Validating a technique for post-hoc estimation of a listener's focus in music structure analysis

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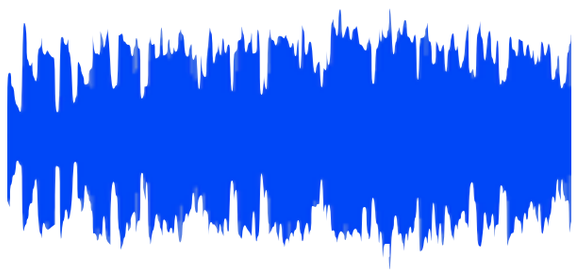
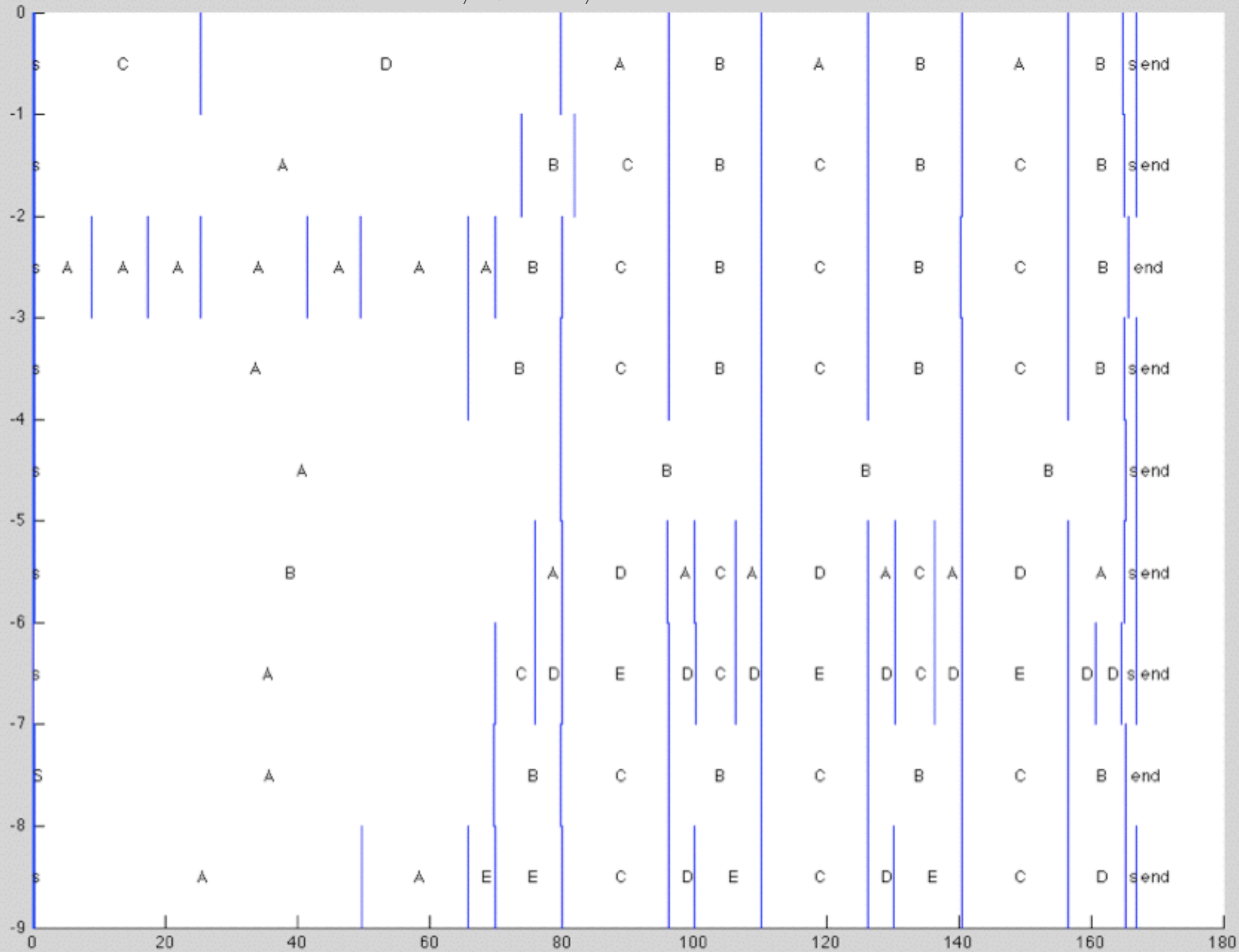
What was the listener thinking?

(when they annotated musical structure)



Melody
Harmony
Rhythm
Meter
Timbre
etc.

Isaac Hayes, Run Fay Run



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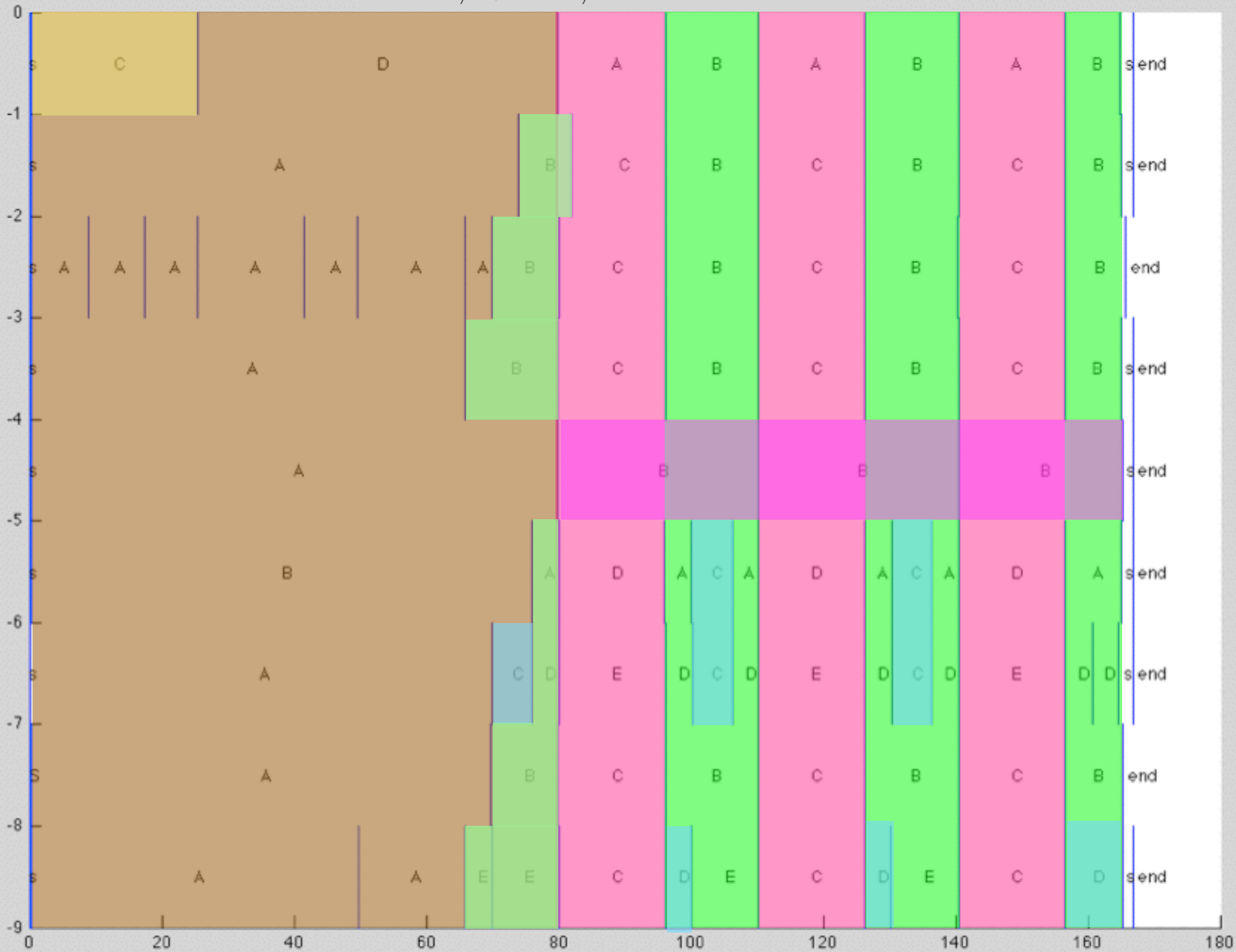
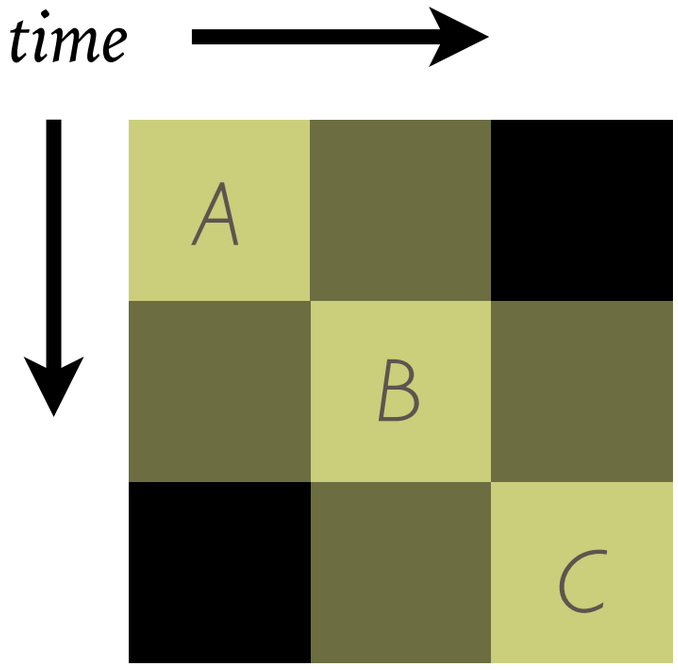
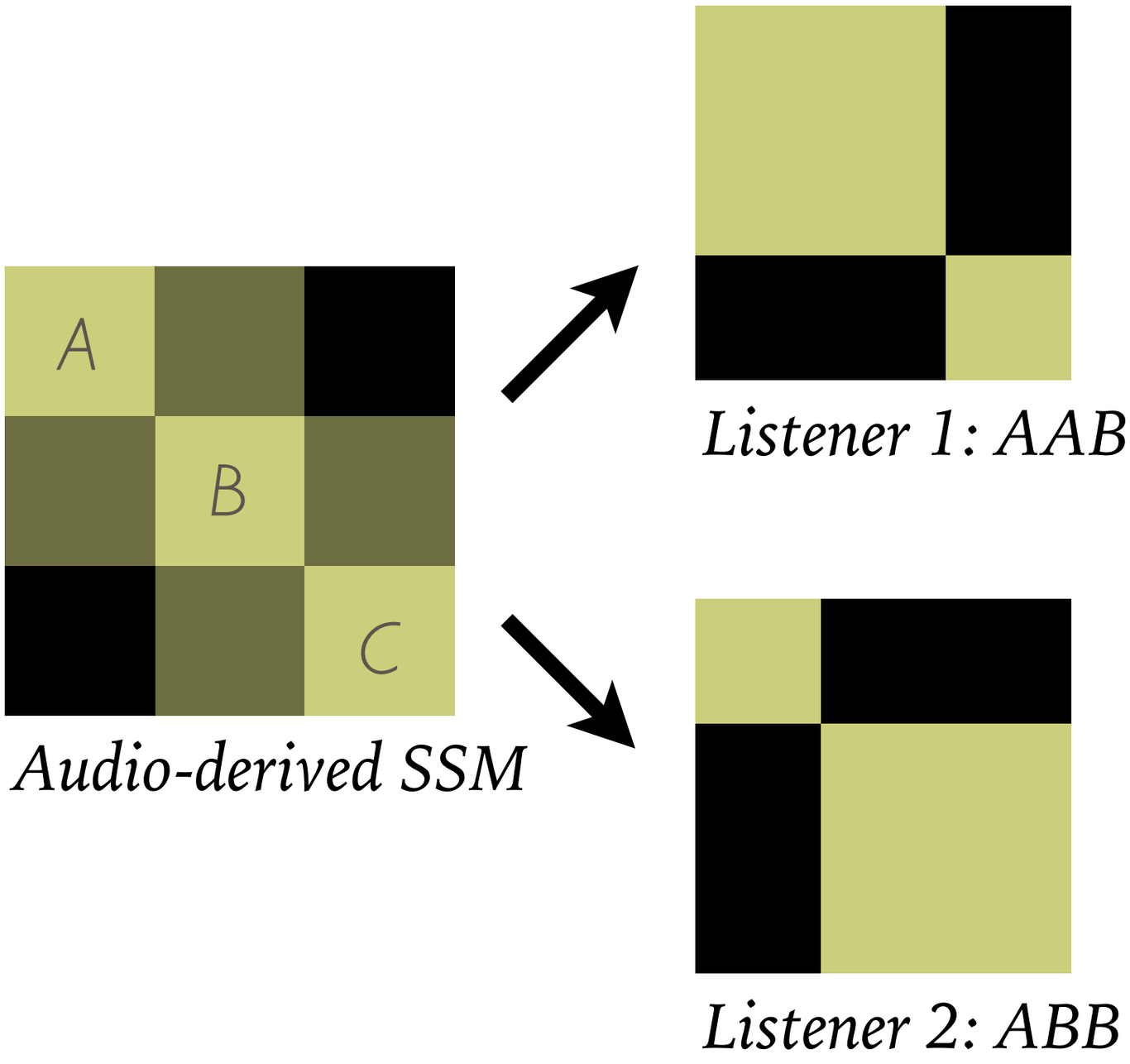


RELATING GROUPING STRUCTURE TO MUSICAL FEATURES



Audio-derived SSM

RELATING GROUPING STRUCTURE TO MUSICAL FEATURES



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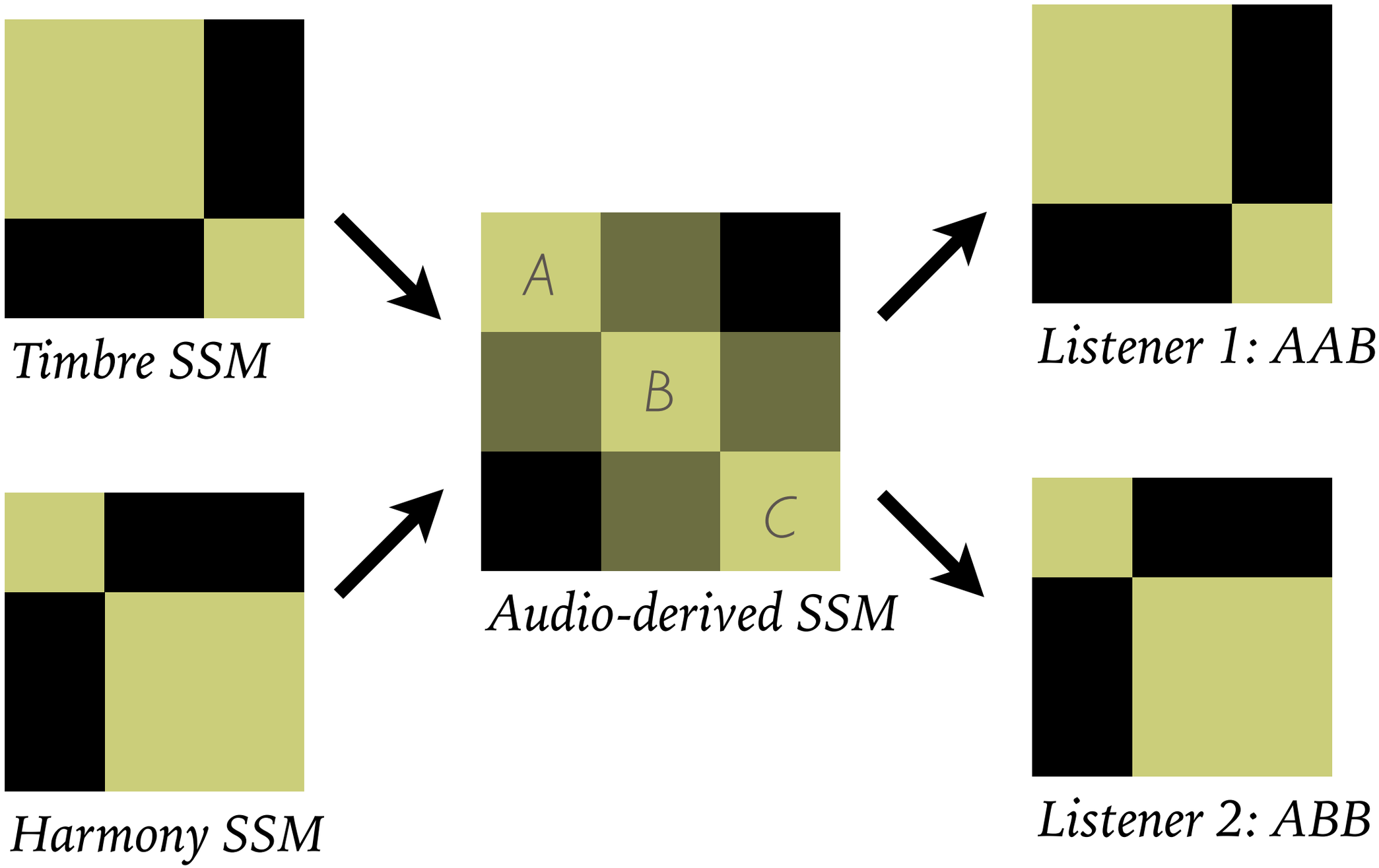

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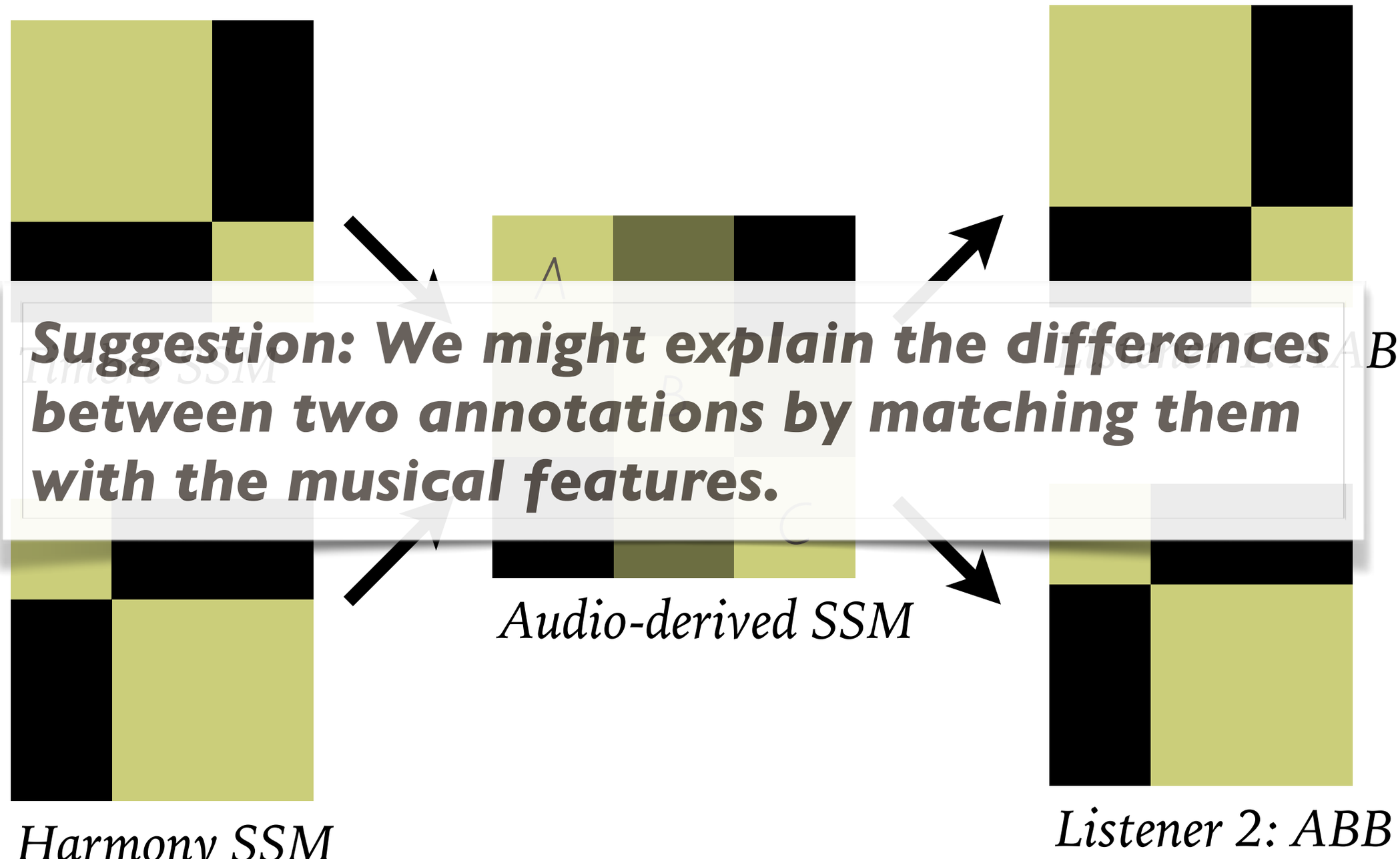
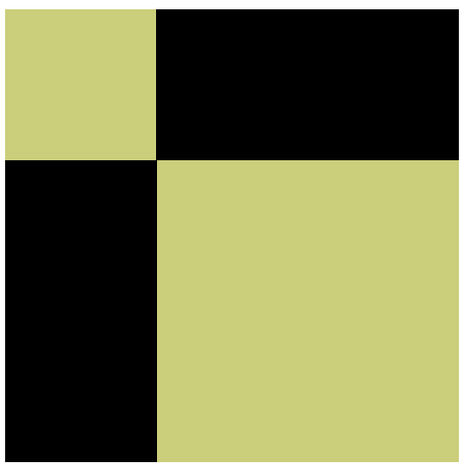


Suggestion: We might explain the differences between two annotations by matching them with the musical features.

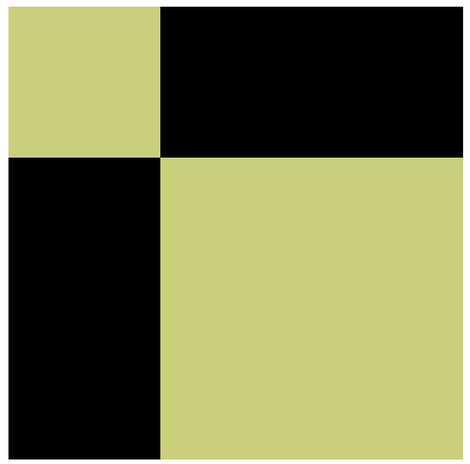
RELATING GROUPING STRUCTURE TO MUSICAL FEATURES

Timbre SSM

Listener 1: AAB



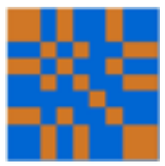
Harmony SSM



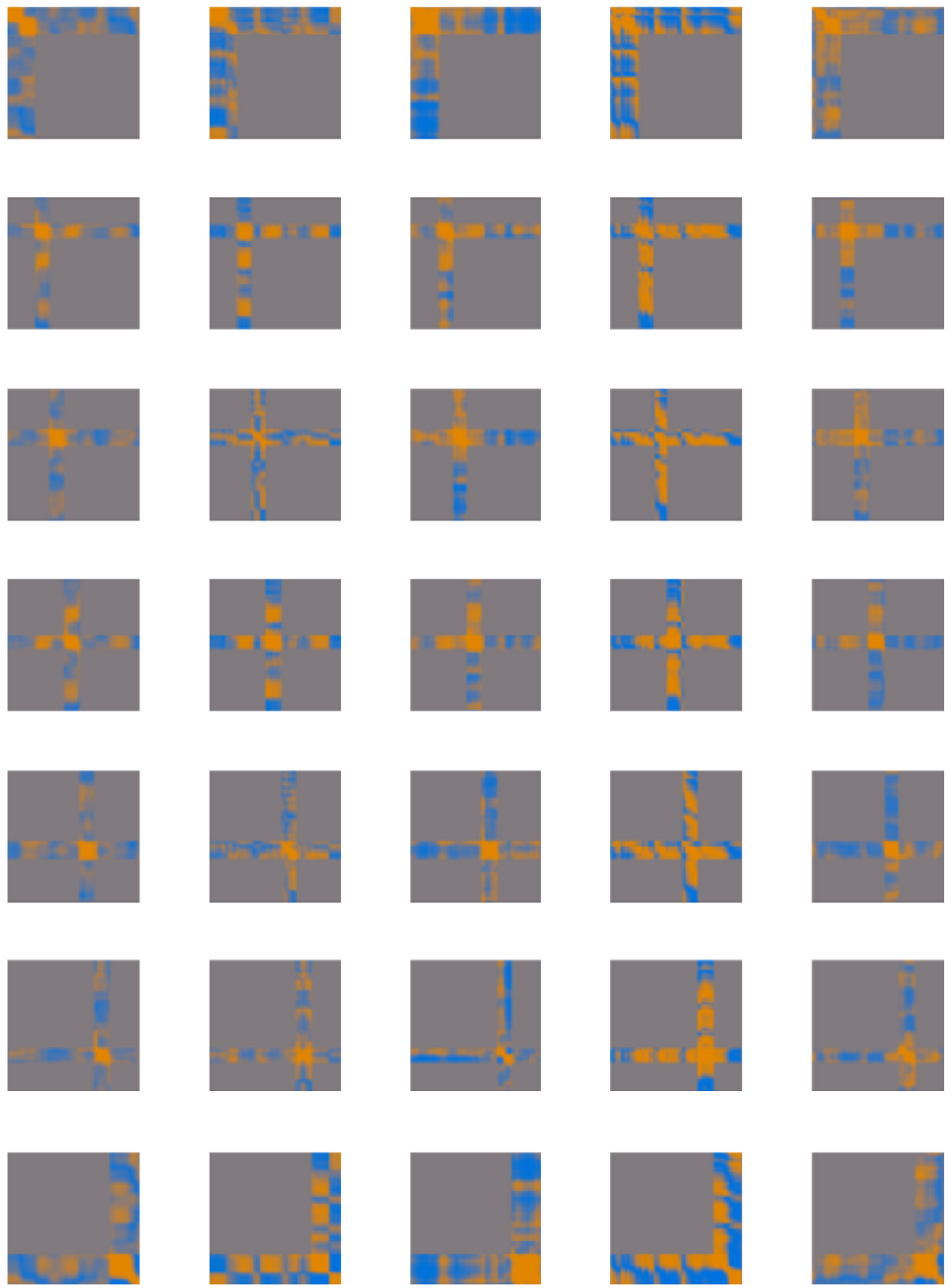
Listener 2: ABB

Target SSM (original annotation)

Feature-derived SSMs



Segment-based masks



Reconstruction components

Target SSM (original annotation)

Feature-derived SSMs

N

$x_{11}M_{11}$ $x_{12}M_{12}$ $x_{13}M_{13}$ ... $x_{15}M_{15}$

$x_{21}M_{21}$

$x_{31}M_{31}$

Segment-based masks

$x_{71}M_{71}$ $x_{75}M_{75}$

Reconstruction components

Target SSM (original annotation)

Segment-based masks

Feature-derived SSMs

N

$x_{11}M_{11}$ $x_{12}M_{12}$ $x_{13}M_{13}$ ... $x_{15}M_{15}$

$x_{21}M_{21}$

$x_{31}M_{31}$

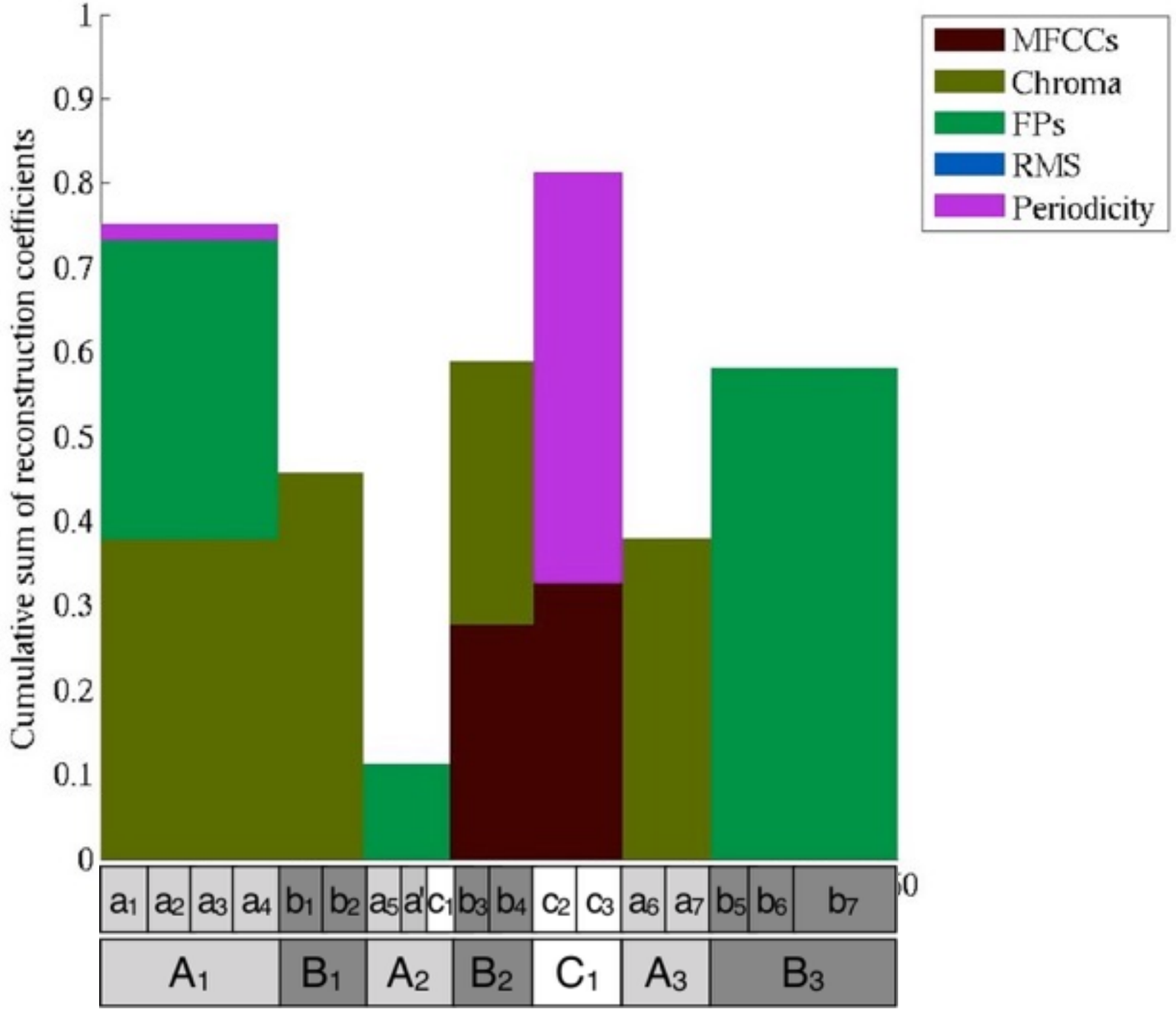
find that minimizes

Reconstruction components

$$\left(\left(\sum_{j=1}^{s}\sum_{i=1}^{f} x_{i,j}M_{i,j}\right) - N\right)^2$$

$x_{71}M_{71}$ $x_{75}M_{75}$

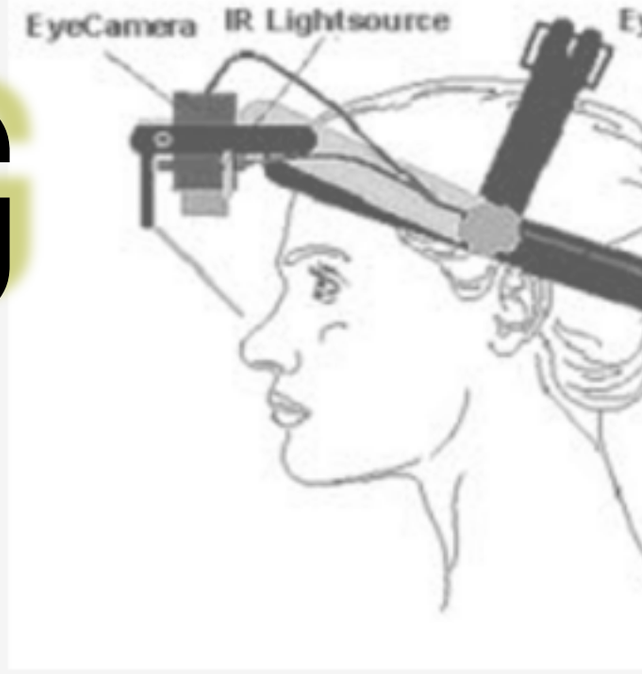
WHICH FEATURE BEST EXPLAINS THE ANALYSIS?

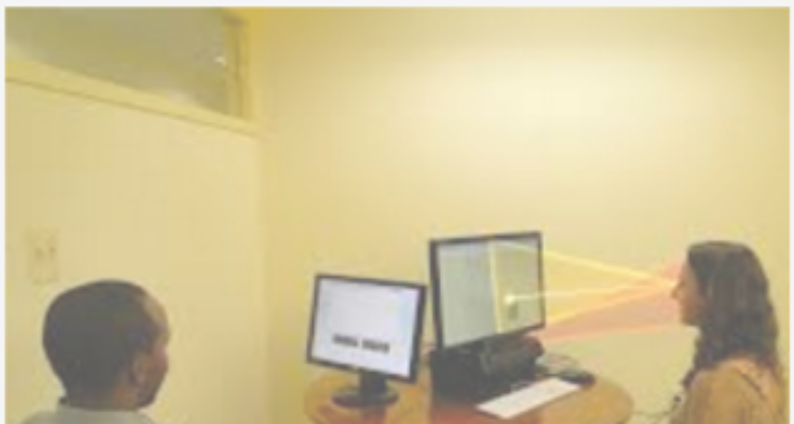


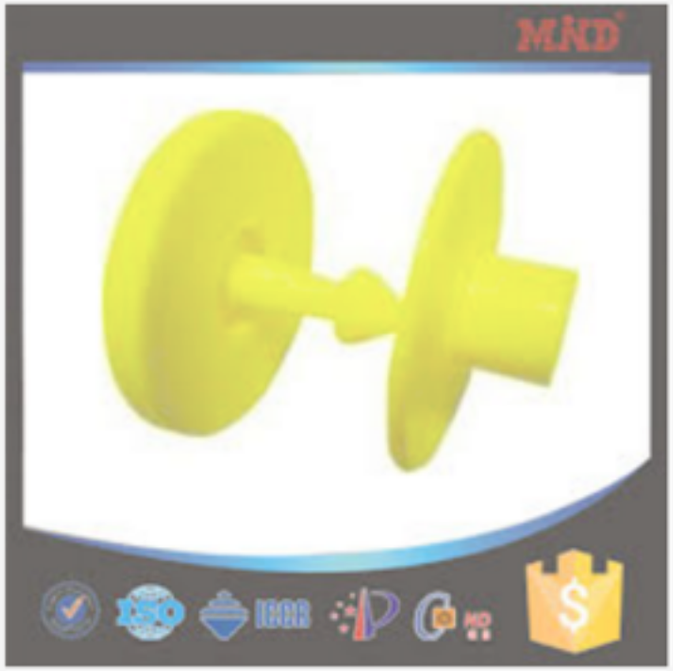
CRITICISM

- Model not validated with real-world data:
    - I.e., analyses paired with attention state of listener

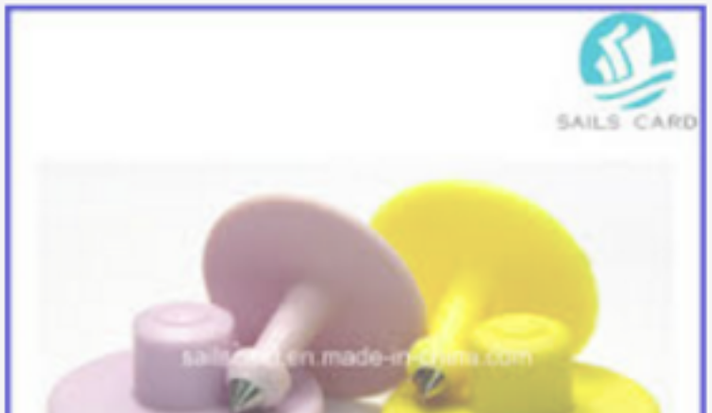
EYE TRACKING







EAR TRACKING



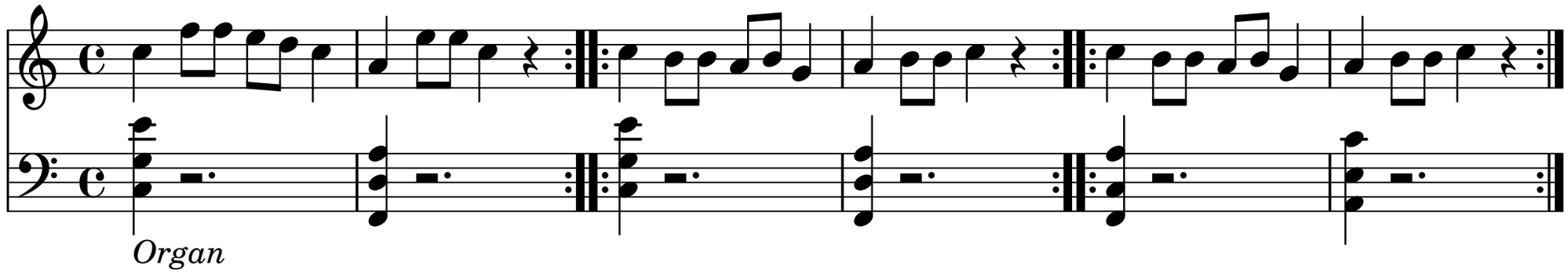
CRITICISM

- Model not validated with real-world data:
    - I.e., analyses paired with attention state of listener
    - One source of data:
        - Ran experiment testing whether focus of listener could affect perception of grouping

STIMULUS EXAMPLES

Melody ABB

Harmony AAB



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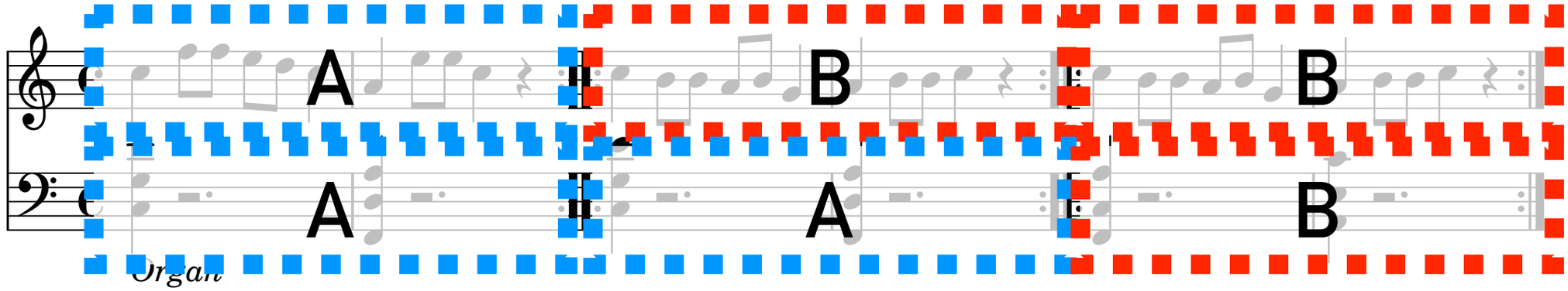

STIMULUS EXAMPLES

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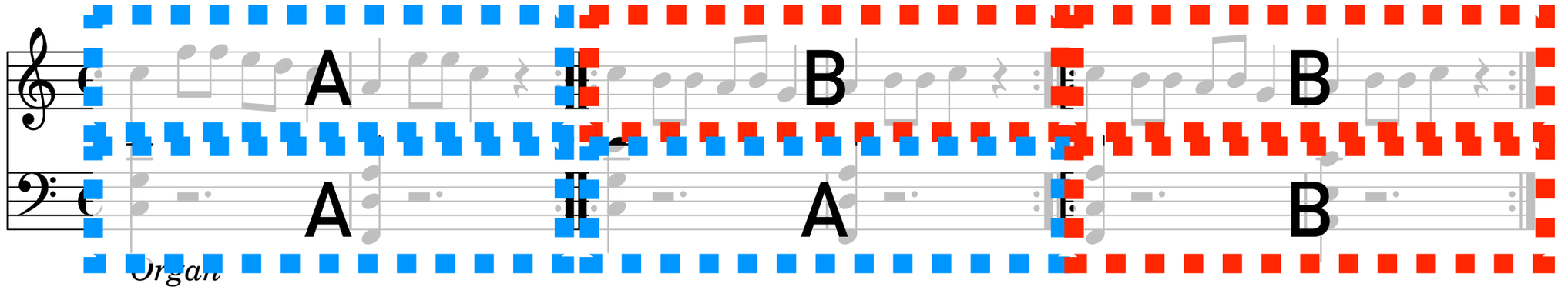
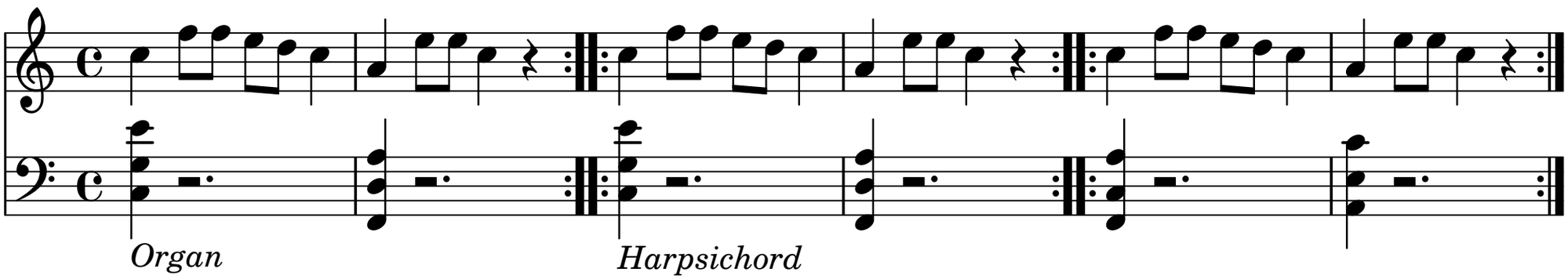


Timbre ABB
Harmony AAB



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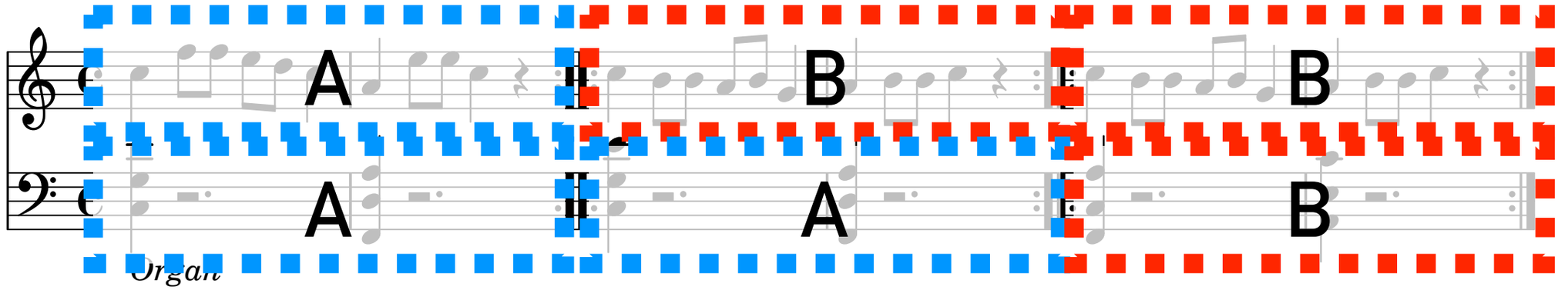

Timbre ABB
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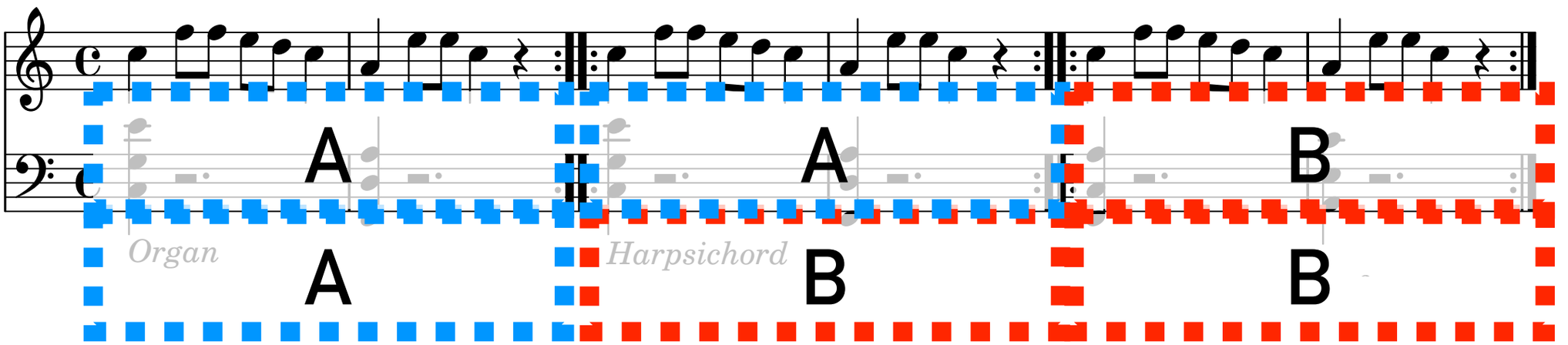

STIMULUS EXAMPLES

Melody ABB
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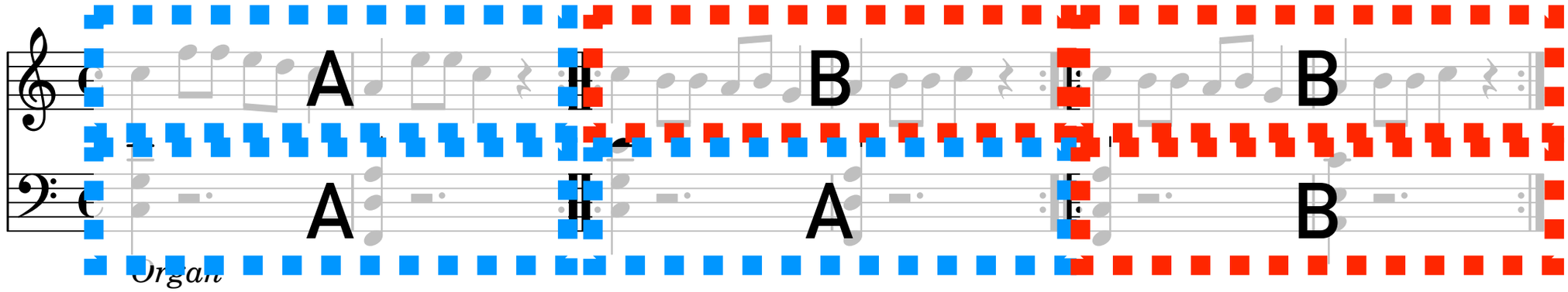

Timbre ABB
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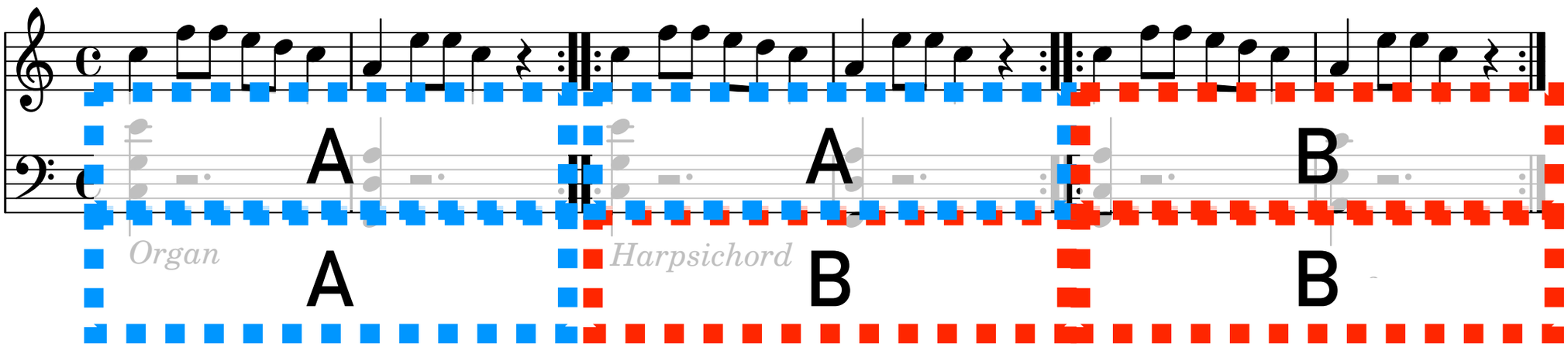


- Experiment outcome: giving listeners a distractor task (to fix attention) affected AAB vs. ABB decisions
  - "Does this chord progression occur in the stimulus?" → prefer AAB
- Note: sometimes, organizing features are convolved

CRITICISM

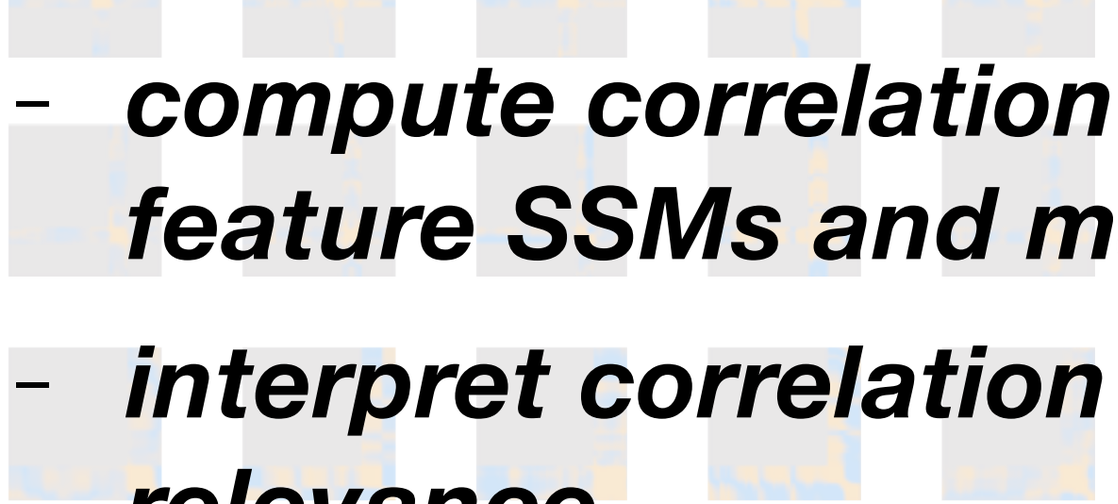
- Model not validated with real-world data:
    - I.e., analyses paired with attention state of listener
    - One source of data:
        - Ran experiment testing whether focus of listener could affect perception of grouping
- Is model needlessly complicated?
    - Try simple correlation instead

Target SSM (original annotation)

Feature-derived SSMs

Segment-based masks

Reconstruction components



QP approach:

- ***find sum of reconstruction components to generate target SSM***
- ***interpret coefficients as relevance***

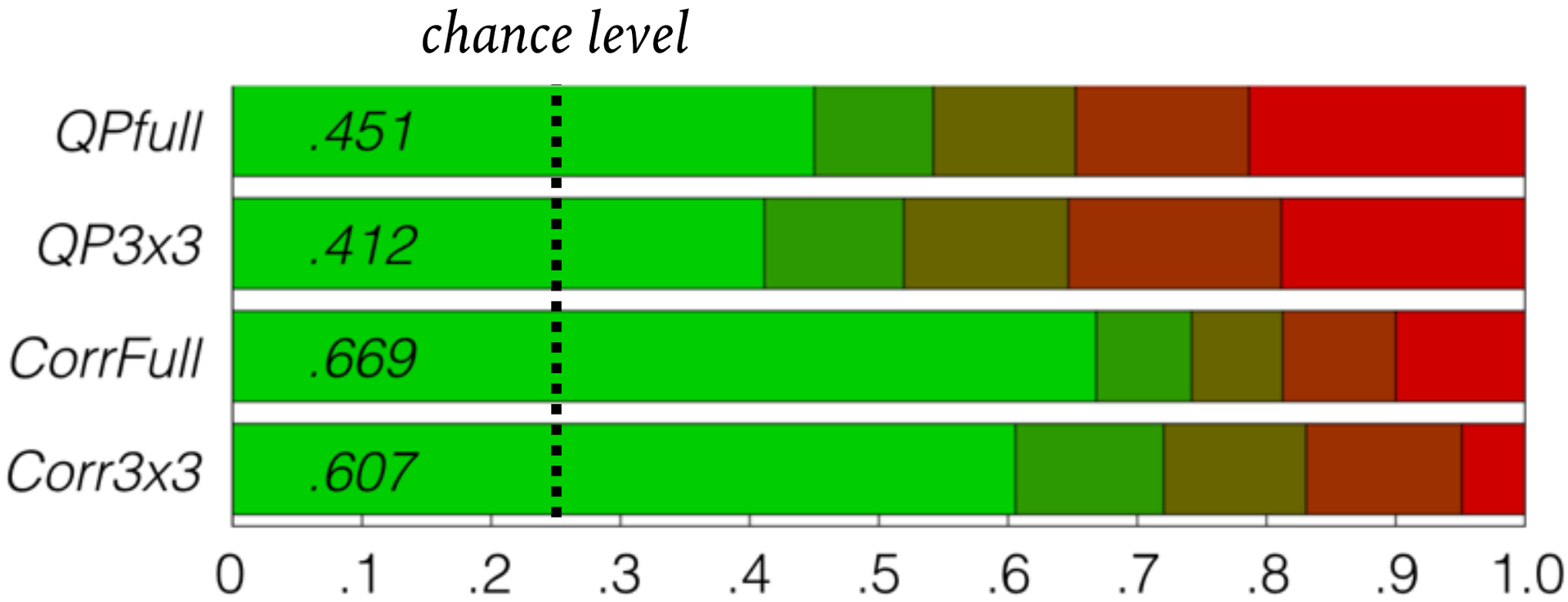
Correlation approach:

- ***compute correlation between feature SSMs and masks***
- ***interpret correlation as relevance***

EXPERIMENT

- Use algorithm to estimate relevance of features to analysis of experiment stimuli
- If the most relevant feature is the feature that changed, count correct

RESULTS



What feature was found to be most relevant?

(i.e., greatest QP weights or correlation)

SUMMARY

- Past work:
  - 1. Algorithm to estimate feature relevance from analyses (Smith and Chew, 2013)
  - 2. Artificial stimuli from psych experiment studying attention
- Current work:
  - Use stimuli (2) to validate algorithm (1) and new variations

SUMMARY

- Algorithm performs above baseline…
- …but artificial context makes non-perfect performance a disappointment!
    - Random effect of small set of stimuli
    - Mismatch between features and musicological interpretations
- Future work:
    - re-optimize (or train) model with more features, more artificial stimuli
    - apply algorithm to investigate trends in large datasets

THANKS!

ADVERTORIAL SUPPLEMENT

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REFERENCES

- Jordan B. L. Smith and Elaine Chew. Using Quadratic Programming to estimate feature relevance in structural analyses of music. In *Proceedings of the ACM International Conference on Multimedia*, 113–122, Barcelona, Spain, 2013.

- Jordan B. L. Smith. Explaining listener differences in the perception of musical structure. Ph.D. thesis. Queen Mary University of London. See Chapter 6: "The effect of attention on grouping decisions."