SHORT-TERM MEMORY, ARTICULATION RATE AND SUBVOCAL REHEARSAL IN DOWN'S SYNDROME

Annick COMBLAIN, Université de Liège, Laboratoire de Psycholinguistique

Baddeley (1986): Working Memory Model

→ There is a significant link between articulation rate and memory span (the faster is the articulation rate the more a subject can recapitulate items in a memory span task).

→ Word-length effect is strongly related to articulation rate and subvocal rehearsal.

BUT

→ Some authors recently showed that word-length effect can be the result of the delay at recall.

Gathercole, Adams & Hitch (1994): Developmental studies of working memory

→ In young children there is significant link between articulation rate and immediate memory span but these variables are closely related in adults.

→ Word-length effect in children is obtained with auditorily presented stimuli.

→ Children do not rehearse during auditory memory tasks. Word-length effect is due to the delay at recall

Hulme and Mackenzie (1992): Working memory in mentally handicapped subjects

→ Mentally retarded persons do not rehearse.

Comblain (1995): Working memory in Down's syndrome subjects

→ There is a highly significant word-length effect in Down's syndrome subjects.

Hypothesis:

If Baddeley's model is right, word-length effect is the cue of subvocal rehearsal in Down's syndrome, than:

→ memory span and articulation rate will be highly correlated in Down's syndrome subjects

→ Hulme and Mackenzie assumption is false and Down's syndrome subjects rehearse.

If Gathercole's assumption is right than:

→ memory span and articulation rate are not correlated.

→ Hulme and Mackenzie assumption is right and Down's syndrome subjects do not rehearse.

EXPERIMENT 1:

Subjects:

* 43 Down's syndrome subjects:

Non-verbal mental age	< 4 years N = 13	4 - 5 years N = 11	5 - 6 years N = 10	> 6 years N = 9
Mean	3; 4 years	4; 8 years	5; 9 years	6; 11 years
Standard deviation	1 month	5 months	3 months	9 months

Method:

* Short-words span / Long-words span / Progressive Color Matrix (Raven).

* Individual testing

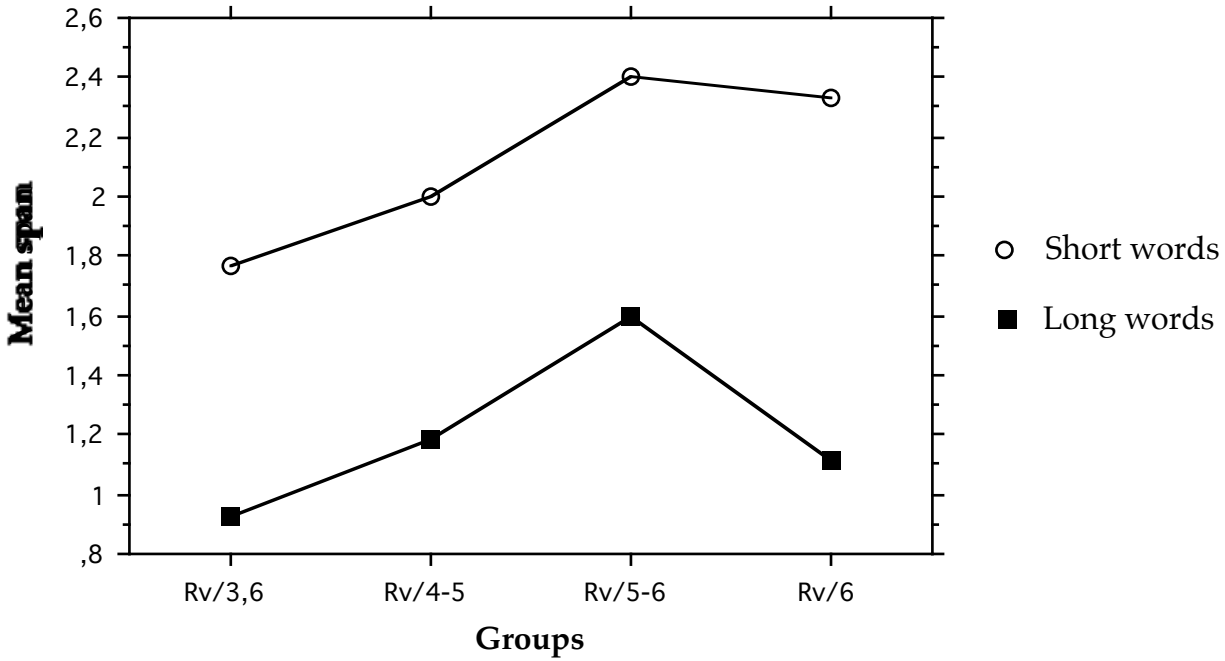
Results:

* Mean short-words span = 2.09 (SD: 0.68) Mean long-words span = 1.19 (SD: 2.82)

	Short-words span	*Long-words span*
Group: <4 years	1.77 (SD: 0.73)	0.92 (SD: 0.95)
Group: 4 - 5 years	2.00 (SD: 0.63)	1.18 (SD: 0.75)
Group: 5 - 6 years	2.40 (SD: 0.52)	1.60 (SD: 0.70)
Group: > 6 years	2.33 (SD: 0.71)	1.11 (SD: 0.78)

SD = standard deviation

* ANOVA 1 factor intra- 1 factor inter-group:
    ° Global length effect: $F(1,39) = 95.57$, $p<0.0001$
    ° No global group effect: $F(3;39) = 1.84$, NS
    ° No interaction between length and group: $F(3,39) = 1.03$, NS



Conclusion:

* There is a word-length effect in Down's syndrome subjects.

* The size of this effect is similar in the four groups.

EXPERIMENT 2:

Subjects:

* 43 Down's syndrome subjects:

Non-verbal mental age	< 4 years N = 13	4 - 5 years N = 11	5 - 6 years N = 10	> 6 years N = 9
Mean	3; 4 years	4; 8 years	5; 9 years	6; 11 years
Standard deviation	1 month	5 months	3 months	9 months

Method:

* Digits span / Letters span / Short-words span / Progressive Color Matrix (Raven) / Articulation rate

* Mean span = mean between letters span, short-words span and digits span

* Individual testing

Results:

* Mean digit span = 2.33 (SD: 0.75) Mean letters span = 1.77 (SD: 0.72)

*Mean word span =2.09 (SD: 0.68) Mean span = 2.03 (SD: 0.63)

* Mean articulation rate = 35.25 words per minute (SD: 8.9)

* Mean non-verbal level = 12.95 (SD: 4.83) correspond to the mean non-verbal level of children of 4; 10 years old.

	1	*2*	*3*	*4*	*5*	*6*	*7*
1. Digits span	1.00						
2. words span	.70*	1.00					
3. Letters span	.63*	.63*	1.00				
4. Mean span	.89*	.88*	.86*	1.00			
5. Articulation rate	**.37****	**.21**	**.31****	**.34****	**1.00**		
6. Non-verbal intelligence	.53*	.41*	.52*	.56*	.39*	1.00	
7. Chronological age	-.1	.02	.09	.004	-.16	-.22	1.00

Correlations between memory span measures, articulation rate, non verbal intelligence and chronological age. (significant level p<0.01, ** significant level p<0.05).*

* High correlation between the memory span tasks ($p<0.0001$).
* Correlation between articulation rate and some of the memory span measures ($p<0.05$).
* High correlation between non-verbal intelligence and memory span measures ($p<0.0001$).
* High correlation between non-verbal intelligence and articulation rate ($p<0.01$).

Can we conclude that there is a clear relationship between memory span and articulation rate ?

→ Gathercole and Hitch (1993) showed that digits span of three years-old is not correlated with articulation rate.

→ Distribution of the subjects in four groups:

Group: < 4 years	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1. Digits span	1.00						
2. words span	.92*	1.00					
3. Letters span	.33	.38	1.00				
4. Mean span	.91*	.93*	.67*	1.00			
5. Articulation rate	**.02**	**.12**	**-.33**	**-.07**	**1.00**		
6. Non-verbal intelligence	.22	.26	.70*	.46	-.03	1.00	
7. Chronological age	-.15	-.004	.02	-.07	.02	-.38	1.00
Group: 4 - 5 years	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1. Digits span	1.00						
2. words span	.52	1.00					
3. Letters span	.24	.63**	1.00				
4. Mean span	.75*	.90*	.74*	1.00			
5. Articulation rate	**.21**	**-.11**	**.16**	**.10**	**1.00**		
6. Non-verbal intelligence	.52	0	-.52	-.006	-.14	1.00	
7. Chronological age	-.46	-.08	.16	-.18	-.26	-.30	1.00
Group: 5 - 6 years	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1. Digits span	1.00						
2. words span	.36	1.00					
3. Letters span	.69**	.61	1.00				
4. Mean span	.80*	.78*	.92*	1.00			
5. Articulation rate	-.05	-.37	-.27	-.28	1.00		
6. Non-verbal intelligence	.08	-.15	-.02	-.02	.21	1.00	
7. Chronological age	.38	.50	.49	.54	-.42	.26	1.00
Group: > 6 years	*1*	*2*	*3*	*4*	*5*	*6*	*7*

1. Digits span	1.00						
2. words span	.68**	1.00					
3. Letters span	.86*	.70**	1.00				
4. Mean span	.94*	.84*	.98*	1.00			
5. Articulation rate	**.85***	**.44**	**.74****	**.77****	**1.00**		
6. Non-verbal intelligence	.72**	.45	.52	.63	.41	1.00	
7. Chronological age	.26	.28	.49	.38	.16	.40	1.00

Correlations between memory span measures, articulation rate, non verbal intelligence and chronological age. (significant level p<0.01, ** significant level p<0.05).*

In the four groups:

° No significant correlation between articulation rate and memory span measures in children under 6 years-old of non-verbal mental age.

<u>Conclusion:</u>

* Our results seems to be similar to those of <u>Gathercole and al. (1994)</u>.

↓

There is no relationship between articulation rate and memory span measure before the age of 4 years-old

Positive association between the two variables in adults

* In experiment 1: clear length effect in all groups.

* In experiment 2: no correlation between memory span measures and articulation rate.

⇒ in young normal children and in Down's syndrome subjects: hypothesis of a direct access of the auditive stimulations to the phonological store where information is maintained until the trace decay.

→ individual difference and possibility (in some young children) to recall 5 items without using rehearsal is due to the variability in the rate of decay.

→ in Down's syndrome subjects, it seems that the phonological store is sufficient to maintain a certain amount of items without rehearsal (3 items regarding the limited capacity of the phonological store).