

SUITABILITY JUDGMENTS OF PITCH AS A FUNCTION OF AGE

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ABSTRACT

Young, middle-aged, and older adult subjects were asked to select the most suitable mean pitch level for speakers of three adult age groups. The subjects chose a high pitch for young people, a low pitch for middle-aged people, and an intermediate pitch for older people. The rated differences between the age groups decreased as subject age increased. A relation is postulated between suitability judgments and stereotypical social characteristics of age groups.

INTRODUCTION

Mean pitch changes with age. This holds not only for childhood but also for adulthood. Various studies have been conducted into pitch change as a function of the age of the adult speaker (e.g. [1] [2] [3]). Most studies agree that the mean pitch of both male and female adult speakers lowers from the age of 20 until middle age. For older speakers the picture is less clear, but most studies seem to agree that the pitch of men rises slightly after they have reached middle age whereas the pitch of females remains constant or lowers slightly.

Pitch change in adult life often is explained by referring to physiological processes. Thick and flexible vocal folds produce a lower pitch than thin and stiff ones. The lowering of pitch until middle age could reflect an increase in the thickness of the vocal folds [2]. The slight pitch rise of older men can be explained by laryngeal processes of ageing which result in thinner and stiffer vocal folds [1] [2]. This ageing process also affects the pitch of older women, but hormonal changes in menopause may cause a lowering of pitch which counteracts this [2] [3].

In addition to being the result of physiological processes, pitch also has a meaning in a social context. There are several ways of describing the social meaning of voice qualities (including mean pitch) [4], of which the sociobiological and the social psychological are particularly relevant for the present study. A proponent of the sociobiological explanation is Ohala [5]. According to Ohala, pitch is used by animals to signal body size, strength, and dominance. A high pitch indicates small, weak, and submissive; a low pitch indicates large, strong, and dominant. This "frequency code" may also be used by humans. High pitch will then be associated with small, insecure, dependent people of relatively low social status, whereas low pitch will be associated with large, secure, independent people of relatively high social status. Graddol & Swann [4] argued that this fits well with a range of social psychological experiments in which higher pitched voices are heard as less competent or less "potent". In line with the scope of their book on gender they point out that such characteristics are components in more general perceptions of masculinity and femininity. These characteristics are also components in general perceptions of specific age groups. Harwood et al. [6] studied young people's impressions of the group vitality of young, middle-aged and elderly people in Hong Kong and California as measured on the dimensions status (e.g. sociohistorical, economic) and institutional support (e.g. in the media, education). They measured, for example, the degree to which the three age groups were perceived to have

strength in : advancing knowledge in society; controlling the economy; local and national government; general status of the group in the past, present and future; wealth; home ownership; etc. A difference in ratings for the three age groups was shown: ratings of the middle-aged exceeded those of young and old across both cultures and the Californian subjects rated the elderly higher than the young.

Both pitch as a physiological process and the meaning of pitch in a social context can influence people's impressions of the most suitable mean pitch level for various groups of people. The aim of the present study was to examine which line of approach provides the best explanation for suitability judgments of the mean pitch level ("pitch" from now on) of various age groups. An experiment was conducted in which subjects listened to the same speech fragment at different pitches and indicated which pitch they found most suitable for a person of a certain age. The suitability judgments might vary as a function of the age group the subjects are in, so the experiment was done with adult subjects of various age groups.

METHOD

Speech material

Fifteen men and 15 women from three different age groups served as speakers (see Table 1). For each speaker seven seconds of speech material were selected from an interview about eating habits. Of each speech fragment three versions with different pitches were made by manipulating pitch by means of Linear Predictive Coding (LPC). The speech fragments of the male speakers were synthesized at 98 Hz, 117 Hz, and 137 Hz. For the female speakers the three mean pitch levels were 171 Hz, 195 Hz, and 221 Hz. The three pitch levels will be referred to as low, middle, and high pitch. The frequencies of the pitch levels were determined by first

calculating the average mean pitch for all speech fragments of the male speakers and all speech fragments of the female speakers. These average pitches were 117 Hz and 195 Hz, respectively. These were taken as the middle pitches. To determine low and high pitches that were perceptually equidistant to the middle pitches, a psychoacoustic scale was used, the equivalent-rectangular-bandwidth-rate (ERB-rate) scale. This scale tries to approximate the way in which the human ear detects pitch [7]. The ERB values for the two middle pitches were calculated and the low and high pitches were determined by adding and subtracting 0.5 ERB.

Table 1. Speaker age groups.

	RANGE	MEAN	N
WOMEN	20-30	25	5
	48-52	51	5
	73-84	78	5
MEN	21-29	24	5
	47-55	50	5
	71-83	77	5

Subjects

Forty-five men and 45 women from three different age groups participated in the experiment (see Table 2).

Table 2. Subject age groups.

	RANGE	MEAN	N
WOMEN	20-31	24	15
	41-56	50	15
	62-83	73	15
MEN	20-30	24	15
	39-53	45	15
	62-74	66	15

Procedure

The subjects heard the three pitch versions of each speech fragment consecutively and had to indicate on an answering form which one they found most suitable for the speaker. The subjects were given the speaker's sex and age. The speech fragments were presented in two blocks, male and female

speakers separated. Within the blocks of male and female speakers the speakers were randomized. For each speaker the three versions of the speech fragment were also randomized.

RESULTS

The data resulting from the experiment were frequency data; information was available on how often the low, middle, and high versions of the speech fragments were chosen by the subjects. To analyze the data, log-linear analysis, more specifically logit analysis, was used. In this type of analysis the relative contributions of the (interaction between the) variables to the variance of the responses is expressed by R^2 , a coefficient similar to the corresponding index of multiple regression, but only in a relative sense. R^2 can yield low values in spite of a strong connection between variables [8] [9]. All significant effects are listed in Table 3.

Table 3. Effects represented by significant parameters ($p < .05$) and their relative contribution to the variance of the responses (R^2). SpA = speaker age, SuA = subject age, SpS = speaker sex, SuS = subject sex.

EFFECT	R^2
SpA	.047
SuA	.003
SpA*SuA	.003
SpA*SpS	.001
SpA*SuS	.001
SuA*SpS*SuS	.001
SpA*SpS*SuS	.001
SpA*SuA*SpS*SuS	.003

Table 3 shows that effects with only age variables have relatively high indexes of association. Correspondingly, inspection of graphical representations of the effects in Table 3 revealed that the interaction between the two age variables (speaker age and subject age (SpA*SuA)) gave the most informative representation of the results of the experiment. The differences in ratings

between the male and female subjects and the male and female speakers were negligible.

Figure 1 presents the interaction effect between speaker age and subject age. The scores of the subjects are represented by an index value, similar to indices used in other sociolinguistic research (e.g. [10]). The index value can vary between 0 and 100. Low values indicate that lower pitches are chosen more often, high values correspond with a more frequent choice of higher pitches.

In general the subjects chose a relatively high pitch for young speakers, a relatively low pitch for middle-aged speakers, and an intermediate pitch for older speakers. However, the three subject groups differed in the pitch they considered suitable for the middle-aged speakers; the younger the subjects, the lower the pitch chosen. For the young and the older speakers, the scores of the three subject groups are nearly identical.

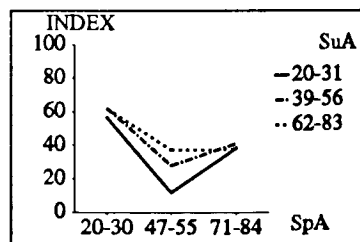


Figure 1. Interaction between speaker age (SpA) and subject age (SuA).

DISCUSSION

From the results of the experiment we conclude that suitability judgments are best explained by referring to the meaning of pitch in a social context. There are two reasons for this. First, the subjects did not differentiate between suitability judgments for men and women, whereas there is evidence that the pitch of older men and women develops differently. The suitable pitch of both older men and women in general was rated higher than the suitable pitch

of middle-aged men and women. Because a high pitch is associated with, among other things, a relatively low status, this corresponds well with the study of Harwood et al. [6] in which young subjects rated older people lower on group vitality than middle-aged people (Harwood et al. did not include gender as a separate variable).

Second, the three subject groups differed in their choice of a suitable pitch for the middle-aged speakers. This can only be explained by elaborating on the social meaning of pitch. We hypothesize that when people age the assumed difference in vitality between middle-aged and older people disappears, and the contrast between younger and older people in this respect becomes less salient. The older subjects in the present study, however, were active people who lived entirely or for the greater part independently, so the results of the experiment cannot be generalized without due consideration. More research on the relation between vocal suitability judgments, vitality judgments, and age is needed to confirm the hypothesis.

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