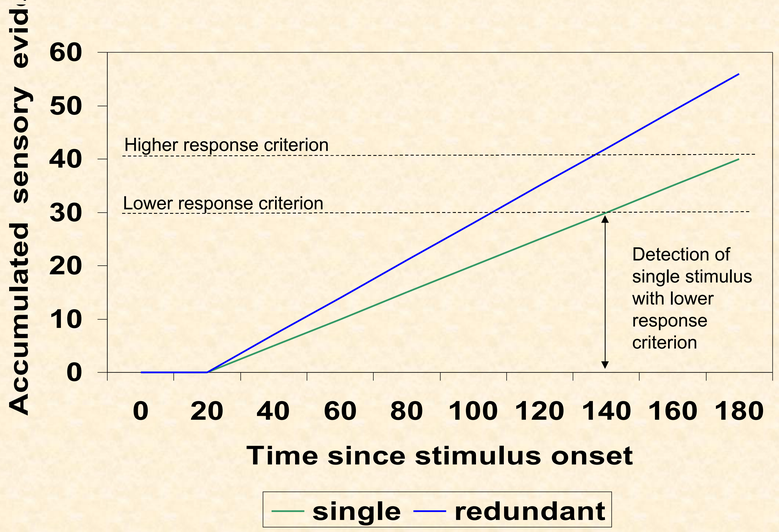
# Does the Response Criterion Affect Redundancy Gain in Simple RT?

Jeff Miller, University of Otago, Dunedin, New Zealand, Contact: miller@psy.otago.ac.nz

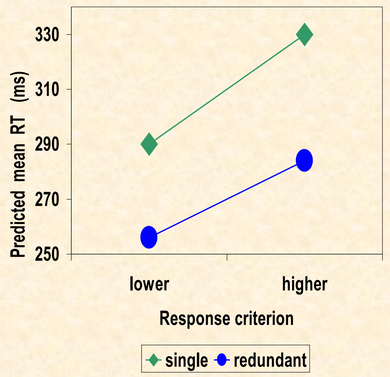
## Background

Divided attention is often studied with simple reaction time (RT) tasks in which people must make a pre-specified response as rapidly as possible to the onset of any visual stimulus. In these tasks, a robust phenomenon of ***redundancy gain*** is observed: People respond more rapidly to the onset of two visual stimuli than to a single visual stimulus (e.g., Schwarz & Ischebeck, 1994).

The figure below illustrates an explanation of redundancy gain within ***sensory-accumulation models:*** Information accumulates following stimulus onset, and it does so at a higher rate for redundant stimuli than for single stimuli. Detection occurs (and the response is initiated) when a preset response criterion is reached. People adjust the height of the response criterion to minimize both RT and false alarms.




Such models predict *that* ***redundancy gain should increase when the response criterion is higher,*** yielding an interaction like that shown in this figure:




***The present experiments tested for this interaction predicted by sensory-accumulation explanations of redundancy gain.***

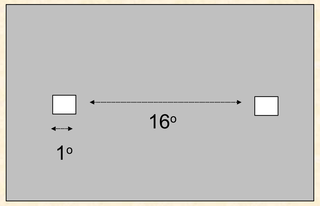
## Experiment 1

### Rationale

Different blocks of trials included either 10% or 40% no-stimulus catch trials. People should use a higher response criterion when catch trials are more common, because there is more opportunity for false alarms in that case.

### Method

***Stimulus Display.*** Imperative stimuli were bright squares on either the left side of a CRT, the right side, or both sides. Stimulus intensity was ~70 cd/m$^2$ against a dark background.




***Instructions:*** "Respond as quickly as possible if 1 or 2 squares appear ('go' trials). Do nothing if no square appears ('catch' trials). For the next block of trials, catch trials will be relatively [frequent/rare]."

***Experimental Factors:***
***Single*** versus ***Redundant:*** 1 versus 2 squares appear (randomized).
***Percentage of Catch Trials:*** 10% versus 40% (blocked).

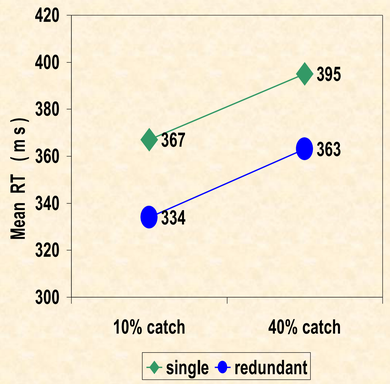
| | *Percentages of Trials* | |
|---|---|---|
| ***Stimulus*** | ***10% Catch Blocks*** | ***40% Catch Blocks*** |
| Left + Right | 40%* | 10%* |
| Left | 40%* | 10%* |
| Right | 10% | 40% |
| None (Catch) | 10% | 40% |

* With these proportions, the left and right stimuli appear independently and stimulus probability is matched for some single versus redundant trials. The single/redundant comparison used only the single stimuli with the same probabilities as the redundant stimuli, as marked with asterisks.

### Results

***Redundancy had the same effect (approx 32 ms) on mean RT regardless of the percentage of catch trials.*** Interaction $F(1,31)=0.05$, $p > .8$.

Responses were 28 ms slower with 40% catch trials than with 10%, suggesting that the proportion of catch trials did affect the response criterion, as was intended. There were also fewer false alarms when there were more catch trials (0.2% vs 0.8%).




## Experiment 2

### Rationale

Different blocks of trials included either no-stimulus catch trials or catch trials with an irrelevant visual stimulus in an unattended location. People should use a higher response criterion when catch trials include an irrelevant stimulus, because the onset of such a stimulus might tend to cause false alarms.

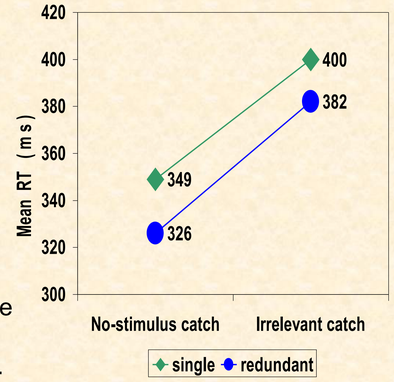
### Method

The relevant stimuli were the same as in Experiment 1. The irrelevant stimulus was a square at central fixation, which people were told to ignore. Each block included equal numbers of trials with the four stimulus types: Left+Right, Left, Right, and Catch. The instructions for each block indicated which type of catch trials would be included.

### Results

***Redundancy had the same effect (approx 20 ms) on mean RT regardless of the presence of irrelevant stimuli in catch trials.*** Interaction $F(1,23)=1.30$, $p > .25$.

Responses were 53 ms slower in blocks with irrelevant stimuli in the catch trials, suggesting that the response criterion was raised by this manipulation, as intended. There were also more false alarms to irrelevant stimulus catch trials (14.1% vs 2.3%).




***Analyses of RT distributions:*** The race model inequality was not violated in either experiment (Ulrich, Miller, & Schröter, 2007).

## Conclusions

- Redundancy gain is the same size whether participants maintain a high or low response criterion.
- Redundancy gain does not arise during the process of accumulating the sensory evidence needed to satisfy the response criterion. It may arise during motor processing instead.

## References

Schwarz, W., & Ischebeck, A. (1994). Coactivation and statistical facilitation in the detection of lines. *Perception, 23*, 157-168.

Ulrich, R., Miller, J. O., & Schröter, H. (2007). Testing the race model inequality: An algorithm and computer programs. *Behavior Research Methods, 39*, 291-302.

## Acknowledgement

*Supported by a grant from the Marsden Foundation administered by the Royal Society of New Zealand.*

Poster # 2025