Redundancy Gain in Simple, Go/No-Go, and Choice RT Tasks: Evidence for an Effect on Response Execution

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Background

A robust phenomenon of ***redundancy gain (RG)*** is observed in many reaction time (RT) tasks: People respond faster to the onset of two redundant stimuli than to a single stimulus (e.g., Todd, 1912). Here we ask ***which processes are speeded by redundancy?***

Experiment 1

Participants performed simple RT, go/no-go, and choice RT tasks. The latter tasks are assumed to require additional processes of stimulus discrimination and response selection, as shown in Table 1 (Donders, 1868).

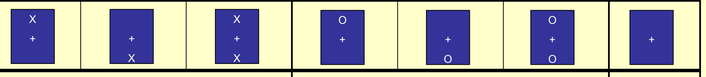
Table 1: Hypothesized Processes in Each of 3 RT Tasks

Task	*Processes*			
Simple	Stim Detection			Resp Execution
Go/No	Stim Detection	Stim Discrimination		Resp Execution
Choice	Stim Detection	Stim Discrimination	Resp Selection	Resp Execution

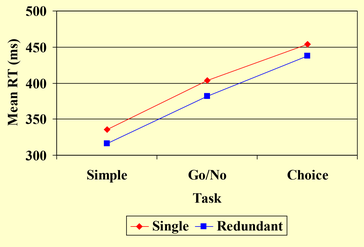
Procedure

All 3 tasks used the same 7 possible stimulus displays of X's and O's, shown as blue rectangles in Table 2. The S-R assignments varied across tasks as shown in the table.

Table 2: Instructed Response For Each Stimulus Display in Each Task.

	Stimulus Displays & Conditions					
	Single		*Redundant*	*Single*	*Redundant*	*Catch*
Tasks						
Simple	Right hand			Right hand		No-go
Go/No-go	Right hand			No-go		No-go
Choice	Right hand			Left hand		No-go

Prediction: **If stimulus discrimination and response selection are speeded by redundancy, RG should be largest in choice RT, intermediate in go/no-go, and smallest in simple RT.**



Results (n=36)**:** RG (advantage for redundant over single) was the same size in all three tasks.

Implications: Neither stimulus discrimination nor response selection is speeded by redundancy. RG probably arises in a process common to all three tasks—either stimulus detection or response execution.

Experiment 2

Rationale

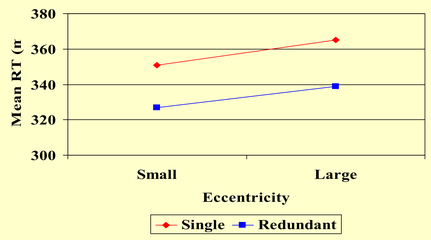
We manipulated the speeds of stimulus detection and response execution to see which of these processes is affected by redundancy gain. The manipulations were:

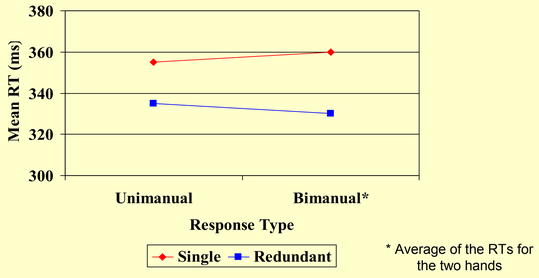
Stimulus eccentricity: Stimuli were presented 2° (small eccentricity) or 8° (large eccentricity) from fixation. **If stimulus detection is affected by redundancy, RG should increase at the large eccentricity.**

Response type: Responses were key presses made either unimanually or bimanually. **If response execution is affected by redundancy, RG should increase for bimanual responses.**

Procedure

- The stimuli were 0, 1, or 2 X's above and/or below the fixation, as in Experiment 1.
- Single and redundant stimuli of different eccentricities were randomly intermixed within each block of trials.
- Participants were instructed to make the same response regardless of which stimulus was presented (simple RT).
- Unimanual and bimanual responses were made in separate trial blocks.





* Average of the RTs for the two hands

Results *(n=46): RG was independent of eccentricity, but it was larger for bimanual responses than for unimanual responses.*

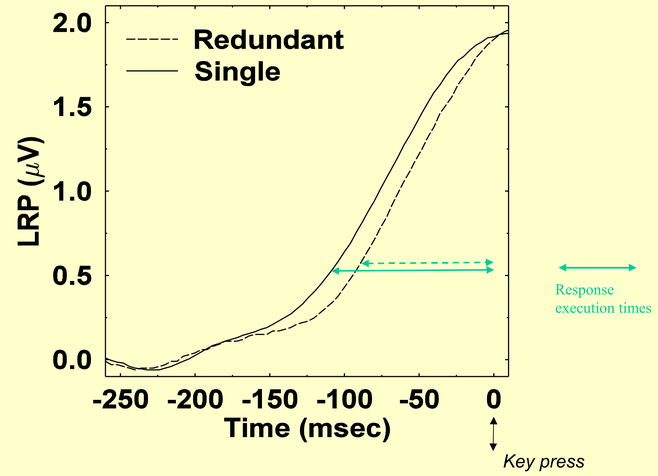
Implications: *Redundancy influences response execution but not stimulus detection.*

Experiment 3

Rationale

We reanalyzed previously published EEG data from a simple RT task similar to those of Experiments 1 & 2 (Miller, 2007). The time needed for response execution was assessed with the lateralized readiness potential (LRP). **If response execution is affected by redundancy, the response execution time from LRP onset to the key press response (time 0) should be shorter with redundant than single stimuli.**

Results (n=16)**:** Response execution time was shorter for redundant than single:



Conclusion

Together, the results of these three experiments suggest that redundancy speeds response execution.

References

Donders, F. C. (1868). Over de snelheid van psychische processen. [On the speed of mental processes.] (W. G. Koster, Trans.). In W. G. Koster (Ed.), *Attention and performance II* (pp. 412-431), 1969. Amsterdam: North-Holland. (Original work published 1868).

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