The protective effect of singing on the aging voices: preliminary evidence

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Introduction

The effects of aging on voice production are well documented, including changes in loudness, pitch and voice quality. However, one important and clinically relevant question that remains, concerns the possibility that the aging of voice can be prevented or at least delayed through non-invasive methods. In this study, we examined the potentially protective effect of singing on voice production on a group of 71 healthy non-smoking adults (20-93 years-old) with different singing habits. Finding a positive effect of singing on voice production in aging could have immediate and broad practical applications for the growing population of senior citizens.

Method

Table 1 Participants' characteristics

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		Age		Education (in years)	Manual preference	GDS	MoCA
Group	N (nb of men)	mean ± SD	range	mean ± SD	mean ± SD	mean ± SD	mean ± SD
Young	26 (12)	28.3 ± 5.1	20-38	17.9 ± 3	18.4 ± 2.3	3 ± 2.4	28.7 ± 1.3
Middle-aged	26 (9)	55.3 ± 7.6	40-65	16.8 ± 3.5	17.4 ± 7.6	1.8 ± 2.6	28 ± 1.8
Older	20 (8)	75.2 ± 6.8	67-93	15.9 ± 4.1	17.8 ± 7.6	2.3 ± 2.8	27.2 ± 1.5
Total	72 (29)	51.1 ± 20.1	20-93	16.9 ± 3.6	17.9 ± 6.1	2.4 ± 2.6	28 ± 1.7

Caption. Participants' characteristics, for each age group and overall. GDS = Geriactric Depression Screening Scale. MoCA = Montreal Cognitive Assessment scale. The MoCA score ranges from 0 to 30 and a cut-off score of 26 optimizes sensitivity and specificity of detection of impairment. Participants were also screened for hearing deficits using audiological assessments (pure tone average), which confirmed that their hearing capacities were within normal limits according to age.

Singing assesment

Participants answered a questionnaire on singing frequency. We then classified them into three categories based on the self-reported frequency of their singing activity (see Table 2).

Table 2 Singing-based grouping

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	Women		Men		Total	
Singing frequency	N	mean age ± SD	N	mean age ± SD	N	mean age ± SD
Never	23	58.3 ± 19.5	17	49.8 ± 19.9	40	54.7 ± 19.9
Occasional (more than once a month)	9	37.3 ± 15.9	6	47.3 ± 20.4	15	41.3 ± 17.8
Frequent (every day or at least more than once a week)	11	51.6 ± 21.3	6	50.7 ± 21	17	51.3 ± 20.6

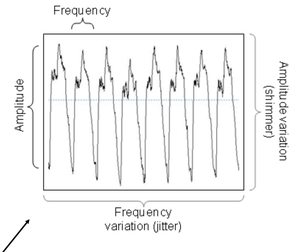
Procedures

- Vowel /a/

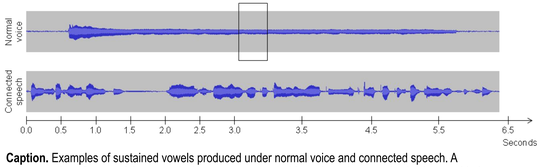
For this task, participants produced the vowel /a/ for as long as possible, 5 times, with a short pause between each production. The participants produced the vowel at a "comfortable range", that is, a range of pitch not associated with subjective muscular tension or discomfort during phonation. To control for intensity, a digital sound meter was placed 65 cm away from the mouth of the participant. The target intensity was set at 80 dB to prevent biases in acoustical measurements of jitter, shimmer, and HNR.

- Propositional speech

For this task, participants read a 2-minute standardized passage called « La bise et le soleil » (*the wind and the sun*). They first read the passage silently and then they read it aloud in a "natural" way (i.e. no theatrical manner).



Voice recording



Caption. Examples of sustained vowels produced under normal voice and connected speech. A representation of some of the acoustical measures extracted from the voice samples is also provided.

Analyses

- Vowel /a/

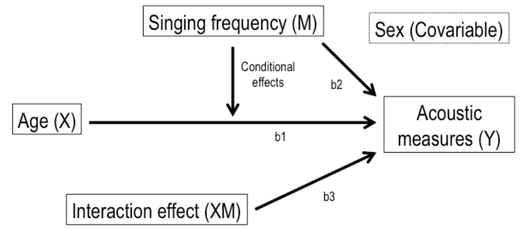
One-second intervals taken in the middle part of the second, third and fourth vowels were selected to ensure that measurements were made on a stable portion of the vowel. An automated procedure was created to select the middle part of each sound for each participant. F0 minimum, maximum, mean and SD, mean amplitude and amplitude SD, jitter, shimmer, and HNR values were extracted automatically for the three /a/, and an average was calculated for each participant.

- Propositional speech

For the standardized reading passage, the visible f0 was extracted from the samples one at a time. The pitch settings were adjusted manually to make sure we analysed the frequencies of interest, in relation with the f0 of each participant. The range of frequencies selected was representative of each participant's speaking range. It varied in range from 50 Hz to 300 Hz for men and from 100 Hz to 450 Hz for women. Standard deviation of the SFF was calculated in semitones (st) and in Hertz.

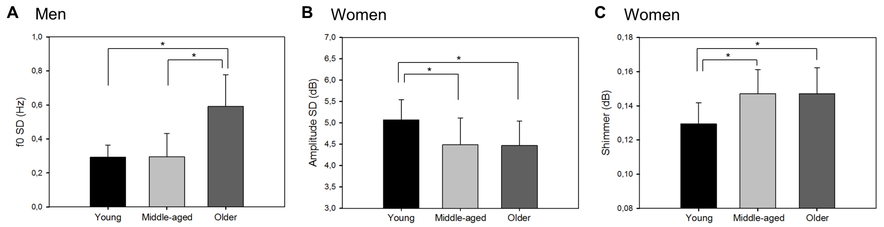
Results

Figure 1 Conceptual moderation model



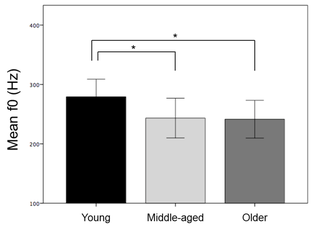
Caption. Conceptual moderation model used to uncover the moderating effect of singing frequency on the relationship between age and voice acoustics.

Figure 2 Main effect of age on voice stability



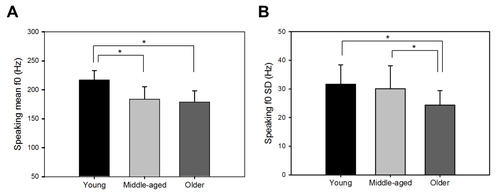
Caption. Voice f0 SD in men (**A**), amplitude SD in women (**B**) and shimmer in women (**C**) are displayed as a function of age groups. Asterisks indicate significance at $p<.05$. Error bars represent the standard error of the mean.

Figure 3 Effects of age on voice mean f0 in women displayed as a function of age groups



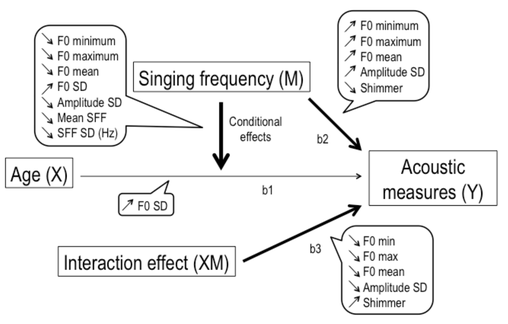
Caption. Asterisks indicate significance at $p<.05$. Error bars represent the standard error of the mean.

Figure 4 Main effect of age on propositional speech in women



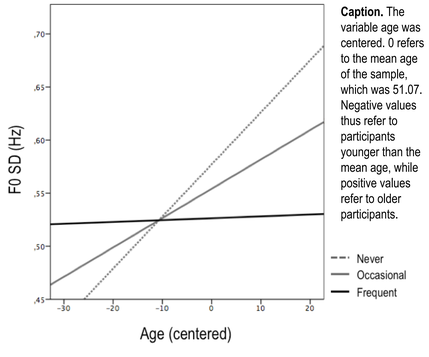
Caption. SFF (**A**) and SFF SD (B) are displayed as a function of age groups. Asterisks indicate significance at $p<.05$. Error bars represent the standard error of the mean

Figure 5 Results of the moderation analyses



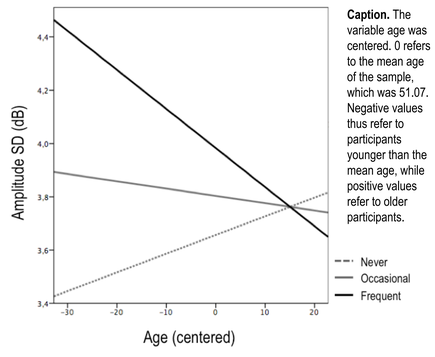
Caption. The relationship between age and several voice acoustic measures was moderated by singing frequency. The direction of the arrows indicates the direction of the effects. From the left: Aging was associated with high f0 SD (b1). There was a direct effect of singing frequency on shimmer, minimum, maximum and mean f0, and amplitude SD (b2). The interaction between age and singing frequency (XM) was associated with low minimum, maximum and mean f0, low amplitude SD and high shimmer (b3). Finally, there was a conditional effect of singing on the relationship of age to voice acoustics whereby frequent singing was associated with low minimum, maximum and mean f0, high f0 SD, low amplitude SD, high shimmer, and low mean SFF and SD (Hz).

Figure 6 Conditional effects of singing frequency on the relationship between age (in years) and voice f0 SD



Caption. The variable age was centered. 0 refers to the mean age of the sample, which was 51.07. Negative values thus refer to participants younger than the mean age, while positive values refer to older participants.

Figure 7 Conditional effects of singing frequency on the relationship between age (in years) and amplitude SD



Caption. The variable age was centered. 0 refers to the mean age of the sample, which was 51.07. Negative values thus refer to participants younger than the mean age, while positive values refer to older participants.

Conclusions

- ★ As was expected, effects of aging were found on most acoustic parameters with significant sex differences
- ★ Importantly, moderation analyses revealed that frequent singing moderates the effect of aging on most acoustics parameters
- ★ Specifically, in frequent singers, there was no increase in the variability of f0 and amplitude with age, suggesting that the voice of frequent singers is more stable in aging than the voice of non-singers, and more generally, providing empirical evidence for a protective role of singing on voice in aging.
- ★ Though additional research is needed to guide clinical practice, these results are among the first to provide evidence that singing exercises could be a low-cost alternative, or a complement, to traditional voice therapy, which could be self-administered at home.

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