Pitch Perfect: Vocal Pitch and the Emotional Intensity of Congressional Speech on Women*

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Abstract

In this paper we argue that legislative speech can reveal how emotionally invested legislators are in an issue area. We construct a novel measure of speakers' emotional intensity—small changes in vocal pitch that are difficult to control. To examine the causes and consequences of emotionally intense speech, we focus on House members' speech on behalf of women. Using the text and audio from nearly 75,000 floor speeches in the U.S. House of Representatives, we first show that female members of Congress are not only more likely to talk about women, but that they do so with heightened vocal pitch. This suggests that women are sincerely committed to this issue area. We further demonstrate that women's emotionally intense speech affects male legislators' behavior. More female speech, delivered with greater intensity, is associated with a corresponding increase in the amount and intensity of male speech. To establish whether this reflects a positive or negative response, we show that male legislators who spoke in response to women were at least as (if not more) likely to vote with those female legislators. This provides some cause for optimism about the power of emotionally intense legislative speech.

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Scholars have long analyzed the content of legislative speech for clues about members of Congress's (MC) electoral, policy, and ideological motivations. Lawmakers devote significant time to their participation on the floor (Hall, 1998), and they use floor speeches to further their re-election goals and affect policy debates (Hill and Hurley, 2002; Maltzman and Sigelman, 1996). Beginning with Mayhew (1974), researchers have used legislative speech as an indicator of position-taking, making what MCs say during debates particularly useful for understanding their underlying ideology and policy positions (Benoit, Schwarz and Traber, 2012; Diermeier et al., 2012). Despite this longstanding focus on verbal communication in congressional scholarship, existing work neglects an important component of speech: emotional intensity.

In this paper we focus on the non-verbal content of legislators' speech as a measure of MCs' emotional intensity on policy issues. We use a novel measure—minor changes in vocal pitch that are difficult for individuals to control—to capture MCs' emotional intensity. We argue that this emotional intensity can arise intrinsically, from lawmaker' sincere commitments to an issue. Vocal pitch not only informs us about the sincerity of speech, it also has important consequences for other legislators' responses to that speech. Because of emotional contagion, emotionally intense speech can encourage other MCs' to speak more, and with more intensity, on an issue. We thus use vocal pitch to more fully understand what gives speech its power or authority.

To develop and test our arguments, we examine female House members' speech on behalf of women. Speech is especially meaningful for traditionally underrepresented groups, and facilitates the link between numeric (or descriptive) and policy (or substantive) representation. Whether it is talking more about women (Pearson and Dancey, 2011*b*) or "women's issues" (Gerrity, Osborn and Mendez, 2007; Osborn and Mendez, 2010), scholars have consistently shown that female representatives are more likely to elevate the voice of women both within (Pearson and Dancey, 2011*a*) and beyond the halls of government (Herrnson, Lay and Stokes, 2003). Because female MCs have a demonstrated commitment to representing

women, this issue area serves as an ideal case for examining whether this commitment is also reflected in the emotional intensity of legislators' speech. It also allows us to establish if lawmakers respond (positively or negatively) to their colleagues' emotional intensity—in this case whether, and in what ways, male MCs respond to female legislators' speech with their own speech and voting behavior.

In the sections that follow we first introduce vocal pitch as a measure of underlying emotional intensity. Focusing on women's representation, we hypothesize about female lawmakers' speech on behalf of women and male legislators' responses to the amount and intensity of this speech. To test our claims about female lawmakers' speech and its effects, we draw on text and audio from nearly 75,000 floor speeches given between 2009 and 2014. We use the text to determine whether a representative is talking about women and the audio to capture the emotional intensity of the speech—as measured by subtle changes in the lawmaker's vocal pitch. As compared to other topics, we find that female MCs are especially intense when talking about women. As the amount and intensity of this speech increases, moreover, Congressmen respond by talking more (and more intensely) about women. We then explore whether male legislators' increased intensity reflects a positive or negative reaction to female lawmakers. Despite concerns about backlash effects, we find that male legislators respond favorably to women's speech. When female MCs deliver more speeches with greater emotional intensity, this increases the likelihood that male members of Congress—particularly Republicans—vote with women. These results have important implications for research on women's political representation in particular and the study of Congress more broadly.

1 Verbal and Non-Verbal Content of Legislative Speech

Existing scholarship has leveraged many forms of Congressional behavior to draw inferences about legislators' ideologies (Poole and Rosenthal, 1985; Clinton, Jackman and Rivers, 2004; Poole and Rosenthal, 2001) and issue attention (Burden, 2007; Jones, Larsen-Price and Wilkerson, 2009; Sulkin, 2005; Woon, 2009; Hayes, Hibbing and Sulkin, 2010). Although these

studies provide insight into lawmakers' behaviors, they are limited in important ways. Roll call voting, for example, is largely constrained by party (Snyder and Groseclose, 2000). Bill sponsorship is not only time consuming, but also influenced by factors not easily controlled by legislators, such as staff size, seniority, and committee assignments (Schiller, 1995). As a result, it is difficult to determine the issues to which MCs are sincerely committed, versus issue activities that are the result of party influence, constituency pressures, or institutional barriers.

We argue that legislative speech can be leveraged to gain a deeper understanding of MCs' policy commitments. Choosing to speak on the House floor is traditionally seen as position-taking (Mayhew, 1974), and the verbal content of floor speeches has been used to estimate legislators' ideologies (Diermeier et al., 2012). Yet, floor speeches offer more than just ideological positions. The non-verbal content of a legislator's speech—in particular, her vocal pitch—captures her emotional intensity about the issue. It is not simply what legislators say that matters, but also how they say it.

Though understudied within legislatures, the non-verbal elements of speech have clear political ramifications. A growing body of work demonstrates that vocal pitch affects evaluations of candidates (Anderson and Klofstad, 2012; Anderson et al., 2014; Klofstad, Anderson and Peters, 2012; Klofstad, Anderson and Nowicki, 2015; Klofstad, 2016). Experimental work by Anderson et al. (2014) shows, for example, that "young adult female voices exhibiting vocal fry are perceived as less competent, less educated, less trustworthy, less attractive, and less hireable" (5). Similar results were found by Klofstad, Anderson and Peters (2012), who artificially manipulated the vocal pitch of sound recordings, ultimately demonstrating that respondents generally prefer female leaders with lower pitched voices. This research demonstrates both that differences in baseline vocal pitch can affect candidates' political prospects, and also that these effects are deeply gendered.

Non-verbal elements of speech can also convey information about a person's emotional activation or intensity. When individuals experience greater emotional activation, one of the

physiological responses is a tightening of the vocal cords. This tightening, in turn, leads to a higher average vocal pitch when speaking. This physiological response, like many automatic and subconscious responses, is typically very difficult to manipulate. As a result, vocal pitch serves as a useful non-verbal measure of speakers' levels of emotional intensity (Bachorowski and Owren, 2003). Indeed, studies "have routinely shown that [pitch]-related measures...are influenced by affect-related arousal" (Owren and Bachorowski, 2007, 240).

Emotional intensity can arise from two distinct sets of phenomena. First, individuals may be more emotionally intense when discussing topics about which they are sincerely committed. In this way, a speaker's emotional intensity can be used to gauge the speaker's intrinsic commitment to (and sincerity about) an issue. Second, emotional intensity can result from extrinsic forces, including exposure to others' emotional states. Emotionally intense speech can generate emotive responses in listeners, thereby increasing their emotional engagement with the topic.

1.1 Intrinsic Sources of Emotional Intensity

The emotional intensity of a lawmaker's speech provides an indicator of her commitment to the issue at hand. Kraut (1978) argues that observers use two rules to determine whether a speaker is sincere when talking about a given issue. First, the ulterior motive rule posits that "one should discount an actor's behavior as a reflection of his or her true nature to the extent the behavior furthers the actor's short-term self interests," suggesting that much of legislative speech should be viewed as cheap talk used to meet the re-election or institutional goals of legislators (Austen-Smith, 1990). Second, the controllability rule argues that "one should believe most in those aspects of a person's performance that the person is least able to deliberately and consciously control" (Kraut, 1978, 381). If there are aspects of speech that are outside the conscious control of legislators, they should serve as a meaningful signal of their sincere positions. In other words, "if one cannot control it, one cannot fake it" (Kraut, 1978, 381).

With respect to legislative speech, features like "verbal content, speech rate and fluency, most body movements, and the large easy-to-see facial expressions, are all more susceptible to deliberate control" (Ekman et al., 1991). As a result, speech topic, choice of words, and the length or extent of remarks have a high degree of "controllability," and should be driven largely by legislators' strategic concerns. Yet, not all aspects of floor speeches are easily manipulated. In particular, vocal pitch typically lies beyond the control of the individual (Ekman et al., 1991, 134). Especially in "deceptions which involve emotion" (Ekman et al., 1991, 133), speakers have an extremely difficult time modulating their own vocal pitch to appear sincere. Because changes in pitch are less "controllable," they are a more honest indicator of a lawmaker's commitment to a given issue.

This argument has not been entirely lost on political scientists. Citing Goffman (1959), Fenno (1977) recognizes the importance of non-verbal expressions to the sincerity of legislators' behaviors. He says:

> Goffman is particularly interested in the second kind of expression - "the more theatrical and contextual kind" - because he believes that the performer is more likely to be judged by others according to the non-verbal than the verbal elements of his presentation of self. Those who must do the judging, Goffman says, will think that the verbal expressions are more controllable and manipulable by the performer; and they will, therefore, read his non-verbal "signs" as a check on the reliability of his verbal "signs" (898).

When MCs speak, they do so with a combination of controllable and manipulable elements, and relatively uncontrolled and sincere elements. The less easily controlled an element, the more likely that it measures a sincerely held position or commitment. Often changing below conscious awareness, scholars have demonstrated that vocal pitch provides just such an "inherently honest indicator" of a speaker's "internal state" (Ekman et al., 1991, 133-134). Discussing a topic with emotional intensity (i.e., a higher vocal pitch), signals an

intrinsic commitment to that issue.

1.2 Extrinsic Sources of Emotional Intensity

Beyond a sincere commitment to a topic, external factors can also influence the emotional intensity of speech. Social psychologists show that an individual's internal emotional state is influenced by the emotional states of others. This phenomenon – called emotional contagion – manifests in people "mimic[ing] the facial expression, vocal expression, postures, and instrumental behaviors" of those around them," and thus "'catch[ing]' other's emotions as a consequence of such facial, vocal, and postural feedback" (Hatfield, Cacioppo and Rapson, 1993*a*, 96). This is not a conscious response, but rather "subtle, automatic, and ubiquitous" behavior (Hatfield, Cacioppo and Rapson, 1993*a*, 97). Emotional contagion occurs via visual (Dezecache et al., 2013) and aural (Neumann and Strack, 2000) cues. Dezecache et al. (2013) even finds that such contagion can occur indirectly; simply observing another person's reaction to an emotional stimulus can trigger a concordant reaction to that stimulus, even when it is not directly observed.

Emotional mimicry ultimately influences an individual's base emotional state (Niedenthal and Brauer, 2012). For example, Hatfield et al. (1995) asked subjects to read aloud scripts expressing happiness, love, sadness, and anger. They found subjects felt happier, for instance, when reading happy messages and felt angrier when reading angry messages. Judges rating the participants' facial expressions corroborated these self-reported assessments, suggesting "emotional experience might be shaped by vocal feedback" (Hatfield et al., 1995, 307). These findings and others (for review, see Chartrand and van Baaren, 2009) suggest that when emotional mimicry and synchronization occurs, people tend to "converge emotionally" (Hatfield, Cacioppo and Rapson, 1993*b*, 5).

When MCs give speeches on topics to which they have a sincere commitment, their internal emotional states are likely observed by other legislators through their increased vocal pitch. Those observing legislators may, in turn, "catch" the speaker's emotional intensity,

and consequently speak with greater intensity – and higher pitch – themselves. In this way, emotionally intense legislative speech can stimulate a more emotionally activated discussion of the topic at hand, even by those who did not previously feel a deep and sincere commitment to the topic. When MCs give speeches with greater emotional intensity, other lawmakers are more likely to become emotionally activated when talking about that issue. We turn now to a study of the emotional intensity of speeches about women.

2 Emotional Intensity and Women's Representation

Men can, and do, act on behalf of women. Likewise, Congresswomen have a range of issue priorities, and working on behalf of women is not a primary concern for every female MC. Yet, scholars have pointed to a unique link between female lawmakers and female constituents, with women being more active on issues that are related to women, both within and beyond their district (Carroll, 2002). This behavior has been attributed in part to women's shared lived experiences. Reingold (1992) finds that female state legislators are "more likely to express some sort of commitment to representing women and/or women's concerns," arguing that "because of their gender, they felt uniquely qualified to handle the concerns of their female constituents" (531). As compared to other topics, we thus expect that in the aggregate female lawmakers are not only more likely to talk about women, but that they are especially emotionally engaged when doing so.

Existing work suggests that Congresswomen do, in fact, use floor speeches to draw attention to issues related to women. Hall (1998) notes that female members of Congress were more active on the House floor during the the Job Training Partnership Act of 1982 and on the Older Americans Act, both of which were supported by the Congressional Caucus for Women's Issues. Pearson and Dancey (2011a, 2011b) show that female legislators are not only more likely to speak on the House floor, but also to reference women in those speeches. Osborn and Mendez (2010) likewise find that female Senators speak more about health and family issues. Shogan (2001) demonstrates that 11 percent of the statements made by female

members of Congress mentioned the specific concerns of women, indicating "that female representatives often utilize the 'talking and deliberating' activity associated with descriptive representation to promote women's issues, interests, and concerns" (140).

Beyond the content of their speech, male and female legislators also differ in their rhetorical style, with women being especially likely to emphasize social bonds and personal experiences. Kathlene (1995) shows that female legislators were much more likely to emphasize the societal link to crime, leading them to speak more about long-term preventative strategies. This "connected" world view is also advanced by women in small group discussions (Karpowitz and Mendelberg, 2014) and other legislative debates (e.g., Levy, Tien and Aved, 2001). Based on her analysis of floor debates on five bills in the 104th Congress, Walsh (2002) suggests that women tend to expand the frame of discussion to not only mention women, but also to relate issues to their personal experiences. Swers (2002) makes similar claims.

Female and male lawmakers' speech differs in both content and style. These differences are especially pronounced in legislative speech referencing women. This is to be expected, given that when talking about women female members of Congress can speak "with a voice carrying the authority of experience" (Mansbridge, 1999, 644). Though previously unexamined, we posit that the effect of experience extends beyond content and style to influence the sincerity of legislators' policy commitments. Because women are more likely to draw on their own experiences when discussing these issues, they not only speak authoritatively, but also with intrinsic emotional intensity. This suggests our first hypothesis:

> H1: Female MCs demonstrate greater emotional intensity when talking about women than other topics.

We also propose that the emotional intensity of legislative speech provides an important insight into lawmakers' personal commitment to a given policy area. We further expect when female MCs talk sincerely (or with greater emotional intensity) about women their

male colleagues will be affected by, and respond to, this speech. Work on men and women in deliberative settings shows that male behavior changes as women's presence and participation changes. Mendelberg, Karpowitz, and Oliphant (2014) demonstrate, for example, that when more women are present in deliberation, they experience fewer interruptions by men. Just as the numbers of women (and women's speeches) affects men, so should the intensity of that speech. Indeed, the work on emotional contagion suggests that when men observe women demonstrating greater emotional intensity in their speeches about women, they should in turn become more intense when speaking about women. Together, the work leads to our second hypothesis:

> H2: When female MCs increase the amount and intensity of their speech on women, male MCs are more likely to speak—and speak with greater intensity—about women.

Female MCs' emotionally intense speech can convey important information to their male colleagues. Focusing on the judiciary, Boyd, Epstein and Martin (2010) find that male judges turn to their female colleagues when deciding cases that directly affect women (particularly sex discrimination cases). In Congress, we expect that men's behaviors in response to women follow a related pattern. When female legislators talk about women with intensity, male MCs give greater weight to their female colleagues' perspectives, as they likely originate from knowledge gained through women's shared lived experiences and thus signal that the issue is important to women. Alternatively, when women speak about women without intensity, it does not signal the same importance. In either instance we expect that male MCs will respond to the intensity of their female colleagues' speech, suggesting that when female MCs talk about women, male MCs listen.

3 Data and Measurement

To measure both legislators' emotional intensity and speech topic, we turn to data from *HouseLive*.[1] *HouseLive* is an online service from the Office of the Clerk that provides both live and archived (dating back to 2009) video of proceedings in the U.S. House. Since our focus is on vocal pitch, we restricted our analyses to the audio and closed-captioning text information embedded in these videos. We collected 6,432 hours of audio from 863 U.S. House debates beginning in January 6, 2009 and ending in August 4, 2014. We then split each audio file into individual speeches using the timestamps found in the closed-captioning information. Focusing on floor speeches that have at least 50 words yielded audio and text of 74,158 speeches.[2] As we explain below, we used the audio data to extract the vocal pitch of each speech and the closed-captioning text to identify speech topic.

3.1 Measuring Emotional Intensity via Vocal Pitch

From our raw audio data, we compute changes in speakers' vocal pitch as our measure of emotional intensity. We first compute speakers' baseline levels of vocal pitch, then measure variations in vocal pitch across speeches. Following Titze (2000), we define pitch (F_0) as:

$$F_0 = \frac{1}{2L}\sqrt{\frac{\sigma}{\rho}} \tag{1}$$

where L is the vocal fold length, σ is the longitudinal stress on the vocal folds, and ρ is the vocal fold tissue density. Individual variations in vocal fold length (L) and density (ρ) are largely determined by genetics (e.g. Przybyla, Horii and Crawford, 1992; Debruyne et al., 2002).[3] Conversely, variations in longitudinal stress (σ) are specific to the speaker and speech.

[1] `http://houselive.gov`

[2] Speeches with under 50 words were typically procedural interjections or interruptions.

[3] Vocal pitch is inversely proportional to vocal fold length and directly proportional to the square root of tension on the vocal folds" (Puts, Gaulin and Verdolini, 2006, 284). Thus, "[l]onger vocal folds with less tension on them lead to lower voice pitch" (Puts, Gaulin and Verdolini, 2006, 284). Vocal fold length is positively correlated with size (both height and weight), which is one of the reasons why adolescent boys experience a lowering of voices after puberty (Fitch and Giedd, 1999). This also explains why men typically speak with a lower pitch than women. Male vocal folds are between 17.5 and 25mm long on average,

Puts, Gaulin and Verdolini (2006, 285) demonstrate that "[e]motional activation raises F_0 by increasing tension on the vocal fold mucosa (σ, in Eq. (1)), mainly via contraction of the circothyroid muscles and consequent lengthening of the vocal folds."

Like other physiological functions, affect-related changes in pitch are difficult for individuals to control. Vocal pitch thus taps into the speaker's underlying emotional intensity. To measure pitch, we extracted the mean fundamental frequency (F_0) (or average vocal pitch) from each floor speech using *Praat*.[4] This commonly used speech analysis software estimates the fundamental frequency by dividing the autocorrelation of a windowed signal by the autocorrelation of the window itself.[5]

We scale the vocal pitch obtained from each speech to standard deviations above or below the speaker's baseline (Dietrich, Enos and Sen, 2017). This is done for two reasons. First, because women's vocal cords tend to be smaller and shorter they typically speak at a higher vocal pitch than men. By standardizing vocal pitch using each speaker's baseline (or mean) vocal pitch, we account for the these inherent sex differences. Second, in this project we are neither interested in whether a lawmaker generally speaks at a higher vocal pitch, nor how other lawmakers respond to these baseline differences. Rather, we are concerned with whether a legislator's vocal pitch changes from its baseline level when speaking about about women's issues. Standardizing vocal pitch not only helps capture whether a speaker is higher or lower than her average, but also gives the relative magnitude of change.

3.2 Identifying Speech Topic

Individual-level variation in vocal pitch provides a measure of emotional intensity. We expect that levels of emotional activation vary by speech topic. We used the closed-captioning text

whereas female vocal folds are between 12.5 and 17.5mm long on average. The denominator for the first part of Equation 1 is smaller for women, increasing their pitch–F_0 (Titze, 2000).

[4] `http://www.fon.hum.uva.nl/praat/`

[5] *Praat* implements a variation of the Boersma (1993) algorithm. To use this software, one has to set five parameters: the pitch floor, pitch ceiling, window length, window shape, and voicing threshold. We set the pitch floor and ceiling to 50Hz and 300Hz, respectively. This resulted in a window length of 60ms. For both the window shape and voicing threshold we used the default settings.

data from *HouseLive* to determine whether a MC addressed women in a given speech. We opted for closed-captioned transcripts because they more accurately report what is said on the House floor than the *Congressional Record*. Legislators can change the *Congressional Record* after the fact, and often read in text that that was not spoken on the House floor (e.g., asking that a letter from a constituent be added to the *Congressional Record* instead of reading it aloud). Since it is directly transcribed, closed-captioning information does not suffer from this limitation.[6]

To determine whether the speaker addressed women we created a binary variable indicating whether the speech used any of the terms outlined by Pearson and Dancey (2011*b*). These include "women," "woman's," "women's," "girl," "girl's," "girls," "girls'," "female," "female's," "females," "females'," "servicewoman," "servicewoman's," "servicewomen" and "servicewomen's." If a speech contained any of these terms it was coded as a 1, otherwise 0. Given that this is a coarse measure of whether a speech addresses women, we also estimated all models using two alternative operationalizations of speech focusing on women, including one derived from a Structural Topic Model (STM) (Roberts et al., 2013; Roberts, Stewart and Tingley, 2014; Roberts et al., 2014). Irrespective of the way we measure the degree to which a speaker addressed women, the results are identical to those outlined below. The models using alternative approaches are reported in the Supplemental Information.

[6]As closed-captions are produced in real-time, typographical errors may be a concern. In email correspondence, the company that performs the closed-captioning service for the House of Representatives asserts their transcribers are generally 95 percent accurate–i.e., 95% of words transcribed are the words actually spoken on the House floor. This assessment is based on yearly evaluations, in which the company randomly selects a certain number of transcripts from each of their transcribers and determines the degree to which those transcripts capture the floor debate for that day. For this study, we transcribed 100 randomly selected speeches. When we compared our transcribing to the closed-captioning information, the closed-captions essentially mirrored the transcripts (regardless of the similarity measure used). Based on these results and our communication with the closed-captioning company, we are confident that the closed-captioning found on *HouseLive* is an accurate reflection of what is said in the U.S. House.

3.3 Modeling Strategy

Our key predictor of interest is speaker sex, which we obtained from *GovTrack*.[7] We view each speech as a unique opportunity to address women. We thus use the legislative speech (rather than the legislator) as our unit of analysis. Aggregating to the legislator-level would obfuscate the important within-individual variation that takes place from speech-to-speech. For example, a single emotionally activated speech could artificially inflate a MC's mean vocal pitch – giving the impression that she is an emotive legislator when in reality she generally delivers subdued speeches (with one extreme exception). At the same time, because speeches given by the same MC will likely share commonalities, we estimated a multilevel linear regression model with a random intercept for each legislator. The multilevel modeling approach not only helps us deal with the problems associated with aggregation, but also estimates an intercept for each MC. This controls for other unobserved differences between legislators that could influence the parameter estimates.

We also control for other factors that may bias the results if omitted. Members who are institutionally disadvantaged are forced to take to the floor more often in an attempt to influence legislation (Maltzman and Sigelman, 1996), as they have fewer other tools at their disposal. We therefore include measures of speaker race and seniority from *GovTrack*, and use data from Stewart and Woon (2016)[8] to determine whether the speaker was a committee chair. We also incorporate data on partisanship and ideology from *Voteview*,[9] both of which have been shown to influence floor speeches (Morris, 2001; Harris, 2005). For similar reasons, we included dummy variables for whether the speech was less than one minute and whether it was delivered during an election year, both of which have been shown to influence speaking behavior (Maltzman and Sigelman, 1996).

[7] `https://www.govtrack.us`
[8] `http://web.mit.edu/17.251/www/data_page.html`
[9] `http://voteview.com`

4 Results

Table 1: Female Members of Congress Are More Likely to Talk Passionately About Women

	Dependent variable:			
	"Women" Mentioned		Standardized Vocal Pitch	
	(1)	(2)	(3)	(4)
Fixed Effects				
Constant	-2.427^{***}	-2.033^{***}	-0.0003	0.138^{***}
	(0.035)	(0.179)	(0.004)	(0.025)
Female	0.866^{***}	0.765^{***}	-0.021^{**}	-0.033^{***}
	(0.078)	(0.081)	(0.011)	(0.011)
Democrat		-0.030		-0.030
		(0.215)		(0.030)
DW-Nominate		-0.173		-0.023
		(0.199)		(0.027)
Seniority		-0.006^{*}		0.001
		(0.003)		(0.0004)
Committee Chair		0.037		-0.053^{***}
		(0.062)		(0.014)
White		-0.129		0.008
		(0.114)		(0.015)
One-Minute Speech		-1.180^{***}		-0.351^{***}
		(0.038)		(0.008)
Election Year		0.152^{***}		-0.072^{***}
		(0.025)		(0.008)
"Women" Mentioned			0.003	-0.060^{***}
			(0.015)	(0.015)
Female × "Women" Mentioned			0.122^{***}	0.138^{***}
			(0.028)	(0.028)
Random Effects				
MC	0.399	0.385	0.000	0.000
	(0.631)	(0.620)	(0.000)	(0.000)
N_1	74,158	74,158	69,290	69,290
N_2	619	619	612	612
Log Likelihood	$-23{,}911.940$	$-23{,}278.910$	$-98{,}011.560$	$-97{,}146.450$
AIC	47,829.870	46,577.820	196,035.100	194,318.900

Note: In Models 1 and 2, the dependent variable equals 1 if the speech included any of the Pearson and Dancey (2011*b*) terms, 0 otherwise. Given that we are interested in a binary variable, in these models we report the results from a multilevel logistic regression. In Models 3 and 4, the dependent variable is the speaker's vocal pitch in standard deviations above the speaker's baseline average. In these models, we report the results from a multilevel linear regression. In both models a randomly varying intercept for each member of Congress was also estimated. Levels of significance are reported as follows: $^{*}p < .1$; $^{**}p < .05$; $^{***}p < .01$. Standard errors are reported in parentheses.

A large body of scholarship suggests that female representatives will be more likely than their male counterparts to talk about women in their legislative speech. Our results extend this important work to show that when Congresswomen do speak on women, they raise their vocal pitch, indicating that they are more emotionally invested in the position they are advancing (supporting H1). We also demonstrate that when female MCs increase the amount and intensity of speeches about women, male MCs not only deliver more speeches about women, but also speak with greater intensity (as posited by H2).

4.1 Referencing Women in Legislative Speech

If women's shared experiences lead them to speak with more emotional intensity about women, then we would likewise expect female MCs to speak more frequently about women than their male colleagues. To verify this expectation, we first establish that female MCs are on average more likely to talk about women in their floor speeches. In Models 1.1 (Table 1, Model 1) and 1.2 (Table 1, Model 2), the dependent variable is whether a given floor speech talked about women. The predictor of interest is `Female` which equals 1 if the member of Congress is female and 0 otherwise. Like previous studies, our findings indicate that female MCs are more likely to explicitly reference women. Based on our model results, female members of Congress are 2.13 times more likely to use a word from Pearson and Dancey (2011*b*)'s "women" dictionary as compared to male MCs (predicted probabilities of 0.17 for women and 0.08 for men). This holds even after accounting for party identification, ideology, institutional position, seniority, race, and whether it was an election year (see Model 1.2).[10]

While this is an important finding in and of itself, it is difficult to assess the degree to which female MCs are emotionally invested in speaking about women using only the text and topic of their speeches. In Models 1.3 and 1.4 our outcome variable is the speaker's vocal pitch, as measured in standard deviations above or below his or her baseline, to determine the emotional intensity. Generally speaking, positive values imply the speaker is speaking

[10]Plots of these predicted probabilities with confidence intervals can be found in the Supplemental Information.

with more emotional intensity than we would expect, whereas the inverse is true for negative values. We test our first hypothesis by interacting `Female` with a dummy variable indicating whether a given speech used any of Pearson and Dancey (2011*b*)'s dictionary terms about women.

The significant main and interactive effects found in Table 1, Model 3 (Model 1.3) show that female members of Congress speak with a higher vocal pitch when talking about women. When female legislators use any of the Pearson and Dancey (2011*b*) dictionary terms, their vocal pitch is 0.10 standard deviations higher than their baseline. This is over thirty-three times greater than male lawmakers, whose vocal pitch only increases by 0.003 standard deviations when talking about women. At the same time, the raw magnitude is slight enough that it is likely beyond the control of the speaker. This suggest that we are capturing an actual change in a speaker's emotional intensity, which is indicative of a sincere, intrinsic commitment to speaking on behalf of women. This finding holds even when additional control variables are included in Model 1.4, lending strong support for our first hypothesis.

4.2 Men's Responses to Women's Vocal Pitch

Female legislators' heightened vocal pitch and more frequent speeches on women together demonstrate their emotional commitment to talking about women. Their emotional activation also has consequences for those observing women's behavior. The work on emotional contagion, for example, suggests that observers of others' emotions can "catch" those emotions, and themselves become emotionally activated.

As posited in H2, female MCs' emotionally intense speeches about women should affect their male colleagues' behavior. By giving more speeches with intensity that reference women, female legislators signal to their male colleagues that the issues under debate are important to women (Boyd, Epstein and Martin, 2010). As a result, male MCs should endeavor to address the concerns of women, and should in turn be more likely to reference women in their speeches. Moreover, because these speeches are delivered with heightened

emotional intensity, it should increase the likelihood of emotional contagion resulting in male MCs becoming more emotionally activated as well.

To see whether this is the case, we now turn to examining whether women's emotional intensity elicits a response from their male colleagues. First, we think about how emotional intensity affects men's willingness to address women in their floor speeches. Models 2.1 and 2.2, the dependent variable is whether a given male MC's floor speech addressed women as defined by Pearson and Dancey (2011*b*). Our primary independent variables in Table 2 are (1) the number of speeches by women on a given legislative day (`Female Speeches`), and (2) the average vocal pitch of women on that day (`Female Pitch`). We are thus interested in the interaction between `Female Speeches` and `Female Pitch`. If this interaction term is positive and statistically significant, then it suggests that male MCs are more likely to mention women when female MCs deliver a large number of speeches at an increased vocal pitch.

In Model 2.1, we find evidence that women's speeches can have a considerable effect on male legislators' discussion of women. Although the interaction term is not statistically significant at the .05-level, when predicted probabilities are calculated vocal pitch does seem to influence whether a male MC mentions women in his speech.[11] For example, when the number of female speeches is set to its maximum (43), and female vocal pitch is allowed to vary from its minimum (-3.73) to its maximum (2.49), male MCs are 38.36 percentage points more likely to reference women.

Of course, it is possible that men's increased likelihood of talking about women results not from greater numbers of female MCs' emotionally intense speeches about women, but instead from changes in the legislative agenda. Both women and men in Congress may be more likely to reference women when there are issues on that day's agenda that directly address women. In order to demonstrate that men are responding to women's speeches—and just not to the

[11]Plots of these predicted probabilities with confidence intervals can be found in the Supplemental Information.

Table 2: The Effect of Quantity and Intensity of Women's Speech on Frequency of Men's Speeches

	Dependent variable:	
	"Women" Mentioned	
	(1)	(2)
Constant	−2.693***	−2.069***
	(0.041)	(0.219)
Female Speeches	0.055***	0.055***
	(0.003)	(0.003)
Female Pitch	−0.094***	−0.115***
	(0.032)	(0.033)
Democrat		−0.101
		(0.248)
DW-Nominate		−0.262
		(0.229)
Seniority		−0.009**
		(0.004)
Committee Chair		−0.008
		(0.078)
White		−0.258*
		(0.146)
Election Year		0.160***
		(0.034)
One-Minute Speech		−1.255***
		(0.050)
Women's Bills		−0.020
		(0.029)
Female Speeches	0.009	0.013**
× Female Pitch	(0.006)	(0.006)
Random Effects		
MC	0.429	0.402
	(0.660)	(0.630)
N_1	48,932	48,932
N_2	509	509
Log Likelihood	−14,398.740	−13,975.450
AIC	28,807.470	27,976.900

Note: Outcome is whether the speech mentioned "women," as defined by Pearson and Dancey (2011*b*). `Female Speeches` is the total number of speeches delivered by female members of Congress on a given legislative day. `Female Pitch` is the average vocal pitch of female members of Congress on a given legislative day. Given the nature of the dependent variable, we report the results from a multilevel logistic regression. In both models, we estimated a randomly varying intercept for each member of Congress and we restrict the data to only male members of Congress. Levels of significance are reported as follows: *p < .1; **p < .05; ***p < .01. Standard errors are reported in parentheses.

legislative agenda—in Model 2.2 we control for the number of votes on each legislative day on bills falling into the six "women's" categories outlined by Volden, Wiseman and Wittmer (2016).[12] Our results are actually stronger after including this variable (`Women's Bills`). When the number of female speeches is set to its maximum (43), and female vocal pitch is allowed to vary from its minimum (-3.73) to its maximum (2.49), male MCs are 58.87 percentage points more likely to reference women. This suggests that women's emotionally intense speeches about women have an important independent effect on male MC's likelihood of mentioning women.

These predicted probabilities are also essentially unaffected by varying the number of votes on "women's bills," as defined by Volden, Wiseman and Wittmer (2016). For example, when `Women's Bills` is set to the minimum (0) and female vocal pitch is allowed to vary from its minimum (-3.73) to its maximum (2.49) while holding the number of female speeches at the maximum (43), male MCs are 58.91 percentage points more likely to reference women. When this same calculation is done while setting `Women's Bills` to the maximum (3), male MCs are 58.43 percentage points more likely to reference women, suggesting that changes in the legislative agenda have a minimal effect on the relationship between female speeches and male behavior.

When delivered with increased vocal pitch, female legislators' speeches increase the likelihood that male MCs reference women. We turn now to investigating whether women's speeches also cause emotional contagion by serving as an extrinsic source of emotional intensity for male legislators. To do this, in Table 3 we consider whether men's speeches about women also demonstrate greater emotional intensity when a large number of female speeches are delivered with increased vocal pitch.

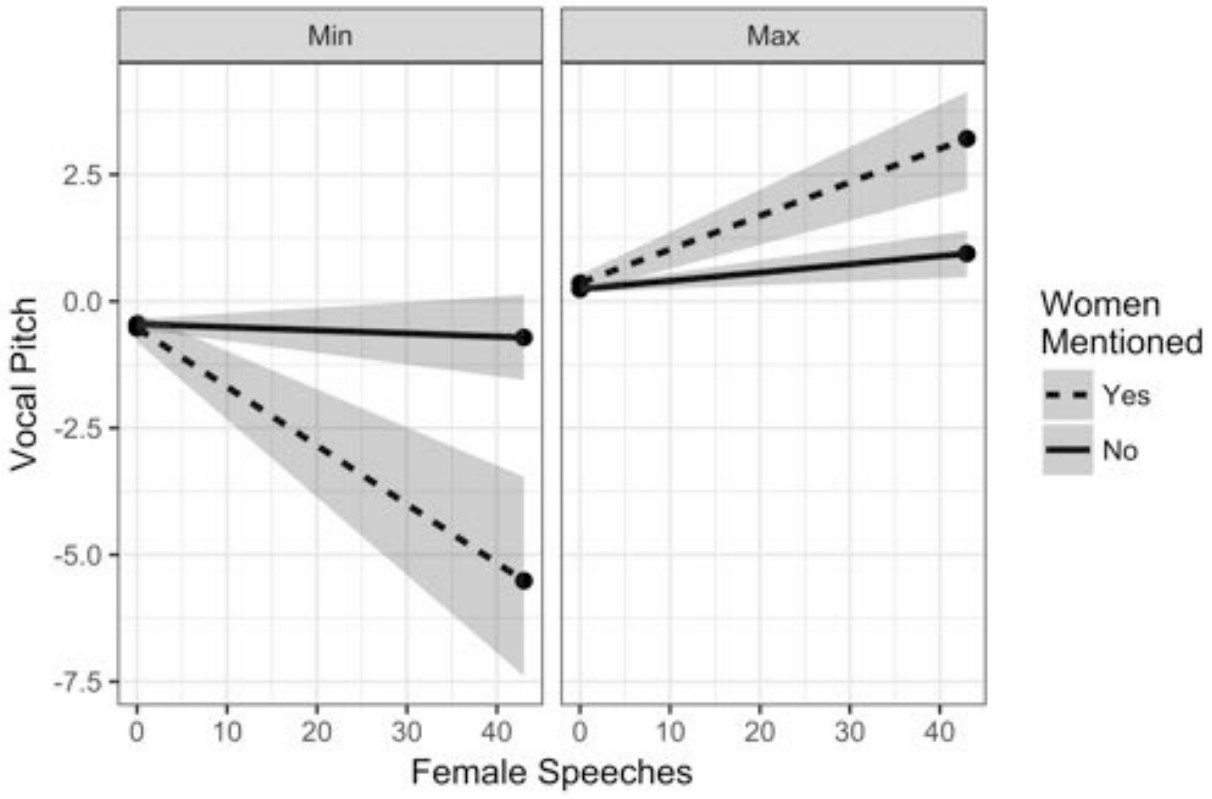
[12]Volden, Wiseman, Wittmer allow female MCs to "self-define" women's issues. That is, they identify women's issue as those that "women in Congress are more likely than men to raise," and that women raise "in a greater volume" than men (5). Following *Policy Agendas Project*, they classify all bills into 19 major topic areas. They find six topics in which significantly more bills are introduced by women than men: health, labor, housing, civil rights, education, and law, crime, and family. Examples of these bills can be found in the Supplemental Information.

Table 3: The Effect of Quantity and Intensity of Women's Speech on Men's Vocal Pitch

	Dependent variable:
	Male Vocal Pitch
Constant	-0.028^{***}
	(0.007)
"Women" Mentioned	0.019
	(0.023)
Female Speeches	0.005^{***}
	(0.001)
Female Pitch	0.096^{***}
	(0.010)
"Women" Mentioned	-0.006^{*}
× Female Speeches	(0.003)
"Women" Mentioned	0.002
× Female Pitch	(0.032)
Female Speeches	0.008^{***}
× Female Pitch	(0.002)
"Women" Mentioned	0.018^{***}
× Female Speeches × Female Pitch	(0.006)
N_1	47,955
N_2	505
Log Likelihood	−67,857.770
AIC	135,735.500

Note: Outcome is the vocal pitch of male speakers scaled to standard deviations above his baseline. `"Women" Mentioned` indicates whether the speech used any of the Pearson and Dancey (2011*b*)'s terms. `Female Speeches` is the total number of speeches delivered by female members of Congress on a given legislative day. `Female Pitch` is the average vocal pitch of female members of Congress on a given legislative day. Levels of significance are reported as follows: *p < .1; **p < .05; ***p < .01. Standard errors are reported in parentheses.

Figure 1: Effect of Number and Emotional Intensity of Female MCs' Speeches on Male MCs' Vocal Pitch



Note: Predicted vocal pitch derived from Model 1 in Table 3. Solid lines indicate a speech about "women." Dashed lines indicate all other speeches. For a given legislative day, `Female Speeches` is the total number of female speeches and `Female Pitch` is the average vocal pitch of female speeches. Both of these variables are allowed to vary from their minimum to maximum. `Female Pitch` is set to the minimum and maximum in the left and right panel, respectively.

In Table 3, our main dependent variable is the vocal pitch of male MCs, scaled to standard deviations above and below their baseline. Our independent variable is the interaction between (1) the number of women's speeches, (2) the average female vocal pitch, and (3) whether a male MC mentioned women. We expect this interaction term will be positive and statistically significant, implying female speeches increase both the quantity and emotional quality of male references to women. In Model 3.1, the interaction of interest is positive and statistically significant at the .05-level which provides initial support for H2.

We plotted predicted values in Figure 1. When average female vocal pitch on a legislative day is set to its maximum (2.49) — that is, women's speech is particularly emotionally activated — increasing the number of female speeches from the minimum (0) to the maximum (43) *raises* men's predicted vocal pitch when talking about women by 2.77 standard deviations. This relationship does not hold, however, when women's speech is less emotionally intense. When average female vocal pitch on that legislative day is set to its minimum (-3.73), increasing the number of female speeches from the minimum to maximum lowers men's predicted vocal pitch when talking about women by 4.19 standard deviations. This lends further support for H2 and suggests when female MCs deliver a large number of speeches with higher vocal pitch, male MCs are not only more likely to mention women, but when they do they are more likely to do so with increased emotional intensity.[13]

4.3 Women's Speech and Men's Voting Behavior

Female legislators' more frequent and emotionally intense speeches about women result in male legislators talking more about women, and with greater emotional activation. But it is not clear if this represents male legislators' genuine desire to address women's concerns, or a backlash against female MCs' speeches. Past research has shown that as women become more prevalent in legislatures, male politicians tend to act to minimize their influence in order to maintain dominance (Heath, Schwindt-Bayer and Taylor-Robinson, 2005; Krook, 2015; Kanthak and Krause, 2012), such as becoming more aggressive and controlling of deliberation (Kathlene, 1994). When female MCs take to the floor to deliver emotionally intense speeches, it could signal to male legislators that their dominance is under threat and thus result in a backlash effect. This backlash could manifest itself by men talking more, and even by talking more intensely, about women.

[13]Since the majority of women in Congress are Democrats, and Democratic men might have more incentive to appeal to female voters (e.g., Chaturvedi, 2016), it is possible that the effects we have observed are contingent on male MCs' party. When separate models are estimated for Republican and Democratic men we find the speaking behavior of female lawmakers has a consistent effect on both, suggesting our results cannot be attributed to a single party. Please refer to the Supplemental Information for additional details.

In order to gain a deeper understanding of whether men speaking (with intensity) about women is generally supportive or counter to the interests of female legislators, we considered the relationship between women's speech and men's voting patterns. To do so, we construct a measure of whether men in Congress became more or less likely to vote with women who gave speeches on the House floor referencing women. That is, our dependent variable captures the proportion of votes male legislators cast in the same direction as female speakers using a Pearson and Dancey dictionary term. Since much of voting behavior is determined by shared partisanship or underlying ideology, we standardized our dependent variable to be standard deviations above or below the average proportion of votes cast between pairs of legislators on any given legislative day. And since speeches can have no direct effect on legislators who are not present, we restrict our analysis to men who also gave speeches on the same day. In doing so, we assume that men who spoke on the same day as women were more likely to be in the room to hear the speeches referencing women. Positive values imply female speakers received more votes from male speakers than we would expect given those men's baseline propensity to vote with those women, whereas the inverse is true for negative values. Additional details, as well as a working example, can be found in the Supplemental Information.

The results of the models predicting this variable are displayed in Table 4. Not only is the interaction between number and vocal pitch of female MCs' speeches statistically significant, but the predicted values plotted in Figure 2 show the effect is sizable. For all Congressmen, there is a clear relationship between the amount and vocal pitch of women's speeches on voting behavior. When women's average vocal pitch is set to its maximum (solid line) and women's speech ranges from the minimum (0) to maximum (43), the rate male members of Congress vote with women on a given day increases from -0.27 to 1.03 standard deviations above what we would expect given their past voting behavior.

These results provide cause for optimism, since they suggest that men respond favorably to female lawmakers' efforts on behalf of women. There is no evidence that women's

Table 4: The Effect of Women's Speech Amount and Intensity on Men's Voting Patterns

	Dependent variable:	
	Male Votes Cast	
	(1)	(2)
Fixed Effects		
Constant	0.016	0.086*
	(0.015)	(0.051)
Female Speeches	0.002	0.001
	(0.001)	(0.001)
Female Pitch	−0.182***	−0.171***
	(0.013)	(0.013)
DW - Nominate		−0.001
		(0.025)
Seniority		−0.002
		(0.001)
Committee Chair		0.084***
		(0.030)
Election Year		−0.085***
		(0.013)
White		−0.051
		(0.052)
One-Minute Speech		0.021
		(0.014)
Women's Bills		0.056***
		(0.010)
Female Speeches × Female Pitch	0.013***	0.010***
	(0.002)	(0.002)
Random Effects		
MC	0.048	0.048
	(0.219)	(0.218)
N_1	21,374	21,374
N_2	485	485
Log Likelihood	−27,514.140	−27,498.650
AIC	55,040.290	55,023.290

Note: Outcome is the proportion of time male MCs voted with women, as described on page 22. `Female Speeches` is the total number of speeches delivered by female members of Congress on a given legislative day. `Female Pitch` is the average vocal pitch of female members of Congress on a given legislative day. Levels of significance are reported as follows: *p < .1; **p < .05; ***p < .01. Standard errors are reported in parentheses.

emotionally intense speech causes backlash effects in men's voting behavior. Indeed, we find evidence that emotionally intense speech about women can actually boost rates of male MCs voting with their female colleagues.[14] Together, this suggests that female MCs' emotionally intense speech can result in positive outcomes: men will talk more about women, with greater emotional intensity, and without backlash.

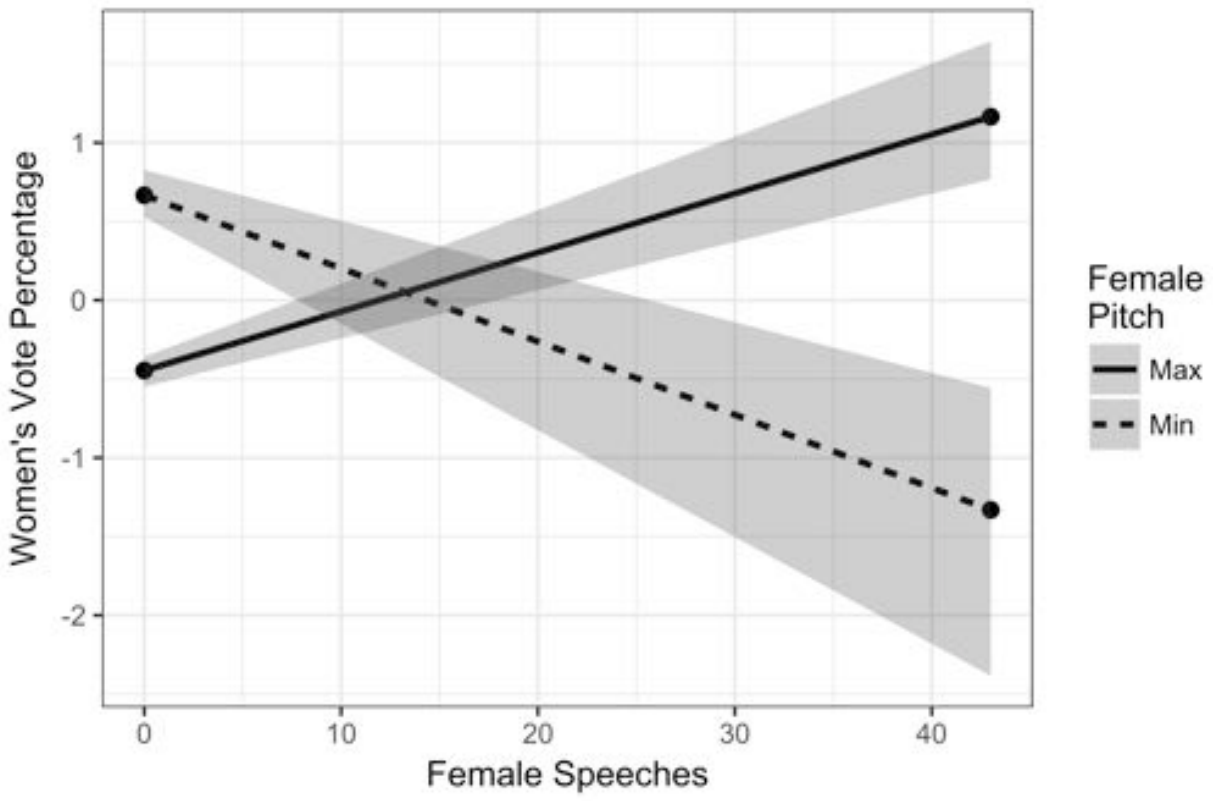
5 Conclusion

Using data from nearly 75,000 floor speeches given in the U.S. House of Representatives, this study offers a new measure—small changes in a speaker's vocal pitch that are difficult to control—for examining the ways in which legislators give voice to women's concerns. We show that the presence of women in Congress is linked not only to greater discussion of women on the floor, but also with greater emotional intensity when speaking on those issues. We also show that women's speech affects their male colleagues. When female legislators give more speeches with greater emotional intensity, male legislators speak more about women and do so with greater intensity.

Our research both underscores, and also extends our understanding of, the importance of descriptive representation in legislatures. While male MCs can and do represent women in Congress, female legislators are able to speak to the experience of women in a way that male MCs cannot. We show that such discussions are likely grounded in a sincere emotional commitment to women. This commitment is one of the main reasons why descriptive representation remains crucial to deliberative bodies. Any legislator can speak about women, but we show that female MCs do so in a way that is distinct from their male counterparts. We contend that female lawmakers' emotional intensity is not only influential in its effects on male MCs, but also fundamentally important to descriptive representation itself.

[14]We also estimated separate models for Democrats and Republicans that can be found in the Supplemental Information. While the interaction between the number and vocal pitch of female MCs' speeches is statistically significant for both Democratic and Republican men, we find the effect is more pronounced among Republicans. This suggests that much of this observed boost is driven by Republicans and not Democrats.

Figure 2: When Female MCs Deliver Passionate Speeches About “Women," Male MCs Are More Likely To Vote With Female MCs



Note: Predicted male voting behavior from Model 1 in Table 4. Solid and dashed lines indicates `Female Pitch` was set to its maximum (2.49) and minimum (-3.73), respectively. On the x-axis `Female Speeches` is allowed to vary from its minimum (0) to maximum (43). The y-axis has the percentage of time the male member of Congress voted with women, as described on page 22.

Our findings are also the first to demonstrate empirically that women's speeches about women can influence male legislators' behavior. Previous scholarship on deliberative settings generally Karpowitz and Mendelberg (2014), and courts in particular (Boyd, Epstein and Martin, 2010), demonstrates that men respond to women's speech. We extend this work to show that men not only listen to women's speeches, but can become emotionally activated by them as well. And our evidence on men's voting behavior suggests that this emotional activation carries with it a positive (rather than backlash) effect. Taken together, this suggests that floor speeches go far beyond signaling a policy position to constituents and colleagues; they can also reflect and shape legislators' emotional states and behavior.

Finally, our vocal pitch measure can be applied to other issue areas and identity groups, as the rationale for expecting female MCs to speak with more emotional intensity about women should apply elsewhere. Veterans, doctors, and educators, for example, each likely draw heavily on personal experiences when discussing veterans' benefits, health policy, and education policy on the floor of the U.S. House. This presents a unique opportunity to develop measures that can separate out those who are true champions of a policy from those who are engaging primarily in response to their districts.

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