Schematic and Veridical Information in the Detection of Wrong Notes in Melodies

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OVERVIEW

Both schematic and veridical knowledge must be involved in detecting wrong notes in familiar melodies. Dowling (1976) proposed that veridical knowledge of melodic contour is combined with schematic knowledge of the tonal scale (tonal hierarchy) in forming a memory representation which can serve in recognition or recall. With familiar melodies listeners also have veridical knowledge of the pitch pattern of the particular melody. There is considerable evidence that we can easily retrieve exact pitch intervals from well-known melodies, whereas we find it very difficult to generate a melody by stringing together arbitrarily collected pitch intervals (Attneave & Olson, 1971). For example, in their first-year ear-training class, music students in college reproduce precise intervals by recalling familiar tunes ("Old Macdonald," descending perfect 4th, "Somewhere," ascending minor 7th). Supporting this view of familiar melody retrieval, our previous studies (APCAM, 2016) showed that scale membership has a stronger effect on wrong-note detection than does intervallic distance from the original pitch. When we looked at the degree of familiarity of the various familiar melodies in that experiment, however, we found indications that the pattern of responses to the most highly familiar 6 or 8 melodies was different from the pattern for moderately familiar melodies. That experiment was not designed in a way that we could test that possibility systematically. In the present experiment, we contrasted the 8 most familiar melodies with 24 less familiar melodies.

PARTICIPANTS

Familiar Melodies:

N = 76; age range = 18 to 33 years

N = 25; musical training = more than 5 years

N = 30; musical training = 1 to 5 years

N = 21; musical training = less than 1 year

Unfamiliar Melodies:

N = 50; age range = 18 to 33 years

N = 16; musical training = more than 5 years

N = 22; musical training = 1 to 5 years

N = 12; musical training = less than 1 year

STIMULI

Stimuli were generated on MATLAB 2009a:

(a) 8 "highly" familiar songs (familiarity ratings: 92% or higher)

Happy Birthday, London Bridge, Mary Had a Little Lamb, Old MacDonald, Pop Goes the Weasel, Rock-a-Bye Baby, Row Row Row Your Boat, & Rudolph the Red-Nosed Reindeer.

(b) 24 "moderately" familiar songs (familiarity ratings: 44 - 91%)

(c) 32 unfamiliar folk songs (Bronson, 1976)

There were 64 trials and each melody was presented twice, with a different category of wrong note each time. The wrong notes were either in or out of the scale, 1 or 2 semitones distant from the original pitch, and were moved up or down.

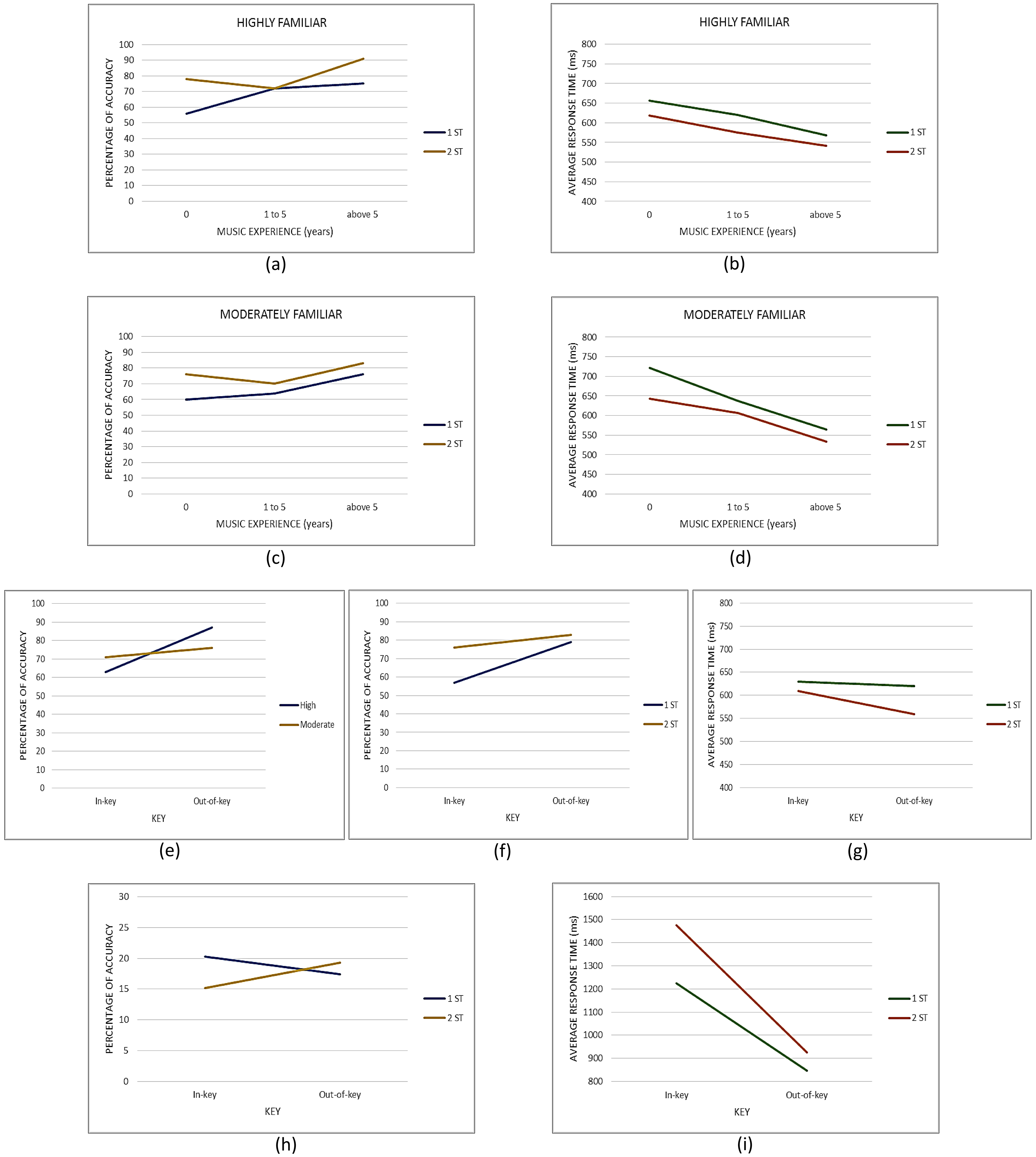
Melodies were presented at 3 quarter-note-values/s over headphones at moderate levels. The sine-wave began with a 60 ms linear on-ramp and ended with a 7 ms off-ramp followed by a 17-ms gap between notes.

TASK

Participants heard 32 familiar and 32 unfamiliar melodies which were repeated twice. Each melody had one wrong note that was either in- or out-of-key, 1 or 2 semitones away, and up or down from the original note. Participants pressed the spacebar when they heard a wrong note.

FIGURES

Figure 1. "Highly" familiar melodies: (a) Hits, (b) Response time (ms) for accurate responses. "Moderately" familiar melodies: (c) Hits, (d) Response time (ms) for accurate responses. All familiar melodies: (e,f) Hits, (g) Response time (ms) for accurate responses. Unfamiliar melodies: (h) Hits, (i) Response time (ms) for accurate responses.



RESULTS

Familiar Melodies: More musical training led to more accurate (Figures 1a, 1c) and faster (Figures 1b, 1d) detection of wrong notes. Responses were quicker with highly familiar melodies (Figures1b, 1d), and the latter effect interacted with training, probably due to a ceiling effect. Detection of out-of-key (vs. in-key) wrong notes was more accurate and faster (Figures 1e, 1g), and their detection varied with distance from their targets (Figures 1f, 1g). The interactions of key membership and distance for both detection and response time showed that out-of-key wrong notes 2 semitones from the target are particularly obvious. And out-of-key wrong notes pop out especially in highly familiar melodies (Figure 1e).

Training interacted with distance with hits: greater distance facilitated detection for the most and least trained listeners, but not for the moderately trained. This interaction was further modulated by degree of familiarity: that pattern was especially pronounced with highly familiar melodies.

Unfamiliar Melodies: Here performance was much worse (Figures 1h, 1i), and more highly trained listeners did not outperform the untrained. Responses were fastest to out-of-key wrong notes, and to those 1 semitone from the target (Figure 1i). Detection was best for out-of-key wrong notes 2 semitones from the target and in-key wrong notes 1 semitone from the target (Figure 1h).

*All results reported are at $p < .05$ or better.

DISCUSSION AND SUMMARY

Unfamiliar Melodies: Schematic information alone only leads to wrong-note detection that is barely better than chance. Responses are much faster with out-of-key wrong notes: the violation of tonal expectations makes the wrong note "pop out." Curiously, responses to 1-semitone deviations are faster than those to 2-semitone deviations. Perhaps the most puzzling result is the interaction between key membership and distance for detection accuracy. When a scale note moves just 1 semitone to another in-key note, that must land on steps 3 and 4, or 7 and 1, which may involve more obvious changes in tonal tendencies than alterations elsewhere in the scale. Also, musical training had no effect whatsoever on wrong-note detection with unfamiliar melodies. Whatever schematic knowledge is being used in this task, nonmusicians have it in roughly the same degree as those with some training.

Familiar Melodies: Both key membership and distance affected detection accuracy and response time. Key membership was especially important for detection accuracy with highly familiar melodies. It is possible that whereas for moderately familiar melodies the pitches tend to be represented in terms of the scale, for highly familiar melodies the scale may be represented in terms of the melody; that is, these melodies in effect serve to define the scale. This fits with the practice of music students to rely on highly familiar melodies to ensure accuracy in the reproduction of scale intervals. The more highly trained listeners performed better than the less trained in both detection accuracy and response times. Taken together with the results with unfamiliar melodies, this suggests that the principal differences due to training (at least at the levels represented here) lie not so much in more finely honed schematic knowledge developed by training, but rather in the better-trained listeners' knowledge of a greater range of actual melodies.

REFERENCES

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