

Working Memory and Attention: A Study in Pre-School Children with Normal and Impaired Language Development

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Aims

It has been repeatedly shown that limited processing of the phonological loop (within the Baddeley model of working memory, see figure 1) may count as a condition for impaired language development.

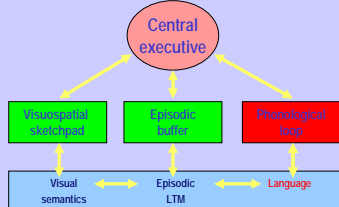


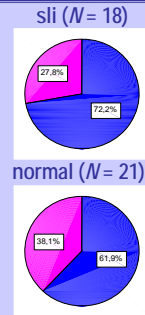
Fig. 1 Working memory model [Baddeley, A. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Sciences*, 4, 417-423.]

Here, we report on a dual-task experiment in which children with normal and impaired language development were compared with respect to a crucial function of the central executive: the ability to direct and allocate attention.

Method

Participants

39 pre-school children participated in this study. Among them, 21 attended a regular German kindergarten ("normal"; $M = 5;6$ years, $SD = 0;4$). The remaining 18 children visited a special kindergarten for language impaired children ("sli"; $M = 6;1$, $SD = 0;6$). This difference of age is significant ($|t| = 4.11$; $p < .01$).



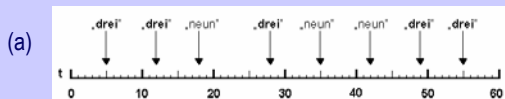
Experimental Design

Three measures related to the phonological loop within the working memory model were raised: (1) The digit-span (i. e. the amount of digits correctly repeated in an immediate serial recall task), (2) the amount of correctly repeated non-words (we used nine nonwords: three consisting of two, three, and four syllables), and (3) the articulation rate (i. e. the maximum of syllables articulated within one second).

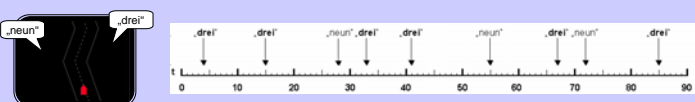
Of main interest here is the dual-task experiment measuring attention and attention allocating. This dual-task experiment consists of the following two tasks:

- In a computer aided tracking-task, the children used a joystick to keep a red "rocket" in the middle of a vertically scrolling road. Dependent variable was the mean deviation.
- In a speeded reaction-task, children had to either repeat a verbal stimulus ("drei" [three]), or not repeat or react to another verbal stimulus ("neun" [nine]). Stimuli were presented by the computer at fixed points of time (see below). Dependent variables here were the reaction times to the stimulus "drei" and a dichotomous variable representing whether a reaction (or no reaction) was judged as correct or not.

1. Both tasks were performed separately.



2. Dual-task condition: Both tasks were performed simultaneously. Children were instructed to focus on the tracking task.



Results

- As expected, all three indicators of the functionality of the phonological loop show that the sli children performed less than the normal children ($p < .01$; see figure 2), although they are about seven months older.
- Main effects of condition (separate vs dual-task) were found for reaction times ($F = 4.69$; $p < .05$) and for the number of correct reactions ($F = 20.87$; $p < .001$; see figure 4). No such main effect occurred for the mean deviation in the tracking task ($F = 0.50$; $p = .48$; see figure 3): Children followed the instruction to focus on the tracking-task and their reaction performance was impaired due to the dual-task condition.
- For none of the variables interactions of condition (separate vs dual-task) and group (sli vs normal) were found. That means, although sli children reacted slower and they made more mistakes, *the effect of the dual-task condition did not vary between both groups*.

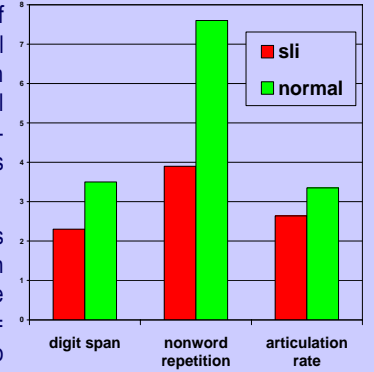


Fig. 2 Performances of sli and normal children in measures of the phonological loop

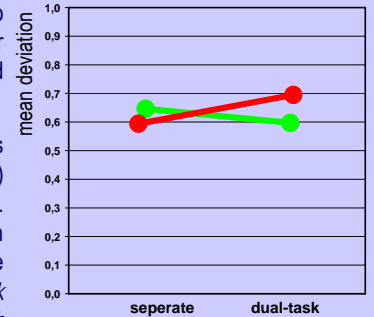


Fig. 3 Performance of sli and normal children in the tracking task

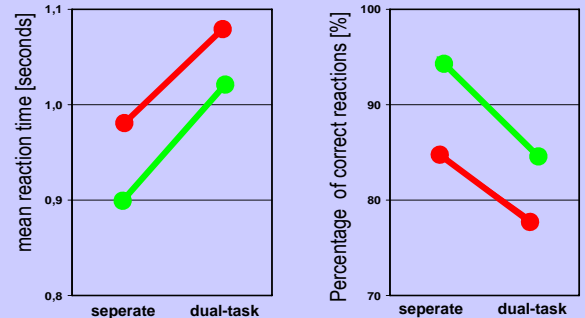


Fig. 4 Performance of sli and normal children in the reaction task (left: reaction time; right: percentage of correct reactions)

Conclusion

The results confirm the often reported deficits in the functionality of the phonological loop in sli children.

Although sli children showed lower performance in the speeded reaction task (longer reaction times and more reaction errors), their ability to direct and allocate attention seems not to differ from normal children.

The results indicate that only the phonological loop, but not the function of the central executive, appears to be responsible for impaired language development (see figure 5).

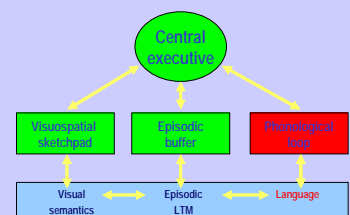


Fig. 5 Working memory model: Only the functionality of the phonological loop differs between language impairment and normal language development

For more detailed information see: Janczyk, M., Schöler, H. & Grabowski, J. (2004). Arbeitsgedächtnis und Aufmerksamkeit bei Vorschulkindern mit gestörter und unauffälliger Sprachentwicklung [Working memory and attention: A study in pre-school children with normal and impaired language development]. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, 36, 200-206.