Cognitive Neuroscience of Language: 9: Synaesthesia and language

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Goals

Understand how synaesthesia can be studied

Understand something of the nature of synaesthesia

Understand the implications of synaesthesia for language processing

Reading for this lecture

Simner, J. et al. (2005). Non-random associations of graphemes to colours in synaesthesic and non-synaesthesic populations. *Cognitive Neuropsychology*, *22*, 1069–1085

Hong, S.W. & Blake, R. (2008). Early visual mechanisms do not contribute to synesthetic color experience. *Vision Research*, *48*, 1018–1026

Synaesthesia

Genetic (Baron-Cohen, 1996), possibly X-linked

For ES, F# produces a purple photism (Beeli, 2005)

Affects 4% of people

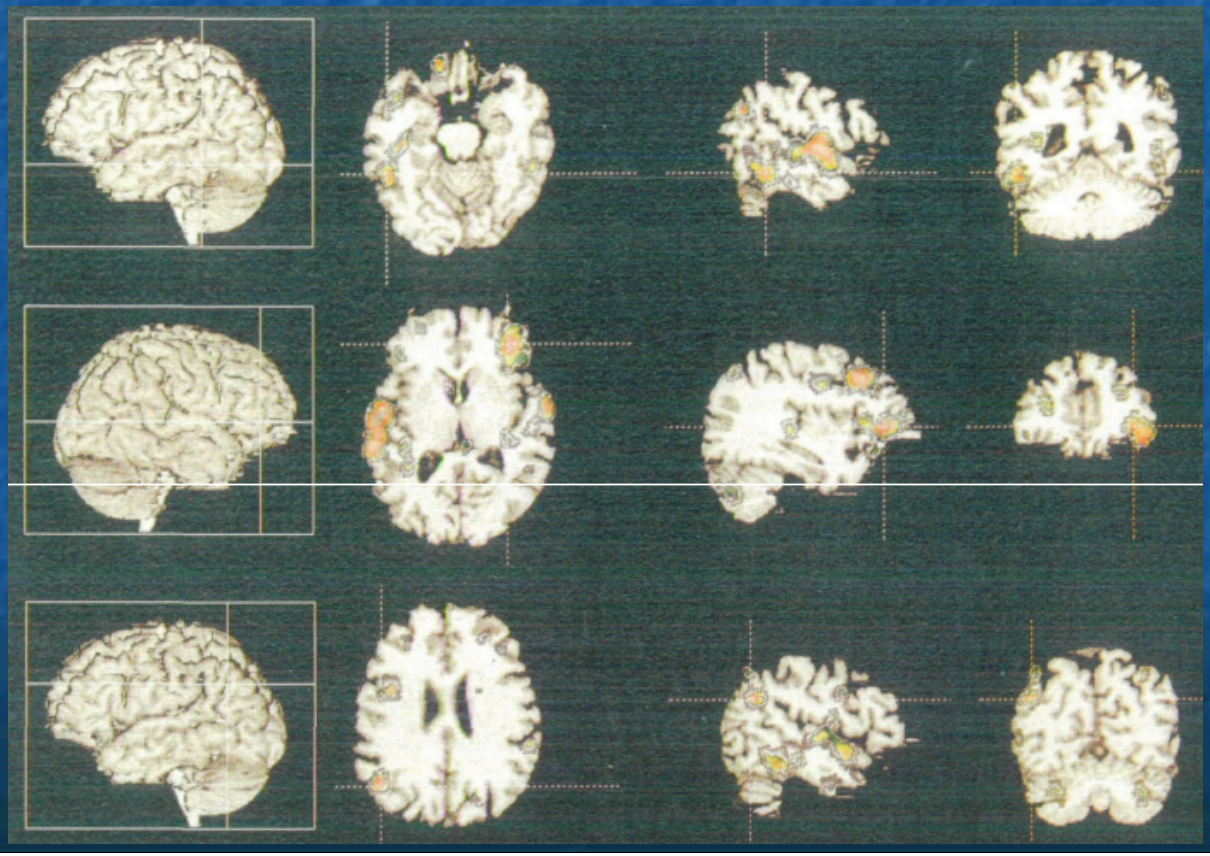
"Exuberant connectivity" – under-pruning, or over disinhibition

88% of synaesthetic experience is triggered by words, numbers, letters, phonemes

"Concurrents" can be colours, shapes, tastes, smells, personality-types, genders

Synaesthesia

Real brain events (Paulesu *et al.*, 1995, below; Hubbard & Ramachandran, 2005) – words can cause real changes in V1, left V4, V8



Synaesthesia

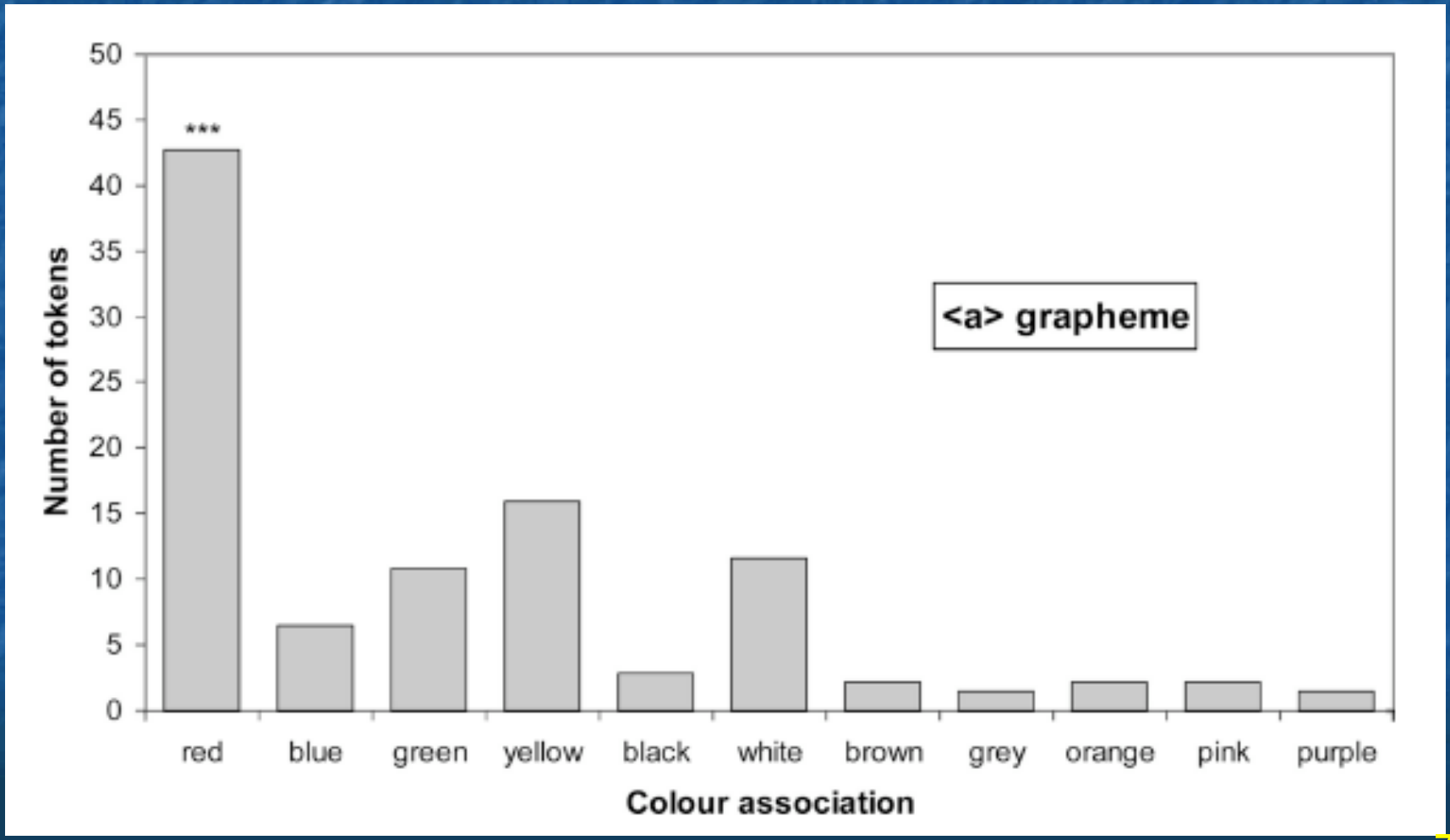
Grapheme-colour synaesthesia: "grapheme" can mean punctuation, *etc*. Sometimes just consonants, or just vowels

Associator vs projector synaesthesias

Mostly orthography not phonology - cat *vs* cite. Rarely it's phonology not orthography (Day, 2005)

Synaesthetes choosing *a*'s colour

Simner et al., 2005



Synaesthesia

Conceptual, not low-level: e.g., an ambiguous "5"/"S" is affected by context - MU_IC *vs* 34_67

A more typical font may elicit more saturated or more vivid colours (Ramachandran & Hubbard, 2003; Witthoft & Winawer, 2005)

In 30% of cases, a single system is involved: of "2" and two, only one is directly affected

Idiosyncratic, but there are generalizations (*a* tends to be red, *o* tends to be black or white)

Such generalizations occur in both synaesthetic and non-synaesthetic individuals

Perceptual grouping

Ramachandran & Hubbard (2001)

(a)

3	8	3	8	3	8	3
7	0	7	0	7	0	7
3	8	3	8	3	8	3
7	0	7	0	7	0	7
3	8	3	8	3	8	3

Perceptual grouping

Ramachandran & Hubbard (2001)

(a)

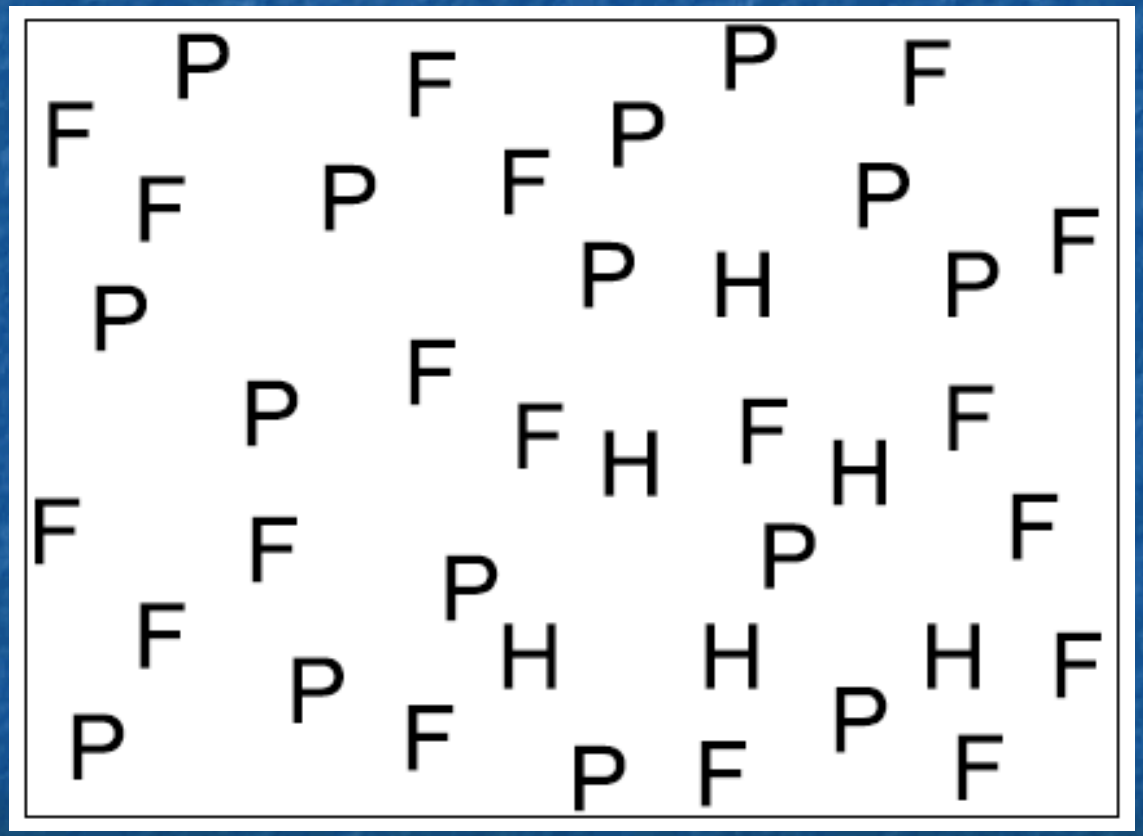
3	8	3	8	3	8	3
7	0	7	0	7	0	7
3	8	3	8	3	8	3
7	0	7	0	7	0	7
3	8	3	8	3	8	3

(b)

3	8	3	8	3	8	3
7	0	7	0	7	0	7
3	8	3	8	3	8	3
7	0	7	0	7	0	7
3	8	3	8	3	8	3

Perceptual grouping

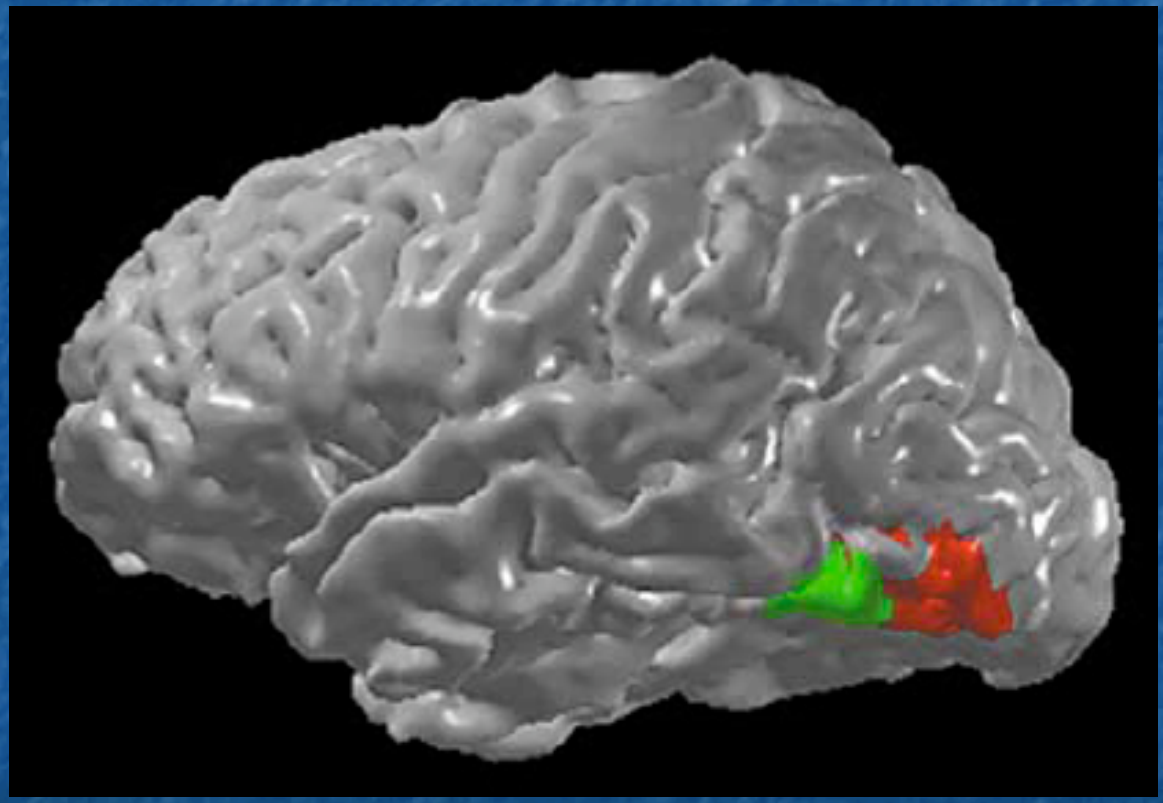
Ramachandran & Hubbard (2001)



JC easily finds the triangle – it's green

Cortical proximity

Ramachandran & Hubbard (2001)



V4 is red, number-grapheme part of the fusiform gyrus is green

Visual fields

Ramachandran & Hubbard (2001)

For ER, no synaesthesia for numbers at 12.1° away from fixation

For JC, no synaesthesia for numbers in the LVF

For central vision, no number-colour synaesthesia for alternations > 5 Hz.

Synaesthesia

High-frequency graphemes pair with high-frequency colour-terms

Initial-letter priming - *b* tends to be blue, *y* tends to be yellow (Simner *et al.* 2005)

Lower numbers and high-frequency letters pairs with cross-linguistically "basic" colours

Lexical-chromatic synaesthetes (words); grapheme-colour synaesthetes (letters)

Synaesthesia

In lexical-chromatic synaesthetes, one colour tends to predominate, reflecting the initial letter or initial vowel

Lexical stress can determine the relevant part of the word: *convict* as a noun or verb

Synaesthesia

Morphology: words with two morphemes (*ferryman*) are more likely to comprise two colours than are words with one (*market*), although high-frequency bimorphemic words (*shoelace*) may not show this, suggesting they have been lexicalized

Linguistic sequences (*e.g.*, days, months) produce specific, idiosyncratic synaesthetic experiences, not determined by initial letter, *etc.* Orientation may be triggered.

Synaesthesia

There may be neurological explanations for the experiences with sequences, with proximity to particular parts of parietal cortex involved

Lexical-gustatory synaesthesia involves complex food experiences. All cases involve phonological mediation (e.g., /k/ words taste of egg for JIW). The tastes are often ones encountered in childhood.

Sometimes such effects are transparent: /ɪ/, /n/ and /s/ trigger mince taste for JIW. Always phonological not orthographic

Synaesthesia

Fine-grained phonological processing is reflected in synaesthetic experience: JIW tastes fingernails for dark /l/ but potato for light /l/, and Rice Krispies for syllabic dark /l/

There is lexical mediation: not all /s/ words produce a lettuce taste, words are more evocative than nonwords, high-frequency words are more evocative. Lexical semantics has a role too – *blue* tastes inky, *etc*

Synaesthesia

There is a possibility that lexical stress and initial consonant/vowel suggest a role for information value (in lexical access) of parts of words. (See Caramazza *et al.*, for the difference between consonants and vowels, and a claim that it is cognitively coded in terms of a level of representation – *N.B.* this may not be necessary.)

Cross-linguistic letter influences also occur, suggesting that the L2 orthography may have been to some extent scaffolded onto the pre-existing L1 orthography

Conclusions

A cross-wiring explanation

What's special about language, given its centrality to synaesthesia?

What is the basic relationship between inducers (triggers) and concurrent sensations?

What are the developmental principles?

What happens before language acquisition?

What other language structure is there in synaesthesia?

What is the connection with metaphor?