Listeners' tolerance when listening to melodic performances

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ABSTRACT

Background

The evaluation of pitch accuracy is mainly based on the precision of pitch intervals and the respect of the tonal center of a melody (Larrouy-Maestri, Lévêque, Schön, Giovanni, & Morsomme, 2013). This finding confirms that listeners rely on the relationship between the tones of a melody in order to judge the quality of a melodic performance. In addition, we found that a deviation (i.e., error in the relation between two tones) of ~20 cents constitutes a threshold for layman listeners to qualify a performance as "out of tune" (Beeken, Morsomme, Larrouy-Maestri, 2014). However, this finding does not reflect the tolerance of music experts, who show particularly low discrimination thresholds in isolated contexts (see Schellenberg & Weiss, 2013 for a review). Also, the generalization of this finding is complex, since the material of Beeken et al. (2014) was limited to non-familiar melodies.

Aims

Two experiments were proposed in order to elucidate the concept of pitch accuracy in melodies. A first experiment (a) aims to clarify the effect of music expertise when listening to familiar vs. non-familiar melodies. The second experiment (b) aims to quantify the perceptual thresholds of music experts when listening to melodic performances.

Experiment (a)

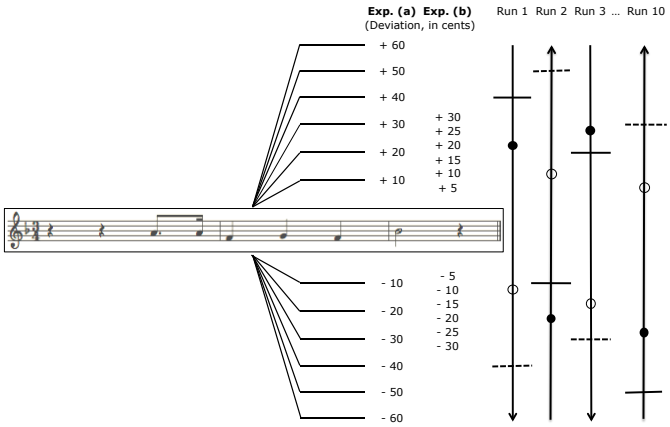
Methods

Participants: 30 non-musicians and 30 music experts, matched in age and gender, were recruited from the Belgian population. For the non musicians, the following inclusion criteria were applied: bilateral hearing threshold of 20 dB SPL at usual frequencies; no history of choral singing and no history of formal musical training (or maximum 2 years of musical training and no practice during the past 5 years); no deficit in music perception (tested with the Montreal Battery of Evaluation of Amusia, Peretz, Champod, & Hyde, 2003) and the ability to perform the song Happy Birthday with respect to appropriate melodic contour.

Material: Familiar (i.e., Happy Birthday) and non-familiar (i.e., alternative version) melodic sequences were manipulated, from "in tune" (deviation of 0 cent) to "out of tune" (10 to 60 cents, in 10 cent steps). Figure 1 illustrates the manipulations for the familiar melody.

Procedure: The tolerance of listeners was examined with the method-of-limits procedure (Figure 1), in a test/retest paradigm. For each condition, participants were asked to specify whether the presented singing performances were "in tune" (answers represented by solid lines) or "out of tune" (answers represented by dashed lines).

Figure 1. Method-of-limit procedure used in Experiments (a) and (b). For each condition (familiar versus non-familiar), 10 separate runs containing 13 melodies (12 out of tune and 1 in tune) where proposed. For each run, the solid line (for Exp. a) or black circle (for Exp. b) represents the melodic sequence which is first defined as "in tune", whereas the dashed line (for Exp. a) or white circle (for Exp. b) represents the melodic sequence which is first defined as "out of tune".

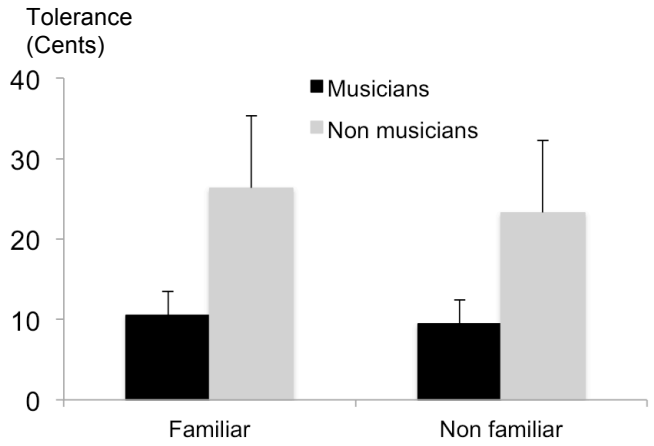


Results

We observed a highly significant correlation between the perceptual thresholds at the test and the retest ($r(60) = .91$, $p < .001$). The tolerance was lower at the retest ($M = 15.80$, $SD = 8.30$) than at the test ($M = 17.33$, $SD = 9.63$), $t(59) = 2.92$, $p = .005$. Note that the direction of the deviation (i.e., enlargement vs. compression of an interval) did not affect the mean tolerance threshold ($t(59) = .-96$, $p = .34$).

As illustrated in Figure 2, there was an effect of expertise ($F(1, 116) = 139.11$, $p < .001$, $\eta^2 = .54$) on the perceptual thresholds but no effect of familiarity ($F(1, 116) = 2.74$, $p = .10$) and no interaction ($F(1, 116) = .60$, $p = .44$).

Figure 2. Mean and Standard Deviation (error bars) of the tolerance (in cents) according to the expertise of the participants (non musicians vs. musicians) and the melody evaluated (familiar vs. non familiar).



These results highlight the low tolerance of all listeners when listening to melodies slightly out of tune (less than a quarter tone). Interestingly, even for a familiar song highly known by the participants (i.e., Happy Birthday), the effect of music expertise was still highly significant.

Experiment (b)

Methods

Participants: 30 music experts (new participants) were selected on the basis of detailed biographical questionnaires.

Material: The melodies of Experiment (a) were manipulated from "in tune" (deviation of 0 cent) to "out of tune" (5 to 30 cents, in 5 cent steps), as illustrated in Figure 1.

Procedure: As for Experiment (a), participants were asked to specify whether the presented singing performances were "in tune" (answers represented by solid circles) or "out of tune" (answers represented by white circles).

Results

When proposing melodies with small manipulations to music experts, we still observe a highly significant correlation between the perceptual thresholds at the test and the retest ($r(30) = .86$, $p < .001$) but no difference anymore ($t(29) = .91$, $p = .37$) between the two sessions (i.e., no training effect). There was an effect of the direction of the deviation ($F(1, 116) = 10.64$, $p < .01$, $\eta^2 = .08$) on the perceptual thresholds but no effect of familiarity ($F(1, 116) = .25$, $p = .62$) and no interaction ($F(1, 116) = .77$, $p = .38$). In line with the results of Experiment (a), the mean tolerance threshold was about 10 cents, with $M = 7.85$ ($SD = 2.61$) for the compressed intervals and $M = 10.01$ ($SD = 4.06$) for the enlarged intervals.

Conclusions

These experiments support that listeners are consistent when categorising melodies as "in tune" or "out of tune", whatever the familiarity of the melody and their musical training. In addition, music experts show less tolerance when listening to melodies and seem to be particularly sensitive to interval compressions. All together, these findings yield the opportunity to refine objective tools for the evaluation of singer pitch accuracy but also to provide pertinent material to investigate the music perception process.

Keywords

Singing voice, Pitch perception, Vocal accuracy, Music expertise, Melodic evaluation

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