

The temporal dynamics of switching tasks

Submitted by Heike Elchlepp to the University of Exeter
as a thesis for the degree of
Doctor of Philosophy in Psychology
In July 2011

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Abstract

The topic of this thesis is cognitive control: how the brain organises itself to perform the many tasks it is capable of and how it switches flexibly among them. Task-switching experiments reveal a substantial cost in reaction time and accuracy after a switch in tasks. This "switch cost" is reduced by preparation (suggesting anticipatory task-set reconfiguration), but not eliminated. The thesis focuses on the sources of the "residual" cost. Most accounts attribute it to response selection being prolonged on a task-switch trial by task conflict, e.g. by 'task-set inertia' — persisting activation/inhibition of the previous task's S-R rules — or their associative reactivation by the stimulus.

Four experiments used event-related potentials (ERPs) to determine which stages of task processing are influenced by a change in tasks, looking for delays in process-specific markers in the ERP. Experiments 1 and 2 showed that a prepared switch to a reading task from a perceptual judgement delayed early ERP markers of lexical access by a large fraction of the RT switch cost, suggesting that a substantial part of the residual cost arises in processes earlier than response selection, possibly due to task-related attentional inertia. Markers of lexical access observed in the non-lexical task were larger on switch than repeat trials, providing the first electrophysiological evidence of task-set inertia. Experiment 3 examined the effects of an unprepared switch in the same way. ERP waveforms were modulated by a switch before markers of lexical access were evident, suggesting additional processing demands compete for resources with lexical access. A simple delay, however, was not found; post-stimulus task-set reconfiguration does not just insert an extra processing stage. Experiment 4 looked for a delay in the onset of an early ERP marker of emotional processing when the task switched between categorising facial expression and classifying a superimposed letter. No such delay was found in this case, and ERP markers of emotion processing were present to the same extent in the letter task. This suggests that, given appropriate spatial attention, processing facial emotion unfolds automatically, independent of attention allocation to the facial features.

Experiments 5-7 further explored the link between conflict due to processing the irrelevant stimulus dimension and the ERP post-stimulus negativity that accompanies the residual cost. The negativity could be elicited even on trials of non-switching blocks by prior training on classifying the irrelevant attribute of the stimulus using the same responses. But this effect did not seem to result from the trained class of irrelevant attribute attracting more attention.

Finally, Experiment 8 followed up an incidental observation in Experiment 1 to establish the novel observation that a task-switching context abolishes the usual ERP correlate of withholding a response in a go/no-go paradigm, suggesting an interesting interaction between task-set control and response inhibition.

List of Contents

CHAPTER 1: INTRODUCTION	21
Theories of the residual switch cost	25
ERP studies of task switching	32
fMRI studies of task-switching	38
Outline of thesis	41
CHAPTER 2: PARTITIONING THE RESIDUAL SWITCH COST WITH ERPs	45
Abstract	45
Introduction	45
Theories of the (residual) task-switch cost, and its locus	47
The experiments	53
Lexical activation during performance of the symmetry task	56
Experiment 1	58
Method	59
Participants	59
Stimuli and Procedure	60
EEG and ERPs	62
ERP latency analysis	63
Results and Discussion	65
Behavioural results	65
ERPs – semantic task, latency analysis	67
ERPs- PCA-based amplitude analyses	68
Experiment 2	73
Method	76
Participants	76
Stimuli and Procedure	76
EEG and ERPs	77
ERP latency analysis	78

Results and Discussion	78
Behavioural results	78
Lexical decision task: ERP latency analysis	81
ERPs- PCA-based amplitude analyses	83
General Discussion	87
Implications for theories of the residual task-switch cost	88
Possible limitations	90
Implications of the bigram frequency/neighbourhood size effects	91
Implications for the automaticity of word-reading	92
Appendix- Chapter 2: Data tables	94
CHAPTER 3: UNPREPARED SWITCHING BETWEEN LEXICAL AND SYMMETRY TASKS	105
Experiment 3	107
Method	107
Participants	107
Stimuli and Procedure	107
EEG and ERPs	107
Results	108
Behavioural results	108
ERPs from the semantic task	111
ERPs from the symmetry task	114
Discussion	116
Appendix Chapter 3: Data tables	119
CHAPTER 4: AN ATTEMPT TO DETECT A SWITCH-INDUCED PROCESSING DELAY IN A FACE TASK	123
Experiment 4	127
Method	128
Participants	128
Stimuli and Procedure	128
EEG and ERPs	130
Results	131

Behavioural results	131
Face task: long CSI post-stimulus ERPs	134
Letter task: long CSI post-stimulus ERPs	140
Long CSI, Cue interval	145
Discussion	147
Appendix Chapter 4: Data tables	153

CHAPTER 5: A NEURAL CORRELATE OF TASK-SET

INTERFERENCE	161
Abstract	161
Introduction	161
Residual switch cost and task-set conflict	162
Level of task conflict	163
Reconfiguration-based accounts of the residual switch cost	164
An electrophysiological correlate of the residual switch cost: conflict or TSR	164
Experiment 5	166
Method	167
Participants	167
Apparatus	168
Stimuli and Procedure	168
EEG and ERPs	170
Results	171
Behavioural results	171
ERP results	172
Bivalent vs. univalent	172
Response conflict: congruent vs. incongruent	174
Set conflict: congruent vs. univalent	174
Discussion	175
Experiment 6	176
Method	176
Participants, apparatus, stimuli and procedure	176
Results	177

Behavioural results	177
ERP results	178
Comparison of ERPs in Experiments 5 and 6	178
Discussion	180
Experiment 7	182
Method	183
Participants	183
Apparatus	183
Stimuli and Procedure	183
Results	186
Discussion	186
General Discussion	187
A brain potential signature of task conflict	187
Deconstructing task conflict	188
CHAPTER 6: THE EFFECT OF SWITCHING ON THE NOGO-N2	191
Experiment 1: Go-Nogo contrast in the symmetry task	191
Method	193
Results	193
Go-nogo analysis of the symmetry task	193
ERP results	193
Possible early effects of switching (150-250 ms)	193
N2 time window (250-450 ms)	194
P3 time window (450-750 ms)	195
Discussion	195
Experiment 8	196
Method	196
Participants	196
Stimuli and Procedure	196
ERPs	197
Results	197
Behavioural results	197
ERP results	198

N2	198
P3	199
Discussion	199
General Discussion	202
CHAPTER 7: GENERAL DISCUSSION	205
Experiments 2-4 (Chapters 2, 3 and 4)	206
Impact of task-set interference on the ERP (Experiments 5, 6 and 7)	212
Task-switching and the no-go N2 (Experiments 1 and 8)	213
Conclusions	214
REFERENCES	217