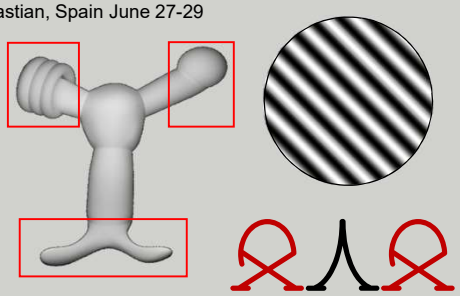
Interdisciplinary Advances in Statistical Learning 2019 - San Sebastian, Spain June 27-29

N-GRAM CODING AS A GENERAL-PURPOSE VISUAL LEARNING TOOL



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INTRODUCTION

- It has been suggested that the visual word identification system identifies recurrent letter clusters (n–grams) as a bridge between letters and words [1][2].
- We investigated how general this n-gram mechanism might be by asking participants to learn novel objects made up of smaller parts, similarly to how novel words are made up of letters (see Vidal's talk).
- We pushed the boundary of n-gram coding by testing it in unarticulated visual objects (Gabor patches) where n-grams are not based on spatially segregated, smaller parts, but on feature co-occurrence (e.g., orientation, density and contrast).

AIMS

- Finding out whether visual bigram coding reflects a general purpose sensitivity of the brain to feature co-occurrences irrespective of whether these are made of letters.
- Testing the limits of bigram sensitivity, we investigate how visual recognition operates on the learning of high (shapes) and low (orientation, contrast and spatial frequency) level features.

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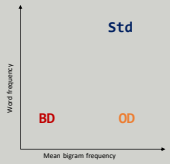
EXPERIMENT 1

STANDARD

Object Dev

Bigram Dev

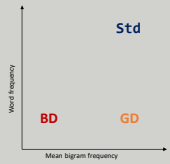


EXPERIMENT 2

STANDARD

Gabor Dev

Bigram Dev

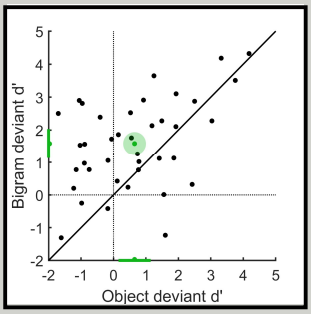


RESULTS

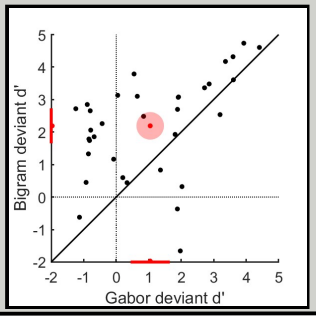
- Participants (n=39) were better at detecting Bigram Deviants than Object deviants.

Mean delta d': 0.93
Effect size (Hedges g): 0.63 (0.26 – 1)
$t_{(38)} = 3.80$, p = 0.00049

EXPERIMENT 1



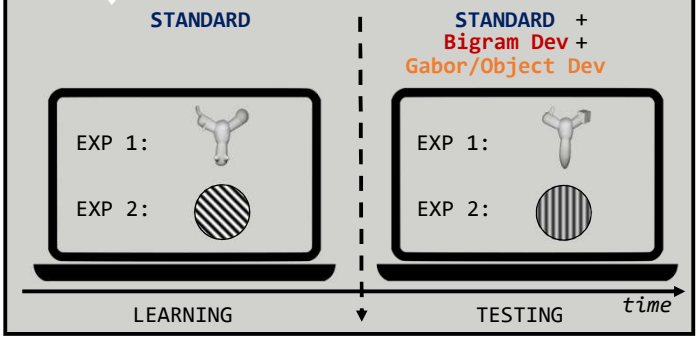
EXPERIMENT 2



- Participants (n=34) were better at detecting Bigram Deviants than Gabor Deviants.

Mean delta d': 1.14
Effect size (Hedges g): 0.69 (0.28 - 1.09)
$t_{(33)} = 3.88$, p = 0.00046

THE TASK



WHAT DID WE LEARN?

- Similar to what happens with (pseudo)reading material, participants have a hard time discarding objects that comply with the statistical pattern of the smaller parts.
- This happens regardless of whether the visual stimuli are novel words, novel objects or gabor patches.
- This is in line with a general-purpose brain mechanism that is based on feature co–occurrence statistics.

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REFERENCES
[1] Dehaene, S., Cohen, L., Sigman, M., and Vinckier, F. (2005). The neural code for written words: A proposal. Trends in Cognitive Sciences, 9(7):335-341.
[2] Grainger, J. and Whitney, C. (2004). Does the huamn mnid raed wrods as a wlohe? Trends in Cognitive Sciences, 8(2):58-59.