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**ABSTRACT**

A study investigated the relationship between prior knowledge, age, instruction, and the relative difficulty and importance of a text in the reading processes and knowledge acquisition of elementary school children in Belgium. Two groups of 42 students (10 and 12 year olds) were given a knowledge questionnaire two months prior to the experimental task. For the experimental task, students read a selection and were told to memorize it or summarize it. Results indicated that age, prior knowledge, and relative importance of the text were significant factors in how well the students read (acquisition input). Age, relative importance, and relative difficulty of the text affected memorization (acquisition output). The results suggest that the analysis of knowledge acquisition by text must take into account both input and output performance variables. A 21-item list of references concludes the document. (SRT)

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## LEARNING FROM TEXT : EFFECTS OF AGE AND PRIOR KNOWLEDGE

by

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Acquisition of knowledge by text has become one of the focal issues of cognitive psychology over the last few years (Denhière and Deschênes, 1985a,b; Schallert, 1982). Research has clearly shown that new information is acquired by integration of knowledge into structures, schemata (Norman, 1980; Rumelhart, 1984); these structures, as well as their role during encoding and retrieval, need to be accurately defined (Denhière, 1982; van Dijk and Kintsch, 1983). On an operational level, knowledge questionnaires must be devised in such a way that knowledge schemata the subjects are

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assumed to possess can be assessed ; subjects' performances must be measured pre- and post-exposure to new information, moreover, the new information to be acquired must be

analysed and texts constructed so that content characteristics --e.g., relative importance and relative difficulty of units of information-- are also known and defined (Denhière and Deschênes, 1985c; Johnston, 1984; Langer, 1982; Le Ny and Denhière, 1982).

The purpose of the experiment reported here was to investigate the relationship between prior knowledge, age, and the input and output processes of acquisition of knowledge in school-age children. The performances of two groups of 42 subjects (aged 10 and 12) during reading (sentence by sentence) and memorization (recall and summary) of a text on the "Desert" (Brown and Day, 1983) were analysed as a function of the results of a prior knowledge questionnaire.

On the basis of previous results, we postulated a variation of reading time according to prior knowledge : the more the prior knowledge, the faster the reading time (see Birkmire, 1985). If age and prior knowledge are positively correlated, 12 y.o. children will be faster than 10 y.o. children. The comparison between different age-groups of children equalized on level of prior knowledge should yield information on the respective roles of knowledge structures and cognitive processes on the acquisition of knowledge (see Carey, 1984; Weinert, 1985). Reading times will also vary according to the instructions (recall or summary) : if more processing is required by recall than summary, reading times with recall instructions should be longer than with summary instructions. From previous studies, we can also predict longer reading times for important and difficult statements than for the others (Denhière, 1985). We assume that there will be an interaction between instruction and importance (or difficulty) : the difference between recall and summary reading times will be longer for important (or difficult) than for the other statements.

The same line of reasoning can be applied to the memorization performances : recall and summary performances will increase with prior knowledge and age : the more important and the less difficult statements will be recalled better than the others; and the difference between recall and summary performances will increase with age and prior knowledge.

## METHOD

### SUBJECTS

84 children from Liège city (Belgium) (42 aged 12 and 42 aged 10) participated in this experiment. Half received

recall instructions and the other half were asked to summarize.

## **MATERIALS**

A modified version of the "Desert" text by Brown and Day (1983) was constructed. It was composed of 24 statements of comparable length and the same number of underlying propositions, having two levels of importance (as assessed by adult judges) and three levels of difficulty (based on subjects' scores on the knowledge questionnaire).

The knowledge questionnaire consisted of 48 questions, two for each statement. One was an open question, and the second a forced 4-alternative multiple choice. An example of the two kinds of questions is presented in table 1.

INSERT ABOUT HERE THE TABLE 1

For the memorization task, the subject was told beforehand that the text would be presented on a screen, sentence by sentence, and that he or she would be able to control display time of each sentence by pressing the space bar. He or she was asked to take his or her time, and to read for comprehension since, depending on the experimental condition, he or she was told that he or she would be asked "to write everything he or she remembered" or to write a summary "only mentioning the most important things".

## **PROCEDURE**

The initial knowledge questionnaire was administered approximately two months prior to the memorization task. A practice test was used to familiarize the subject with the equipment. Recall or summarizing took place immediately after the reading of the "Desert" text.

## **SCORING**

The answers to the open and force choice questions were scored on a 4-point scale. The protocols for recall and summary were broke down into propositions (see Kintsch and van Dijk, 1978) and were classified either as propositions identical to the text base, or similar to the text base as a function of the variation in the content of the predicate and/or argument(s).

## **RESULTS**

Reading times, recalled propositions (identical and similar to the text base) and the ratio of recalled propositions/reading times (Kintsch and Vipond, 1979) were submitted to the two following ANOVA :

$\underline{S}7 <G2 * K3 * In2> * St12 <Ir2>$  and  $\underline{S}7 <G2 * K3 * In2> * St8 <D3>$

where  $\underline{S}$  represents the subjects ( $n= 84$ ); G: Age (10 and 12); K: the level of prior knowledge (L: low, A: average, H: high); In: the instructions (recall and recognition); St : the statements of the text, which were divided into two levels of importance (Ir) and three levels of difficulty (D).

## READING

Three factors were significant :

**Prior knowledge**, ( $F(2,72)= 6,31$ ,  $P <.01$ ), reading times varied with the initial level of knowledge and the weaker group read slower than the two other groups ( $F(1,72)= 11,63$ ,  $p <.01$ );

**Age**, ( $F(1,72)= 46,6$ ,  $p <.01$ ), 12 year olds read faster than 10 year olds;

**Relative Importance**, ( $F(1,72)= 15,79$ ,  $p <.01$ ), reading times of the important statements were shorter than the other statements.

**Instruction** produced only a marginal effect, ( $F(1,72)= 3,35$ ,  $p <.07$ ), the recall instructions produced longer reading times than the summary instructions.

Only one two-way interaction between **Age and Prior knowledge** was significant, ( $F(2,72)= 3,87$ ,  $p <.02$ ); the difference between the two age groups was greater for LK subjects than for AK and HK subjects ( $d= 9,44$  vs  $4,55$  vs  $3,95$ ).

One three-way interaction was significant between **Age \* Instruction \* Prior knowledge**, ( $F(2,74)= 3,72$ ,  $P <.03$ ); at age 10, the instruction to recall or to summarize produced differences between the LK subjects vs the AK and HK subjects who did not differ from each other ; whereas at age 12, the HK subjects were significantly different from the AK and LK who did not differ.

## MEMORIZATION

Three factors were significant :

**Age**, ( $F(1,72)= 34,86$ ,  $p <.01$ ), 12 year olds memorized more propositions than 10 year olds, and the comparison between

identical and similar recalled propositions showed an interesting difference : the older children exceeded the younger for similar recalled propositions, ( $F(1,72)= 78,63$ ,  $p < .01$ ), but not for identical propositions ( $F < 1$ ) ;

**Relative importance**, ( $F(1,72)= 7,81$ ,  $p < .01$ ), the important statements were better recalled than the less important ;

**Relative difficulty**, ( $F(2,144)= 35,20$ ,  $p < .01$ ), the number of recalled propositions steadily dropped as difficulty increased, level 1 being superior to levels 2 and 3, ( $F(1,144)= 12,40$ ,  $p < .01$ ), and level 2 superior to level 3, ( $F(1,144)= 12,34$ ,  $p < .01$ ).

Two two-way interactions were significant, **Age \* Importance**, ( $F(1,72)= 4,67$ ,  $p < .03$ ), and **Age \* Difficulty**, ( $F(2,144)= 3,44$ ,  $p < .03$ ) : the difference between the two age groups was larger for the less important statements than for the important ones ; and, secondly, the difference between the two age groups was smaller for the difficult statements than for the others.

One three-way interaction was also significant, **Age \* Importance \* Instruction**, ( $F(1,72)= 11,06$ ,  $p < .01$ ) : at age 10, the difference between recall and summary was significant for important statements but not for the others; whereas at age 12, the reverse was true : the number of important statements in the recall and summary protocols was similar whereas the statements of lesser importance were more frequent in the summary protocols.

### RECALL PER UNIT OF TIME

Three factors were significant :

**Age**, ( $F(1,72)= 89,01$ ,  $p < .01$ ), 12 year olds were more efficient than 10 year olds ;

**Relative importance**, ( $F(1,72)= 9,85$ ,  $p < .01$ ), the ratio was higher for the important statements than for the other ones;

**Relative difficulty**, ( $F(2,144)= 32,12$ ,  $p < .01$ ), the ratio was higher for the more difficult statements (D1) than for the two others (D2 and D3), ( $F(1,144)= 51,80$ ,  $p < .01$ ); and for the intermediate (D2) than for the lower level (D3) difficulty, ( $F(1,144)= 12,44$ ,  $p < .01$ ).

Two interactions, **Age \* Importance**, ( $F(1,72)= 4,51$ ,  $p < .03$ ), and **Age \* Difficulty**, ( $F(2,144)= 16,32$ ,  $p < .01$ ), were significant : the difference between the two age groups was smaller for the important and for the difficult statements than for the less important and for the less difficult statements.

## DISCUSSION

Overall, the findings are in line with the hypothesis that analysis of the acquisition of knowledge by text must take input and output performances variables into account : whereas Age and Relative importance were significant both for input and output, Instructions and Prior knowledge only affected reading time; recall, on the other hand, varied significantly with the Relative difficulty of the statements.

The efficiency of processing increased with age : the older children memorized more information per unit of time than the younger ones, and awareness of the Importance and the Difficulty was different across the two age groups. The fact that children having equivalent levels of knowledge but differences in age show variation in performance both at encoding and retrieval phases, led us to study both the structure of the pertinent knowledge structures and the processes using them.

As concerns knowledge structures, quantitative indications of prior knowledge do not appear to be sufficient to explain qualitative change in acquisition (see Chi, 1984). Our present work focuses on this issue and attempts to shed light on specific elements of knowledge acquisition. As concerns processes, it would seem that as of age 10, children begin to be able to partially monitor their learning : this is shown by variation in reading time as a function of the initial level of knowledge and the relative difficulty of statements. However, this regulation has not been completely mastered, since for example the recall and summary instructions produced similar performances.

So, we need to know more about how individuals manage and use the cognitive resources at their disposal both as regards prior knowledge, and as regards acquisition.

The secondary task technique (see Britton and Tesser, 1982) was used during reading to test whether variation in time processing is related to differences in quantity of available cognitive resources : if this is the case, reaction times to the secondary task should vary as a function of the age of the subjects, the relative importance and the relative difficulty of the statements read. To gain clearer understanding of the way in which information is organized in memory after reading while avoiding the problems connected to production, the semantic priming technique was used (see Lorch, 1982).

Our hope is that, in conducting parallel research on the identification of structures and processes involved in the acquisition of knowledge, we will succeed in facilitating learning and making the memorization more efficient.

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