What's Behind Hits and False Alarms in Musical Memory?

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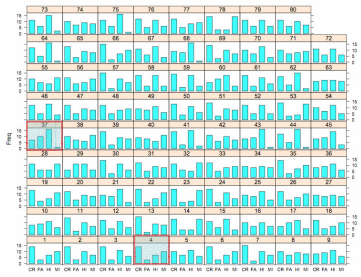
Question

What is it about a melody that makes listeners think that they have heard it before?

Answer

Motivic patterns that are rare in a melody corpus increase both hits and false alarms.

Some melodies elicit a higher sense of familiarity than others

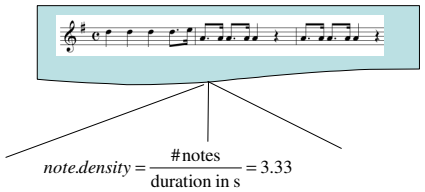


What's the Approach?

Predict human memory judgments by quantitative information about the structure of real melodies. Use corpora of melodies to approximate real-life listening histories and musical knowledge.

Summary Features

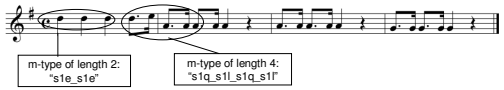
Computed from notes of a melody ignoring note order, e.g. *note density* indexing complexity of melody



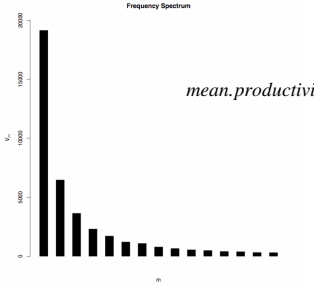
$$note.density = \frac{\#notes}{\text{duration in s}} = 3.33$$

Motivic patterns (m-types features)

Computed from frequency distribution of short note sequences observing note order.



Count motivic patterns in melody and in melody corpus and characterise the resulting frequency distributions by numerical values, e.g. *productivity* (the proportion of motivic patterns only occurring once).



$$mean.productivity = \frac{\sum_n \frac{V(1,N)}{N}}{|n|}$$

What's the Evidence?

The Experiment:

Recognition task including study list of 40 melody items and test list of 80 items, half old and half new.

Participants:

34 adults with low musical background.

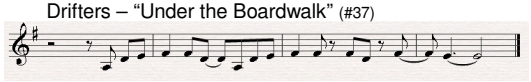
Stimuli:

80 melodic phrases (testset corpus) randomly drawn from the vocal lines of 14,063 commercial pop songs (pop corpus) and unfamiliar to participants.

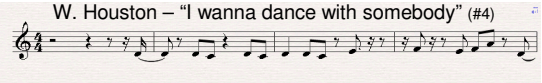
Task:

Confidence rating on 6-point scale "How sure are you that you have heard this melody before?"

Melody eliciting highest "old" ratings:
Drifters – "Under the Boardwalk" (#37)



Melody eliciting highest "new" ratings:
W. Houston – "I wanna dance with somebody" (#4)



Regression Analysis

a) Random mixed effects modeling for all-item as well as old-item trials and new-item trials separately.

b) Model selection based on model fit (log-likelihood), model parsimony, significance of predictor coefficients.

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Results

All-item model: R^2 = .253

Fixed effects	beta	std error	*t*	95% CI
Intercept	1.9	0.85	2.28	[0.3, 3.6]
Condition (old/new)	-0.9	0.05	-18.46	[-1, -0.8]
Commonness of note density in testset	0.4	0.23	1.66	[-0.1,0.8]
Commonness of motivic patterns in testset	-53.3	54.59	-.97	[-155, 53]
Variance in rarity of motivic patterns	-7.0	2.43	-2.88	[-12, -2]
Proportion of rare motivic patterns in testset	1.4	0.53	2.64	[0.4, 2.4]

Old-item model: R^2 = .276

Fixed effects	beta	std error	*t*	95% CI
Intercept	2.6	1.19	2.2	[0.4, 4.7]
Variability of melodic Contour	0.1	0.03	2.53	[0.02, 0.12]
Commonness of motivic patterns in testset corrected by frequency in melody	-12.9	7.1	-1.82	[-25.4, 0.1]
Variance in rarity of motivic patterns	-7.3	3.99	-1.82	[-14, -0.2]

New-item model: R^2 = .229

Fixed effects	beta	std error	*t*	95% CI
Intercept	0.6	0.24	2.5	[0.1, 1.0]
Commonness of overall duration wrt pop-corpus	-0.8	0.43	-1.99	[-1.7, -0.1]
High repetition of rare motivic patterns wrt pop-corpus	-1.1	0.5	-2.28	[-2.1, -0.2]

So what? - Interpretations

When is recognition correct (what makes a *hit*)?

Rare motivic patterns stand out at encoding and a stronger memory trace is generated. Also, at recognition, attention is directed towards rare motivic patterns and hits are facilitated.

What creates illusions of familiarity (*false alarms*)?

Attention is directed towards rare motivic patterns at recognition and an unusual motive is registered. This registration is misattributed to recognition and leads to a false alarm.