CURRENT RESEARCH IN SOCIAL PSYCHOLOGY
http://www.uiowa.edu/~grpproc/crisp/crisp.html

Submitted: September 10, 2019
Revised: September 21, 2019
Accepted: October 11, 2019

LEADERSHIP, GENDER, AND VOCAL DYNAMICS IN SMALL GROUPS

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ABSTRACT

Previous research shows that certain patterns of vocal dynamics in small groups are useful indicators of group status structures. In the present study, we utilize measures of non-conscious vocal dynamics to assess how expectations related to leadership status (i.e., supervisor versus assistant) combine with expectations based on external status characteristics (gender) to shape strategies for constructing and maintaining status and power hierarchies. We find that when leadership position and external status characteristics are consistent, leaders use their vocal pitch to differentiate themselves from subordinates. When leadership position and external status are inconsistent, leaders rely more on vocal accommodation, which is associated primarily with dominance perceptions.

INTRODUCTION

After several decades of work by sociologists examining vocal adaptation in group settings, Kalkhoff, Thye, and Gregory (2017) recently found that patterns of variability in nonverbal adaptation between speakers is related to listeners' perceptions of dominance within dyads. Interestingly, total speaking time and vocal pitch were linked to prestige, and the effects of these were distinct from nonverbal adaptation. Much of the research in this tradition has examined the vocal behaviors of all-male dyads. Other lines of research, however, suggest that nonverbal vocal patterns might operate differently when the gender composition and size of groups vary.

Concerning gender differences in communication, Laplante and Ambady (2002) examined differences in perceptions of leaders in situations containing "mixed messages" between the content of the speech and the speaker's vocal tone. They found that male supervisors are deemed most effective when they deliver negative evaluations but use a positive vocal tone. A reversed pattern was shown for female supervisors. In short, positive vocal tone was only effective for

men. One interpretation of these findings is that female supervisors benefit from sounding more negative as it increases the salience of their formalized position, while male supervisors' image is "softened" when they use a positive tone to deliver negative evaluations. Regardless, it appears that social status and gender can affect the way in which group members interpret leaders' vocal cues.

In what follows, we report results from an experiment in which we examine patterns of nonverbal vocal accommodation as it relates to leadership roles and gender in small task groups. We extend existing literature on vocal accommodation by comparing vocal outcomes based on the combined effects of actors' position within the group (supervisor vs. assistant) and the group's gender composition. We also build on previous work that suggests vocal pitch is tied to status and dominance perceptions. Lastly, whereas previous vocal accommodation research has focused almost exclusively on dyadic groups, this study expands the understanding of vocal dynamics and social structures by exploring how these processes play out in three-person groups.

THEORETICAL AND EMPIRICAL BACKGROUND

Decades of research on vocal dynamics in small groups has shown that patterns of convergence and accommodation within the vocal frequencies below 500 Hz are useful for modeling the status and dominance structure of small groups (Gregory and Webster 1996; Dippong and Kalkhoff 2018). That is, as individuals interact, their behaviors tend to "sync up" such that they display shared patterns of hand gestures, speech rates, and a variety of other readily observable behaviors. Along with those behaviors that are easily observed, individuals also non-consciously converge within the lower frequencies of the voice. Importantly, we know that group members do not contribute equally to vocal convergence (Dippong and Kalkhoff 2018). Rather, lower-status group members tend to move much more toward higher-status actors, and higher-status actors' voices tend to display greater stability. Recent research also highlights differences in vocal pitch as another avenue through which the voice reflects status differences.

Regarding small group status structures, expectation states researchers have suggested that diffuse status characteristics, such as race and gender, affect the ways that we perceive group leaders. In groups led by members of typically status-disadvantaged social groups (women, racial minorities, etc.), then, group members' status position within the group can be inconsistent with their status as it relates to diffuse characteristics. Preexisting expectations loom as a persistent challenge to the legitimation of such a group's status structure (Zeldtich and Walker 1984, 2000; Walker and Zelditch 1993). Even when status-disadvantaged actors are successful in obtaining localized endorsement, however, their initial disadvantage based on diffuse characteristics often carries over into new situations.

Ridgeway (1997) explains how gender inequality is routinely re-created and reinforced in social interactions by routinized behavior that communicates referential beliefs favoring men. In particular, Ridgeway argues that ideas about generalized competencies favor men and thus produce performance expectations that favor men in mixed-gender groups. Rashotte and Webster (2005) argue that even though gender is salient in the vast majority of social interactions, researchers have yet to offer empirical evidence that identifies the "subtle mechanisms" that perpetuate gender-based inequalities. Foschi (2000) and others (Foddy and Smithson 1989) have

previously offered one "subtle mechanism" when they argued that "stricter standards" exist for individuals in possession of lower diffuse status characteristics when it comes to creating the impression they can competently contribute to the group's task. It follows then that women in mixed-gender groups likely must work harder than men to be perceived as effective leaders.

Regarding status inconsistency, Fişek et al. (2005) posit that it is easier for actors who emit consistently high-status cues to succeed in dominating others than it is for those who send mixed messages. Cues that invoke multiple and consistent beliefs about status and/or ability have the capacity to create, challenge, or reinforce relevant performance expectations and beliefs about how others will view local status arrangements. Further, some researchers suggest that gender affects the way group members evaluate such information (Foddy and Smithson 1989; Foschi 2000; Eagly and Karau 2002). Accordingly, status cues, status characteristics, and status outcomes are interdependent, socially managed, subject to the effects of gender norms, and gendered forms of talk and interaction (Ridgeway 1988; Ridgeway and Diekema 1989; Foschi 2000).

We argue that assessing variability within the paraverbal band of group members' voices, as well as vocal pitch, will allow us to assess how the effects of gender and leadership status combine in small task groups (Kalkhoff et al. 2017). To date, researchers have primarily used this approach to evaluate the status and power structure in same-sex dyads. It is possible that examining vocal accommodation and pitch will shed light on how group members construct hierarchies of power and prestige differently when formalized in-group status positions are consistent with external status, compared to when these are inconsistent. Building on this argument, we offer the following hypotheses:

H1) Group leaders will demonstrate greater vocal stability than assistants
H2) Group leaders will demonstrate higher vocal pitch than assistants

We also expect that participant gender will interact with leadership status. Given the general lack of empirical work on vocal accommodation in mixed-sex groups, however, we offer no specific hypotheses in this regard, other than to state that we anticipate a significant interaction effect.

In sum, patterns of nonverbal vocal adaptation and vocal pitch are two ways that the "work" of communicating status and power perceptions is likely to be evident. If men are presented with a "lower bar" to clear in establishing leadership, we expect that they may not need to be as vocally dominant as women leaders in the same situations. Rather, male leaders might be able to employ other vocal strategies aimed at enhancing their apparent competence, likability, and prestige – such as increasing their relative overall vocal pitch – a strategy far riskier to employ for women.

METHODS

We present results from a laboratory experiment examining how occupying the status of group leader versus assistant shapes patterns of vocal accommodation and other vocal behaviors. The data for the present study were originally collected as part of a separate study of leadership and legitimacy. Our analyses employ audio recordings of group interactions, as well as post-study questionnaire data from participants.

Procedures

Participants volunteered for a study on creativity. The study involved two phases: 1) a leadership manipulation phase; and 2) an interaction phase in which group members worked together to generate ideas for a creative task.

Leadership Manipulation. Upon arrival at the lab, participants were escorted to a group discussion room, and provided informed consent. Next, participants completed a pre-test questionnaire that asked about grade history, work history, and other leadership positions they have occupied. The questionnaire also contained a brief creativity measure. An experimenter collected the completed questionnaires, and left the room for a few minutes. Upon returning, the experimenter explained that past research indicated that the task they would be working on together would benefit if the group had a good leader. In half of the groups, participants were informed that the group leader was selected based on leadership ability. In the other half, participants learned that the group leader was selected at random.

Group Discussion. Participants were informed that they had been hired to write a radio commercial to recruit out-of-state students to their large, Southern United States, public university. Participants were seated in pre-designated positions (by Supervisor and Assistant roles) around a circular table. Three separate video cameras were positioned to record the groups' discussion. Participants were given twenty minutes to complete the task. Following the group task, the experimenter returned and participants completed a brief questionnaire, which included items assessing their perceptions of each other, as well as demographic questions.

Dependent Variable. The primary dependent variable for our analyses is the degree of vocal accommodation between group members. Following previous research we employ a measure known as Acoustic Analysis Result (AAR). AAR quantifies the degree of stability/ variability within the paraverbal frequencies of actors' voices across an interaction. The assumption underlying AAR is that a higher degree of frequency variability reflects increased movement toward an interaction partner (Dippong and Kalkhoff 2018). Higher AAR values correspond to greater stability in the paraverbal vocal frequencies. Accordingly, we anticipate that assistants' vocal behaviors will demonstrate greater variability, and consequently, will produce lower AAR values. We utilize audio data from the three video recordings of group interactions. We analyze only those groups in which all three members voices were captured with sufficient clarity on at least one of the recording sources.

After isolating each group member's audio file, we employed Fast Fourier Transform (FFT) to convert the audio signals into quantitative values. FFT analyses convert the time domain to the frequency domain, producing output that reflects the amplitude (in decibels) of the voice at each frequency point. Focusing only on the frequencies at or below 500 Hz, and following previous research, we employ principle components analyses to estimate the relative stability in each group member's voice. Please see Dippong and Kalkhoff (2018) for a complete overview of procedures for calculating AAR.[1]

Independent Variables. Our focal independent variable is a dichotomous indicator of the participants' experimentally manipulated position within the group. If a participant was assigned to the leadership position, *Supervisor* = 1. Otherwise, *Supervisor* = 0. We also control for a variety of vocal characteristics, including vocal pitch, the total time (in seconds) that each group members spoke, and the average degree of convergence that group members achieved with each other. We calculate convergence by averaging the bivariate correlations between group members' paraverbal frequencies across three separate temporal segments of the discussion. Because using AAR to assess vocal accommodation assumes that the actor with greater variability is moving *toward* another actor, we ensure that the average convergence score for all of our groups is positive.

Our models also control for individual and group characteristics. Concerning individuals, we control for participants' age (in years), academic level (0 = freshman, 1 = sophomore, etc.), and gender (1 = female). In terms of group characteristics, we control for the gender composition of the group. There were four different group structures (female leader/ male assistants; female leader/ female assistants; male leader/ female assistants; male leader/ male assistants). We include a dummy variable indicating female-led groups, with male-led groups as the comparison. Lastly, because both group role (supervisor vs. assistant) and gender function as status characteristics, we include an interaction term to assess the potential moderating effects of gender on supervisor - assistant position.[2]

RESULTS

We present results from 25 three-person discussion groups. Although the original project from which we draw our data involved 71 groups, the original audio data were not collected explicitly for acoustic analyses. As such, a substantial number of the recordings were of insufficient quality to derive our vocal measures.

Table 1 presents descriptive statistics for our analytical sample. As can be seen in Table 1, our participants were on average around 20 years old (range = 18 - 31 years), and 73 percent of participants were in either their freshman or sophomore year in college. Regarding group structure, five groups were comprised of only female members, five consisted of only male participants, six groups involved a female supervisor working with two male assistants, and nine involved a male supervisor working with female assistants.

To assess the effectiveness of the leadership manipulation, we employ two items from the post-experiment questionnaire. The first item asked participants to rate the extent to which position assignments within their group were appropriate (1 = very appropriate; 7 = very inappropriate). Across all groups, the mean appropriateness score was 3.15, reflecting a generally weak tendency to view group positions as appropriately assigned. Foreshadowing a complex relationship between gender and leadership position, however, groups with female supervisors and male assistants rated the positions as less appropriate compared to groups with male supervisors and female assistants (t = -2.311; df = 40; two-tailed p = .026). The second manipulation check asked participants to rate whether the supervisor was a good leader (1 = good; 7 = bad). Overall, participants rated supervisors as good leaders (mean = 2.50; sd = 1.46), and there was no significant difference based on supervisor gender.

Table 1. Descriptive Statistics & Group Characteristics for 25 Triads (*N* = 75)

Variable	Total Sample	Assistant Positions	Supervisor Position
Vocal Accommodation (AAR)	.523 (.326)	.512 (.333)	.546 (.318)
Vocal Pitch	308.402 (130.644)	276.346 (128.740)	372.515 (111.197)
Speaking Time (in seconds)	206.560 (111.413)	221.040 (119.690)	87.831 (111.197)
Convergence	.297 (.172)	.302 (.163)	.287 (.191)
Age	19.960 (2.539)	20.020 (2.684	19.840 (2.267)
Academic Year			
Freshman	.48	.58	.42
Sophomore	.25	.20	.42
Junior	.09	.11	.08
Senior	.09	.11	.08
Group Structure			
All Female Group	.20		
All Male Group	.20		
Female Supervisor	.24		
Male Supervisor	.36		

Turning to our substantive analyses, Table 2 presents regression results predicting vocal accommodation (AAR) from leadership position (standard errors adjusted for group-level clustering). As can be seen in model 1, when group position is the sole predictor, it is not significantly related to vocal accommodation. When we add controls for vocal characteristics (Model 2) and demographic characteristics (Model 3), the relationship between group position and vocal accommodation remains non-significant. In model 4, we enter the interaction term between group position and participant sex (1 = female). This term is positive and significant, indicating that although group position and sex fail to significantly predict AAR independently, their effects combine to shape patterns of accommodation within groups.

Table 2. Mixed Models Predicting Vocal Accommodation From Group Position (N = 75)

	Model 1	Model 2	Model 3	Model 4
Constant	.513***	.274*	.073	.167
	(.042)	(.119)	(.229)	(.201)
Supervisor	.033	.082	.106	-.058
	(.102)	(.084)	(.077)	(.111)
Vocal Pitch		-.024	-.026	-.021
		(.027)	(.028)	(.025)
Speaking Time		.033	.038	.038
		(.035)	(.037)	(.034)
Convergence		.769***	.665***	.676***
		(.134)	(.147)	(.114)
Group Structure			-.040	-.135*
			(.043)	(.060)
Age			.009	.009
			(.010)	(.009)
Academic Year			-.026	-.032
			(.085)	(.079)
Sex			.122	.025
			(.089)	(.075)
*Supervisor*Sex*				.338*
				(.148)

*$p < .05$; **$p < .01$; ***$p < .001$

To further parse the combined effects of assigned group position and gender, we split our sample based on supervisor gender and compared AAR values across group positions. Table 3 presents paired-sample t-test results. As can be seen in Table 3, in female-led groups, the supervisor demonstrated a significantly higher AAR, which indicates that assistants accommodated the supervisor. In male-led groups, supervisors demonstrated a *lower* AAR value, though the difference is not significant. This counterintuitive result leads us to wonder whether different vocal processes predominated in our sample based on the gender of the group leader. To assess this possibility, we turned to analyses of vocal pitch.

Table 3. Paired-samples t-tests Comparing AAR Scores across Group Position[a]

	Assistant	Supervisor	Comparison
Female-led Groups[b]	.413 (.334)	.701 (.195)	t = 3.126** df = 30 p = .004
Male-led Groups	.592 (.312)	.424 (.346)	t = 1.526 df = 24 p = .140

[a]For female-led groups N = 33; Male-led groups N = 42
[b]Female-led groups t-test results reflect unequal variances

Table 4 presents the results of our supplemental analyses of vocal pitch and positions within groups. Again, we employ mixed models with standard errors adjusted for clustering. Looking at model 1 in table 4, when group position is the sole predictor, it has a positive and significant effect. This effect holds across all subsequent models that introduce vocal and demographic controls.

Table 4. Predicting Vocal Pitch From Group Position

	Model 1	Model 2	Model 3
Constant	2.763*** (.166)	2.746*** (.359)	2.647 (1.375)
Supervisor	.962*** (.261)	.958*** (.264)	1.098*** (.253)
Speaking Time		-.013 (.089)	.056 (.094)
Convergence		.153 (.922)	.196 (1.080)
Group Structure			.093 (.215)
Age			.010 (.066)
Academic Year			-.654* (.295)
Sex			-.092 (.371)

*$p < .05$; **$p < .01$; ***$p < .001$

Although the effect of group role on vocal pitch was significant for the full sample in table 4, we examined the extent to which male-led and female-led groups differed on this dimension as well. Table 5 presents the results of paired-samples t-tests comparing vocal pitch across group positions, split by group leader gender. In the case of vocal pitch, in female-led groups, there is no significant difference between supervisors and assistants. Conversely, in male-led groups, those assigned to the position of supervisor demonstrated significantly higher vocal pitch than those in assistant positions.

Table 5. Paired-samples t-tests Comparing Vocal Frequency across Group Position[a]

	Assistant	Supervisor	Comparison
Female-led Groups	2.956 (1.390)	3.715 (1.155)	t = 1.661 df = 24 p = .110
Male-led Groups	2.612 (1.205)	3.33 (1.121)	t = 2.978** df = 28 p = .006

[a]For female-led groups N = 33; Male-led groups N = 42

In sum, our results appear to indicate separate vocal indicators of leadership and status, depending on the sex of the group supervisor. In female-led groups, group structure was reflected in patterns of vocal accommodation, with assistants accommodating supervisors. Alternately, in male-led groups, the structure was reflected in patterns of vocal pitch, with supervisors demonstrating higher vocal pitch. In what follows, we discuss some implications that our findings have for research on vocal dynamics in small groups.

DISCUSSION

Persuasive speech achieves its compelling quality in part from the meanings its delivery creates for listeners. Floyd and Ray (2003) note that a higher overall vocal pitch is sometimes interpreted to mean that a speaker has a higher level of affection toward the audience, and Bianchi and Lancianese (2007) suggest speakers who generate positive affect in a group might further benefit from a subsequent increase in status. Perhaps because male leaders enjoy a relatively stronger "(leader) cue gestalt" (Fişek et al. 2005) than female leaders, they can at times afford to invest in likability (prestige) enhancing behaviors that are also less vocally dominant because their position is more socio-culturally assured. Navigating this pathway is riskier for female leaders, as it requires a secure enough dominant position from which it may be safely attempted.

It may also be risky for men to not dial back their vocal dominance in certain situations. Social cues communicate status information by signaling individuals' apparent attitudes related to the situation. This information serves as evidence of tacit acceptance or resistance to local status arrangements and information relating to one's perceived abilities and competencies. For

example, a supposedly secure and able leader who continually engages in excessively dominant behaviors might come to be perceived by others in the group as lacking in personal confidence, competence, or compensating for a hidden flaw. In general, it makes sense to moderate one's vocal dominance when your position is otherwise assured.

Overall, male supervisors in our study demonstrated a heightened vocal pitch compared those assigned to assistant roles. Conversely, female supervisors utilized a strategy of vocal dominance and accommodation to establish their leadership position. Our results provide evidence that group positions and external status characteristics shape the non-conscious vocal strategies that groups employ to construct and maintain status hierarchies. When in-group status positions are consistent with members' external status, leaders may need to rely less on dominance cues and may be freer to employ strategies that maximize prestige and likability.

ENDNOTES

1. Kalkhoff and colleagues (2017) provide an online supplement that also details step-by-step instructions for calculating AAR, including software settings and complete procedures.

2. Because some groups were informed that the supervisor was assigned based on qualifications and others were told that assignment was random, we also estimated models controlling for supervisor legitimacy. The inclusion of this control did not produce results substantively different from those presented. Analyses available upon request.

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AUTHORS' NOTE

We would like to acknowledge Dawn T. Robinson for access to data she previously collected that was also used in the first author’s dissertation.

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