Typical real-world locations impact the time course of object coding

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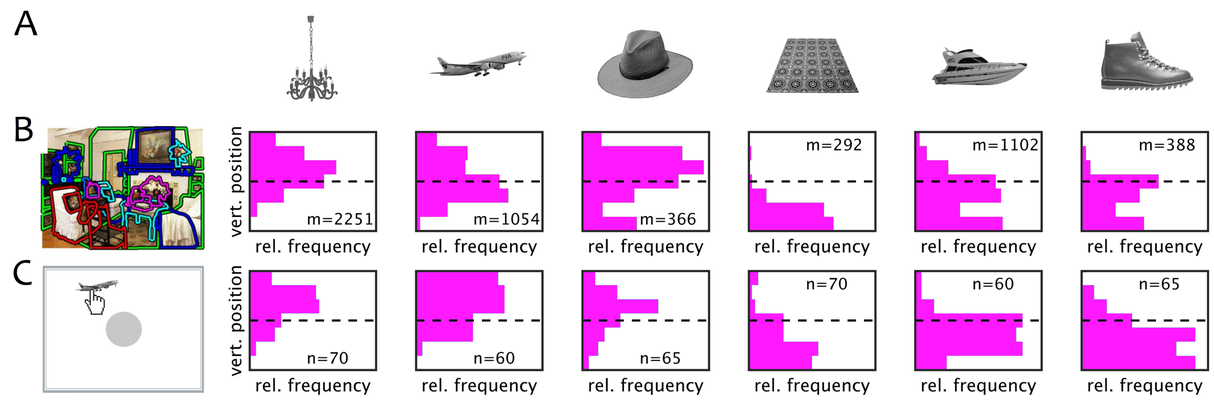
DFG Deutsche Forschungsgemeinschaft

Abstract

Our environments are structured, consisting of multiple objects frequently appearing at specific locations. For example, lamps in upper parts of the visual field and carpets in lower parts. This leads to the prediction that the visual system is tuned to objects frequently appearing at similar locations, which could enhance the processing of typically positioned objects [1-4]. Here, we used EEG decoding to test whether the time-course of object processing is influenced by typical locations in scenes. Participants viewed individual objects on typical and atypical locations. Multivariate classification revealed that typically compared to atypically positioned objects are decoded more accurately during early stages of visual processing, suggesting that early object processing is influenced by typical real-world locations.

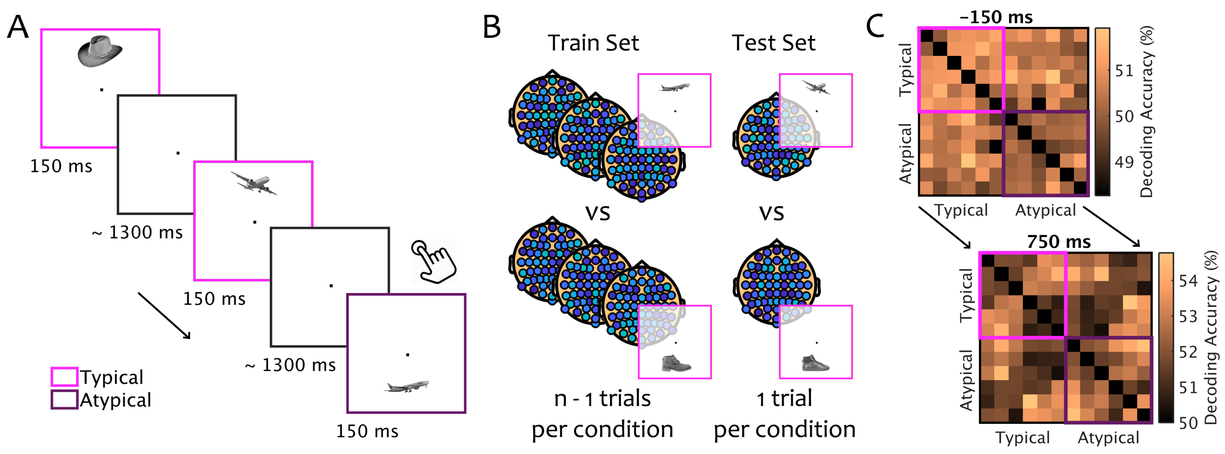
Regularities in Scenes

Stimuli



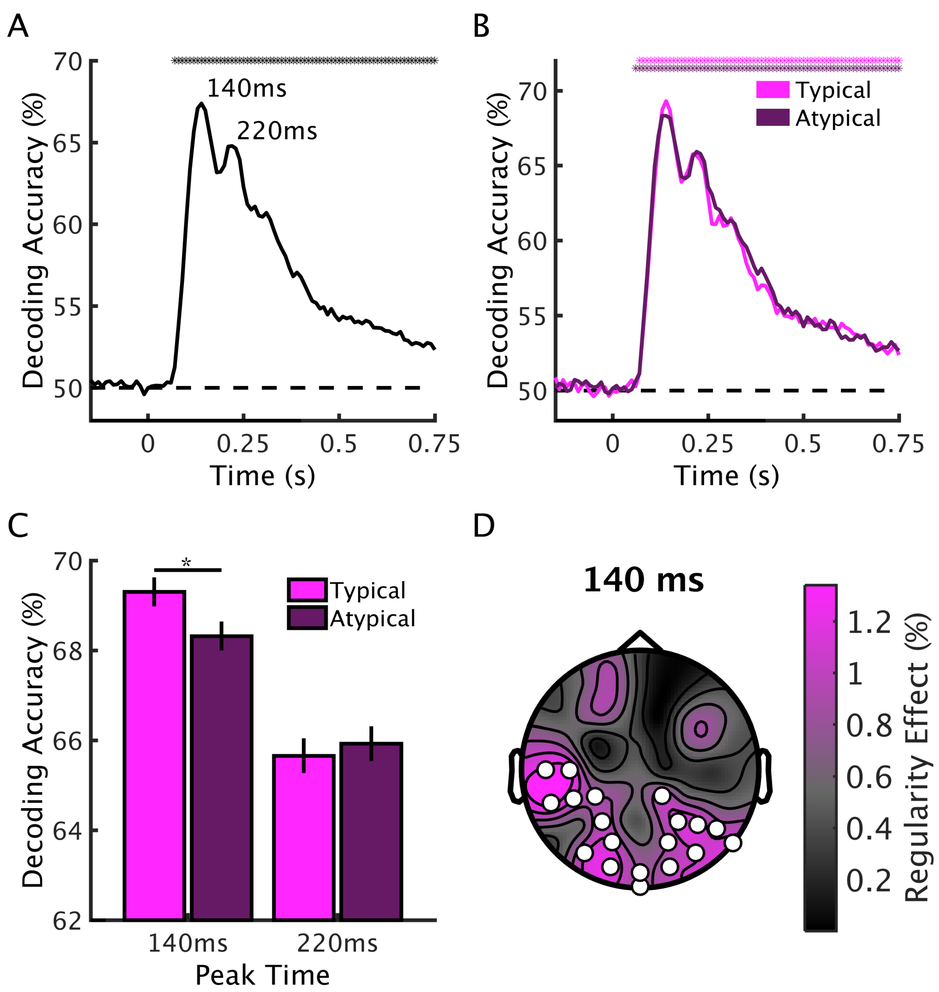
A) Examples of the three upper visual field objects and the three lower visual field objects. B) Typical object locations estimated from a large set of labelled scene images [5]. C) Typical object locations from participants' explicit judgements.

Experimental Design and Classification Scheme



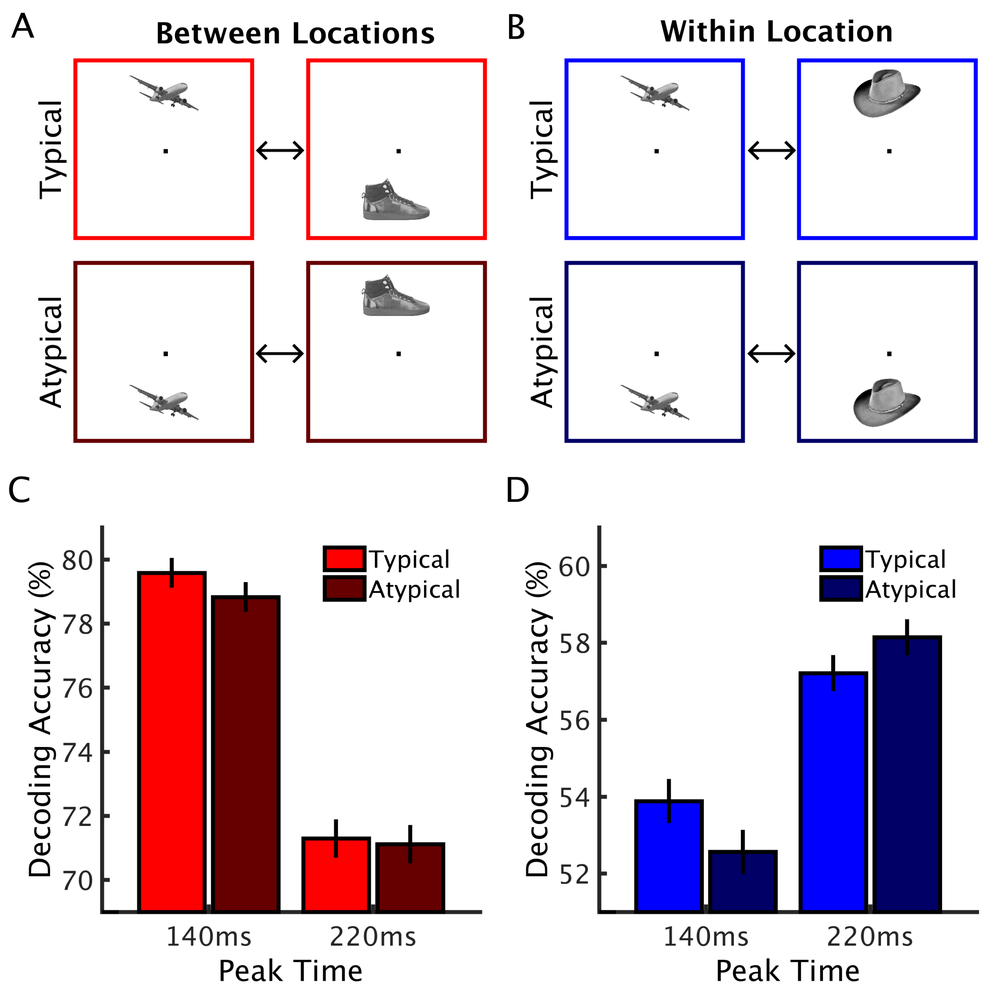
A) Objects were briefly presented in the upper or lower visual field. Participants performed a one-back task. B) Pairwise classification was performed in a leave-one out scheme. C) Pairwise accuracies were subsequently averaged for comparisons of typically and atypically positioned objects.

Classification Results



A) Overall classification revealed two prominent peaks at 140 and 220ms. Decoding of typically, versus atypically, positioned objects (B) was more pronounced at the first, but not the second peak (C). A sensor-space searchlight (D) revealed that this difference was most pronounced in occipital and temporal electrodes.

Classifying within/between locations



Peak decoding accuracy for typically and atypically positioned objects separately for comparisons between locations (A) and within locations (B). For both comparison types, we found a similar pattern (C, D) with a benefit for typically positioned objects at the 140ms peak.

Conclusions

Our results support the hypothesis that long-term experience with natural scene structure enhances early object coding of objects at typical locations. This location-specific neural processing of objects may reduce resource overlap in neural channels. Together with findings from multi-object processing [6], it may provide a neural mechanism for efficient natural scene parsing, where a large number of objects needs to be processed.

References

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