young generation. They are very active in purchasing robots, even though you have to be careful to clean up your floor before doing it. I have been interviewing new families with full-time workloads for both husbands and wives. They are making the most use of those kinds of new devices. Whereas the traditional families, where mothers tend to work more as housewives, they are used to washing up by themselves. I used to wash dishes myself, but after a while I got used to using the dishwasher. So today, it's a must. The dishwasher is getting more popular now.

Audience member: In this presentation there was talk about AI, and talk about automation. AI in terms of capabilities that are potentially ready to be used in sorts of products has moved to a lot more than just automating certain specific tasks. It's also able to do deeper things. I was wondering, as someone who likes and does all the dishwashing by hand, what kind of tasks are they considering in terms of AI for the future? Is it just sort of routine mundane tasks at home? Or could it also be to the extent of an assistive entity or something at home that could do multiple things?

Ekaterina Hertog: In terms of something like an assistive entity that is very much multipurpose, like a little robot that kind of replaces a human, I think we are still quite far from that at the moment. That's my impression from interviewing the experts. The model is not necessarily going to be like that for all the tasks- I think for some of the tasks like cleaning the floors, that has to happen inside the household, as you cannot clean the floors remotely. However, many other tasks like cooking or even laundry, in the UK for example, there are a number of startups where the automation of laundry cleaning is happening, with me putting out a basket with the laundry outside, and this being taken somewhere, potentially a factory-like facility. You could benefit from the economies of scale of doing laundry across hundreds of households rather than just one. At the moment, I don't think we're quite there yet, but potentially there could be that.

When it comes to the household, there is no actual robot in the household, but perhaps we could control that through an app. The experts are imagining a mix of those approaches, not just that robots are going to win and take over in the houses; rather it will all be done through an app and externally.

Audience member: I was wondering about the financial considerations of buying these robots. Obviously, if it's cheaper to employ a human being to do it, then you probably wouldn't invest in a robot.

Jason James: To add on to this, I was wondering, again, there might be cultural differences here between Japan and the UK. I think in the UK, people are much more accustomed to having people come into their house and do cleaning or babysitting, those kinds of jobs. Whereas in Japan, I have more of a feeling that people are resistant to having strangers come into their house and might well prefer to get a robot to do it.

Nobuko Nagase: I did several interviews with working wives, and many of them did not have cleaners come into their house. Maybe just once a year. They do not like having people come into their house. Sometimes they have a babysitter, but that too, they'd prefer to bring their children to their house, instead of having them come into their house. I do think there is some kind of resistance to having a stranger in the house, and therefore the robot might be preferred. According to my interview with experts, they say that it's technically possible, but it's too expensive.

Jason James: Thank you so much to all of our three speakers today, and to everybody else, especially those who were very active in asking questions and chatting about the issues.