# Statistical learning of novel musical material:

## Evidence from an experiment using a modified probe tone profile paradigm and a discrimination task.

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## Introduction

Statistical learning is thought to play a crucial role in the process of gaining musical knowledge. It is theorized that we abstract statistical regularities contained in the music around us during passive exposure[1]. Our aim is to explore this role. We asked:

**A**: are participants able to abstract statistical (pitch distributional) information from novel melodies after 30 minutes of exposure?,
**B**: does this abstraction become a mental representation?, and
**C**: does this representation influence responses to melodies generated from a similar, but not identical, pitch distribution?.

## Methods

- **Procedure**

We assessed statistical learning, by comparing goodness of fit (GoF) ratings obtained for probe tones[2] before and after an exposure phase. 40 Participants indicated the GoF of each of 12 probe tones to novel melodies (contexts). Melodies heard during exposure and as contexts were both based on a whole-tone scale, but differed in 12% of the presented tones. This allowed us to investigate GoF responses to probe tones

that occurred both during exposure and in contexts ($EC$),
that occurred in the contexts, but not during exposure ($\bar{E}C$),
that occurred during exposure, but not in contexts ($E\bar{C}$), and
that occurred neither during exposure or in contexts ($\bar{E}\bar{C}$).

Then, participants completed a discrimination task, in which they indicated which of two melodies resembled the heard melodies. One of the melodies was based on the same scale, from which melodies were generated for the exposure phase, the other did not resemble any of the heard melodies.

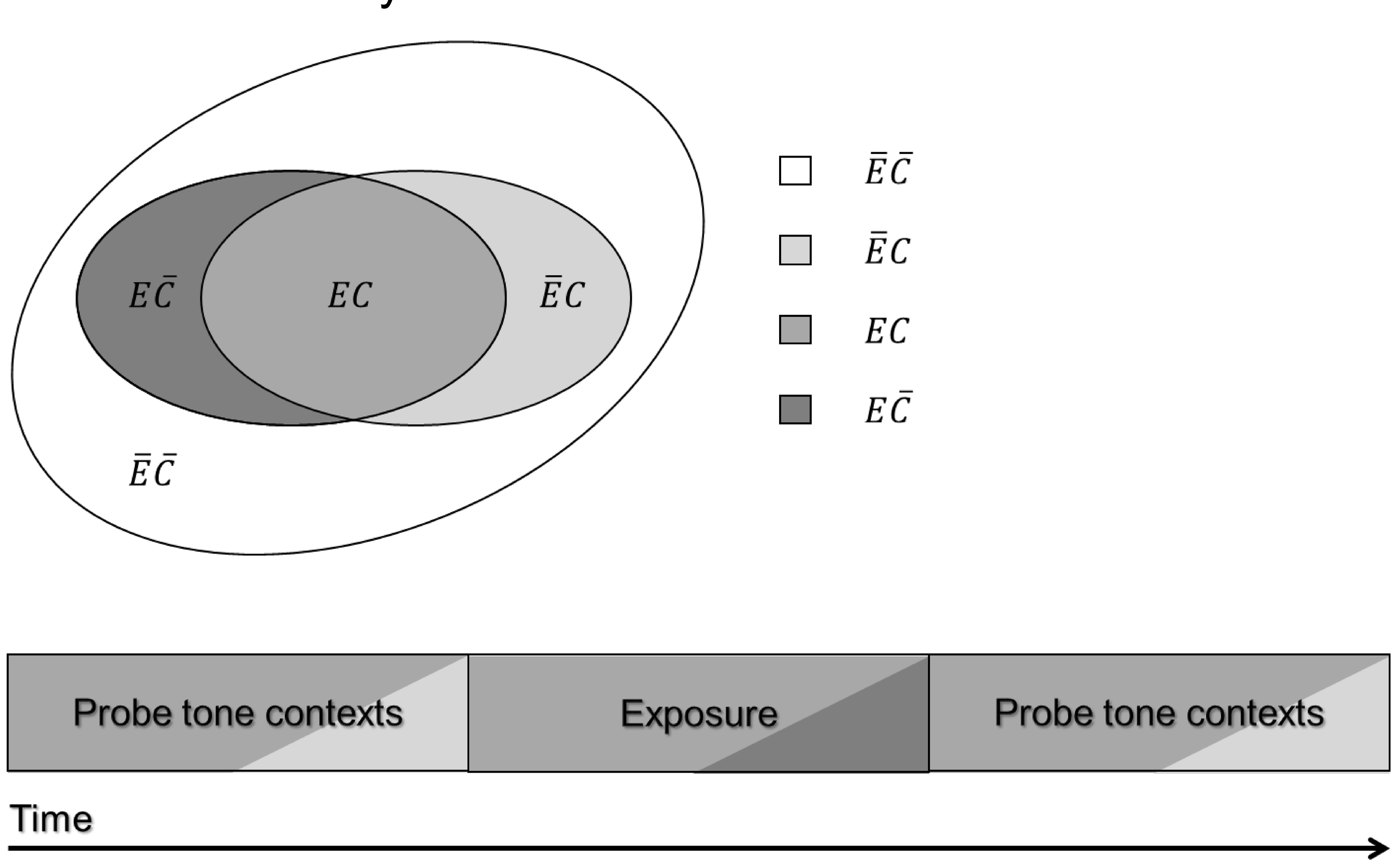


Figure 1: probe tone categories and timeline indicating which probe tone categories were heard throughout the experiment

- **Analysis**

IV*a*: Time (before or after), Exposure ($E$ or $\bar{E}$), Context ($C$ or $\bar{C}$)
DV*a*: proportion of trials in which probe tone was rated as fitting
IV*b*: Scale (same as exposure or different from exposure)
DV*b*: proportion of trials in which "same" melody was chosen

## Results

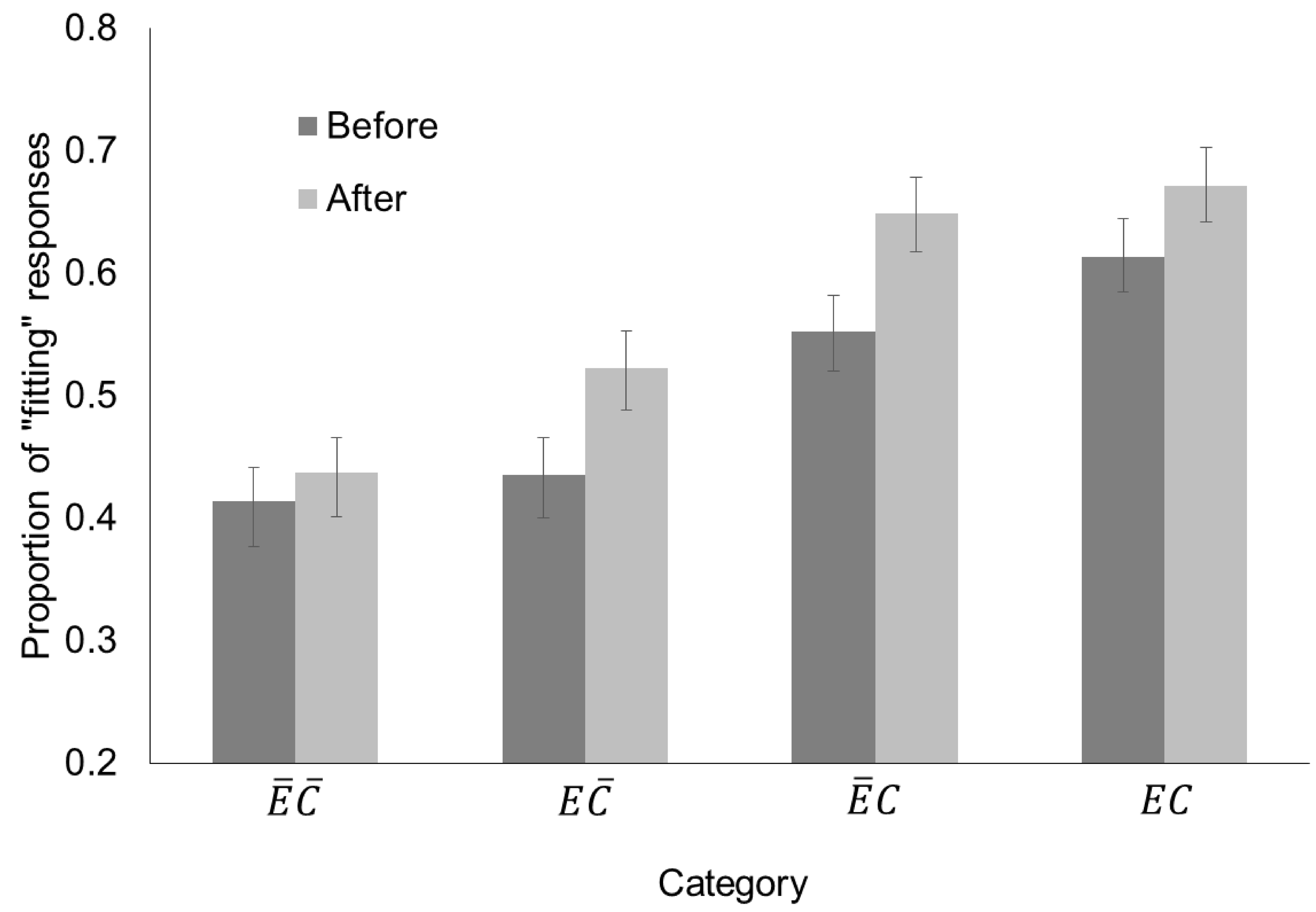


Figure 2: proportion of "fitting" responses for each probe tone category

- *a*: Three-way interaction: Time, Exposure, Context
  → before exposure: main effect of Context
  → probe tones $\bar{C}$: interaction effect of Exposure and Time
- *b*: Melodies of the "same" scale as exposure melody chosen more often than chance, M = .75, SD = .20

## Conclusions and Discussion

As expected, prior to exposure, GoF responses were higher for probe tones appearing in the novel melodies than probe tones not appearing in the novel melodies, indicating that participants gained a short-term representation of the distributional information contained in the melodies[3]. This finding also held post exposure, but in addition, GoF responses for probe tone category $E\bar{C}$ increased significantly after exposure, showing a long-term representation of distributional information.

This indicates that participants were able to abstract pitch distributional information during 30 min of exposure as well as when readily accessible (heard in the probe tone context), and integrate this information when making GoF responses.

The average percent correct of 75% in the discrimination task shows that participants were able to transfer the gained musical knowledge to another task.

## References

- [1]Rohrmeier M, Rebuschat P. 2012. Implicit learning and acquisition of music. *Topics in cognitive science*, 4:525-553.
- [2]Krumhansl CL, Shepard RN. 1979. Quantification of the hierarchy of tonal functions within a diatonic context. *Journal of experimental psychology: Human Perception and Performance*, 5:579-594.
- [3]Oram N, Cuddy LL. 1995. Responsiveness of western adults to pitch distributional information in melodic sequences. *Psychological Research,* 57:103-118.

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