AN EXAMINATION OF RELATIONSHIPS BETWEEN COGNITIVE PREFERENCES, FIELD-INDEPENDENCE AND LEVEL OF INTELLECTUAL DEVELOPMENT

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Introduction

Efforts to account for individual differences in approach to and performance on cognitive tasks have led to the development of a number of constructs which may be subsumed by the generic label, "cognitive style". Much of the work in science education has centred around investigations of what Heath (1964) first described as cognitive preferences. In summarising what is known of cognitive preferences, MacKay (1975) has indicated that they are related to performance on cognitive tasks and that they should reflect features of the cognitive structure of the learner.

A second cognitive style characteristic which is of interest to science education is the cognitive-perceptual characteristic which Witkin and his colleagues have termed field-independence (Witkin et al., 1962). This characteristic is of special interest because Pascual-Leone has incorporated it as a factor in his neo-Piagetian model of intellectual functioning (Pascual-Leone, 1969; Pascual-Leone and Smith, 1969). In order to understand the hypothesized relationship between field-independence and performance on cognitive tasks, it is necessary to amplify the Pascual-Leone model. The following summary is based on the description given by Case (1974).

1. The basic construct of Pascual-Leone's theory is the Piagetian scheme. Schemes are conceptualized as mental blueprints which represent experience and produce behaviour.

2. New schemes are assumed to be acquired by:
   (a) the modification of an old scheme;
   (b) the combination and consolidation of several old schemes.

3. Problem-solving involves a systematic activation of various forms of schemes.

4. Unless its releasing component is activated by the immediate perceptual input, the activation or rehearsal of any scheme requires the application of "mental effort". Since the amount of mental effort which can be applied at any particular time is limited, the number of schemes which can be activated in any one mental step also is limited.

5. If two schemes are activated which have incompatible content, cognitive conflict ensues, or "disequilibrium" in the Piagetian sense.

6. Whether or not an individual actually solves a particular problem is held to depend on the following four factors:
   (a) the size and quality of the repertoire of schemes which the subject brings to the problem;
   (b) the maximum number of schemes which the subject's system is capable of activating at any one time — this maximum mental effort or M-power is assumed to vary both within and across age groups;
   (c) the subject's tendency to utilize the full M-power which he has available (this assumes that some subjects are habitually low M-processors — that is, they
prefer to look at or to respond to problems in the simplest manner possible (with a set of operations involving the least mental effort));

(d) the relative weight which the subject gives to cues from the perceptual field, as opposed to cues from other sources, in selected schemes.

From the point of view of this study, the most critical feature of Pascual-Leone's theory is as follows. The individual differences described in 6(c) and (d) above are assumed to be highly correlated and together are posited to account for the dimension of cognitive style called "field dependence-independence". Case (1974, p. 5) described the relationship in the following way:

Field-dependent subjects are assumed to be habitually low M-processors who assign higher weight to perceptual cues than to cues provided by the task instructions, in situations where these two sets of cues suggest conflicting executive schemes. Field independent subjects are assumed to be habitually high M-processors, who assign a higher weight to the task instructions than to perceptual cues in such conflicting situations.

In essence, then field-independent subjects are less prone to be distracted or fazed by irrelevant perceptual "noise" when they attend to a problem and proceed to attempt to solve it, than are field-dependent subjects. This role of field dependence-independence in affecting performance in cognitive tasks is supported by results obtained by Pascual-Leone (1969), Case and Globerson (1974), Niemark (1975), and, to a lesser extent by Saarni (1973). These studies indicate that field-independence is associated with superior performance on cognitive tasks. In fact, Karplus has offered the influence of this cognitive style characteristic as a possible explanation for the generally poor performance of subjects on the Karplus Ratio Puzzle (Karplus et al., 1974). In so doing, Karplus and his colleagues referred to cognitive style as a "personal preference", a description which bears a striking resemblance to the concept of cognitive preference.

In summary, one line of investigation has identified the construct, cognitive preference, as related to cognitive performance. Another line of investigation has described the construct, field-independence, as a factor involved in cognitive performance. One may therefore ask two questions. Firstly, what relationship exists between these two cognitive style characteristics? Secondly, how do they both relate to level of intellectual development? Flavell has described the Piagetian notion of formal thought as

"a generalized orientation . . . towards problem solving: an orientation towards organizing data . . . towards isolation and control of variables, towards the hypothetical, and towards logical justification and proof." (Flavell, 1963, p.211).

One might expect, therefore, that the degree of field-independence and the cognitive preferences of formal-operational thinkers would be different from subjects of the same age, but who are concrete-operational.

Purpose

As one facet of a major study of the effect of teaching strategy on intellectual development and cognitive style (Blake, 1976), the following questions were posed:

1. is there a relationship between cognitive preferences and degree of field-independence in