

body movements which may indicate the level of activity considered in the literature as an important personality trait.

The individuality factor proved to be significant also in the frequency of smiling and crying interpretable as an indicator of emotionality.

The effect that the effect of the infant's individuality was significant already in the early stages of development seems to be indicative of the role of the genetic component in the development of these behavior patterns.

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Institute for the Care of Mother and Child, Prague

Errorless training as a method in the study of cognitive development

M. Richelle

Activ. nerv. sup. (Praha), 19, 4, 1977

Cognitive development is described by Piaget as an invariable sequence of stages, characterized by structural properties and evolving through a dialectic interaction between the subject and the environment. The concept of *d e s e q u i l i b r a t i o n* is central in accounting for the dynamic changes occurring between one stage and the next one. However, no detailed analysis of these changes has ever been given, that would identify the crucial factors at work. These are, of course, impossible to disentangle in the natural course of development. Experimental manipulations of some sort seem necessary. Training situations recommend themselves, as members of Piaget's group have recently recognized (Inhelder et al., 1974), because they provide for a systematic exploration of the conditions that are necessary and sufficient to provoke change in cognitive behavior.

Many studies have been published in learning conservations, but generally conditions of training are only loosely defined and controlled. The use of errorless training methods as elaborated in operant conditioning research is proposed as a tool to assess with precision the role of environmental variables amenable to experimental control. Complementary, when they fail in inducing the expected changes, they will help in defining the part of the subject.

At the present stage, research along these lines is still exploratory, but enough has been done to demonstrate the applicability of the method to the study of cognitive development (Botson and Deliége, 1975). The procedures used are characterized by the fact that the child is not confronted with a complex situation out of which it must take what he can, but is progressively led through the preprogrammed items arranged in such a way that error occurs. Each response to an item is followed by a reinforcement. Verbal instructions are reduced to a minimum or completely eliminated; this dispenses us from an important source of perplexities in the understanding of the child's thought.

Three aspects of cognitive development have been explored: multiple classifications, in children of 4 and 4.5 years of age; seriation, in children from 3.9 to 4.6 and number conservation, in children of 5.0 and 5.6. In all cases, pre and post-tests were carried out using Piaget's classical techniques. The training procedures themselves amounted to 400, 275 and 220 items for classification, seriation and number conservation respectively. These sequences of items were retained after a number of preliminary studies. Training took place during up to 11 separate sessions. Control groups matched for age and pre-test results were used.

All the subjects went through the programs with a percentage of errors less than 5 percent.

Results at the post-tests demonstrate an effect on piagetian tests, in variable proportion depending on the nature of the experiment and the group considered. On the whole, the transfer effect is higher than that generally reported in the literature for children of comparable level of development, using other training procedures. Some results to be considered as preliminary are in table 1.

Table 1

	Group	Number	Age	Number of subjects improving
1. Classification	Exp.	10	4; 0	9
	Control	10	4; 0	0
2. Number	Exp. I	24	5; 6	24
		24	5; 6	0
	Exp. II	25	5; 0	15
		25	5; 0	3
3. Seriation	I*	31	3; 9—4; 6	31
		31	3; 9—4; 6	0
	II*	20	4; 6	18
		20	4; 6	0

* Post-tests here were not strictly piagetian situations.

A loose analysis of these results indicate that in some aspects the behaviors attesting mental operations by Piaget's standard can be obtained through training from children who do not exhibit them spontaneously. Whether or not this can be assimilated to the true operations as defined by Piaget is still a matter of controversy, and depends on the meaning one accepts to give to the word *operation*. In some cases, paradoxically, the outcome of errorless procedures seem to suggest that some aspect is more important than Piaget had realized.

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University of Liège, Laboratory of Experimental Psychology, B-4.000 Liège, Belgium