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A Commentary on the Significance of Recent Cross-Cultural Piagetian Research

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Cross-cultural research has yielded results that show differences between groups in the attainment of Piagetian concepts and the stage of formal thinking. These differences appear more in the area of projective and Euclidean structures than in the area of algebraic or group structures. It is argued that the former, as special cases of topological relations, are transmitted by cultural experiences whereas the algebraic or group structures are universal, basic and fundamental to the acquisition of other concepts. This point of view is supported by examples drawn from a historical Asian document and from recent Piagetian research. The need for future research to be directed towards variables that affect environmental manipulation and the surfacing of skill profiles of different cultural groups is emphasized.

Piaget's theory of cognitive development has been extended to samples from a wide range of cultures[1] and researchers are concerned about findings that are inconsistent with Piaget's theory. The theory was originally considered to be culture free. Researchers are now convinced that differences exist in the rate at which and the extent to which Piagetian concepts and formal aspects of thinking develop. All that cross-cultural research seems to have confirmed so far are Piaget's observations regarding the order of acquisition of some of these concepts and the invariant sequence of the stages of development.

One probable reason for the confirmation of the invariant sequence of the development of cognition can be attributed to the nature of Piagetian theory. According to it, the active organism, the individual- in the process of interaction with the environment generates 'operations' according to which he interprets the world. Once the foundation is laid in the form of a set of operations performed upon the raw data of experience, new structurea would emerge and they would in turn be employed in further intellectual activity. One of the postulates of

1. P. R. Dasen, (ed), (1977) *Piagetian Psychology, Cross Cultural Contributions*, Gardner Press, New York.

structuralism which is Piaget's philosophical standpoint, is that intellectual development takes the form of a gradual approximation to higher and still higher states of equilibrium, always passing from a simple to a more complete structure. In this sense the structures are ordered.

This aspect of Piaget's theory and the fact that it has been cross-validated in a great many cultures is a great contribution. It provides a hopeful alternative to the previous modes of looking at intelligence and intellectual development – namely the innateness of human reason on the one hand and the permanence of the human intellect on the other. Piaget's theory shows human reason to be the product of an evolving process of construction. It is a positive attitude which holds a ray of hope for each of the so-called primitive cultures as well as for the whole of mankind for whom the process of evolving higher and more and more complex structures seem possible However, any positive steps in the direction of promoting the acquisition of Piagetian concepts or development through the stages require that reasons for cross-cultural differences be explained.

A possible explanation lies in another assumption of Piaget's theory– namely, that operations depend upon the subject's activities which lead to an interaction between the hereditary codes and an environment generally being manipulated by the child. Only if we assume a common basis in the activities of all subjects in all parts of the world in manipulating the environment can we expect common structures to emerge. Granted that all environments are 'manipulable' one still has to take into account – 1) differences in the environmental milieu; 2) the extent to which the environment is actually manipulated and 3) the nature of this manipulation, before one can assume a common basis in the activities of all individuals.

The extent of environmental manipulation is important in still another way. New structures are always built upon old structures and the necessity for the construction of new structures 'instead of being an a priori condition for learning – is its outcome'[2]. Therefore, it is always ongoing activity that generates the need for further activity and for further structures. The question needing an answer is whether all subjects or groups of subjects manipulate the environment to the same extent and at the same level. However, most research so far has bypassed direct concentration on this aspect of the problem and tested the influence of different environmental variables such as schooling, urban–rural differences, and language.

2. J. Piaget, (1971) *Structuralism* (English translation) Routledge, p. 62.

Results of cross-cultural studies such as that of Lourendeau-Bendavid[3], have shown that there are performance differences due to educational variations and that the stage-concept was not substantiated with partially schooled and unschooled Rawandese children. This research also showed that such effects were apparent for certain structures-namely those which appealed to verbal representation or are reinforced by conventionalized modes of verbal expression and are for this reason more subject to the influence of schooling. It means that lack of schooling does not affect all structures to the same extent. Leurendeau-Bendavid concluded that school attendance is an essential and perhaps necessary factor in stimulating intellectual development. This may be more so in underdeveloped cultures although in the West schooling may be redundant. Piaget himself remarks about the necessary but insufficient role of schooling in the elaboration of formal thought[4].

Similarly, research on urban-rural differences in cognitive development has produced data which show that situational factors and particular experiences facilitate the development of certain concrete operational tasks. Kiminyo[5] showed that for Kenya children the time lag between acquisition of conservation in weight and volume is not as distinctive as it is with American children because of the environmental factor. Subsistence agricultural life of the Kenyans leads to much experience with practical and concrete use of material as opposed to the much more abstract and analytical thinking emphasized by Western education. Similarly Price-Williams[6] showed that on all five tasks of conservation on which he tested a group of potters' children and a control group the former performed better than the latter although the results were not significant. All these tests suggest the important role of manipulation of substances in the attainment of conservation.

Berry and Dasen[7] report a study on urban-rural differences conducted by Peluffo in Italy. Peluffo concluded that slow cultural level or an underdeveloped milieu does not stimulate the development of operational thinking.

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3. P. R. Dasen, op. cit.

4. J. Piaget, (1964) "Development and teaching" in *J. of Research in Science Teaching*, 2 (3), pp. 176 – 186.

5. D. M. Kiminyo (1977) "A cross-cultural study" in P. R. Dasen (ed) *Piagetian Psychology: Cross Cultural Contributions*, Gardner Press, New York.

6. D. R. Price Williams, (1977) "Skill in conservation: A study of Pottery making children" in *Developmental Psychology* 1 (6) p. 769.

7. J. W. Beryy & P. R. Dasen, (eds.), (1974) 'Culture and Cognitition", *Readings in Cross Cultural Psychology*, Methuen and Co. Ltd.

Thus although many studies have presented data that show some relationship between specific environmental variables and qualitative and quantitative aspects of cognitive development of the sort Piaget outlined, unless cause and effect relationships between these can be established, they would be of little use to educators.

Some general observations on recent research findings on the development of different Piagetian concepts may help us to get a clearer picture of another aspect of the researcher's problem as it stands today.

According to many research findings 'conservation' is achieved by most children in most cultures even with a certain amount of delay. This could be due to the fact that ability for conservation does not presuppose structural rules which include other related operations as in the case of classification. Conservation tests are the first series of tests Piaget uses to look for signs of transition from the pre-operational to the operational stage, and it is considered to be one of the important components of this transition. Its presence actually indicates the child's ability to decentre perceptual clues and attend to more than one property of the stimulus situation at a time, ability to pay increased attention to transformations, and ability for reversible cognitive actions, all of which are signs that the child is leaving behind intellectual egocentricism. Sometimes children achieve conservation during the process of being tested. It is another indication of its basic position among cognitive abilities Piaget speaks of.

Beyond this transition, Piaget[8] outlines three parent structures which correspond to coordinations that are necessary for all intellectual activity namely:

1) topological structures; 2) order structures and
3) algebraic or group structures.

The topological structures categorise spatial acquisitions. They yield classes in terms of proximity, order, enclosure and continuity. The following example is a test Piaget designed to explore this ability. The child is made to explore manually various objects placed behind a screen and is asked to match each shape with duplicates that are visible. Then in the second step he is called upon to draw the objects he has handled unseen. He is able, by the age of 3 or 4, to discriminate objects on the basis of topological properties (for example, closed from an open figure; a figure with a hole in the middle from one without a hole etc.). However,

8. J. Piaget, (1964) op. cit.

it is not until the child is 11—12 years old that he grasps the notion of continuous wholes, tested by the experiment of cutting a length of paper continuously into halves to find out whether he knows that a continuous whole is made up of shapeless points.

Piaget also makes use of Projective and Euclidean geometric structures to map out conceptions of space. These take account of the properties of the topological structures and add other properties which remain perceptually invariant under changes in the point of view from which a figure is looked at (in the case of projective geometry) and properties such as angularity, parallelism and distance (in the case of Euclidean geometry).

Most topological relations become integrated into operational systems around seven years although Projective and Euclidean structures appear only around 9 and 10 years of age according to Piaget. Thus, in the process of development topological structures precede Projective and Euclidean structures. Piaget also mentions that Projective and Euclidean geometrics can be considered as special cases of topology.

It is in the tests designed to probe these abilities and not in tests of conservation, that performance differences among cross-cultural samples are most common. The results point to two different reasons for this commonality.

First, it is possible that Projective and Euclidean geometry are aspects of a culture and their apparently greater tangibility in Western cultures is due to the fact that they have been formulated and have been the objects of intensive study and application. Their elements and operations are thus more explicit in the West.

The second reason could be that even in cultures where Projective and Euclidean geometrics have been in active use by the people, as special cases these topological relations are transmitted by cultural experiences such as play materials, schooling etc.

Thus one problem for future research is to carry out ethnographic studies which would reveal the particular modes of calculi in a given culture. A problem common to the acquisition of all parent structures is that they depend on the subject's activities. As mentioned before we cannot assume that all cultures down the ages have been equally active in the same areas of thinking. Thus it is extremely important for ethnographic studies to expose and explain areas in which there has been reflective abstraction in particular cultures.

I wish to substantiate this statement with an example from the culture of Sri Lanka.

The 'Mahavamsa'[9], the earliest literary record of Sri Lanka's history, narrates the encounter between Rev. Mahinda who brought the Buddha's message to Sri Lanka in the 3rd century BC and the then King of Sri Lanka—Devanampiya Tissa, in the following terms:

"To test him (the king) that most wise thera now asked a subtle question, and even as he was questioned the monarch answered the questions severally.

"What name does this tree bear, O king?"

"This tree is called a mango"

"Is there yet another mango beside this?"

"There are many mango trees"

"And are there yet other trees besides this mango and other mangoes?"

"There are many trees, Sir; but these are trees that are not mangoes"

"And are there, besides the other mangoes and these trees, which are not mangoes yet other trees?"

"There is this mango tree, Sir"

"Thou hast a shrewd wit, O ruler of men!"

"Hast thou kinsfolk, O King?"

"They are many, Sir"

"And are there also some, O King, who are not kinsfolk of thine?"

"There are yet more of those than of my kin"

"Is there yet, anyone besides the kinsfolk and others?"

"There is yet myself, Sir"

"Good thou hast a shrewd wit, O ruler of men!"

When the Ven. Mahinda realised that the king was a keen witted person, the wise thera preached to the monarch the Cullahatthipadupama Suttanka.[10]

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9. Mahavamsa, the Pali chronicle of the early history of Sri Lanka, was composed by a Buddhist priest called Mahanama in the 5th century A. D. The incident referred to namely the introduction of Buddhism to Sri Lanka, took place in 247 B. C. Geiger (1912) belives that the Chronicle is based upon older materials and for this reason should be regarded as a source of history. There was a literary traditlon in the country from the 1st century A. D. prior to which the Buddhist priests kept up an oral tradition.

10. W. Geiger, (1912) Mahavamsa, Oxford University Press, pp 92—93.

It is as if the Buddhist concept of cognitive functioning and cognitive development had anticipated an essential feature of Piaget's theory by over 2000 years. It shows their belief at the time in a system of thought at work, in the ascending degrees of complexity in thought and in a basic minimum level of thought structure one should have reached in order to understand the complex and abstract teachings of the Buddha. What is important to me is that the algebraic or group structures these questions represent-one of the three parent structures in Piagetian theory-was either considered fundamental or perhaps initial and necessary for the acquisition of any complex and abstract concept.

This example also shows that what we call the scientific enterprise is the flowering of a dimension of discourse which already existed in what historians call the pre-scientific age.

It is useful to examine when a child is said to possess a full-fledged operational structure of classification or class inclusion and exclusion embodied in the questions put to the king. Piaget says it is a subtle and hard to diagnose but nevertheless crucial ability to grasp and keep constantly in mind the inclusion relation obtaining between a class and its subclassess, to recognize that a subclass 'A' is included in class 'B' but does not exhaust it and to keep this A-B relation firmly in mind across all manner of changes in the spatial distribution of class and sub-class or in one's distribution of attention between them.

For Piaget, the initial mastery of this inclusion relation with all that its mastery implies is the sine-qua-non of concrete operational cognition of logical classification.

It is also important to note that the presence of a given operation presupposes a structural system which includes other related operations which may be latent at the moment but potentially actualizable themselves.[11]

Another observation I wish to make is that there is a fundamental difference in the position adopted by empiricism and structuralism regarding the basic competences as well as the nature of acquisition of these competences. Empiricism postulates only the most general intellectual capacities, for example the ability to form associations and logical reasoning in order for particular environments to teach the organism particular

11. J. H. Flavell, (1963) Developmental Psychology of Jean Piaget D. Van Nostrand, Princeton N. J.

concepts. Structuralism on the other hand allows that some particular physical competences as well as general processes like logics are developed only by the interaction of hereditary codes and an environment generally amenable to being manipulated by the child. The important question is whether it is possible to agree that logical reasoning such as that implicit in classification and class inclusion – exclusion is basic and fundamental (irrespective of how they acquire it) for the acquisition of other 'concepts' through contact with environments that are generally amenable to being manipulated.

I place within quotes the phrase 'acquisition of other concepts' concepts of invariance of quantity, weight, volume, area, etc.; concepts of time, movement and velocity: concepts of space, geometry and chance and so on. These concepts must first be achieved at a concrete level for them ever to be applied beyond the actual to the potential.

It is also important that it is in the acquisition of the above concepts that most cross-cultural research has yielded diverse results.

Let us turn to recent research for evidence of the presence of the algebraic structures,

Kelly[12] states that for the Papua New Guinea children he tested the level of success in the class inclusion task is high for all groups at all levels of the hierarchy. He believes that 'the basic intellectual structures to be developed in Papua New-Guinea children are those dealing with hierarchization or to construct lattices of increasing class inclusiveness. The presence or absence of these lattices seem to correlate with success in the current *Western Style* school system. It may be that this is an intellectual structure more basic to humans than some of the others which Piaget ascribes to Western children. Or it may be a necessary condition for development through the Piagetian stages'.

A recent statement made by Piaget regarding the development of the stage of formal operations even in Western cultures needs some examination.

He maintains that all individuals reach the stage of formal operations if not between 11 and 15 years of age, at least between the years 15 to 20. However, they reach this stage in different areas according to their aptitudes and their professional specialization.[13]

12. M. Kelly, (1977) "Papua New Guinea and Piaget" in P. R. Dasen (ed) Piagetian Psychology: Cross Cultural contributions, Gardner Press, New York.
13. P. R. Dasen, (1977) op. cit., p. 6

What does this concession imply? First, all do not reach the stage of formal operations in all the areas represented by his three parent structures and second it depends on individual aptitude and area of professional specialization.

Piaget also enumerates[14] a number of factors that affect cognitive development. Among them are: (1) biological factors linked to the epigenetic system; (2) equilibration factors which depend on epigenetics potentialities such as intelligence and on environmental circumstance; (3) modes of interpersonal exchange and socialization and (4) educational and cultural transmission. Of these only the first could strictly be called common to all. Piaget however assumes that social life of children among themselves which come under the third factor mentioned above is common to all societies.

The implication of these observations, however, is that it is almost futile to carry out further replication studies to test for the presence or absence of Piagetian concepts in cultures remote from the dominant cultures. What is required would be more research on variables that affect, limit or determine the quality of environmental manipulation on the one hand and ethnographic studies of particular cultures to surface the skill profiles nurtured by each of them, on the other. Once this is accomplished our knowledge of factors that lead to variations will pave the way for effective means of bringing about improvement.

14. J. W. Berry & P. R. Dasen (eds), (1974) op. cit.