Empirical Research Paper

Speech Rate, Intonation, and Pitch: Investigating the Bias and Cue Effects of Vocal Confidence on Persuasion

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Abstract

Three experiments were designed to investigate the effects and psychological mechanisms of three vocal qualities on persuasion. Experiment 1 (N = 394) employed a 2 (elaboration: high vs. low) × 2 (vocal speed: fast vs. slow) × 2 (vocal intonation: falling vs. rising) between-participants factorial design. As predicted, vocal speed and vocal intonation influenced global perceptions of speaker confidence. Under high-elaboration, vocal confidence biased thought-favorability, which influenced attitudes. Under low-elaboration, vocal confidence directly influenced attitudes as a peripheral cue. Experiments 2 (N = 412) and 3 (N = 397) conceptually replicated the bias and cue effects in Experiment 1, using a 2 (elaboration: high vs. low) × 2 (vocal pitch: raised vs. lowered) between-participants factorial design. Vocal pitch influenced perceptions of speaker confidence as predicted. These studies demonstrate that changes in three vocal properties influence global perceptions of speaker confidence, influencing attitudes via different mediating processes moderated by amount of thought. Evaluation of alternative mediators in Experiments 2 and 3 failed to support these alternatives to global perceptions of speaker confidence.

Keywords

attitudes, persuasion, vocal confidence, elaboration likelihood model, communication

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For the better part of a century, researchers have investigated variables that facilitate or inhibit attitude change and the underlying processes by which these changes take place. While a great deal of research has shown that the content of what we say matters (see Albarracín & Vargas, 2010; Eagly & Chaiken, 1993; Petty & Wegener, 1998), research has suggested that how we say something is also important. Indeed, this latter point is crucial in oral communication because voices convey substantial information beyond the content of communications (Johnson, Ernde, Scherer, & Klinnert, 1986; Pell, Monetta, Paulmann, & Kotz, 2009).

Variations in people's psychological states are often associated with differences in their vocal characteristics. Likewise, people also infer psychological states from these characteristics (e.g., see Brennan & Williams, 1995; Brown, Giles, & Thakerar, 1985; Jiang & Pell, 2014; Kimble & Seidel, 1991; Mehrabian & Williams, 1969; Scherer, London, & Wolf, 1973; V. L. Smith & Clark, 1993). Such characteristics include speech rate (i.e., slow vs. fast speech), volume (i.e., soft or loud speech), pitch (i.e., the frequency of vocal fold vibrations, with higher frequency indicating high pitch), and intonation (sentences ending with rising or falling pitch).

Research on Vocal Characteristics and Persuasion

Despite the fact that persuasion has an oral component in many real-world settings, there has been comparatively little interest in the study of vocal characteristics within the persuasion literature. Indeed, only speech rate has received appreciable attention. Research on speech rate has produced contradictory findings, with some research suggesting that an increased speech rate produces more persuasion (Mehrabian & Williams, 1969; Miller, Maruyama, Beaber, & Valone, 1976) and other studies finding no evidence for a general persuasive advantage of fast speakers over slow speakers (Gunderson & Hopper, 1976; Hausknecht & Moore, 1986; Moore, Hausknecht, & Thamodaran, 1986; S. M. Smith & Shaffer, 1991, 1995; Woodall & Burgoon, 1983).

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Two explanations have been suggested for why speech rate affects persuasion. First, some have argued that as speech rate increases it becomes more difficult for people to carefully consider the merits of the arguments being presented (i.e., to cognitively elaborate the message). Supporting this view, several studies have found that at comparatively fast rates of speech, people's ability to cognitively elaborate persuasive messages is undermined (Hausknecht & Moore, 1986; Moore et al., 1986; S. M. Smith & Shaffer, 1991, 1995).

A second explanation for the effect of speech rate on persuasion is that people tend to perceive fast speakers as more credible than slow speakers (Miller et al., 1976). Evidence for this mechanism has been mixed. Some studies have failed to find clear evidence that speech rate affects persuasion via perceived speaker credibility (Hausknecht & Moore, 1986; S. M. Smith & Shaffer, 1991; Woodall & Burgoon, 1983), whereas other studies have reported evidence consistent with this explanation (Miller et al., 1976). Some studies have suggested credibility might only explain speech rate effects when motivation to elaborate messages is low and thus people use credibility as a cue to infer their attitudes (S. M. Smith & Shaffer, 1995).

Evaluation of the Vocal Persuasion Literature and Research Objectives

In summary, the vocal persuasion literature provides good evidence that speech rate plays a role in persuasion as a function of its impact on the ability of people to cognitively elaborate persuasive messages. In addition, evidence for this view provides some insight into why overall effects of speech rate on persuasion have been comparatively uncommon: Increased speech rate would be expected to facilitate persuasion when arguments are weak, but to inhibit persuasion when arguments are strong.

However, the literature also presents numerous unresolved issues. First, the most obvious limitation is the exclusive focus on speech rate. The literature on vocal perception has suggested that people are sensitive to several features of voice beyond speech rate. The extent to which these properties of voice influence persuasion and the mechanisms by which they do so has been ignored. Indeed, given that speech rate and other vocal properties are known to sometimes covary as a function of psychological states (e.g., Scherer et al., 1973), this raises the possibility that their combined effects on persuasion may either be additive or interactive, thus suggesting the value of multivariable studies.

Second, even if speech rate operates in isolation of other properties, much remains to be learned regarding its underlying processes. For example, although there is evidence for the amount of elaboration mechanism, evidence for the role of speaker credibility is more tenuous. Moreover, it is not clear that the present explanations exhaust the possible mechanisms by which speech rate could affect persuasion. As we will discuss later, contemporary theories of persuasion suggest additional mechanisms that have yet to be considered.

A final caveat to the present literature is that the techniques that have been used to manipulate speech rate present interpretational ambiguities. Typically, speech rate has been manipulated either by instructing speakers to talk fast or slow (e.g., Miller et al., 1976; Woodall & Burgoon, 1983) or forcibly increasing speech rate by compressing an analog audio file through rerecording the original track (e.g., Hausknecht & Moore, 1986; Moore et al., 1986; S. M. Smith & Shaffer, 1991, 1995). Problematically, by instructing a person to speak fast or slow, this may inadvertently introduce changes to multiple properties of voice (e.g., volume, pitch), which may confound the manipulation. Similarly, forcibly compressing an audio file could potentially alter other parameters of voice.

The goal of the present program of research is to begin to address these unresolved issues. First, these experiments examine two previously unexplored characteristics of voice in the persuasion literature (vocal intonation and vocal pitch) and evaluate the degree to which these characteristics exert their effects via two psychological mechanisms not previously considered in the vocal persuasion literature. Second, these experiments explore the extent to which these two new potential mechanisms might also in part account for the effects of speech rate on persuasion. Finally, we explore these three properties of voice using more advanced methods of altering vocal properties so as to avoid introducing confounds to manipulations.

Theoretical Overview

In approaching these research objectives, our first theoretical premise is that a critical construct in explaining the persuasion effects of many vocal characteristics is vocal confidence. This premise is based on the fact that the vocal perception literature has suggested that vocal characteristics are indeed diagnostic of speaker confidence. That is, relative to unconfident speakers, confident speakers typically communicate faster (Brown et al., 1985; Jiang & Pell, 2014; Scherer et al., 1973), louder (Kimble & Seidel, 1991; Scherer et al., 1973), and use falling versus rising intonation at the end of their sentences (Brennan & Williams, 1995).

We hypothesize that various vocal properties related to confidence will have some overlapping effects on persuasion as a function of the common mechanism of perceptions of speaker confidence. Interestingly, the vocal perception literature has not provided a formal definition of speaker confidence, but rather relied on lay definitions. However, a review of measures used to assess it within this literature suggest that in some respects it parallels the well-known construct of attitude certainty (Briñol & Petty, 2009; Tormala & Rucker, 2007). Attitude certainty refers to the subjective sense of conviction one has about an attitude. Vocal confidence can be viewed in part as the extent to which a person is perceived

to convey a sense of conviction in what one is saying as a function of one's vocal features.

However, vocal confidence could reflect more than a sense of subjective conviction. It could also capture more general qualities such as comfort in social interactions or comfort with public speaking. In addition, the attitude certainty literature has indicated that people's subjective conviction can be divided into two related but separable dimensions of clarity (a subjective sense that one has a clear notion of one's attitudinal position) and correctness (a subjective sense of the validity of one's attitude; see Petrocelli, Tormala, & Rucker, 2007). The extent to which people react to vocal confidence as an undifferentiated quality versus a more multidimensional set of beliefs remains unknown and will be addressed in the present studies.

Regardless of whether vocal confidence is perceived by listeners as a uni- or multidimensional construct, we argue that perceptions of confidence influence persuasion in at least two distinct ways. Our view is based on the elaboration likelihood model of persuasion (ELM; Petty & Cacioppo, 1986; Petty & Wegener, 1998). The ELM postulates that several distinct processes guide attitude change. Which specific process emerges is a function of where an individual falls on the elaboration continuum, that is, the extent to which receivers carefully scrutinize the merits of an argument.

Applying this to qualities of voice tied to confidence, when a person is able and motivated to carefully consider the merits of an issue, the ELM suggests he or she is more likely to consider both the relevance and quality of all information that comes to mind as it relates to the persuasive communication. Under these conditions, the ELM proposes that a variable can influence persuasion via biasing the recipient's thoughts to be favorable or unfavorable toward the message.[1] Take, for example, the topic of nuclear power. The confidence with which the speaker delivers the message in no way directly informs the listener as to the wisdom of nuclear power. Nonetheless, listeners might infer that confident speakers must have good reasons to hold their position with conviction. Consequently, the listener may focus on the strengths of the argument and approach the message in a confirmatory way. This may positively bias thoughts toward the message, and these positive thoughts will then be used as a basis for the attitude. However, if the speaker sounds unconfident, the listener may reason that the speaker has reasons for his uncertainty. Consequently, the listener may focus on the weaknesses in the arguments, which then negatively bias their thoughts toward the message. Research suggests the biasing effects of a variable should be most powerful when a message is of moderate strength (Chaiken & Maheswaran, 1994). Importantly, research has not investigated whether vocal properties associated with confidence impact persuasion via influence on perceptions of speaker confidence, which in turn can bias the favorability of issue-relevant thoughts.

In contrast, when a person is unable and/or unmotivated to think carefully, the ELM suggests they are more likely to use simple cues in the environment to guide their response to the message. Applying this to qualities of voice tied to confidence, a listener may evaluate whether a speaker sounds confident and then use this perception as a peripheral cue to directly infer his attitude in the absence of any careful evaluation of the quality of the advocacy.

Experiment 1

Experiment 1 explored these theoretical ideas using speech rate and the previously unexplored property of vocal intonation. Specifically, Experiment 1 tested the processes by which these properties influenced persuasion under high and low thought. Perceptions of speaker confidence and cognitive responses were tested as mediators of these processes.

Method

Participants and design. Undergraduates (N = 394) were recruited in exchange for course credit.[2] Participants were randomly assigned to conditions in a 2 (elaboration: high vs. low) × 2 (vocal speed: increased vs. decreased) × 2 (vocal intonation: falling vs. rising) between-participants factorial design. Minimum sample size requirements were based on a goal of 20 participants per cell (Simmons, Nelson, & Simonsohn, 2011) to test the predicted 2 × 2 × 2 interaction. Once this number was exceeded, data collection continued for the remainder of the academic semester. This rule was applied to all experiments.

Procedure. Participants listened to an audio passage describing a policy that allowed students to reduce their tuition in exchange for working as part-time university staff members. The passage was adapted from prior research (Baker & Petty, 1994; Clark, Wegener, & Fabrigar, 2008) and modified to contain moderately strong arguments because prior research suggests that biasing effects of variables (e.g., vocal confidence) are most effective when arguments are moderately strong (Chaiken & Maheswaran, 1994).

An important goal of Experiment 1 was to investigate how vocal properties affect persuasion at the end points of the elaboration continuum (i.e., high- vs. low-elaboration). Thus, we intentionally confounded our manipulations of ability and motivation (i.e., high ability with high motivation, and low ability with low motivation) to maximize the effects of our elaboration manipulation. Specifically, the high-elaboration condition maximized processing ability by placing participants in semiprivate conditions, thereby minimizing audio and visual distractions to the greatest extent possible. Motivation was maximized by informing participants that their university was considering implementing the tuition reduction policy the following year, thus enhancing personal relevance (Petty & Cacioppo, 1979, 1984). In contrast, the low-elaboration condition minimized processing ability by requiring participants to memorize an eight-digit

number for later recall (see Gilbert & Osborne, 1989) and minimized motivation by informing participants that their university was not considering the program, thus decreasing personal relevance.

The audio passage was delivered by a female speaker recruited from the university drama program. A digital recording and editing program (PRAAT©) was used to create the audio passage, making it possible to manipulate only vocal speed and intonation without affecting other vocal qualities. When recording the passage, the speaker talked at her normal rate of speech and delivered the content as naturally as possible. Vocal speed was manipulated by increasing speech rate by 10% (191 words per minute [WPM]) and decreasing speech rate by 15% (149 WPM) relative to baseline in the original audio recording. Vocal intonation was manipulated by raising or lowering the intonation in the speaker's voice on the last word in 10 target sentences. Prior research conducted in our lab indicated these manipulations were successful. Fully crossing these manipulations produced four audio recordings in which the speaker either spoke fast with rising or falling intonation, or slow with rising or falling intonation. Decreased speed and rising intonation were coded as 0. Increased speed and falling intonation were coded as 1. Following the audio passage, participants assigned to low-elaboration entered the eight-digit number. Next, all participants answered three filler questions regarding the speaker's delivery style. Participants then evaluated the speaker on two attributes and two qualities of voice. Attitude toward the proposed tuition-reduction plan was then measured. Finally, participants listed up to 12 thoughts.

Measures

Stylistic qualities. Three questions assessing the stylistic qualities of the speaker helped mask the study's intent. Question order was randomized. Participants evaluated the speaker's clarity of presentation, complexity of vocabulary, and organization of points. Responses were made on a 1 to 7 scale (1 = *very unclear/basic/disorganized*, 7 = *very clear/complex/organized*).

Speaker attributes and vocal qualities. Four questions were presented, of which two (i.e., vocal confidence, speech rate)[3] were of interest and two (i.e., intelligence, loudness) were filler items. Question order was randomized. Responses were made on a 1 to 7 scale (1 = *very unconfident/slow/quiet/unintelligent*, 7 = *very confident/fast/loud/intelligent*).

Attitude scale. Participants reported their attitudes toward the tuition reduction program using eight, 7-point unipolar rating scales: *good, bad, like, dislike, positive, negative, favorable*, and *unfavorable* (Crites, Fabrigar, & Petty, 1994). Each item was rated from 1 (*not at all*) to 7 (*definitely*). Final scores were created by reverse coding the negative items, then averaging the scores across all items. Item ratings were highly correlated (α = .93) and thus were averaged to form one overall attitude index.

Thought listing and rating task. Participants were asked to list up to 12 thoughts that came to mind while listening to the audio passage and then rate the favorability of each thought as *positive, negative*, or *neutral*, as it applied to the university service plan (e.g., Cacioppo & Petty, 1981). Two independent raters also coded participants' thoughts on favorability and relevance to the topic, while blind to condition (e.g., Cacioppo & Petty, 1979; Petty & Cacioppo, 1984). Interrater agreement on both thought-favorability (92%) and thought relevance (88%) was high. Final values were calculated by averaging the scores for both independent raters on each dimension (e.g., Petty, Cacioppo, & Heesacker, 1981). Based on the coding assigned by the independent raters, an index of thought-favorability was computed using the following formula: Thought-favorability = (Number of positive relevant thoughts – Number of negative relevant thoughts) / Total number of thoughts (e.g., Petty & Cacioppo, 1986). The elaboration manipulation was evaluated by examining the *proportion* of all thoughts generated by the participant that were topic-relevant.[4]

Results

Elaboration manipulation check. The first goal was to test whether the elaboration manipulation was successful. If successful, participants carefully processing the message should have a significantly greater proportion of topic-relevant thoughts than participants not carefully processing the message. This was tested by conducting an ANOVA with vocal speed, intonation, and elaboration as the independent variables and the proportion of topic-relevant thoughts as the dependent variable.[5] As expected, there was a greater proportion of topic-relevant thoughts for participants assigned to the high-, M = .82, SE = .02, 95% confidence interval (CI) = [.79, .86], than to the low-elaboration condition (M = .75, SE = .02, 95% CI = [.71, .78]), $F(1, 380) = 7.88$, $p = .005$, $\eta p^2 = .02$. Although no other effects were predicted, a greater proportion of topic-relevant thoughts emerged in response to falling (M = .85, SE = .02, 95% CI = [.81, .89]) versus rising intonation (M = .72, SE = .02, 95% CI = [.68, .76]), $F(1, 380) = 19.71$, $p < .001$, $\eta p^2 = .05$. No further effects reached significance. These data confirmed that the elaboration manipulation was successful.

Evaluation of vocal confidence measure. Next, because speaker confidence was postulated to play a critical role in explaining the effects of speech rate and vocal intonation, it was important to confirm that both vocal manipulations influenced confidence. This was tested by conducting an ANOVA with vocal speed, intonation, and elaboration as the independent variables and ratings of speaker confidence as the dependent variable. Two critical effects were expected. First, a main

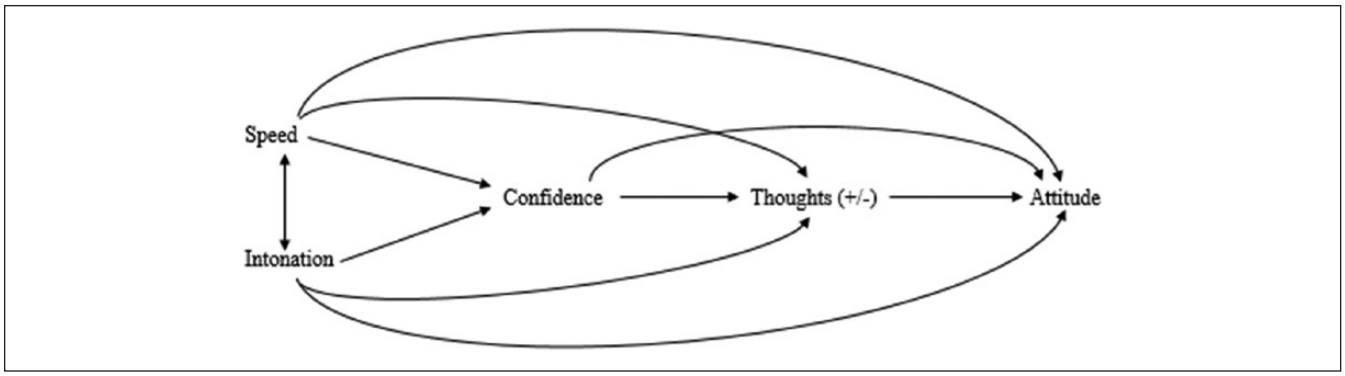

Figure 1. Path model depicting relationships between variables under high- and low-elaboration.

effect of vocal speed was predicted. Confirming expectations, the speaker with an increased speech rate (M = 5.39, SE = .11, 95% CI = [5.18, 5.59]) was rated as more confident than the speaker with a decreased speech rate (M = 4.51, SE = .11, 95% CI = [4.30, 4.72]), $F(1, 386) = 34.26$, $p < .001$, $\eta p^2 = .08$. Second, a main effect of vocal intonation was predicted. As anticipated, the speaker with falling intonation (M = 5.51, SE = .11, 95% CI = [5.30, 5.72]) was rated as more confident than the speaker with rising intonation (M = 4.39, SE = .11, 95% CI = [4.20, 4.59]), $F(1, 386) = 55.75$, $p < .001$, $\eta p^2 = .13$. No main effect of elaboration or interaction between vocal qualities and elaboration was expected or found (all ps > .162). The absence of an interaction between elaboration and vocal qualities is important because it suggests that perceptions of speaker confidence were not influenced by the amount of processing. Interestingly, no interaction emerged between vocal speed and vocal intonation, $F(1, 386) = .22$, $p = .639$, $\eta p^2 = .01$, supporting an additive rather than an interactive effect of the manipulations. A three-way interaction was not expected or found.

The effects of vocal qualities and elaboration on attitudes. The next step entailed investigating the effects of vocal qualities and elaboration on participants' attitudes. This was tested by conducting an ANOVA with vocal speed, intonation, and elaboration conditions as independent variables and attitude as the dependent variable. Although prior research suggests the possibility that several effects could emerge, it is important to consider that because attitudes assume the most distal position in the proposed causal model, these effects should be comparatively weak. Nonetheless, the model implies that persuasion might be greater in response to a speaker who communicated at a comparatively rapid pace and/or used falling intonation at the end of a sentence. However, no main effect of vocal speed, $F(1, 386) = .07$, $p = .790$, $\eta p^2 = .00$, or vocal intonation, $F(1, 386) = 1.34$, $p = .247$, $\eta p^2 = .00$ was found. No main effect of elaboration or interaction between vocal qualities and elaboration was expected because vocal qualities were hypothesized to have similar effects on attitudes but through different mediating processes at each level of elaboration. As anticipated, none of these effects reached significance (all ps > .507). The absence of a main effect for either vocal quality was not surprising. Critical to our model, however, was the fact that neither vocal quality interacted with elaboration.

Vocal confidence as a biasing factor and peripheral cue. The most central prediction of our theoretical framework was that the process by which vocal speed and vocal intonation influenced persuasion differed under high- and low-elaboration. This was tested by conducting a multisample structural equation model using LISREL 9.20 (Jöreskog & Sörbom, 2015).[6] First, participants were divided into high- and low-elaboration conditions. Next, the covariance matrix for each level of elaboration was computed using the measured variables designated as exogenous (i.e., vocal speed and vocal intonation) and endogenous (i.e., ratings of speaker confidence, cognitive responses, and attitude). When conducting the analyses, the model depicted in Figure 1 was fit simultaneously to both groups.[7] Using Maximum Likelihood to estimate the model parameters, the various paths were tested to determine whether they significantly differed from one another across levels of elaboration by placing equality constraints on specific coefficients of interest. A chi-square difference test was used to evaluate the fit of our constrained model against its unconstrained counterpart. A significant chi-square statistic indicates that the coefficients being compared are significantly different. Finally, recall that the earlier ANOVA investigating the joint effects of vocal speed and vocal intonation on perceptions of confidence revealed that these variables influenced confidence in an additive rather than interactive fashion. Thus, these models assume additive effects of voice. The results for both path models are represented in Figure 2 and report unstandardized coefficients for each path. Dotted lines indicate nonsignificant paths.

According to the ELM, the process by which a variable influences persuasion differs based on the extent of careful thought regarding the merits of an argument. Under high-elaboration, the ELM suggests a variable should bias thought-favorability, which in turn guides the formation of

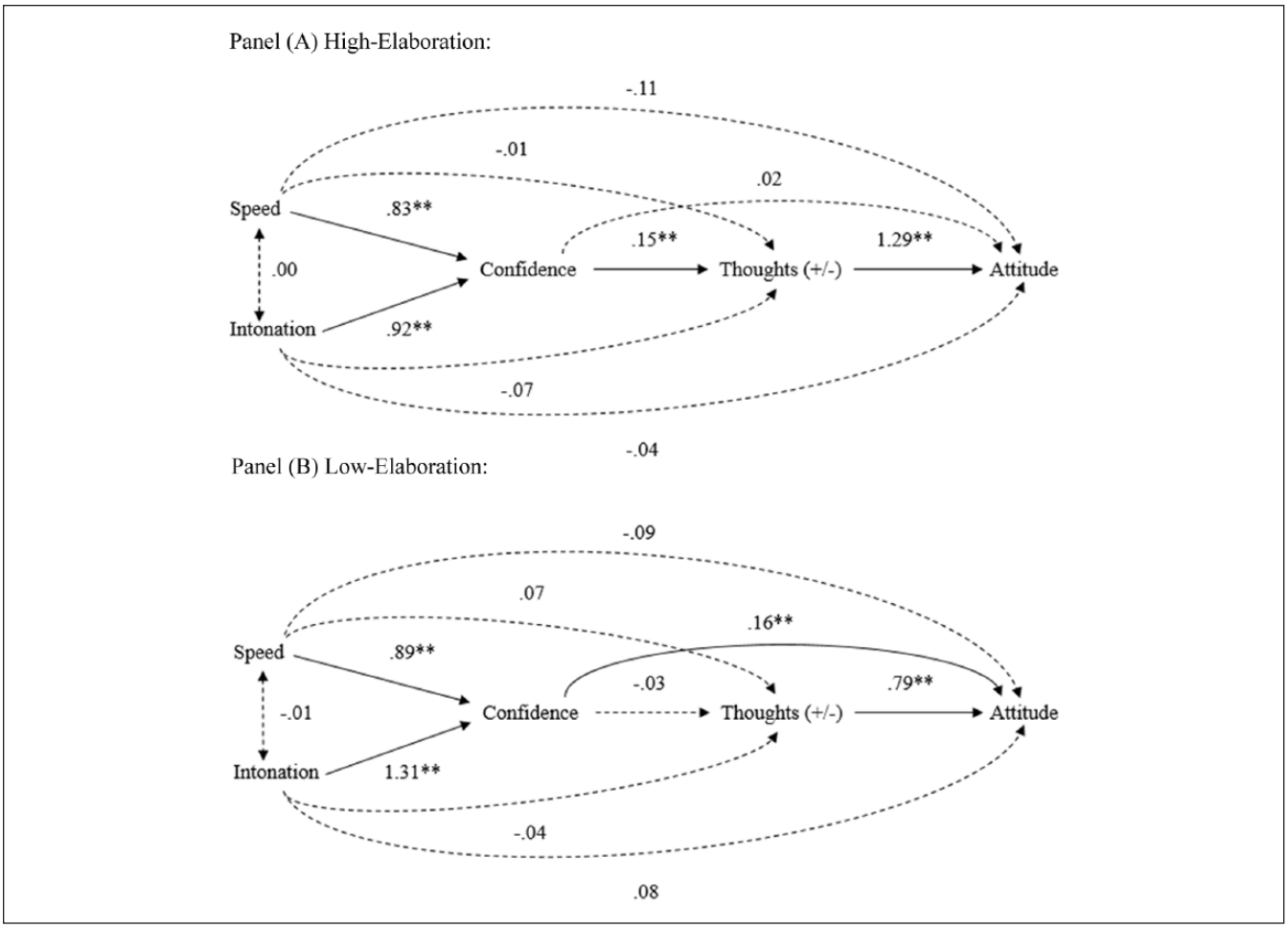

Figure 2. Vocal confidence and cognitive responses as mediators of the relationship between vocal speed and vocal intonation and attitude (Experiment 1).
*p < .05. **p < .01. ***p < .001.

attitudes. Thus, vocal speed and vocal intonation should influence perceptions of speaker confidence, which in turn should bias recipients' thoughts and these thoughts should influence attitudes. Importantly, the ELM suggests a different process should occur under low-elaboration. In this case, although vocal speed and vocal intonation should still influence perceptions of speaker confidence, confidence should no longer bias thought-favorability, but rather directly influence attitudes as a peripheral cue.

Turning first to the pattern of effects under high-elaboration, as found in Panel A of Figure 2, both vocal speed, b = .83, SE = .21, p < .001, and vocal intonation, b = .92, SE = .21, p < .001, influenced perceptions of speaker confidence as predicted. Next, a confident-sounding speaker should bias thoughts to be more positive toward the message. Evidence of thought bias was supported by the data, b = .15, SE = .03, p < .001. Finally, because participants were presumed to be engaged in careful thought, this suggests that thoughts should have a robust effect on attitudes, which the data supported, b = 1.29, SE = .11, p < .001. Next, the direct effect of speaker confidence on attitude was examined. Because this is a high-elaboration situation, the ELM predicts that speaker confidence should have little direct impact on attitude as a peripheral cue. As anticipated, this cue effect was nonsignificant, b = .02, SE = .05, p = .732. As expected, no further paths reached significance. This is important because it suggests that speech rate and intonation do not directly affect attitude but rather do so indirectly because of how they influenced perceptions of speaker confidence. Taken together, these data reveal a pattern of effects congruent with the theoretical framework proposed by the ELM.

Turning next to the pattern of effects that emerged under low-elaboration, Panel B of Figure 2 reveals that once again vocal speed, b = .89, SE = .23, p < .001, and vocal intonation, b = 1.31, SE = .23, p < .001, influenced perceptions of speaker confidence as expected. Thus, as expected, people were adept at detecting changes in speech rate and intonation as indicating confidence regardless of elaboration level. Indeed, comparing these coefficients with their counterparts in Panel A revealed similar numerical values. Tests of these

coefficients across elaboration levels indicated the effects of vocal speed, $\chi^2 = .03$ ($df = 1$, $N = 371$, $p = .853$), and intonation, $\chi^2 = 1.67$ ($df = 1$, $N = 371$, $p = .204$), were of similar magnitude.

Next, when ability and/or motivation to carefully process a message are lacking, speaker confidence should have a comparatively weak effect on thought-favorability. Indeed, comparing this coefficient with its counterpart in Panel A suggests this was the case, $b = –.03$, $SE = .03$, $p = .382$. A test of these coefficients across levels of elaboration confirmed that confidence was a significantly better predictor of thoughts under high- than low-elaboration, $\chi^2 = 15.85$ ($df = 1$, $N = 371$, $p < .001$). Importantly, although thoughts may still have some influence on attitudes under low-elaboration, the ELM suggests this effect should be weaker than under high-elaboration. As anticipated, a smaller coefficient emerged relative to its counterpart in Panel A ($b = .79$, $SE = .10$, $p < .001$). Once again, testing these coefficients across elaboration confirmed the expected difference, $\chi^2 = 11.10$ ($df = 1$, $N = 371$, $p < .001$).

Finally, under low-elaboration, speaker confidence should directly influence attitudes as a peripheral cue. Thus, a significant positive coefficient was expected, which emerged as anticipated, $b = .16$, $SE = .05$, $p = .013$. When comparing this coefficient with its counterpart in Panel A, tests confirmed this effect was significantly more powerful under low- than high-elaboration, $\chi^2 = 4.46$ ($df = 1$, $N = 371$, $p = .034$). No further paths reached significance. These data support the framework proposed by the ELM by showing that under low-elaboration, confidence does not influence thought-favorability but rather directly affects attitude as a peripheral cue.

Discussion

These data confirmed our prediction that speech rate and vocal intonation influenced perceptions of speaker confidence. Importantly, this experiment is the first to demonstrate that these vocal properties influence persuasion because of how they affect the recipient's perception of speaker confidence. As predicted, these data show that at high-elaboration, perceptions of speaker confidence can bias thought-favorability. However, at low-elaboration, speaker confidence does not bias thought-favorability but rather directly affects attitudes as a cue.

Experiment 2

As previously noted, other vocal qualities beyond speech rate and intonation should influence persuasion in a similar manner as shown in Experiment 1. For example, research has shown that changes in vocal pitch reliably influence listener's judgments of a speaker on various dimensions, including competence (Brown, Strong, & Rencher, 1974), honesty (Streeter, Krauss, Geller, Olson, & Apple, 1977), and anxiety (Apple, Streeter, & Krauss, 1979), such that raised pitch elicits more negative evaluations on each dimension. Given that raised pitch is associated with negative evaluations on anxiety, and anxiety and confidence are inversely related, it follows that listeners may associate decreased confidence with raised pitch. If so, vocal pitch should function in a similar fashion as the two properties investigated in Experiment 1. Thus, an important goal of Experiment 2 was to show that the same psychological processes that emerged in Experiment 1 could also be extended to an additional vocal quality not previously investigated in the persuasion literature.

Method

Participants and design. Undergraduates ($N = 412$) were recruited in exchange for course credit and randomly assigned to condition in a 2 (elaboration: high vs. low) × 2 (vocal pitch: raised pitch vs. lowered pitch) between-participants factorial design.

Procedure. Participants listened to an audio passage that discussed the benefits of using phosphate-based laundry detergent (Shavitt & Brock, 1986). Similar procedures were used to manipulate processing ability as in Experiment 1. Motivation to process the message was influenced by using a manipulation of personal responsibility (e.g., Petty, Harkins, & Williams, 1980). Under high-elaboration, motivation was enhanced by informing participants that because very few students would be completing the survey, their feedback was especially important to the researchers. By contrast, under low-elaboration, motivation was reduced by informing participants that because so many students would be completing this survey, their responses may be discarded. Thus, any information they provide may not be read.

The audio passage was delivered by a male speaker recruited from the university psychology department and manipulated using PRAAT©, thus enabling manipulation of the speaker's pitch without altering other vocal qualities. The speaker spoke at his natural speech rate, pitch, and intonation level. Vocal pitch was manipulated by raising the pitch in the speaker's voice by 120 Hz or lowering the pitch by 20 Hz relative to the speaker's natural baseline. Research conducted in our lab using the same speaker and manipulations of pitch produced the expected effects on ratings of confidence. Raised pitch was coded as 0, lowered pitch as 1. Following the audio passage, participants assigned to low-elaboration entered the number they were given. Next, attitude toward phosphate-based laundry detergents was measured. Participants then evaluated different attributes of the speaker and the speaker's voice. Finally, participants listed up to 10 thoughts, then rated the favorability of those thoughts as either *positive, negative, neutral*, or *unrelated* (Briñol, Petty, & Tormala, 2004).

Table 1. Zero-Order Correlations of Study Variables in Experiment 2.

	1	2	3	4	5	6	7	8	9	10
1. Low pitch condition	X									
2. Confidence	.46*** [.38, .53]	X								
3. Credibility	.37*** [.28, .45]	.56*** [.49, .62]	X							
4. Competence	.35*** [.27, .44]	.61*** [.55, .67]	.62*** [.55, .67]	X						
5. Intelligence	.39*** [.30, .47]	.62*** [.56, .68]	.66*** [.6, .71]	.66*** [.6, .71]	X					
6. Knowledgeable	.32*** [.23, .40]	.56*** [.49, .63]	.69*** [.63, .74]	.65*** [.59, .7]	.74*** [.69, .78]	X				
7. Trustworthiness	.34*** [.25, .42]	.57*** [.51, .64]	.66*** [.6, .71]	.58*** [.51, .64]	.61*** [.55, .67]	.59*** [.53, .65]	X			
8. Anxiety	−.43*** [−.51, −.35]	−.41*** [−.49, −.33]	−.24*** [−.33, −.15]	−.33*** [−.42, −.25]	−.32*** [−.4, −.23]	−.28*** [−.36, −.18]	−.26*** [−.35, −.17]	X		
9. Age	.38*** [.29, .46]	.17*** [.07, .26]	.16** [.06, .25]	.13** [.03, .22]	.16*** [.07, .26]	.21*** [.11, .3]	.09 [−.01, .18]	−.18*** [−.27, −.08]	X	
10. Honesty	.30*** [.20, .38]	.48*** [.41, .55]	.59*** [.52, .65]	.47*** [.39, .54]	.53*** [.46, .6]	.58*** [.51, .64]	.70*** [.65, .75]	−.22*** [−.31, −.13]	.07 [−.03, .16]	X
11. Sincerity	.22*** [.13, .31]	.51*** [.44, .58]	.52*** [.45, .59]	.46*** [.38, .53]	.50*** [.42, .57]	.47*** [.39, .54]	.64*** [.58, .69]	−.17*** [−.26, −.07]	.01 [−.08, .11]	.54*** [.47, .61]

Note. Values in larger font are the estimated Pearson correlations, with smaller values beneath (in square brackets) representing the 95% confidence intervals around those estimates.
*$p < .05$. **$p < .01$. ***$p < .001$.

Measures

Attitude scale. The identical measure was used as in Experiment 1 (Cronbach's $\alpha = .92$).

Speaker attributes and vocal qualities questionnaire. Of 12 items, three (confidence, pitch, and naturalness)[8] were of primary theoretical interest. Nine items (age, honesty, sincerity, intelligence, knowledgeable, competence, trustworthiness, credibility, and anxiety) were included for exploratory purposes. Ratings of confidence, pitch, and naturalness were always presented first. All remaining items were randomized. Ratings of speaker pitch ranged from −3 (*very low*) to +3 (*very high*). All remaining questions used identical scaling (1 = *not at all*, to 7 = *a great deal*), except ratings of speaker age, which were open-ended.

Thought listing and rating task. The identical measures and coding procedures were used as in Experiment 1, with the exception that participants could list a maximum of 10 rather than 12 thoughts. Evaluations of thought-favorability and thought relevance used the same independent raters and identical procedures as Experiment 1. Interrater agreement on both thought-favorability (89%) and thought relevance (87%) was high.

Results

Elaboration manipulation check. As in Experiment 1, the first goal was to evaluate whether the elaboration manipulation was successful. Once again, carefully processing the message should result in a significantly greater proportion of relevant thoughts than not carefully processing the message. This was tested by conducting an ANOVA, with vocal pitch and elaboration conditions as independent variables and the proportion of relevant thoughts as the dependent variable. As expected, participants assigned to high-elaboration ($M = .71$, $SE = .02$, 95% CI = [.67, .76]) generated a greater proportion of relevant thoughts than low-elaboration ($M = .62$, $SE = .02$, 95% CI = [.57, .67]), $F(1, 401) = 7.83$, $p = .005$, $\eta p^2 = .02$. Against expectations, a main effect of vocal pitch emerged, $F(1, 401) = 14.35$, $p < .001$, $\eta p^2 = .04$, revealing that lowered pitch ($M = .73$, $SE = .02$, 95% CI = [.68, .78]) elicited a greater proportion of relevant thoughts than raised pitch ($M = .61$, $SE = .02$, 95% CI = [.56, .65]). No interaction was predicted or found, $F(1, 401) = .38$, $p = .540$, $\eta p^2 = .00$. These data indicate that the elaboration manipulation was successful.

Evaluation of vocal confidence measure. We hypothesized that lowered pitch should elicit perceptions of higher speaker confidence. This was tested by conducting an ANOVA, with vocal pitch and elaboration as the independent variables and ratings of speaker confidence as the dependent variable. Critically, lowered pitch ($M = 4.63$, $SE = .10$, 95% CI = [4.43, 4.83]) elicited higher ratings of confidence than raised pitch ($M = 3.12$, $SE = .10$, 95% CI = [2.92, 3.32]), $F(1, 408) = 109.43$, $p < .001$, $\eta p^2 = .21$. Although there was no basis to expect a main effect of elaboration, participants assigned to the low-elaboration condition ($M = 4.02$, $SE = .10$, 95% CI = [3.82, 4.22]) provided higher ratings of confidence than those in the high-elaboration condition ($M = 3.73$, $SE = .10$,

Table 2. Zero-Order Correlations of Study Variables in Experiment 3.

	1	2	3	4
1. Low pitch condition	X			
2. Confidence	.35*** [.26, .43]	X		
3. Confidence—Correctness	.09 [–.01, .18]	.49*** [.41, .56]	X	
4. Confidence—Clarity	.03 [–.07, .13]	.47*** [.39, .55]	.68*** [.63, .73]	X
5. Confidence—Delivery	.38*** [.29, .46]	.71*** [.66, .76]	.59*** [.53, .65]	.56*** [.49, .63]

Note. Values in larger font are the estimated Pearson correlations, with smaller values beneath (in square brackets) representing the 95% confidence intervals around those estimates.
*p < .05. **p < .01. ***p < .001.

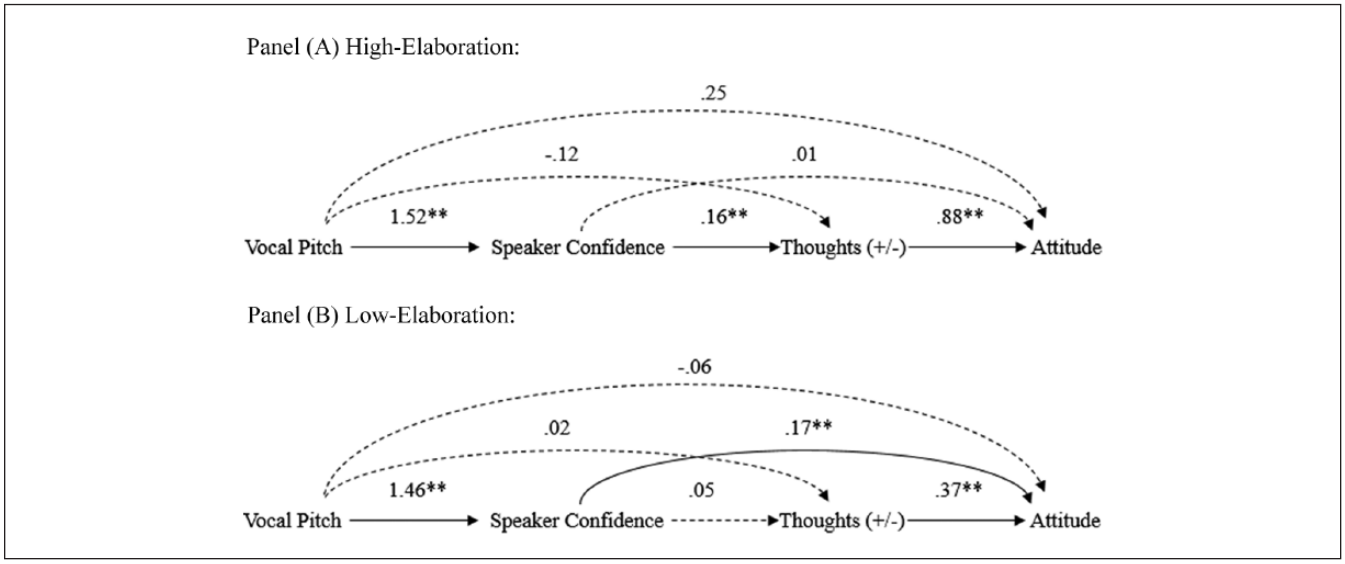

Figure 3. Vocal confidence and cognitive responses as mediators of the relationship between vocal pitch and attitude (Experiment 2).
*p < .05. **p < .01. ***p < .001.

95% CI = [3.53, 3.92]), $F(1, 408) = 4.17$, $p = .042$, $\eta p^2 = .01$. Importantly, no interaction between vocal pitch and elaboration emerged, $F(1, 408) = .001$, $p = .974$, $\eta p^2 = .00$. This indicated that the effects of vocal pitch on ratings of confidence did not differ significantly across elaboration levels.

The effects of vocal pitch and elaboration on attitudes. Next, the effects of vocal pitch and elaboration on participants' attitudes were examined by conducting an ANOVA with vocal pitch and elaboration as the independent variables and attitude as the dependent variable. Recall that in Experiment 1 the possibility of an overall effect of vocal properties on attitude was hypothesized, with the caveat that their distal position in the causal chain could reduce or weaken this effect. Similar logic guided predictions for vocal pitch. Results indicated lowered pitch ($M = 4.89$, $SE = .08$, 95% CI = [4.74, 5.04]) elicited more persuasion than raised pitch ($M = 4.60$, $SE = .08$, 95% CI = [4.45, 4.75]), $F(1, 408) = 7.26$, $p = .007$, $\eta p^2 = .02$, suggesting the effects of vocal pitch were strong enough to influence attitudes. No other effects were predicted or found.

Vocal confidence as a biasing factor and peripheral cue. As in Experiment 1, the critical analysis utilized a multisample structural equation model that tested the psychological processes the ELM predicts should emerge under different levels of thought. Similar patterns were anticipated as those in Experiment 1. The results for both path models are represented in Figure 3 and report unstandardized coefficients for each path. Dotted lines indicate nonsignificant paths.

Under high-elaboration, as seen in Panel A of Figure 3, vocal pitch, $b = 1.52$, $SE = .22$, $p < .001$, influenced perceptions of speaker confidence as predicted. Next, confidence should bias the favorability of a person's thoughts. As

anticipated, evidence of bias was supported by the data, b = .16, SE = .03, $p < .001$. Importantly, because participants were presumed to be engaged in careful thought, thoughts should have a robust effect on postmessage attitude. Indeed, the data revealed this was the case, b = .88, SE = .11, $p <$ .001. Finally, recall that under high-elaboration, speaker confidence should bias thought-favorability but have little direct impact on attitude as a peripheral cue. Indeed, this cue effect did not emerge, b = .01, SE = .05, p = .813. In line with the ELM, no further paths reached significance. As in Experiment 1, these data reveal a pattern of effects consistent with the proposed theoretical framework.

Turning to low-elaboration, as found in Panel B of Figure 3, vocal pitch influenced perceptions of speaker confidence as predicted, b = 1.46, SE = .21, $p < .001$. Because people should be equally adept at detecting changes in pitch regardless of how carefully they are thinking, similar effects of pitch on confidence were expected across levels of elaboration. Indeed, comparing this coefficient with its high-elaboration counterpart revealed similar numerical values, χ^2 = .04 (df = 1, N = 358, p = .841).

Next, recall that when ability and/or motivation to carefully process a message are lacking, the ELM predicts speaker confidence should have a comparatively weak effect on thought-favorability, b = .05, SE = .04, p = .233. Comparing these coefficients across levels of elaboration confirmed that confidence was a better predictor of thoughts under high- compared with low-elaboration, χ^2 = 5.20 (df = 1, N = 358, p = .023). Importantly, although thoughts should still have some influence on attitudes under low-elaboration, b = .37, SE = .10, $p < .001$, this effect should be weaker than under high-elaboration. Once again, testing these coefficients across elaboration revealed the expected effect, χ^2 = 10.81 (df = 1, N = 358, $p < .001$).

Finally, under low-elaboration, speaker confidence should directly influence attitudes as a peripheral cue. Thus, a significant positive coefficient was expected, which emerged as anticipated, b = .17, SE = .05, p = .001. Importantly, this effect was more powerful under low- than high-elaboration, χ^2 = 4.59 (df = 1, N = 358, p = .036). No further paths reached significance. Importantly, these data replicate the patterns in Experiment 1 while also extending the findings to an additional vocal determinant of perceived speaker confidence.

Testing potential alternative mediators. Despite providing evidence that perceptions of speaker confidence mediate the effects of speech rate, intonation, and pitch on persuasion, this does not preclude that other perceived attributes of the speaker could also mediate this relationship. If confidence is correlated with other perceived speaker attributes, it is possible that it might only appear to function as a mediator because it serves as a proxy for a different attribute. Thus, Experiment 2 measured a variety of other potentially relevant attributes to better evaluate if confidence is the most plausible mediator driving the effects of these vocal qualities on persuasion. Specifically, Experiment 2 assessed perceptions of the speaker's credibility, competence, intelligence, knowledgeability, trustworthiness, anxiety, age, honesty, and sincerity (Table 1 presents correlations between these variables).

Similar multisample structural equation models as reported in Figure 3 were employed to evaluate whether any of these additional attributes served in a mediating role and produced the same bias and cue effects predicted under conditions of high- and low-elaboration. The results of these analyses revealed that none of these attributes produced the expected pattern of effects under either level of elaboration, with the exception of sincerity. More specifically, in each analysis, at least one but in many cases several of the expected paths under high- and low-elaboration failed to emerge.

However, in the case of sincerity, the data revealed the anticipated mediational patterns via the bias and cue effects. Thus, to evaluate whether confidence may serve as a proxy for sincerity and thus not be the actual mediator of vocal pitch on persuasion, the identical analyses were conducted, but in this case included both confidence and sincerity as potential mediators. Supporting the perspective that perceptions of speaker confidence are responsible for the effects of vocal qualities, analyses indicated that the bias and cue effects for confidence predicted by the ELM under high- and low-elaboration remained significant, while at least one path under each level of elaboration for sincerity dropped to nonsignificance.

Discussion

This study presents the first evidence for persuasion effects of vocal pitch. Moreover, it suggests that like other vocal qualities that influence perceptions of confidence, pitch affects persuasion via the same confidence-based bias and cue processes. Critically, by testing potential alternative mediators, these data strengthen the claim that confidence is a mediator responsible for the effects of pitch on persuasion. None of the more specific beliefs regarding the speaker proved to be a viable alternative to global judgments of speaker confidence. Most notably, speaker credibility and related judgments, which have sometimes been postulated in past research to account for speech rate effects, failed to emerge as significant mediators.

Experiment 3

Experiments 1 and 2 found consistent support for speaker confidence as the mechanism by which vocal qualities influenced persuasion under high and low thinking. However, in these experiments, confidence was treated as a general and unidimensional construct. After all, when reacting to properties of the voices of others, listeners may infer general perceptions of confidence without spontaneously partitioning these perceptions into more specific subdimensions that

ultimately influence subsequent judgments. However, it is also plausible that they do infer more specific dimensions and that all or some subset of these judgments is actually responsible for the effects we observed in prior experiments. The goal of Experiment 3 was to evaluate these two competing possibilities.

As noted in the introduction, the literature on vocal perceptions has never formally articulated whether perceptions of speaker confidence should be regarded as unidimensional or multidimensional. However, this literature suggests that to the extent such specific beliefs do comprise confidence, they might in part parallel the clarity and correctness dimensions identified in the attitude certainty literature. In addition, it could also in part reflect the extent to which speakers are perceived as comfortable in their ability to communicate their views. Measures were constructed for each of these three potential dimensions of speaker confidence and subsequently evaluated for their viability as mediators of cue and bias effects in persuasion.

Method

Participants and design. Undergraduates (N = 397) were recruited in exchange for course credit and randomly assigned to condition in a 2 (elaboration: high vs. low) × 2 (vocal pitch: raised pitch vs. lowered pitch) between-participants factorial design.

Procedure. Participants were first exposed to some general instructions, which once again included identical manipulations of ability and motivation designed to either increase (high-elaboration) or decrease (low-elaboration) careful processing of the message. Next, participants listened to the audio recording from Experiment 2, with identical manipulations of vocal pitch. Raised pitch was coded as 0, lowered pitch as 1. Following the audio recording, low-elaboration participants entered the number they were given. Next, all participants indicated their attitudes toward phosphate-based detergents. After this, participants rated the speaker on several dimensions (pitch, naturalness, then confidence), then completed three blocks of more specific confidence items, with the order of blocks randomized. Participants then estimated the speaker's age. Finally, participants listed and rated up to 10 thoughts as in Experiment 2.

Measures

Attitude scale. The measure from Experiments 1 to 2 was used again (Cronbach's α = .88).

Vocal qualities questionnaire. Identical measures of speaker pitch,[9] naturalness, confidence (single-item), and age were used as in Experiment 2. The speaker attribute items (e.g., credibility, intelligence) were discarded because they failed to produce clear effects.

Confidence subscales. Three distinct subcomponents of confidence that could be implied by a speaker's vocal signals were selected, each represented by three items. First, a correctness subscale (α = .85) assessed how confident the speaker seemed to be in the validity of his attitude and arguments in support of it (e.g., "To what extent does the speaker seem to believe that he has strong arguments in favor of using phosphate detergents?"). Second, a clarity subscale (α = .84) assessed to what extent the speaker seemed clearly aware of his own opinion (e.g., "To what extent does the speaker seem to have a clear notion of where he stands regarding the use of phosphate laundry detergents?"). Third, confidence in delivery (α = .87) measured the speaker's apparent confidence in his ability to communicate clearly (e.g., "To what extent does the speaker seem confident that he is clearly expressing himself?"). All items used identical 7-point scaling (1 = *not at all*, 7 = *a great deal*). Item order was randomized within each block, and block order was also randomized.

Thought listing and rating task. Identical measures and coding procedures were used as in prior experiments. Interrater agreement on both thought-favorability (84%) and thought relevance (85%) was once again high.

Results

Elaboration manipulation check. Using the same analytical approach as prior experiments, tests were conducted to evaluate the success of the elaboration manipulation. As expected, participants assigned to high-elaboration (M = .80, SE = .02, 95% CI = [.76, .83]) generated a greater proportion of relevant thoughts than those assigned to low-elaboration (M = .68, SE = .02, 95% CI = [.64, .72]), $F(1, 387) = 16.88$, $p < .001$, $\eta p^2 = .04$), thus confirming that the elaboration manipulation was successful. As in Experiment 2, lowered pitch (M = .79, SE = .02, 95% CI = [.75, .83]) elicited a greater proportion of relevant thoughts than raised pitch, (M = .69, SE = .02, 95% CI = [.65, .72]), $F(1, 387) = 14.74$, $p < .001$, $\eta p^2 = .04$. No interaction was predicted or found, $p = .621$.

Evaluation of general vocal confidence measure. As was done in Experiment 2, analyses were conducted to test whether lowered pitch elicited perceptions of higher speaker confidence.[10] Confirming expectations, lowered pitch (M = 4.14, SE = .10, 95% CI = [3.93, 4.34]) elicited higher ratings of confidence than raised pitch (M = 3.05, SE = .10, 95% CI = [2.85, 3.25]), $F(1, 393) = 54.93$, $p < .001$, $\eta p^2 = .12$. A main effect of elaboration was not predicted and did not emerge, $F(1, 393) = 2.18$, $p = .141$, $\eta_p^2 = .01$. The interaction between vocal pitch and elaboration just failed to reach significance, $F(1, 393) = 3.58$, $p = .059$, $\eta p^2 = .01$. This suggests that, at most, effects of vocal pitch on ratings of confidence varied only slightly across levels of elaboration.

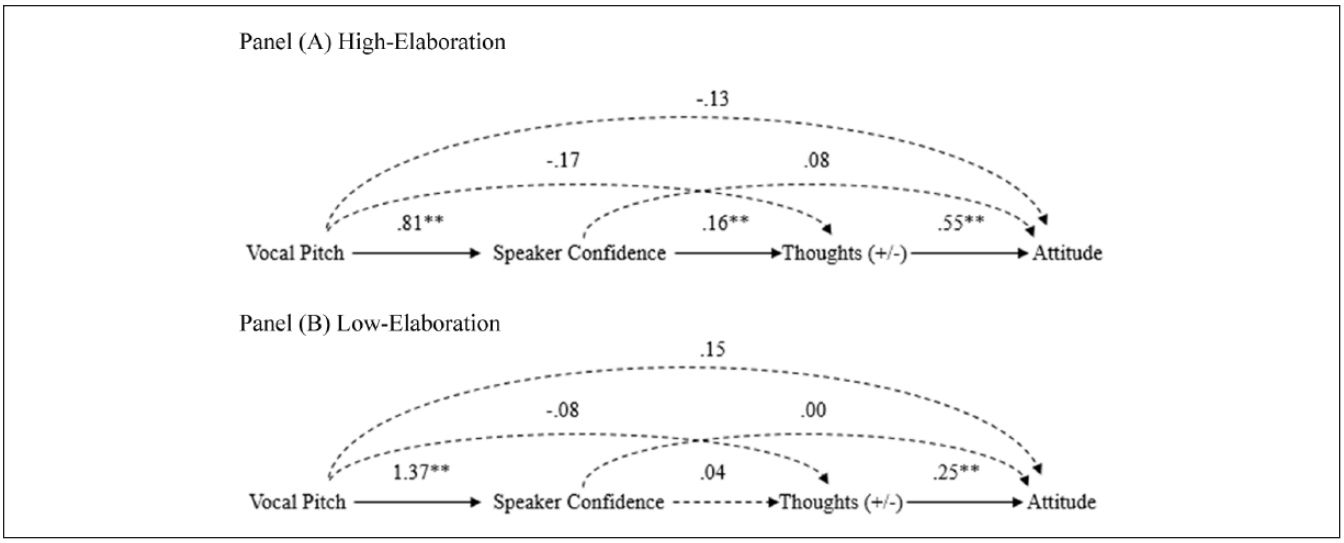

Figure 4. Vocal confidence and cognitive responses as mediators of the relationship between vocal pitch and attitude (Experiment 3). *p < .05. **p < .01. ***p < .001.

The effects of vocal pitch and elaboration on attitudes. As in Experiment 2, the effects of vocal pitch and elaboration on participants' postmessage attitudes were examined. Recall that in Experiment 2 the possibility of an overall effect of pitch on attitude was hypothesized with the caveat that its distal position in the causal chain may preclude this effect from emerging. Contrary to Experiment 2, pitch had no effect on attitude, $F(1, 393) = .07$, $p = .798$, $\eta p^2 = .00$. No further effects were predicted and none emerged (ps > .234).

Vocal confidence as a biasing factor and peripheral cue. As in the prior experiments, a multisample structural equation model was employed to test the psychological processes predicted by the ELM under different amounts of thought (see Figure 4).

Under high-elaboration, as seen in Panel A of Figure 4, vocal pitch, $b = .81$, $SE = .21$, $p < .001$, influenced perceptions of speaker confidence as predicted. Next, confidence should bias the favorability of a person's thoughts. As anticipated, evidence of bias was supported by the data, $b = .16$, $SE = .03$, $p < .001$. Importantly, because participants were presumed to be engaged in careful thought, we expected and found that thoughts had a robust effect on postmessage attitude, $b = .55$, $SE = .11$, $p < .001$. Finally, recall that under high-elaboration, speaker confidence should bias thought-favorability but have little direct impact on attitude as a peripheral cue. Indeed, this cue effect did not emerge, $b = .08$, $SE = .05$, $p = .093$. No further paths reached significance.

Turning to low-elaboration, as found in Panel B of Figure 4, vocal pitch influenced perceptions of speaker confidence as predicted, $b = 1.37$, $SE = .22$, $p < .001$. Because our theoretical framework suggests that people should be able to detect changes in pitch across levels of thinking, similar effects of pitch on confidence were expected across elaboration conditions. This coefficient did not significantly differ from its counterpart in Panel A, although the test approached significance, $\chi^2 = 3.27$ ($df = 1$, $N = 373$, $p = .070$).

Next, under low-elaboration, speaker confidence should have little effect on thought-favorability, $b = .04$, $SE = .04$, $p = .264$. Comparing these coefficients across levels of elaboration confirmed that confidence was a better predictor of thoughts under high- compared with low-elaboration, $\chi^2 = 6.03$ ($df = 1$, $N = 373$, $p = .014$). Importantly, although thoughts should still influence attitudes under low-elaboration, $b = .25$, $SE = .09$, $p = .005$, this effect should be weaker than under high-elaboration. Once again, testing these coefficients across elaboration revealed the expected difference, $\chi^2 = 4.59$ ($df = 1$, $N = 373$, $p = .032$).

Finally, under low-elaboration, speaker confidence should directly influence attitudes as a peripheral cue. However, this effect did not emerge, $b = .00$, $SE = .05$, $p = .924$. Follow-up tests confirmed no difference in the magnitude of this effect across levels of elaboration, $\chi^2 = 1.61$ ($df = 1$, $N = 373$, $p = .204$). No further paths reached significance. Thus, with the single exception of the confidence to attitude path under low-elaboration, these analyses replicated the patterns found in Experiments 1 and 2.

Specific dimensions of speaker confidence as mediators. The final set of analyses examined whether people's perceptions of specific dimensions of speaker confidence were responsible for the persuasion effects rather than more global perceptions of speaker confidence (Table 2 presents correlations between the general and specific confidence variables). This was tested for each of the three specific dimensions of speaker confidence, using identical analyses as the multisample structural equation model reported in the previous subsection. The results of these analyses revealed

that clarity and correctness failed to produce the expected pattern of effects under high- and/or low-elaboration. In each analysis, at least one but in some cases several of the expected paths under high- and/or low-elaboration failed to emerge. In addition, expected differences in coefficients across levels of elaboration sometimes failed to emerge.

However, the measure of confidence in delivery produced a pattern of effects very similar to global confidence, although the predicted difference in the confidence-in-delivery to thought-favorability coefficient across levels of elaboration did not emerge as it had for global confidence. Nonetheless, to more fully evaluate the viability of this specific dimension, analyses were conducted that included both global confidence and confidence in delivery as potential mediators (supplementary analyses also indicated that this was the specific dimension most strongly correlated with global confidence). Supporting the role of global confidence, all significant effects in Figure 4 including those involving global confidence remained significant. However, several key effects of confidence in delivery disappeared in this analysis. Thus, combined analyses suggested that people seemed to primarily respond to general confidence rather than more specific dimensions of confidence.

Discussion

Experiment 3 replicated Experiment 2 with only two exceptions: An overall effect of pitch on attitudes did not emerge, and the multisample mediational analyses failed to obtain the direct confidence to attitude effect under low-elaboration. All other predicted effects emerged. New to Experiment 3 was an investigation of the potential mediating role of more specific dimensions of speaker confidence. Ultimately, none of the three specific dimensions proved to be a viable alternative to global judgments of speaker confidence.

General Discussion

Summary of Findings

The present studies provided clear evidence that increased speech rate and falling intonation (Experiment 1), as well as lowered pitch (Experiments 2 and 3) produced perceptions of enhanced speaker confidence. In the case of speech rate and vocal intonation, these characteristics combined in an additive fashion to influence perceptions of confidence. Moreover, as hypothesized, all three experiments indicated that these perceptions of confidence influenced subsequent persuasion. Under conditions of low-elaboration, people used perceptions of speaker confidence to directly infer their postmessage attitudes in two of the three experiments. Under conditions of high-elaboration, in all three experiments, confidence biased the valence of thoughts and these thoughts in turn served as the basis for postmessage attitudes. In addition, Experiments 2 and 3 evaluated possible alternatives to general vocal confidence and found no evidence for these other judgments playing a role in the observed effects.

Implications

Although oral exchanges constitute a large portion of real-world persuasion, researchers have neglected exploration of vocal properties in persuasion, with previous persuasion research confined to studying speech rate. The present studies go beyond this work by providing the first assessments of the persuasive effects of two additional properties of voice: intonation and pitch.

Moreover, the present research proposed and provided the first evidence for two mechanisms by which these two newly studied properties, as well as the previously studied rate of speech, influence persuasion. Specifically, it was proposed that central to the effects of all three vocal properties is their influence on perceptions of global confidence. Confidence perceptions can influence persuasion by either serving as a peripheral cue under low-elaboration or biasing the valence of issue-relevant responses to the message under high-elaboration.

This perspective differs from prior discussions of speech rate in several important ways. First, prior discussions of speech rate effects have never highlighted speaker confidence as a relevant construct. Rather, some researchers have argued that perceptions of speaker credibility might play a role in these effects (e.g., Miller et al., 1976; S. M. Smith & Shaffer, 1995). As we noted, however, evidence in support of this view has been equivocal. Indeed, our research further challenged this explanation by failing to reveal any evidence for a role of credibility, as demonstrated in Experiment 2. Instead, the present studies suggested that when people are forming their thoughts and/or attitudes, they are relying on more general and undifferentiated perceptions of speaker confidence rather than more specific beliefs about the speaker such as credibility.

Second, to the extent that researchers have assumed that perceptions of the speaker do play a role in the persuasion effects of vocal properties such as speech rate, these perceptions have been presumed to exert their effects under conditions of low-elaboration (e.g., see S. M. Smith & Shaffer, 1995). We too argue that they can play this role as a peripheral cue under low-elaboration (although we argue the relevant perception is speaker confidence, not credibility). However, we differ from prior views in that we also believe these perceptions are important under high-elaboration conditions. Specifically, the present studies demonstrated that these perceptions bias the valence of thoughts. The biasing role of speaker perceptions has not been considered nor tested in prior research on vocal properties. Indeed, prior discussions of speech rate have never explicitly postulated effects of speech rate on persuasion under high-elaboration. They have argued either for cue effects of credibility under

low-elaboration or argued for effects on amount of elaboration (which would be expected to occur in contexts where people are near the middle of elaboration continuum; see Petty & Wegener, 1998). Thus, the current studies suggest that vocal properties can influence even individuals who are very motivated and able to think carefully—by shaping the direction of their thoughts about a persuasive message.

Another implication of the proposed vocal confidence perspective is that it suggests that although vocal properties such as speech rate, intonation, and pitch differ on many surface features, the underlying processes by which they exert their effects are the same. All three properties influence perceptions of confidence, and perceptions of confidence influence attitudes as a cue under low-elaboration or as a biasing factor under high-elaboration. As such, both the high- and the low-elaboration confidence-driven mechanisms can be contrasted with the ability to elaborate mechanism that has been presumed to explain speech rate effects in many past studies. The logic for this ability to process mechanism is relatively specific to speech rate in that properties such as intonation and pitch would not generally be expected to have a strong impact on the difficulty of processing a message.

Although most of the present findings were comparatively consistent across experiments and followed quite directly out of our perspective, two aspects of the findings were somewhat inconsistent across studies. First, an overall effect of vocal properties on postmessage attitudes failed to consistently emerge. This effect was significant in Experiment 2 but failed to reach significance in Experiments 1 and 3. As noted in the introduction, overall effects of speech rate on attitudes have been comparatively rare. Thus, the current experiments are not discrepant with the literature. Furthermore, the fact that these effects were comparatively weak and inconsistent is not surprising given our perspective. Although vocal properties are proposed to influence postmessage attitudes, their effects are presumed to be quite indirect. For example, consider that in the context of low-elaboration, attitudes are two steps removed in the causal chain from the vocal properties (e.g., see Figure 2). In high-elaboration conditions, attitudes are three steps removed. When independent variables do not exert direct effects on the final outcome variable of interest, one would necessarily expect effects to be weaker the more distal that outcome variable is in the causal chain. Indeed, it has long been noted that tests of overall effects of independent variables on dependent variables are less powerful than the tests of mediational effects (e.g., see Rucker, Preacher, Tormala, & Petty, 2011).

Moreover, even in these data, the evidence for overall vocal property effects on attitudes is somewhat stronger than might be apparent. For example, when the effect of pitch on attitudes across Experiments 2 and 3 was meta-analyzed, this effect was significant, $r = .074$, $SE = .035$, $p = .034$, 95% CI = [.006, .143], with modest indication of heterogeneity, $Q(1) = 2.97$, $p = .085$. Thus, despite attitude forming the most distal point in a causal chain by which vocal pitch influenced attitudes, there was an aggregate pitch effect on persuasion when experiments were aggregated.

The second effect that proved somewhat inconsistent across experiments was the cue effect of vocal confidence on attitudes under low-elaboration. This effect is clearly predicted by our perspective and the evidence for it was certainly stronger than the evidence for overall effects of vocal properties on attitudes. Confidence cue effects emerged in two experiments. However, its failure to emerge in Experiment 3 was unexpected and does raise the question as to whether Experiment 3 substantially undermined the case for its existence. To evaluate this issue, the cue effect under both low- and high-elaboration conditions across our three experiments was meta-analyzed. As expected, under high-elaboration, there was no indication of a cue effect at the meta-analytic level, $r = .056$, $SE = .042$, $p = .182$, 95% CI = [–.026, .137, with no indication of heterogeneity, $Q(2) = 1.36$, $p = .507$. Importantly, under low-elaboration, the cue effect was clearly present at the meta-analytic level, $r = .177$, $SE = .042$, $p < .0001$, 95% CI = [.095, .259], with significant heterogeneity, $Q(2) = 8.35$, $p = .015$. Thus, the three experiments provide collective support for this direct effect of global confidence on attitude when individuals are not thinking carefully. Furthermore, a meta-analytic test of the difference between these effects across elaboration confirmed the prediction that the effect is stronger under low-elaboration than high-elaboration, $b = .122$, $SE = .059$, $p = .039$, 95% CI = [.006, .237].

Overall then, there was robust evidence that vocal properties can influence attitudes via perceptions of speaker confidence biasing thoughts under high-elaboration. The evidence for vocal properties producing cue effects under low-elaboration is somewhat less robust, but still substantial. These processes clearly provide a different account of the mechanisms by which vocal properties influence persuasion than has traditionally been assumed in the vocal property literature. At a more general level, these experiments can also be viewed as contributing to the broader literature on the ELM perspective. The present studies provide yet another test of the ELM's ability to organize a broad range of variables into a cohesive structure that predicts how a variable will function under a diverse set of conditions and the underlying psychological processes responsible for its effect on attitudes. This notion of multiple roles has been successfully applied to a host of variables (see, Petty, Rucker, Bizer, & Cacioppo, 2004). The present data show that this framework also applies in the context of vocal properties.

Future Directions

While the present experiments certainly constitute a useful step forward in understanding the persuasion effects of vocal properties, they of course also suggest issues for future research. One possibility might be to investigate the

processes by which vocal properties affect persuasion at other levels of the elaboration continuum. Specifically, in these studies, the focus was on high and low levels of elaboration. However, the ELM postulates a different process when people are in the middle of the elaboration continuum. Here the ELM suggests that the primary effect of vocal properties should be to influence the amount of processing. In this context, one might expect that properties affecting speaker confidence should influence a listener's motivation to attend to the message because people might be more motivated to listen to a confident speaker. Importantly, one would not necessarily expect all vocal properties to function in the same way. For example, whereas speech rate, intonation, and pitch should all affect perceptions of confidence and thus influence motivation to process a message in a similar manner, ability to process may be influenced in different ways. Specifically, fast rates of speech may negatively affect the listener's ability to process a message (as postulated in much of the prior literature). However, there is no compelling basis to suggest that variability in vocal intonation or pitch should necessarily affect ability. Thus, although all three variables might be expected to function similarly under high- and low-elaboration conditions, their effects could be more distinct under moderate-elaboration.

Likewise, the present studies only investigated three properties of voice. However, the vocal perception literature suggests that people are sensitive to more than just these three properties. Testing the effects of additional properties (e.g., loudness) under varying levels of elaboration would be useful. Our view suggests that for any property known to alter perceptions of speaker confidence, one might expect similar effects as the present properties under high- and low-elaboration. However, under moderate-elaboration, variables might be expected to have different effects depending on whether they influence both motivation and ability to elaborate versus just motivation. Testing these predictions would provide a more comprehensive picture of the roles played by different properties of voice in persuasive communication.

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Notes

1. The elaboration likelihood model (ELM) proposes three ways a variable can influence attitudes under high-elaboration. Although we focused on the role of confidence as a biasing factor, the ELM suggests variables can also serve as an argument for or against an advocacy or in a self-validating role. Speaker confidence could serve as an argument if communicating with confidence was directly relevant to the advocacy, such as advertising a course on public speaking. Variables that serve in a self-validating role by enhancing or reducing confidence in one's thoughts often have the greatest impact when they are introduced after the message has been received. Thus, because how a speaker communicates is inherently part of the message, speaker confidence is unlikely to serve in a self-validating role.
2. As sample size relates to issues of power, the analyses most sensitive to sample size were the multisample structural equation model (SEM) conducted in Studies 1 and 2. A minimum of 10 participants per free parameter is recommended. Given that our multisample SEM analyses for Study 1 had 15 free parameters in both high- and low-elaboration groups, we required at least 150 participants per group. Our multisample SEM for Studies 2 to 3 had 12 free parameters in both groups, thus requiring at least 120 participants per group. We continued data collection for the remainder of the academic term once those values were exceeded.
3. Participants indicated the fast-talking speaker (M = 4.74, SE = .08, 95% CI = [4.59, 4.90]) spoke faster than the slow-talking speaker (M = 3.53, SE = .08, 95% CI = [3.37, 3.69]), $F(1, 386) = 116.51$, $p < .001$, $\eta p^2 = .23$. No main effect of vocal intonation emerged, $F(1, 386) = 3.29$, $p = .070$, $\eta p^2 = .01$, However, a main effect of elaboration revealed that high-elaboration participants (M = 4.30, SE = .08, 95% CI = [4.14, 4.45]) rated the speaker as talking faster than low-elaboration (M = 3.97, SE = .08, 3.82, 4.13), $F(1, 386) = 8.37$, $p = .004$, $\eta p^2 = .02$. A significant intonation by elaboration interaction, $F(1, 386) = 4.02$, $p = .046$, $\eta p^2 = .01$, revealed that high-elaboration participants perceived the speaker as talking faster when intonation rose (M = 4.51, SE = .11, 95% CI = [4.29, 4.74]), versus fell (M = 4.08, SE = .11, 95% CI = [3.87, 4.30]), $p = .007$. Under low-elaboration, no difference in ratings of intonation emerged, $p = .894$. No further effects reached significance. The absence of an interaction suggests that *constraining* processing did not affect participants' ability to detect changes in the speaker's speech rate. These data suggest our speech rate manipulation was successful.
4. In all studies, participants also rated the favorability of their thoughts. Analyses based on participants' favorability ratings produced similar but slightly weaker results as analyses based on independent coders' favorability ratings.
5. Two common alternative analyses use the total number of thoughts or the number of topic-relevant thoughts as the dependent variable. In Studies 1, 2, and 3, these analyses yielded a highly similar pattern as when proportion of relevant thoughts was the dependent variable.
6. In all studies, these relationships were also evaluated using a regression-based moderated mediation analysis. The results closely resembled those produced through multisample structural equation modeling.
7. Because all variables are measured variables and do not have multiple indicators, this model was specified such that each variable was fixed with a factor loading of 1 on its underlying construct and the associated error for each variable was set to 0. This assumes the measure is a perfect representation of its underlying construct. This assumption is implicitly made in all

ANOVA and regression-based analyses (including traditional mediational analyses) and thus is not unique to our statistical approach. In addition, our model presumed the residual variances in our endogenous variables were independent. Because mediational models of the sort we are estimating in our studies are nearly saturated, indices of global fit cannot be meaningfully interpreted in any absolute fashion as such models are virtually guaranteed to have excellent fit. Thus, we do not report global fit indices.

8. Participants rated the speaker with raised pitch (M = 3.93, SE = .10, 95% CI = [3.74, 4.12]) as having a higher pitched voice than the speaker with lowered pitch (M = 2.54, SE = .10, 95% CI = 2.34, 2.73), $F(1, 408) = 102.25$, $p < .001$, $\eta p^2 = .20$. No main effect of elaboration, $F(1, 408) = .85$, $p = .358$, $\eta p^2 = .00$, or interaction between pitch and elaboration, $F(1, 408) = 2.46$, $p = .118$, $\eta p^2 = .01$, was predicted or found. The absence of an interaction suggests that *constraining* processing did not affect participants' ability to detect changes in the speaker's pitch. These data suggest our vocal pitch manipulation was successful.
9. Participants rated the speaker with raised pitch (M = 3.50, SE = .10, 95% CI = [3.32, 3.69]) as having a higher pitched voice than the speaker with lowered pitch (M = 2.68, SE = .10, 95% CI = [2.49, 2.87]), $F(1, 392) = 36.90$, $p < .001$, $\eta p^2 = .09$. No main effect of elaboration, $F(1, 392) = 2.96$, $p = .086$, $\eta p^2 = .00$, or interaction between pitch and elaboration, $F(1, 392) = 1.72$, $p = .191$, $\eta p^2 = .00$, was predicted or found. The absence of an interaction suggests that *constraining* processing did not affect participants' ability to detect changes in the speaker's pitch. These data suggest our vocal pitch manipulation was successful.
10. To determine the effects of our manipulations on each confidence subtype, vocal pitch and elaboration were used to predict each measure separately. For confidence-correctness, no main effect of vocal pitch emerged, $F(1, 392) = 3.06$, $p = .081$, $\eta p^2 = .01$. No other effects were predicted or found (ps > .116). Likewise, for confidence-clarity, no main effect of vocal pitch emerged, $F(1, 392) = .45$, $p = .501$, $\eta p^2 = .00$. No other effects were predicted or found (ps > .078). These data revealed that correctness and clarity, two important facets of confidence, were unrelated to changes in vocal pitch and thus unlikely to be responsible for the effect of our vocal pitch manipulation on thoughts and attitudes. However, we did find an effect of vocal pitch on confidence-delivery, $F(1, 392) = 66.53$, $p < .001$, $\eta p^2 = .15$. Specifically, lowered pitch (M = 4.34, SE = .10, 95% CI = [4.15, 4.53]) elicited higher ratings of confidence-delivery than raised pitch (M = 3.23, SE = .10, 95% CI = [3.04, 3.42]). No other effects were predicted or found (ps > .064).

Supplemental Material

Supplementary material is available online with this article.

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