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Voter responses to female candidates' voice pitch: experimental evidence from Japan

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Abstract
Politicians' voice pitch is known to affect voters' evaluation of the candidates in the US. But to what extent is this true outside of the American context? To address this question, we conducted an original survey experiment in Japan. Our findings are threefold. First, in contrast to previous studies, voters in Japan do not systematically prefer lower-pitched over higher-pitched female politicians. Second, our findings suggest heterogeneity in the effect of voice pitch by voters' gender – while Japanese women are indifferent as to female candidates' pitch levels, men are more likely to prefer female candidates who speak at lower pitch. Third, preliminary analyses reveal limited evidence that female candidates' political experience conditions the effect of voice pitch over voters' willingness to vote for that candidate. Our findings suggest that lowering pitch is likely to increase female candidates' electoral prospects by attracting male voters without backlash from female voters.

Key words: Voice pitch: female representation; gender; Japan

1. Introduction

That voters assess political candidates based on how they look and sound is well-known. Candidates who are considered to be physically attractive tend to be viewed more favorably than those seen as less attractive (Sigelman *et al.*, 1987; Verhulst *et al.*, 2010; Stockemer and Praino, 2015). Voters typically prefer taller, as opposed to shorter, political candidates, not only in the US (McCann, 2001; Stulp *et al.*, 2013), but elsewhere as well (Sorokowski, 2010). Attire also impacts voter assessments of candidates (Rosenberg *et al.*, 1991), while smiling can improve one's chances of winning an election (Horiuchi *et al.*, 2012).[1] These studies suggest that in addition to various correlates of electoral success such as candidates' ideological positions and political experiences, voters are also influenced, whether directly or indirectly, by candidates' physical cues.

Among different physical traits, this study zeroes in on the impact of female candidates' voice pitch on voters' assessments of those candidates. Recent studies of female representation typically find limited evidence of outright discrimination against female candidates (Lawless and Pearson, 2008; Palmer and Simon, 2010; Teele *et al.*, 2018; Kage *et al.*, 2019; Schwarz and Coppock, 2021). Yet studies in the field of psychology show that individuals' voice pitch has a considerable impact over how speakers are perceived, including their strength (Sell *et al.*, 2010; Puts *et al.*, 2012; Armstrong *et al.*, 2019), formidability (Aung *et al.*, 2021), hierarchical rank (Ko *et al.*, 2015), attractiveness (Pisanski *et al.*, 2012; Tigue *et al.*, 2012; Leongómez *et al.*, 2014), trustworthiness (Montano *et al.*, 2017) and even

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[1]See also Asano and Patterson (2018) for more nuanced findings.

aversiveness (O'Connor and Barclay, 2018). In recent years, political scientists have begun to build on these insights and have shown voice pitch to shape perceptions of leadership capacity (Klofstad *et al.*, 2012), vote choice and/or election outcomes (Klofstad, 2016, 2017; Klofstad *et al.*, 2016; Banai *et al.*, 2018), and the amount of political discussion (Dietrich *et al.*, 2019). Female politicians are often aware of the potential impacts of voice pitch. As the examples of Hillary Clinton and Angela Merkel illustrate, female politicians often change their voice pitch to attract more voters, while male politicians do not need to do so (Jones, 2016; Boussalis *et al.*, 2021), suggesting that gender bias continues to affect female politicians in subtler ways, if not through blatant discrimination.

Studies find that US voters typically prefer both female and male candidates with lower pitch (Klofstad *et al.*, 2012; Klofstad, 2016), but we know little about the generalizability of these findings beyond the American context.[2] It is important to assess the extent to which voters' preferences for lower-pitched candidates travel to other contexts.

This study draws on an original survey experiment conducted to examine whether voters in Japan, as in the US, prefer low-pitched female candidates. As is well-known, Japan is a more gender-stratified society than the US. At 9.7%, Japan has the lowest rate of female national legislators in the developed world (Inter-Parliamentary Union, n.d.). A recent study finds surprisingly little discrimination against female candidates among the Japanese electorate (Kage *et al.*, 2019), but it is possible that Japan's female politicians suffer from subtler bias via other channels, including their voice pitch. Japanese women typically speak at higher pitch levels than Caucasian women (e.g., speakers of American English (Yamazawa and Hollien, 1992) or Dutch (Van Bezooijen, 1995)), and this has been attributed to the cultural norm of exhibiting powerlessness among Japanese women as well as a cultural preference for higher pitch (Van Bezooijen, 1995). On the one hand, if these cultural preferences extend to candidate choice, voters may prefer higher-pitched female candidates over lower-pitched candidates. Alternatively, Japanese voters, much like their American counterparts, may prefer low-pitched as opposed to high-pitched political candidates. Whether, and to what extent, Japanese women's relatively high voice pitch impacts their electability thus poses an important empirical puzzle.

We also ask whether different segments of the population prefer female candidates of different pitch levels. If Japanese voters do respond to candidates' pitch levels, an exploration of who among the voters reward or punish candidates with higher or lower pitch would illuminate which voters could be won over or lost if candidates changed their pitch. This study takes first steps in this direction by examining the differential impacts of different voice pitch.

We conducted a survey experiment in March 2021 in Japan. We asked respondents to listen to a recording of a hypothetical female candidate's speech and to indicate whether they would vote for that candidate. We find that in contrast to American voters, who typically prefer female candidates with lower voice pitch, Japanese respondents were, on average, indifferent between female candidates of higher and lower pitch. But Japanese preferences over voice pitch were conditioned by gender, with male voters being more willing to vote for low-pitched female candidates than female voters. In addition, contrary to our expectation, we find that the effect of voice pitch on voters' willingness to vote for a candidate is little affected by that candidate's political experience.

Existing studies report that outside the realm of politics, men typically find women with higher voice pitch to be more attractive (Borkowska and Pawlowski, 2011; Fraccaro *et al.*, 2013).[3] Our findings suggest that in Japan as well, men use a different metric for evaluating whether women are fit for political office than when they assess general 'attractiveness.' Further, our finding that male voters prefer lower-pitched female candidates more than female voters also points to different mechanisms of candidate evaluation by voters' gender. While male voters may prefer those who sound more authoritative, female voters do not associate voice pitch with candidate quality. Moreover, while previous studies suggest the existence of backlash effect of women unnaturally lowering their voice pitch

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[2]For notable exceptions, see Banai *et al.* (2018), Boussalis *et al.* (2021), Okada (2016, 2017).

[3]Some studies find that individuals with exaggerated pitch levels may be found to be unattractive (Fraccaro *et al.*, 2013; Levon and Ye 2020).

(Fraccaro *et al.* (2013), Levon and Ye (2020), see also Jones (2016)), our findings suggest that all else equal, female candidates in Japan may be able to attract more votes from male voters by lowering their voice pitch while avoiding backlash from female voters.

More broadly, our findings provide new evidence to recent findings from the US, Japan and other developed democracies that voters do not exhibit outright discrimination against female politicians (Kage *et al.*, 2019),[4] but that their sensitivity to female candidates' physical cues, including physical appearance and voice pitch (Carpinella *et al.*, 2016; Klofstad, 2016, 2017; Klofstad *et al.*, 2016; Bauer and Carpinella, 2021; Boussalis *et al.*, 2021) indirectly place an additional burden on women who seek to run for office. In the concluding section, we discuss the implications of our findings in more detail.

2. Voice pitch and voting behavior: the argument

Voice pitch is a perceptual measure of how high or low a voice sounds. There are several acoustic characteristics that contribute to voice pitch, and the easiest measure is F0, or fundamental frequency. F0 is typically measured in Hertz (Hz), and it may be perceived as being 'high' or 'low' – lower values of Hz correspond to lower pitch, and vice versa. Pitch is inversely correlated with the thickness of the vocal fold (Hollien, 2014), and women typically speak at higher pitch than men. Other factors also shape voice pitch, such as height and weight (Fitch and Giedd, 1999), age (Pisanski *et al.*, 2018) as well as socio-cultural factors (Van Bezooijen, 1995).

Studies in the field of psychology show that individuals' voice pitch has a considerable impact over how speakers are perceived, including their strength (Sell *et al.*, 2010; Puts *et al.*, 2012; Armstrong *et al.*, 2019), formidability (Aung *et al.*, 2021), hierarchical rank (Ko *et al.*, 2015), attractiveness (Pisanski *et al.*, 2012; Tigue *et al.*, 2012; Leongómez *et al.*, 2014), trustworthiness (Montano *et al.*, 2017) and aversiveness (O'Connor and Barclay, 2018). Accordingly, changing one's pitch also shifts assessments of the speaker (Fraccaro *et al.*, 2013; Cheng *et al.*, 2016; Sorokowski *et al.*, 2019). Importantly, these are character traits that are valued in politicians, and not surprisingly, political scientists have recently begun to build on these insights to show voice pitch to impact perceptions of leadership capacity (Klofstad *et al.*, 2012), vote choice and/or election outcomes (Klofstad, 2016, 2017; Klofstad *et al.*, 2016; Banai *et al.*, 2018), and the amount of political discussion (Dietrich *et al.*, 2019).

Existing studies find that both female and male voters in the US prefer low-pitched over high-pitched candidates, regardless of candidate gender (e.g., Klofstad et al., 2012, Klofstad, 2016). Klofstad (2016, 2017), in particular, finds that voice pitch can influence vote choice and, by implication, electoral outcomes. However, previous studies of the impact of voice pitch on voting behavior have been largely conducted on US voters, and we know little about the effect of voice pitch in other contexts.

The small handful of studies that have been conducted outside of the US largely concur that voters prefer lower-pitched candidates. A study of 51 presidential elections around the world found lower-pitched candidates to be more likely to emerge victorious than higher-pitched candidates (Banai *et al.*, 2017). Another study of 69 presidential and prime ministerial countries also found lower-pitched candidates more likely to win elections than higher-pitched (Banai *et al.*, 2018). Although these are valuable studies, they are observational in design, making it difficult to isolate the effects of pitch from other confounding factors that may have been correlated with pitch, such as age, height, weight, and socio-cultural factors. Both studies also lack information on voter attributes, so we know little about the extent to which assessments of voice pitch differ across different segments of the population. For instance, do female voters prefer low-pitched female candidates more than male voters, or *vice versa*?

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[4]According to Kage *et al.* (2019), Japanese voters actually *prefer* female over male candidates and they do not expect them to stress traditionally 'female' issue-areas such as social policy. The study also reveals that female politicians are still under-represented for other reasons such as gate-keeper effects. Other studies point to persistent gender bias against female politicians in Japan (Ono and Yamada, 2020).

In a pioneering study of the impact of voice pitch on Japanese voters, Okada (2016) reports that as in the US, Japanese respondents, regardless of gender, prefer lower-pitched female politicians over those who are higher-pitched, but the sample size is small, at just 74 college students, and the voice treatments were not randomly assigned. We thus know little as to whether Japan's female candidates would fare better electorally by changing their voice pitch, and by attracting the votes of which segments of the population. We empirically examine these questions by using a broader sample of the Japanese population as well as random assignments of voice pitch.

We also seek to push the literature forward by assessing how candidate experience mediates the effects of voice pitch. Klofstad *et al.* (2015) finds that voters typically prefer lower-pitched candidates because it serves as a signal for age as well as experience. But pitch can also signal other candidate qualities such as authoritativeness and/or leadership capacity. If Japanese voters do prefer low-pitched over high-pitched female candidates, to what extent is it because they prefer those with more political experience? This paper seeks to disentangle the effects of pitch and political experience and to ask whether, and to what extent, political experience mediates the effect of voice pitch on voters.

With our motivations in mind, we now derive theoretical expectations about the effect of voice pitch from two contrasting perspectives: (1) the leadership role perspective, and (2) the societal norm perspective.

2.1 Leadership role perspective

First, Japanese voters may assess women of more professional occupations, including politicians, by different standards than women of less professional occupations. If this is the case, like US voters, Japanese voters may prefer female politicians with lower voice pitch, as low pitch is often associated with professional candidate qualities such as competence and trustworthiness (Klofstad *et al.*, 2012; Carpinella *et al.*, 2016; Klofstad, 2016). From this perspective, we hypothesize that voters in Japan prefer female candidates who speak with lower voice pitch than those with higher.

As noted earlier, voter impressions of candidates' voice pitch may also be conditioned by that candidate's political experience. To the extent that perceived authority is an important trait for political leaders and low voice pitch signals a candidate's authority, we may expect voters to prefer female candidates with low voice pitch over those with high pitch. From this perspective, high-pitched female candidates with less political experience should be the least preferred, with high-pitched candidates with more experience and low-pitched candidates with less experience falling somewhere in between. Which is more valued by voters, more political experience or lower voice pitch, presents an empirical question.

Women and men may also have different expectations for female leaders. Female more than male voters may welcome female candidates who are breaking out of the traditional mold to pursue political careers. By the same token, we may expect female voters to be more willing to vote for low-pitched female candidates than those who are high-pitched, as lower pitch serves as a signal of greater liberation from 'traditional' gender norms (Ohara, 1999).

We summarize three hypotheses from the *leadership role perspective* as follows:

H1-1: Japanese voters are more likely to prefer female candidates with lower voice pitch than those with higher pitch.
H1-2: Japanese voters are more likely to prefer experienced female candidates with lower voice pitch more than less experienced female candidates with lower pitch or more experienced candidates with higher pitch. They are least likely to prefer less experienced candidates with high pitch.
H1-3: Japanese female voters are more likely to prefer female candidates with lower voice pitch more than male voters.

2.2 Societal norm perspective

In contrast to the leadership role perspective, voters may assess political candidates in the same way that they assess 'ordinary' women. Japan not only has few female politicians, but it is a much more

highly gender-stratified society in general than most other developed democracies. As of 2021, only 12.6% of seats of boards of the largest publicly listed companies in Japan were women, compared to 37.8% in the UK, 36.0% in Germany, or 29.7% in the US (OECD, n.d.). As of 2020, only 13.3% of managers in Japan were women, much lower than the 41.1% in the US, 35.5% in France, or 28.1% in Germany (OECD, n.d.). Given the high degree of gender stratification in society and relative paucity of female candidates in Japan, congruity with societal gender roles may play a larger role in voters' assessments of candidates' voice pitch (see also Eagly and Karau, 2002, for role congruity theory). From this perspective, voters should prefer female politicians with high voice pitch because Japanese women in general are expected to speak at high pitch. We thus hypothesize that voters are likely to prefer female candidates with higher voice pitch than those with lower pitch. If this is the case, as with Japanese women of other occupations, female politicians who deviate from this expectation by speaking at low pitch may be penalized more than those who speak at high pitch.

Further, if broader societal norms are more important than leadership expectations in shaping voter preferences, in contrast to the leadership role perspective, we expect Japanese voters to be more likely to prefer candidates who are more similar to the 'average' Japanese female, i.e., high-pitched and inexperienced in politics. For the same reason, they should least prefer low-pitched female candidates with more experience.

Finally, because male voters are typically more likely to value traditional gender roles, we expect Japanese male voters to prefer female candidates with high voice pitch than female voters.

Hence, we derive the following three hypotheses from the *societal norm perspective*:

H2-1: Japanese voters are more likely to prefer female candidates with higher voice pitch than those with lower pitch.
H2-2: Japanese voters are likely to most prefer high-pitched female candidates with little political experience and least prefer low-pitched female candidates with more experience.
H2-3: Japanese male voters more than female voters are more likely to prefer female candidates with higher voice pitch.

3. Research design

We conducted an original survey experiment in March 2021 upon approval by the Institutional Review Board of the University of Groningen. The sample was randomly drawn by a Japanese survey firm, *Rakuten Insight*, from their opt-in online panel, stratified on key demographic variables of age and residential locations.[5] We obtained responses from 414 respondents. As noted above, studies show voice pitch to be influenced by many factors such as one's height and weight (Fitch and Giedd, 1999), age (Pisanski *et al.*, 2018) as well as socio-cultural factors (Van Bezooijen, 1995). We thus follow most existing studies on the effects of voice pitch in using an experimental design, which allows us to isolate the effects of different voice pitch levels from other confounding factors. Because the experiment was conducted as part of another study, we over-sampled female respondents, and this will be accounted for in the analyses below. The English-language translation of the question wording for the items is provided in the Appendix, and the original Japanese-language version of the survey is available upon request. Table A.1 in the Appendix provides summary statistics for the respondents.

Because this survey involved listening to a voice recording, at the beginning of the survey, we asked the respondents to complete the survey in a quiet location, and, if they were not, they were given the option of terminating the survey. After asking a series of demographic questions, we randomly split the respondents into one of four treatment groups and asked them to listen to a recording of a speech by a female political candidate. Half of the respondents were informed that the speaker was a 45-year-old candidate who has been elected once, and the other half were told that the speaker was a 45-year-old candidate who has been elected five times. Half of the respondents were given the same speech at a

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[5]Because our study sought to examine the attitudes of the working-age population, we surveyed respondents between the ages of 20 and 50.

Table 1. Four treatment groups

		Voice pitch	
		Low	High
Experience	1 term	Inexperienced politician with low pitch ($N = 116$)	Inexperienced politician with high pitch ($N = 92$)
	5 terms	Experienced politician with low pitch ($N = 107$)	Experienced politician with high pitch ($N = 99$)

higher pitch, and the remaining half were given the same speech at a lower pitch, resulting in four treatment groups, as shown in Table 1.

We chose 45 years old as our experimental condition for several reasons. First, as noted earlier, women's voice pitch levels usually co-vary with age, with women typically speaking at lower pitch levels as they become older, so it would not be credible to provide high-pitched recordings of older women. Secondly, a younger candidate, say, aged 35, would not be credible to Japanese respondents, for legal reasons. Japanese law stipulates that citizens must be at least 25 before they can run for public office.[6] Although we did not specify whether this candidate was running for national or local office, a five-term candidate aged 35 running for the House of Representatives would have been elected for the first time when they were roughly 21, given that Japanese House of Representatives elections occur on average once every 2.8 years (Kawato, 2018). This would stretch credulity, since they would not have been legally eligible to run at that age. Japanese House of Councillors (Upper House) and local elections occur even less frequently, every 6 and 4 years, respectively, so a five-term candidate would have had to been elected for the first time when they were in their teens. Lastly, our 45-year-old hypothetical female candidate is not without precedent. In the House of Representatives, Yuko Obuchi, a member of the Liberal Democratic Party (LDP), was first elected to office when she was 26 and won her fifth term when she was 38; similarly, Seiko Noda, also of the LDP, first won office when she was 33 and her fifth term when she was 44. These are highly successful female politicians, but they suggest that our hypothetical scenario is certainly plausible.

We created two voice pitch levels, high and low. We constructed the two pitch levels by digitally manipulating the pitch track of a voice recording using Praat, a software program for linguistic analysis (Boersma and Weenink, 2021). We then randomly assigned one of the four conditions in Table 1 to respondents, which allows us to estimate the causal impact of our intervention. Note that as shown in Table A.2 in the Appendix, randomization was not successful for some of the covariates, owing to our small sample size.[7] Thus, in addition to *t*-tests, we provide regression results with covariates for all analyses to increase precision of our estimates. Following existing studies, we included the covariates of respondents' age, gender, education (college-educated or not), and income levels. The *Male voter* variable was coded 1 for male respondents and 0 for female respondents. The *College* variable was coded 1 for respondents who have a college degree or above and 0 otherwise. The *Age* variable denotes respondents' age. The *Income* variable consists of a categorical measure ranging from 0 (household income of below 2 million yen a year) to 5 (household income of more than 10 million yen a year).

The low-pitched recording was the original recording by the speaker, one of the members of the research team. The high-pitched version was 50 Hz higher than the original recording and fell between 180 and 380 Hz. This high-pitched version falls within a typical Japanese woman's normal pitch range (Imaida, 2006). After listening to the 45-second recording, respondents were asked whether or not

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[6]Public Offices Elections Act, Article 10.

[7]The use of block randomization may mitigate potential imbalances in covariates and increase efficiency for a small-N study (Horiuchi *et al.*, 2007; Gerber and Green, 2012).

they would vote for the candidate, assuming that the candidate was running in the respondents' electoral district for the party that the respondent supports.

The text of the speech was taken from an actual female candidate to increase the external validity of our findings but modified for length. The English-language translation of the speech excerpt is shown as follows, and the original Japanese-language text of the speech is available upon request.

> The Japanese population, which has steadily increased over 100 years since around 1900, will return to 1900 levels over the next 100 years. What kind of future can we create in an era of depopulation and super-aging that is proceeding now at unprecedented speed? We now stand at a turning point. It is also a turning point in politics. What remains for the next generation should not be a burden or debt but dreams and possibilities. I strongly hope that all children in Japan will feel that there is some hope for the future.

The issues of aging and children, which are the main issues discussed in this text, may be a valence issue, but welfare and child policies are also often considered to be 'female' issues (Ono and Yamada, 2020). This also justifies our focus on only female politicians in this paper. Still, it is also possible that female voters may be more concerned about aging and children's issues and thus prefer the speech more than their male counterparts. This point underscores the importance of examining within-gender variation in the impact of voice pitch on voting intentions.

Two further caveats are in order. First, with just 414 respondents, our analyses are generally under-powered.[8] Given the limited sample size, our analyses below focus on the effect of voice pitch and the interaction effect of voice pitch and respondents' gender, controlling for experience and other covariates. Second, because we did not pre-register our survey experiment prior to data collection, the following analyses chiefly focus on our three main variables of interest, i.e., voice pitch, political experience, and respondents' gender. Our analyses of the effects of respondents' education level, age, and income are largely exploratory.

4. Findings

First, we report the distribution of respondents who were willing to vote for the hypothetical candidate, by pitch level. Figure 1 shows that controlling for candidate experience, differences in pitch levels did not lead to systematic differences in voters' willingness to vote for that candidate. In total, 62.8% of respondents who were given the higher-pitched recording and 62.7% of respondents who were given the lower-pitched recording expressed willingness to vote for the candidate.

Model 1 of Table 2 confirms the initial exploration. All of the results shown use ordinary least squares models. Controlling for candidate experience, the effect of high voice pitch is negative but fails to reach statistical significance at the 10% level (model 3 includes respondents' covariates).[9] These results fail to lend support to either H1-1 or H2-1.

The results shown in Figure 1 also suggest the possibility of an interaction effect between politicians' voice pitch and political experience. Respondents exhibit the greatest willingness to vote for the low-pitched candidate with more political experience (i.e., five terms), while voters are also more willing to vote for inexperienced candidate with high voice pitch. The low-pitched candidate with one-term experience was the least preferred. These results appear to be more consistent with the leadership role perspective, especially H1-2, than the societal norm perspective, especially H2-2. However, models 2 and 4 of Table 2, which interact the voice treatment with the experience treatment, show that the interaction term between candidate voice pitch and experience fails to reach statistical significance at the 10% level.

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[8]When alpha is set at 0.05 and beta is at 0.8, a comparison between inexperienced and experienced politicians with lower voice is well powered. But other experimental comparisons are under-powered with the same specifications, and future research should use our study as a reference when calculating sufficient sample size.

[9]In addition to simple regression analyses without covariates, as a robustness check, we also report results controlling for respondents' gender, education, income, and age.
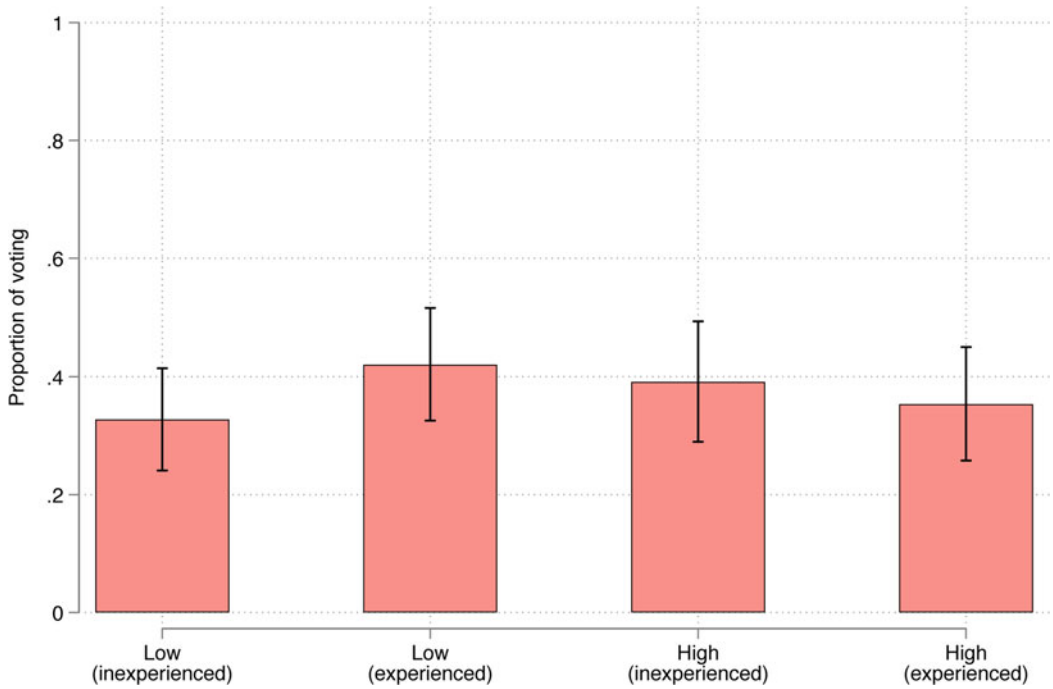
Figure 1. Percentage of respondents willing to vote for the candidate, by treatment group.
Note: N = 414.

Table 2. Regression analysis by treatment groups

	(1)	(2)	(3)	(4)
High voice	−0.002	0.064	−0.001	0.058
	(0.048)	(0.068)	(0.050)	(0.072)
Experienced	0.033	0.093	0.022	0.077
	(0.048)	(0.065)	(0.050)	(0.070)
High voice × experienced		−0.131		−0.117
		(0.096)		(0.101)
Male voter			0.163***	0.170***
			(0.063)	(0.063)
College			0.020	0.018
			(0.052)	(0.052)
Age			−0.063	−0.070
			(0.103)	(0.103)
Income			0.007	0.003
			(0.024)	(0.025)
Constant	0.357***	0.328***	0.342***	0.323***
	(0.040)	(0.045)	(0.077)	(0.078)
Observations	414	414	376	376

Standard errors in parentheses.
*$P < 0.10$, **$P < 0.05$, ***$P < 0.01$.

We now examine the extent to which respondent characteristics condition the effects of our experimental variables. Table 3 reports the results.

First, the leadership role perspective had led us to expect female voters to prefer female candidates with low voice pitch more than male voters (H1-3), while the societal norms perspective suggests that male voters prefer high-pitched female candidates more than female voters (H2-3). Table 3 and Figure 2 show that

Table 3. Regression analysis by respondents' covariates

	(1)	(2)	(3)	(4)
High voice	0.041	0.087	0.095	0.071
	(0.058)	(0.073)	(0.129)	(0.070)
Experienced	0.022	0.017	0.019	0.013
	(0.050)	(0.050)	(0.050)	(0.051)
High voice × male voter	−0.162			
	(0.113)			
High voice × college		−0.168*		
		(0.100)		
High voice × age			−0.162	
			(0.202)	
High voice × income				−0.065
				(0.043)
Male voter	0.244***	0.159**	0.167***	0.161**
	(0.084)	(0.063)	(0.063)	(0.063)
College	0.017	0.102	0.022	0.015
	(0.052)	(0.071)	(0.052)	(0.052)
Age	−0.059	−0.053	0.010	−0.071
	(0.103)	(0.103)	(0.137)	(0.103)
Income	0.007	0.006	0.005	0.043
	(0.024)	(0.024)	(0.024)	(0.034)
Constant	0.320***	0.300***	0.301***	0.316***
	(0.078)	(0.080)	(0.092)	(0.078)
Observations	376	376	376	376

Standard errors in parentheses.
*$P < 0.10$, **$P < 0.05$, ***$P < 0.01$.

neither hypothesis is supported. However, although the interaction term between voice pitch and respondent gender in model 1 of Table 3 fails to reach statistical significance at the 10% level, Figure 2, which shows the marginal effect of voice pitch by respondents' gender controlling for other covariates and candidates' experience based on model 1 of Table 3, reveals that male voters in fact prefer low-pitched female candidates more than female voters ($X_{MaleLow} = 0.547$, S.D. $= 0.502$ vs $X_{FemaleLow} = 0.317$, S.D. $= 0.466$).[10] The figure also shows that Japanese women are largely indifferent to candidate voice pitch levels, whereas male voters prefer lower-pitched female candidates more than higher-pitched. These results suggest that different mechanisms may be at work for male and female voters, with male voters being more influenced by candidate's authoritative qualities.

We also conduct several exploratory analyses using respondents' other covariates: college education, age, and income. Model 2 of Table A.2 in the Appendix shows that the interaction between candidates' voice and respondents' college education is statistically significant at the 10% level, but Figure A.2 in the Appendix shows the interaction term exerts limited impact over candidate choice. Models 3 and 4 of Table 3 fail to find support for the view that the interaction term between candidates' voice and respondents' age and income level, respectively, affects voters' preferences. Older voters typically harbor stronger prejudices than younger voters (Von Hippel *et al.*, 2000; Gonsalkorale *et al.*, 2009), thus making them more likely to support candidates who conform to traditional gender roles. But we find that respondents' age does not affect the likelihood of supporting candidates with different pitch levels. The null finding may be driven by the fact that our sample only includes respondents who are aged between 20 and 50. Future research should explore whether including older respondents would change the results. We also explore the interaction effect between political experience and respondents' gender. Note here again that due to limited sample size, our analyses should be interpreted with caution. But none reached statistical significance at the 10% level. These findings fail to support either the

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[10]Figure A.1 in the Appendix also reports means and standard deviations by the four groups. Adjusting for multiple comparisons (using Bonferroni methods) does not affect the main results. The use of a triple interaction model (i.e., voice pitch × experience × respondents' gender) also yields similar results (Table A.3 in the Appendix).
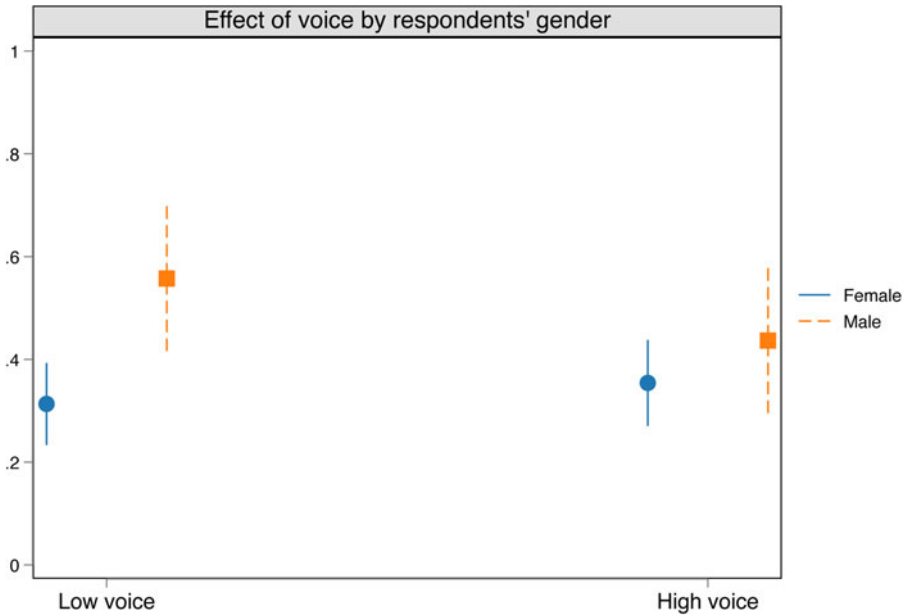
Figure 2. Marginal effect of candidates' voice pitch by respondents' gender.
Note: The figure is generated using results from model 1 of Table 3.

leadership role perspective or the societal norms perspective. Lastly, we note that male respondents are considerably more likely to vote for any of the four candidates compared to female respondents (models 1–4 of Table 3).

In sum, our results offer limited support for either the leadership role perspective or the societal norm perspective. They confirm our broader theoretical expectation of significant interaction effects among the two variables of candidates' voice pitch and respondents' gender, but in a different direction from we had expected in H1-3 and H2-3; males more than females preferred female candidates with lower pitch. Although our results are consistent with previous studies that have been conducted in Japan and other countries that men are more willing to support low-pitched female candidates than high-pitched female candidates, our finding that male voters would be *more* willing to do so than female voters presents a puzzle that deserves further exploration in future studies.

5. Discussion

Politicians' voice pitch is known to affect voters' assessment of politicians. The case of Japan offers a window into examining the generalizability of the findings of earlier studies, as well as heterogeneity in the effects.

Our findings push the literature forward by expanding the geographical scope to Japan, a society in which traditional gender stereotypes are stronger than in the US, where most studies on the effects of voice pitch have been conducted. We found that in contrast to earlier findings by Banai et al. (2018), Banai *et al.* (2017) and Okada (2016) that voters, regardless of gender, prefer low-pitched female candidates, Japan's female voters are indifferent to female politicians' voice pitch; only male voters in Japan preferred lower-pitched female politicians than higher-pitched. These findings suggest that different mechanisms may drive women and men's responses to female candidates' voice pitch. Male voters, on the one hand, may look for candidates who sound more professional or authoritative. Japanese women, on the other hand, might care more about substantive issues rather than physical traits such as voice pitch; or, they may not view voice pitch as a proxy for candidate quality at all.

Why the mechanisms may differ in Japan, as well as the broader generalizability of our findings, presents a fruitful avenue for future research.

We also found limited evidence that political experience conditions the effect of voice pitch. Voters' preferences for low-pitched or high-pitched female candidates were little affected by their knowledge that the candidate had more or less political experience. Although studies have found voters to view voice pitch as a signal for experience, our findings suggest that at least for Japan's male voters, voice pitch signals something other than experience, possibly authoritativeness and/or leadership capacity. Future work should further disentangle the effects of pitch itself from these other qualities.

Our findings are also revealing because they point to a dilemma for women who aspire to political careers. Heterosexual female candidates may face a trade-off between appealing to male voters and remaining attractive to their partners as they gain in political experience. Studies suggest that men typically find higher-pitched women to be more 'attractive,' whether in the US (Feinberg *et al.*, 2008; Puts *et al.*, 2011), or Japan (Oguchi and Kikuchi, 1997). For women, lowering pitch in order to improve electoral prospects may come at the cost of 'attractiveness.' If women are aware of this dilemma, they may refrain from running for office in the first place. Our study thus adds to the growing body of work that point to subtler forms of bias, rather than outright discrimination *per se*, that leads to female under-representation.

Finally, we point to at least two directions for future research. First, our results are likely to be conditioned by the information environment. Studies show that subtle cues such as voice pitch are more effective in changing voters' perceptions when information about politicians is not available (Klofstad, 2017). Accordingly, the effect of voice pitch may be more important in low information environments when voters have only limited information on political candidates. The combined effects of greater information on the candidates, including their policy positions or personal backgrounds, and voice pitch, present a fruitful avenue for further inquiry.

Second, even if male voters prefer female politicians with *low* voice pitch, there is likely to be a limit. Studies show that when individuals' voice pitch is perceived as being unnaturally low or unnaturally high, there is a backlash effect (Fraccaro *et al.*, 2013; Levon and Ye, 2020), and the listener ceases to view the speaker in a positive light. These findings are consistent with the societal norm perspective. In the present study, we used the 130–330 Hz pitch range for our low-pitched treatment, yet whether, and at which point, low pitch provokes voter backlash against political candidates in Japan and other countries also deserves exploration in future studies.

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