

Visually and aurally presented prime sentences automatically activate our senses

Scerrati E.¹, Baroni G.¹, Borghi A.M.^{2,3}, Galatolo R.¹, Lugli L.¹, Nicoletti, R.¹

¹ Department of Philosophy and Communication, University of Bologna

² Department of Psychology, University of Bologna

³ Institute of Cognitive Sciences and Technologies, Italian National Research Council

elisa.scerrati@unibo.it



INTRODUCTION

- A growing number of neuroimaging studies show that modality-specific brain areas are active during conceptual processing [1, 2].
- Further, the behavioral literature shows that when different-modality properties for concepts are processed during a property verification task, a cognitive cost typically occurs [3, 4, 5].
- This effect, known as the Modality-switch effect (henceforth, MSE), has been claimed to be the result of an automatic perceptual simulation.
- However, it has not been fully explored whether the MSE is actually automatic and independent of the stimulus' presentation modality.

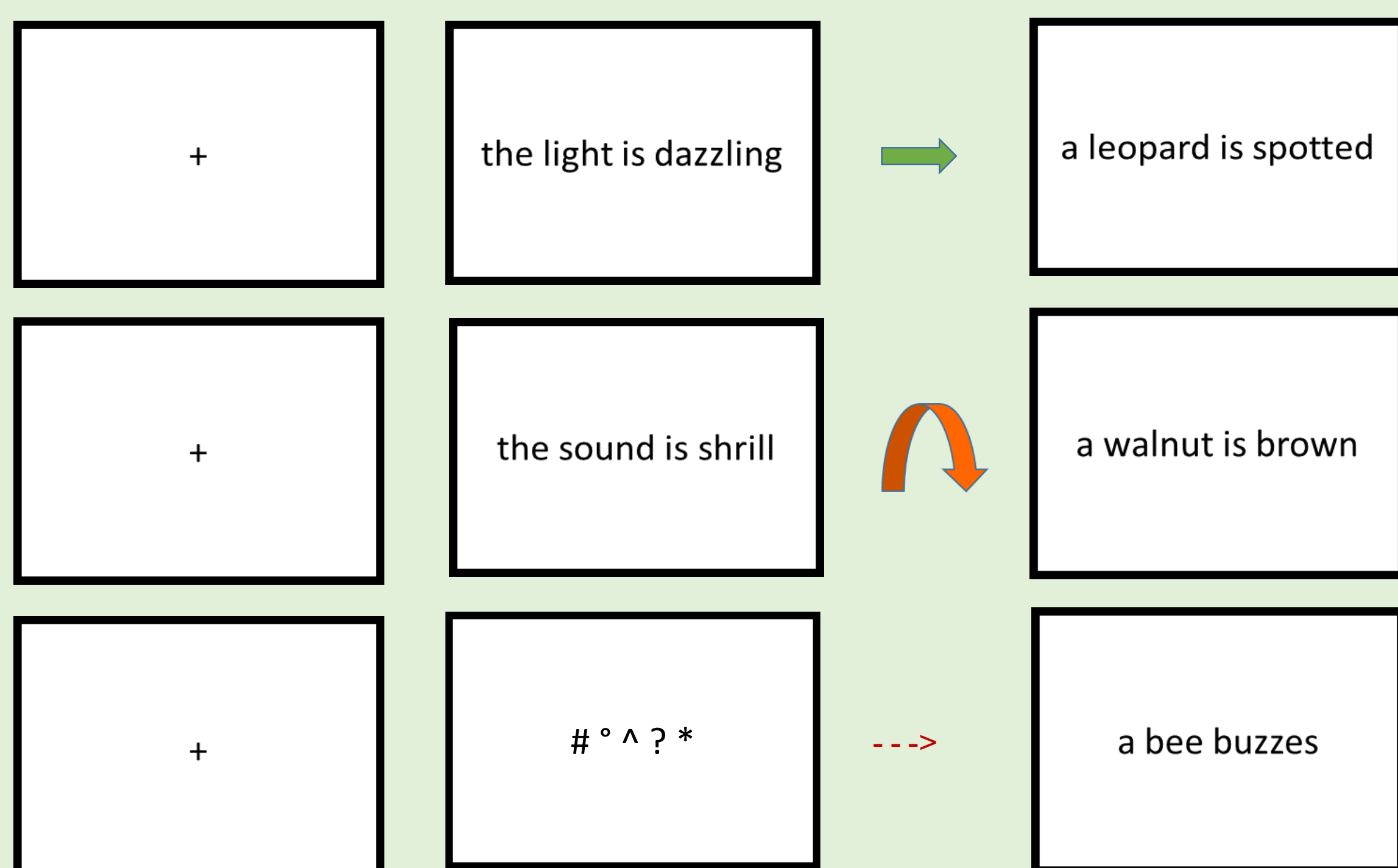


Figure 1: Example of written same, different and neutral-modality prime and target sentences.

METHOD

Participants: 64 students (43 females; mean age: 20.26, SD: 1.58).

Task: property-verification task on 96 concept-property target pairs, either written or spoken (see figure 1 for an example of the experimental procedure).

RESULTS

A Repeated Analysis of Variance (ANOVA) on RTs, with *Modality* (same vs. different vs. neutral) as a within-subject factor and *Condition* (visual vs. auditory) as a between-subjects factor was performed. The main effect of *Modality*, $F(2, 124) = 58.32$, $MS_e = 13302.62$, $p < .001$, $\eta_p^2 = .485$ and *Condition* $F(1, 62) = 320.32$, $MS_e = 146787.41$, $p < .001$, $\eta_p^2 = .838$ as well as their interaction $F(2, 87.1) = 7.88$, $MS_e = 18941.26$, $p < .001$, $\eta_p^2 = .113$ resulted as significant. See Table 1 and Figure 2 and 3 for details.

Table 1: Mean Response Times (in Milliseconds) with Standard Deviations in parenthesis, as a Function of Modality (same, different, neutral) for both visual and auditory conditions.

	Visual	Auditory
	ms	ms
Same	1538 (178.3)	2462 (202.2)
Different	1588 (206.5)	2552 (245.4)
Neutral	1676 (222.2)	2756 (349.1)

Visual Presentation

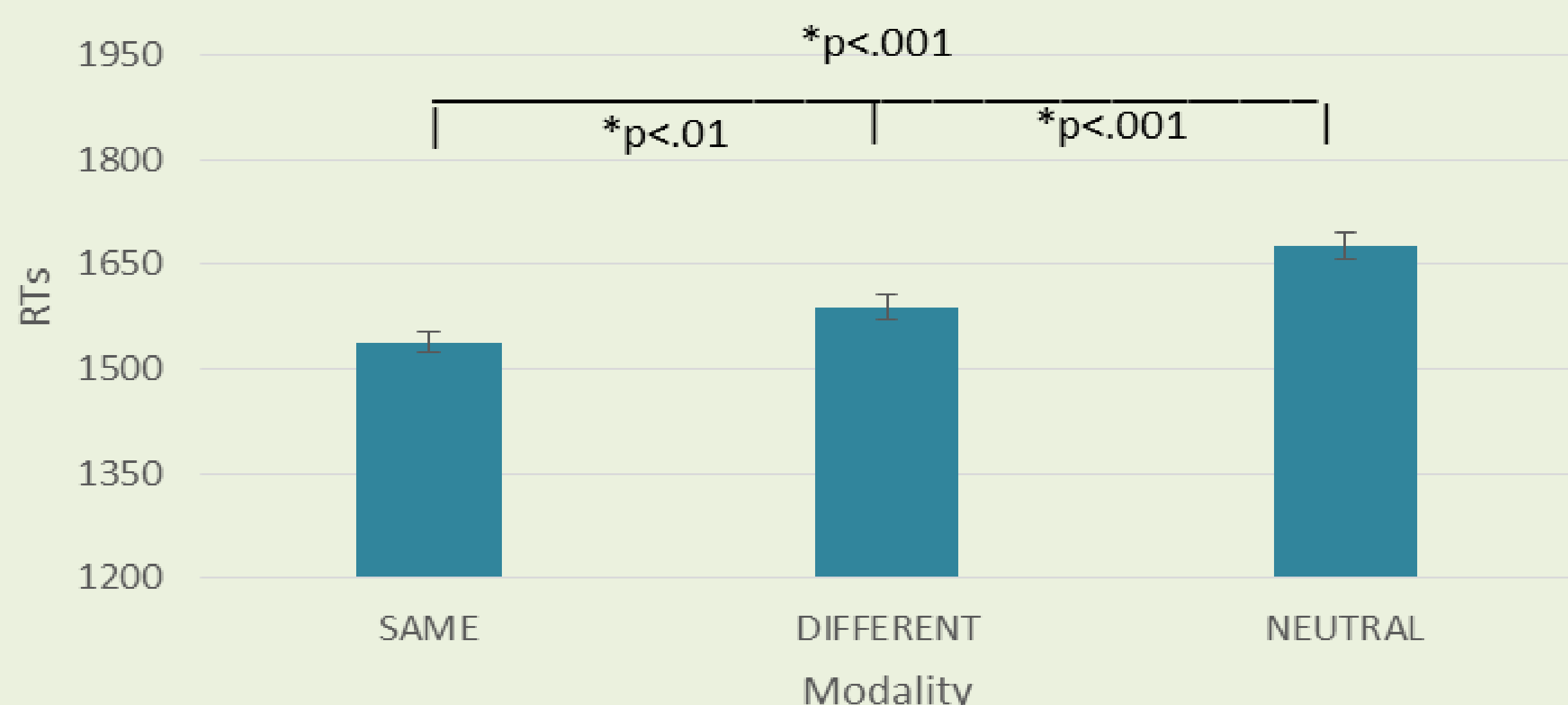


Figure 2: Mean Response Times (in Milliseconds) as a Function of Modality (same, different, neutral) for the visual condition. Bars are standard Errors.

Auditory Presentation

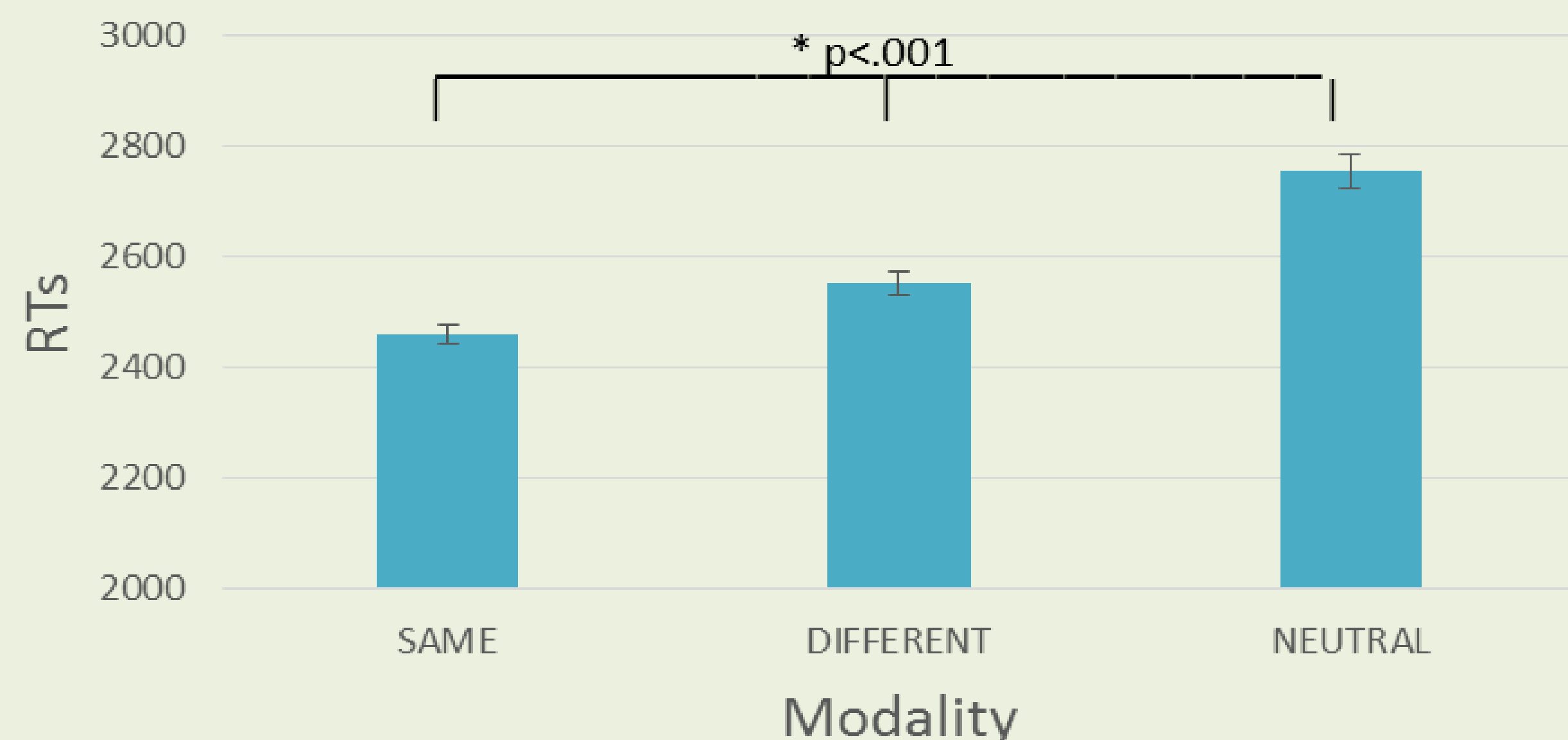


Figure 3: Mean Response Times (in Milliseconds) as a Function of Modality (same, different, neutral) for the auditory condition. Bars are standard Errors.

TIP

Is the MSE actually independent of the stimulus' presentation modality?
A within-subject design provisional data*

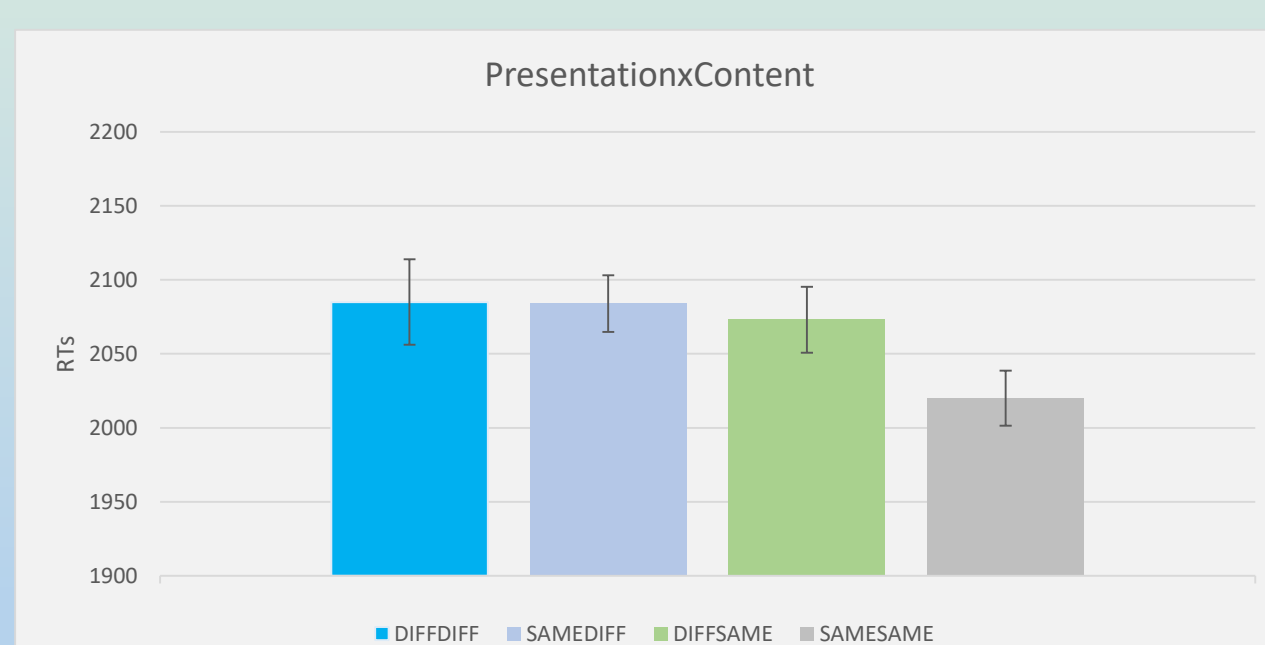


Figure 4: Mean Response Times (in Milliseconds) as a Function of Presentation Modality (Same, Different) and Content Modality (Same, Different). Bars are standard Errors.

Table 2: Mean Response Times (in Milliseconds) with Standard Deviations in parenthesis, as a Function of Presentation Modality (Same, Different) and Content Modality (Same, Different).

Presentation x Content	RTs
	ms
DIFF-DIFF (DD)	2085 (378.5)
SAME-DIFF (SD)	2084 (291.6)
DIFF-SAME (DS)	2073 (250.6)
SAME-SAME (SS)	2020 (245)

*Data concerning 43 participants (24 females; mean age: 20.27; SD: 1.27)

DISCUSSION

- In line with the hypotheses, our findings showed a cost when two different modalities alternate, compared to when the same modality is repeated.
- Our results boost and broaden previous findings on the MSE during conceptual processing [see 3, 4, 5]. Specifically, two results are worth mentioning: (1) the MSE emerges independently of the stimulus' presentation modality; (2) the MSE occurs when participants could not possibly construct a mental image of the content of prime and target sentences due to the restricted time of exposition of both. This result furthers the hypothesis that the MSE is an automatic effect originating from a simulation process.
- The slowest RTs in the neutral condition could be due to the fact that neutral primes were perceptually non informative, hence they did not pre-activate any specific sensory modality. Therefore, participants could not take advantage of a general activation of the sensory system and this consequently resulted in an overall slower processing of targets.
- We conclude that the MSE speaks in favor of the embodied and grounded cognition view, which claims that conceptual knowledge is grounded into the perceptual system.

REFERENCES

- [1] Martin, A. (2007). The representation of object concepts in the brain. *Annual Review of Psychology*, 58, 25–45.
- [2] Martin, A., & Chao, L. (2001). Semantic memory and the brain: Structure and process. *Current Opinion in Neurobiology*, 11, 194–201.
- [3] Pecher, D., Zeelenberg, R., & Barsalou, L.W. (2003). Verifying the properties of object concepts across different modalities produces switching costs. *Psychological Science*, 14, 119–124.
- [4] Lynott, D., Connell, L. (2009). Modality exclusivity norms for 423 object properties. *Behavior Research Methods*, 41 (2), 558–564.
- [5] van Dantzig, S., Pecher, D., Zeelenberg, R., Barsalou, L.W. (2008). Perceptual processing affects conceptual processing. *Cognitive Science*, 32, 579–590.