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LETTER

Legislators' Emotional Engagement with Women's Issues: Gendered Patterns of Vocal Pitch in the German Bundestag

Oliver Rittmann

School of Social Sciences, University of Mannheim, Mannheim, Germany
Email: orittman@mail.uni-mannheim.de

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Abstract

Through an innovative analysis of audio recordings of plenary speeches, Dietrich, Hayes, and O'Brien (2019) find that women in the U.S. House of Representatives speak with greater emotional intensity about women than other issues. With vocal pitch as a new measure of personal issue commitment, the finding suggests that women legislators' efforts to work on behalf of women result from intrinsic motivation. I ask whether the same is true in an alternative parliamentary setting, the German Bundestag, where personal preferences play a very different role due to strict party discipline. The answer is yes. Analyzing audio and text data from more than 30,000 speeches in the Bundestag between 2011 and 2020, I find that women in the Bundestag address women more frequently and with greater emotional intensity than men. The results suggest that women legislators are more emotionally invested in women-related issues than men.

Keywords: Women's representation; parliamentary debate; audio data; vocal pitch; emotional speech

A precondition for the link between women's descriptive and substantive representation is that women, once elected to parliament, act on behalf of women. For that to hold true, women legislators must be more committed to women's issues than men. Yet, studying whether individual representatives are intrinsically committed to specific issues is difficult if it is based only on observing their behaviour in parliament. Legislators' behaviour is influenced by what they internally care about and external factors such as party pressure or strategic considerations. This challenges the empirical study of individual issue commitment and the micro-foundations of the link between descriptive and substantive representation.

Dietrich, Hayes, and O'Brien (2019) analyze a large body of audio recordings of congressional speeches in the U.S. House of Representatives (the House) to make progress on this frontier. Other than previous studies that focus on the content of legislative speech (for example, Pearson and Dancey 2011), they use audio recordings to analyze the emotional intensity of legislators' voices during their speeches. This is valuable because a legislator's voice transmits information about their emotional engagement with the issues being discussed. Dietrich, Hayes, and O'Brien (2019) argue that this is a credible indicator of legislators' issue commitment. They show that women politicians are more likely than men to talk about women and do so with greater emotional intensity. Through its innovative use of audio recordings for analyzing parliamentary speech, the study represents a significant step forward for research on the link between women's descriptive and substantive representation. Specifically, it provides convincing empirical

evidence that women in the House are more emotionally committed to women-related issues than men representatives – providing cause for optimism for those who believe that increasing numbers of women in parliaments eventually fosters their substantive representation (Campbell, Childs, and Lovenduski 2010; Phillips 1995).[1]

On a more critical note, the study by Dietrich, Hayes, and O'Brien (2019) is based on one case, the House of Representatives. This poses the question of whether the findings generalize beyond the House. Here, I examine whether the central results by Dietrich, Hayes, and O'Brien (2019) – that is, women speak more and with higher emotional intensity about women's issues – replicate in a different context, the German Bundestag (Bundestag). The Bundestag is a valuable second test case because it substantially differs from the United States case along dimensions critical for the findings' generalizability: incentives to cultivate a personal vote, party discipline, and the countries' histories of women's political representation.

The results support the generalizability of the initial study's findings: analyzing audio recordings of more than 30,000 plenary speeches between 2011 and 2020, I show that women representatives in the Bundestag speak more often and with greater emotional intensity about women's issues. Even more, the estimated magnitudes of those differences are remarkably close to those in the United States. Thus, the results suggest that women legislators are more emotionally invested in women's issues and that this is true irrespective of the contrastive institutional settings and the parliamentary cultures in the House and the Bundestag.

My findings add to our knowledge about gendered differences in legislators' communication styles (Hargrave and Blumenau 2022). Moreover, the results complement recent studies using audio and video data to trace gendered differences in politicians' non-verbal communication in parliament (Dietrich, Hayes, and O'Brien 2019) and during campaigns (Boussalis et al. 2021; Neumann, Franklin Fowler, and Ridout 2022). Finally, the study also adds to a broader development in political science research, which recognizes the value of audio data for studying non-verbal elements of political speech (Dietrich, Enos, and Sen 2019a; Knox and Lucas 2021).

The Dietrich, Hayes, and O'Brien (2019) Study

In their paper '*Pitch Perfect: Vocal Pitch and the Emotional Intensity of Congressional Speech*', Dietrich, Hayes, and O'Brien (2019) use audio recordings of more than 70,000 floor speeches in the House to examine whether women representatives speak more emotionally when they refer to women than when they talk about other issues and whether this differentiates them from men representatives. The study departs from the basic recognition that the content of a speech is not exclusively transmitted in terms of its verbal content but also by the tonality of the voice. While verbal content can be represented in text, vocal tone conveys a speech's affective content (Gobl and Ní Chasaide 2010). Building on research traditions in other disciplines (see, for example, Mauss and Robinson 2009), the study introduces variation in vocal pitch as a measure of the emotional intensity of a speech, where a higher vocal pitch indicates increased emotional activation.

One advantage of this measurement rests on the argument that variation in vocal pitch is more informative about the speaker's emotional state than the mere content of the speech. Variation in vocal pitch, the argument goes, is the consequence of a physiological reaction to an emotionally aroused state of the speaker and is difficult to control. As such, it is a 'more honest indicator' of the speaker's emotional engagement with the issue. As a result, it offers more credible information about legislators' intrinsic issue commitment than traditional measures based on voting records or the pure content of speech.[2]

[1]It is important to emphasize that fostered 'substantive representation' of women does not guarantee greater feminist substantive representation: progressive women may speak more emotionally about women-related issues while taking feminist positions, but conservative women may do so while explicitly taking anti-feminist positions (Celis and Childs 2012).

[2]I offer a discussion about the scope of this argument in the discussion section at the end of this paper.

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Dietrich, Hayes, and O'Brien (2019) present three main results. First, women in the House reference women in their speeches more often than men. Second, on average, women talk about women with greater emotional intensity than they do about other issues. Third, men are, on average, not more emotionally activated when they talk about women than when they talk about other issues.

U.S. House of Representatives and the German Bundestag

The leading question of this paper is whether the main three findings by Dietrich, Hayes, and O'Brien (2019) – women in the House speak more and with greater emotional intensity about women, but men do not – hold in an alternative parliamentary setting, the Bundestag. I outline three threats to the replicability of the findings in alternative contexts and explain why the Bundestag is a valuable replication case to learn about the validity of those threats. Differences along three dimensions substantiate this claim: incentives to cultivate a personal vote, party discipline, and the countries' histories of women's political representation.

The first threat stems from the possibility that, contrary to the argument by Dietrich, Hayes, and O'Brien (2019), women do not speak at a higher vocal pitch because they care about women-related issues but because they think that signaling emotional commitment helps them cultivate a personal vote. Crucially, legislators in the Bundestag have much fewer incentives to cultivate a personal vote than legislators in the House because their re-election does not exclusively depend on winning a district vote (Carey and Shugart 1995). If legislators speak emotionally to secure their re-election, we would expect legislators in the Bundestag to primarily deliver emotionally activated speeches about women-related issues if this is in line with the overall agenda of their party. Legislators in the United States only do so if such speeches are to their personal electoral benefit. The two mechanisms are unlikely to lead to similar empirical patterns in both parliaments.

The second threat presupposes that the original argument about issue commitment is valid but unfolds only under conducive institutional settings. Women in other parliaments may be as emotionally committed to women-related issues as those in the House. However, context-specific hindrances absent in the House may prevent them from expressing this commitment on the plenary floor. The Bundestag is useful to test the validity of this argument due to its extraordinarily high party discipline, contrasting the comparably low levels of party discipline in the House. This difference becomes apparent concerning party unity of legislative voting (Carey 2007; Sieberer et al. 2020) but also manifests itself during parliamentary debates. Previous research shows that party group leaders in Germany preserve party unity by giving less floor time to legislators with views distant from the party leadership (Proksch and Slapin 2012). Thus, if women legislators express their emotional issue commitment to women-related issues only in the absence of institutional hindrances, then party discipline in the Bundestag could constitute one such hindrance – causing the results from the Bundestag to differ from those in the House.

The third threat builds on the notion that the findings by Dietrich, Hayes, and O'Brien (2019) are closely tied to the history and state of women's political representation in the United States. The trajectory of women's representation in political offices in Germany differs significantly. Over the past decades, substantially higher shares of women have been elected to the German Bundestag than the House (see Appendix A for an overview). With Angela Merkel, Germany has a sixteen-year-long era with a woman in the highest political office. Previous research demonstrates that higher numbers of women in deliberative bodies come with changes in the dynamics of political debates (Ban et al. 2022; Blumenau 2021). Thus, differences in women's representation constitute another reason why the findings by Dietrich, Hayes, and O'Brien (2019) may not hold in the Bundestag.

Data and Measurement

Assessing legislators' vocal pitch when talking in parliament rests on analyzing audio recordings of parliamentary debates. The Bundestag maintains an online archive,

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www.bundestag.de/mediathek, with video recordings of plenary debates since 2011. I downloaded the audio recordings of all plenary speeches between February 2011 and July 2020, which resulted in a data set comprising 4,542 h of audio recordings of more than 50,000 speeches.

I matched these audio files with transcribed text to determine whether legislators mentioned women in their speeches. I acquired text data from two sources. The first source was the ParlSpeech V2 data set, containing full-text corpora of speeches in the Bundestag between 1991 and the end of 2018 (Rauh and Schwalbach 2020). For the period after 2018, I relied on plenary protocols, which can be downloaded from the Bundestag homepage. Following the approach by Dietrich, Hayes, and O'Brien (2019), I excluded speeches with fewer than fifty words. I also excluded all procedural speeches by the chair. The final sample comprises audio and text data from 33,514 parliamentary speeches. The left panel of Fig. 1 shows the number of speeches per month in the data set between 2011 and 2020.

Notably, the number of Bundestag speeches is less than half that of the House speeches used by Dietrich, Hayes, and O'Brien (2019). Nevertheless, a power approximation in the online appendix (A3) shows that the replication study is still sufficiently powered, with statistical power ranging between 79 and 99 per cent, depending on the estimand ($\alpha = 0.05$).

All measurements follow the Dietrich, Hayes, and O'Brien (2019) measurement strategy. There are two key variables: whether a legislator mentions women in a speech and the emotional intensity of that speech. To measure emotional intensity, I extract the mean fundamental frequency from the audio recording of each speech. The mean fundamental frequency quantifies the average vocal pitch of a speech and can be extracted from audio files using the open-source software `Praat` (Boersma and Weenik 2021). This software requires users to pre-specify pitch floor and pitch ceiling parameters. Following Dietrich, Hayes, and O'Brien (2019) and the `Praat` suggested settings, I set the floor and ceiling parameters to 100 and 500 Hz for women and 75 and 300 Hz for men. Because there is systematic variation in the voice pitch between speakers – some legislators generally speak at a higher or lower pitch than others – this measure is rescaled to reflect standard deviations from a speaker's average pitch.

Dietrich, Hayes, and O'Brien (2019) rely on a dictionary approach previously developed by Pearson and Dancey (2011) to identify whether a speaker mentions women in their speech. Their dictionary contains women-related terms. To apply the dictionary to the German text, I translated and adapted the dictionary. The original dictionary and the translated version are documented in the online appendix (E), together with evidence indicating that the dictionaries detect speeches about women similarly well in both languages. The variable 'women mentioned' indicates whether a speaker used at least one of the words listed in the translated dictionary during a speech.

Results

The analysis comprises two inquiries. First, do women legislators in the Bundestag address women more frequently than male legislators? Second, do they do so with greater emotional intensity than men, and compared to themselves when they do not address women? To begin, I examine how often men and women in the Bundestag mention women in their speeches. The right panel of Fig. 1 shows the frequency with which men and women in the Bundestag use at least one of the dictionary terms in their speeches over time. On average, women talk more frequently about women than men do, and this difference is stable over time. In total, women in the Bundestag use one of the dictionary terms in 21.81 per cent of their speeches (2,426 of 11,122), but men do so in only 11.20 per cent (2,508 of 22,392). This is very much in line with the results from the House, where Congresswomen use one of the dictionary terms in 17.82 per cent of their speeches, while Congressmen do so in 9.08 per cent of theirs.

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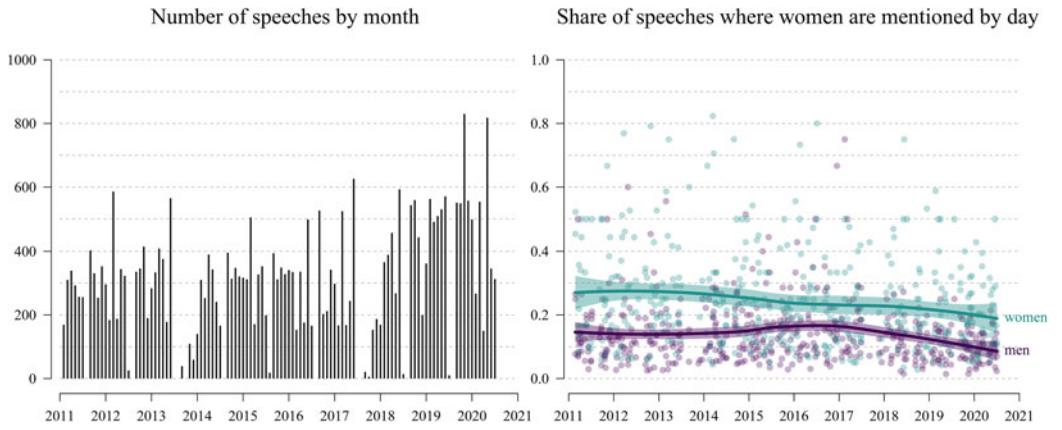

Figure 1. The left panel shows the number of speeches in the German Bundestag by month. The right panel shows the share of speeches by men and women legislators where women are mentioned by day. Trend lines for men and women are based on local polynomial regressions with 95 per cent confidence intervals.

I further validate this result with a logistic multi-level regression model with varying intercepts on the legislator level. The dependent variable indicates whether a given floor speech mentions at least one of the 'women' dictionary terms. The independent variable indicates whether a woman gave the floor speech. Table 1 shows the results from the Bundestag alongside the results of Dietrich, Hayes, and O'Brien (2019) from the House. Confirming the results from above, the estimates indicate that women in both parliaments are more likely to address women in their speeches than men. Figure 2 shows that the difference in predicted probabilities between men and women to mention women in their speeches is 10.12 percentage points in the Bundestag and 9.25 percentage points in the House.

Having confirmed the baseline result, namely that women in the Bundestag address women in their speeches more frequently than their male colleagues, I now assess whether they are more emotionally activated when they address women. I employ linear fixed effects regression models to estimate differences in emotional intensity between men and women when speaking about women or other issues. The dependent variable is the average vocal pitch during a speech (z-standardized by the legislator). As independent variables, I include a variable that indicates whether a given speech mentions at least one of the 'women' dictionary terms and a variable that indicates whether a woman legislator gave the speech. The model further includes a multiplicative interaction term between the two variables to test whether only women but not men speak with greater emotional intensity when they talk about women than when they talk about other issues. The model also includes fixed effects for each legislator in the data set. The modeling strategy differs from the model choice by Dietrich, Hayes, and O'Brien (2019) in one aspect. Their analysis relies on multi-level (random effects) models with varying intercepts for legislators, while I include legislator fixed effects. I argue that this is the more appropriate and conservative modeling approach. Because the dependent variable is z-standardized, all legislator-specific means are zero by definition. Consequently, all random effects in the multi-level models are zero, and the estimated effect coefficients are identical to those of a fully pooled linear regression estimated by OLS. Thus, to estimate legislator-specific intercepts, fixed effects are necessary. It is important to emphasize that this alternation of the modeling strategy does not meaningfully change any of the results by Dietrich, Hayes, and O'Brien (2019).

The left table in Fig. 3 reports the results of the fixed effects regression models for the House and the Bundestag. Higher values of the dependent variable (variation in vocal pitch) indicate that the legislator speaks with higher emotional intensity. The main interest focuses on the

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Table 1. Regression coefficients of logistic multi-level models, standard errors in parentheses

	U.S. House	Bundestag
Intercept	−2.427*	−2.452*
	(0.035)	(0.050)
Women speaker	0.866*	0.938*
	(0.078)	(0.078)
AIC	47,825.407	25,389.222
BIC	47,853.049	25,414.481
Log likelihood	−23,909.704	−12,691.611
N	74,151	33,514
N(Legislators)	619	1,153
Var: Legislators (Intercepts)	0.399	1.033

Note: The dependent variable is whether a speech mentioned one of the 'Women'-dictionary terms. The results show that women in the United States and Germany are more likely to talk about women.
Multi-Level Models with varying intercepts on the legislator level. *p < 0.05.

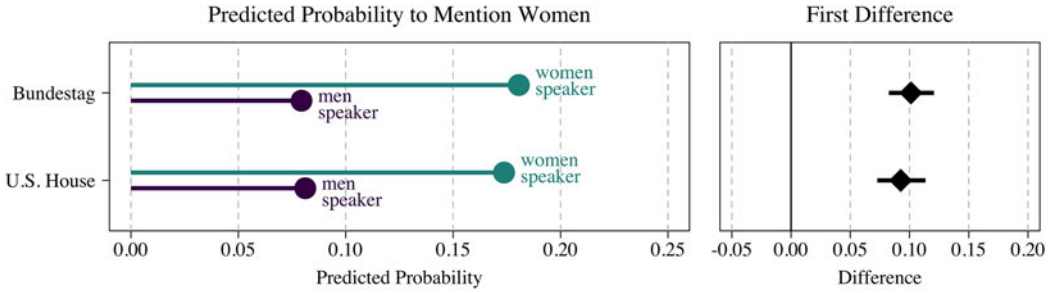

Figure 2. Predicted Probabilities of men and women in the Bundestag and the U.S. House of Representatives to mention 'women' in plenary speeches based on the models in Table 1 (left) and differences between women's and men's probabilities (right).

marginal effect coefficients of mentioning women depicted in the right panel of Fig. 3. In line with the results by Dietrich, Hayes, and O'Brien (2019) in the House, these indicate that, on average, women in the Bundestag are more emotionally activated when talking about women than when talking about other issues. When women use one of the dictionary terms, their vocal pitch is, on average, 0.089 standard deviations higher than when they talk about other issues.[3] The same does not hold for men. When men in the Bundestag speak about women, their vocal pitch heightens on average by only 0.016 standard deviations (SE = 0.022), and this coefficient is not distinguishable from zero at conventional levels of significance. This confirms the finding by Dietrich, Hayes, and O'Brien (2019) in a contrastive case. The differences in emotional voice activation between men and women in both parliaments align in terms of their direction and their magnitude. The right panel of Fig. 3 substantiates this claim, showing that the marginal effect coefficients of mentioning women are similar in the House and the Bundestag.

Discussion

In empirical political science, universally interesting questions are often studied within single contexts. An important question related to evidence generated by such studies concerns the

[3]Note that the independent variables do not explain substantial amounts of within-speaker variation of vocal pitch. This is not surprising because variation in emotional intensity has many sources. Adj. R^2-values are negative due to the inclusion of legislator fixed effects after eliminating between-speaker variation through the z-standardization of vocal pitch by legislators.

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	U.S. House	Bundestag
"Women" mentioned	0.021	0.016
	(0.015)	(0.022)
"Women" mentioned	0.094*	0.073*
× Women Speaker	(0.028)	(0.034)
R^2	0.000	0.000
Adj. R^2	−0.008	−0.035
Num. obs.	71198	33489

Legislator Fixed-Effects Models. $^*p < 0.05$.

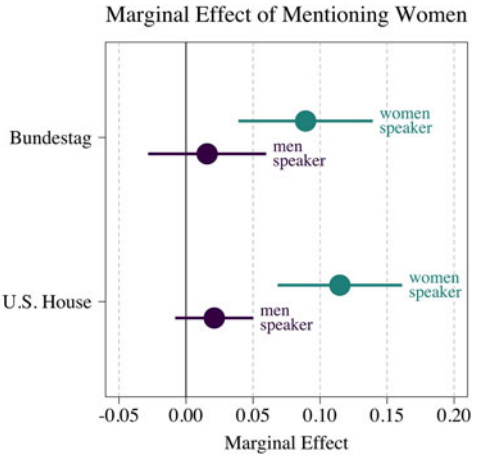

Figure 3. Estimation results of linear regression models. The dependent variable is the average vocal pitch of a speech (*z*-standardized by the legislator). The results show that women in the United States and Germany speak more emotionally about women than other issues, but men do not.

findings' external validity (Egami and Hartman 2022). Replication – conducting the same study in a different context – is essential for learning about scientific knowledge's scope conditions.

Here, I present replication results of an important study by Dietrich, Hayes, and O'Brien (2019) on the link between women's descriptive and substantive representation in the House. The original study analyzes audio recordings of legislative speeches in the House to show that women legislators in the United States speak more often about women-related issues than men and do so with greater emotional intensity. The replication study asks whether the same results hold in the Bundestag, a parliament that differs in many critical dimensions from the House.

Three reasons make the original study worth replicating. First, questions about the link between women's descriptive and substantive representation are not specific to the United States context. We are equally interested in whether the same links hold in other parliaments. Second, it is unclear whether women legislators express the same emotional commitment to women-related issues in environments where they face fewer incentives to cultivate a personal vote and higher party discipline and are surrounded by more women within parliament. A failure to successfully replicate the results in the Bundestag would indicate that the results reported by Dietrich, Hayes, and O'Brien (2019) may be restricted to the legislative environment of the House. Third, the study by Dietrich, Hayes, and O'Brien (2019) is one of the first in political science to quantitatively analyse audio data to study political speech. As this methodology grows in popularity, replication is particularly useful in establishing trust in these new methods.

The replication confirms the results by Dietrich, Hayes, and O'Brien (2019): women legislators in the German Bundestag speak more often and with higher emotional intensity on women-related issues. The results of both studies are remarkably similar, especially in light of the stark differences between the House and the Bundestag. With variation in vocal pitch as a new measure of personal issue commitment that is less affected by extrinsic considerations than the content of speeches, the interplay of both findings advances our understanding of how women's social identity shapes issue commitment across different institutional settings.

This study remains subject to limitations. First, it is important to emphasize the scope conditions of the vocal pitch as an 'honest' measurement of legislators' internal emotional state. This interpretation of vocal pitch rests on the argument that heightened vocal pitch results from automatic physiological responses to emotional arousal. For example, emotional activation increases muscle tension, including the tension of muscles involved in voice production, which raises the vocal pitch (Scherer

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1986, 152). Whenever such physiological reactions are the source of vocal pitch variation, pitch is an honest indicator of legislators' level of emotional arousal on the floor. However, humans can also deliberately speak in an emotionally aroused tone. Studies investigating the relationship between vocal pitch and emotional arousal based on spoken utterances produced by professional actors provide evidence for this notion (Banse and Scherer 1996). While it holds true that vocal pitch is more difficult to control than verbal content, this means that (with vocal pitch) we cannot be sure whether we measure honest emotional activation or the signaling of emotional activation.

Second, even though the study increases our confidence with which we may believe that the results by Dietrich, Hayes, and O'Brien (2019) generalize to other parliaments, we must remain careful when applying the finding to different contexts and acknowledge the scope conditions. The two cases are contrastive concerning many critical dimensions, but they also share similarities: both parliaments are embedded in Western, educated, industrialized, rich, and democratic societies. As such, the results are likely to be informative for parliaments in societies that share those attributes, but they may carry little information for parliaments in societies that do not share them (Henrich, Heine, and Norenzayan 2010).

Finally, the limits of using vocal pitch variation as a measure of emotional intensity across languages should be acknowledged. The fact that variation in vocal pitch carries information about the speaker's emotional state is principally independent of the spoken language. However, it is crucial to differentiate between tonal and non-tonal languages. Like most Indo-European languages, English and German are non-tonal languages where variation in vocal pitch conveys information about the speaker's emotional state but does not change the meaning of words.[4] On the other hand, pitch variation also encodes lexical information in tonal languages, such as Mandarin Chinese and many other languages in East Asia and Africa. Here, the same sound can have different meanings depending on pitch modulation. Variation in vocal pitch is thus a much less straightforward measure of emotional intensity in tonal languages than in non-tonal languages (Scherer, Johnstone, and Klasmeyer 2003).

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Data availability statement. Replication Data for this article can be found in Harvard Dataverse at: https://doi.org/10.7910/DVN/PAE6GB.

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[4]See Haspelmath et al. (2005, 13) for a global overview of tonal and non-tonal languages.

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