

A conceptual mediation hypothesis of synaesthesia: What can yellow Tuesdays tell us about how we represent objects?

Anina N. Rich

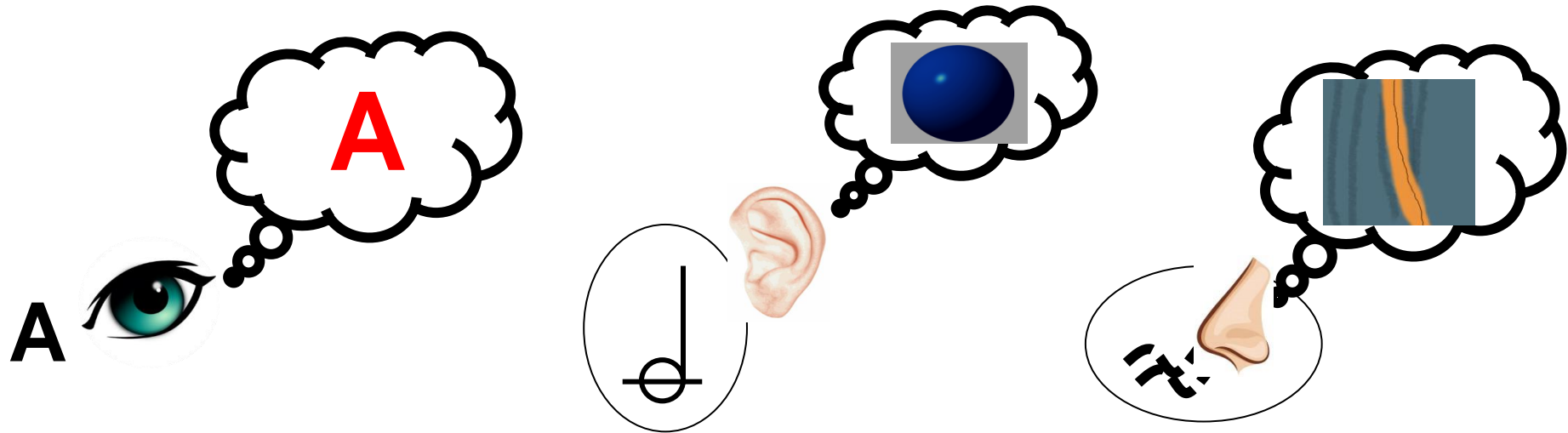
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Rocco Chiou

(University of Manchester, UK)

Synaesthesia

- Perception of a specific stimulus induces a concurrent and distinct experience in a separate modality, or within the same modality



- Neural hypotheses:
 - Synaesthetes have extra connections between relevant brain areas
 - Synaesthetes have disinhibition of connections present in us all
- => Neuroimaging thus far has primarily focused on early perceptual regions (V4)

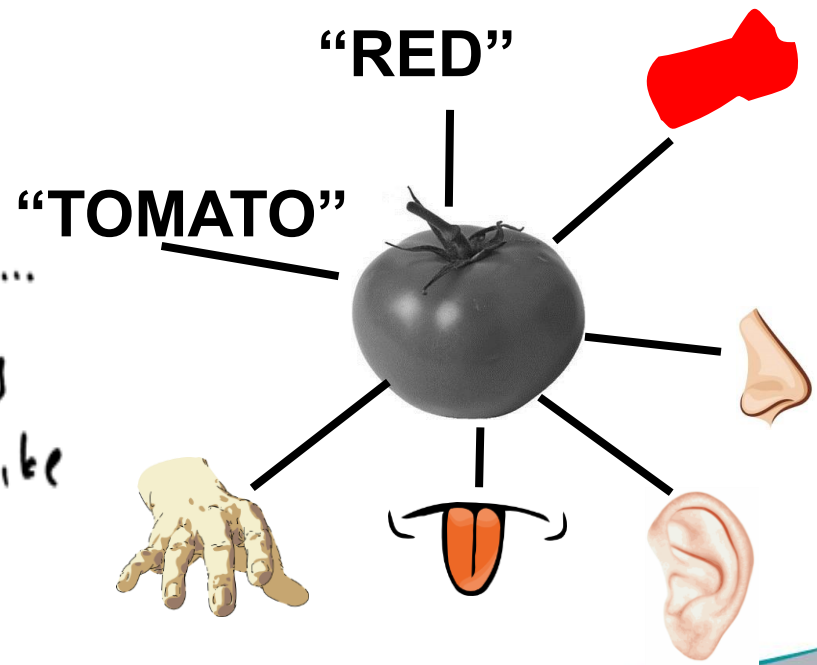
Why study synaesthesia?

Hypothesis: synaesthetic links are
(1) conceptual; and
(2) analogous to links between
object features

000 what's your
emergency?



i've got synaesthesia...
my chest is turning
green and sounds like
the number six



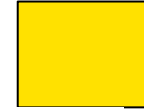
Modified from EvanBradley.net

The evidence for higher-level processes at work in synaesthesia...

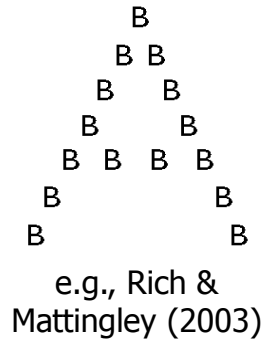
INDUCER:

- Concept of an inducer can elicit synaesthesia
- Attended inducer determines experience
- Context determines the experience
- Conceptual links can overcome usual letter-based colours
- Need substantial processing (~conscious identification) to elicit synaesthesia

$$5 + 2 =$$



Dixon et al. (2000)

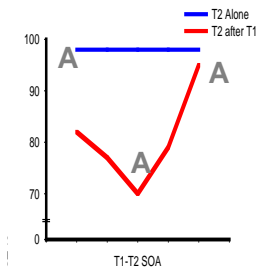


1 2 3 X Y Z

e.g., Myles et al. (2003); Dixon et al. (2006)

T, TEST, TWO, 2

Rich et al. (2005)

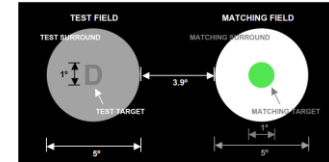


Rich & Mattingley (2010)

The evidence for higher-level processes at work in synaesthesia...

EXPERIENCE:

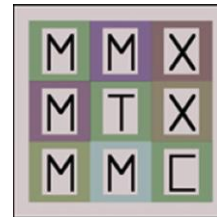
- No brightness contrast or chromatic adaptation effects
- Simultaneous colour contrast effects are not comparable with 'real' colour
- No colour constancy effect
- Resemble recalled colours in precision



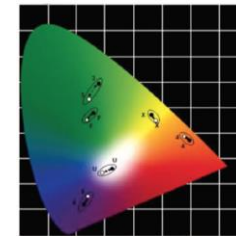
(Hong & Blake, 2008)



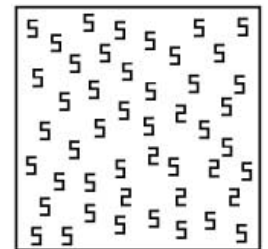
Nijboer et al. 2011



Erskine et al. 2012



Arnold et al. 2011



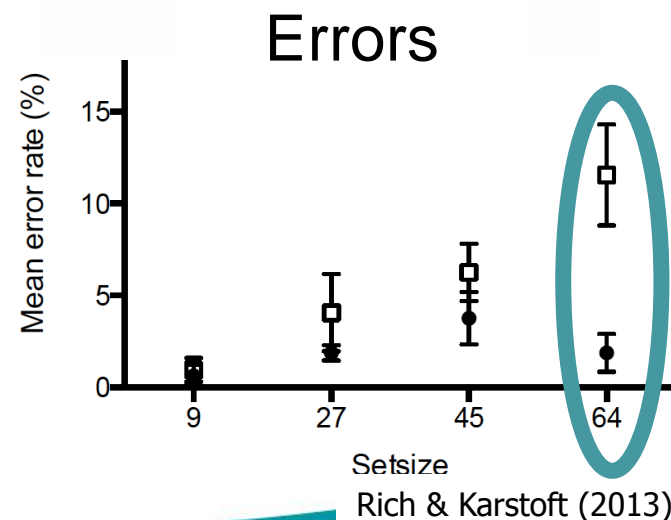
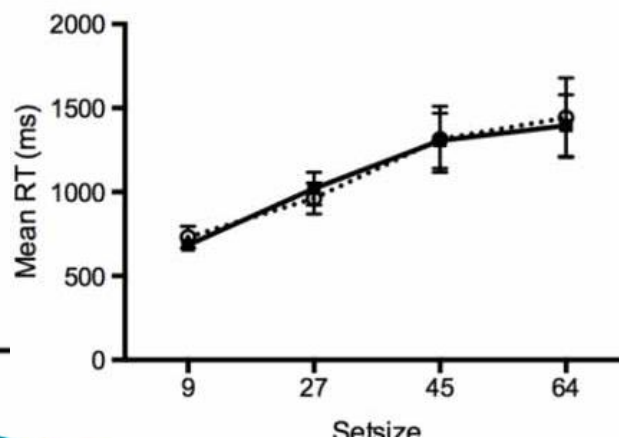
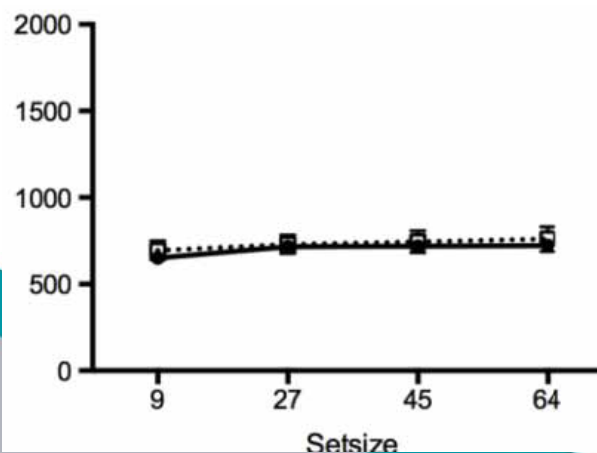
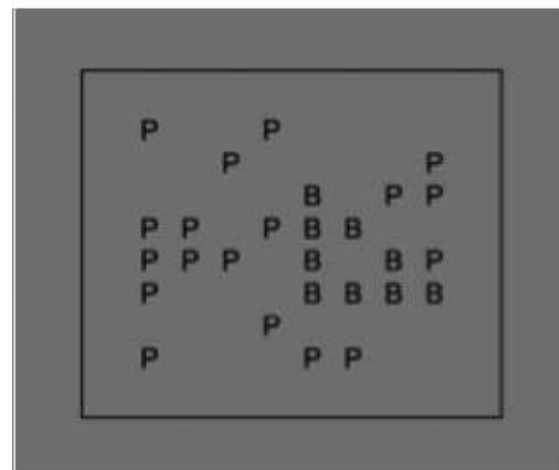
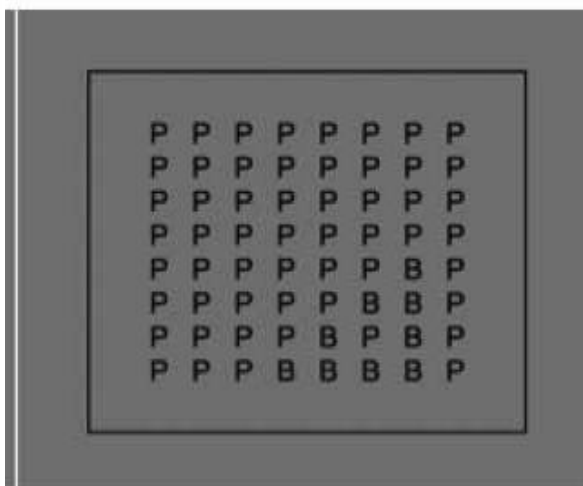
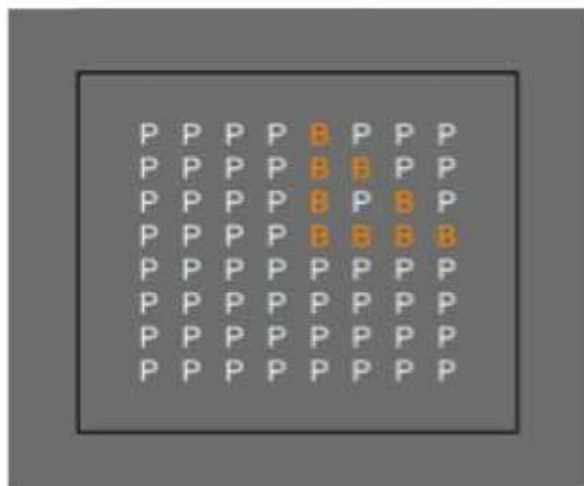
But didn't Ramachandran & Hubbard show 'pop-out'?

- ⇒ synaesthetic colours very early in perception of inducers
- ⇒ act like real colours



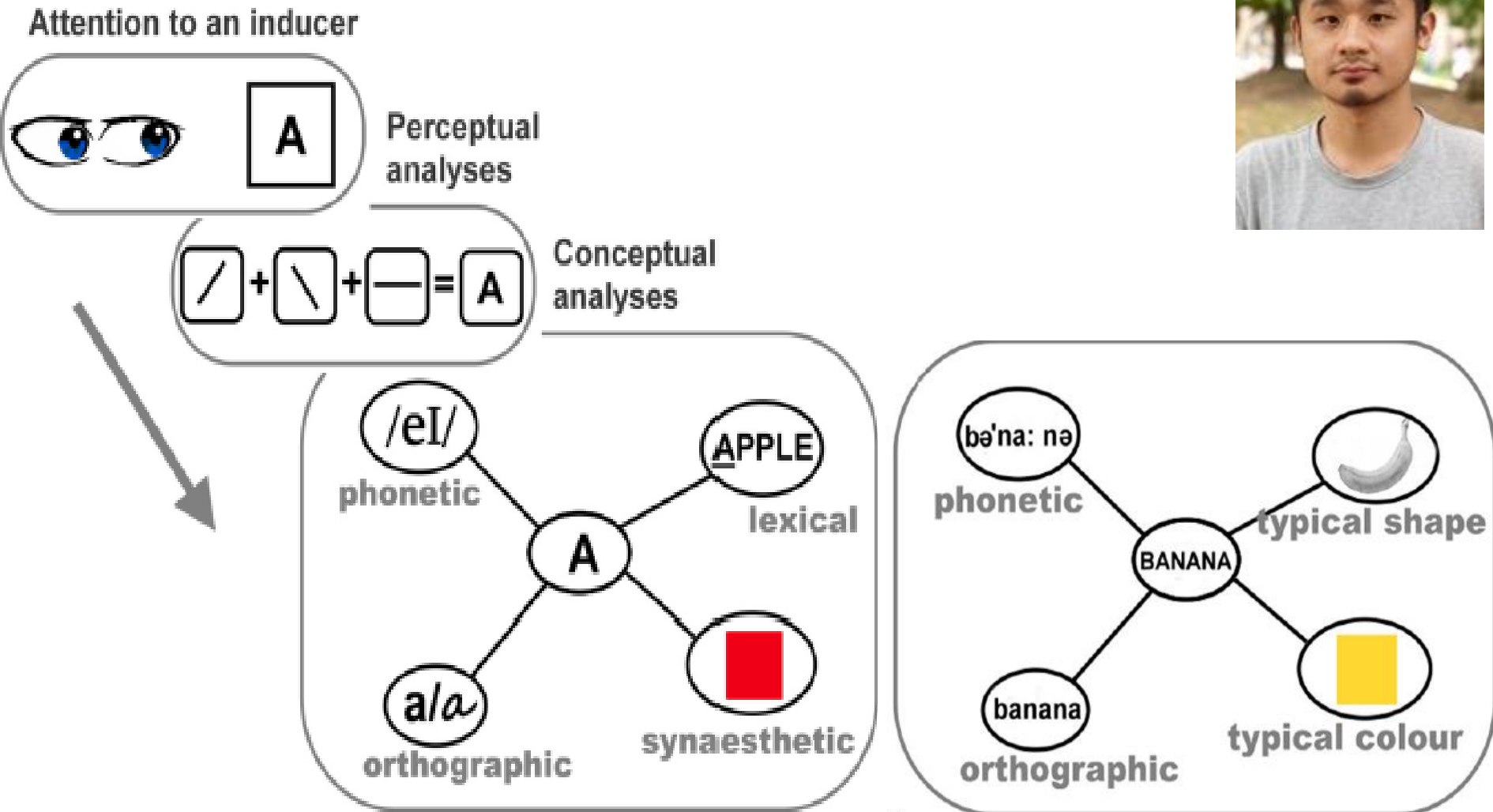
Testing for synaesthetic “pop-out”

- Synaesthetes
- Controls



Rich & Karstoft (2013)

A conceptual-mediation hypothesis of synaesthesia



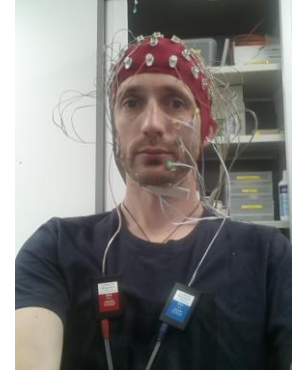
Does knowing the colour of a banana rely only on early perceptual regions?

- Distributed view: knowledge of object features relies only on relevant sensorimotor regions
 - Hub+spoke view: an amodal hub holds abstract information about object features
 - Patients with damage to the Anterior Temporal Lobe have semantic dementia
- ⇒ Amodal 'hub' holding conceptual knowledge? (Patterson/Lambon-Ralph)



A conceptual lemon?

*Does knowledge of typical colour
involve the ATL?*



- Transcranial magnetic stimulation
 - More focal than patient lesions
 - Transient effects
 - Test the effect of ATL disruption on a task that measures object-colour knowledge
- Offline theta-burst stimulation
 - 40 secs TMS
 - Lasts ~15-30 mins
- ATL & Occipital pole

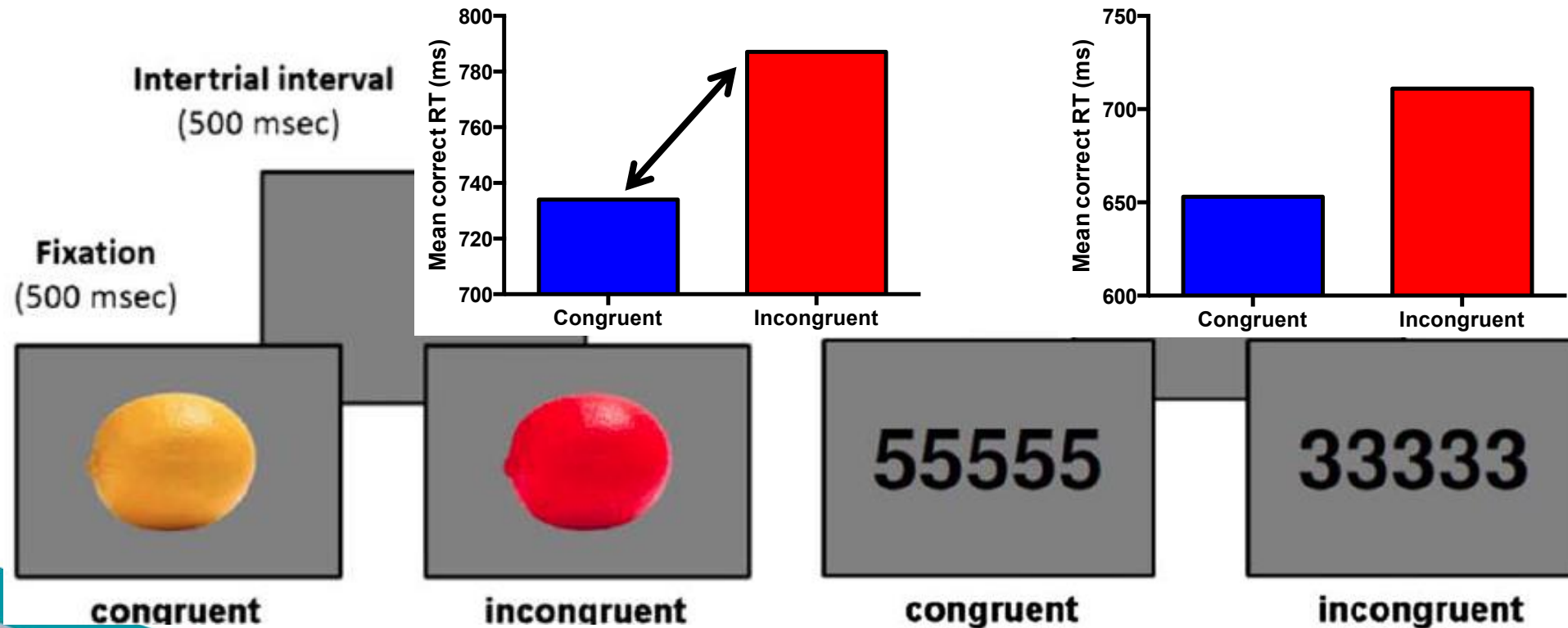
(control site)



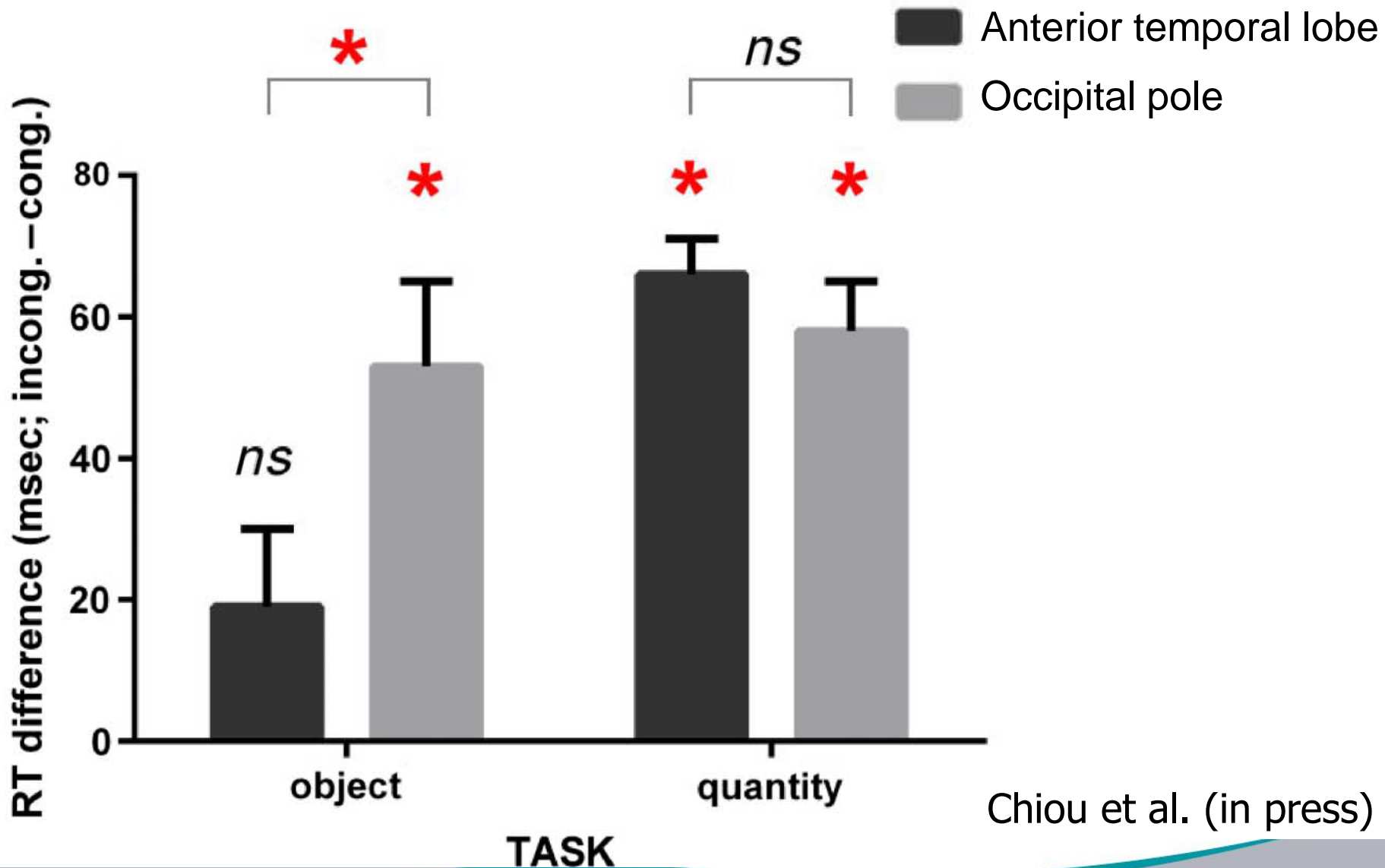
Behavioural measures

Object naming task

Quantity naming task



Is the ATL involved in object-colour binding?



Chiou et al. (in press)

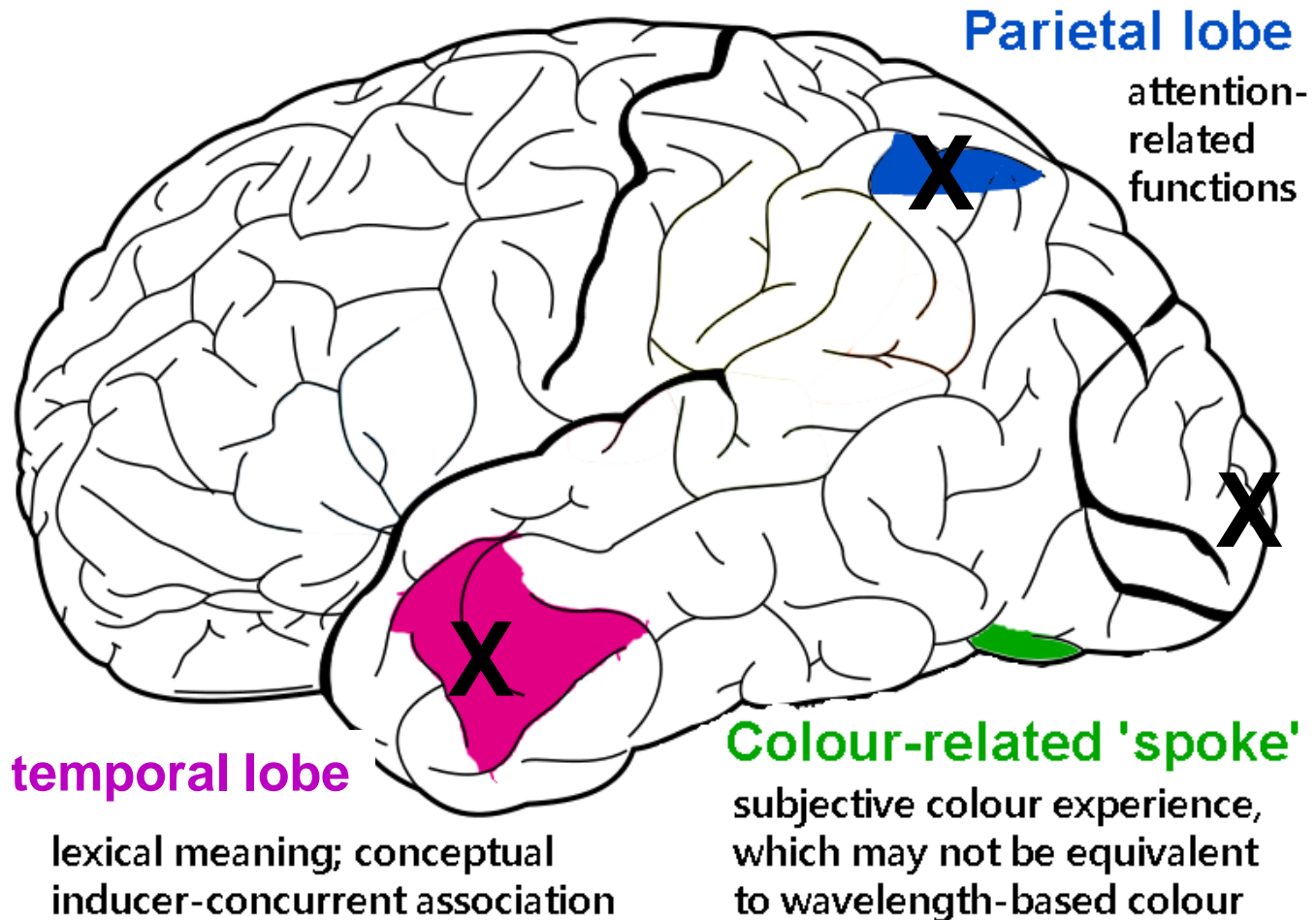


A conceptual connection?

Disrupting synaesthetic colour-form binding

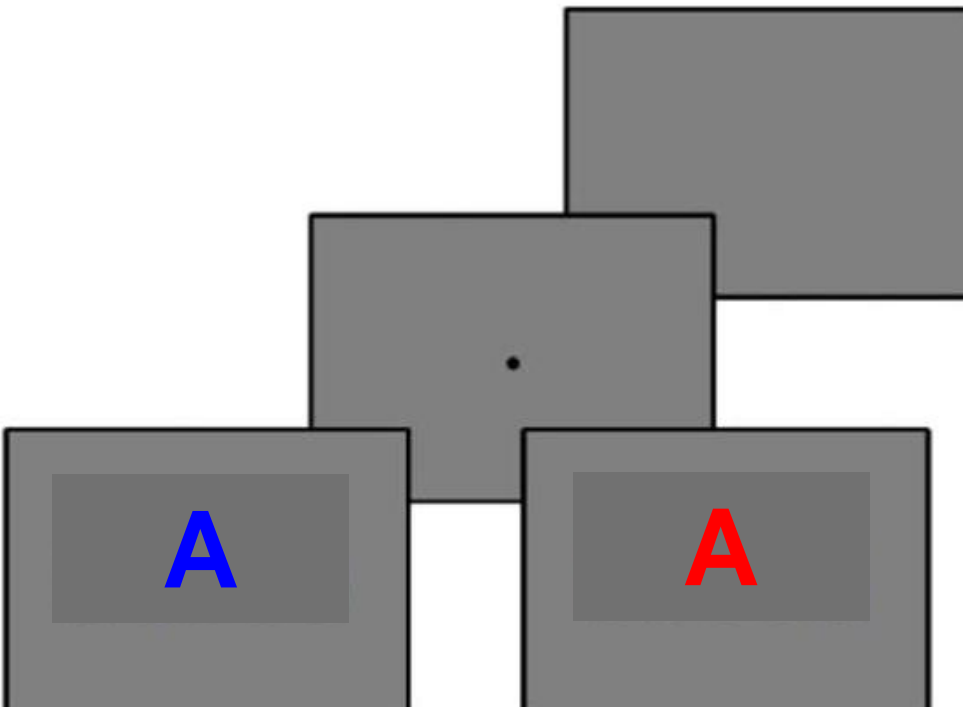


TMS: theta-burst

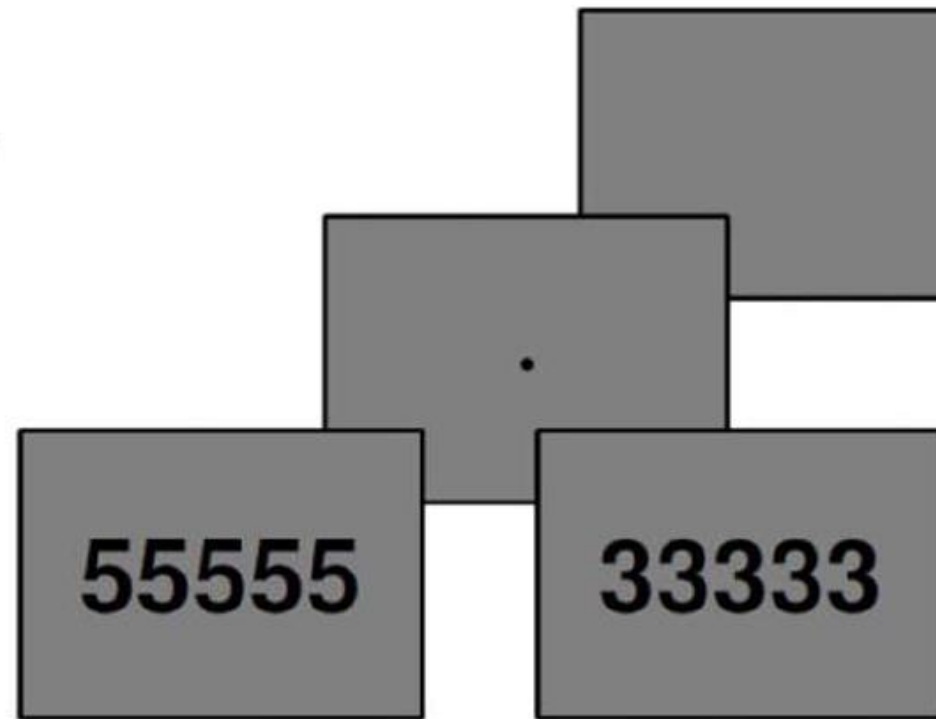


Behavioural measures

Synaesthetic congruency



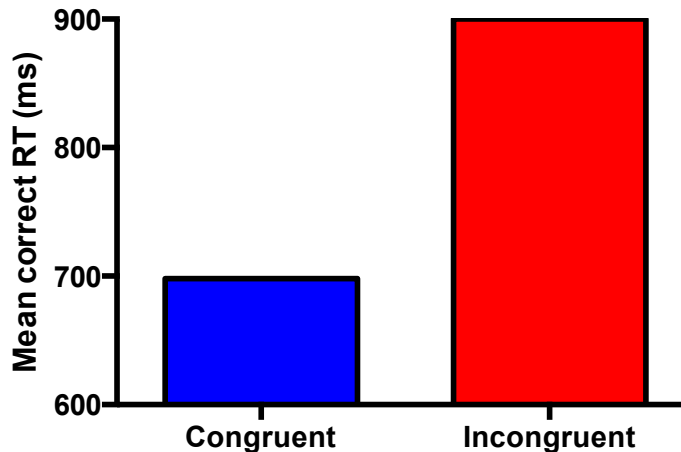
Quantity



congruent

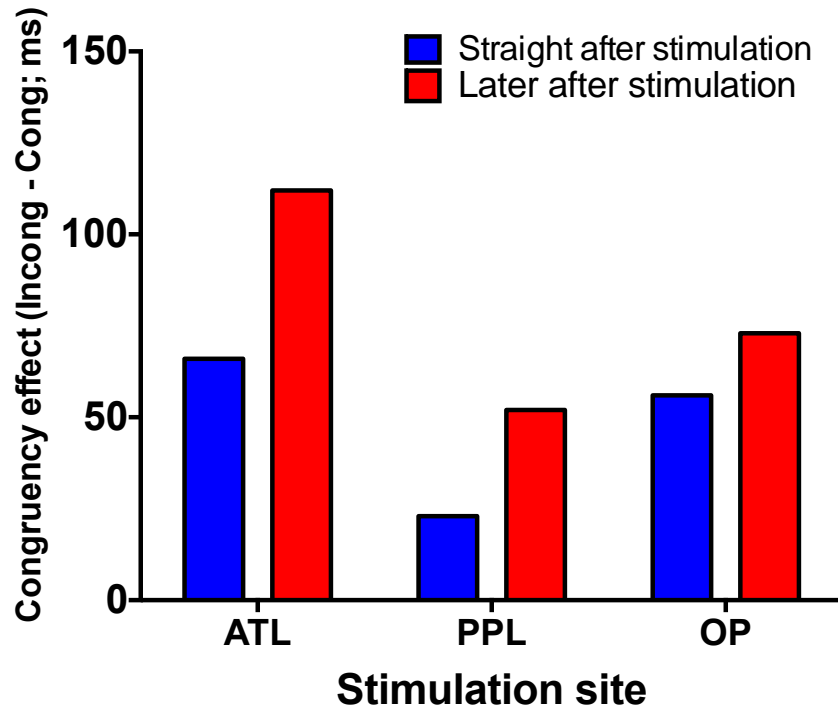
incongruent

Task: Name the quantity of digits

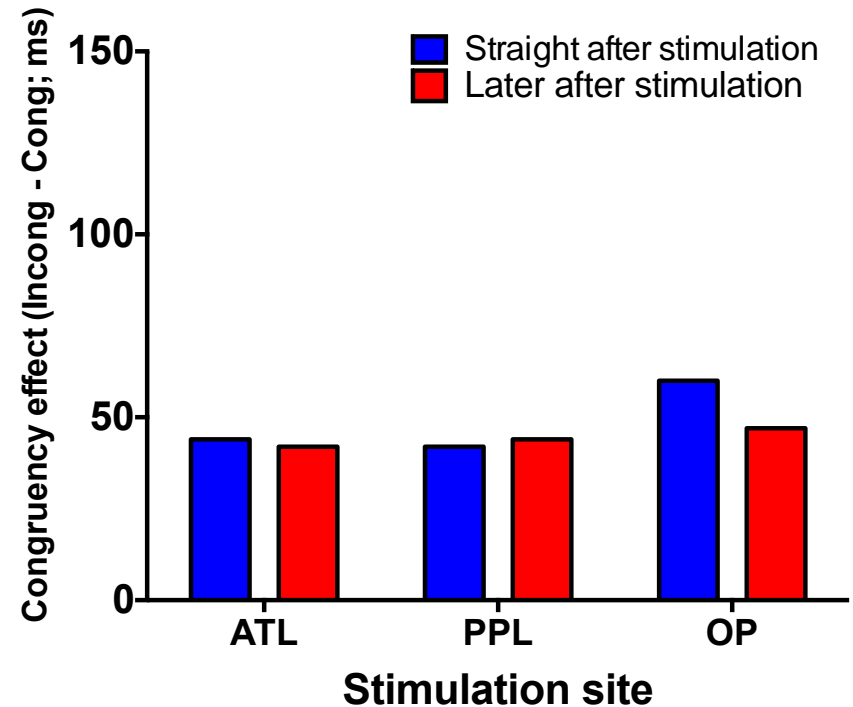


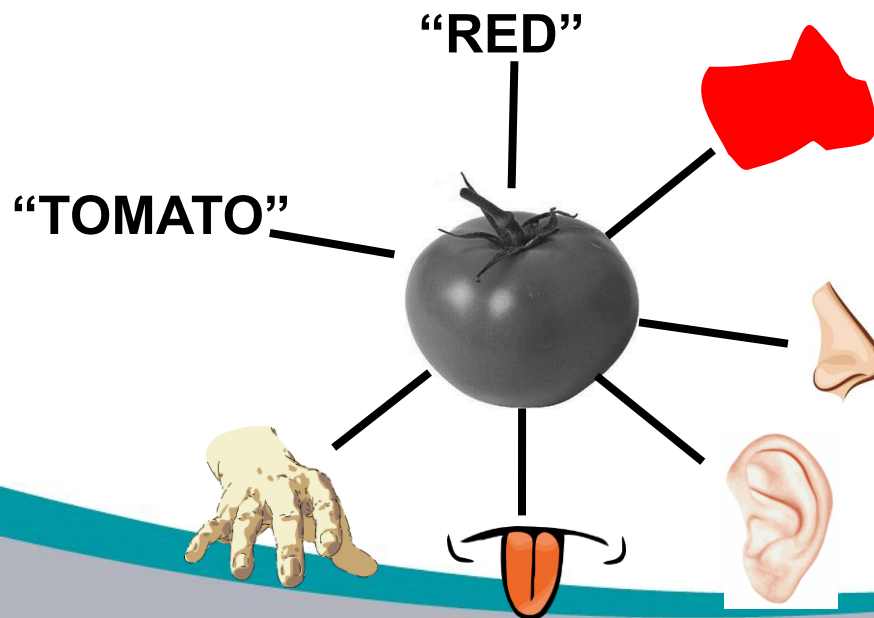
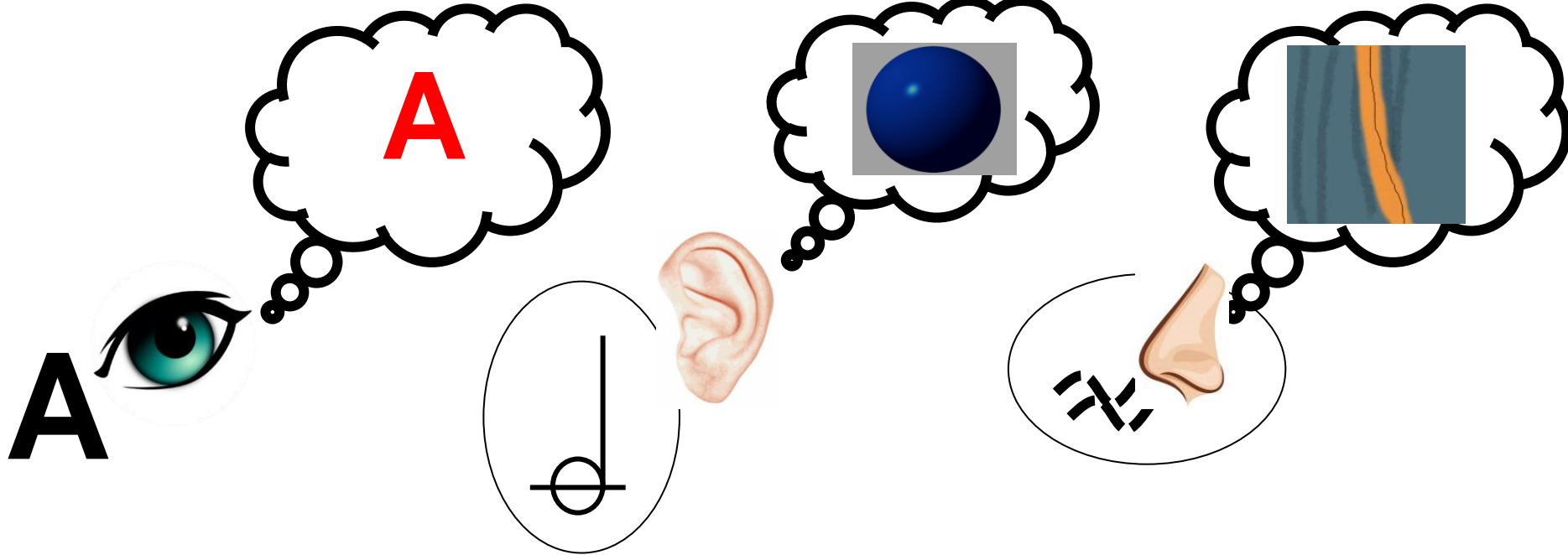
Preliminary results (3 synaesthetes)

Syn congruency measure



Quantity congruency measure

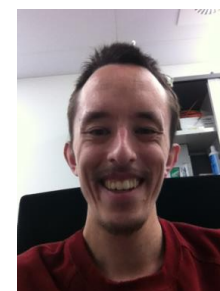




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