The Experience of Hearing Music: Is It What We Remember?

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Overview

- General Framework: Outside View vs Inside View
  - Outside View – behaviorist – evaluate memory performance
  - Inside View – understand experience and explain how it comes about – Helmholtz's program of finding out how the brain provides us with conscious experience, and shapes that experience – Treisman's Feature Integration Theory
    - Introspective account – Proust
    - Testing memory at different times = Treisman
    - Which version will we remember as having experienced?

General Framework – *con't*

- Perception & Memory all part of one process
  - What we experience as perception is already in memory
  - Includes both automatic & controlled processes
- Schematic & Veridical Knowledge
  - Longstanding issue in memory research – prototypes vs instances
  - Schematic information (e.g., tonal scale) seems to be involved at various stages of processing – we hear pitches in terms of their scale functions (bottom-up), but we can also call scale patterns into working memory (top-down)

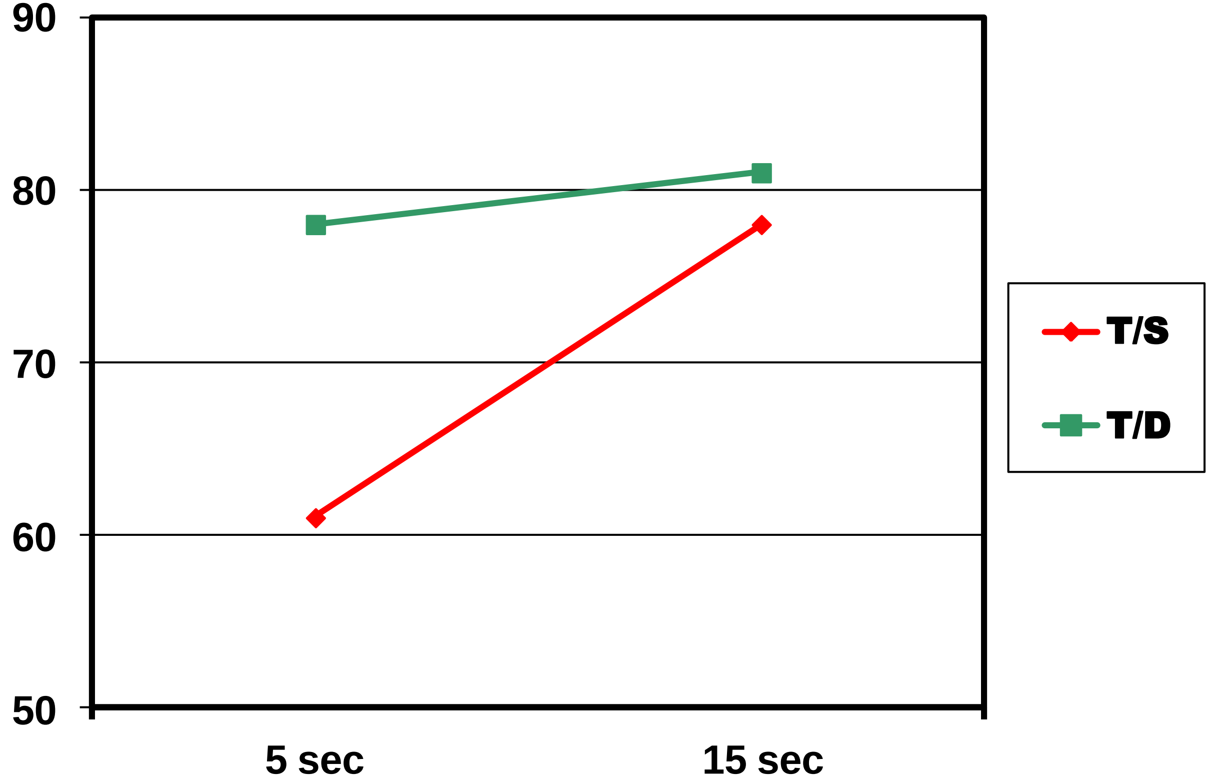
Experiments: Memory for phrases in ongoing music

- Listeners hear the beginnings of classical minuets.
- After a delay of either 4-5 sec or 12-15 sec an earlier phrase (one of the first two) is tested.
- The test is a Target, a Similar (same contour) lure, or a Different lure.
- We get hit & false-alarm rates to Ts, Ss, & Ds, and use them to calculate area scores assessing success in discriminating T vs S, and T vs D.

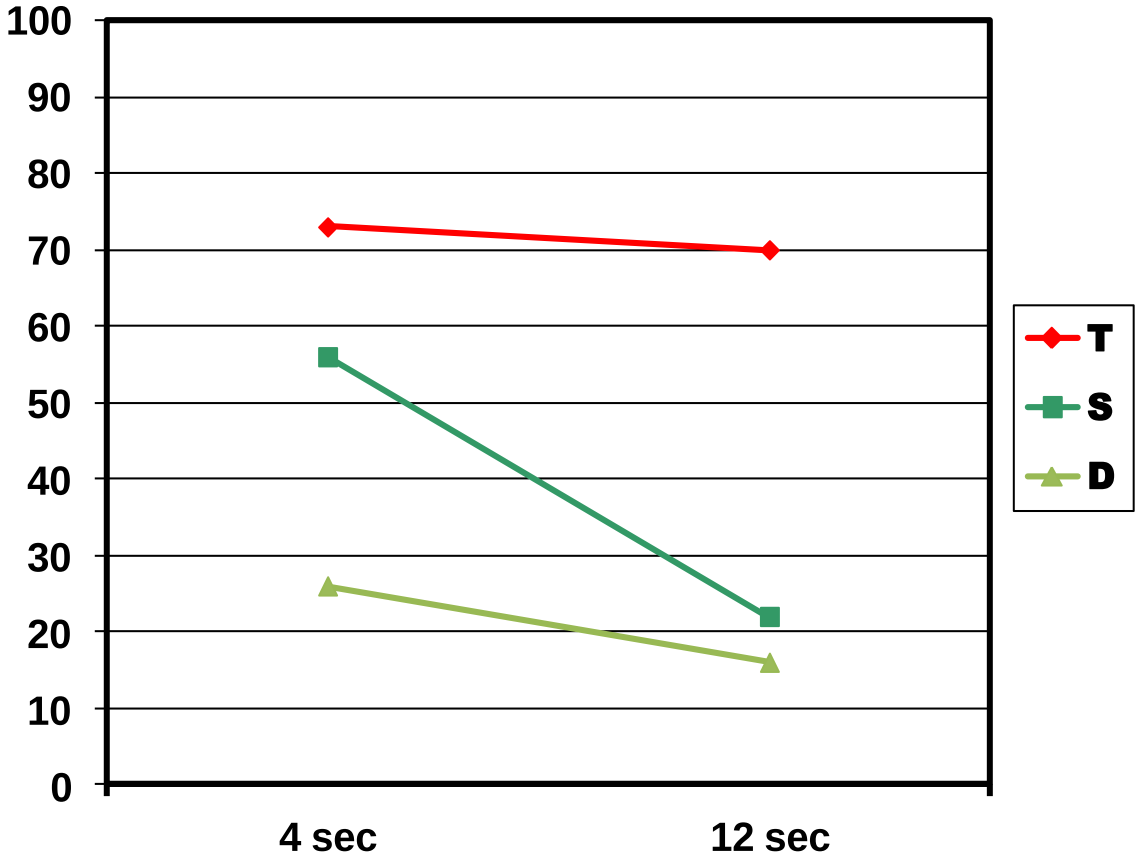

1
2
3
4
1.
2.

Results – area under ROC (% correct)

Dowling, Tillmann & Ayers, 2002; Dowling & Tillmann, 2016



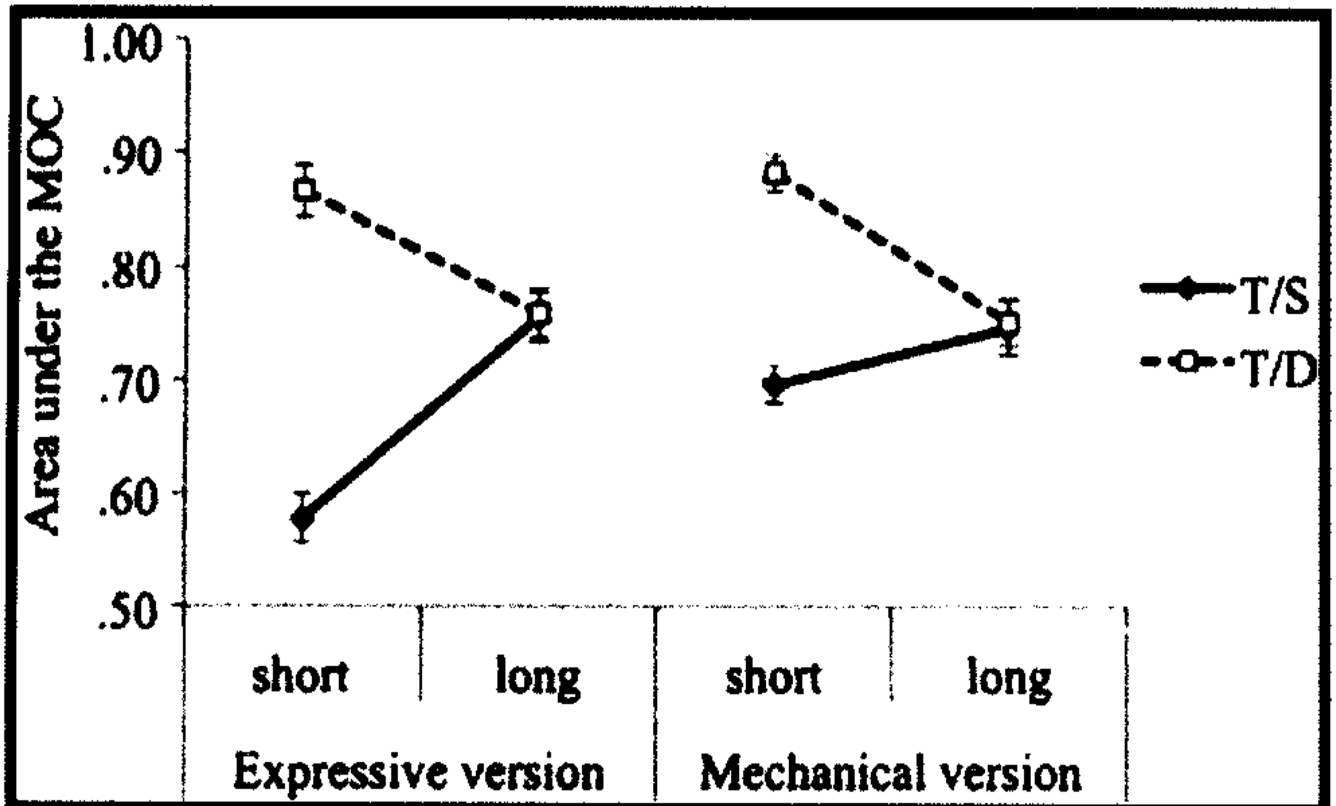
Hits & False Alarms - % ‘yes’



Experiments

Tillmann et al, 2016

- We also replicated this with “natural” piano playing (vs MIDI).

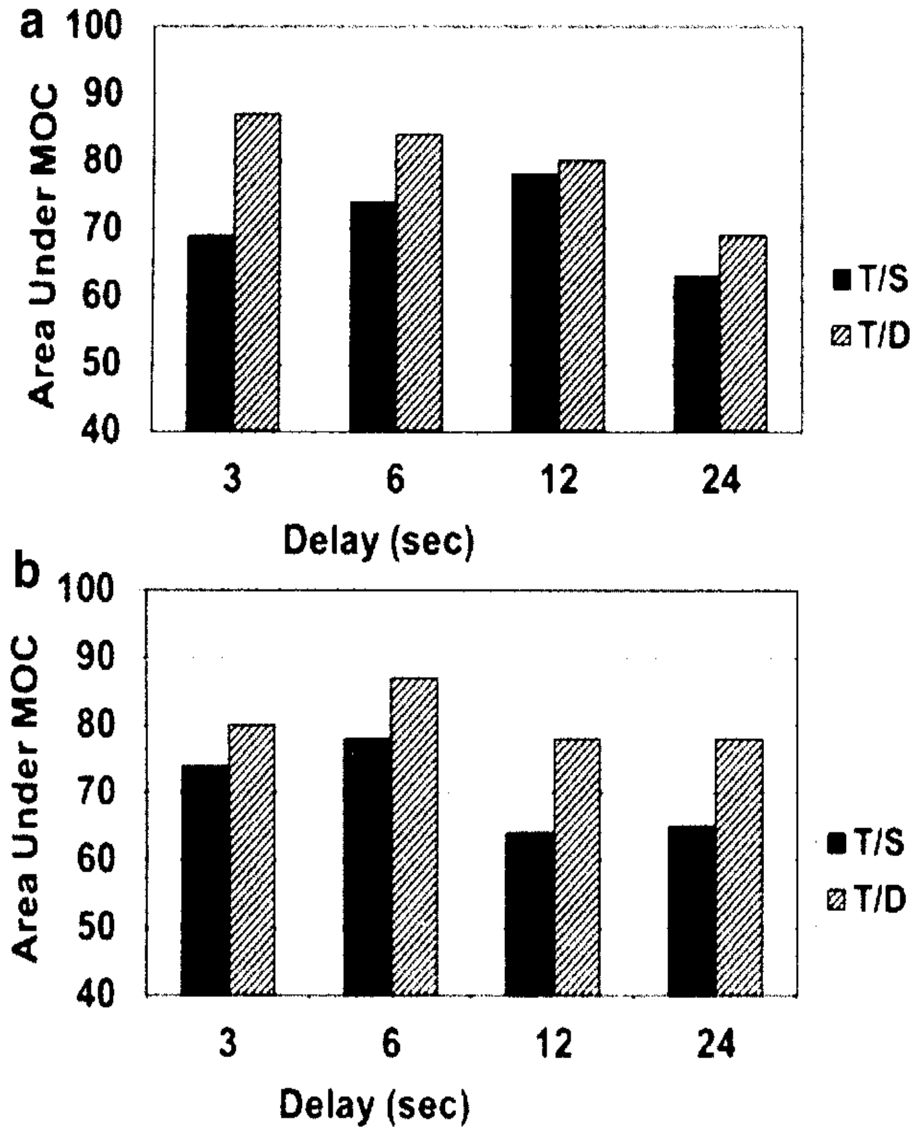


Experiments - Replication with Ottmar Liebert's guitar music

Dowling, Magner & Tillmann, 2016

Results

- a = On-Peak, b = Off-Peak



What we think is happening

- The listener initially registers the individual features of the phrases of the minuet: melodic-rhythmic contour, tonal scale, etc.
- When tested at the short delay, the features of S, taken one at a time, match those of T, and so the listener accepts S as T
- After a delay, the memory system has created an ‘object file’, binding the contour to the scale at the right place, and so is able to reject S

Further Observations

- Leaving the delay interval silent leads to good rejection of S lures even at the short delay; i.e., without ongoing music to interfere, binding occurs very quickly
- Filling the delay interval with foreign material, such as a different minuet, a gavotte (4/4 meter) or a different instrument source, leads the system to dump the current object files, leading to equally poor performance at both the short and long delays

Control of Contour and Accompaniment

- The stimuli, as written, often had small changes in the accompaniment as well as a shift of the melody along the scale, therefore we constructed S lures in which the *only* difference between T and S was the pitch level of the melody on the scale
- We also constructed D lures in which the melody started out like T, but then at a given point deviated, so that the only difference between T and D was the contour of the melody

Results

Similar lures copy targets with pitch level of melody changed

	T/S		T		S	
	S	L	S	L	S	L
inexperienced	.64	.61	.61	.61	.41	.41
moderately exp'd	.66	.75	.62	.65	.40	.25

N = 40

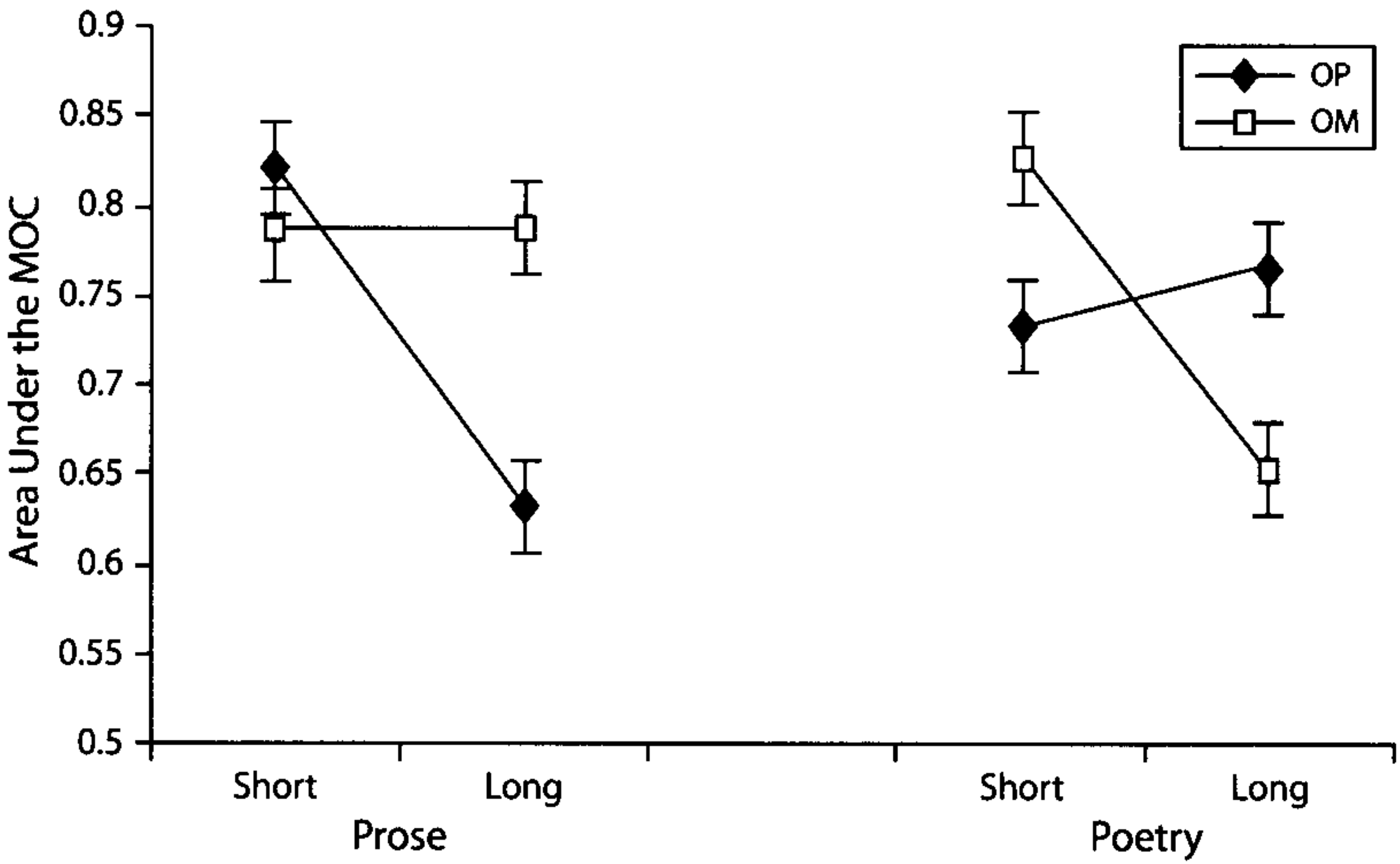
Different lures copy targets but with contour of melody changed

T/S		T/D		T		S		D	
S	L	S	L	S	L	S	L	S	L
.66	.75	.72	.70	.66	.61	.30	.23	.44	.30

N = 31

We also tried this with poetry

Tillmann & Dowling, 2007



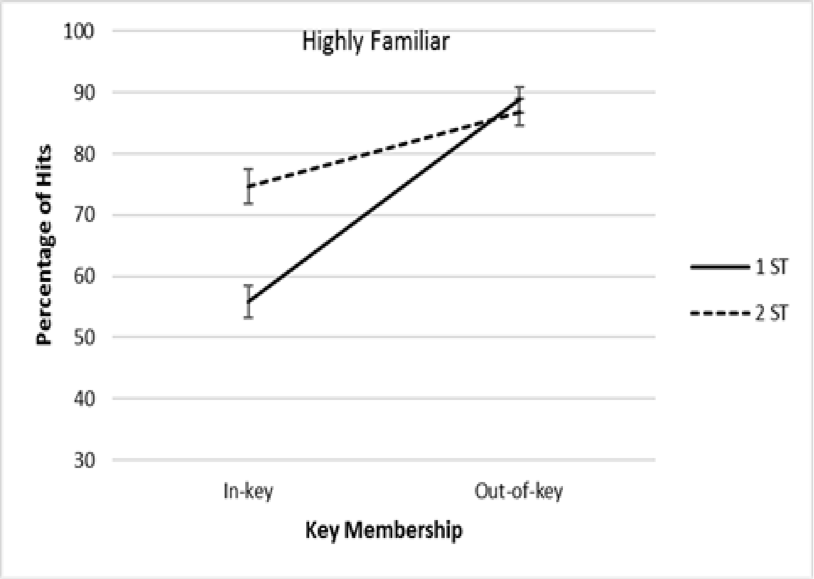
Schematic & Veridical Knowledge

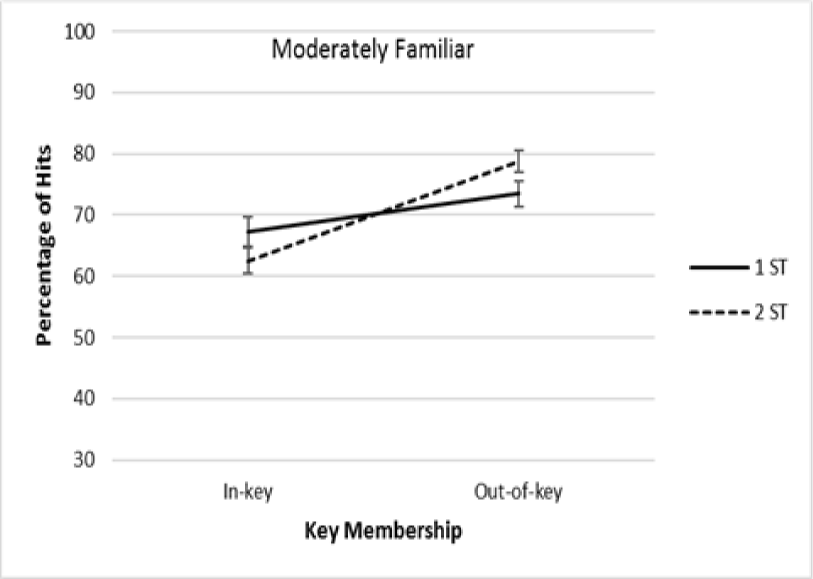
- The previous experiments involve both schematic and veridical knowledge in the form of the tonal scale and the particular melody's contour.
- We have been looking at those aspects in a series of experiments on detection of wrong notes in melodies. The wrong notes are either in-key or out-of-key, and are 1 or 2 ST removed from their original pitch.
- We take the effects of key membership as indicating the strength of schematic knowledge, and interval displacement as indicating veridical knowledge.

Wrong Notes

- We chose 32 melodies with the highest familiarity ratings out of a list of 50. These included tunes like “On Top of Old Smoky” and “Bingo”.
- Of those 32 we separated out the 8 very most familiar, such as “Happy Birthday” and “Rudolph the Red-Nosed Reindeer”.
- We played sine-wave versions with the four possible types of wrong notes scattered among them, and listeners had to respond as quickly as possible when they heard a wrong note.

Results


Highly Familiar
100
90
80
70
60
50
40
30
Percentage of Hits
In-key
Out-of-key
Key Membership
1 ST
2 ST


Moderately Familiar
100
90
80
70
60
50
40
30
Percentage of Hits
In-key
Out-of-key
Key Membership
1 ST
2 ST

Schematic & Veridical Knowledge

- Knowledge of the interval sizes was more important for the highly familiar melodies than for the moderately familiar.
- This suggests that those melodies may be as important to preserving the pitch pattern of the tonal scale as the scale is to defining their pitches.
- This makes sense cross-culturally, because many cultures lack an explicit theoretical basis for musical pitch, and the pitch patterns (which are very durable) are stored in the melodies everyone knows.

Perception & Memory

- Our experience listening to music is complicated and always changing. It isn't what we'll remember later, and it's often unpredictable when we're immersed in it. (Otherwise it wouldn't be so interesting.)
- There is a continual interplay of bottom-up and top-down processes, and of what we expect and what we actually hear.
- Unlike our relationship to the spatial/visual world, we can revel in all this uncertainty and excitement.

Thanks to

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&

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