



Theory of Mind and Executive Functioning: Dual Task Studies

Claire Conway, Rebecca Bull & Louise Phillips

School of Psychology, University of Aberdeen, Aberdeen AB24 2UB, UK. Phone: +44 1224 274457. Email: c.conway@abdn.ac.uk, r.bull@abdn.ac.uk, louise.phillips@abdn.ac.uk

INTRODUCTION

Theory of Mind (ToM) - ability to understand, attribute and interpret another's mental states, which may differ from one's own knowledge and from reality. By this understanding an individual can predict the behaviour and intentions of another.

Executive functions (EF) - diverse range of mechanisms contributing to the monitoring and control of thought and action. These skills include self-regulation, attentional flexibility, updating of information in working memory and inhibition of prepotent information.

- * Recent studies have indicated a close overlap between performance on ToM tasks and EF tasks.
- * Number of possible explanations to account for these (Perner and Lang, 1999). Some studies show that the two are not related at all and in fact could have separate cognitive modules within the brain.
- * Previous studies have used a correlational design but this study will use a dual-task paradigm to examine the overlap between ToM and EF.
- * The dual-task paradigm works on the assumption that when two tasks that rely on the same cognitive system are performed simultaneously, there will be a decrease in performance in one or both tasks compared to two tasks not relying on the same resources.
- * If ToM and EF rely on the same cognitive mechanisms, when a ToM task is performed in conjunction with an EF task the performance on at least one of them will decrease.

Questions:

- * Do ToM and EF tasks depend on the same pool of cognitive resources? If so, there will be interference in the performance of one or both tasks when they are performed simultaneously.
- * Is interference due to greater demands on general attentional resources or is it specific to the performance of ToM and a specific EF?

METHOD

Design

- * Between subjects experiment with 4 groups.
- * Group 1 took part in all tasks in the single task condition, groups 2, 3 and 4 took part in each ToM and control (age and gender judgement for eyes and non-mental state judgement for stories) task in combination with one EF task (inhibition, switching or updating).

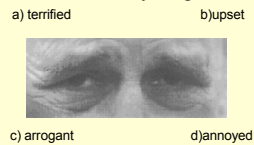
Participants

120 undergraduate psychology students (aged 16-30 years). 65 females and 55 males.

ToM Tasks

Eyes task (Baron-Cohen et al, 2001)

Participants picked one of four responses that best describes the eye region.



Stories task (Happe, 1994; Stone et al, 1998; Channon & Crawford, 2000)

During the war, the Red army captures a member of the Blue army. They want know where his army's tanks are. They know that the prisoner will want to save his army and so will certainly lie to them. The prisoner is very clever; he will not let them find his tanks. The tanks are really in the mountains. When the other side ask him where his tanks are, he says, "They are in the mountains".

Q: Why did the prisoner say that?

- To confuse the Red Army.
- Because it's his own army.
- Most likely to save his own life.
- The mountains are steep and the Red Army will not search there.

EF tasks

Participants made responses to a series of auditorily presented numbers.

Inhibition

- * n+3, inhibit 8 and 13.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Switching

- * n+2 until 'beep' then n-1.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

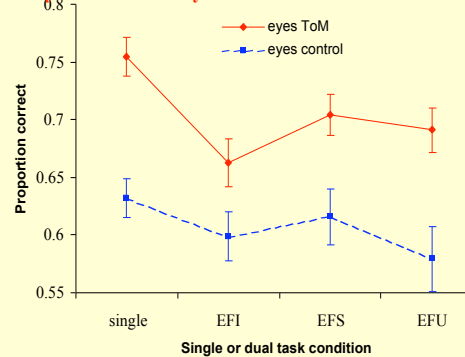
Updating

- * (n-1)+1.

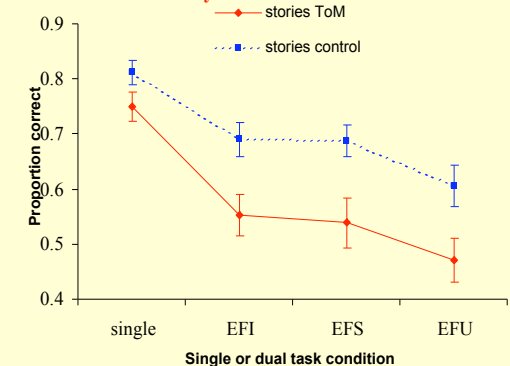
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

RESULTS

Eyes task accuracy



Stories task accuracy



ToM and control eyes accuracy - Only significant difference in performance was between single eyes ToM and dual-task eyes ToM with inhibition. No differences between conditions on eyes control.

ToM and control stories accuracy - Significant differences in performance between the single task and all dual tasks for both stories ToM and stories control.

ToM and control eyes and stories tasks reaction times - Analyses revealed no effect of task condition.

EF task accuracy - Comparing accuracy in single and dual task conditions in each EF task revealed only a general dual task effect, with lower performance on the dual task conditions

EF task reaction times - Similarly, a general dual task effect - responses were slower in dual task combination for all tasks.

DISCUSSION

*Analyses of the eyes ToM task demonstrated significantly poorer performance in the inhibition dual task compared to single task. As there was no interference in performance in the eyes control task, even though this task was more difficult, the inhibition interference is specific to the eyes ToM task. This contradicts Baron-Cohen's claim that this is a very automatic ToM task. It is possible that when participants see the eyes stimuli they have an automatic first impression of the thoughts or feelings of that person before they look at the four options. They then need to inhibit their own initial response and pick one of those four options.

*As the majority of the results demonstrated a decrease in performance in both the experimental and control dual tasks, this suggests that there is a general sharing of cognitive resources between ToM and EF, and involvement of EF is due to task demands.

*The eyes and stories tasks are very different ToM tasks, demonstrated by the different amount of involvement of the different EF tasks, thus it is possible that this has led to the inconsistent findings regarding the relationship between ToM and EF in previous studies.

Selected References

- Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y. & Plumh, I. (2001). The "Reading the Mind in the Eyes" test revised version: A study with normal adults, and adults with Asperger syndrome or high-functioning autism. *Journal of Child Psychology and Psychiatry*, 42, 241-251.
- Channon, S. & Crawford, S. (2000). The effects of anterior lesions on performance on a story comprehension test: left anterior impairment on a theory of mind task. *Neuropsychologia*, 38, 1006-1017.
- Happe, F.G.E. (1994). An advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. *Journal of Autism and Developmental Disorders*, 24, 129-154.
- Perner, J. & Lang, B. (1999). Development of theory of mind and executive control. *Trends in cognitive sciences*, 3, 337-344.
- Stone, V.E., Baron-Cohen, S. & Knight, R.T. (1998). Frontal lobe contributions to theory of mind. *Journal of Cognitive Neuroscience*, 15, 324-337.