Tracking Modulations to the Dominant in Classical Minuets: A Concurrent Probe-Tone Study

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ABSTRACT

This study investigated the time course of formation of tonal hierarchy representations in nonmodulating and modulating classical minuets. Participants at three levels of expertise rated brief excerpts using the concurrent probe-tone technique[1]. We compared the Western major profiles[2] of tonic and dominant keys with profiles of modulating excerpts. Results indicated that modulation to the dominant does not strongly alter the sense of tonal center.

BACKGROUND

Previous investigations have shown that:

(a) People form mental representations of tonal hierarchies of a musical scale at a very young age[3].

(b) Age and musical experience have little effect on the formation of mental representations of tonal hierarchies; mere exposure to an individual's culture leads to the formation of such representations, whereas training enhances it[4].

(c) Nonmusicians have a relatively sophisticated implicit understanding of tonal hierarchy and expectancies in music[5].

(d) Listeners access their mental representations of the hierarchy of notes in musical scales of their own culture when listening to culturally familiar and unfamiliar melodies[6].

(e) Musicians can track modulations successfully, whether with schematic chord sequences[2], continuously modulating melodies[7], or excerpts of real music[1].

PARTICIPANTS

Musicians:

• N = 36, age range = 18 to 42 years, musical training, > 6 years

Moderate Musicians:

• N = 36, age range = 18 to 42 years, musical training, 1 to 6 years

Nonmusicians:

• N = 36, age range = 18 to 44 years, musical training, < 1 year

STIMULI & TASK

• Six excerpts from Haydn minuets, consisting of the first 8 measures: 3 nonmodulating and 3 modulating from tonic to dominant (fifth) around the sixth measure.

• Excerpts were about 13 s in length, presented at 110 beats/min.

• Excerpts were played on a Yamaha Clavinova using natural articulations and dynamics, and recorded and edited with Cakewalk, a MIDI editor, so as to ensure an even tempo.

• Each excerpt was presented 12 times, forming a block.

• Participants heard the excerpt in one ear only; in the other ear, they heard a constant probe tone corresponding to one of the 12 pitch classes in the octave (i.e., C, C#, D, D#, etc.).

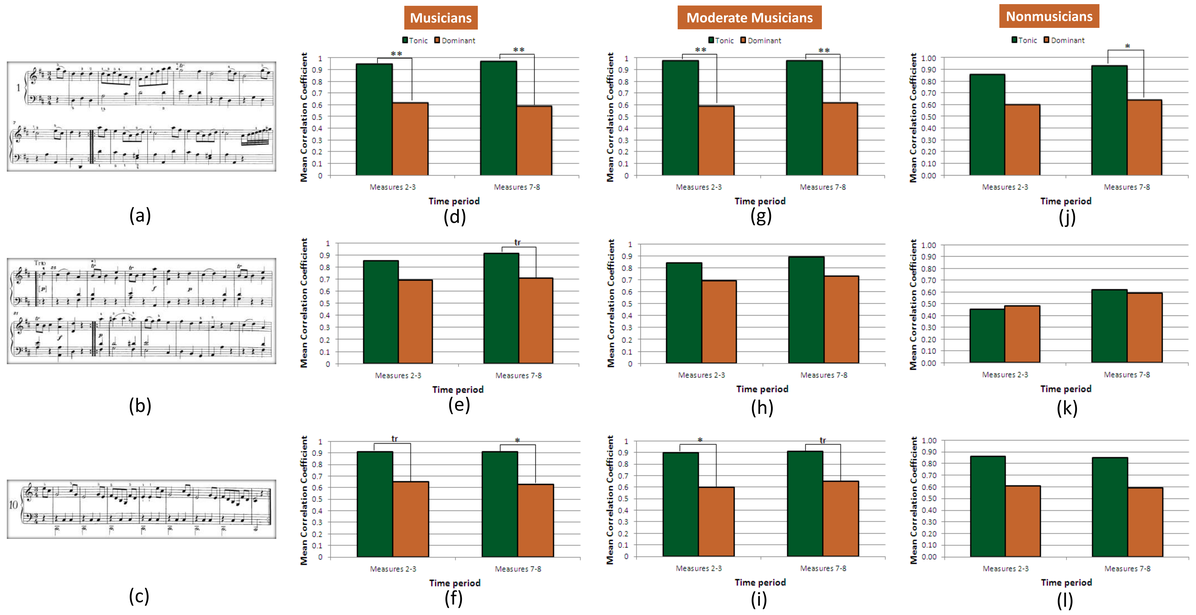
• Each probe tone consisted of sine waves sounded in 3 octaves (in the range of D3 to C#6) spanning the range of the minuets.

• Use mouse to rate continuously how well each tone fits the minuet at every moment on a 0 to 100 scale.

• Stimuli were presented in six blocks, each devoted to one of the minuets. Each minuet was rated 12 times in each block, once for each probe. The orders of trials within blocks were organized in a Latin square, so that different participants contributed ratings of different probes at the various stages of exposure to the minuet, in a counterbalanced order. That allowed us to look at the course of development of a tonal hierarchy profile across repeated hearings of the minuet.

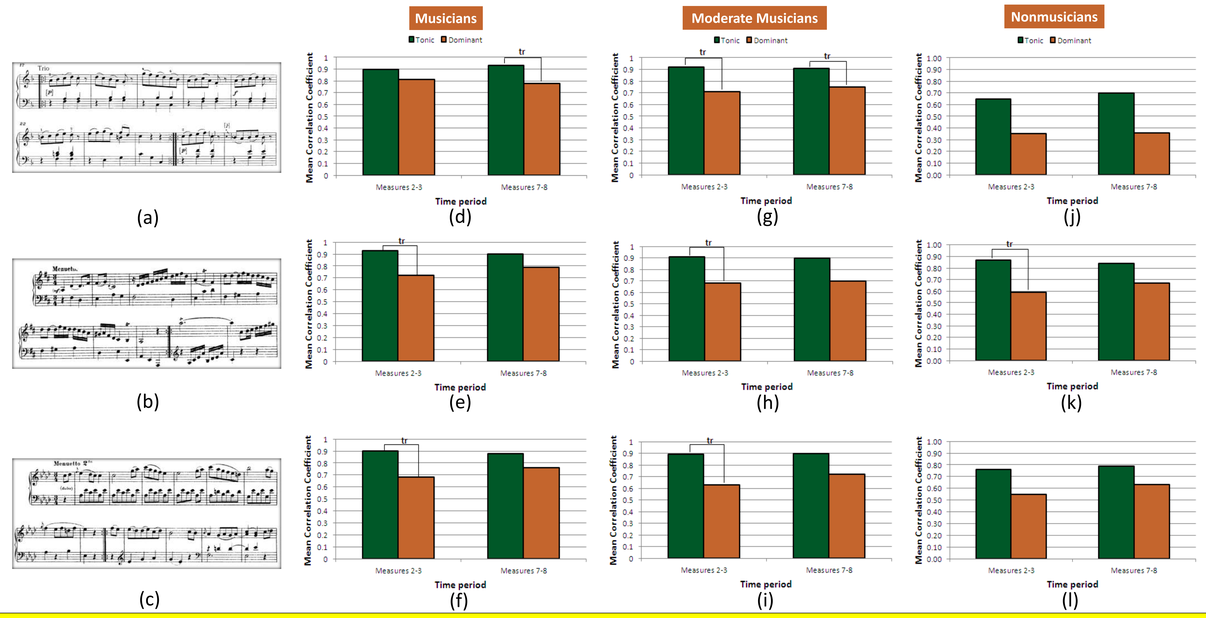
RESULTS –PROFILES OF NONMODULATING EXCERPTS

Figure 1. Left panel (a to c)—Nonmodulating excerpts from Haydn's Dances for Piano. Right panel—Profiles of (d to f) musicians, (g to i) moderate musicians, and (j to l) nonmusicians compared with Western major profiles of tonic and dominant keys at measures 2-3 and 7-8. tr = trend approaching significance. * $p < .05$, ** $p < .001$ (one-tailed Fisher's z-test).



RESULTS – PROFILES OF MODULATING EXCERPTS

Figure 2. Left panel (a to c)—Modulating excerpts from Haydn's Dances for Piano and Piano Sonatas. Right panel—Profiles of (d to f) musicians, (g to i) moderate musicians, and (j to l) nonmusicians compared with Western major profiles of tonic and dominant keys at measures 2-3 (before modulation) and 7-8 (after modulation). tr = trend approaching significance (one-tailed Fisher's z-test).



DISCUSSION AND SUMMARY

• Profiles increased in their differentiation of the various probes across the 12 trials in each block. However, the profile was substantially formed by the end of the third trial.

• Musicians formed their profiles somewhat faster than nonmusicians.

• Profiles of participants with the two higher levels of training showed uniformly high correlations with the tonic profile throughout both nonmodulating and modulating minuets.

• Nonmusicians obtained somewhat less strong tonic profiles, except for the nonmodulating minuet 1b, where their correlations were noticeably low.

• In the nonmodulating minuets, the correlations with the dominant profile throughout were not often far from the baseline correlation of .59 between tonic and dominant.

• For the modulating minuets, the correlation with the dominant increased across the modulation for highly-trained musicians for minuets 2b and 2c, but not for 2a.

• Moderate musicians showed this effect only for minuet 2c.

• Nonmusicians showed this effect for minuets 2b and 2c, but to a much smaller extent than the musicians.

• No group appears to have registered the modulation in minuet 2a. The original tonality of this minuet is somewhat ambiguous, without a solid tonic in the melody until measure 4, and the nonmusicians had some difficulty registering its original key (though the two more highly trained groups had no difficulty with that).

• In general, in agreement with previous research, it is clear that listeners were treating the brief modulation to the dominant in these minuets as simply a variant of the original tonic key, in that, as the correlation with the dominant profile increased across the modulation, the correlation with the original tonic did not decrease.

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