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Sensory Exploitation, Sexual Dimorphism, and Human Voice Pitch

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Abstract

Selection for low male voice pitch is generally assumed to occur because it is a valid cue of formidability. Here we summarize recent empirical challenges to this hypothesis. We also outline an alternative account in which selection for low male voice pitch is a byproduct of sensory exploitation.

Main text

The most popular hypothesis for why men have lower voice pitch than women do is that low male voice pitch has been selected for because it is a valid cue of critical aspects of formidability, such as physical strength and large body size, meaning that men with lower voice pitch will be more successful in intrasexual competition [2]. This hypothesis is based on the results of studies showing that experimentally lowering pitch in recordings of men's voices increases perceptions of both their dominance and physical size [2]. A small number of studies have also reported that men with lower voice pitch tend to have greater upper body strength and larger body size [e.g., 2].

Although this hypothesis has been highly influential, the results of many recent empirical studies have challenged the claim that low voice pitch is a valid cue of men's formidability. For example, several studies have found no evidence for a significant negative relationship between voice pitch and measures of men's upper body strength [3]. Indeed, the correlations between voice pitch and upper body strength reported previously would not have been significant if corrected for multiple comparisons, suggesting they were not robust. Moreover, a meta-analysis of the putative relationship between voice pitch and body size estimated that a sample size of at least 610 men would be required to detect a significant negative relationship between men's voice pitch and body size [4]. Such a relationship would explain, at most, ~2% of variance, suggesting that the relationship between men's body size and voice pitch is unlikely to be ecologically meaningful. Collectively, these results suggest there is little compelling evidence for a relationship between voice pitch and formidability in men, challenging the claim that low voice pitch is a valid cue of men's formidability.

If low voice pitch is not a valid cue to men's formidability, why are men with lower pitched voices perceived to be more dominant and why has low

male voice pitch been selected for? One possibility is that selection of low male voice pitch simply reflects sensory exploitation of an evolutionarily old pre-existing bias for organisms to react to objects that emit lower-frequency vibrations [6].

Sensory exploitation theories of sexual selection suggest that males with traits that elicit high amounts of stimulation from sensory systems are more successful [5]. Over evolutionary time, selection ramps up the frequency and size of those traits via female choice [5]. In the sensory exploitation theory of sexual selection, preferences for traits do not have to be adaptive in their own right, but can be byproducts of neural responses that evolved to deal with different (i.e., unrelated) evolutionary pressures [5].

When struck with a stick, larger rocks emit lower-frequency vibrations. This tendency for larger objects to emit lower-frequency vibrations is a simple physical property of the world [1]. In line with this rule, people implicitly ascribe largeness to low pitch in non-biological auditory stimuli, such as pure tones [6], in exactly the same way as they do to men's voices [7]. In fact, people continue to ascribe greater largeness to lower-pitched voices when the pitches of these voices are well outside of the human vocal range [8]. The perception that low pitch is large and frightening is evident across the animal kingdom, suggesting it is evolutionarily old [6]. The tendency to perceive men with lower voice pitch to be larger is equally evident in congenitally blind and sighted participants, further suggesting it requires no visual learning [9].

The results described above suggest that people apply a general "low pitch is large" heuristic when processing auditory stimuli. Thus, the tendency to ascribe greater size and dominance to lower-pitched voices may simply be a byproduct of this heuristic [10]. Further evidence that low pitch influences size perception via such a heuristic, rather than because it is a valid cue of body size, comes from research investigating the effects of voice cues on the neural representation of body size. Voice pitch influences size representations via different neural processes than those used to process valid cues of body size in humans [11].

How might this general "low pitch is large" heuristic lead to selection for male voices with low pitch? We propose two possible, non-mutually exclusive routes. First, the "low pitch is large" heuristic could lead to selection for male

voices with low pitch via female choice if, all other things being equal, men with low pitched voices exploit the sensory bias for women to be attracted to large sounding men. Consistent with this possibility, experimentally lowering voice pitch in men's voices has a positive effect on their attractiveness, particularly to women [12]. Second, the "low pitch is large" heuristic could lead to selection for male voices with low pitch via intrasexual selection if, all other things being equal, men with lower voice pitches are more likely to succeed in competition for resources because they exploit a bias that makes them sound larger and more intimidating to other men. Consistent with this possibility, experimentally lowering voice pitch in men's voices has a positive effect on their perceived dominance [12]. Crucially, neither of these possibilities requires voice pitch to be a valid cue of body size or formidability, meaning that they are perfectly compatible with research suggesting voice pitch is not related to men's body size or strength. Selection against low voice pitch in women would also be expected under this account since perceptions of large body size are typically negative correlated with women's attractiveness [13]. The possibility that voice pitch is a cue of men's immunocompetence, previously discarded [2], might also be re-evaluated, although evidence for an association between men's immunocompetence and voice pitch is equivocal [14,15]

In summary, some empirical work challenges the common assumption that selection for low male voice pitch occurs because it is a valid cue of formidability. We suggest that sensory exploitation is a more parsimonious explanation for the marked difference in men's and women's voice pitch. Studies and experiments testing competing predictions from these honest signaling and sensory exploitation accounts are likely to be a fruitful line of inquiry into the reasons for sex differences in voice pitch.

Text box

What is human voice pitch?

Voice pitch is the perception of vocal fundamental frequency and/or the corresponding harmonics that result from vocal fold vibration [1]. Larger, thicker vocal folds produce vocalizations with lower fundamental frequency [1]. Human vocal folds change in length and thickness as we age. Voice pitch

changes particularly dramatically during puberty, when reproductive hormones accelerate vocal fold growth [1]. There is a striking sex difference in human voice pitch; men's voices are typically an octave lower in pitch than are women's voices [1]. Much of the research on human voice production and perception attempts to understand the factors that drove the evolution of this large and reliable sex difference.

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