ELSEVIER

Evolution and Human Behavior 29 (2008) 268–274

Evolution and Human Behavior

Women's voice attractiveness varies across the menstrual cycle

R. Nathan Pipitone*, Gordon G. Gallup Jr

Department of Psychology, University at Albany, State University of New York, New York, NY, USA

Initial receipt 24 July 2007; final revision received 17 February 2008

Abstract

We investigated ratings of female voice attractiveness as a function of menstrual cycle phase. Women had their voices recorded at four different times during their menstrual cycle. Voice samples were categorized from low to high conception risk based on menstrual cycle phase and empirical pregnancy data. Results showed a significant increase in voice attractiveness ratings as the risk of conception increased across the menstrual cycle in naturally cycling women. There was no effect for women using hormonal contraceptives. Previous research shows that the sound of a person's voice appears to serve as an honest signal of fitness, and our results show perceptual shifts in women's voices that match the predicted output of an independent and well-designed fertility monitoring system. More work is needed to identify the biological mechanisms that underlie these perceptual differences, but growing evidence points to the impact of hormones on the larynx as being the source of these changes.

Keywords: Voice attractiveness; Conception risk; Hormonal contraceptives; Menstrual cycle; Ovulation

1. Introduction

Research on the human voice has been subject to increased attention in recent years. Variation in dominance (Feinberg et al., 2006; Puts, Gaulin, & Verdonili, 2006), personality attributes (Zuckerman & Driver, 1989), fluctuating asymmetry (Hughes, Harrison, & Gallup, 2002), attractive body features (Hughes, Dispenza, & Gallup, 2004) and a host of other behavioral characteristics have been shown to correlate with variation in the sound of a person's voice. In other words, independent of the content of speech, voice appears to be a medium for the transmission of important biological information.

The human larynx is a hormonal steroid target organ (Caruso et al., 2000). During puberty, estrogen and progesterone affect the morphology of the larynx and shape the mature female voice, while testosterone modifies and deepens the male voice (Abitbol, Abitbol, & Abitbol, 1999). The same sex hormones that affect the voice at puberty also influence the development of sex-specific body configurations (Kasperk et al., 1997; Singh, 1993).

Just as physical characteristics like facial features may be involved in mate choice (Thornhill & Gangestad, 1999), vocal cues may also be important, especially since they can provide information about potential mates when visual cues are ambiguous or not available, such as at night (Hughes et al., 2002). Recent evidence shows that the sound of a person's voice not only provides information about body morphology, but also about features of their sexual behavior as well (Hughes et al., 2004).

Cyclic hormones affect the physical properties of a woman's voice across the menstrual cycle (Abitbol et al., 1999). Variations in female vocal production that occur during menstruation, pregnancy and menopause (Caruso et al., 2000) all coincide with marked hormonal changes. Epithelial smears from the larynx and vagina show similar cytology for steroid hormones (Caruso et al., 2000), particularly estrogen (Fegusson, Hudson, & McCarthy, 1987). Histologic laryngeal changes during the menstrual cycle mirror those of the endometrium (Abitbol et al., 1999). The use of hormonal contraceptives also has an effect on female vocal production. Investigating these changes through spectrogram analysis, Amir, Kishon-Rabin and

* Corresponding author. Tel.: +1 518 442 4786; fax: +1 518 442 4867.
E-mail address: rp2497@albany.edu (R.N. Pipitone).

1090-5138/$ – see front matter © 2008 Elsevier Inc. All rights reserved.
doi:10.1016/j.evolhumbehav.2008.02.001

Muchnik (2002) found that females using hormonal contraceptives had significantly lower jitter and shimmer in their voices than naturally cycling females. Chae, Choi, Kang, Choi and Jin (2001) showed that females experiencing premenstrual syndrome (PMS), which corresponds to hormonal aberrations, were also more prone to vocal changes (e.g., more jitter, lower frequency) compared to other times during the menstrual cycle. G. Bryant and M. Haselton (unpublished data) have also recently reported preliminary evidence for an increase in voice pitch at ovulation compared to other times during the menstrual cycle.

Progesterone increases the viscosity and acidity levels of glandular laryngeal cells, which leads to a decrease in volume, causing vocal cord edema. Estrogen has a hypertrophic effect on laryngeal mucus and increases glandular cell secretion (Abitbol et al., 1999; Amir et al., 2002). Abitbol (1989) and Abitbol et al. (1999) have identified vocal characteristics such as hoarseness, fatigue and decreases in range as being clinical signs of vocal PMS. In summary, the larynx and genitals clearly seem to be targets for the same sex hormones, and both seem to be affected by hormonal fluctuations across the menstrual cycle.

A number of adaptive behaviors vary across the menstrual cycle that correspond to changes in conception risk. Sexual risk-taking behaviors (Chavenne & Gallup, 1998), reactions to the scent of more symmetrical males (Gangestad & Thornhill, 1998) and preference for more masculine facial features (Penton-Voak & Perrett, 2000) have all been shown to vary as a function of cycle phase. It is reasonable to suppose that the cyclic hormones driving these behaviors could also affect women's voices as well.

In the present study, we investigated attractiveness ratings of female voices collected at different points during the menstrual cycle.

2. Methods

2.1. Voice participants

A total of 51 female undergraduates from the State University of New York at Albany were recruited to provide voice samples. Students were recruited through the research subject pool and by advertisements posted around campus. Participants recruited through the research pool were given course credit; those recruited by posters were paid US$2.50 for each voice session they participated in. The study was approved by the university Institutional Review Board.

Using a coded anonymous survey, participants were asked about their age, number of committed partners and number of lifetime sexual partners. There were no significant differences between females using hormonal contraceptives and naturally cycling females for number of committed partners (t_{35}=.24, p=.81), or number of sexual partners (t_{36}=−.86, p=.39). Naturally cycling females were between 17 and 30 years of age (mean=21.12, S.D.=3.16), and their cycle length ranged from 19 to 48 days (mean=29.59, S.D.=7.12). All females were asked to report whether their menstrual cycle was regular, somewhat regular, somewhat irregular or very irregular (regularity was defined as the number of days between periods being the same from cycle to cycle, e.g., every 28 days). The majority of females reported having either somewhat regular or regular cycles. All females except three met the criterion of reporting somewhat regular or regular cycles and were included in the analyses. Two females had atypical cycle lengths but reported having regular cycles. Upon returning for follow-up voice samples, we were able to verify that menstruation did happen on the days predicted for these females; therefore, they were included in analyses. One naturally cycling female had used a form of hormonal contraceptive 3 months prior to the study. All other naturally cycling females indicated not having used hormonal contraceptives for more than 3 months prior to this study.

Females taking hormonal contraceptives ranged from 18 to 26 years of age (mean=20.19, S.D.=2.09), and their cycle length ranged from 24 to 34 days (mean=27.86, S.D.=1.8). One participant started using hormonal contraceptives 2 months prior to the study. All others had been using hormonal contraceptive for longer periods of time. Participants were not included in the analysis if they were not fluent in English, had speech impediments, were chronic smokers (more than a pack a week), had a cold or illness on the day of voice recording, had very irregular menstrual cycles, were pregnant or used any form of morning-after pill within the last 3 months. Thirteen women were excluded for these reasons, leaving 17 naturally cycling females and 21 females using hormonal contraceptives.

2.2. Voice raters

An additional 34 males and 32 females were recruited through the university research subject pool to rate the voice recordings. Raters ranged from 17 to 25 years of age. All raters reported being heterosexual. Raters all reported having normal hearing. Six raters handed in incomplete rating forms and were not included in the analysis, leaving 30 male and 30 female raters.

2.3. Procedures — female voice recordings

The initial session consisted of two parts: completion of a background survey (menstrual cycle length and regularity, use of hormonal contraceptives, etc.), and a voice sample. To preclude the possibility that the content of what participants said could influence the perception of their voices, subject's voices were only recorded while they counted from 1 to 10. This procedure has been used previously to hold the content of recordings constant and to obtain speech samples that are cognitively and affectively neutral (Hughes et al., 2002, 2004). Voice recordings were taken using an Altec Lansing AHS515 headset, with the