Bigram coding as a general visual mechanism

(Nothing special about reading?)

Davide Crepaldi

International School for Advanced Studies (SISSA), Trieste

https://lrlac.sissa.it
Tweets at @CrepaldiDavide

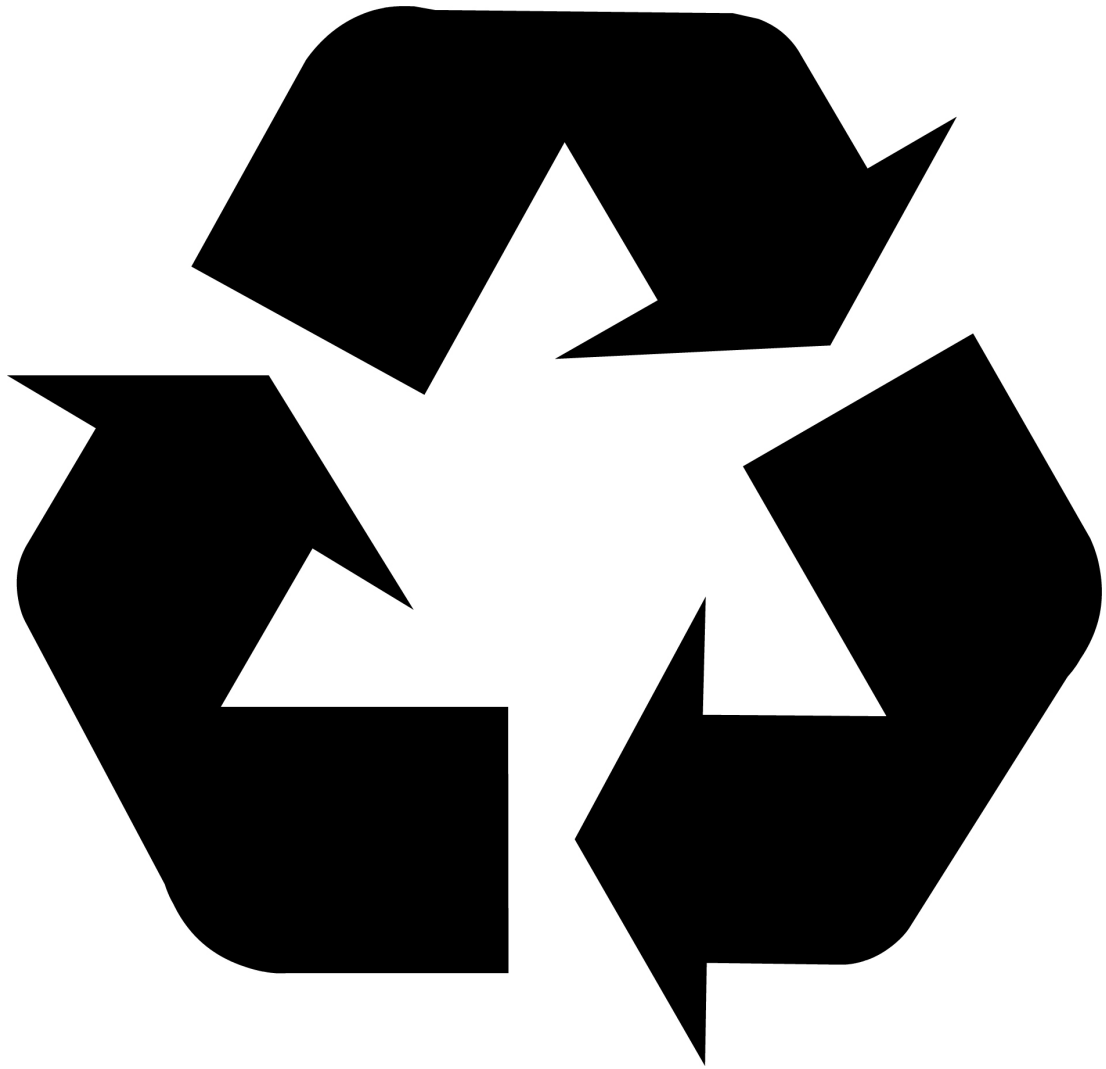
ESCoP, Tenerife, 28 September 2019

Reading is a human wonder

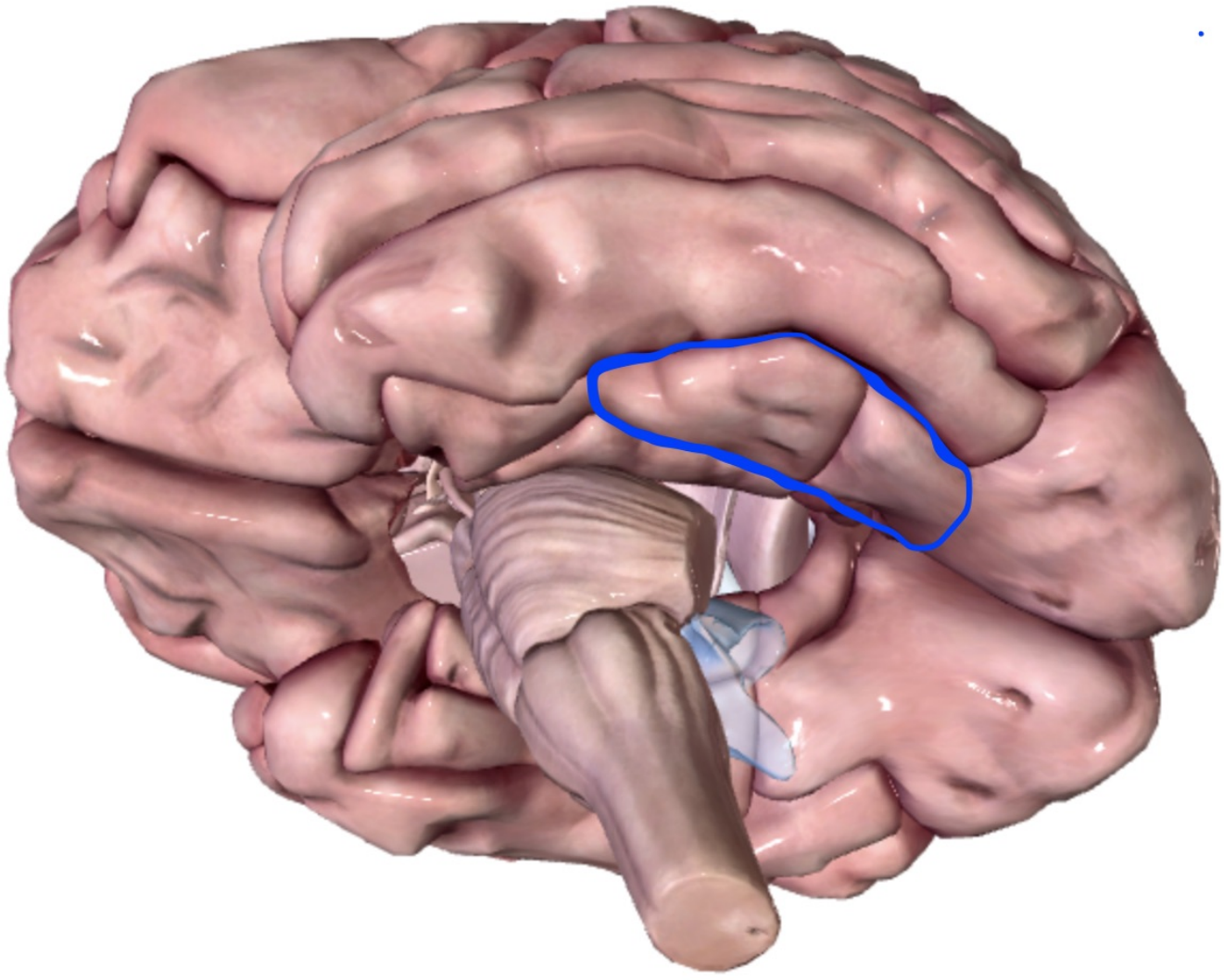
- We can read 8–letter words in ~35ms (e.g., Forster and Davis, 1984)
- We gather information about ~20 letters every ~200ms (e.g., Rayner, 1998)
- We read ~250 words per minute (e.g., Brysbaert, 2019)

No genetic endowment

- Written language isn't observed universally
- Literacy isn't acquired spontaneously
- Writing appeared ~5.5K years ago

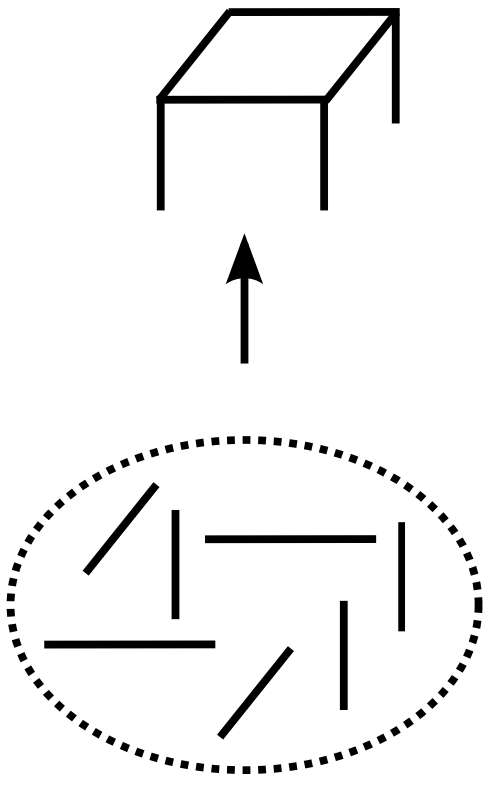


The ventral occipito–temporal cortex (VOTC)



The Statistical Learning hypothesis

- Find regularities in low–level units
- Build higher–level units based on these regularities



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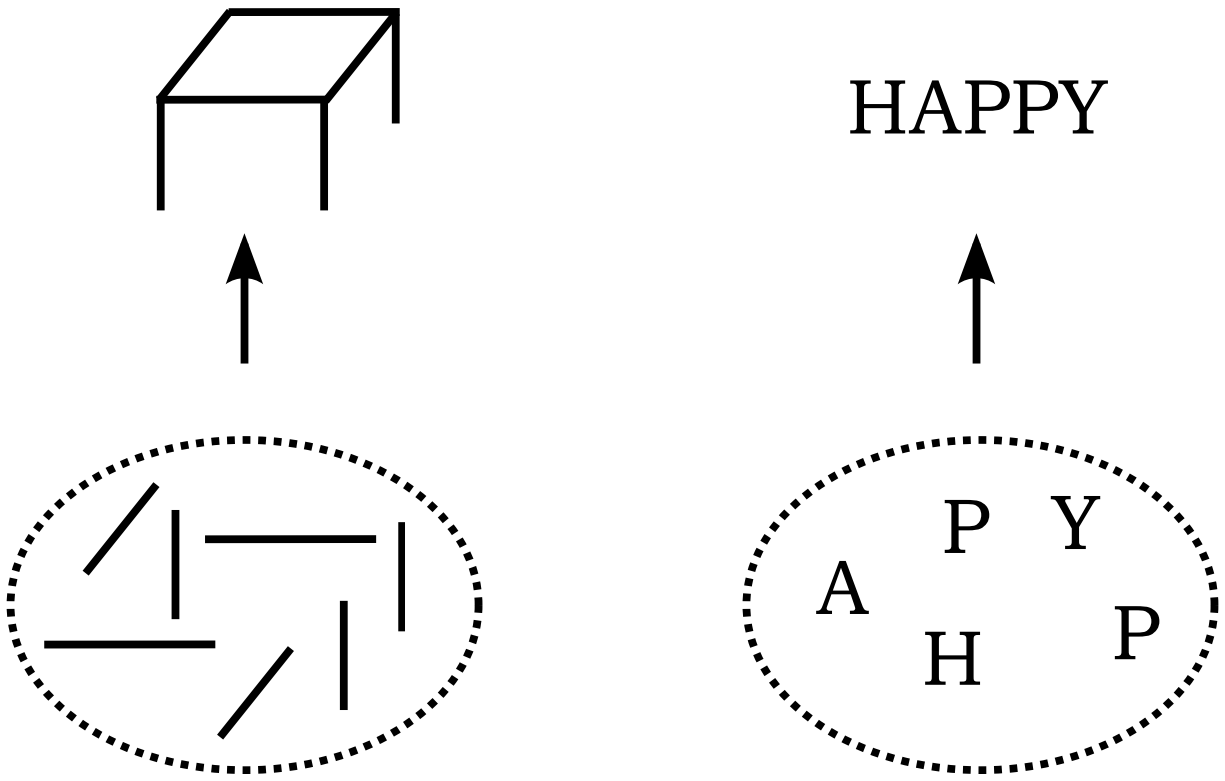

Statistical Learning and reading?

Nah

- Reading ability doesn't really correlate with statistical learning tasks (Schmalz et al., 2019)
- No bigram frequency effects in lexical decision (Schmalz and Mulatti, 2017)

Yeah!

- Orthographic processing in non–linguistic animals (Grainger et al., 2012; Rajalingham et al., 2019)
- Sensitivity to frequent bigrams in artificial scripts (Chetail, 2017)

Phantom words paradigm (Endress and Mehler, 2009)

ABF

DBC

AEC

Phantom words paradigm (Endress and Mehler, 2009)

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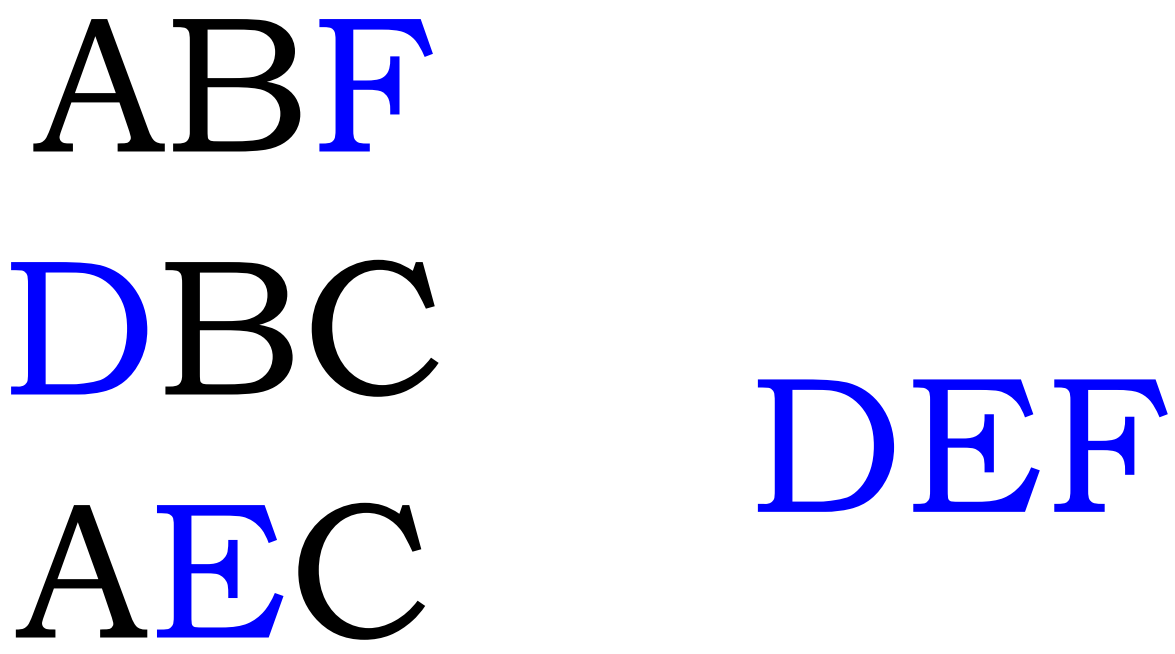

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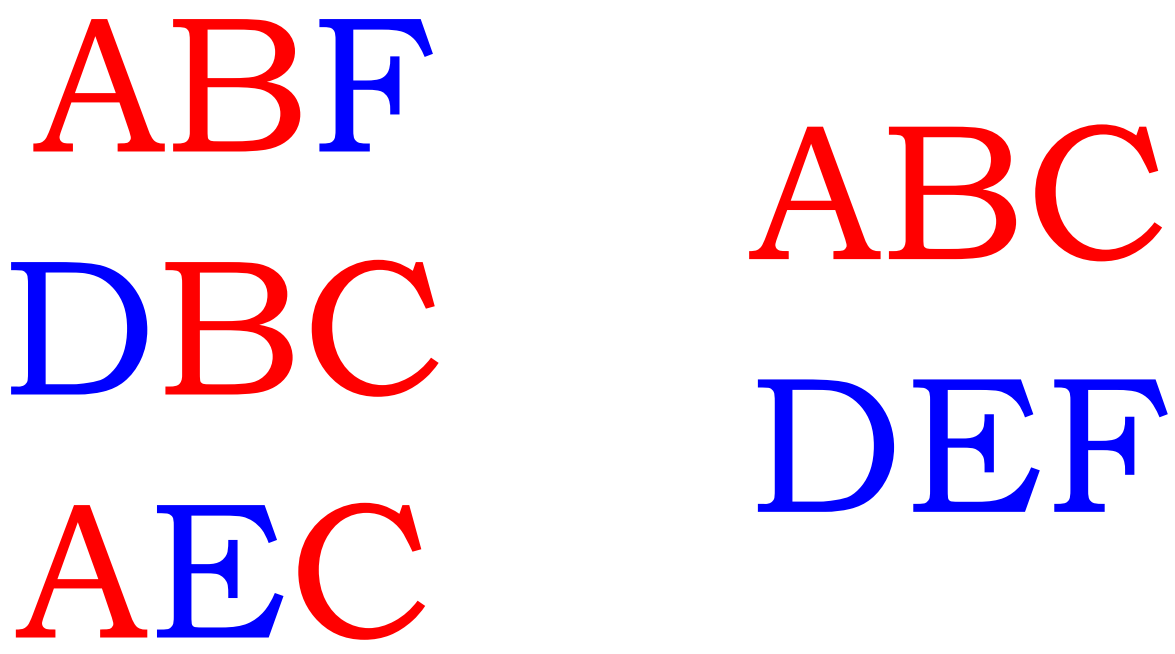
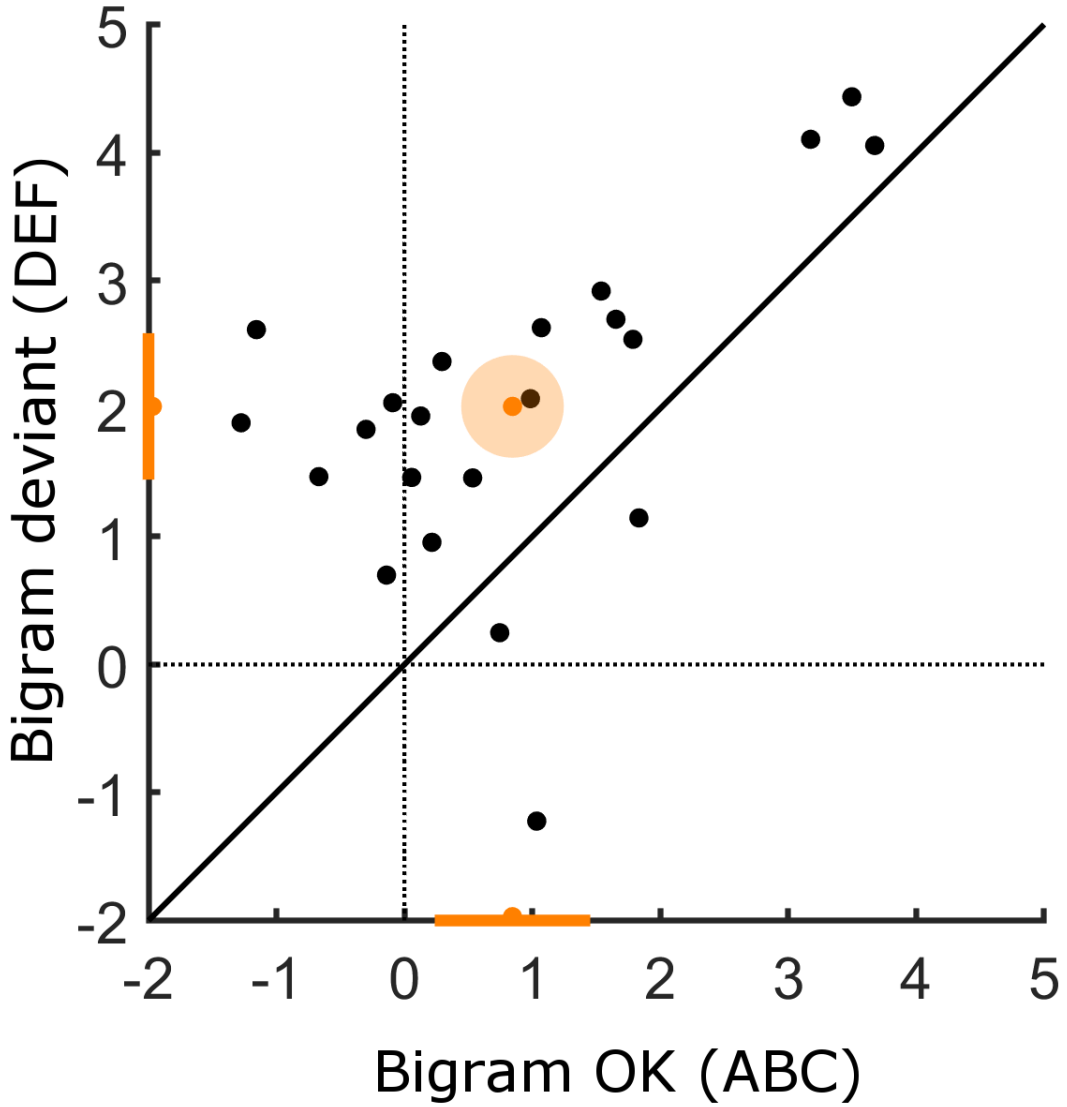
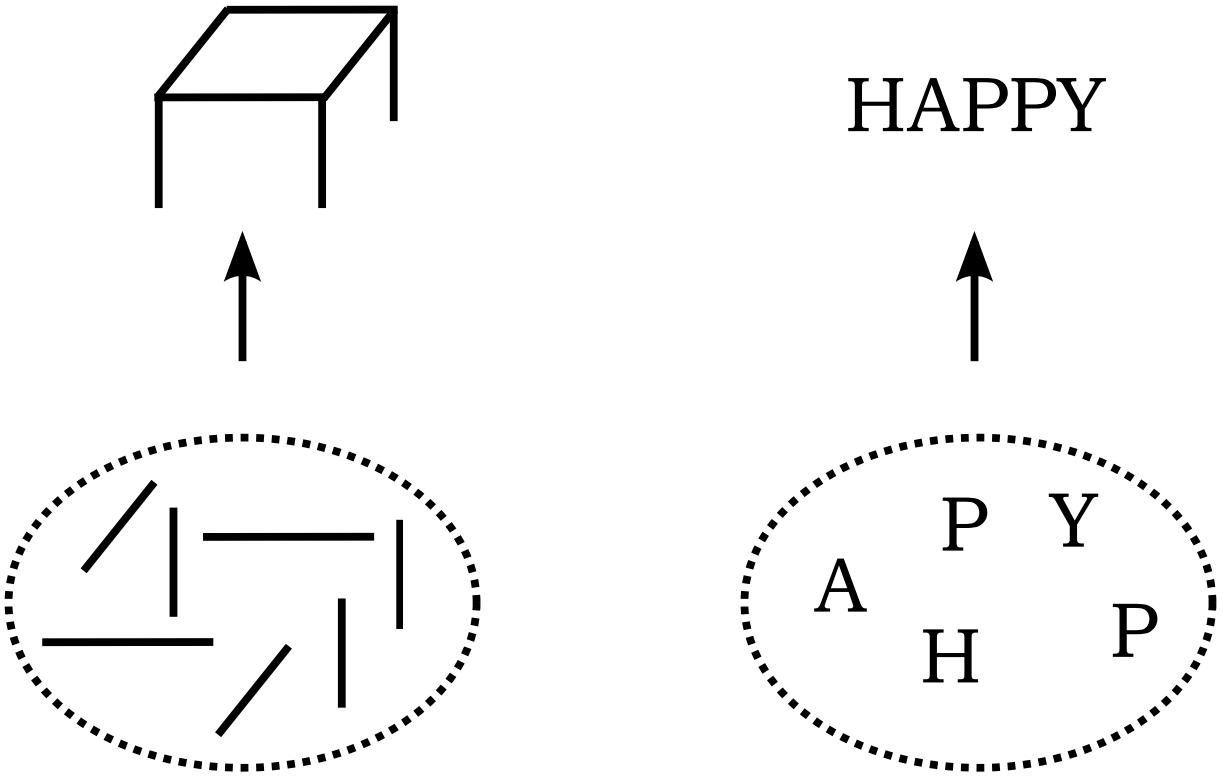


Pseudo–letters (Vidal et al., 2017)

Results

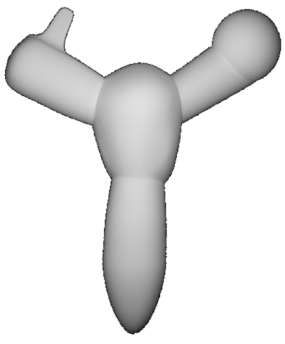
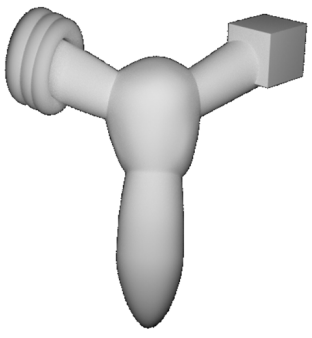
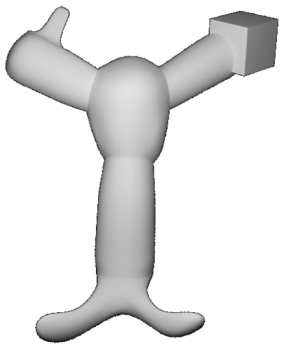
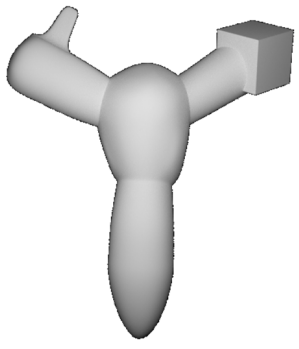
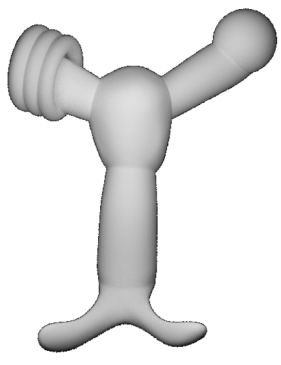


The Statistical Learning hypothesis



Vision, not language

Phantom tripods

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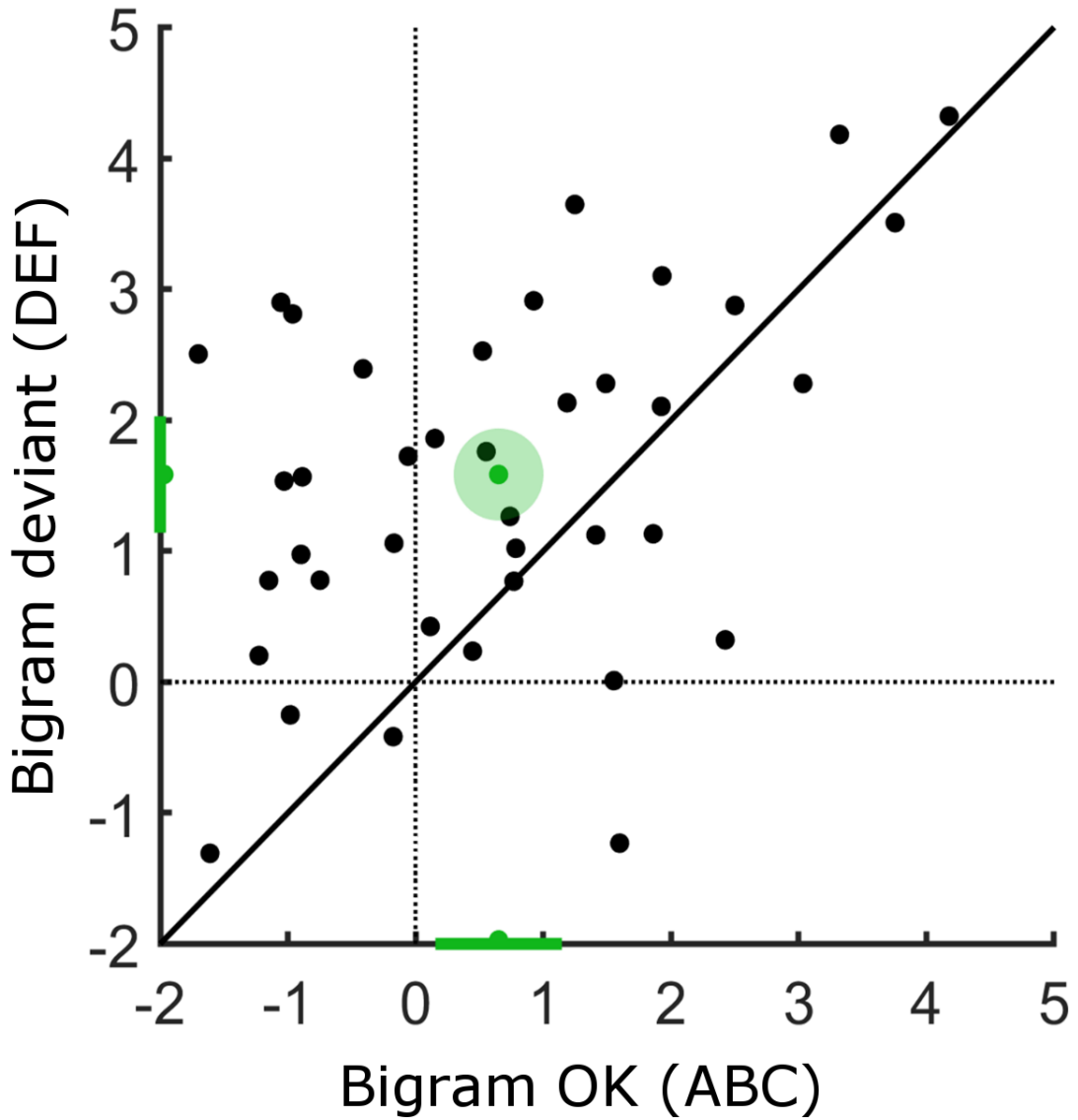
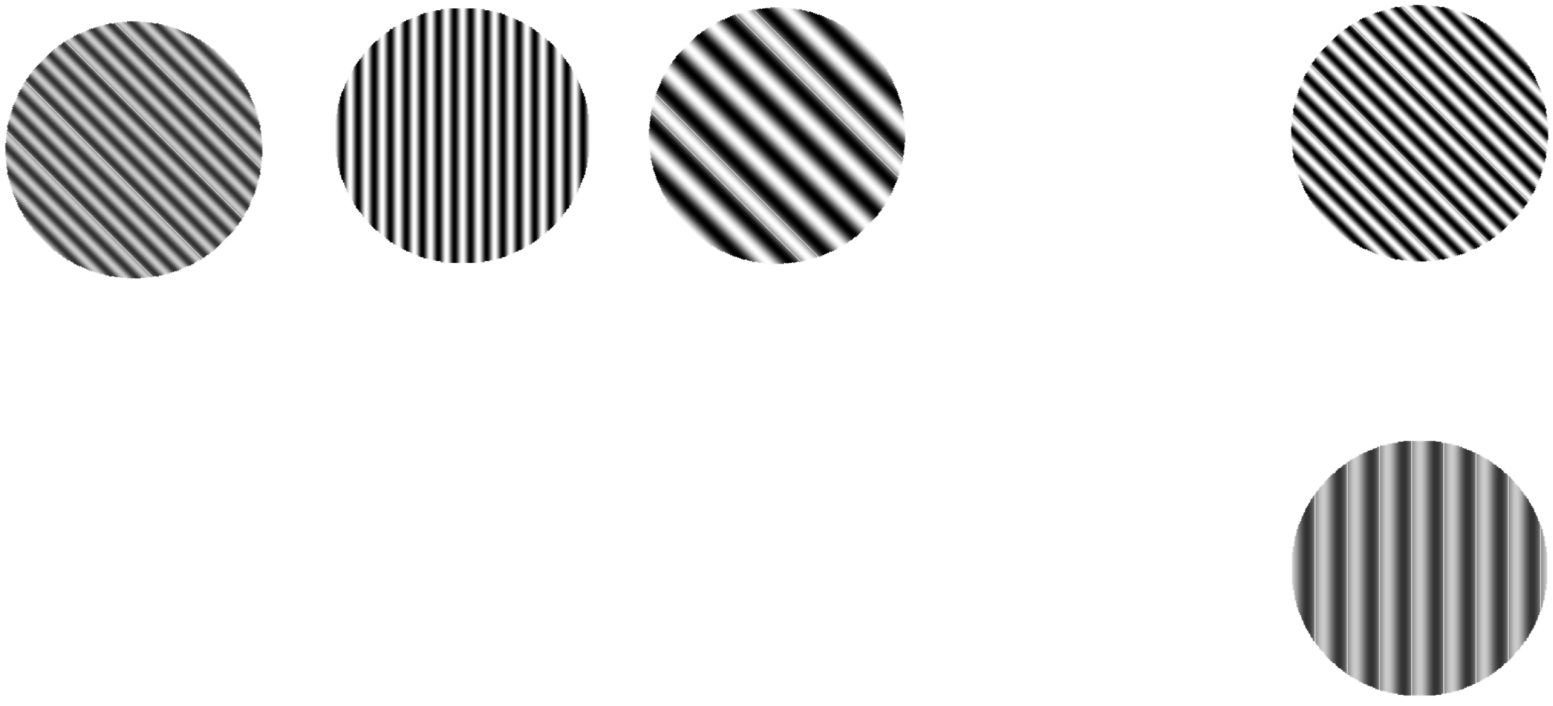


Phantom Gabors



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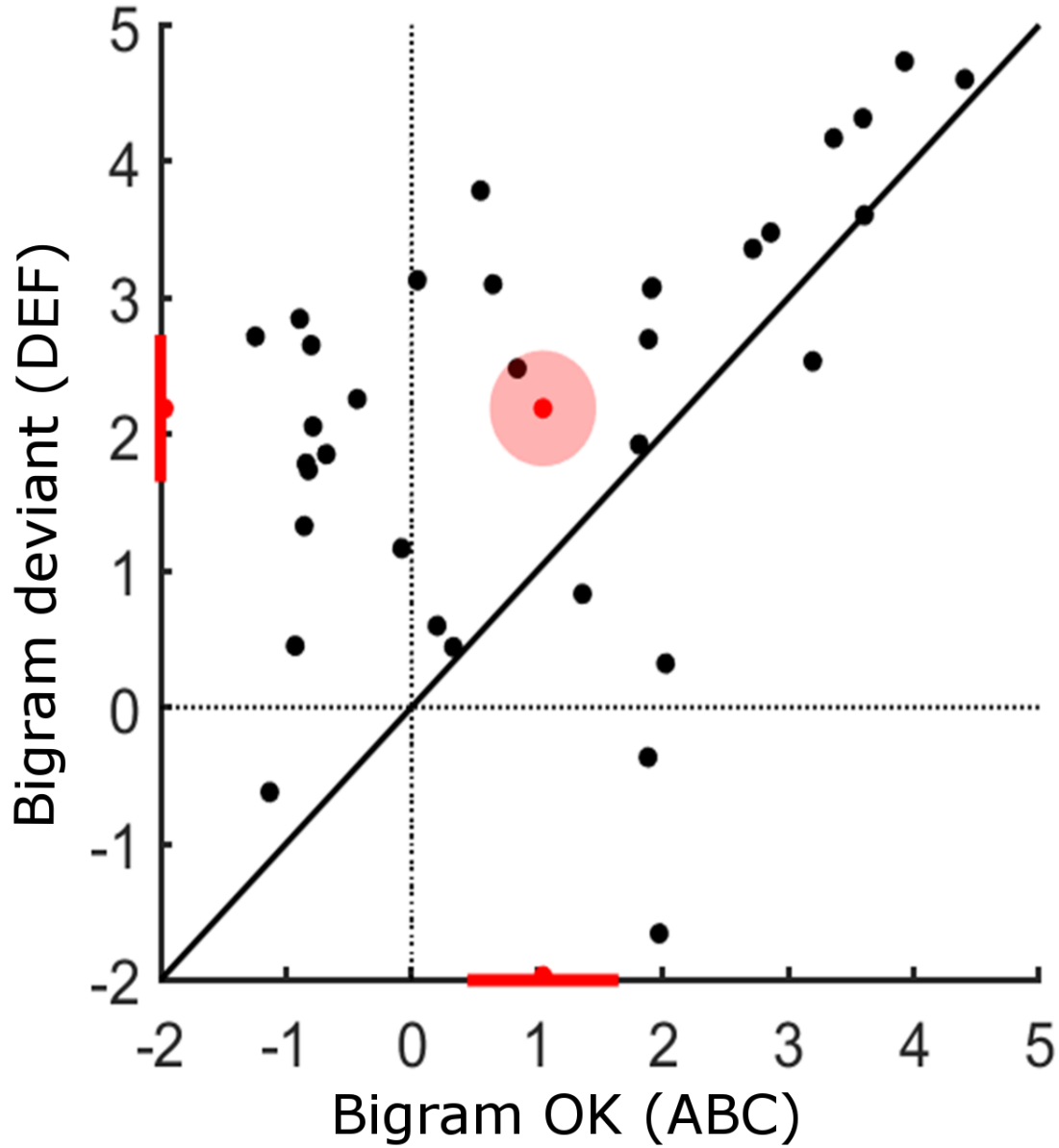

Take–home message

- We code for nGrams/letter transition stats while learning novel words
- We use the same mechanism while learning novel objects, where the lower–level units are:
  - not arranged horizontally, and very different visually from letters
  - not even spatially segregated

- More generally, reading shares (part of) its computational core with vision
- This computational core is captured by the statistical learning hypothesis

Acknowledgments

Yamil Vidal

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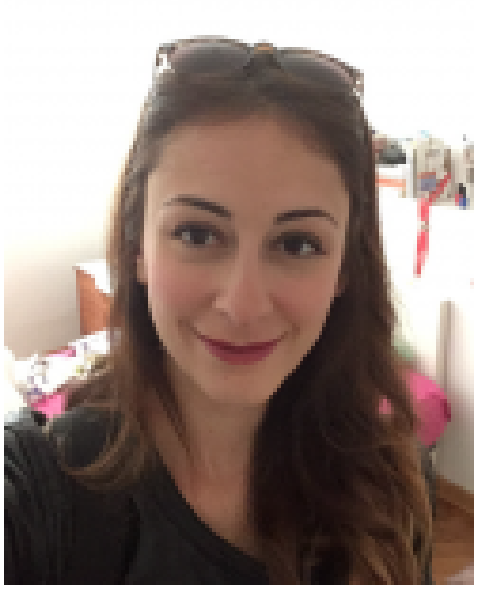

StG 2015 – STATLEARN

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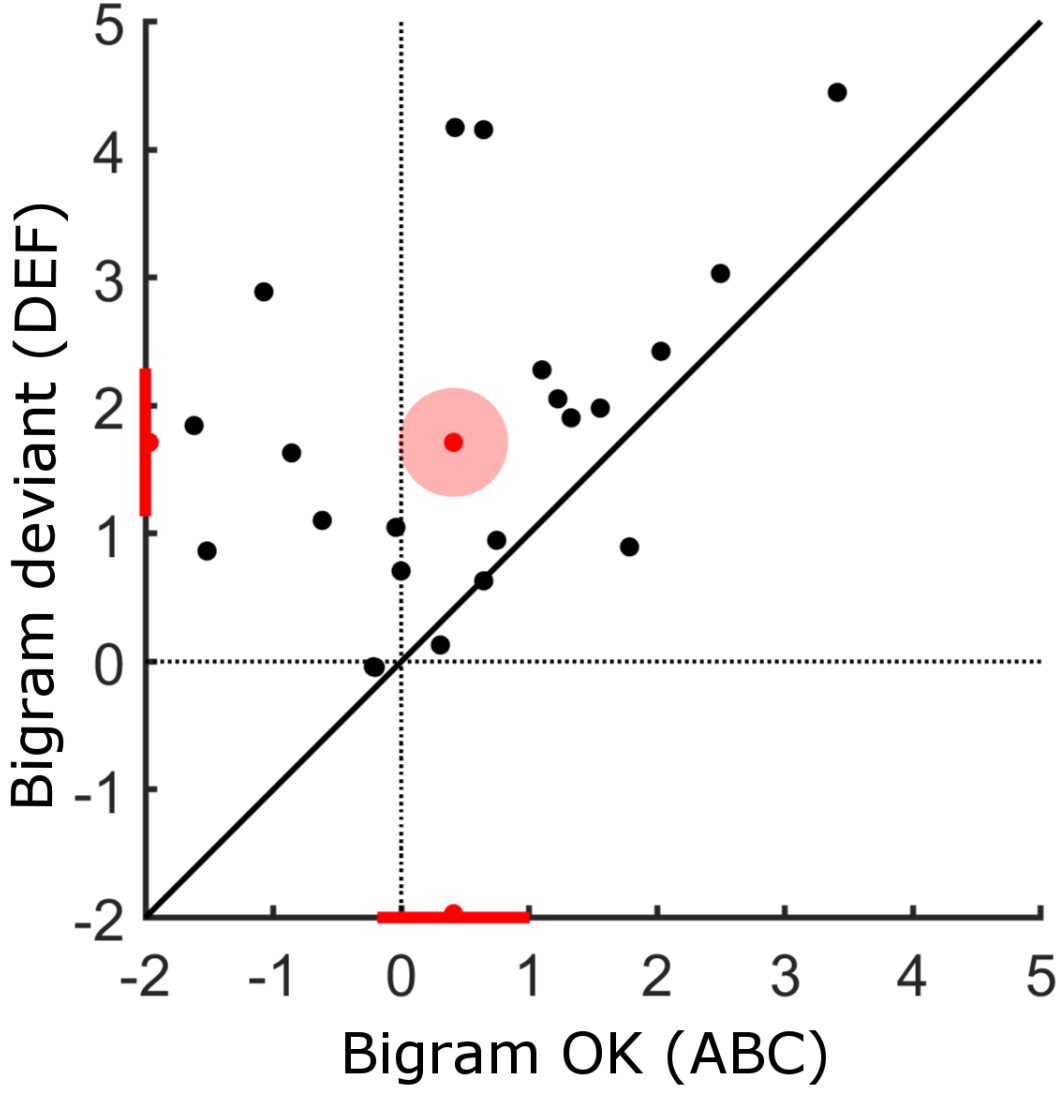
Phantom words in reading, d prime

STIMULUS PRESENTED

RESPONSE GIVEN

	STD	WD	BD
Correct	Correct rejection	Miss	Miss
Mistaken	False alarm	Hit	Hit

dprime (d')

z(Hit) - z(False Alarm)

Phantom words experiment, 6–letter words