

Judgments of Intelligence and Likability of Young Adult Female Speakers of American English: The Influence of Vocal Fry and the Surrounding Acoustic-Prosodic Context

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Summary: Objective. Vocal fry is a prevalent speech feature in college-aged American women living in the United States. However, there is currently little consensus about how its use influences listener judgments of the speaker. This study investigated how vocal fry influences judgments of intelligence and the likability of young adult female speakers of American English while taking into account the surrounding acoustic-prosodic context, specifically voice pitch and speech rate.

Method. Speech samples were obtained from eight American English-speaking females who presented with different combinations of voice pitch (low or high), speech rate (slow or fast), and vocal fry (presence or absence). Listener judgments of ratings of intelligence and likability were collected from 463 adults via online crowdsourcing.

Results. Generalized estimating equation models revealed significant three-way interactions between the voice pitch, speech rate, and vocal fry for listener judgments of intelligence and likability. While vocal fry had favorable effects in some contexts (eg, high pitch, fast rate) it had unfavorable effects in others (eg, low pitch, fast rate).

Conclusion. Listener judgments of young American women based on information afforded in their speech are not solely based on the presence or absence of vocal fry, but rather a combination of features that interact with one another in unique ways. Thus, whether or not the use of vocal fry in this population projects a favorable impression depends on the acoustic-prosodic context in which it is produced.

Key Words: Vocal fry–Speech rate–Voice pitch–Listener judgments–Speaker characteristics.

INTRODUCTION

Vocal fry describes a salient speech feature that is linked to the quality of a speaker's voice. Perceptually, vocal fry has been depicted as creaky sounding or popping^{1,2} and is likened to the imitated sound of a "motor boat engine."³ During the production of vocal fry, the vocal folds vibrate in a unique dirotic pattern, whereby relatively short glottal pulses (with low amplitude) are ensued by longer phases of vocal fold adduction.⁴ Simply, the vocal folds vibrate at a slow enough rate that single vibrations are discernable.⁵ Acoustically, vocal fry is characterized by very low frequencies, (around 20–70 Hz) regardless of speaker gender, and increased measures of jitter and shimmer.³ Although once regarded as a voice pathology, today vocal fry is accepted as the lowest end of the normal pitch range⁶ and one of three normal phonational registers.⁷

A number of studies have reported the prevalence of vocal fry in young adult female speakers of American English and speculated that the use of this speech feature is increasing (eg, Wolk et al,⁸ Yuasa,⁹ and Anderson et al¹⁰). Wolk et al⁸ examined speech samples from 34 female American English speakers (18–25 years) and identified the use of vocal fry in over two thirds of the participants. A follow-up study with young adult male speakers of

American English reported that vocal fry was four times less prevalent in male speakers when compared with the previously reported female data.¹¹ In an investigation of the influence of gender and nationality on vocal fry use in college-aged students engaged in conversation, young American female speakers were observed to use significantly more vocal fry than male and Japanese speakers.⁹ Additionally, Yuasa⁹ surveyed 175 college students (18–34 years) in the United States (Northern California and Iowa) and reported that approximately 80% of the students agreed with the statement that they heard vocal fry frequently used by women in their residential area. As Borrie and Delfino¹² have previously pointed out, there is currently no empirical evidence that the use of vocal fry in young American women is increasing; however, there is certainly robust evidence that it is prevalent in the speech behaviors of this population.

Given that initial impressions, based on the speaker's speech features, have been shown to influence social interaction, including mate selection, leader selection, and consumer choices,^{13–15} the high prevalence of vocal fry in speech behaviors of young adult female speakers of American English has raised enquiries as to how its presence may influence listener impressions. To date, the evidence in this area is largely equivocal. Some studies report that vocal fry is associated with favorable impressions of the female speaker. In the survey of 175 college students in Northern California and Iowa, Yuasa⁹ also asked the listeners to judge the speech of a young American woman according to a set of preselected speaker attributes. When substantial vocal fry, relative to no vocal fry, was present in the woman's utterances, listeners identified her as sounding fundamentally more educated, professional, genuine, and nonaggressive. Other studies have also reported favorable listener impressions of speakers using

Accepted for publication August 1, 2017.

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Journal of Voice, Vol. ■■■, No. ■■■, pp. ■■■–■■■
0892-1997

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<https://doi.org/10.1016/j.jvoice.2017.08.002>

vocal fry, linking the speech feature with higher ratings of trustworthiness, intelligence, and friendliness.¹⁶

However, unfavorable listener impressions associated with the use of vocal fry in the speech of American women have also been reported. Anderson and colleagues¹⁰ examined the effect of vocal fry on listener judgments (18–65 years) of speakers (19–27 years) on attributes considered important for success in the job market. Audio recordings of the phrase “*thank you for considering me for this opportunity*” were elicited from seven males and seven females. Each speaker produced one phrase production with vocal fry and one without. Using an online survey tool, listeners were presented with pairs of phrase productions (vocal fry and no fry) and asked to select which one sounded more educated, competent, trustworthy, and attractive, and which speaker they would choose to hire. Data on listener judgments of the female speakers revealed that the use of vocal fry may negatively influence a woman’s job prospects—productions without vocal fry were judged as more educated, competent, trustworthy, and hireable compared with productions with vocal fry. The authors concluded that the presence of vocal fry in the speech of young women may undermine their success in the labor market. Other negative associations have been previously reported with the use of vocal fry linked with impressions of speaker boredom and sadness.¹⁷

In sum, while vocal fry is clearly prevalent in the speech of young American women, there is currently little consensus about how its presence influences listener judgments of the speaker. While methodological differences undoubtedly contribute to discrepancies between existing studies (see Borrie and Delfino¹²), it may also be that the impressions of speakers with vocal fry are influenced by accompanying speech features. As Gobl and Ní Chasaide¹⁷ have stated, a single speech feature cannot be produced in isolation. That is, spoken utterances are produced with a set of speech features including perceptually salient features such as speech rate and voice pitch—both of which have been shown to independently influence listener judgments of the speaker (eg, Aronovitch¹⁸; Breitenstein et al¹⁹). Thus, we postulate that the way in which vocal fry influences listener judgments of speaker attributes is shaped by the surrounding acoustic-prosodic context.

In contrast to the vocal fry literature, there is a relatively strong consensus regarding the influence of speech rate on listener judgments of a speaker. Overall, the studies in the area of speech rate afford evidence that a fast speech rate is perceived more favorably than a slow speech rate regardless of the attribute being examined (eg, Brown²⁰; Rosenberg and Hirschberg²¹). Speakers who use a faster speech rate are consistently judged as more competent, charismatic, and socially attractive than their slower-speaking peers (eg, Rosenberg and Hirschberg²²; Smith et al²³; and Street and Brady²⁴). Additionally, a faster speech rate has been linked with enhanced speaker persuasiveness and credibility,^{25–27} whereas a slower speech rate has been linked with speaker sadness and inexperience.^{19,28}

Voice pitch has also been reported to influence listener judgments of speaker attributes; however the effect is more variable. Studies have reported that lower-pitched voices are associated with speaker dominance and strength^{29,30} and that higher-

pitched voices are judged as less competent and less trustworthy than lower-pitched voices.^{13,31} Yet, other studies have observed that higher-pitched voices are perceived as more charismatic than lower-pitched voices,^{22,32} suggesting that the way in which voice pitch influences listener judgments may be differentially influenced by the attribute under judgment (eg, charisma versus competence). Speaker gender may also differentially influence the pattern of results. When making judgments of speaker attractiveness, listeners judged higher-pitched female voices as more attractive than lower-pitched female voices, but lower-pitched male voices as more attractive than higher-pitched male voices.^{33,34} Conversely, for ratings of agreeableness, listeners judged lower-pitched female voices as more agreeable than higher-pitched female voices, but higher-pitched male voices as more agreeable than lower-pitched male voices.³⁵

The purpose of this study was to offer a more comprehensive understanding of how the use of vocal fry by young adult female speakers of American English influences listener judgments of speaker attributes by accounting for the surrounding acoustic-prosodic context. Given that spoken utterances are always produced with a speech rate and voice pitch, and that these vocal features have been shown to independently influence listener judgments, these speech features were accounted for in the current study design. We also selected two speaker attributes, intelligence and likability, allowing us to relate our work to previous studies, namely those by Yuasa⁹ and Anderson et al,¹⁰ and examine if different attributes yield a different pattern of results. Thus, our research questions addressed the following: (1) Does the influence of vocal fry on listener judgments of young adult female speakers of American English depend on the accompanying voice pitch and speech rate? (2) Are listener judgments based on the speech features of young adult female speakers of American English influenced by the particular attribute being rated (ie, intelligence versus likability)? In our efforts to answer these questions, we addressed limitations of previous studies by using spoken utterances with naturally produced vocal fry and no fry, carefully controlling for other vocal features that may impact judgments (eg, nasality, breathiness) and drawing from a large, geographically distributed sample of listener participants.

METHODS

Listener participants

A total of 463 adults (262 males and 201 females) 20–70 years of age ($M = 35.84$, $SD = 9.78$) participated as listeners in this study. All listener participants were native speakers of American English currently residing in the United States. Demographic information regarding age, geographic region, and level of education of the participants is available in Table 1.

Participants were recruited using the crowdsourcing website Amazon Mechanical Turk (MTurk; <http://www.mturk.com>). All participants were volunteers and protected through MTurk’s participation agreement and privacy notice. We used the MTurk setup option to limit participation to high-performing workers with an earned “master’s” status.³⁶ We also applied a location restriction, permitting only individuals confirmed as current residents

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