

Introduction

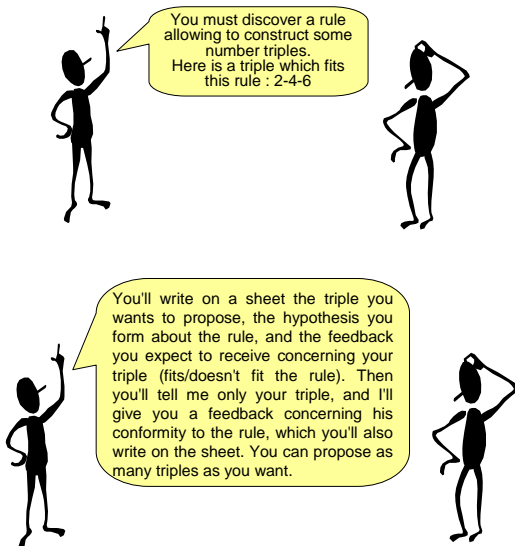
Mental Models Theory (Johnson-Laird, 1983) proposes that reasoning errors could be due to limitation of working memory storage capacities. Earlier research concerning the working memory functions in reasoning all deal with deductive reasoning, and use for the most part a method of competing tasks.

We studied hypothetico-deductive reasoning, which is involved in knowledge spread processes and combines deductive and inductive inferences through hypothesis testing (Poletiek, 2001). Our work's novelty lies in the fact that we had recourse to the correlations method. We correlated the performance clues collected on the reasoning task, the Wason's 2-4-6 rule discovery task (Wason, 1960), with cognitive scores evaluating the whole WM capacities, information storing, attention, planification, flexibility, inhibition, and memory updating.

1. Method

40 voluntary students of the University of Caen (17 men and 23 women), being 18 to 23 years old (mean age = 19,5) participated to this study during 2 sessions of 2 hours. They were given a modified version of the Wason's 2-4-6 task and a cognitive tests battery.

The Wason's 2-4-6 task



There are two major differences between the original version of the task and our version. 1- Following Caverni et al. (2000), we took into account the feedback that participants expect to receive concerning the conformity of their triple to the rule (see Table 1) and 2- the task ended after the first rule announcement, even if it's false.

Triple	Hypothesis	Expected feedback	Received feedback	Type of hypothesis test
8-10-12	Even numbers	YES	YES	Direct confirmatory
1-3-5	Even numbers	YES	YES	Direct infirmatory
1-2-3	Add a constant number	NO	YES	Indirect infirmatory
5-10-20	Add a constant number	NO	YES	Indirect confirmatory
2-8-32	Multiply with a constant number	YES	YES	Direct confirmatory
Rule proposed : add or multiply a constant number (FAILURE)				

Table 1: Sample of 2-4-6 problem solution

Working Memory evaluation

Storing capacities were measured with verbal and visual spatial spans. Attention was evaluated with a signs checking test, Planification with the Tower of London, Flexibility with the Plus/Minus (Miyake et al., 2000) and the Brixton Test (Burgess & Shallice, 1996a), Inhibition with the Stroop Test and the Hayling Sentences Completion Test (Burgess & Shallice, 1996b), Memory updating was measured with the Running Span (Morris & Jones, 1990).

Classically, the following phenomenon are observed in the 2-4-6 task :

- focusing on the salient features of the given triple and proposition of a narrowed hypothesis (i.e. *even numbers, increasing by 2, ...*) which is included in the correct rule (*any increasing sequences*)
- tendency to confirm tested hypotheses by using positive hypothesis tests.

Coupling of these phenomenon leads to a high failure rate at the first attempt. We propose that this failure is related to inefficient executive capacities of working memory.

2. Results

Reasoning task

As regards the hypothesis testing strategies (see Figure 1), we observed a significant difference between the subjects who succeed and those who failed at the first attempt. The latter used more direct confirmatory tests than those who succeed (72,11 vs. 44,95, $t(38) = -3,33$; $p < .01$). Only subjects who succeed used direct infirmatory tests.

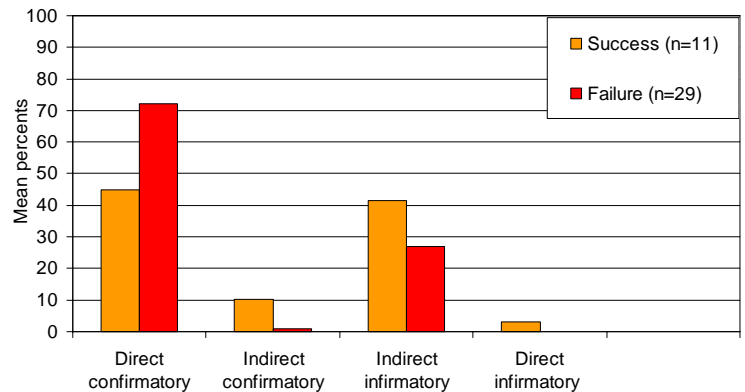


Figure 1 : Mean percents of the four type of hypothesis test

Working Memory

Subjects who succeed in 2-4-6 task had better results on two other tasks than those who failed : the Running Span (12 vs. 9,93 ; $t(38) = 1,98$; $p = .05$) and the Verbal Span (5,73 vs. 5 ; $t(38) = 2,23$; $p < .05$).

Correlations

High flexibility capacities (TR on Plus/Minus Test) are associated to weak proportion of direct confirmatory tests ($rBP = .31$, $p < .05$) and to high proportion of negative expected feedback ($rBP = -.33$, $p < .05$). High inhibition capacities (TR on Hayling Sentences Completion Test) are associated with high proportion of indirect confirmatory hypothesis tests ($rBP = -.30$, $p = .05$).

3. Discussion

Inter-individual differences on the reasoning task could be explained by a limitation of executive capacities, rather than by defaults of storing in working memory postulated in Mental Models Theory (Johnson-Laird, 1983). Defaults of flexibility and inhibition seem indeed to lead to observed reasoning errors.

Our results underline the correlations method relevance which, unlike the competing tasks method centered on storage capacities, allows to obtain information concerning the relationship between executive control and inferential capacities.

Références

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