REDUNDANCY GAIN IN SEMANTIC CATEGORISATION

Peter Shepherdson and Jeff Miller
Department of Psychology, University of Otago, Dunedin, New Zealand
contact: peter@psy.otago.ac.nz

Introduction

Redundancy gain (enhanced response to redundant stimuli) is usually explained by reference to one of two model types: race models, where enhancements result from statistical facilitation (Raab, 1962), or coactivation models, where evidence from all stimuli is summed. Mohr et al. (1996) demonstrated gains in a lexical decision task, where *word* responses were faster and more accurate when multiple word copies were presented. They suggested this was due to coactivation of a word's neural representation (Hebbian cell assembly) by each copy. To what extent might such enhancement be possible in other tasks requiring higher-level processing of word stimuli? We ran a series of experiments using a categorisation task, to see whether this would also show gains that could be explained by Mohr et al.'s cell assembly account.

Experiment 1

In Experiment 1, participants made category membership decisions (*animal* or *non-animal*) about words presented for 100 ms to the left visual field (LVF) or right visual field (RVF) (with a non-word presented simultaneously in the opposite field), or redundantly to both (RED). Redundancy gain was observed as shown in Figure 1:
RTs were shorter in RED trials than LVF or RVF (single-target) trials, but only for positive (*animal*) responses.
Further, the race model inequality (RMI) was not violated.

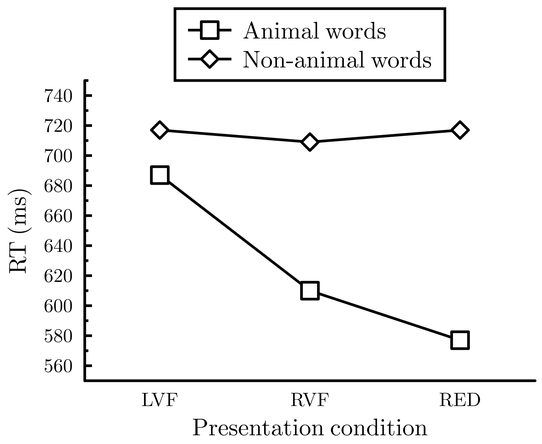

Figure 1 : Mean response latencies for target-present (*animal*) and target-absent (*non-animal*) responses in Experiment 1.

Experiment 2

Experiment 1 showed redundancy gain in semantic categorisation with lateralised presentation. To determine whether gains depend on some form of interhemispheric cooperation as suggested by Mohr et al. (1996), in Experiment 2 stimuli were presented to the top (HI) or bottom (LO) halves of the screen.

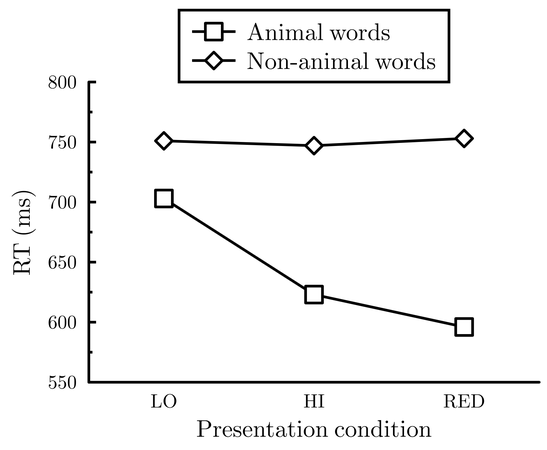

Figure 2 : Mean response latencies for target-present (*animal*) and target-absent (*non-animal*) responses in Experiment 2.

Figure 2 shows that responses were still faster when stimuli were presented redundantly than in either single-target condition, implying that interhemispheric cooperation is not necessary for redundancy gain. Again, no RMI violations occurred.

Experiment 3

In Experiment 3, we used RT distributions to test the cell assembly model's prediction that neural summation (and thus redundancy gain) should be greater with more overlap between the representations of redundant stimuli. Two disparate categories — "animals" and "musical instruments" — were defined as targets, and redundancy gain was compared between redundant trials with two words from a single category versus those with one word from each. The cell assembly model would predict greater redundancy gain in the former trial type.
Figure 3 shows CDFs for redundant RTs in the four types of redundant trials (Animal/Instrument, Instrument/Animal, Animal/Animal, and Instrument/Instrument), along with CDFs derived from single-target data using a stochastically independent race model. Analysis of the differences between redundant and modelled RT distributions showed no significant changes in redundancy gain from same-category to different-category trials at any point of the CDF, implying that semantic similarity of redundant stimuli had no effect on redundancy gain.

Experiment 3 (continued)

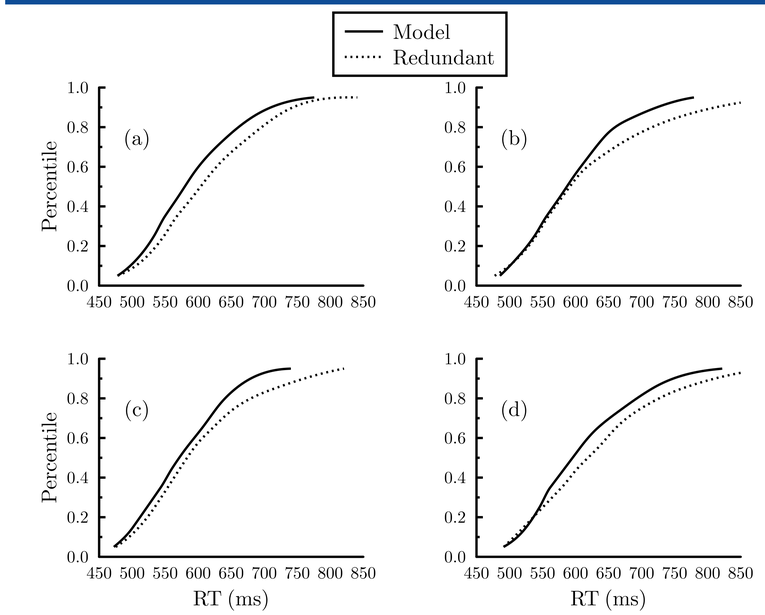

Figure 3 : CDFs for the four redundant trial types, along with independent race model CDFs derived from single-target trial data. Panel (a) shows Animal/Instrument trials, panel (b) Instrument/Animal trials, panel (c) Animal/Animal trials, and panel (d) Instrument/Instrument trials.

Conclusion

The cell assembly model appears unsuitable as an explanation for redundancy gain in semantic categorisation. Rather, statistical facilitation (that is, a race model) provides a more appropriate account.

References

Mohr, B., Pulvermüller, F., Mittelstadt, K., & Rayman, J. (1996). Multiple simultaneous stimulus presentation facilitates lexical processing. *Neuropsychologia*, *34*, 1003–13.
Raab, D. H. (1962). Statistical facilitation of simple reaction times. *Transactions of the New York Academy of Sciences*, *24*, 574–90.

Presentation at the annual meeting of the Psychonomic Society, Minneapolis, November 2012.