

Task-set control and procedural working memory

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Abstract

Flexible and goal-driven behaviour requires a process by which the appropriate task-set is selected and maintained in a privileged state of activation. This process can be conceptualised as loading a task-set into a *procedural working memory (PWM)* buffer. Task switching experiments, which exercise this process, reveal “switch costs”: increased reaction times and error rates when the task changes, compared to when it repeats. The process of loading a task-set into PWM may be one source of these costs. The switch cost is reduced with preparation, suggesting that at least some of the processes involved in a successful change of task can be achieved in advance of the stimulus.

The aim of this thesis was to investigate the properties of PWM, and its contribution to task-set control. One account of PWM distinguishes between the level at which recently exercised (but currently irrelevant) task-sets are represented, and the level at which only the currently relevant task-set is maintained in a most active state. To distinguish between these levels of representation, and to assess the extent to which the process of getting a task-set into a most-active state (loading it into the PWM buffer) is subject to a capacity limit at each level, the experiments varied the number of tasks participants switched among (Experiments 1 and 2), and the complexity of individual task-sets (Experiments 3-6) in a task-cueing paradigm.

In Experiments 1 and 2, participants switched among three or five tasks, in separate sessions. There was no effect of the number of tasks on the switch cost, or its reduction with preparation, provided that recency and frequency of task usage were matched. When recency and frequency were not matched, there appeared to be a larger switch cost with five tasks at a short preparation interval, suggesting that the time consumed by getting a task-set into a most active state is influenced by its recency and frequency of usage, not the number of alternatives per se.

However, Experiment 3 showed that the time required to select an S-R mapping within a task-set does increase as a function of the number of alternatives (even when stimulus frequency and recency are matched), suggesting that representation of the most active task-set in a PWM buffer is subject to a strict capacity limit. Experiments 4-6 further investigated the capacity limit of this PWM buffer, and found that task-set preparation was more effective for task-sets that are less complex (i.e. specified by fewer S-R rules). These findings suggest that only very few S-R rules can be maintained in a most active state in the PWM buffer.

Finally, Experiments 7-9 investigated whether S-R rules are represented phonologically for task-set maintenance and preparation, by manipulating the phonological properties of the stimulus terms. But task-cueing performance was not affected by the name length (Experiment 7) or phonological similarity (Experiments 8 and 9) of the stimulus terms. These results suggest that phonological representations of S-R rules do not make a functional contribution to task-set control, possibly because the rules are compiled into a non-linguistic PWM.

The results of these experiments are discussed in terms of a procedural working memory which is separate from declarative working memory, and distinguishes between two levels of task-set control: the level of task-sets, which are maintained in a capacity unlimited state of representation, and the level at which the currently relevant task-set is maintained in a most-active but highly capacity limited state of representation.

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Index

Chapter 1: General Introduction	19
1.1 Task-set control.....	20
1.1.1 Task switching paradigms	20
1.1.2 Theories of the switch cost	22
1.1.3 Task switching phenomena	22
1.1.4 What does task-set reconfiguration exist of?.....	28
1.2 Procedural working memory.....	31
1.2.1 Retrieving a task-set into the capacity-limited component of PWM.....	36
1.2.2 Selecting a stimulus-response mapping within the capacity-limited component of PWM	37
1.2.3 The representation of S-R rules	40
1.2.4 Overview of thesis	43
Chapter 2: Is it harder to switch among a larger set of tasks?	45
Abstract.....	45
Introduction	46
Experiment 1	51
Method.....	52
Results and Discussion	55
Experiment 2	62
Method.....	63
Results and Discussion	65
General Discussion	72
Chapter 3: The contribution of stimulus recency and frequency to Hick's law	77
Introduction	77
Experiment 3	81
Method.....	81
Results	83

Discussion.....	89
Chapter 4: The effect of task-set complexity on preparation for a task switch: Evidence for a limited capacity component of procedural working memory.	91
Introduction	91
Experiment 4	96
Method.....	97
Results	99
Experiments 5.....	103
Method.....	104
Results	107
Experiment 6	114
Method.....	114
Results	114
General Discussion.....	120
Chapter 5: Are stimulus-response rules represented phonologically for task-set preparation and maintenance?	125
Abstract.....	125
Introduction	126
Experiment 7	131
Method.....	132
Results	135
Experiment 7a: Measurement of articulatory duration.....	137
Discussion.....	138
Experiment 8	139
Method.....	139
Results	140
Discussion.....	144
Experiment 9	146
Method.....	146

Results	148
Discussion.....	152
General discussion.....	152
Chapter 6: General Discussion	155
The effect of the number of tasks on task-cueing performance (Chapter 2).	155
The effect of task-set complexity on single task performance (Chapter 3).....	157
The effect of task-set complexity on task-cueing performance (Chapter 4).	157
The effect of the phonological properties of the stimulus terms on task-cueing performance (Chapter 5).....	160
Conclusions	164
References	165

List of Figures

Figure 1.1 Oberauer’s model of working memory.....	33
Figure 2.1 Examples of stimuli used in Experiment 1.....	52
Figure 2.2 Mean correct RTs (top) and % error (bottom) data in Experiment 1 with three and five tasks, on switch and repeat trials, as a function of CSI; plotted separately for probe task trials (left) and all task trials (right).....	56
Figure 2.3 Mean correct RTs (top) and % error (bottom) data in Experiment 1 with three and five tasks, on long and short CSI trials, as a function of lag; plotted separately for probe task trials (left) and all task trials (right).....	58
Figure 2.4 Mean correct RTs (top) and % error (bottom) data in Experiment 1 with three and five tasks, on switch and repeat trials, as a function of response congruence.....	60
Figure 2.5 Mean correct RTs (top) and % error (bottom) data in Experiment 2 with three and five tasks, on switch and repeat trials, as a function of CSI; plotted separately for probe task trials (left) and all task trials (right).....	66
Figure 2.6 Mean correct RTs (top) and % error (bottom) data in Experiment 2 with three and five tasks, in long and short CSI trials, as a function of lag; plotted separately for probe task trials (left) and all task trials (right).....	68
Figure 2.7 Mean correct RTs (top) and % error (bottom) data in Experiment 2 with three and five tasks, on switch and repeat trials, as a function of response congruence.....	70
Figure 3.1 Stimuli used in Experiment 3.....	82
Figure 3.2 Trial matrix displaying the frequency of all transition types in the 6 S-R condition (left) and the 4 S-R condition (right) in Experiment 3, with the probe transitions highlighted in bold.....	82
Figure 3.3 Mean correct RT (top) and % error (bottom) data in Experiment 3, for 6 S-R and 4 S-R trials, plotted as a function of probe/nonprobe stimuli (left), and as a function of practice (right).....	85
Figure 3.4 Mean correct RT (left) and % error (right) data in Experiment 3, for 6 S-R and 4 S-R trials, plotted separately for probe/nonprobe stimuli as a function of lag.....	86
Figure 3.5 Percentiles for probe stimuli and nonprobe stimuli in Experiment 3, in the 6 S-R and 4 S-R conditions.....	88
Figure 4.1 Example of stimuli used in Experiment 4. Congruent stimuli are illustrated on the left (dominant features: green and T; orange and O; purple and X); incongruent stimuli on the right (orange and T; green and O; purple and X).....	97

Figure 4.2 Mean correct RTs (top) and % error (bottom) data in Experiment 4, plotted separately as a function of switch/repeat (left) and congruency (right).....	99
Figure 4.3 RT switch cost (ms) in the 3-choice and 2-choice conditions in Experiment 4, for fast (average of 10 th -40 th percentile) and for slow responses (average of 60 th -90 th percentile), as a function of CSI.....	101
Figure 4.4 Examples of stimuli used in Experiments 5 and 6. In each experiment, half of the participants switched between the country and shape tasks in the category-rule condition and between the animal and symbol tasks in the arbitrary-rule condition, and vice versa for the other half of participants.....	105
Figure 4.5 RTs and errors in Experiment 5 for switch and repeat trials (left) and congruent and incongruent trials (right), plotted separately for the category-rule and the arbitrary-rule condition, as a function of CSI.....	107
Figure 4.6 RTs and errors in Experiment 5 for repeat trials plotted as a function of position in run.....	109
Figure 4.7 RTs and errors in Experiment 5 for now relevant value switch (vs) and now relevant value repeat (vr) trials as a function of task switch/task repeat.....	111
Figure 4.8 RTs and errors in Experiment 6 as a function of switch/repeat, arbitrary-/category-rule and CSI plotted separately for incongruent (left) and congruent (right) trials.....	115
Figure 4.9 RTs and errors in Experiment 6 for repeat trials plotted as a function of position in run.....	117
Figure 4.10 RTs and errors in Experiment 6 for now relevant value switch (vs) and now relevant value repeat (vr) trials as a function of task switch/task repeat.....	117
Figure 4.11 RT switch cost (ms) in Experiment 6 in the arbitrary- and category-rule conditions, for fast (average of 10 th -40 th percentile) and for slow responses (average of 60 th -90 th percentile), as a function of CSI.....	118
Figure 5.1 Example trial sequence and stimuli for Experiment 7.....	132
Figure 5.2 Mean correct RTs and error data for Experiment 7. A RTs and errors for the one- and three-syllable stimulus names as a function of switch/repeat and CSI. B Single task practice data. C Word-length effects (WLE) plotted for switch and repeat trials, by CSI (100 ms or 1300 ms), as a function of block number.....	134
Figure 5.3 List completion times in centiseconds (cs) for mono and trisyllable stimulus names, in the overt condition (participants cycled through list once) and the covert condition (participants cycled through list four times) in Experiment 7a.....	138

Figure 5.4 The stimulus sets used for Experiment 8 (dissimilar set in blue: Q, J, R and F; similar set in red: B, D, T and P), arranged to provide illustrations of stimulus pairs.....	140
Figure 5.5 Mean correct RTs and error data for Experiment 8. A RTs and errors for the similar and dissimilar stimulus names as a function of switch/repeat and CSI. B Single task practice data. C Phonological similarity effects (PSE) plotted for switch and repeat trials, by CSI (100 ms or 1300 ms), as a function of block number.....	141
Figure 5.6 Mean correct RTs and errors for the “common” stimulus in Experiment 8.....	143
Figure 5.7 Examples of stimuli used in Experiment 9 (left) assigned to participants for whom the picture stimuli are similar, and the letter stimuli dissimilar, and (right) vice versa.....	148
Figure 5.8 Mean correct RTs and error data for Experiment 9. A RTs and errors for the similar and dissimilar stimulus names as a function of switch/repeat and CSI. B Single task practice data. C Phonological similarity effects (PSE) plotted for switch and repeat trials, by CSI (100 ms or 1300 ms), as a function of block number.....	149

List of Tables

Table 2.1 Tasks, task-cues and response assignments for the 2 sets of stimuli (creatures and trees) used in Experiment 1.....	52
Table 2.2 Mean correct RTs (ms), with the % error data between brackets, for the different conditions in Experiment 1.....	56
Table 2.3 All 32 word stimuli used in Experiment 2 and their respective classifications along the 5 task dimensions.....	64
Table 2.4 Mean correct RTs (ms), with the % error data between brackets, for the different conditions in Experiment 2.	66
Table 2.5 Differences between the 5-task and 3-task switch costs in ms (% errors between brackets) for the following trial types: probe trials following probe trials (PP), probe trials following all trials (AP) and all trials following all trials (AA). * = $p < 0.05$	71
Table 4.1 Switch costs (ms) for the arbitrary- and category-rule conditions (and the difference between them) in Experiment 5 as a function of CSI and congruency (* = $p < 0.05$).....	111
Table 4.2 Switch costs (ms) for the arbitrary- and category-rule conditions (and the difference between them) in Experiment 6 as a function of CSI and congruency (* = $p < 0.05$).....	115
Table 5.1 Monosyllabic and threesyllabic words (and normative naming latencies) descriptive of pictures used in Experiment 7).....	131
Table 5.2 Pictures used in Experiment 9 and their normative naming latencies.....	148

Declaration

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This dissertation has not been submitted, in whole or in part, for any other degree, diploma or qualification at any university. Chapters 2 and 5 are articles that will be submitted to scientific journals. Chapter 2 will be submitted to *Journal of Experimental Psychology: Human Perception and Performance* by van 't Wout, F., Monsell, S., and Lavric, A. I conducted the experiments, wrote the first draft and prepared the figures and tables. My co-authors have edited the manuscript. Chapter 5 will be submitted to *Journal of Experimental Psychology: Learning, Memory and Cognition*. I conducted the experiments, wrote the first draft and prepared the figures and tables. My co-authors have edited the manuscript.

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