Hum. Dev. *21:* 170–189 (1978)

Piaget's Theory and Cultural Differences

The Case for Value-Based Modes of Cognition

James Mangan

University of Massachusetts, Amherst, Mass.

Key Words. Cognitive development · Cross-cultural differences · Cultural test bias · Modes of cognition · Paradigms · Piagetian tasks · Values

Abstract. Tests in non-Western cultures often reveal either a slower acquisition of conservation skills or a general inability to conserve. While many research efforts correlate conservation with formal schooling, more fundamental social and cultural influences are at work. Success in performing conservation tasks depends on familiarity with methods of analyzing the physical world that are not pan-cultural. Piagetian tasks are rooted in current scientific paradigms. These paradigms constitute cultural conventions integral to Western world views, conventions to which a great many cultures do not yet adhere. The theory of genetic epistemology assumes that the view derived from adherence to such paradigms is correct, and therefore contains an inherent cultural bias. To clarify the cultural and epistemological factors which contribute to test performance, two broad modes of cognition, based on cultural differences in beliefs and values, are suggested: the mythicomagical and the empiricoscientific. While the cognitive skills involved in Piagetian conservation are derived from an empiricoscientific mode, they may undergo negative reinforcement in cognitive domains characterized by the mythicomagical mode. While one or the other mode may be found to be predominant within a given culture, these modes of cognition more aptly describe the kind of thinking in emically defined cognitive domains.

Broad similarities which characterize the behavior of all humans have stimulated speculation that all human thinking must have concomitant similarities. The crises of life defined by anthropology, while dealt with differently in each culture, characterize the lives of virtually everyone. Certain inventions – the bow and arrow and the blowpipe to name just two – seem to have been

invented independently by different human groups occupying similar ecological environments on entirely different continents. The history of science in China and the West display certain very striking parallels (*Needham*, 1956, p. 63; *Sambursky*, 1964, pp. 237–238). It is not surprising, therefore, that there have been efforts throughout the history of both psychology and anthropology to seek for universals in human thinking. The strongest current proponent of the existence of universal processes of thought is the psychology of *Jean Piaget*.

Piaget (1974, pp. 300–303) names four sets of factors which can influence the development of the individual: (1) biological factors; (2) equilibration factors; (3) social factors of interpersonal coordination present in all cultures (p. 302), and (4) factors of educational and cultural transmission which vary from culture to culture. It is primarily with this fourth set, seen by *Piaget* as only one of many influencing cognitive development, that we are herewith concerned. *Piaget* discusses two of the 'main' cultural factors of educational transmission; educational activities of adults (as they affect children) and language itself. Others are not enumerated. He has furthermore remarked (p. 303) that cultural differences in classification are due to language differences, implying (*Dasen*, 1977a, p. 4) that only content of classification systems differ culturally. This paper will claim a deeper basis in values and beliefs for cultural differences in classification systems, and that different values and beliefs shape both form (*Buck-Morss*, 1975, p. 41) and content of these systems (see discussion of cultural frames of reference below). Fundamental values and beliefs which vary culturally can also affect cognitive testing. Far from remaining free from cultural bias, tests for conservation and formal operations reflect notions of validity conveyed by modern scientific paradigms, themselves cultural conventions. *Greenfield* (1976), for example, has noted that development is impossible to understand unless one has a picture of the end toward which it is developing, and has commented that the assumed endpoint in Piagetian cognitive development would seem to be a Western scientist. Other endpoints could conceivably result in alternative developmental sequences or other cognitive skills. The point will be made that values and beliefs constitute an important influence on cognitive development, one which must be accounted for in future research design. Finally, two modes of cognition stemming from culturally based epistemological assumptions – the *mythicomagical* and the *empiricoscientific* – are proposed. A persuasive test for the universal existence of Piagetian cognitive structures is contingent on redefinition of the 'secondary' role of educational and cultural influences in cognitive development (*Dasen*, 1977a). To accomplish this redefinition, more 'emic' cross-cultural experimentation (*Dasen*, 1977b) –

experimentation into which the influence of culturally relative 'epistemological assumptions' (*Lawrence*, 1964) or 'primitive beliefs' (*Rokeach*, 1968) has been factored – is required.

Piaget's Theory

Piaget (1950) has put forward the claim that cognition develops in stages, the sequence of which is invariant for all humans. This is based on the view that cognition is as much an adaptive strategy for the individual human organism as are other more fundamental biologic functions, and that cognition, like biological regulations within the body, develops as a device to maintain dynamic harmony between the organism and the environment within which it must survive.

Equilibration is the regulatory process by means of which assimilation and accommodation are kept apace. *Piaget* (1970a) himself views equilibration as the cognitive counterpart of autoregulation in the organic process of embryogenesis through which the development of the many systems of the embryo (e.g., vascular, nervous, endocrine) as well as its organs and organ complexes is all kept in phase. On the cognitive level, it is equilibration which keeps the system from becoming lopsided or dysfunctional, which assures that learning proceeds at a pace neither too abrupt nor too lethargic for the organism's survival needs.

It is important to note that *Piaget*'s own observational research took place in a European cultural environment, and that his claim that cognitive structures are universal stems from his conviction that, like the fundamental attributes of the human organism itself, basic cognitive structures are common to all men and women. His conception of cognitive development is based on strict analogy with physiological development.

In both its origins and its implicit valuations of knowledge, *Piaget*'s theory is rooted in the Western scientific view of the world. Its assumptions, assertions and criteria for validity all stem from Western scientific paradigms – a point discussed in greater detail below. To *Piaget*, the scientific conception of the world is a reflection of a natural adaptive capacity innate within the human species. Science is a method which reveals to us the very structure of nature itself. The world we see, hear, smell, touch and taste is a world we have an inherited capacity to apprehend (*Piaget*, 1970b, p. 6). According to this view, our cognitive structures are adapted to reflect the inherent structure of the universe itself. *Phillips* (1969, p. 111) has noted that *Piaget* 'is convinced that

the rules of logic have developed out of the interaction of humans, both phylogenetically and ontogenetically, with the exigencies of living in a lawful universe'. Logic, in other words, is inherent in the universe. *Piaget*'s argument asserts the evolutionary adaptability for the human species of logicomathematical thought (*Piaget*, 1970a, p. 100). In contrast, *Luria* (1976) and *Cole et al.* (1971) argue that cognitive skills are primarily *culturally* induced and that any search for cognitive universals across cultures is off target. Primarily linguistic interpretations – like the *Sapir-Whorf* hypothesis (1956) which states that grammatical categories and the thought patterns they regulate are the arbitrary impositions of culture, not the lawful reflection of nature – are also at odds with Piagetian theory.

Cultural Factors in Cognitive Growth

Claiming that any theory of psychology remains conjectural 'as long as the necessary cross-cultural material has not been gathered as a control', *Piaget* (1974, p. 309) has emphasized the need for cross-cultural research of his theory. *Dasen* (1974a) identifies two kinds of general influences on the acquisition of conservation skills; schooling and European contact. Both influences are cultural in nature. Referring to conservation tests she conducted among Australian Aborigines, *de Lemos* (1969, pp. 264–265) says, 'because the Aboriginal society does not appear to recognize or encourage the development of concepts of conservation, these may not be clearly formulated even when the operational capacity is present. In this case it is likely that a little experience with the test situation would be sufficient to develop the concepts.' Her argument indicates that acquisition of conservation skills is dependent on emphasis within the culture.

Prince (1968) attributes acquisition of conservation to schooling alone. His data from Papua New Guinea suggest a strong correlation between school grade level (*not* chronological age) and ability to conserve. More recently, *Laurendeau-Bendavid* (1977) has assembled evidence for a more complex and less straightforward stimulation of cognitive development by schooling, while in contrast, *Kiminyo* (1977) has argued that schooling does not promote conservation among the Kamba of Kenya, but that, rather, rural Kamba children, daily exposed to traditional activities of buying and selling of produce and distribution of food and livestock, learn to conserve *earlier* than their urban counterparts. In either case, culturally sanctioned activity plays a strong, focusing role.

Heron (1974) suggests that in addition to schooling and European contact, the cognitive 'ambience' within which children develop must be considered an important influence on acquisition of conservation. And in another study done with Australian Aborigines, *Dasen* (1974b, pp. 407–408) concludes that 'social and cultural factors are more important for cognitive growth than *Piaget* has hypothesized. The present research ... stresses the importance of *Piaget*'s fourth factor' (i.e., educational and cultural transmission). Finally, *Dasen* (1977a, p. 5) has characterized the current picture of cultural influences on development as 'much more complex than was thought at first'. Particularly regarding the rate of development through the stages, recent cross-cultural research displays considerable cultural variation.

Precisely *how* cultural differences affect cognition is as yet poorly articulated in the theory of genetic epistemology. Dealing for the most part with the rational interaction between the individual and his physical environment – with 'autonomous equilibration' (*Piaget,* 1974, p. 309) – the theory is not yet able to satisfactorily explain culturally conditioned differences in cognitive development. If culturally-based belief systems impell or impede acquisition of cognitive skills, then how does this interplay between beliefs on the one hand and accepted methods of generating and verifying knowledge on the other affect cognitive growth? In an attempt to clarify the relationship between beliefs and cognition and the consequent influence of beliefs on cognitive testing, we first turn to a description of a case in which values differences between two cultures led to radically different conceptions of human problems, then to a discussion of scientific paradigms as cultural conventions, and finally to an analysis of conservation and a discussion of possible different modes of cognition.

A Cultural Basis for Values Differences

Values vary from culture to culture. *Kluckhohn and Strodtbeck* (1961) conducted extensive surveys among five ethnic communities within the United States, and found considerable differences along ethnic lines in values having to do with human relations, time, man's relation to nature, and activity. Conception of human relations varied among orientations labelled individual, linear and collective. Time orientations likewise varied, depending on ethnic background, among orientations toward past, present or future. The man-nature relationship visualized man as either subject to nature, working together with nature, or in

control over nature. Activity values emphasized either being or doing. To *Kluckhohn and Strodtbeck,* value orientations are the patterned outcomes of interplay between the *cognitive,* the *affective* and *directive* elements 'which give order and direction to the ever-flowing stream of human acts and thoughts as these relate to the solution of 'common human problems' (p. 341). They thus claim cognition is integrally involved with values. *Rokeach* (1968) has described the important role of what he termed 'primitive beliefs', fundamental beliefs rooted in individual experience and reinforced by total social consensus. *Rokeach* states it is upon these that other 'derived' beliefs – including social attitudes and opinions – are based. He asserts that it is the nature of primitive beliefs to persist unquestioned in most societies.

The degree to which such beliefs persist and the power with which they mold one's world view are documented in *Lawrence*'s (1964) history of the cargo movement in the Madang District of Papua New Guinea. The people he describes believed all their material culture to be the product of the intersession of their gods. The most important human activity was thought to be engaging in ritual to manipulate these gods from whom all material culture was derived. It was therefore only reasonable to assume that the (to the Papuans) remarkable material culture of the European colonialists, who began arriving in their land in the late 19th century, must be due to European ritual control over superior deities. Their actions were quite reasonable in light of what *Lawrence* (1964, passim) termed their 'epistemological assumptions', which are virtually the same as 'primitive beliefs'. Their subsequent efforts to learn all of the Bible stemmed not, as it turned out, from their newfound Christian zeal, but rather from a desire to gain control over European deities with their vast capacity to bestow material wealth.

European and Papuan values clearly differed along the dimensions described by *Kluckhohn and Strodtbeck. Lawrence* describes the Papuan cosmos as fixed, timeless, material and finite, with no distinction made between the natural and the supernatural. Papuan human relationships with strangers were face to face while Europeans tended to treat strangers according to a set of abstract principles. Papuan conceptions of human activity viewed man foremost as a conductor of ritual, while the European viewed man – especially the Papuans – as a producer of goods. These value differences resulted in conflicting formulations of both the human problems at play in this cultural encounter, and the solutions to those problems. For the Papuans, it was only logical to acquire the European religion and, when that failed to produce the 'cargo', to incorporate European rituals into new 'cargo cults' to see if this would produce the goods. To the

Europeans, who controlled the cargo, the only problem was keeping the natives in line and on schedule.

As was the case in Papua New Guinea, both formulation and solution of 'common human problems', a process involving the exercise of cognition, might be expected to differ between cultures predominantly characterized by magical conceptions of causality on the one hand (in this case, the Papuans), and those entertaining empirical notions of causality (the European colonialists) on the other. It is precisely this difference *Lawrence* documents. Human problems are not purely cognitive in nature; they are suffused with values and beliefs that are not necessarily pan-cultural. It may be that isolation of cognitive elements from the many other ingredients involved in human problem solving can only be approximated in cross-cultural cognitive testing.

Paradigms as Cultural Conventions

Kuhn (1970) has described the history of science in terms of the replacement of older 'paradigms' less able to explain the universe, by newer ones capable of bringing order and understanding to a greater range of perceived phenomena. According to *Kuhn,* the history of Western science from the ancient Greeks to modern times has been characterized by a succession of ever more powerful paradigms. In technologically advanced societies not only virtually all scientists, but a very large segment of the population at large adhere to the formulations of theories and laws, as well as to the broad conception of the universe, which these paradigms convey. *Bronowski* (1965, p. 38) has noted that science brings with it its own 'test of truth', its own integral standards of verification which stand independent of social authority.

Paradigms are social conventions. In societies adhering to current scientific paradigms, only a minute number of people are actually engaged in testing their assumptions on an empirical basis. The rest of us carry on simply believing them to be true, and change our beliefs only reluctantly when the authorities (usually scientists) inform us that a 'scientific revolution' has occurred.

Piagetian theory, together with the experimental tests used to verify that theory, implicitly conveys to experimental subjects scientific notions of causality. Such notions are adhered to as social conventions. The following example illustrates how this can affect interpretation of Piagetian task performance.

Piaget himself (1970, p. 84) points out that Aristotle viewed the flight of projectiles much as does a Geneva schoolboy. Not yet having access to New-

tonian mechanics, Aristotle could not but conclude, according to the notions then adhered to, that a projectile remained aloft not due to the initial force imparted to it, but rather because it floated on a cushion of air which its own forward motion had displaced. On the surface it would appear that Aristotle had not reached formal operations. But the propositions from which Aristotle derived his explanation were not Newtonian paradigms; without benefit of Newton's formulations he could only come to conclusions consistent with paradigms then current – paradigms which he himself was active in reformulating.

The Aristotelian paradigm, which did not clearly stipulate an empirical standard of validity and came historically to value speculative contemplation above observation, came to be so universally adhered to in Europe that when Galileo rendered it obsolete with his controlled experiments, the result was a major social trauma. The point is that such paradigms come to constitute a set of beliefs, and exert a powerful grip on observation. Indeed, *Pearce* (1977, pp. 5–6) believes this grip to be so strong and considers disagreements on the level of theory to be so fundamental that it may be impossible for the people disagreeing to even agree on a set of observations that would allow them to resolve their dispute. In his comparison of Western and traditional African thought systems, *Horton* (1967a, b) concludes that belief systems can exert a profound influence on modes of thought.

Scientific paradigms, schools of thought and religious and magical beliefs constitute social conventions which can affect performance on cognitive tests. Paradigms bring with them notions of validity which are culture-specific. Conservation is a skill emphasized in Western scientific paradigms, a skill generally believed (whether explicitly or implicitly) to be necessary for functioning in a Western cultural environment. *Buck-Morss* (1975, p. 36) has remarked that one cannot account for the frequent chronological lag in test performance of non-Western samples without also implying the cultural superiority of the West. Piagetian cross-cultural research has implicitly been testing members of other cultures for their acceptance of social conventions to which they may not adhere. Unless it is assumed *a priori* that our scientific kind of reasoning with its paradigms and notions of validity is inherently superior to other modes in explaining phenomena perceived by *all* humans, we run the risk of stating only that, on an empirical basis, the empirical method is superior to all other forms of explanation – that all knowledge is empirical in nature. Such an assessment could only be self-vindicating. Itself rooted in current Western scientific paradigms and therefore assuming the values of validity within those paradigms to be

superior, Piaget's theory cannot claim to be free from cultural bias. But we are seldom convinced by nonscientific standards of validity, and are reluctant to accept a less rigorous yardstick of validity as a social standard. If the empirical approach is not assumed to be more valid than some other, not only is the universal existence of cognitive structures impossible to verify, but the very existence itself of cognitive structures remains impossible to frame.

Cultural Frames of Reference and the Conservation Task

Conservation tests are valid only within limited and controlled circumstances. Conservation of volume tests, for instance, are scientifically based on known behavior of substances within specific circumstances. For example, the volume of a given amount of water is conserved when poured from one beaker to another only within a limited time frame. If, however, a beaker of water were to be left in a vacant room overnight, volume would not be conserved. Some water would be lost through evaporation. Or if the same beaker of water were frozen, the volume occupied by the resultant ice would be greater than that of the water that had produced it. In either case, an imperceptible amount of water would be lost through evaporation anyway.

In each of these cases a different characteristic of water (not cognition) is at issue. Water behaves in different ways in different circumstances. The test subject must be familiar with the behavior of water within those specific circumstances presented in a conservation of volume test in order to correctly determine whether or not volume is conserved. While such difficulties in testing for conservation of volume are for the most part taken into account, there may be other characteristics of water, clay and other substances that persons from different cultures are more familiar with than are Europeans – ocean wave behavior among Puluwatans, for instance (*Gladwin*, 1970), or perhaps evaporability of water among desert nomads.

Bronowski (1965) offers an interesting example of a similar kind of cultural bias that may be affecting cognition.

> In the village in which I live there is a pleasant doctor who is a little deaf. He is not shy about it and he wears a hearing aid. My young daughter has known him and his aid since she was a baby. When at the age of two she first met another man who was wearing a hearing aid, she simply said, 'That man is a doctor'. Of course she was mistaken. Yet if both men had worn not hearing aids but stethoscopes, we would have been delighted by her generalization (p. 37).

That doctors characteristically wear stethoscopes and not hearing aids is culture-bound; yet there is a 'correct' answer. More accurate would be a statement like 'within Western cultures we may infer with high probability that a mean wearing a stethoscope is what is called a doctor, a healer of certain sicknesses we identify in our society'. Likewise, when conservation tasks are performed correctly, an equally conditional answer is called for, one which might read, 'when water from a short, wide beaker is poured into a tall, narrow beaker, the amount of water in the second beaker is so nearly the same (discounting loss through evaporation during pouring and a few drops left adhering to the first beaker) that we culturally sanction the statement "the volume is the same" as being consistent with the laws of science which we identify'.

Familiarity with Materials

Price-Williams et al. (1974) found that children from pottery making families in Mexico learned to conserve substance earlier than those from families practicing other trades or skills. Moreover, unlike in Europe, conservation of substance occurred *before* conservation of number, liquid, weight and volume. The authors conclude that 'the role of skills in cognitive growth may be a very important factor. Manipulation may be a prior and necessary prerequisite in the attainment of conservation' (p. 352). *Cole et al.* (1971) and *Cole and Scribner* (1974) have commented extensively on the use of appropriate materials in cross-cultural testing. Their findings generally indicate that familiarity with materials promotes successful task performance. An alien apparatus significantly inhibited successful performance of an inferential task otherwise easily accomplished (*Cole et al.*, 1971, p. 206).

Does Conservation Reflect Nature?

Conceptions derived from the law of conservation of matter and energy as well as from atomic theory – conceptions neither recognized nor adhered to by a large percentage of the world's peoples – seem to be implicit in conservation tasks. For example, a medieval alchemist producing pure mercury from its sulfide, cinnabar, thought he was transmuting one substance into another. He moreover conceived the universe as generally capable of undergoing such transmutations, and would perhaps have thought the principle of conservation of matter and energy or atomic theory to place undue limits on this characteristic of mutability. Chemical changes are now seen to obey inherent laws of nature rather than the ritualistic legerdemain of the alchemist. But ideas similar to the alchemist's are still prevalent.

Conservation of volume. Children in many cultures witness leavening bread dough expand in apparent violation of conservation of volume. The amount of highly compressible substances like goose down can be better estimated by the texture of the pile than by its volume. Science informs us that water has certain properties, among them incompressibility. As noted above, a change of test circumstances either in terms of time or temperature could easily render the volume of a beaker of water quite variable. When dealing with gases, however, volume is *not* invariantly conserved. Instead, volume expands to the shape of the container. If the container is elastic – say a rubber tire – the container itself will expand with a rise in temperature; pressure rises with temperature according to Charles' law. So conservation of volume cannot be tested with quantities of colored gas contained in closed beakers, nor can pressure of a gas be expected to remain constant over a range of differing temperatures. Demonstration of conservation of volume virtually requires a liquid.

Conservation of substance. Nor can substance be conserved in all liquids. Ethyl ether, the common anesthetic, is so volatile that perceptible amounts of it evaporate from an open container within mere minutes. On top of that, ethyl ether is hygroscopic; that is, as it rapidly evaporates, the pure ether replaces itself with water from the ambient atmosphere. Not only is volume variable, so is the very substance itself.

Conservation of weight. With regard to conservation of weight we should recall that there was a time before mass-volume relationships for specific substances were recognized by Archimedes, and that Aristotle thought heavier objects fell faster than lighter ones. Modern conceptions of weight incorporated in *Piaget*'s theory are largely indebted to Newton and others. Among the many inventions of Leonardo da Vinci is a hygrometer – a device for measuring humidity (unauthored IBM publication). His hygrometer consisted of a simple balance with a wad of cotton on one side and a counterweight on the other. As atmospheric humidity increased, the cotton absorbed water and became heavier than the counterweight. As it decreased, the cotton dried out and became lighter than the counterweight. A simple gauge attached to the fulcrum of the balance indicated atmospheric humidity in increments. Leonardo built this hygrometer on the principle that the weight of the cotton wad will vary with humidity. Without introduction to the science behind such a hygrometer, the naive observer may well conclude that the weight of the cotton is not conserved. Again, the tests of weight are based on scientifically defined – not universally apparent – notions.

Some might argue that this point – that conservation is indeed imposed by the mind on a nature that itself never really simply conserves – bears out the Piagetian premise that knowledge is *constructed* by the learner. However, it seems inconsistent with *Piaget*'s assertion that the mind has evolved to accurately reflect an actual nature. Moreover, it indicates that conservation itself can only be perceived within the confines of conventionally recognized paradigms which differ from culture to culture, and which themselves constitute distinct frames of reference (see discussion on Puluwat navigation below). If conservation is mere cognitive superimposition of structure on phenomena that are always more complex, and if that superimposition takes place within the limits of reference frames which are culturally relative, the methodological problems involved in determining the universality of conservation in particular or Piagetian structures in general, have yet to be surmounted.

Non-Western Paradigms and Formal Operations

Formal or propositional operations to *Piaget* mean the ability to employ hypothetico-deductive reasoning. What that means is the ability to derive from a hypothesis all of its possible logical conclusions, or to deal with all possible combinations in a systematic fashion (*Ashton*, 1975, p. 485). The concepts which are utilized in this type of testing are concepts related to Western scientific learning, to which there are alternatives. One such alternative body of knowledge with its own theory and set of concepts is found on the Puluwat atoll in the Central Caroline Islands.

Gladwin (1970, p. 113), referring to the craft of canoe building on the Puluwat atoll, states that 'the design and operation of Puluwat canoes is governed by an explicit theory, a body of knowledge expressed in cause and effect terms'. He goes on to point out that the bow and stern of a Puluwat canoe are blunt, and that:

'At a naive level, one expects a hull to be sharp in cleaving the water, not blunt, and most small Western boats are built this way. It is surprising, too, however, because the bluntness conforms to the principles which have been worked out as preferable only in recent years in low tanks and model basins in the United States and elsewhere. Furthermore, this research has indicated that a wide range in the amount of bluntness frequently makes little difference in performance, precisely as the Puluwat builders contend. That they are right is attested to also by the very small bow wave which the Puluwat sailing canoe produces despite its bluntness even when it is traveling quite fast' (p. 123).

Ikuliman, the most accomplished of the Puluwat canoe builders, formed the hull of his canoes with two separate parallel contours. Ikuliman was unable to express explicitly the theoretical reasons for doing this but claimed it made his canoes more efficient and faster. Since his canoes beat all others in canoe races, he must have known what he was doing even if *Gladwin* himself could not understand it (pp. 122, 123). With regard to Puluwatan conceptions of the influence on moving canoes of ocean wave patterns generated by submarine reefs, *Gladwin* mentions that the navigator Hipour 'could work with discriminations I not only could not perceive but could scarcely conceive' (p. 143).

Gladwin tested Hipour's ability to systematically sort six stacks of colored chips into as many unduplicated pairs of contrasting colors as possible, a test requiring for its solution the formulation of an originally conceived plan. While most American school children do well on this test. Hipour performed very poorly. The only two persons on Puluwat who performed well on this test were also the only two who had lasted through the final year of high school on Truk.

The Puluwat navigator is able to deal with all possible combinations of indigenous navigation knowledge in a systematic fashion, and can derive from a familiar hypothesis all possible logical conclusions as prescribed by the cannons of Puluwat navigation. But his familiar body of knowledge was conceived as fixed and prescriptive. Given a problem in navigation, there is a prescribed way to solve it; 'heuristic' thinking is penalized (pp. 228–231). While Puluwatans solve such problems at a formal level, their cognitive skills are limited to a fixed cognitive domain within which, due to our ignorance, Piagetian tests are difficult

to conduct. When formal operations occur according to a set of principles which are not among one's own cultural conventions, they become extremely difficult to recognize.

In response to problems of this type, *Piaget* (1972) has conceded that acquisition of formal operations is contingent on 'aptitudes and professional specializations' (p. 10) and are restricted to particular domains. *Dasen* (1977a, p. 7) has commented that 'this limitation creates a paradox: the formal operations, which were supposed to be independent of context, are in fact situation-bound'. *Dasen* goes on to comment that while everyone agrees more 'emic' studies are needed to ascertain what these culture-specific situations might be, 'no one seems to know how to go about it'.

Cole et al. (1971, p. 322) have remarked that 'cultural differences in cognition reside more in the situations to which particular cognitive processes are applied than in the existence of a process in one cultural group and its absence in another'. More useful than finding whether or not members of a given culture conserve or think formally would be to find the cognitive domain(s) within a culture within which conservation or propositional thinking commonly occur and why, as well as determining whether and where heuristic reasoning processes are valued (*Cole and Bruner,* 1974).

Beliefs and Multiple Modes of Cognition

Differences in basic assumptions about the nature of the universe occur from culture to culture. *Lawrence* (1964, p. 31) and *Jahoda* (1974, p. 143) have noted that certain cultures in New Guinea and Africa draw no distinction between the natural and the supernatural. *Lawrence* (1964) and *Horton* (1967b) have noted that certain cultures regard established cultural tenets as fixed, and do not visualize the possibility of alternative explanations for identified phenomena. Such 'epistemological assumptions' *(Lawrence)* or 'primitive beliefs' (*Rokeach,* 1968) lie at the heart of different world views, and seem to influence outcomes on Piagetian tests.

The social milieu – the culture – must direct the attention of learners to the phenomena to be learned. Cultures which emphasize adherence to a rigidly or exhaustively defined set of values and beliefs emphasize social order but in effect discourage the subject from looking at certain phenomena because they are not considered important in that culture. *Bruner et al.* (1966) has claimed that attention is differentially directed in certain West African cultures, which

may account for members of some cultures performing well on conservation tests while members of others generally do not. Such differences in value systems may also account for the relatively poor perceptual performance of 'traditional' cultural groups when compared with 'transitional' groups (*Berry*, 1974). They may also exert an influence on cultural differences in 'cognitive style' (*Witkin*, 1974), 'field-dependent' styles characterizing the traditional groups and remaining typical of cultures claiming a fixed cosmos and 'closed' thought systems (*Lawrence*, 1964; *Horton*, 1967b), and, by contrast, 'field-independent' styles remaining more typical of 'transitional' cultures entertaining the possibility of alternative theories and having 'open' thought systems. Such social forces can differentially influence acquisition of skills as defined by *Piaget*.

While maintaining a universalist hypothesis, *Dasen* (1977a, p. 10) has stated that there 'are alternative cognitive structures that may be more adaptive in a given environment and more culturally valued'. *Furby* (1971) has identified two 'types of reasoning', the 'empirical' and the 'magical', discussed further below. This, together with the foregoing evidence, lead me to suggest an elaboration and recasting of *Furby*'s scheme. I propose the existence of two modes of cognition based in fundamental epistemological assumptions. These are the mythicomagical on the one hand, and the empiricoscientific on the other.

The Mythicomagical Mode

Greenfield (1966) reported cultural factors which had a decided effect on acquisition of conservation among Wolof children of Senegal, West Africa. She reports that when a foreign experimenter poured water from one beaker to another in a test for conservation of volume, children would tend to give answers that indicated they could not conserve. Among younger Wolof subjects whom she tested, only a quarter of one group showed conservation when the experimenter poured the water. When they themselves poured the water, however, a full two-thirds of a similar group could clearly conserve (p. 246). The difference, she reports, may have been due to notions of 'action magic' in her subjects. The experimenter was seen as a kind of magician.

Such results can be taken as support for *Piaget*'s assertion that learning requires individual action. But they also indicate influences on cognitive development that are distinctly cultural in nature, and that play a role not clearly explicated in the theory of genetic epistemology. These results further suggest that cultural differences in conceptualizing cause and effect may interfere with performance of conservation tasks.

Kohlberg (1968) reported that among the Atayal, an aboriginal people living

in the mountains of Taiwan, conservation of substance took place at the theoretically expected age of 6 or 7; but that it was later partially lost at ages 11–15. *Kohlberg* conjectures that the reason for this loss was conflict between the values inherent in conservation on the one hand and traditional magical beliefs – beliefs conveying a quite different conception of the physical world than that assumed to be true in modern science – on the other. *Simpson* (1974, p. 100) commenting on *Kohlberg*'s cross-cultural research, supports the legitimacy of other sources of authority besides those used by science – including faith and belief stemming from personal, intuitive and inner knowledge. And *Furby* (1971, p. 247), in her analysis of the conservation task, states that 'the degree to which magical thinking is permitted in the culture may determine the degree to which conservation of identity is a difficult concept for children in that culture'. She goes on to propose a theoretical framework for analyzing both the conservation task itself and the child's relevant cognitive processes. She identifies two 'types of reasoning', the empirical which is broadly typical of Western and Westernized cultures, and the magical more frequently found in non-Western cultures. She speculates that different types of reasoning produce different results on a given conservation task. These findings suggest that mythical or magical notions of causality can indeed shape cognition.

The Empiricoscientific Mode

Levi-Strauss (1966) has stated that modern science and the 'science of the concrete' represent 'two distinct modes of scientific thought. These are certainly not a function of different stages of development of the human mind but rather two strategic levels[1] at which nature is accessible to scientific inquiry' (p. 15). He goes on to describe the *'bricoleur'* as a practitioner of the science of the concrete, in contrast to the engineer, the practitioner of modern science. The *bricoleur* is a sort of jack-of-all-trades who uses whatever is available to (seemingly heuristically) accomplish his task. 'The engineer works by means of concepts, the *"bricoleur"* by means of signs' (p. 20).

In quite a similar vein, *Luria* (1976) has described the approach of illiterate peasants in remote areas of the USSR as 'graphic-functional' while *Scribner*

[1] Like *Bronowski* (1973), *Levi-Strauss*' terminology seems to imply a stratigraphy of scientific development, earlier and more immediately sensible scientific conceptions forming the bedrock for historically later, more sensibly remote and abstract ones. They seem to suggest, whether intentionally or not, that such levels mark stages of technological evolution, a suggestion which assumes a common endpoint for technological evolution across cultures.

(1976) has also argued in favor of two distinct modes of dealing with cognitive tasks, the 'empiric' which reasons from real-life knowledge (i.e., the *bricoleur*), and the 'theoretic' which accepts given premises as a postulate (i.e., the engineer). These descriptions suggest that empirical or scientific notions of causality affect cognitive processes.

That mode of cognition characterizing most indigenous systems of thought in cultures termed 'traditional' (*Berry*, 1974), possessing notions of a fixed cosmos and 'closed' (*Horton*, 1976a, b) thought systems and displaying 'field-dependent' (*Witkin*, 1974) cognitive styles, can be described as mythicomagical. The mode of cognition predominant in cultures described by *Berry* as 'transitional', cultures entertaining the possibility of alternative explanations for the cosmos, possessing 'open' thought systems and displaying 'field-independent' cognitive styles can be labeled empiricoscientific. Acquisition of cognitive skills as defined by Piagetian theory might be found to be generally more limited to culturally identified and sanctioned cognitive domains among the former, and more generally transferable from one cognitive domain to another among the latter.

While this hypothesis is tentatively offered, empirical practices may be found to have mythical or magical explanations, or the reverse. In addition, it is suggested that these modes of cognition be taken to describe thinking within specific cognitive domains as indigenously or emically defined. A culture which limits itself entirely to one mode or the other (to say nothing of other possible modes) probably does not exist. While one or the other of the two modes defined here may indeed characterize most of the cognitive domains in a given culture, the usefulness of the scheme lies primarily in its ability to throw light on differences in thinking within different domains, as well as in its utility in charting boundaries between such indigenously defined domains. Finally, by helping clarify our conception of the influence of cultural values such as indigenous epistemological assumptions or primitive beliefs on cognitive processes, such a scheme would help more precisely identify the nature of cultural differences in cognition.

Conclusion

There is ample evidence that cultural differences exert influence on cognitive development. It has been pointed out that conservation tasks use current scientific paradigms as their standards of accuracy – paradigms which are at

once historically modern and culture-specific. In judging subjects from cultures not accepting modern science as the yardstick for validity, such cognitive testing measures these subjects according to standards to which they may not adhere and with which they may even disagree. The Piagetian assertion that all people possess a mind capable of reflecting the characteristics of a reality accurately portrayed by modern science has led to the assumption, implicit in *Piaget*'s theory, that our species is the scientific animal. But we are also the economic, cultural and religious animal. Without cultural emphasis and social reinforcement to shape the attention of the learner, the cognitive skills defined by *Piaget* cannot be expected to develop; without taking such factors into account, *Piaget*'s theory remains incomplete.

It has been further argued that the tasks chosen to test for conservation are scientifically valid only within certain specified circumstances of time, space, temperature, etc., and that even within these there is ample room for misinterpretation. Familiarity with test materials – particularly with the scientifically defined properties of these materials – has also been shown to affect test performance. It has, moreover, been asserted that different cultures define different domains within which they may display cognitive abilities absent in Western or Westernized subjects.

To account for the numerous variables at play in cross-cultural cognitive testing, a working hypothesis – one which will hopefully inform future research design – has been suggested. This hypothesis identifies two distinct modes of cognition rooted in culturally-based epistemological assumptions – the mythicomagical and the empiricoscientific. The distinction between the two stems from cultural differences in basic beliefs and values. Cultural differences in world view may be at the root of cognitive differences.

Cole and Scribner (1974, p. 169) have remarked that 'psychology has developed no generally agreed upon techniques for studying the cognitive mechanisms at work in the domain of beliefs'. This paper claims that beliefs must be accounted for if we are to acquire a clearer picture of cross-cultural differences in cognition.

References

Ashton, P.T.: Cross-cultural Piagetian research. An experimental perspective. Harvard educ. Rev. *45:* 475–506 (1975).

Berry, J.W.: Ecological and cultural factors in spatial perceptual development, in Berry and

Dasen, Culture and cognition. Readings in cross-cultural psychology, pp. 129–140 (Methuen, London 1974).

Bronowski, J.: Science and human values. Revised (Harper & Row, New York 1965).

Bronowski, J.: The ascent of man (Little, Brown, Boston 1973).

Bruner, J.S.; Olver, R.R., and Greenfield, P.M.: Studies in cognitive growth. A collaboration at the Center for Cognitive Studies (Wiley, New York 1966).

Buck-Morss, S.: Socio-economic bias in Piaget's theory and its implications for cross-cultural studies. Hum. Dev. *18:* 35–49 (1975).

Cole, M. and Bruner, J.S.: Cultural differences and inferences about psychological processes; in Berry and Dasen, Culture and cognition. Readings in cross-cultural psychology, pp. 231–246 (Methuen, London 1974).

Cole, M.; Gay, J.; Glick, J.A., and Sharp, D.W.: The cultural context of learning and thinking. An exploration in experimental anthropology (Basic Books, New York 1971).

Cole, M. and Scribner, S.: Culture and thought. A psychological introduction (Wiley, New York 1974).

Dasen, P.R.: Cross-cultural Piagetian research. A summary; in Berry and Dasen, Culture and cognition. Readings in cross-cultural psychology, pp. 409–424 (Methuen, London 1974a).

Dasen, P.R.: The influence of ecology, culture and European contact on cognitive development in Australian Aborigines; in Berry and Dasen, Culture and cognition. Readings in cross-cultural psychology (Methuen, London 1974b).

Dasen, P.R.: Piagetian psychology. Cross-cultural contributions (Gardner Press, New York 1977a).

Dasen, P.R.: Cross-cultural cognitive development. The cultural aspects of Piaget's theory; in Adler, Issues in cross-cultural research, vol. 285, pp. 332–337 (New York Academy of Sciences, New York 1977b).

Furby, L.: A theoretical analysis of cross-cultural research in cognitive development. Piaget's conservation task. J. cross-cultural Psychol. *2.* 241–255 (1971).

Gladwin, T.: East is a big bird. Navigation and logic on Puluwat atoll (Harvard University Press, Cambridge 1970).

Greenfield, P.: Cross-cultural research and Piagetian theory. Paradox and progress; in Riegel and Meacham, The developing individual in a changing world (Mouton, The Hague 1976).

Greenfield, P.M.: On culture and conservation; in Bruner, Olver and Greenfield, Studies in cognitive growth. A collaboration at the Center for Cognitive Studies, pp. 225–256 (Wiley, New York 1966).

Heron, A.: Cultural determinants of concrete operational behavior; in Dawson and Lonner, Readings in cross-cultural psychology, pp. 94–101 (Hong Kong University Press, Hong Kong 1974).

Horton, R.: African traditional thought and western science. I. From tradition to science. Africa *37:* 50–71 (1967a).

Horton, R.: African traditional thought and western science. II. The closed and open predicaments. Africa *37:* 155–187 (1967b).

Jahoda, G.: Supernatural beliefs and changing cognitive structures among Ghanaian uni-

versity students; in Berry and Dasen, Culture and cognition. Readings in cross-cultural psychology, pp. 141–158 (Methuen, London 1974).

Kiminyo, D.M.: A cross-cultural study of the development of conservation of mass, weight, and volume among Kamba children; in Dasen, Piagetian psychology. Cross-cultural contributions, pp. 64–88 (Gardner Press, New York 1977).

Kluckhohn, F.R. and Strodtbeck, F.L.: Variations in value orientations (Row, Peterson, Evanston 1961).

Kohlberg, L.: Early education. A cognitive-developmental view. Child Dev. *39:* 1013–1062 (1968).

Kuhn, T.S.: The structure of scientific revolutions; 2nd ed. (Univ. of Chicago Press, Chicago 1970).

Laurendeau-Bendavid, M.: Culture, schooling, and cognitive development. A comparative study of children in French Canada and Rwanda; in Dasen, Piagetian psychology. Cross-cultural contributions, pp. 123–168 (Gardner Press, New York 1977).

Lawrence, P.: Road belong cargo. A study of the cargo movement in the Southern Madang District, New Guinea (Manchester University Press, Manchester 1964).

Lemos, M.M. de: The development of conservation in Aboriginal children. Int. J. Psychol. *4:* 255–269 (1969).

Levi-Strauss, C.: The savage mind (Univ. Chicago Press, Chicago 1966).

Luria, A.R.: Cognitive development. Its cultural and social foundations (Harvard University Press, Cambridge 1976).

Needham, J.: Science and civilization in China, vol. II (Cambridge Univ. Press, Cambridge 1956).

Pearce, W.B.: Metatheoretical concerns in communication. Communication Q. *25:* 3–6 (1977).

Phillips, J.L., jr.: The origins of intellect, Piaget's theory (Freeman, San Francisco 1969).

Piaget, J.: The psychology of intelligence (Routledge & Kegan Paul, London 1950).

Piaget, J.: Biology and knowledge. An essay on the relations between organic regulations and cognitive processes (Univ. of Chicago Press, Chicago 1970a).

Piaget, J.: Genetic epistemology (Norton, New York 1970b).

Piaget, J.: Intellectual evolution from adolescence to adulthood. Hum. Dev. *15:* 1–12 (1972).

Piaget, J.: Need and significance of cross-cultural studies in genetic psychology; in Berry and Dasen, Culture and cognition. Readings in cross-cultural psychology, pp. 299–310 (Methuen, London 1974).

Price-Williams, D.; Gordon, W., and Ramirez, M., III: Skill and conservation. A study of pottery making children; in Berry and Dasen, Culture and cognition. Readings in cross-cultural psychology (Methuen, London 1974).

Prince, J.R.: Effects of western education on science conceptualization in Papua New Guinea. Br. J. educ. Psychol. *4:* 255–269 (1968).

Rokeach, M.: Beliefs, attitudes and values. A theory of organization and change (Jossey-Bass, San Francisco 1968).

Sambursky, S.: Structural and dynamic elements in the Greek conception of physical reality; in Northrop and Livingston, Cross-cultural understanding. Epistemology in anthropology, pp. 237–253 (Harper & Row, New York 1964).