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Dominance and the evolution of sexual dimorphism in human voice pitch

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Abstract

The developmental and anatomical causes of human voice sexual dimorphisms are known, but the evolutionary causes are not. Some evidence suggests a role of intersexual selection via female mate choice, but other evidence implicates male dominance competition. In this study, we examine the relationships among voice pitch, dominance, and male mating success. Males were audio recorded while participating in an unscripted dating-game scenario. Recordings were subsequently manipulated in voice pitch using computer software and then rated by groups of males for dominance. Results indicate that (1) a masculine, low-pitch voice increases ratings of men's physical and social dominance, augmenting the former more than the latter; and (2) men who believe they are physically dominant to their competitor lower their voice pitch when addressing him, whereas men who believe they are less dominant raise it. We also found a nonsignificant trend for men who speak at a lower pitch to report more sexual partners in the past year. These results are consistent with the hypothesis that male intrasexual competition was a salient selection pressure on the voices of ancestral males and contributed to human voice sexual dimorphism.

Keywords: Dominance; Male contests; Mating success; Sexual selection; Vocal fundamental frequency; Vocal masculinity; Voice pitch

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1. Introduction

The human voice is highly sexually dimorphic. Pitch, the most perceptually salient feature of human voice (Banse & Scherer, 1996), is about half as high in men as it is in women (Titze, 2000). This dimorphism is due not merely to sex differences in body size; relative to both height and body volume, voice pitch is lower in men than it is in women and prepubescent children of both sexes (Titze, 2000). Sexual selection (Darwin, 1871) is the primary evolutionary cause of sex differences, and Collins (2000) suggested that sex differences in the human voice evolved though sexual selection via female mate choice. Some studies have shown correlations between female mate preferences and male voice pitch (Collins, 2000; Oguchi & Kikuchi, 1997), whereas others have examined the effects of experimental pitch manipulation on female preferences (Feinberg, Jones, Law Smith, et al., in press, Feinberg, Jones, Little, Burt, & Perret, 2005; Puts, 2005). Puts (2005) and Feinberg, Jones, Law Smith, et al., (in press) demonstrated menstrual cycle variation in women's preferences for masculine voices. Normally-cycling women's preferences for low, masculine voices increased with conception risk (Feinberg, Jones, Law Smith, et al., in press; Puts, 2005), and women preferred lower male voices mainly for short-term, sexual relationships (Puts, 2005). Taken together, these findings suggest that female mate choice may have influenced the evolution of male voice.

However, another type of sexual selection, intrasexual selection via male dominance competition, may also have been an important selection pressure on the voices of ancestral males. Dominance entails access to mates and resources that is relatively unchallenged by competitors. In most animals, dominance is achieved through aggression or threats of aggression, here termed *physical dominance*. In humans, dominance may also be achieved through skillful leadership and persuasion (Henrich & Gil-White, 2001), hereafter called *social dominance*. Among nonhuman animals, low voice pitch is associated with physical dominance (Morton, 1977; Morton & Page, 1992), and in humans, voice pitch is associated with interpersonal power and deference relations (Benjamin, 1981, 1992; Gregory, 1994; Gregory, Webster, & Huang, 1993).

The reasons that the acoustic features of voice may have evolved as dominance signals can be clarified by examining their proximate causes. The frequency of vocal fold vibration during phonation is called the fundamental frequency, or F_0, and closely determines what is perceived as pitch. The determinants of F_0 are apparent from the equation

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

where L is the vocal fold length, σ is the longitudinal stress on the vocal folds, and ρ is the vocal fold tissue density (Titze, 2000). Thus, voice pitch is inversely proportional to vocal fold length and directly proportional to the square root of tension on the vocal folds. Longer vocal folds with less tension on them lead to lower voice pitch. The perception of pitch is also affected by formant frequencies (Higashikawa, Nakai,