THE TRANSITION FROM CONCRETE TO FORMAL THINKING

A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

by

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This thesis describes original research carried out by the author in the Department of Psychology of the Australian National University from April 1967 to December 1970

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ABSTRACT

The thesis consists of a developmental study designed to investigate the transition from Concrete to Formal Operational Thought. A total of 236 subjects - 48, 48, 44, 48, and 48 in five age groups ("10", "11", "12", "13" and "14" year-olds, respectively) - is tested (a) on one of Inhelder and Piaget's (1958) tasks (the Pendulum Problem) and (b) on a Four Group Task adapted from Dienes and Jeeves (1965). It is argued that there are distinguishable concrete and formal operational approaches to the latter task. The samples of subjects for individual testing are chosen to be typical of the relevant school grades in terms of two variables:- raw score on the Standard Progressive Matrices and Mathematics Mark in a school examination.

An introduction to the transition from Concrete to Formal Operational thinking is given and then Chapters 1, 2 and 3 provide the theoretical and empirical background to the study. The format and the learning and questioning procedures for the Four Group Task are described in Chapter 4 (with details in Appendices I and II) and the descriptions of other measures and the experimental design given in Chapter 5 (with details in Appendix III). Scoring procedures developed for performance on the Pendulum Problem are outlined in Chapter 6 and for performance on the Four Group Task in Chapter 7 (with some transcripts from interviews on the latter task presented in Appendix IV; Appendix II also gives indications of the different types of response to questioning and the associated ratings made). Chapter 8 discusses the results purely in

terms of performance categories and the frequencies of subjects in them (associated tables are in Appendix V). Chapter 9 describes the derivation of quantitative scores on the two tasks, and investigates the interrelationships of a number of variables (associated tables are in Appendix VI). Tables of raw data are presented in Appendix VII.

Concrete and Formal levels of understanding of the Four Group Task are described, using detailed material from interviews, in Chapter 10, and the relationship of performance on this task to other variables discussed, together with theoretical and methodological implications in Chapter 11.

INTRODUCTION

The unusual and challenging work of Piaget and his collaborators is being slowly incorporated into the body of modern experimental psychology. There is considerable disagreement about the usefulness and validity of his logical models of thought structures, but general enthusiasm for many of his experimental techniques. Interest has been concentrated on the behaviour and thought of children in relatively young age ranges and it is probably the work concerned with the development of conservations, in particular, which has most often been repeated, challenged, or compared with other abilities, by other experimenters.

In most of the work on conservations little discussion of Piaget's logical model of concrete operational thought has arisen from the findings, although Elkind (1967) and others have developed some new ideas about the logical processes necessary for conservation. More direct discussion of the logical model has occurred in studies of classificatory ability (Kofsky, 1966) and in the work of Furth and others (Furth, Youniss and Ross, 1970) on the learning of logical symbols. However specific attempts to evaluate the models of concrete (and formal) operational thought themselves have been left to logicians (Parsons, 1960) and those with an alternative point of view (McLaughlin, 1963). It is not clear how necessary the logical models are considered to be by those mainly interested in empirical work. Thus, while there is now a great deal of evidence confirming that the behaviours characteristic of the Stages of Preoperational and Concrete Operational Thought, according

to Piaget, do occur in children of the appropriate ages, there have been few experimenters taking up theoretical issues concerned with the thought structures themselves. One area in which it has commonly been said that the theory is lacking is that of the role of language in the development of thought (Vygotsky, 1962; Ausubel, 1965, 1968). Considerable attention has also been paid, by some authors, to the relationship of figurative to operative functions in the course of development (Bruner, Olver and Greenfield, 1966; Furth, 1969) but the adequacy of Piaget's description of the operative functions, as such, is infrequently evaluated. Perhaps the lack of theoretical comment stems from the difficulty of knowing exactly what is meant by an "operation", or internalised action, in Piaget's theory; and the even greater difficulty of finding experimental tests, other than those devised by Piaget himself, of whether a child uses such operations in his approach to conceptual tasks or not. The problem is aggravated by the fact that Piaget commonly relies on the comparison of a younger child, who does not use "operations", with an older child, who does, in order to demonstrate their existence. It would seem desirable to be able to describe (for example) concrete operational thought, directly, without recourse to a description of inadequacies which occur in its absence. Perhaps the work of Furth and his associates, on the learning of logical symbols, comes closest to an active description of what a child at the Stage of Concrete Operations can do.

As is the case in most other studies repeating, or relating to, Piaget's work, Furth, Youniss and Ross (1970) are able to locate subjects

in a number of developmental stages which appear to correspond with those described by Piaget (e.g. 1950). In common with a number of other investigators (Smedslund, 1963; Halpern, 1965; Wason, 1969) Furth, Youniss and Ross (1970) suggest that there are conditions under which one may expect a child to "regress" that is to display forms of behaviour characteristic of an earlier stage of development than the one which he has, in fact, attained. Furth, Youniss and Ross (1970) and Halpern (1965) make this point in the context of regression from a concrete operational to a preoperational type of response. Smedslund (1963) and Wason (1969) are suggesting that normal adults, who have presumably attained the final developmental stage (that of formal operational thought) commonly display concrete operational forms of reasoning. Further to this, Furth, Youniss and Ross (1970) suggest that most "concepts" commonly used and understood by adults require only concrete operational thought.

The implication of some of these studies appears to be that formal operational thought will be observed relatively rarely, even in the conceptual processes of mature adults. There are two possible attitudes to such a suggestion. The first, which Smedslund (1963) and Halpern (1965) appear to endorse, is that formal operational thinking is very difficult for any adult to achieve and that it must be expected that earlier and easier modes of thought will persist in many of a person's areas of intellectual activity. The supposition is possibly even that formal training in the use of such advanced reasoning processes is necessary before they can be used. Studies such as those of Johnson-

Laird and Tagart (1969) and Wason (1969) certainly appear to show that adults do not immediately structure the problem in terms of logical relationships which are contained in Piaget's model of formal operational thought. That there may be difficulties involved in the relation of their results to Piaget's theory will be pointed out in a later chapter.

The second possible attitude to the results discussed above entails an endorsement of the spirit of Inhelder and Piaget's (1958) definitive work on the Stages of Concrete and Formal Operations, rather than an adoption of their logical model of the latter stage in too strict a sense. Inhelder and Piaget (1958) do not seem to be concerned with a subject's ability to reason perfectly with logical symbols, presented to him a strict experimental setting. They attempt to show that a subject's laborious, self-directed structuring of real experimental materials (which may be used to illustrate a variety of physical laws) shows whether or not he isolates the variables, understands the principles of experimental control, and is able to deduce the kind of empirical relationships which exist. The logical model is used to describe, in a concise way, the conceptual processes of the subject. These processes are "observable" only in the light of extensive questioning by the experimenter, taking place in the context of the subject's own manipulations of experimental materials. It is probably only under such circumstances as these that most adults, or 12 to 15 year-old children, could be expected to exhibit formal operational thought.

Those who have used exactly the same tasks as Inhelder and

Piaget (1958), have, generally speaking, reported that the stages described by the original authors can be discerned in the behaviour of their subjects (Lovell, 1961; Jackson, 1965; Dale, 1970). Exceptions to this exist in the studies reported by Smedslund (1963) and Neimark (1970), although differences in experimental procedures and scoring techniques may account for these anomalies.

Against this background, the present study aims to provide evidence that a change from concrete to formal operational thinking can be detected, in children between 10 and 15 years of age, using a task not identical to any of those used by Inhelder and Piaget (1958). Rather than constructing a problem which embodies Piaget's model of formal operational thought, directly, an attempt is made to say, from a consideration of that model (and other aspects of Inhelder and Piaget's (1958) descriptions of formal thinking) how a concrete operational and a formal operational subject could be expected to approach and conceptualise a particular problem. The problem chosen is one for which the authors who developed it (Dienes and Jeeves, 1965) isolate two (broad) levels of approach and understanding, but do not interpret these in terms of the differences between concrete operational and formal operational thought.

The succeeding three chapters will amplify the discussion given above of the stages of Concrete and Formal Operations, the logical models put forward by Piaget to describe them, and the relevant experimental evidence provided by Inhelder and Piaget (1958) and others.

Attention will thus be focussed on a very small part of Piaget's total contribution to developmental psychology; namely the transition (said to begin at about the age of 11 or 12 years) from concrete to formal thinking. Discussion of Piaget's theory of development will be limited to those aspects of knowledge (the operative, rather than the figurative), and of the logical models he provides, which are essential to this transition. The discussion of the theoretical and empirical background will conclude with a description of the work of Dienes and Jeeves (1965), which provides the task for the present study, together with an interpretation of their results in Piagetian terms.

This interpretation is then tested by means of a developmental study employing one of Inhelder and Piaget's (1958) original tasks (the Pendulum Problem) as a means of validation of the new task. The study is designed to provide data from relatively large, typical samples of children within each of five narrow age ranges, covering the period of development from 10 to 15 years. This makes it possible to relate the performance on different tasks within samples of children of the same age, thus providing the kind of information seen as desirable by Flavell and Wohlwill(1969).