

Sensory representations are causally involved in cognition but only when the task requires it

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The ranger saw the eagle flying in the sky



The ranger saw the eagle flying in the sky



ladder & railtracks vs. ladder & snowball



perceptually
similar



perceptually
dissimilar

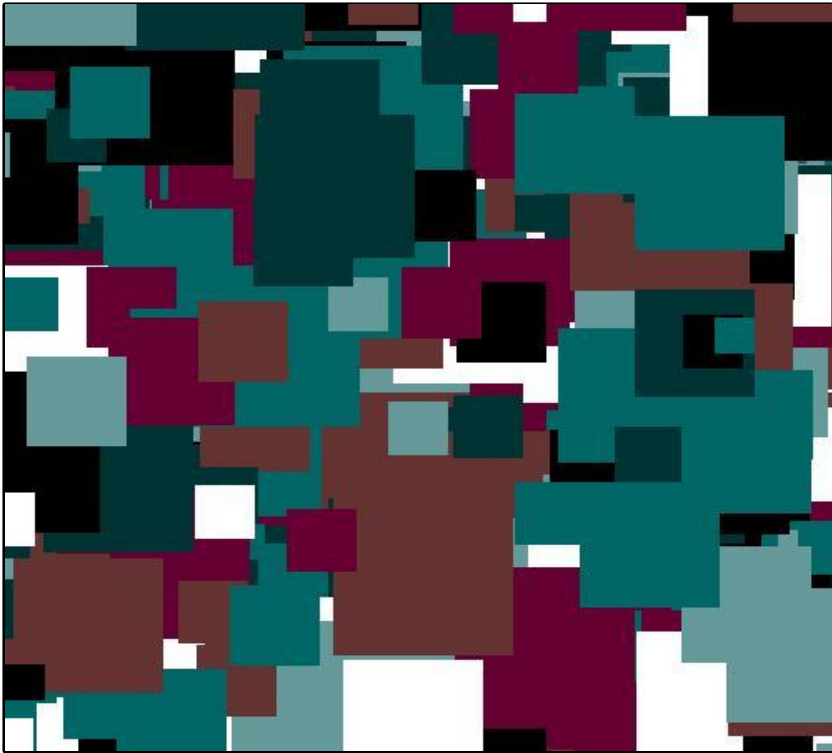
Uncontroversial claim: **Semantic processing involves the activation of visual knowledge**

Still debated: **How is it represented?**

Neuroimaging data:

- Processing object words activate visual cortex (Desai et al., 2009)
- Imageability correlates with visual cortex activation within 200ms (before lexical access; Lewis & Peoppel, 2014)
- Generating „visual“ concepts activates occipital lobe (Hwang et al., 2009)

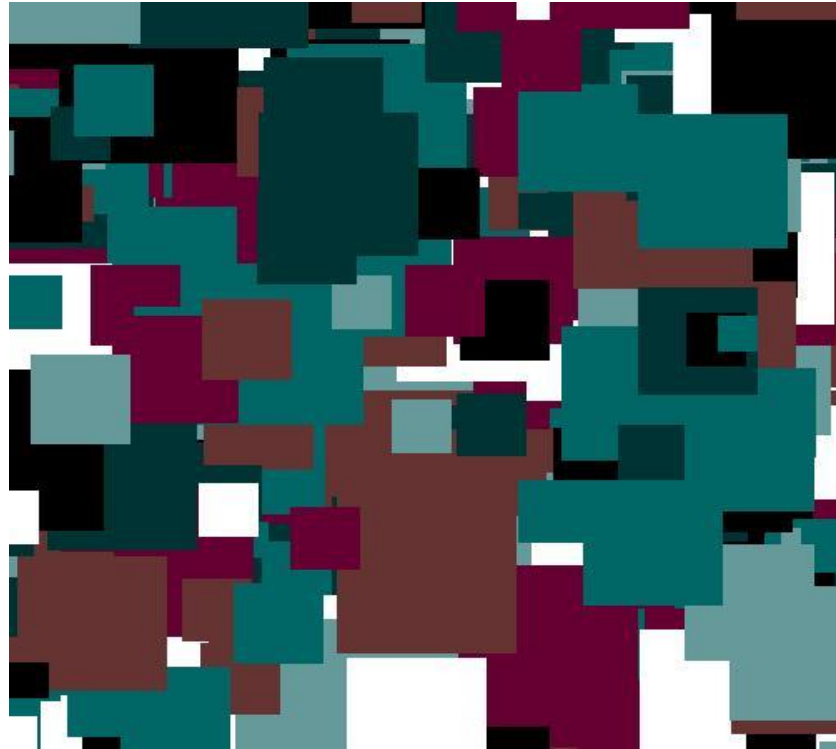
Activation is category-specific



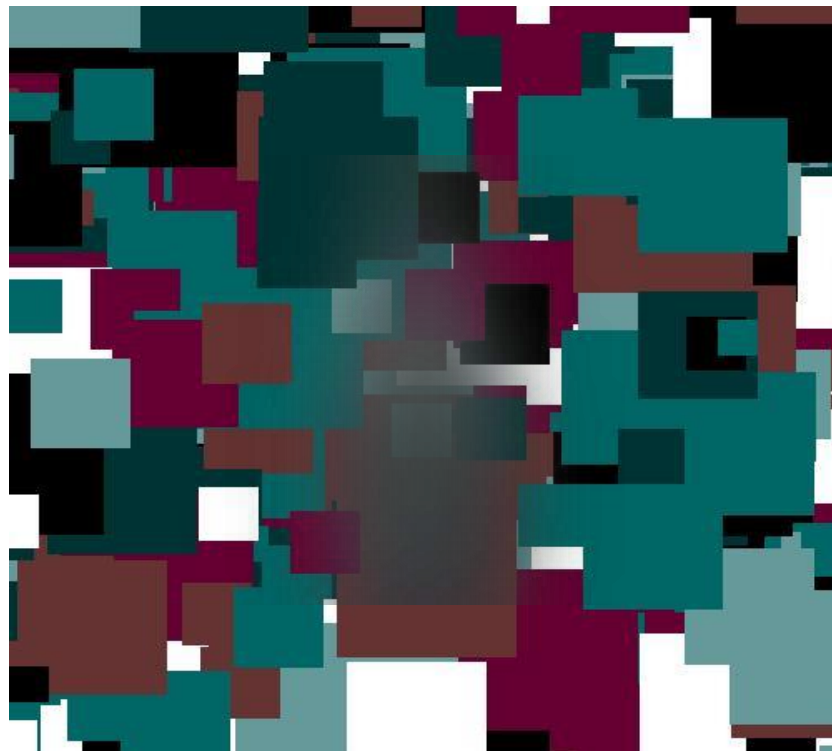
randomly generated flashes
of colorful patterns changing
at ca. 10Hz



picture of a bottle



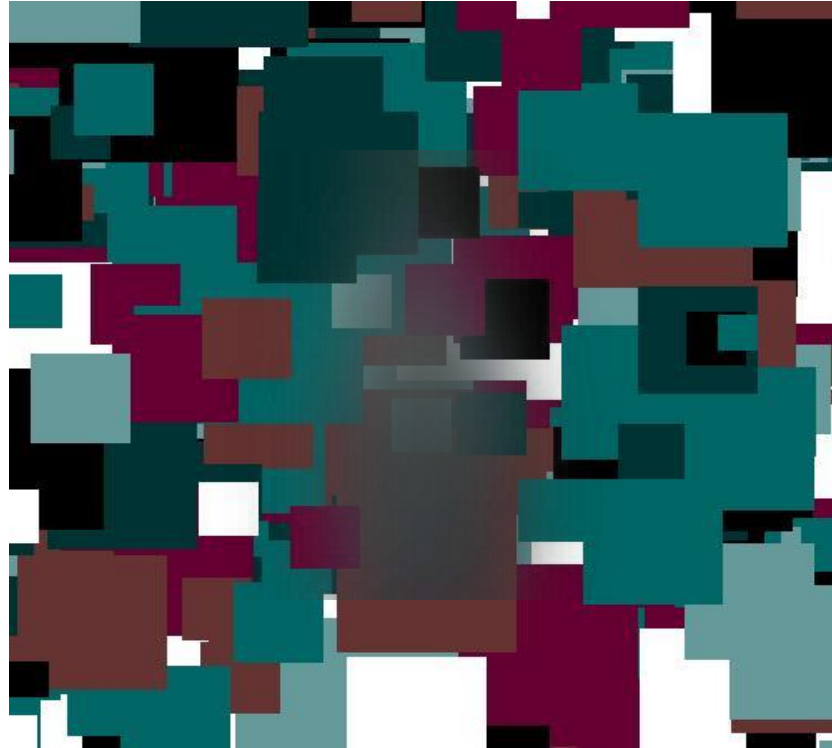
Is there a picture?



congruent



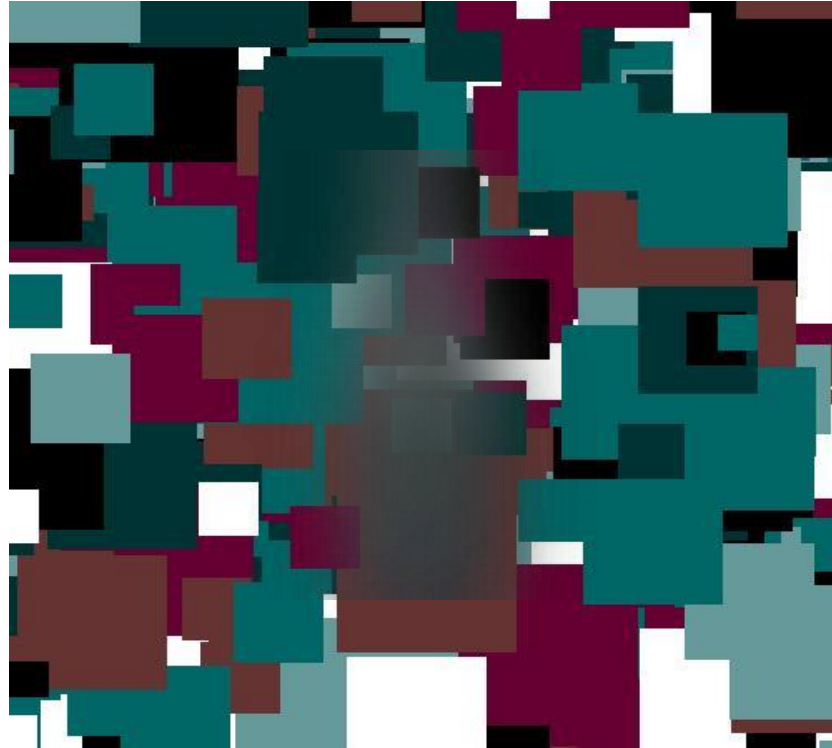
„fles“



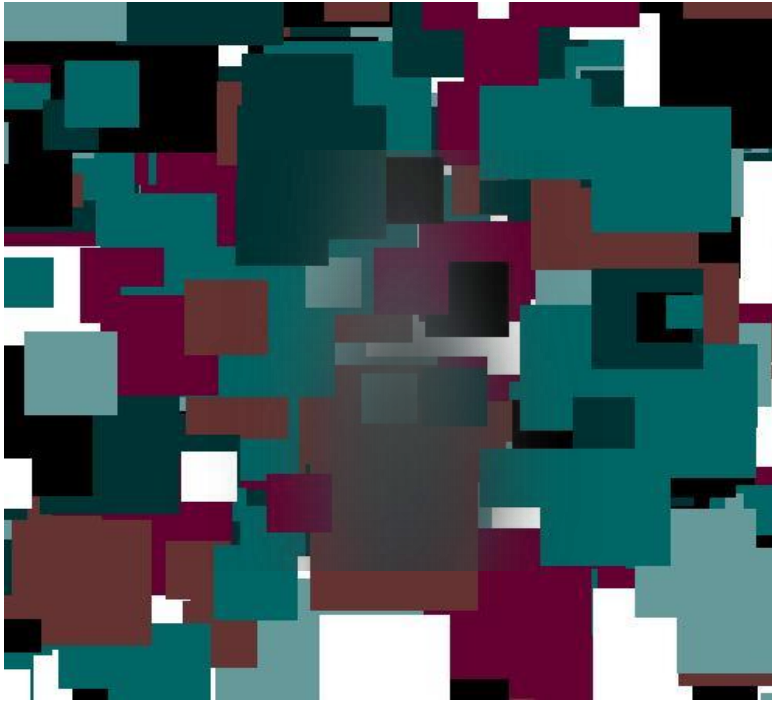
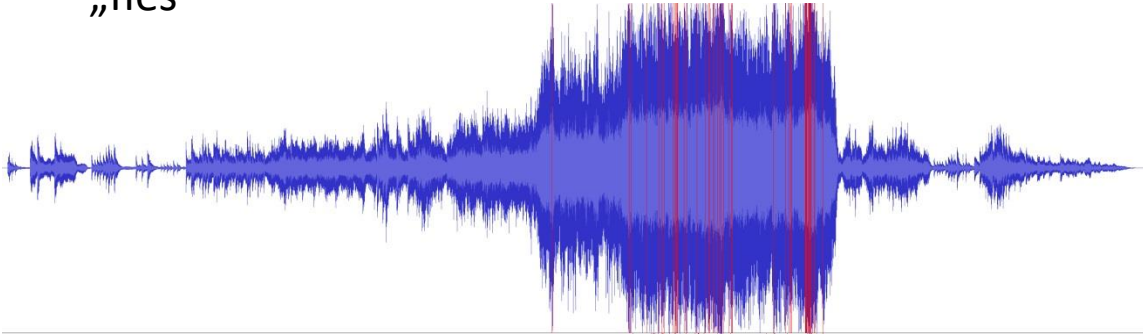
incongruent



„ball“



„fles“



was there a picture?

0

200ms

600ms



Results

- detection rates in congruent condition ca. 5% higher ($p=0.01$)

	Condition	Mean Yes-Responses
1	congruent	46.7%
2	incongruent	41.7%
3	No Picture	15.0%

- higher sensitivity (d' ; $p=0.006$)

	Condition	Mean RT	SD
1	congruent	838ms	257ms
2	incongruent	897ms	279ms

- shorter RTs ($p=0.002$)

What we've got

- Object word processing involves perceptual features
- Object words activate visual cortex
- This activation is rapid and category-specific

BUT

Are visual representations **necessary** for comprehension?

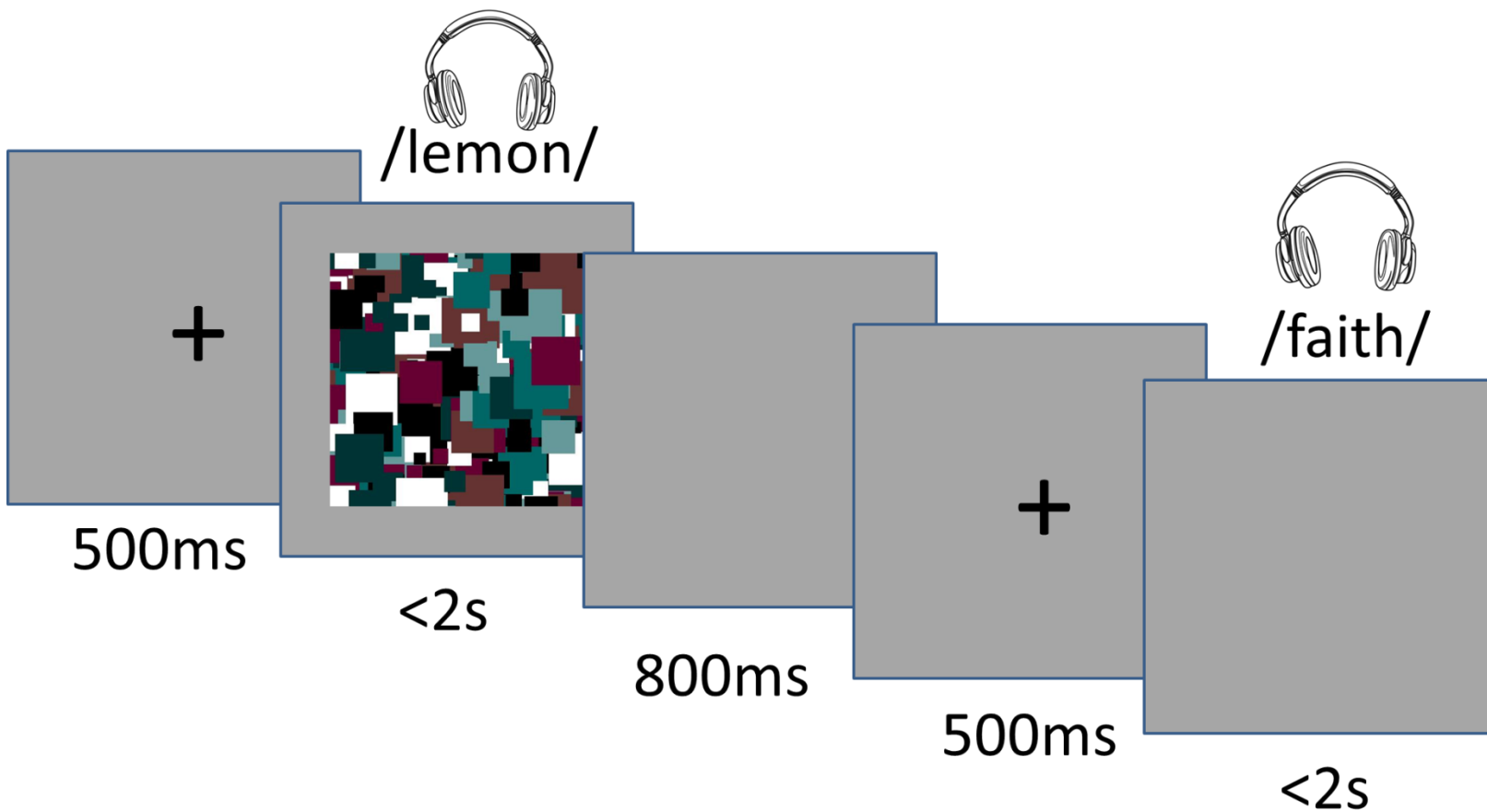
Tackling the question of functional relevance

A strong test: Interfere with low-level visual processing during semantic tasks to (potentially) establish a causal role of the visual system

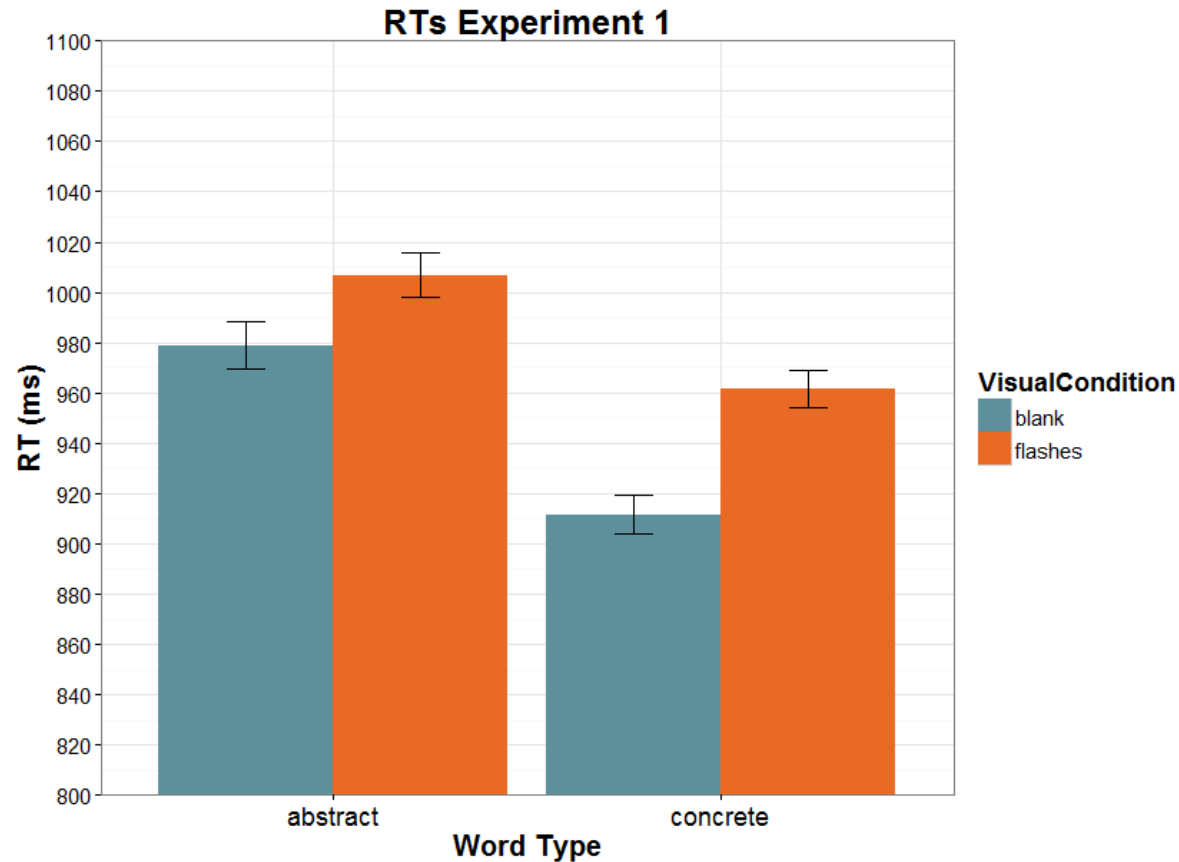
Experiment 1: Concreteness task (within-subjects design)

- 50 participants
- 52 concrete and 52 abstract words

Prediction: Interference should affect concrete object words more than abstract words

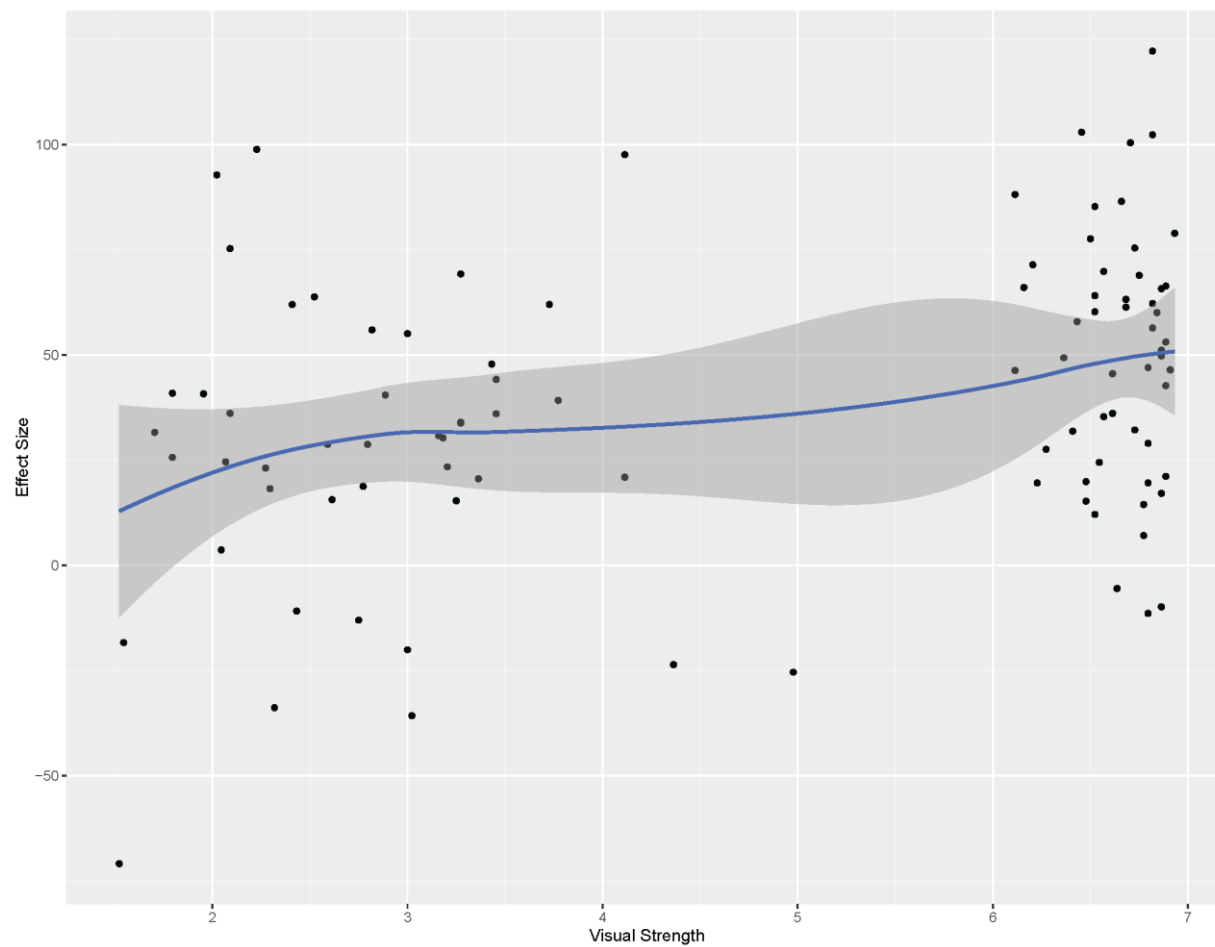


Results



Visual noise interfered more with concrete object word processing (interaction: $p=0.002$)

→ Functional role of low-level visual representations for semantic processing



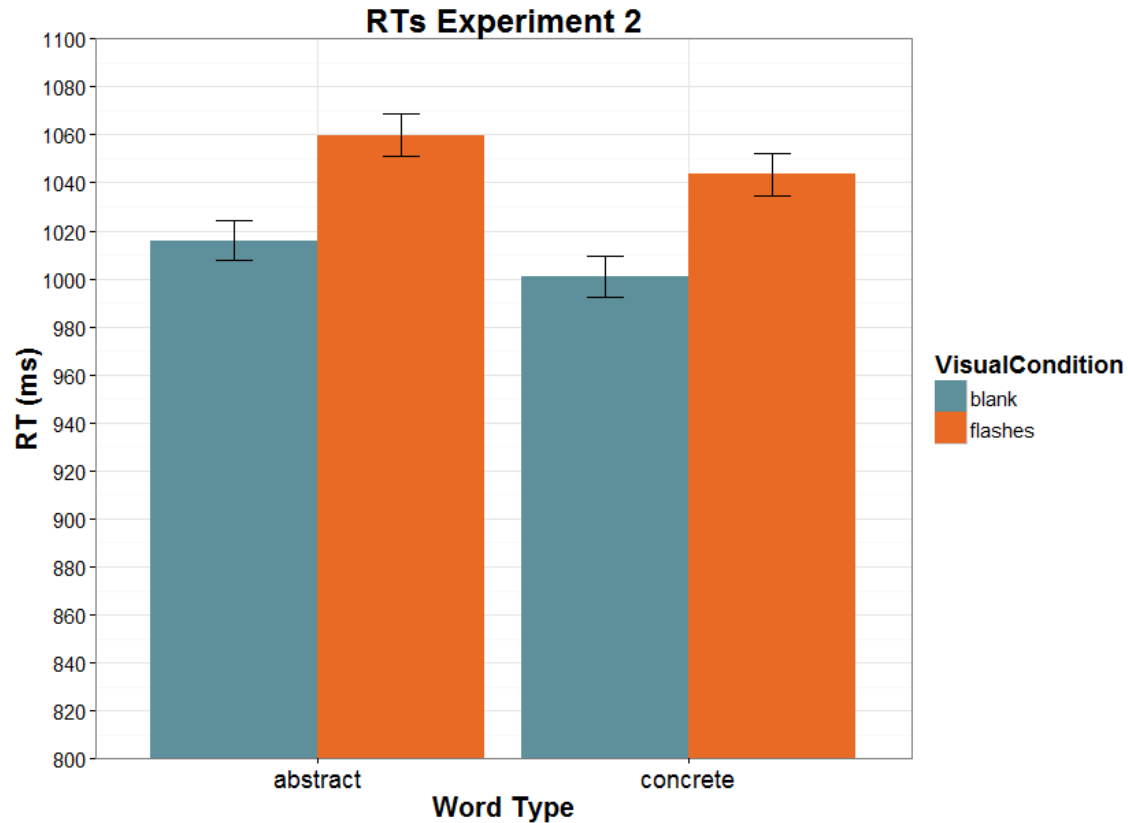
Evidence for a causal role of low-level visual system for language comprehension

Are visual representations recruited automatically
or does their recruitment depend on task
requirements?

Experiment 2: Lexical decision task

- 46 participants
- 42 concrete and abstract words + 84 nonwords

Results



Visual representations not necessary for this task

→ Evidence against obligatory role of visual system in word processing

Participants may have relied on phonological processing

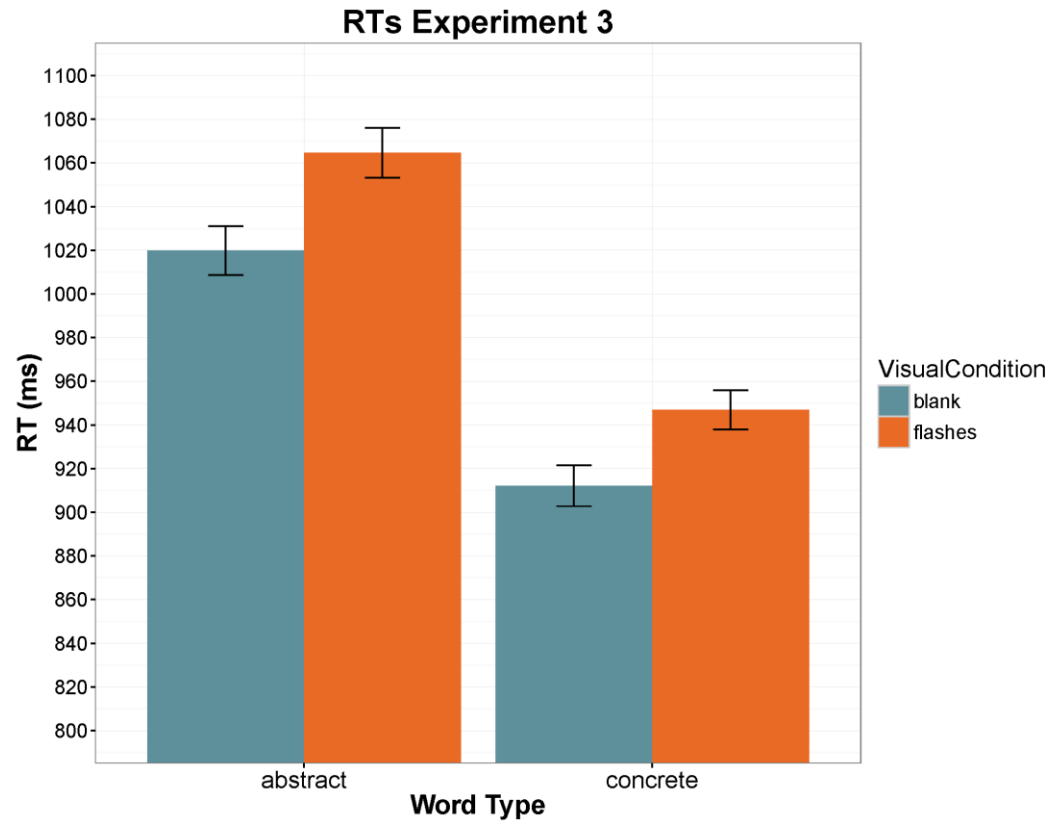
Possibility 1: Visual representations are necessary for semantic processing

Possibility 2: Visual representations are important specifically for visual knowledge retrieval

Experiment 3: Noun vs. adjective decision task

- 42 participants
- 42 concrete and abstract words nouns and adjectives

Results



Again, no Word Type by Visual Condition interaction

Visual representations not generally necessary for semantic processing

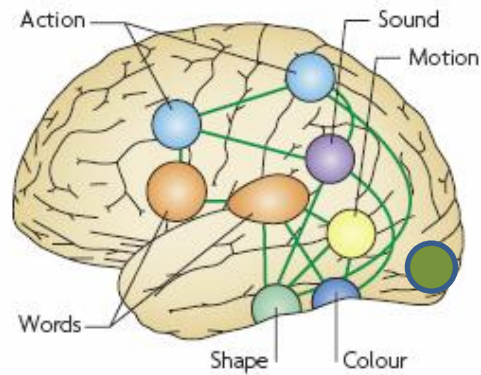
Summary

- Visual noise interfered with object word processing in concreteness task, but not LDT and word class decision task
- Visual representations are important for retrieving visual information about word referents
- Low-level sensory representations are an optional processing device dependent on task-requirements

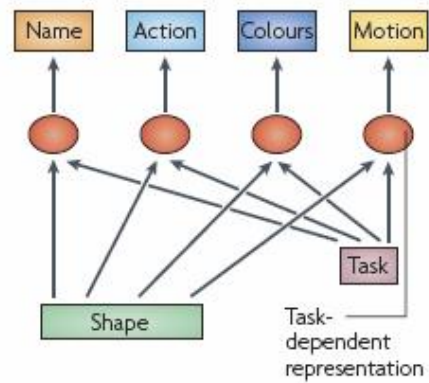
Conclusion

- Modality-specific visual representations are causally involved in verbal semantics
- The ‚embodiment‘ of cognition is determined by the given task situation
- Mechanistic explanations of modality-specific and non-specific systems are needed

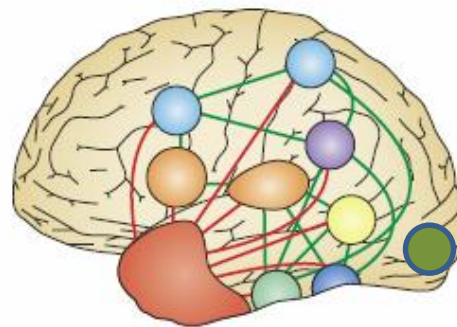
a Distributed-only view



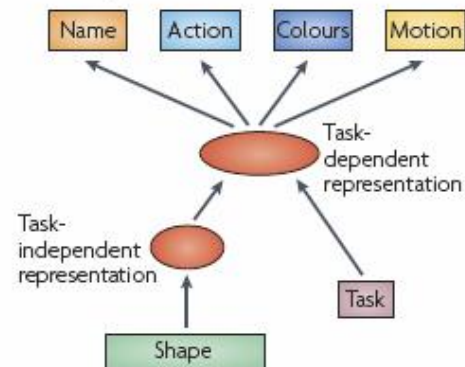
Gating architecture



b Distributed-plus-hub view



Convergent architecture



Thank you!