EFFECTS OF MEMORY SPAN ON COGNITIVE LOAD AND ON WRITING STRATEGIES

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The use of Kellogg's experimental paradigm (1994) allows us to evaluate the cognitive effort which writers engage in planning, translating and revising writing task.

Previous results systematically showed that planning and revision require more effort than translating. Moreover, these results showed that planning was mobilized in the early phase of writing and then decreased whereas revision progressively increased from phase to phase. Translating appeared to be the most frequent process in each phase (Kellogg, 1994; Levy & Ransdell, 1995; Piolat, Roussey, Olive & Farioli, 1996).

GOALS OF THE EXPERIMENT

The cognitive effort corresponds to attentional resources allocated to the different writing processes (Kellogg, 1996; Levy, 1997). It is important to ask if the general pattern concerning the cost and the manner of mobilizing these processes are dependent on the memory capacities of the writers.

Most specifically, our study examines the effect of memory span on the allocation of attentional resources as well as on writing strategies.

METHOD

Participants

30 participants were studied with a test designed to measure their memory span associated to a writing task. Depending on their scores to the test, participants were categorized in a " low memory span " group (N = 15) and in a " high memory span " group (N = 15).
During the test, writing performance of the participants was measured. The utterance rate of the low memory span group was significantly slower (12,09 w/mn) than that of the high memory span group (18,32 w/mn; F(1,28) = 5,962, p =.021; Figure 1). The mean number of words in the text was also smaller (F(1,28) = 3,808, p =.06; Figure 2).

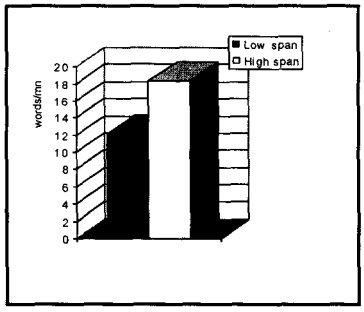

Figure 1 : Utterance rate (words per min.) as a function of memory span (Low versus High)

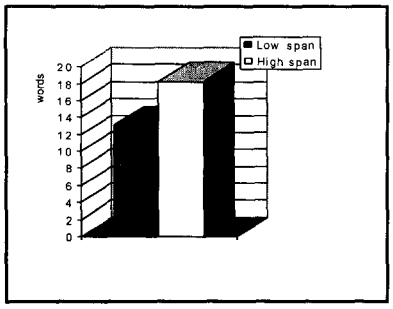

Figure 2 : Mean number of words for each text as a function of memory span (Low versus High)

Test of memory span

The verbal material used in the test comprised three groups of five lists of sentences (plus two training lists). The length of these lists was different (2 sentences, 3 sentences, 4, 5 & 6 sentences). These sentences were extracted from Desmette et al.'s (1995) test. This test is a French adaptation of the Daneman and Carpenter's (1983) test.

Each sentence contained a misspelled word. The frequency and the length of syllables of each misspelled word was controlled. The type of spelling error did not alter the

pronunciation of these words (which can happen with the French orthographic system). These words were not only present at the end of the sentences, but also at the beginning, or in the middle of the sentence. The distribution of these locations was randomized;

First list of sentences (misspelled words were not in italic in the test)

Training

0.1. Les soirs d'été, nous aimions manger dans le *jardin,* en compagnie des abeilles.
0.2. Pour l'anniversaire de son *maris,* elle hésitait entre une ceinture et une cravate.

Recall

0.3. Le notaire a donné rendez-vous à son client vendredi prochain en fin de *matinée.*
0.4. Ce jeune *aventuriers* est parti en Amérique et il y a vite fait fortune.
0.5. Comme toujours dans ce bureau de poste, il n'y avait personne derrière le *guicher.*

Recall

First list

1.1 Elle se leva avec nonchalance et dit à son ami qu'il était un ivrognes.
1.2. La jeune fille est partie en abandonnant sa *voitures* devant le magasin.

Recall

1.3. D'une main qui tremblait, il se coiffa puis, sans détourner la tête gagna la *sorties.*
1.4. I1 renversa deux cyclistes et termina sa *courte* entre les bras d'un policier.
1.5. Elle regagna le balcon de son *apartement* pour y admirer les toits de la cité.

Recall

1.6. Sans rien dire, il s'asseyait près du feu et buvait un alcool de *poires.*
1.7. Le *navires* se mit à prendre l'eau car sa coque avait été percée par un rocher.
1.8. Dès qu'elle fut arrivée sur la rive du fleuve, la troupe se disposa en *cairclе.*
1.9. L'homme regarda discrètement son invité et sut alors qu'il avait atteint son buts.

Recall

1.10 La *prises* de vue n'était pas bonne mais cela ne diminuait en rien son éclat.
1.11 Le malade se pencha à l'oreille de son *voisain* pour lui confier ses angoisses.
1.12 Après avoir dévasté le *villages,* le vieux pirate ordonna de gagner le large.
1.13 Le *flacons* contenait un liquide bleu clair et frais, au goût de miel et de banane.
1.14 L'incompétence des directeurs est souvent à *l'aurigine* de graves problèmes.

Recall

1.15 A ce moment, le train entra en gare et mon ami abandonna sa lecture avec *reggret.*
1.16 Le *lemdemain, il* retrouva la clef de sa maison parmi les verres et les bouteilles.
1.17 Ce mauvais *peintres* reproduisait le même coucher de soleil sur toutes ses toiles.
1.18 Le bateau leur fit sentir quelques légères *secouses* lorsqu'ils montèrent sur le pont.
1.19 A peine fut-il entré chez le dentiste qu'il ressentit un pénible *sentiments.*
1.20 Ces sacs de *semence* étaient précieux car ils représentaient vraiment leur seul avenir.

Recall

The task was designed to constrain participants to using the three writing processes (planning, translating and revising).

The test was inspired by the speaking span test of Daneman & Green (1986), and by the writing span of McCutchen et al. (1995).

Our test had the following features : To force the use of a revision process, in the first phase participants had to read a list of sentences. Then they had to detect the misspelled word and memorise it. At the end of reading the list of sentences, participants were requested to recall the words by writing a story.

Procedure

Both groups of participants (low & high memory span) were tested with these three phases

Phase I : The participant was trained in the retrospection task.

Phase 2: The average reaction time was calculated. The participant had to react to a sequence of 30 tones and we used the last 25 tones for the baseline .

Phase 3 : A writing task was proposed. The topic was a discussion about the increase in academic registration fees. While the participant was engaged in writing (Principal Task), he/she was confronted simultaneously with two other tasks.

Tones were delivered every 30 seconds (on average) and the participant was asked to react by pushing a key (Reaction Time Task).

Then, the participant was requested to verbalize what he/she was thinking while he/she was engaged in writing (Restropective Task). For this purpose, he/she designated the appropriate key (Planning, Translating, Revising) on a keyboard (reaction time to beeps and directed retrospection were recorded with the software SCRIPTKELL; Piolat, Olive, Roussey, Thunin & Ziegler, in press).

RESULTS

Main results show that RT's are higher among writers with a low memory span (748 ms) than among writers with a high span (625 ms; $F(1,28) = 7,048$, $p = .013$). This is particularly true for revising ($F(2,56) = 4,437$, $p = .016$). Revising required more effort than planning and translating ($F(2,56) = 3,024$, $p = .056$; Figure 3).

Moreover, (in) as a function of their memory span, writers (differently) use these processes differently during the three phases of the task. Writers with a low memory span did more frequent planning in the two first phases, whereas other writers immediately translated. Revision was used less than planning and translating ($F(2,56) = 18,54$, $p = .0001$; figures 4, 5 & 6).

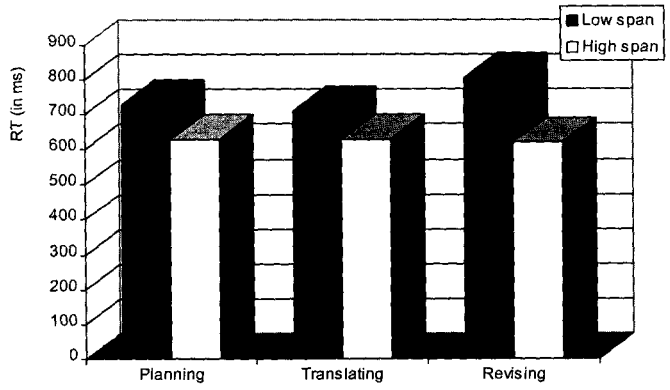

Figure 3 : Cognitive effort : Effect of memory span (Low versus High) on the RT'S (in msec) for the writing processes (Planning, Translating, Revising)

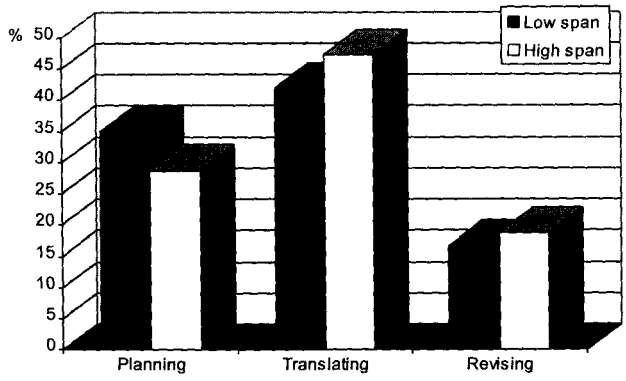

Figure 4 : Time processing: Percentages of the three writing processes (Planning, Translating, Revising) as a function of memory span (Low versus High)

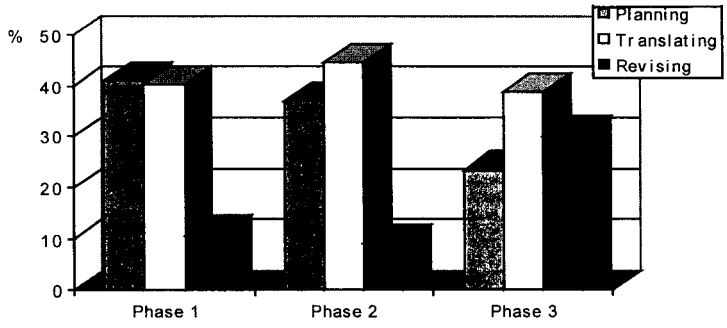

Figure 5 : Time processing: Percentages of the writing processes (Planning, Translating, Revising) in the 3 writing phases as a function of low memory span

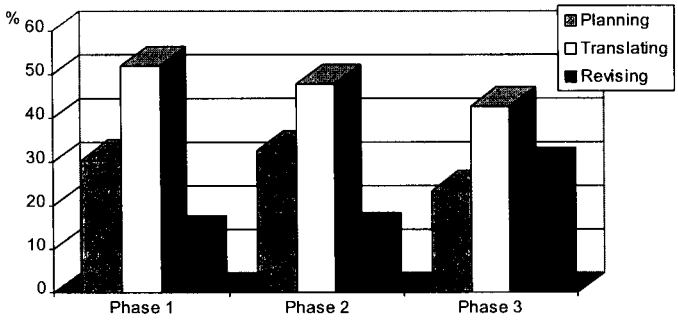

Figure 6 : Time processing: Percentages of the writing processes (Planning, Translating, Revising) in the 3 writing phases as a function of high memory span

Other comparisons between low and high memory span writers indicate that

1) the utterance rate of low span writers was slower than that of high span writers ($F(1,28) = 6,17$, $p = .02$; figure 7);

2) the low span group produced less syntactically complex sentences ($F(1,28) = 9,8\ 1$, $p = .004$; figure 8);

3) the number of revisions was higher in the low span group ($F(1,28) = 13,49$, $p = .001$; figure 9);

4) however, text quality did not differ between the two groups.

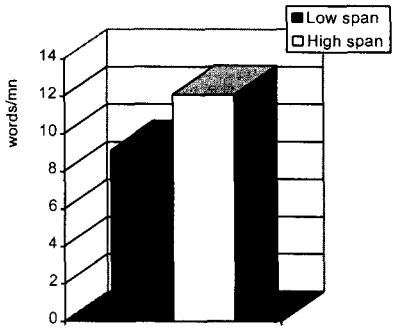

Figure 7 : Utterance rate (words per min.) as a function of memory span (Low versus High)

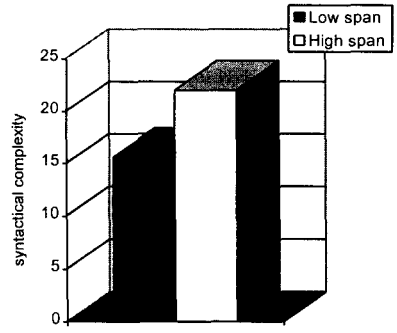

Figure 8 : Syntactical complexity as a function of memory span (Low versus High)

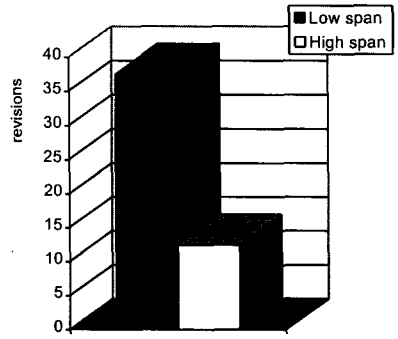

Figure 9 : Number of revisions as a function of memory span (Low versus High)

CONCLUSION

The results show that writers' memory capacities induce the use of different strategies for text composition.

The high memory span writers compose quickly and make more complex sentences. They plan less during the first phase of composition and revise less, particularly during the final phase of composition. They bring few concrete revisions to their text. Their cognitive effort is lower for the 3 writing processes in comparison to the low memory group.

The low memory span writers compose slowly, use many revisions and this editing is associated with the greatest cognitive effort.

This set of data confirm the role of working memory in writing strategies (Kellogg, 1996; Levy, 1997).

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