Is synaesthesia a female trait?

Validating the synaesthesia battery with novel prevalence and sex-ratio data



Synaesthesia & Sensory Integration Lab

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Overview



- Aim 1: prevalence and sex ratio?
- Aim 2: methodological question
- How was synaesthesia evaluated previously?
 - Consistency is key
- What does synesthete.org do?
- What we did
- •What does it mean?

Consistency



- Why is it important?
 - Provides objective measure of subjective experience
- •Good way to test for synaesthesia
 - Of every 5 self-reported synaesthetes, only 1 genuine

(Simner et al., 2006)

• Cheap and easy

What happened before?



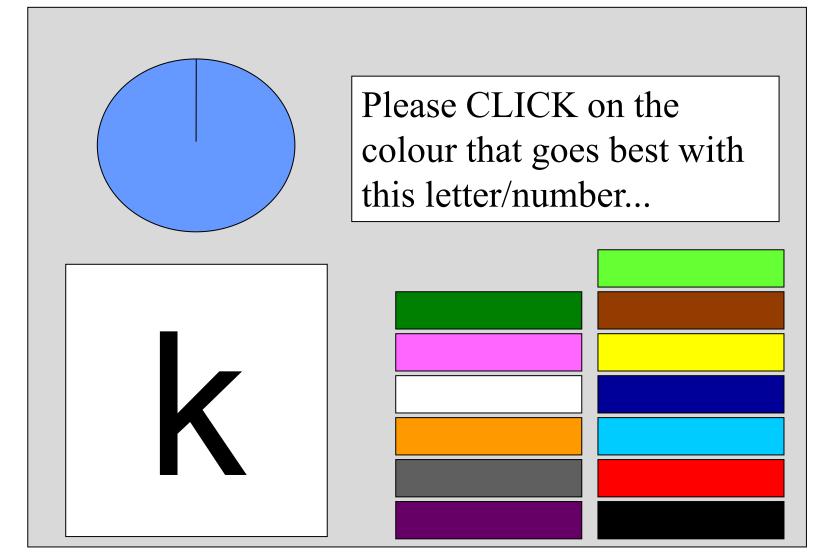
- Multiple test sessions
 - •(Baron-Cohen et al., 1996, Asher et al., 2006, Simner et al., 2006)
- Consistency assessed in variety of ways:
 - verbal, visual, questionnaire

- Disadvantages:
 - No standard methodology
 - Limited set of colour stimuli
 - Hard to compare data across groups

Limited colour palette

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Simner et al., 2006, Simner et al., 2009

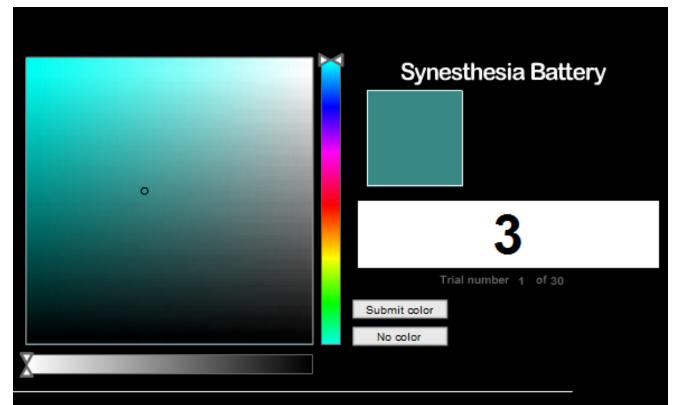
www.synesthete.org



- Online testing battery
- Assess genuineness in a single test session
 - Consistency test
 - Speed-congruency test
- Quantitative measure of consistency
- Provides a widely accessible, standard test

Grapheme-colour consistency test

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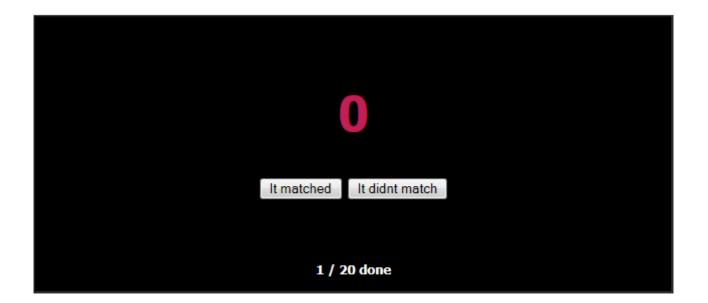
Instructions: Click and drag the triangles or circle to choose a color which most closely resembles the synesthetic color associated with the letter or word presented. You may also use the arrow keys on your keyboard to adjust the color. The test will end automatically when all trials are complete.

Eagleman et al. 2007

Speed-congruency test

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Eagleman et al. 2007

How it works



•each grapheme 3x in random order

- Calculates RGB value for each grapheme
- Consistency score calculated by taking average variation across all selected graphemes

Results

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Grapheme Color Picker Test

0

2

4

5

6

7

8

9

0	0	Α	Α	Α		N	Ν
1	1	B	B	B		0	0
2	2	С	С	С		P	Р
3	3	D	D	D		Q	Q
4	4	E	E	E		R	R
5	5	F	F	F		S	S
6	6	G	G	G		Т	Т
7	7	Η	Η	Η		U	U
8	8	Ι	Ι	Ι	· [V	V
9	9	J	J	J	٦	W	W
		K	K	K		X	X
		L	L	L		Y	Y
		Μ	Μ	Μ	Γ	Ζ	Ζ

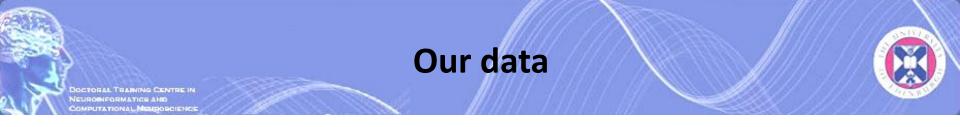
Score: 0.65

In this battery, a score below 1.0 is ranked as synesthetic. Non-synethetes asked to use memory or free association typically score in the range of a 2.0. A perfect score of 0.0 would mean that there was no difference in the colors selected on each successive presentation of the same letter. For more information on the Synesthesia Battery and the details of how it is scored, please refer to David M. Eagleman, Arielle D. Kagan, Stephanie S. Nelson, Deepak Sagaram, Anand K. Sarma. A standardized test battery for the study of Synesthesia. Journal of Neuroscience Methods, 2007 Jan 15;159(1):139-145. [Click here for pdf] and or email us.

Speed-Congruency Test

Accuracy	98.61 %		
Mean Reaction Time	1.557 seconds +/- 0.406		

Eagleman et al. 2007



- Large-scale recruitment: n = 1527, F= 827, M= 700
- Randomly selected sample
 - Self referral bias removed

Prevalence

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N = 1527

72 participants reported having grapheme-colour synaesthesia and completed the battery

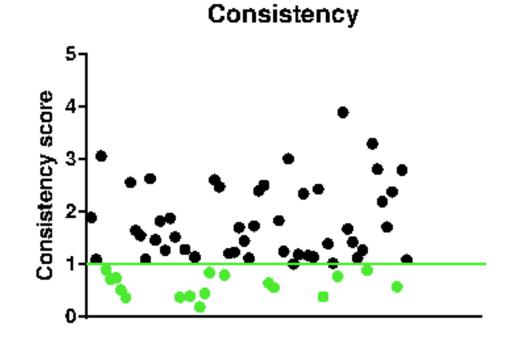


Prevalence

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N = 1527

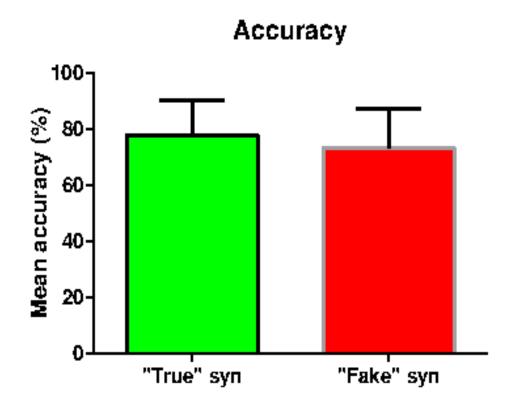
17 participants met synesthete.org's threshold of <1 consistency score



Speed-congruency test

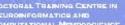




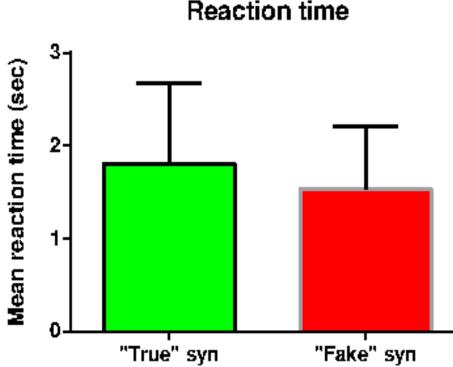


No signif difference

Speed-congruency test







Reaction time

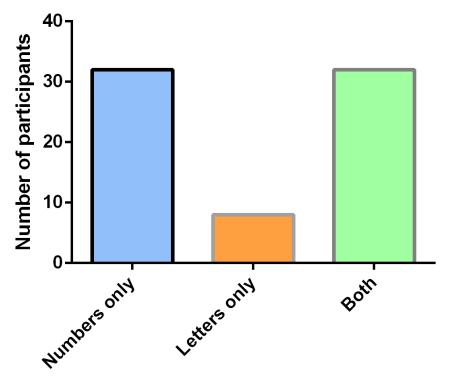
No signif difference

72 self-reported cases

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Grapheme-colour varient

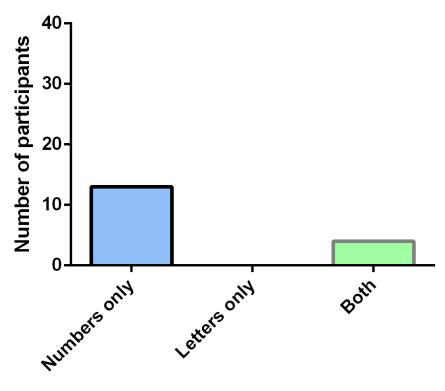


17 verified cases

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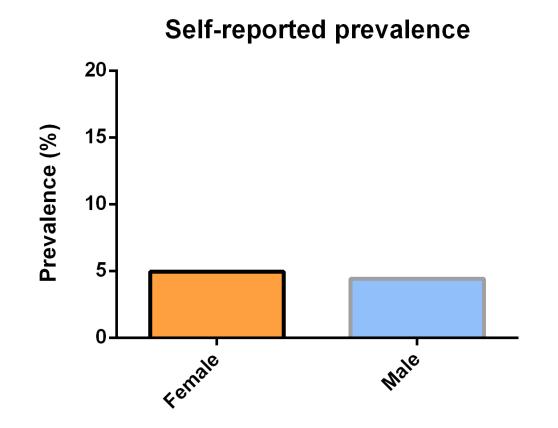
Grapheme-colour varient





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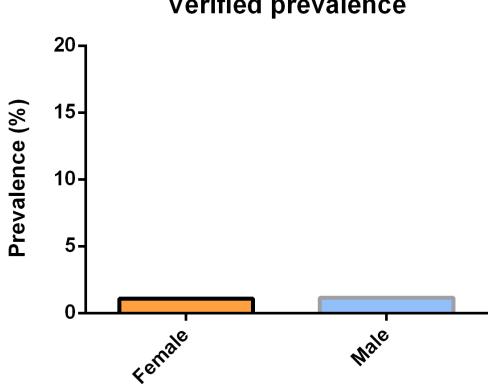






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Verified prevalence

Conclusions



- Is there a sex bias in synaesthesia?
- Why have other studies reported different **sex ratios**?
 - Baron-Cohen et al. (1996) 6:1 self-referral bias? – Rich et al. (2005) 6:1 Barnett et al. (2008) 6:1 Ward & Simner (2005) 2:1 2.7:1
 - Tomson et al. (2011)

Conclusions



- How do our data fit existing **prevalence** knowledge?
 - Our study : 1.1%
 - Simner et al. (2006): 2%
 - Simner et al. (2009; children): 1.3%
- Quantitative vs qualitative?
- Consistency vs stability?

Acknowledgements

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$$v_j = \sum_{c \in \{R,G,B\}} |x_1^C - x_2^C| + |x_2^C - x_3^C| + |x_3^C - x_1^C|$$

$$V = \frac{\sum_{j=\{A-Z, 0-9\}} v_j}{N}$$

Eagleman et al. 2007

