

Manipulations of Concrete Representations of Formal Systems, Language Development, Reading and other Cognitive Skills

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Concrete Representations of Formal Systems

Instead of a direct observation of our subjects' language, we chose to observe their non-verbal problem solving behaviors: we confronted them to logical problems presented in a non-verbal way. We created a new technique for cognitive observations. This technique is based on manipulations of tools which we call Concrete Representations of Formal Systems (CRFS).

A concrete representation of a formal system is a set of objects which do not belong to the cognitive background of the subject and which are provided with technical constraints. Some results, presented below, show the specific interest of this technique.

A first group of researches is based on manipulations of Cohors-Fresenborg's Dynamical Mazes (DM). This device enables the subject to build and explore the regularities of a mechanical finite automata. Results show that this situation favors activities such as hypothesis formulation, testing and adaptation. The main result is that, among children confronted to traditional reading learning strategies, those who manipulate DM become better readers (Lowenthal, 1986). New results show that the significant differences observed are due to the performances of students who were previously supposed to be future "poor readers". These new results show also an influence of manipulations of DM in arithmetic scores for the same subjects, and in abstract visuo-spatial organization for all subjects.

A second group of researches is based on the use of pegboards. This device enables the experimenter to introduce the subject, without computer, to a procedural programming language. Results show that the 6 year olds who used this device have acquired at the age of 7 a verbal language which is significantly more complex than that used by the subjects of the control group (Lowenthal, 1990).

Specific exercises were used in order to train segmentation abilities in 7 year olds for whom a reading problem had been diagnosed. Results show that reading becomes easier for words which should be treated by the sub-lexical route.

A third groups of researches show that manipulations of CRFSs can help aphasic subjects who lost the ability to produce and/or understand language, to reconstruct a function enabling them, at least partially, to communicate in a structured way (Lowenthal, 1991).

How Can We Interpret These Results ?

All these results seem to confirm that manipulations of CRFSs are relevant for the acquisition and the development of language, reading skills and other cognitive skills. This is the case in normal children but also with persons having a language problem.

It can be difficult to perceive why non-verbal mechanisms have effects on some cognitive abilities. In fact, we think it is possible that manipulations of **Concrete Representations of Formal Systems favor a cerebral reorganization enabling the subject to construct – or reconstruct – the neurological bases necessary to support the superior cognitive functions** required for the logical problem solving activities we confront him with. Since these superior cognitive functions are linked to some of the functions required by the language understanding and language production abilities, the cerebral reorganization mentioned above entails a language reorganization in the subject.

References

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