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Temporal Dynamic of Spatial Frequency Representation in IT Cortex

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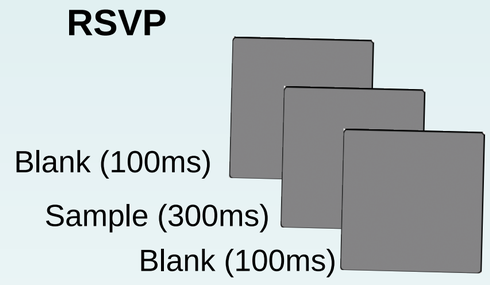
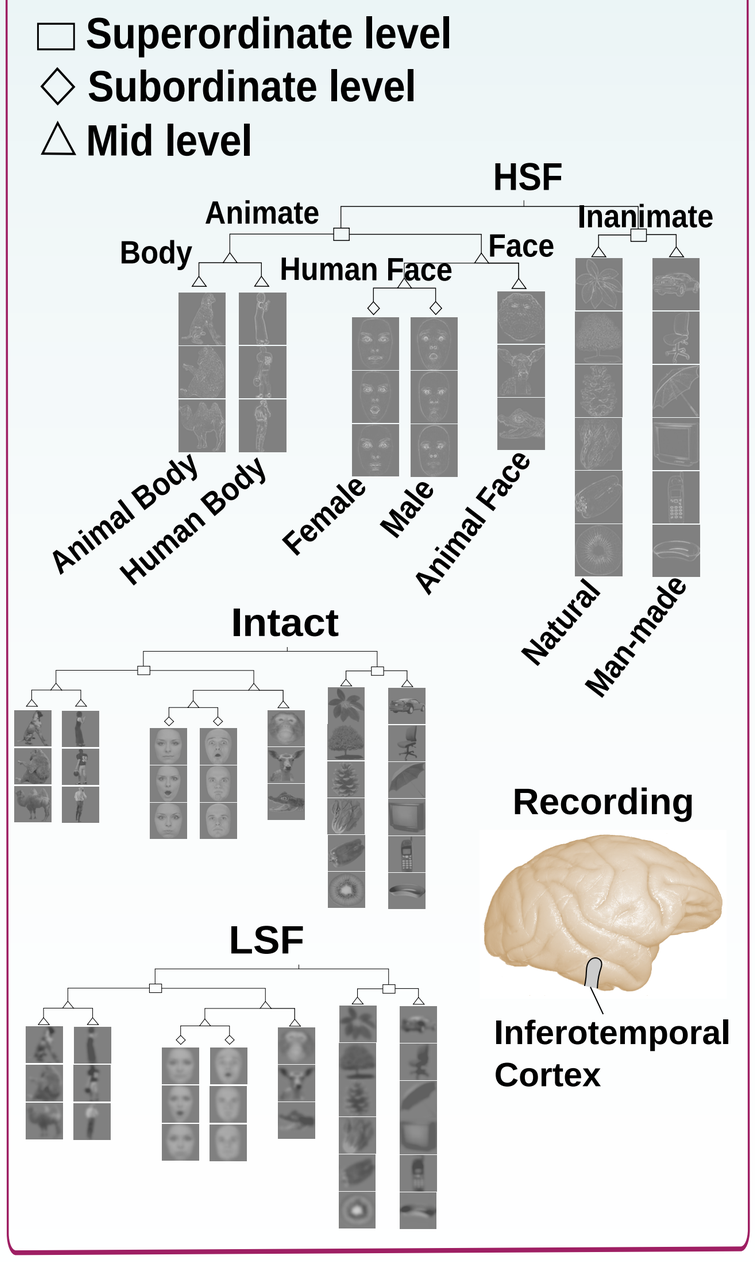
OBJECTIVES

Introduction

One of the important features in information processing along the visual hierarchy from the retina to the inferotemporal cortex is the spatial frequency of input images. A massive body of studies suggests that stimulus with different frequency contents has distinct representations in the primary visual system. However, the representation of stimulus with different spatial frequencies in high level visual areas across the ventral stream is poorly understood.
Using neural data recorded from the monkey brain, we examined and analyzed the representation of spatial frequency filtered objects at different levels of abstraction. A combination of coding and decoding methods were applied to extract temporal dynamics of category information at a different level of abstraction. Using band pass spatial frequency filters, we produce three versions of stimuli including Intact (no filter), High (high pass spatial frequency filter), and Low (low pass spatial frequency filter).

Experimental Paradigm, Stimuli and Recording

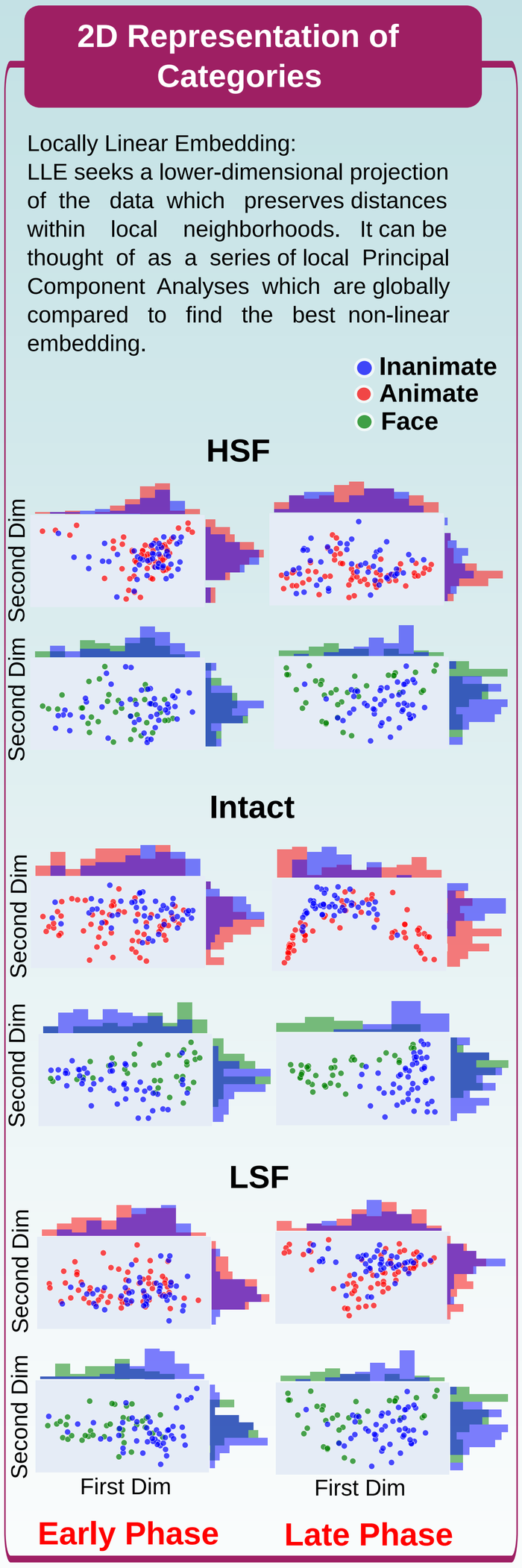




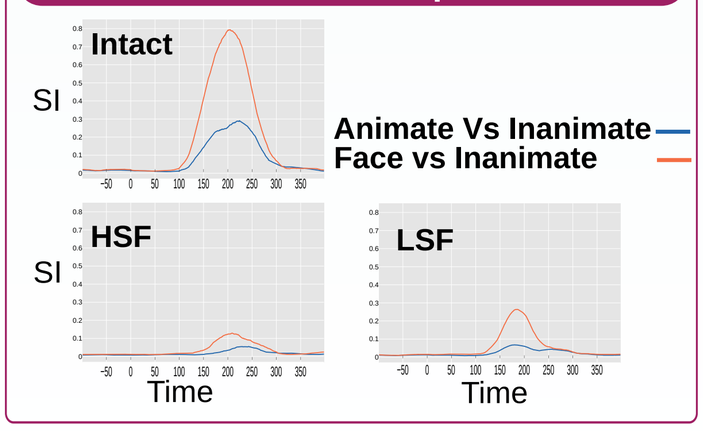
METHODS

2D Representation of Categories

Locally Linear Embedding:
LLE seeks a lower-dimensional projection of the data which preserves distances within local neighborhoods. It can be thought of as a series of local Principal Component Analyses which are globally compared to find the best non-linear embedding.

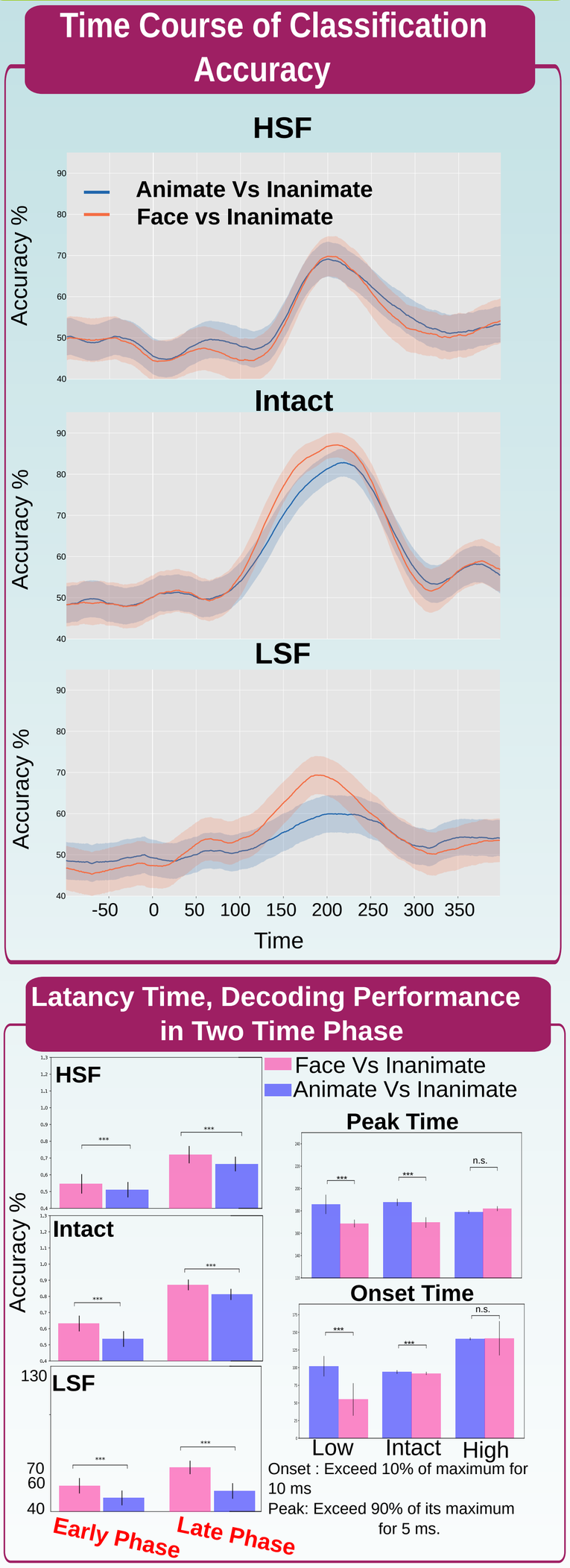


Time Course of The Separability Index in Reduced Space



RESULT

Time Course of Classification Accuracy



Latancy Time, Decoding Performance in Two Time Phase

CONCLUSION

Consistent with previous studies, we observed the basic level advantages in Intact stimuli, whereas the temporal dynamic of category representation exhibits different patterns of advantages in Low and High spatial frequency stimuli. In Low stimuli, there is a great advantage of the basic level while in High stimuli, the basic and subordinate level exhibit a similar time course of representation. Our observation provides evidence for the interaction of spatial frequency and temporal dynamics of category representation in the visual cortex.