5 Are Cognitive Processes Universal? A Contribution to Cross-cultural Piagetian Psychology

PIERRE R. DASEN

I. INTRODUCTION

Are cognitive processes universal? After more than a century of controversies around this apparently simple question, we still have no simple answer. However, a wealth of data has now been accumulated and some convincing generalizations begin to appear. In one of the best introductions to "culture and thought", Cole and Scribner (1974) come to the conclusion that "we are unlikely to find cultural differences in basic component cognitive processes" (p. 193). However, cultural differences are found in the way these basic processes combine into "functional cognitive systems" for various purposes. In other words: "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" (Cole *et al.* 1971, p. 233).

The goal of this chapter is to ask the same overall question and look for similar generalizations in one specific area of cognitive psychology, the developmental theory of Jean Piaget and his co-workers. Are the structures described by Piaget in Swiss children (and since extensively documented in many Western countries) to be found in the cognitive development of children all over the world? Are the stages and their hierarchical ordering universal? Or are there aspects of the child's reasoning which are culturally determined? What are the situational components which determine whether a particular basic operation will be applied or not? These are some of the

constructed (Uzgiris and Hunt, 1975; Corman and Escalona, 1969; Casati and Lézine, 1968). So far, however, there has been little cross-cultural work published in this area. Within Western samples, Golden and Birns (1968) failed to find social-class differences in object permanency in 18- and 24-month-old infants. Wachs *et al.* (1971) on the other hand found social-class differences at some ages on some of the items of the Uzgiris–Hunt scale. Paraskevopoulos and Hunt (1971) compared the ages at which infants living under differing conditions achieve levels of object construction and verbal and gestural imitation; they found a significant effect of the infant–caretaker ratio in two Athenian orphanages. Goldberg (1970) studied sensori-motor intelligence in urban Zambian infants, using the Corman–Escalona scale. She found an advance on American norms at 6 months and a slight retardation at 9 and 12 months. Performance on the S (space) scale was significantly better than on the OP (object permanency) scale at each age level, which is the reverse of Corman and Escalona's (1969) results with American babies.

The study which is to be reported here is an application of the Casati–Lézine scale to infants in a rural area of the Ivory Coast.

A. Method

1. The Casati–Lézine (1968) Scale of Sensori-motor Intelligence

The Casati–Lézine scale of sensori-motor development follows Piaget's observations and theory very closely; it concentrates on Piaget's sensori-motor stages 3 to 6 inclusive. Stages 4 to 6 are further sub-divided into sub-stages A and B, marking the beginning and the full accomplishment of each stage. The scale consists of seven series (or tasks, which are sub-divided into hierarchically ordered items):

1. Object permanency. The infant has to find an object hidden under a screen (cloth), either when it is still partly visible (stage 3B), or when it is completely hidden but the child has already started a grasping movement (4A). At stage 4B, the child searches for the object under one screen (without having started a grasping movement) but if it is moved behind a second screen, the child continues to search under the first. The "visible displacement" to a second screen is followed at stage 5A, whereas at stage 5B the child is able to follow the object through an "invisible displacement" under one screen (the object is hidden in a box, the box is hidden under the screen, and the object is released: the object remaining hidden under the screen, the empty box is shown to the infant). At stage 6A the infant follows the object through an invisible displacement to a second screen. At the end of the sixth stage (6B) the infant is able to follow systematically an object through a series of invisible displacements in sequence, using three screens.
2. An object is placed out of reach, with a string attached to it. The level of development (stages 4A to 5B) is determined by the complexity of the situation (length, position and number of strings) in which the subject is able to solve the problem by pulling the string.
3. An object is placed out of reach on a cloth. The infant is able to get at the object by pulling the cloth. The complexity of the situation (e.g. cloth nearby or further removed) again determines the level of development (stages 4A to 5A). In a more difficult situation, the object is placed on a wooden board which can be rotated on a pin to move the object within reach. The child is placed at stage 6B if he solves the problem by "insight", at stage 6A if he solves it by trial and error, and at stage 5B if he can do it after a demonstration.
4. Use of an instrument. An object is placed out of reach, and the infant is given a toy rake or a ruler with which he may reach for the object. The way he solves this problem indicates his stage of development (4B to 6B).
5. Exploration of objects. The infant is given a small mirror and a matchbox and his level of development is judged from the way he handles these objects (3B to 6B).
6. Combination of objects: tube and rake. A small object wrapped in a piece of paper is placed inside a tube in such a way that it cannot be reached with the fingers. The plastic toy rake is placed within reach. The stage of development (5B to 6B) is judged from the way the child uses the rake to push the paper out of the tube.
7. Combination of objects: tube and small chain. The same tube is placed in front of the child at the same time as a small chain made of paper clips. The way the child discovers how to make the chain pass through the tube (almost all children attempt to do this, but a regrouping of the clips is necessary to solve the problem) determines his developmental stage (5B to 6B).

The details of the techniques and the assessment of the observed behaviours are described fully by Casati and Lézine (1968).

2. Subjects

In a first part of the study, 73 infants aged 6 to 24 months were tested, 39 in 1971 by Dasen and 34 in 1972 by Bovet and Othenin-Girard. Subjects were included only if their dates of birth were known. Subsequently a more extensive longitudinal study was arranged (1973-75) by Dasen, Lavallée and Retschitzki. This second part can be considered as a replication of the preliminary study, although it will eventually lead to much more extensive analyses.

The studies took place in villages in the Ivory Coast, about 200 km north-west of Abidjan, the capital city, in the area where tropical rain forest gives way to savannah. The inhabitants of the region are from the Baoulé tribe and live mainly from subsistence-level agriculture (yams, plantain, manioc) and from the production of some cash crops (coffee, cocoa). Although acculturation is well on its way, child rearing in these villages still follows the traditional patterns. The daily life and customs of the Baoulé have been described by Guerry (1970).

3. *Experimental Situation*

The infants were tested when sitting on their mother's lap in front of a table; constant personal contact with the mother and the possibility of reaching for the breast seem to be most important to insure a satisfactory testing situation. The examinations took place in familiar surroundings, in the children's own courtyards in the first part of the study, in a specially built straw observation-hut in the second part. Care was taken to create as natural a testing situation as possible: the children and mothers were quite familiar with the experimenters, and local assistants were trained to present the objects to the child and to serve as interpreters.

The administration of the scale took between 30 minutes and two hours, and often several sessions were necessary to complete the testing. Emotional reactions were taken into account: some children show aversion or apathy towards strangers (particularly in the second year of life) and their behaviour cannot be interpreted as a true indicator of their developmental level. Some records had to be discarded completely from the analysis for this reason (20 in 1971, 3 in 1972, 13 in 1973/75). With other subjects only partial results were obtained; these were retained in the samples. Generally speaking the number of "refusals" diminished as the skill of the experimenters in creating an adequate experimental situation increased. The fear of strangers seems to be especially marked in the African child (Ainsworth, 1967; Konner, 1972), but similar difficulties exist when testing Western infants (e.g. Lézine *et al.*, 1969, p. 36), and the discarding of results presents a serious methodological problem (Lewis and Johnson, 1971).

B. Results and Discussion

1. *First Study* (Bovet *et al.*, 1974)

The cumulative frequencies for the attainment of each sub-stage were calculated for each of the seven series in the scale, dividing the sample into

five age-groups. These results are presented in detail in Bovet *et al.* (1974) and are compared with the French norms provided by Lézine *et al.* (1969). Such a comparison presents some methodological difficulties, especially since the European norms were not obtained by the same group of experimenters as the African data (Warren, 1972). Furthermore the number of subjects in the first study is quite small compared to the number of infants tested by Lézine *et al.* Our sample can be considered to be representative of the general Baoulé infant population, whereas Lézine's subjects were obtained in day-care centres of lower-class suburbs of Paris, and therefore may not be representative of the French population. Thus any comparison has to remain tentative, and we shall consider only overall trends.

On three series (both combinations of objects and the use of an instrument-series 4, 6 and 7) there is an obvious advance of the African results over French norms throughout the age-range and at each sub-stage. On all three tasks, the infant has at least one object within reach, the problem being to explore the possibilities of combining it with a second object, or to use it as a means for reaching a coveted object. The tasks call for exploration, active manipulation and the solving of a problem either by trial and error or with foresight.

On the other series (object permanency, object attached to a string or placed on a cloth, and exploration of objects, series 1, 2, 3 and 5) there is an advance over French norms in the first sub-stages (up to 5A). In the later sub-stages results are parallel to French norms on series 1 and 2, and a small delay occurs compared with French norms on series 3 and 5.

It seems that the advance occurs when the objects are close at hand or can be manipulated directly: on object permanency (series 1) as long as the object is not displaced to a second screen, as long as the string (2) is placed in direct line with the object (as opposed to being placed in a "Z" shape), when the object is placed on a cloth (3) near the child but not when it is further removed, or when the exploration of an object (5) requires only simple motor schemes. The development seems to parallel that of French children when the situations are spatially or temporally more complex, when the object is hidden (1) under a second screen or under two superimposed screens or is moved in succession, or when the object is placed far away (2, 3) and a complex scheme of actions is necessary to retrieve it.

The slight lag which occurs in two situations (the second parts of series 3 and 5) seems to be quite directly linked to the content of the problem: they require the manipulation of some bizarre apparatus such as rotating a wooden board or opening a match box. It is probably not the lack of familiarity with the test material as such which causes the difficulty; the plastic tube and rake, the toy cars and other objects used for further tasks are quite unfamiliar to the infants of the study, and despite this they manage to

use them very satisfactorily. Rather it seems to be the type of manipulation, the rotating around an axle, or sliding the inner part of the box, which is not culturally relevant. Few objects exist in the child's environment which would require such actions, whereas the European child would usually have plenty of occasions to observe or manipulate toys, furniture, or other objects which involve a rotation (wheels of toy cars, spinning-tops) or a sliding movement (opening a drawer, nesting boxes).

At this stage we cannot "explain" the precocity of the African infants on some of our sensori-motor tasks, but we can speculate on some of the cultural characteristics which may produce it. The Baoulé neonate and his mother remain inside the house for the first two weeks after birth; immediately thereafter, the mother returns to normal life, carrying the baby on her back. Compared with an infant lying in a crib for most of the day, the African baby thus receives an enormous amount of proprioceptive, tactile and visual stimulation which enhances its psycho-motor and postural development. The baby may take advantage of this motor precocity to explore his environment, and build up the schemes which lead to the kind of sensori-motor structures of intelligence we have been studying.

Furthermore the Baoulé infant is breast-fed on demand until weaning occurs at about 18 months. The infant seems to be quite active in this process: he may get immediate satisfaction by crying, but we have also observed many occasions when he actively searched for the breast. Even when he is attached to the mother's back, he wriggles to the side until he can reach for it. This early experience in searching actively for the breast, and in finding that he can build up motor schemes which will lead to satisfaction, may explain at least part of the precocity in object permanency and in the handling of objects which are within easy reach.

However much more detailed observation of the infants' spontaneous behaviour is required to reach more definite conclusions. For example it seems, at first sight, that being attached to the back with arms and legs separated on each side of the mother (which prevents the child from touching one hand with the other) would hinder the development of object manipulation, particularly in the case when two objects, each held in one hand, have to be combined. Lézine (personal communication) suggests that this position may in fact foster an early lateralization, which would in turn favour the manipulation and combining of objects; this hypothesis is open to verification. It has also been suggested that object-manipulation is not generally valued in African cultures, whereas social interactions are highly stressed (Zemplémi, 1970; Valantin, 1970). However it is possible that these social interactions, which also involve the active participation of the infant, may foster the same sensori-motor structures as physical actions would (Piaget, 1965). In any case, no detailed ethological study of the African

infant's spontaneous behaviour and object manipulation has yet been published. We are currently involved in such a study, and seem to find more object manipulation than expected, especially since the infant is left very free to explore his environment and to take any objects he likes (even dangerous ones).

2. *Second Study* (Dasen, Lavallée and Retschitzki)

More extensive data have been obtained in an on-going, longitudinal project. For the moment, pending further analysis, we can consider this new set of results as a cross-sectional replication of the first study. Such a replication is not without interest, since the first results were based on relatively few subjects and were obtained by two different groups of experimenters.

The results calculated on 254 observations are presented in Table 1 for object permanency only, together with the previous results of the first study and the French norms of Lézine *et al.* (1969). The results of the two studies are notably similar. Compared with the French norms, there is a marked precocity of stage 4 (A and B). In both cases, this precocity is also found in stage 5A at 9 to 12 months, but disappears after that age; neither is it significant for stages 5B and 6A. On stage 6B, however, a significant advance over French norms appears in the second study, whèreas this was not the case in the preliminary work. On the whole it is not the small differences but the striking similarity in developmental curves which is the remarkable feature of these results.

On object permanency, all subjects have attained the upper stage (6B) at 20 months, whereas on all other series (except series 4, the use of an instrument) this is the case at 22–26 months only. However item 7 of this series may in fact be too easy to mark the end of stage 6: since the object is shown between displacements, it corresponds to item 8 in the Uzgiris–Hunt (1975) scale, which is a stage 5 item. Thus items 14 (serial, systematic displacement under three screens; the object is not shown during displacement) and 15 (as 14, but the object is left under the first screen) of the Uzgiris–Hunt scale were administered to examine the upper limit of stage 6. The results for item 14 are comparable to those of item 7 in the Casati–Lézine scale, whereas item 15 is slightly more difficult (as well as more difficult to score), 100% success being attained at 26 months.

C. Conclusion

The most important conclusion to be drawn from this set of studies may have been overlooked because we have paid attention to cultural variations and

Table 1

Object permanency. Cumulative percentages of subjects attaining sub-stages as a function of age.

French norms, from Lézine *et al.*, 1969, p. 17[a]

Age in months		6	7	8	9	10	11	12	13	14	15	16	17–18	19–20	>21
N		8	22	29	30	29	23	17	28	19	32	16	24	16	12
Stages	Items														
3B	1	25	82	93	100	100	100	100	100	100	100	100	100	100	100
4A	2	0	14	31	60	83	91	94	96	100	100	94	100	100	100
4B	3	0	5	17	30	62	70	76	93	100	94	94	100	100	100
5A	4	0	5	0	3	21	30	41	71	84	84	81	100	94	100
5B	5	0	0	0	0	0	0	24	29	47	50	63	92	94	100
6A	6	0	0	0	0	0	0	0	11	40	38	38	67	94	100
6B	7	0	0	0	0	0	0	0	0	11	16	6	58	94	92

[a] Reproduced by permission of Les Editions du Centre de Psychologie Appliquée, Paris, from their Monographie No. 1, "Les Étapes de l'Intelligence sensori-motrice de l'Enfant", by I. Lézine, M. Stambak and I. Casati, 1969, p. 17.

Baoulé infants, Ivory Coast (Dasen, Lavallée and Retschitzki) (second study)

Age in months		6	7	8	9	10	11	12	13	14	15	16	17–18	19–20	>21
N		5	4	14	11	11	10	16	18	16	11	13	28	31	66
Stages	Items														
3B	1[a]	60	75	100	90	100	100	100	100	100	100	100	100	100	100
4A	2[a]	40	50	57	90	100	100	100	100	100	100	100	100	100	100
4B	3[a]	0	25	42	54	90	100	100	94	100	100	100	100	100	100
5A	4[b]	0	0	0	36	54	70	68	44	93	81	84	100	100	100
5B	5[b]	0	0	0	9	9	0	25	11	68	72	76	100	100	100
6A	6[b]	0	0	0	0	0	0	6	0	43	63	76	89	97	100
6B	7[c]	0	0	0	0	0	0	6	0	12	36	38	68	94	100

Significance level of Baoulé/French comparison, using the Kamara and Easley (1976) statistic: [a]NS [b]NS (0·10) [c]0·05 [d]0·01.

Baoulé infants, Ivory Coast (Bovet *et al.*, 1974), p. 372 (first, preliminary study)

Age in months		6–8	9–12	13–16	17–20
N		12	15	17	10
Stages	Items				
3B	1	72	100	100	100
4A	2	55	100	100	100
4B	3	33	85	100	100
5A	4	6	48	70	100
5B	5	0	18	44	94
6A	6	0	0	26	94
6B	7	0	0	9	60

differences in the rate of development of the various sub-stages on different tasks: it is, in fact, that the qualitative characteristics of sensori-motor development are quite similar or even identical in French and Baoulé infants, in spite of vast differences in their cultural environment. Not only are the structural properties of the stages, and therefore their order of appearance, identical in both groups, but even the actions and schemes, and the way these are slowly built up into more complex action-patterns which eventually enable the infant to solve rather difficult problems, seem to be identical.

For example, the last series in the Casati–Lézine scale (the combination of a tube and a small chain) is, at first sight, a quite impossible task. For one thing, why should the infant wish to combine these two objects? He may just as well look through the tube, roll it on the table, put the chain around his fingers, or throw it at the experimenter. Yet, after stage 5A, almost every infant starts to search for some way of making the chain pass through the tube. When this task is presented to a Baoulé infant, it seems even more ludicrous, since the subject will never have seen a plastic tube or paper clips before. Yet he takes these two strange objects, and combines them exactly as the infants in the day-care centre of Paris did; not only does he get the idea of combining them, but he does this following the same steps, with the same errors, and finding the same successively more and more adapted solutions. (On average, he even finds them significantly earlier than his French age-mate.)

These striking similarities, which we dare not call universals after a comparison of only two populations, seem to show that there may be generalities in the way the human infant interacts with his environment, builds up knowledge of this environment and develops the basis of his later reasoning processes.

Yet, the cultural variations in the rate of development show that sensori-motor intelligence is not completely determined by biological factors (genetics or maturation) but also depends on particular stimulations. We have not found an overall precocity, but advances in some respects, parallel results in others, and a few delays, which reminded us of Super's (1973) results for motor development in Kenyan infants. These differential rates of development seem to be linked to cultural characteristics, to the predominant mode or quantity of stimulation, to the cultural value placed on certain skills over others. We are not in a position to specify the details of this link or to describe the mechanism of the cultural influence on cognitive development. Detailed observations on the spontaneous behaviour of the same infants in their "home" situation should provide part of the missing information. However this type of correlational research is not fit to prove causal links.

As we move, in the next section, to a discussion of the next stage, that of concrete operations, we shall come to much the same conclusion: the qualitative aspects of development, the structure of the stages, their ordering and the type of answers the children give to Piagetian tasks, seem to be quasi-universal, whereas the rates of development seem to vary under the influence of socio-cultural factors. However, we shall also find that the rates of development are not uniform across conceptual domains within a cultural group, but are dependent to some degree on the cultural value placed on some concepts over others.

III. THE STAGE OF CONCRETE OPERATIONS

A. Qualitative Aspects: the Sequence of Stages

Among the many aspects of concrete operational development which Piaget and his colleagues have described, conservation behaviour has received an unduly large amount of attention. To apprehend the invariance of certain characteristics of an object across the transformation of its perceptual aspects is an important step in cognitive development, although its precise mechanisms are still being debated; it is often considered a sort of "marker" of concrete operational development, whereas other interesting indices are neglected. The same emphasis on conservation has been evident in cross-cultural studies; since so much information has been accumulated on a single aspect of development, we were tempted to follow the general trend, and chose it as the example for our discussion.

There are strong indications that conservation (be it of quantity, weight, volume, number, length or area) is a universal, insofar as it has been found in at least some of the subjects in every population studied. Flavell and Wohlwill (1969, p. 84 f.n.) have made a distinction between "strong" and "weak" sequential invariance, or what may be called strong and weak universals.

> "A sequence is strongly invariant if it is both universally present and universally fixed in the childhoods of undamaged human beings. For instance, we imagine that all intact human infants achieve primary and tertiary circular reactions, and achieve them in that order only. A sequence is weakly invariant if, when present, it is universally fixed. One may be able to find children who do not attain A, or B, or both; but for all children who do attain both, the order of attainment is the same."

Thus, following this definition, concepts of conservation (as well as most other concrete operational concepts) could be viewed as "weak" universals, whereas sensori-motor development would be a case of a "strong" universal.

The variations among cultural groups or sub-groups in the proportion of subjects displaying conservation on a particular concept will be discussed later. Since this proportion usually increases with age, it is often referred to as a measure of the "rate" of development. It is this quantitative aspect of conservation behaviour which seems subject to cultural variations. The qualitative aspects of conservation, the succession of non-conservation, transitional and conservation answers, and the type of reasons given to explain either a non-conservation or a conservation judgment, are usually reported to be identical with those described by Piaget and verified by many others in Western children. There are, however, some exceptions to this general rule, and these deserve special attention.

Bovet (1974) for example has reported a "deviation" from the usual sequence of stages in the acquisition of conservation of quantity (liquids) in illiterate Algerian children. Very young children (5 to 6 years old) gave undifferentiated non-conservation answers, based on the action of pouring the liquid from one glass to another rather than on the dimensions of the containers. Somewhat older children (7 to 8 years) gave conservation answers, but were unable to give a proper reason for the judgment. Still older children gave dimensional non-conservation or transitional answers (8 to 11 years) or conservation answers justified by the usual identity, compensation or reversibility arguments (10 to 12 years).

The same children were then subjected to two additional situations, one in which they were to pour water from one container to the next of a different shape, predicting each time where the water level would be (usually solved correctly before conservation is achieved), the second in which they were asked to pour quantities of liquid as equal as possible into pairs of glasses which differed either in diameter or in height or in both dimensions (usually solved correctly at about the same age as conservation problems).

The 7- to 8-year-old "conservers" could not solve these additional tasks correctly: they were obviously not taking into account the dimensions of the glasses, although their attention must have been gradually drawn to the perceptual aspects of the situation, for when presented with the initial conservation task again, they now gave dimensional non-conservation answers. This apparent "regression" led Bovet to conclude that these children were still at the pre-operational stage in spite of their initial conservation answers; in other words, they were not "conservers" but "pseudo-conservers". The same "additional" stage characterized by non-operational conservation answers occurred in conservation of quantity using

plasticine balls, and in conservation of weight, but not in conservation of length.

Bovet emphasizes the fact that this additional stage is a temporary departure from the usual sequence: with increasing age, the pseudo-conservation gives way, first to non-conservation and then to intermediate and finally conservation answers. Greenfield (1976), in a discussion of Bovet's paper, suggests that pseudo-conservation may have occurred also in her Wolof study (Greenfield, 1966) but has gone unnoticed because of procedural differences. Greenfield's conservation task had two parts: first the water was poured from the initial container into a single narrower glass, and on the second part it was poured from the initial container into six shorter, narrower glasses. Most subjects classified as non-conservers in the 8 to 9 and 11 to 13 year-old groups made conservation judgments in the first part but not in the second part of the procedure. These children may have been "pseudo-conservers". In this case, the pseudo-conservation pattern seems to persist among unschooled Senegalese children until a much later age than reported by Bovet for Algerian unschooled children, and it can no longer be considered as a temporary discontinuity, occurring only in young children before the usual sequential development takes place.

However Greenfield's "pseudo-conservers" may also have been at the intermediate stage of fluctuating answers. In the absence of data on the justifications given by these subjects and since the situational variations suggested by Bovet had not been used, it is impossible to decide. Similarly the early rise and subsequent decline of conservation answers reported by de Lemos (1966) in a sample of Australian Aboriginal children (Hermannsburg), and found again five years later by Dasen (1970, 1974a), may have been due to pseudo-conservation. Seagrim and Lendon (personal communication) are conducting longitudinal research in the same location which should clarify the issue. There are no reports of pseudo-conservation in other populations; the question also remains open whether it could be found in very young Western children.

B. Quantitative Aspect: Cross-cultural Comparison of Rates of Development

The results obtained with Piagetian tasks are often reported in the form of a percentage of subjects classified at each stage (or sub-stage) within each age group. In graphical form, a curve resembling the normal ogive is usually obtained, although other polynomials may also be adequate (Kamara and Easley, 1976). These curves can be considered to represent the "rate" of

development of the particular concept in the population studied but of course *not* the rate of development in any individual child.

To provide some idea of the large cross-cultural variability, we have chosen to present on one single graph (Fig. 1, reprinted from Dasen, 1973a, p. 157) the developmental curves for conservation of continuous quantities (liquids) from all cross-cultural studies until 1972 for which percentage data were available to us. Such a comparison is methodologically imperfect, since nothing guarantees the comparability of the studies. The various curves are affected by differences in task administration, scoring, language and communication difficulties, age determination or any other aspects of the testing situation and the method used. Such recently described phenomena as pseudo-conservation (discussed previously) or the competence/ performance distinction (to be discussed later) may also interfere with such a comparison. In any case, the curves should not be taken as comparative measures of cognitive capacity in the groups compared.*

With all these precautions, and looking only at the general trends indicated by these curves, it remains obvious that the cross-cultural variability in the proportion of individuals attaining this concept of conservation is very large. The rate of development seems to be determined by cultural factors to a large extent; we shall discuss some of these factors, and their effect, in a later section. Of interest are those developmental curves which do not reach 100% (described by Dasen, 1972, 1973a, 1975c, as asymptotic), particularly if the study included adolescents or adults. These curves indicate that there is a large proportion of individuals who do not acquire (or at least, display) this particular set of concrete operations. This is a serious limitation to the universality of Piagetian stages.†

What is the significance of this phenomenon? In Cole and Scribner's words, "Until we have some better idea of what induces some members of traditional societies to solve conservation problems while their neighbours do not, we cannot be certain about the significance of conservation tests as a tool for understanding the relation between culture and cognitive development" (1974, p. 156). Elsewhere in the same chapter they write, "Can we imagine an adult who would pour water from a small bucket into a larger one

* It seems that the following interpretation of such curves may sometimes be made (quoted by Cole and Scribner, 1974, p. 156): "Tribe X does not mature past the European 11-year stage if 50% of the members of tribe X conserve and 50% do not." We personally know of no such silly statement in print, but it seems not impossible that it may occur, since Porteus (reviewed in Kearney, 1973) has had the effrontery to establish a "hierarchy of races" according to the results on his maze test, expressed in terms of mental age. Maybe it is only wishful thinking to believe that cross-cultural psychology has now moved beyond this stage of naïve ethnocentrism.

† After Flavell and Wohlwill's (1969) definition, a concept characterized by an asymptotic developmental curve would be a "weak" universal (if those who do acquire it follow the same sequence of sub-stages).

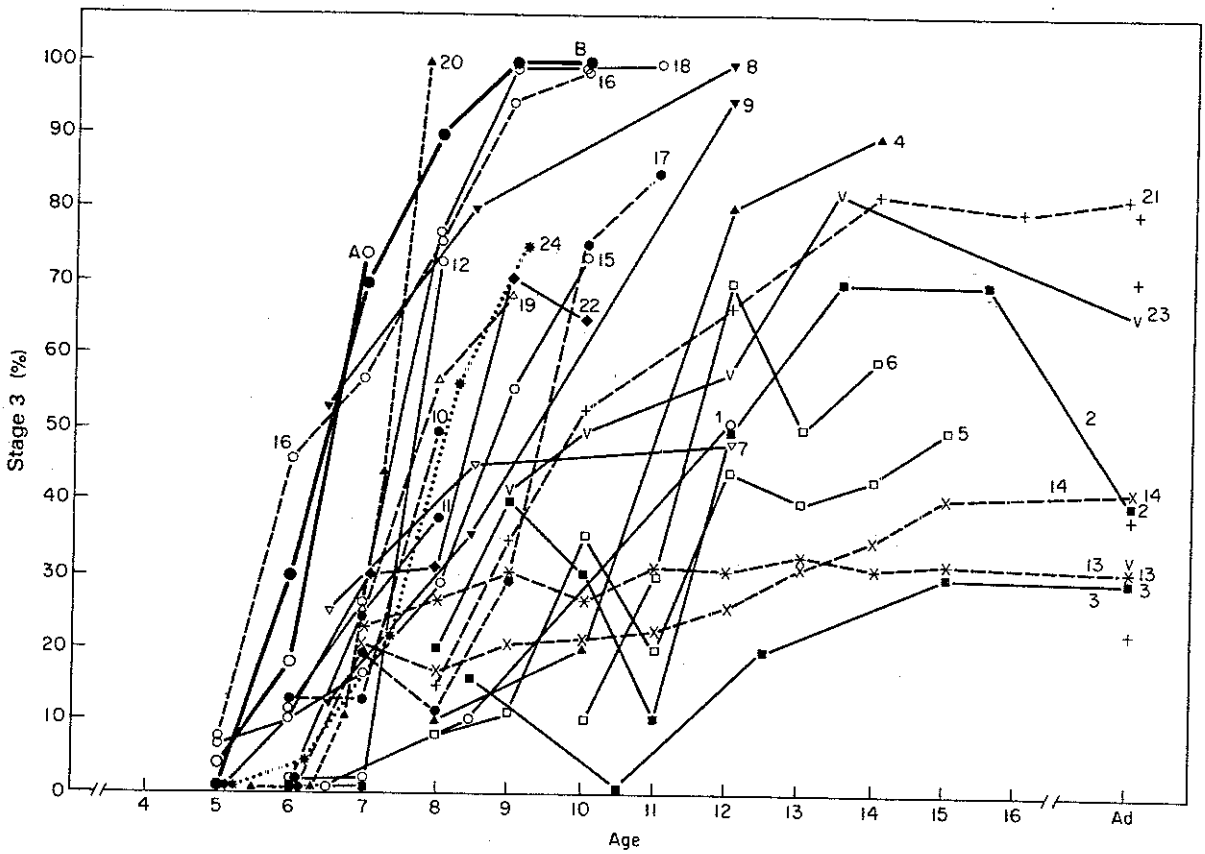

Fig. 1. Conservation of quantity (liquids). Percentage of subjects attaining full conservation. Reprinted from Dasen (1973a). Reproduced by permission from *Psychologie Canadienne/Canadian Psychological Review*, University of Calgary, Alberta, Canada

A	Europeans, Geneva	(Piaget and Inhelder, 1963)
B	Europeans, Canberra	(Dasen, 1974a)
1	Algerians, unschooled	(Bovet, 1974)
2	Australian Aborigines (Hermannsburg), medium contact	(Dasen, 1974a)
3	Australian Aborigines (Areyonga), low contact	(Dasen, 1974a)
4	Ebrié, Ivory Coast (Adiopodoumé)	(Dasen, 1975a)
5	Australian Aborigines (Hermannsburg)	(de Lemos, 1969)
6	Australian Aborigines (Elcho Island)	(de Lemos, 1969)
7	Wolof, Senegal, rural, unschooled	(Greenfield, 1966)
8	Wolof, Senegal, rural, schooled	(Greenfield, 1966)
9	Wolof, Senegal, Dakar, schooled	(Greenfield, 1966)
10	Aden, Arabs	(Hyde, 1970)
11	Aden, Indians	(Hyde, 1970)
12	Aden, Somali	(Hyde, 1970)
13	Papua-New-Guinea, unschooled	(Kelly, 1970)
14	Papua-New-Guinea, schooled	(Kelly, 1970)
15	Iran, rural	(Mohseni, 1966)
16	Iran, urban	(Mohseni, 1966)
17	Thailand, rural	(Opper, 1971)
18	Thailand, urban	(Opper, 1971)
19	Rwanda, rural, schooled and unschooled	(Pinard *et al.*, 1973)
20	Tiv, Nigeria, rural, unschooled	(Price-Williams, 1961)
21	Papua-New-Guinea, schooled	(Prince, 1969)
22	Oglala Sioux	(Voyat, personal communication)
23	Papua-New-Guinea, schooled	(Waddell, personal communication)
24	Lebanon, Beirut, schooled	(Za'rour, 1971)

and believe that the amount of water has been decreased by this act? In desert communities where water is a treasured commodity, everyone can be expected to conform to certain laws of conservation" (pp. 151–52). Yet de Lemos (1969, p. 262) mentions a practical situation in which adult Aboriginal women in central Australia could choose between one measure of sugar poured into a tall and narrow container and two measures poured into a larger one; of 12 women, eight chose the one with less sugar, but where the level was higher. Thus non-conservation seems to occur even in situations more natural than the usual task administration; but there is still no study testing conservation in a completely natural, culturally relevant situation.

Does being a conserver or non-conserver have any practical significance? Heron (1971) found no relation between a non-verbal measure of conservation of weight and the scores on a non-verbal reasoning test. The reasoning test scores, but not the results of the conservation task, were related to school achievement. A similar lack of correlation between conservation of weight and multiple classification and other operational tasks was further demonstrated by Heron and Dowel (1973, 1974) in Papuan children and in Yugoslav child immigrants to Australia, leading Heron (1974, p. 100) to propose "a *clear separation* of conservation from other cognitive behaviours".

However, the problem of the interpretation of "asymptotic" curves is not limited to conservation alone, for they also occur in other areas of concrete operational development. Part of the answer may come from the suggestion that we may have been measuring a "performance" which is only a poor indicator of the underlying "competence". It is to a discussion of this important distinction that we will now turn our attention.

C. The Performance/Competence Distinction

Recurrently, there have been indications that the initial answer a child gives in a Piagetian task may not reflect his "true" level of reasoning, i.e. the underlying structure or competence. In some cases, with very little "help" (either further questioning, or additional task situations, or exposure to other operational tasks, or training procedures), they seem to be able to "actualize" the latent structure.

De Lemos (1969, pp. 264–65) for example states that "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."

Bovet (1974) reports the following "Aktualgenese" in Algerian illiterate adults, when testing for conservation of weight:

> ". . . in several instances, the initial response was a conservation one. Then when the experimenter, in an attempt to obtain a justification for this response, pointed out the differences in appearance of the two objects, the subjects would no longer give a conservation response. In the course of the dialogue, however, the subjects would return to a conservation judgement, and would be able to relate the various dimensions of the objects by means of reasoning based on compensation. These adults' reactions seem to replicate in a condensed sequence the developmental trends noted in the children where an initial non-operational conservation finally becomes, at a later stage, an explicit conservation judgement.
>
> For some of the nonconserving subjects, all that was required for them to grasp the notion of conservation was to weigh the two pieces of clay once on a pair of scales in front of them. They then accompanied their judgements by logical justifications and, what is more, generalized their conservation responses to various changes in shape." (pp. 324–25)
>
> "It is interesting to observe therefore the existence of two concomitant ways of approaching the problem, with an intuitive approach characteristic of everyday practical use being the spontaneous response, and at the same time the logical approach being latent." (p. 330)
>
> "The use of learning situations therefore seems essential in any cross-cultural study, in order to try and reach the potential reasoning capacity of the subjects. A number of precautions must, however, be taken. If these learning techniques are related to the Piagetian type of concepts, they need to come within the framework of Piagetian theory, that is to say, they should consist of 'exercises in operativity.'" (pp. 333–34)

Such a learning study was carried out by Pinard *et al.* (1973) on three groups of 16 7-year-old children, respectively French Canadian, unschooled Rwandan and schooled Rwandan (5 to 6 months of schooling), with the corresponding control-groups. All these children were completely pre-operational on a pre-test comprising eight tasks of conservation of quantity. Thereafter the experimental groups were subjected to a training procedure using anticipation and compensation situations. Two post-tests were administered, at 15 days and 2 months after the pre-test. The induced acquisition of conservation in the experimental groups was stable over both post-tests, generalized to a variety of situations, and the conservation answers were justified by the usual identity and some compensation and reversibility reasons.

The number of training sessions to induce conservation was not significantly different among the three groups. Whereas there seems to be a

small time-lag in the spontaneous acquisition of conservation of quantity in the Rwandan samples compared to the French Canadian children, the capacity to learn the concept seems to be identical, and the learning procedures are able to reduce or suppress the time-lag. The only difference found between the three groups was in the number of children successful on the compensation exercises after one single session: there were none in the French Canadian group, three in the Rwandan group with schooling, and seven in the unschooled group. One possible interpretation of this rapid learning is that these children already had a latent competence for conservation of quantity, which, for some unknown reason, did not manifest itself in the performance on the pre-test, but was then "activated" by a minimum of operational exercises.

In this experiment all the subjects were at an age when conservation is acquired spontaneously by most children within a short time. What effect would the learning procedures have on children (in those populations where the developmental curve is asymptototic) who have not acquired the concept even at a much later age? Would their learning be even faster, since

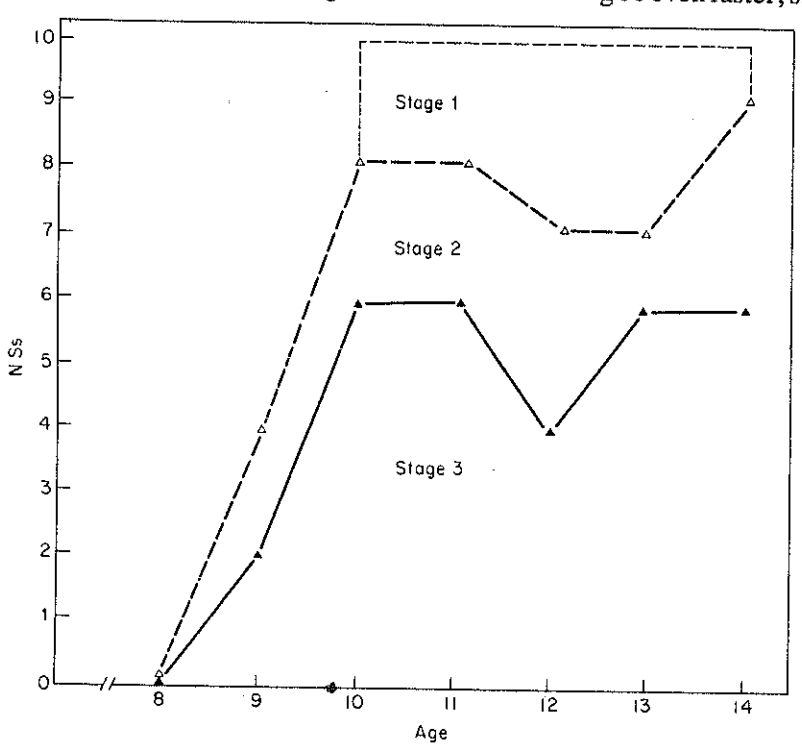

Fig. 2. The development of conservation of quantity in Cape Dorset Eskimo children. Stages: 1 = non-conservation; 2 = transitional; 3 = full conservation.

they are older? or would it be slower, since they may have missed the "critical period" in which the concept is usually acquired? A small training experiment which we carried out as part of a study with Eskimo children (Dasen, 1975b) may give us some preliminary indications.

The study was conducted at Cape Dorset, on Baffin Island (Canada), with Central Eskimos. Ten schooled children were examined at each age from 8 to 14 years for conservation of quantity (liquids) as well as for a variety of other Piagetian concepts (for a detailed report on procedures and results, see Dasen, 1975b). Figure 2 presents the results of the initial testing ("pre-test 1"). The stage 3 curve (full conservation) shows an "asymptote" at 60% beginning with age 10. Among the 50 children aged 10 to 14 years, there were 11 who gave non-conservation answers (stage 1); all except two explained their judgments by perceptual (dimensional) reasons. More than half of these children had less than average school attendance and below average school achievement; their results on other Piagetian tasks (elementary logic and space) were average for their age, except for below-average performance on mental imagery tasks.

These 11 children were subjected to the task of conservation of quantity (liquids) for a second time ("pre-test 2"), on the average 12 days (2 to 27 days) after the first pre-test. The results of the pre-tests are shown in Fig. 3, each subject being identified by a number, the first two digits of which indicate his age. On the second pre-test, four subjects have attained stage 3, and three subjects give transitional answers (stage 2). For these children, it seems that a mere exposure to other operational tasks, and/or becoming more familiar with the testing situation, has been sufficient to produce a learning effect.

The eight subjects situated at stages 1 and 2 on the second pre-test were then subjected to a learning procedure developed by Lefebvre and Pinard (1972). On a first session, a conflict is produced by showing the inefficiency of the child's predominant notional rule based on the height of the liquid in the container. Thereafter the child is subjected to operational exercises based on compensation and addition/subtraction operations. After each set of exercises, the child is asked to pour in a second glass of different shape the same quantity of liquid as contained in a standard glass. If the child succeeds on a complete set of exercises and on the anticipation task, he is subjected to a post-test (the usual conservation of quantity task), but training is continued if he does not give full conservation answers. The results on the post-tests are shown in Fig. 3.

The three subjects who started at stage 2 moved to stage 3 after two or three training sessions. The subjects starting at stage 1 moved to stage 2 after two to four sessions; because of time limitations, the experiment had to be discontinued, and it is not known whether these subjects would also have

attained stage 3, and how many training sessions would have been required. The only subject showing absolutely no learning in spite of five training sessions was an additional subject aged 12 years, who was partly deaf and probably mentally retarded.

This small experiment lacks the elaborate pre-tests, the control groups and large number of subjects, the post-tests checking generalization and stability, which are the usual requirements of this type of study (cf. Inhelder *et al.*, 1974). However, its limited results give us some additional clues as to the competence/performance distinction. All subjects who showed rapid

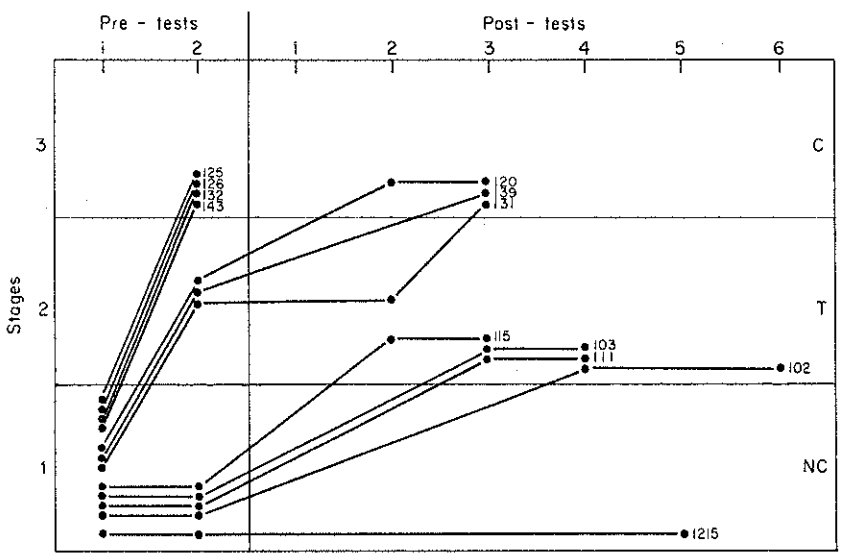

Fig. 3. Training conservation of quantity, Cape Dorset Eskimo children. Stages: 1 = non-conservation; 2 = transitional; 3 = full conservation.

learning and moved to stage 3 were aged 12 to 14 years; it is difficult to believe that these children did not already have the operational structures for conservation of quantity on the first pre-test. But for some reason their (supposed) latent competence did not manifest itself in their performance. On the other hand, those subjects ramaining at stage 1 on the second pre-test and moving to stage 2 after the training sessions, were all aged 10 and 11. It is likely that these children had not acquired the necessary operational structures for conservation, but that these were being built up during the training procedure.

The competence/performance model was first proposed for cognitive-developmental phenomena by Flavell and Wohlwill (1969, pp. 71–5) who derived it from Chomsky's linguistic model.

> "The competence model gives an abstract, purely logical representation of what the organism knows or could do in a timeless, ideal environment, whereas the automaton model has the job of describing a real device that could plausibly instance that knowledge or skill, and instance it with the constraints (memory limitations, rapid performance, etc.) under which human beings actually operate" (p. 71).

Similarly, Cole and Bruner (1971) are drawing on the work of another linguist, Labov, to suggest that a competence/performance distinction should be introduced in comparative studies of cognition, and that the "deficit" interpretation ought to be replaced by a "difference" interpretation.

> "The crux of the argument, when applied to the problem of 'cultural deprivation', is that those groups ordinarily diagnosed as culturally deprived have the same underlying competence as those in the mainstream of the dominant culture, *the differences in performance being accounted for by the situations and contexts in which the competence is expressed*" (Cole and Bruner, 1971, p. 238).

Similarly, Cole *et al.* (1971) concluded from a large set of cross-cultural studies in experimental anthropology 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" (p. 233). Or, in other words (Cole and Scribner, 1974), "we are unlikely to find cultural differences in basic component cognitive processes" (p. 193). Cultural factors however influence the way basic processes are organized into "functional systems" and how these are applied in any given situation.

> "If cultural differences are assumed to be reflected in the way functional systems are organized for various purposes, then a double line of research becomes important: the first is to uncover the culturally determined experiential factors that give rise to different dominant functional systems . . .; the second is to determine which situational features — content domain, task requirements — call out which functional organizations" (p. 194).

These formulations were not specifically aimed at cross-cultural Piagetian psychology, but they may well apply to this area as well. This is explicitly stated by Heron (1974; Heron and Dowel, 1973, 1974), who cites Flavell and Wohlwill (1969) and Cole and Bruner (1971) to explain the discrepancy in performance on tasks regarded as characteristic of the same stage. Possibly the absence of conservation of weight in some of his Zambian or Papuan subjects may be attributed to the "Labov effect": maybe the weight conservation task was not "their problem".

In this respect, Heron (first in Heron and Simonsson, 1969) calls attention to what he has termed "cognitive ambience":

> "By this term I mean the 'values with cognitive relevance that are *implicit* in the total pattern of adult and older sibling behaviour within which (early) development takes place . . . the total pattern of implicit cognitively-relevant cultural values communicated through linguistic and other behaviour by adults and older children'. I must re-emphasise what is the vital feature of this 'communication of cognitively-relevant cultural values': it is *the unintentionality, the day-by-day usualness, the taken-for-granted assumptions about what is and what is not important in life*" (Heron, 1974, p. 97).

For example, Heron and Simonsson (1969, p. 290) suggest that precise comparisons of quantity are not culturally relevant to Zambian children: "Questions of amount or quantity are not dealt with in the terms of precision and exactitude with which they are invested in other cultures; the probability of a Zambian preschool child becoming aware of any importance being attached by his elders to exact identity or equivalence is effectively zero." Much the same observations have been made by Waddell (personal communication) for Papuan children.

All this seems to indicate that *performance* on conservation tasks, and possibly on other Piagetian tasks as well, is partly culture-bound. If this is so, and since these concepts are obviously relevant in the Western technological culture in which Piaget's theory was developed, performance should increase with acculturation. This is the question we will examine next, as we turn to a discussion of some of the factors which may influence concrete operational development.

D. The Influence of Acculturation*

Most quasi-experimental cross-cultural Piagetian studies comparing two or more sub-groups of the same ethnic group have attempted to assess some aspect of acculturation, or factors which are usually linked to acculturation, such as schooling or urban/rural residence, the use of a second language being often associated with these variables. The first study we are summarizing here differs from most previous ones insofar as both groups compared live in isolated locations in the semi-desert of Central Australia, both have kept their ethnic identification and speak their vernacular, although both groups are attending school and learning English; the main difference between the two groups lies in the length and amount of contact

* The studies reported in this section were carried out under the guidance of Professor Gavin N. Seagrim (Australian National University).

they have had with the dominant European culture, and in the extent to which traditional values and activities have persisted.

1. *Study 1* (Dasen, 1970, 1974a)

One hundred and forty-five children, aged 6 to 16 years, and 20 adults, were tested in two different locations in Central Australia, both west of Alice Springs. The low-contact group consisted of the total school population at Areyonga Settlement (N = 55); the high-contact group was selected from the Hermannsburg Mission school (N = 90).

The following is a description of the history and present situation of the two groups to be compared:

> "The low-contact group consists of Pitjantjara (Pitjantjajara) Aborigines living at the Areyonga Government Settlement, which was established as a ration depot in 1944 and which has included a school since 1950 and a medical dispensary since 1952. Some contact between the Western Desert tribes and European missionaries had existed since 1920, but even when Areyonga was established, contact with European culture was only sporadic, and mainly limited to the distribution of goods, the Aboriginal population remaining mainly nomadic. In later years, some Aborigines became more sedentary, but traditions and customs were constantly revived by the arrival of new groups from the desert (up until about 1965). In 1969, when this study was carried out, the Aboriginal population at Areyonga had become sedentary for part of the year, although most families did not use the houses provided by the settlement, but lived in tin shacks resembling the traditional shelters and which could be moved from time to time. For about four months each year, however, most of the population still leaves on 'walkabout', visiting their ancestral sacred grounds and performing ceremonies, travelling over wide distances in the Western Desert, and living mainly from hunting and gathering. During the sedentary months, the children attend school more or less regularly and most adults have some form of employment, although these jobs tend to be rather artificial because there is no real economic reason for them, except welfare. Access to the settlement, which is situated on Reserve 1028, is restricted and is subject to a permit issued by the welfare administration; access is further hindered by distance (approximately 140 miles from Alice Springs) and poor road conditions.
>
> The medium-contact group consists of Aranda (Arunta) Aborigines living at Hermannsburg Mission, which was established in 1877, with school activities dating back to 1880. Schooling was initially conducted in Aranda, but from the 1930s onward English became more important, and finally the sole language of instruction; the curriculum and facilities were extremely basic until the 1950s. In 1969, the schooling conditions in Areyonga and Hermannsburg tended to be quite similar, although Hermannsburg had slightly better equipment and a more stable staff. The Aboriginal population at Hermannsburg still uses the vernacular almost exclusively, but Aboriginal values and traditions have been abandoned to some

extent, without being necessarily replaced by their European equivalents. Housing tends to be of a better standard than at Areyonga, although this is a recent achievement and a few families are moving back into tin shacks. The population is more stable than at Areyonga; there is no annual 'walkabout', although many Aborigines tend to travel frequently to other settlements. Adults are employed on the same type of jobs as at Areyonga, but the mission also has a productive cattle industry and a tannery, and a cash economy is promoted by a well-equipped store. Access to Hermannsburg is free, and tourist buses pay regular visits to the mission; the station is linked to the nearest European centre by 70 miles of a relatively good road." (Dasen, 1974a, pp. 382–83).

The following Piagetian tasks were used: conservation of quantity, weight, volume and length, seriation of lengths. These tasks are widely known and their description need not be repeated here (the detailed procedures are reported in full in Dasen, 1970, and with some detail in Dasen, 1974a). In addition three tasks assessing the development of topological, projective and Euclidean spatial relationships (Piaget and Inhelder, 1948) were used:

(1) *Linear, reverse and circular order.* The subject has to copy a linear display of nine objects, reverse this order and finally change a circular display into a straight line. The task assesses topological spatial relationships of neighbourhood, order, and one-to-one correspondence.

(2) *Rotation of landscape models.* (Localization of topographical positions.) The subject has to locate on one landscape model rotated by 180°, seven successive positions and orientations of a corresponding object placed on an unrotated landscape model. The models and objects used were adapted to the local landscape, but retain the same spatial features as originally used by Piaget and Inhelder (1948; 1956, p. 421). The task assesses topological, projective and Euclidean (metric) spatial relationships, the construction of a coordinate system and the flexibility of spatial operations.

(3) *Horizontality.* This task assesses the coordination of two spatial (Euclidean) reference systems. The subject is required to draw, on corresponding outline figures, the level of water in a half-filled bottle tilted into various positions. The complete task consists of three parts: (a) the water level is hidden (anticipation); (b) the water level is visible (copy); (c) the level is hidden again (anticipation after copy). However, results will be reported for part (a) only, reflecting the spontaneous performance level, as with the other tasks, without any additional learning effect.

Results

The comparison of the number of subjects classified as having attained concrete operations (stage 3) in the Hermannsburg and Areyonga samples

is presented in Table 2. The chi-squares were calculated according to a method recently proposed by Kamara and Easley (1976) which takes into account not only the total frequencies, but cumulates the p values for each age level. The differences are statistically significant beyond the 0·05 level for six of the tasks, favouring the Hermannsburg group and thus indicating a strong effect of European contact. Only one of the differences is significant for the spatial tasks, indicating that the influence of acculturation is more marked on concepts, such as conservation, which are less relevant to Aboriginal culture.

Table 2

The influence of acculturation (study 1). Comparison of the attainment of concrete operations (stage 3) in the Hermannsburg and Areyonga samples.

Task	V (Chi-square)	d.f.	p (1 tail)
Quantity	26·735	10	0·001
Weight	17·763	10	0·05
Volume	9·781	10	NS
Length 1	16·519	8	0·05
Length 2	16·145	8	0·05
Seriation	27·592	10	0·001
Orders	11·672	10	NS
Rotation	19·179	10	0·05
Horizontality			
Stage 3A+3B	−0·141	12	NS
Stage 3B only	11·339	12	NS

2. *Study 2* (Dasen *et al.*, 1973)

Thirty-five children, aged 5 to 14, were tested in their homes in the vicinity of Adelaide, South Australia. These children had been adopted or were being fostered by European families; since it is quite difficult to locate such children, our sampling suffers from various deficiencies. The most important of these is probably the age at which the children were adopted or first fostered: although this occurred in the first year of life for 21 children, the mean age at adoption was 18·5 months for the total sample, and many children had changed families several times. The tribal origin of most of the children was not known, and only seven were of full Aboriginal descent (the mode, 17 children, being of half Aboriginal ancestry). Early medical histories were sketchy, but it seems that early malnutrition and severe illnesses were quite common. Three of the five oldest children (13 to 14 years) had very bad early medical histories; their results on the cognitive tasks were completely out of line with the results of the rest of the sample.

Thus this age group was not included in the statistical analyses reported below. The following Piagetian tasks were used: conservation of quantity (liquids), conservation of weight, seriation of lengths, reclassification, horizontality. The procedures were identical with those described previously; the reclassification (Nixon) task has been described by de Lacey (1970).

Results

The number of subjects classified as having attained concrete operations (stage 3) in the Adelaide sample is compared with the results obtained previously with Aboriginal children living on an isolated mission station in Central Australia (Hermannsburg) and with European children living in Canberra. (Full results of these two comparison groups are available in Dasen, 1970, 1974a.) The results on the reclassification task are compared with results obtained at Hermannsburg in a subsequent longitudinal study (unpublished) and with the results reported by de Lacey (1970) for Europeans of high social status living in Sydney. The p values of chi-squares calculated according to the method proposed by Kamara and Easley (1976) are reported in Table 3.

Table 3
The influence of acculturation (study 2): comparison of the attainment of concrete operations (stage 3) in the Adelaide sample of adopted children and the Canberra and Hermannsburg samples. P values of chi-squares.

Task	Adelaide/Canberra p	Adelaide/Hermannsburg p
Quantity	0·01	0·001
Weight	NS	NS
Seriation	NS	0·001
Reclassification (Nixon)	NS[a]	0·001
Horizontality	NS	0·001

[a] Comparison of Adelaide children with Europeans of high social status living in Sydney (data from de Lacey, 1970).

The results obtained by these adopted and fostered Aboriginal children are identical to those of European children on the tasks of seriation, reclassification and horizontality (as well as on the Peabody Picture Vocabulary Test, Form A). In each case, the number of children classified at stage 3 is significantly larger than in the Hermannsburg sample. On the conservation of quantity, the number of children attaining stage 3 is intermediate between the frequencies obtained at Hermannsburg and at

Canberra. It has not been possible to ascertain why the results on this conservation task differ from those on the other operational tasks. There is a possibility that the conservation tasks demand a more advanced level of verbal competence than the other tasks, because a verbal judgment is required (despite the fact that adequate reasons were not required in the scoring), whereas the response to the other tasks is mainly non-verbal (although the subject has to specify the dimension of reclassification on the Nixon task). Possibly the language models provided by the families of the two samples compared were somewhat different (although performance on the Peabody Picture Vocabulary Test, Form A, was comparable to European norms taken from the instruction manual). Possibly conservation tasks may be more sensitive to adverse conditions in the early environment. We may also take into account Lefèvre's (1970) suggestion that conservation concepts may present particular problems to the adopted child because of emotional difficulties: the possible difficulty in "conserving" a stable image of himself and of his parents as objects of identification. This hypothesis is open to experimental verification. The study is being replicated in Britain by Sohan Modgil (personal communication) with apparently very similar results.

3. Conclusion

Drawing together the results of these two studies, it seems that the variable of "European contact" may form a continuum which is directly related to the "rate" of development of concrete operations (or at least to the performance on concrete operational tasks).

A first interpretation of these findings could be phrased in terms of the "deficit hypothesis" (Cole and Bruner, 1971): our measures would be a direct reflection of cognitive competence, and Aboriginal culture, for whatever reason (lack of early stimulation, deficient linguistic models, disorganized communities and social interactions, etc), would be deficient in its ability to foster this cognitive competence. With increasing contact with the dominant culture, the proportion of children being able to display the proper competence would increase.

A second interpretation could be phrased in terms of the "Labov effect": our experiments being inadequate, their results are meaningless. The differences we have found in the performance levels simply reflect the fact that the tasks were not "their problem". With increasing contact with the dominant culture, the proportion of children being able to display the proper performance would increase simply because the experimental situation becomes more adequate.

Neither of these extreme positions seems satisfactory, although the second interpretation is certainly safer than the first in our present state of knowledge. However a third, intermediate interpretation is possible and preferable, which we could phrase in terms of the "difference interpretation" (Cole and Bruner, 1971): there is a true difference in cognitive performance (but maybe not in competence) between the two cultural groups. This difference results from the fact that the two cultures value different areas of cognitive development. The "cognitive ambience" in Heron's terms may not be favourable within Aboriginal culture for the development of such concepts as conservation or number, although it is quite adapted to produce other skills (e.g. hunting and tracking, spatial orientation, knowledge of kinship structures*). As contact with the dominant culture increases, the value orientation and "cognitive ambience" changes. This cultural difference is not to be seen as a deficiency in one culture; there ought to be no values applied to cultural differences. However cultural variations are certainly more than experimental artefacts; there may be real differences which cannot be neglected.

In the next section, we shall give an extensively documented example of how different cultures may foster the development of certain areas of cognitive development over others. In the study to be reported, the results of Canadian Eskimos, Australian Aborigines and Ebrié Africans are compared on selected Piagetian tasks; no reference is made to a Western "norm". The three subsistence-economy populations are placed on an eco-cultural scale, with low food-accumulating, nomadic, hunting groups at one extreme, and high food-accumulating, sedentary, agriculturalist groups at the other extreme, following a model proposed by Berry (1966). In the nomadic groups, spatial concepts are expected to be valued and to develop more rapidly than in the sedentary groups. In the latter, on the other hand, concepts of conservation of quantity, weight and volume are expected to be valued and to develop more rapidly than in the nomadic groups. In other words, each cultural group is expected to develop specifically those skills and concepts which it most needs. These cultural differences do not exclude the universality of the underlying cognitive competence.

E. The Influence of Ecological Demands†

Within the renewed tradition of ecological cultural functionalism, Berry (1966, 1971) has suggested a model linking individual behavioural development to the "ecological demands" placed on a group of people, partly through the mediation of cultural adaptation to this ecology ("cultural aids").

* The cognitive "operations" underlying these skills ought to be studied more extensively; cf. the attempts at more "emic" studies by Gladwin (1970), Levine and Price-Williams (1974), Price-Williams *et al.* (1976), Greenfield and Childs (1976).

† This study has been reported previously in the *Journal of Cross-Cultural Psychology* (1975), **6**, 156-172.

> "Specifically, it is argued, persons who inhabit ecologies where hunting is the mode of sustenance should develop perceptual discrimination and spatial skills adapted to the ecological demands of hunting. . . . Their cultures are expected to be supportive of the development of these skills through the presence of a high number of 'geomentrical-spatial' concepts, a highly developed and generally shared arts and crafts production, and socialization practices whose content emphasises independence and self reliance, and whose techniques are supportive and encouraging of separate development. Implicit in this argument is the expectation that as hunting diminishes in importance across samples ranked in terms of this ecology dimension, the discrimination and spatial skills will diminish, as will each of the three cultural aids" (Berry, 1971, pp. 328–29).

Thus, an ecology dimension was defined by placing low food-accumulating, migratory, hunting and gathering, low population density groups at one end of the scale, and high food-accumulating, sedentary, agricultural, high population density groups at the other extreme. Socio-cultural characteristics which are known to vary fairly consistently with this ecological dimension are socialization practices, family structure, social structure and social relations (Berry, 1975a).

This model was largely supported by a comparative study (Berry, 1966) of Temne (Sierra Leone) and Eskimos (Baffin Island), which was later expanded (Berry, 1971) to include two populations considered to be at intermediate positions on the ecology dimension: Australian Aborigines and Melanesians (New Guinea). Both traditional and transitional samples were included and their results were analysed separately. The rankings of the dependent variables (scores on perceptual discrimination, Embedded Figures Test, Kohs Blocks and Raven's Matrices) followed the rankings on the ecology dimension with only one exception.

Still more recently, the model was considerably expanded (Berry, 1975a), and eco-cultural, socialization and acculturation indices were developed which enable a precise ranking of the populations on the eco-cultural scale. The model was then retested, using 17 different samples (Berry, 1975b).

The extension of Berry's model to the Piagetian area suggests that, although the sequence of stages in the development of concrete operations may prove to be universal, the rate of development may be partly determined by ecological and cultural factors. Thus the first of two hypotheses is advanced: if three subsistence-economy populations are placed on an eco-cultural scale, with low food-accumulating, nomadic, hunting groups at one extreme (e.g. Eskimos and Australian Aborigines),

and high-food accumulating, sedentary, agriculturalist groups at the other extreme (e.g. Ebrié of the Ivory Coast), the former are expected to develop spatial concepts more rapidly than the latter. The choice of tasks assessing the development of spatial concepts would be based on Piaget and Inhelder's (1948) analysis of topological, projective and Euclidean spatial representation in children.

Furthermore, it seemed reasonable to expect that the African group, under the pressure of its own eco-cultural milieu, would develop other concepts more rapidly than the Eskimo and Aboriginal groups. This leads to the second hypothesis: because of the agricultural production, accumulation and exchange of food in the African group, its members are expected to attain concepts of conservation of quantity, weight and volume (Piaget and Inhelder, 1941, 1963) more rapidly than do Eskimos and Aborigines. A similar hypothesis could be formulated for the concept of number, but will not be tested here.

These hypotheses deal with the quantitative aspects of cognitive development, the differential rate of development of various areas of concrete operational reasoning, and not with the qualitative aspects of structure and hierarchical ordering of stages. Note also (see Berry, 1971) that the model is functional, emphasizing interactions rather than causal sequences, and that it applies only to subsistence-economy populations, for which the "ecological demands" are expected to be more uniform than in technological societies. For these and other methodological reasons, any comparison with a Western "norm" will be avoided.

Earlier support for a hypothesis stemming from the combination of Berry's model and a Piagetian framework came from the finding that Australian Aborigines, in two specific samples, acquired a particular set of spatial operations before they acquired a particular set of conservation concepts, whereas the reverse was found to be true in a European sample (Dasen, 1970, 1974a). This demonstration, however, required the use of an arbitrary scoring system in order to combine the results of several tasks into a single measure, and it had the drawback of using a Western comparison group. Later (Dasen, 1973a), these inconveniences were overcome by comparing directly the results of the Aboriginal sample with those of an Ebrié African sample (Adiopodoumé). However, the design was not yet judged to be satisfactory, in view of Campbell's (1961) suggestion that three points are required to make meaningful cross-cultural comparisons.

However, the above hypotheses do not clearly specify the ranking of the Eskimo and Aboriginal samples on the independent variable. Berry (1971) has placed his Eskimo samples at one extreme of the ecology scale, and the Australian Aboriginal samples at a more intermediate position, but definitely on the nomadic/hunting/low food-accumulating side; his results

clearly support this ranking. We could therefore add to our first hypothesis the prediction that the rate of spatial concept development should be greater in the Eskimo than in the Aboriginal sample. Anthropological evidence in regard to this ranking seems to be equivocal, however, particularly if we wanted to include a similar distinction in the second hypothesis.

F. Method

1. Subjects

The subjects were 6- to 14-year-old schooled rural children drawn from three cultural groups.

(1) *Central Eskimos.* The settlement of *Cape Dorset* is situated on the south-west tip of Baffin Island, in the Northwest Territories of Canada. Its population is about 600. Cape Dorset Eskimos are well known for their artistic achievements: stone carvings and prints provide a large part of their income, together with local service jobs and welfare. But part of the food is still provided by hunting and fishing. Every family owns a house in the village, but while on hunting expeditions they may still live in igloos during winter and in tents during summer. Some families live for part of the year in isolated hunting camps. An excellent study of the village of Sugluk, very similar to Cape Dorset, has been provided by Graburn (1969).

(2) *Australian Aborigines.* The results to be reported here are those of the *Hermannsburg* sample, which has been described above (cf. pp. 179-180).

(3) *Ebrié Africans.* The village of *Adiopodoumé* is situated 17 km west of Abidjan, the capital city of the Ivory Coast. Its populaton is about 2,000. Most of its inhabitants are Ebrié, although some other ethnic groups are also present. The main activity is the growing of staple food (yams, plantain and various vegetables) as well as cash crops (coffee, cocoa and bananas). There is also some fishing in the lagoon, and a number of paid jobs are available in the city or at a nearby research station.

It should be noted that the cultural characteristics of the three samples come close to the requirements of Berry's model, but are not absolutely ideal. The Eskimos and Aborigines no longer rely exclusively on hunting and gathering and have become partly sedentary, whereas the African sample is somewhat heterogeneous as to ethnic background and parents' occupations.

The three samples will be labelled by the names of the locations in which

they were obtained, to indicate that they are not necessarily representative of each ethnic group as a whole. In particular, as we have seen in the previous section, results may be influenced by acculturation; the three samples were chosen to represent approximately equal levels of acculturation, as far as this could be done across different historical and cultural backgrounds. However, no measure of acculturation, other than the author's casual observations, can be offered.

In each sample, ten subjects (as nearly as possible five of each sex) were sampled randomly within each given age group. All subjects attended the local primary school, where teaching took place in a second language, and their ages were known from reliable school records. The sample characteristics are summarized in Table 4.

Table 4
The influence of ecological demands. Sample characteristics.

Age groups (years)	Central Eskimos of Cape Dorset Baffin Island: Sex M	F	Mean (years and months)	Range (years and months)	Australian Aborigines of Hermannsburg Central Australia: Sex M	F	Mean	Range	Ebrié Africans of Adiopodoumé Ivory Coast: Sex M	F	Mean	Range
6	5	5	6; 0	5;10– 6;5	5	5	6; 3	5; 7– 6;5				
8	6	4	8; 1	7; 7– 8;4	5	5	8; 1	7; 8– 8;6	4	6	8; 1	7;7– 3;6
9	6	4	8;11	8; 7– 9;6	5	5	9; 1	8; 7– 9;5				
10	5	5	10; 2	9;10–10;5	5	5	10; 1	9; 7–10;6	5	5	9;11	9;7-10;4
11	4	6	11; 1	10; 8–11;6	5	5	10;11	10; 7–11;4				
12	5	5	12; 0	11; 7–12;4	5	5	12; 0	11; 8–12;6	6	4	12; 1	11;7–12;6
13	5	5	13; 1	12; 8–13;6								
14	5	5	14; 0	13; 7–14;7	5	5	13; 7	12;11–14;6	5	5	14; 1	13;7–14;6
n	41	39			35	35			20	20		

2. *Tasks*

The results of the following tasks will be reported in this section; they have been described or referred to previously (cf. p. 180).

Space:
(1) Linear, reverse and circular order.
(2) Rotation of landscape models (localization of topographical positions).
(3) Horizontality (water-level in tilted bottle), Part 1.

Conservation:
(4) Conservation of quantity (liquids).
(5) Conservation of weight (plasticine).
(6) Conservation of volume (water displaced by plasticine).

Concurrently, other tasks which are not relevant to the present hypothesis were used with some of the samples. These included conservation of length, mental imagery and optico-geometrical illusions. The only other tasks administered to all three samples were seriation of lengths and reclassification (Nixon test, cf. de Lacey, 1970); on both tasks the rate of attainment of concrete operations was fastest in the Cape Dorset sample, followed by the Hermannsburg and Adiopodoumé samples. The differences are statistically significant beyond the 0·05 level, except for the Hermannsburg/Adiopodoumé comparison on reclassification.

3. *Procedure*

The testing took place in the second language used in the subjects' schools (English for Eskimos and Aborigines, French for Ebrié). Adequate

communication was ensured through check-items preceding each task; if communication was judged to be inadequate, results were classified separately. The testing was carried out by the author and his wife at Hermannsburg and Adiopodoumé, and by the author and Serge Rioux at Cape Dorset. The order in which the tasks were administered was randomized, except for the order of the tests of conservation of quantity, weight and volume, which was counterbalanced within each age group. For various reasons all tasks were not administered to all age groups; this appears clearly in the presentation of the results, each percentage being calculated on an age group of ten subjects.

G. Results

The structural properties of the stages and their hierarchical ordering were verified in each sample. Detailed analyses of the results, including frequencies of each sub-stage, are presented elsewhere (Dasen, 1970, 1974a, 1975b). For the purpose of the present argument, only the rate of development of stage 3 (the final stage of attainment of concrete operations) will be considered.

Hypothesis 1: Space

Results on the three tasks of a spatial operations are presented in Figs 4, 5 and 6 in the form of percentages of children, at each age group tested, attaining stage 3 in the three samples. The results clearly support hypothesis 1. On all three tasks, the rate of development is faster in the Cape Dorset and Hermannsburg samples than in the Adiopodoumé sample. The statistical significance of the differences in the proportions of children in each age class reaching the concrete operational stage was computed according to the scheme proposed by Kamara and Easley (1976). The corresponding p values appear in Table 5. For the spatial tasks, the developmental curves are all significantly different beyond the 0·05 level, except for the Hermannsburg and Cape Dorset samples on task 1 (linear, reverse and circular order), topological relations being acquired early in both these samples. On the two other tasks, the rate of development is significantly faster for the Cape Dorset sample than for the Hermannsburg sample, which confirms Berry's placing of these two populations on the ecology scale.

On the most difficult task, namely horizontality, the frequency of attainment of stage 3 is generally low. However the intermediate stage

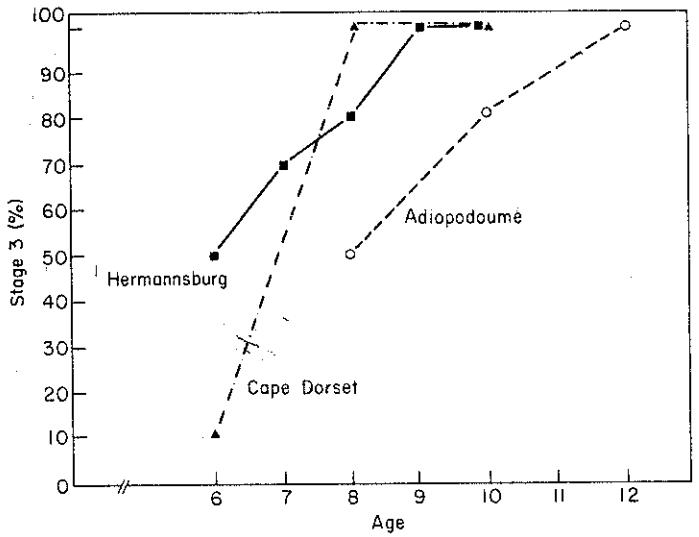

Fig. 4. Orders: percentages of subjects at stage 3 (full concrete operations).

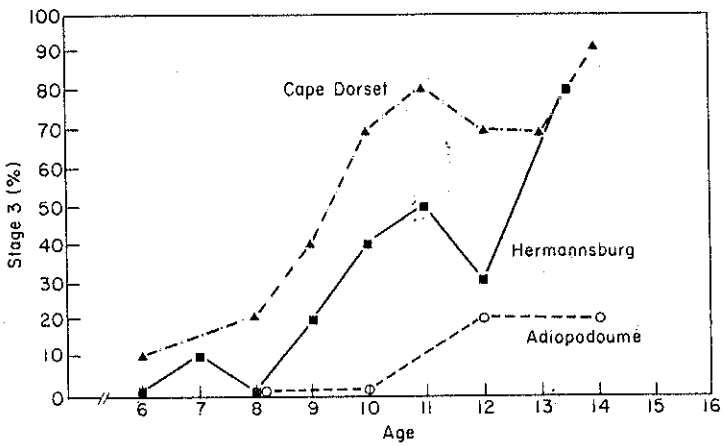

Fig. 5. Rotation: percentages of subjects at stage 3 (full concrete operations).

immediately preceding stage 3 already reflects the emergence of concrete operations. If this intermediate stage is combined with stage 3 (cf. Fig. 6), the differences between the three samples become even more marked, and are all statistically significant beyond the 0·0005 level.

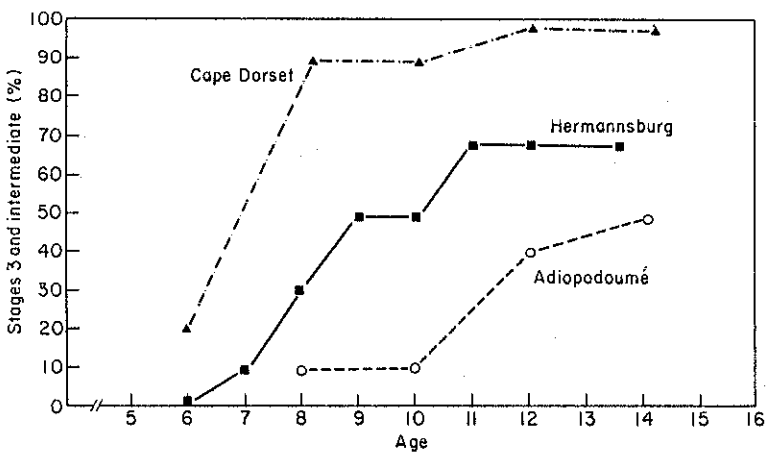

Fig. 6. Horizontality: percentages of subjects at stage 3 (full concrete operations) and intermediate stage, combined.

Table 5
The influence of ecological demands.

Level of significance of the differences in the proportions of children reaching stage 3 (p values)

	Tasks								
	Space			Conservation[b]					
	Orders	Rotation	Horiz.	Q	W	V	Q	W	V
Age range	6–14 years			8–14 years			12–14 years		
Samples compared[a]									
A/H	0·01	0·05	0·05	NS	0·025	NS	0·025	0·001	0·025
A/C.D.	0·005	0·0005	0·0005	0·025	NS	NS	0·005	0·005	0·05
C.D./H	NS	0·0005	0·01	NS	NS	NS	NS	NS	NS

[a] A = Adiopodoume; H = Hermannsburg; C.D. = Cape Dorset.
[b] Q = Quantity (liquids); W = Weight; V = Volume.

Hypothesis 2: Conservation

The results on the three conservation tasks are presented in Figs 7, 8 and 9 and the corresponding p values in Table 5. The second hypothesis receives only partial support from the data. If the age range 12 to 14 years is considered alone, the order of the developmental curves is as expected from the hypothesis: the rate of development in the Adiopodoumé sample is significantly faster than in the two other samples on all three tasks. On the other hand if the complete age range is considered, the differences are statistically significant in two cases only, because several discontinuities

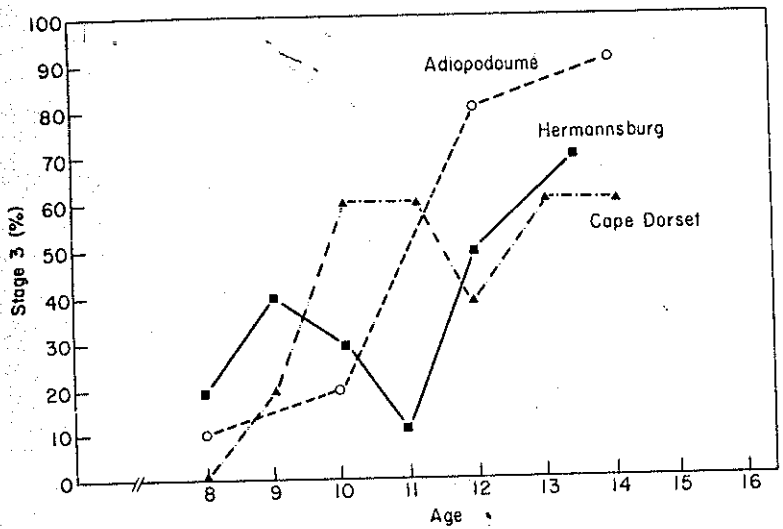

Fig. 7. Conservation of quantity: percentages of subjects at stage 3 (full conservation).

occur below age 12 which are not in accordance with the hypothesis. On conservation of quantity, the percentage of conservers in the 8-, 9- and 10-year-olds appears to be exceptionally high when compared with the results of the older children; it has not been verified whether pseudo-conservation (Bovet, 1974) might have occurrred at these ages in the Hermannsburg sample. In any case, high percentages of conservation also occur in the Cape Dorset group at 10 and 11 years; in this case, the operational character of these conservation answers has been clearly established.

On conservation of weight, no clear differences occur between the three samples in the results of the 8- to 10-year-old children. On conservation of volume, the frequencies of stage 3 answers are higher in the Cape Dorset

involved, nor to use concrete operations in general. In particular, the eco-cultural factors would determine the final levels of spontaneous use of the concepts (the levels of the asymptotic curves), whereas competence may be either universal or under the influence of other cultural factors.

Further research is needed to clarify this distinction. The present results demonstrate that the rates of development (at least of performance) are not uniform across different areas of concrete operations, and that these rates may reflect the adaptive values of the concepts concerned.

IV. CONCLUSION

This chapter started with a question concerning the universality of cognitive processes; subsequently we have continually switched back and forth between data arguing in favour of universality and other facts favouring cultural relativism. The initial warning, that we would not reach a definite conclusion, should now make sense.

Already in the first stage of cognitive development, that of sensori-motor intelligence, we have seen that culture seems to influence the rate of development to some extent, although the similarity in structure and process is certainly more striking than the differences. No doubt the initial interaction between the human organism and its environment follows universal paths, even though the content of the structures and interactive mechanisms may vary a great deal. Content seems to be of little relevance to the activation of sensori-motor schemata.

During the move from pre-operational to concrete operational thinking, on the other hand, content does become important; and even more important seem to be the functional aspects of concrete operational concepts. The underlying structures, the mechanisms, or "operations" in Piagetian terms, seem to be universal, but whether and at what rate they become functional seems to be determined to a large extent by cultural patterns. This may be why the results of cross-cultural Piagetian studies are often less than clear. This may also be why most, but not all, studies find large effects of acculturation, schooling and urbanization, and why large but often unexplained differences occur in the rate of development of concrete operational concepts. Future research ought to attach more importance to these functional aspects and in particular to the competence/performance distinction. The study we have presented on the verification of Berry's eco-cultural model within Piagetian psychology is a first step in this direction; it is one of the first quasi-experimental studies in this area, but its scope is still limited. In particular, the link with the competence/

performance model could only be suggested and not fully substantiated, and the precise mechanisms through which eco-cultural variables may influence cognitive processes remain to be demonstrated. On the one hand we feel that we have already accumulated a wealth of data, on the other it becomes obvious that the most important and most difficult research is still to be done.

Future research may possibly be more fruitful if it is no longer conceived as a verification of Piaget's theory, but is able to go beyond, to a search for mechanisms. Constant vacillation between consideration of universality and of cultural relativism has been a feature of this chapter: neither interpretation is true in itself, and choosing one over the other seems to be mainly a matter of personal preference; in any case neither "proves" or "disproves" Piaget's theory. If anything, the cultural variations simply expand the theory to encompass functional aspects which have been neglected in Piaget's earlier work, but which have since come to attention also in Western Piagetian research.

For example, Piaget's last stage of intellectual development, that of formal operations, has recently come under closer scrutiny, and it is often reported that large proportions of the population do not display formal operations (e.g. Lovell, 1961). Piaget (1972) still believes that all normal individuals are capable of reaching the stage of formal operations, if not between 11 and 15 at least between 15 and 20. "However, they reach this stage in different areas according to their aptitudes and their professional specializations" (p. 10). Thus the tasks initially devised to assess formal operational reasoning (Inhelder and Piaget, 1958) may be adequate for testing adolescents undergoing higher schooling but are not applicable to individuals in manual occupations, nor to those who are more interested in languages or law than in physics and mathematics. Little cross-cultural research has been published on formal operations, probably because it is obvious that the standard tasks would be culturally inadequate in most situations. New tasks have to be devised which test the same cognitive structures, but which are directly relevant to the daily activities and interests of the subjects.

The same programme could also be usefully carried out for concrete operations. Greenfield (1976) rightly suggests that cross-cultural researchers ought to follow Piaget's theory rather than his procedures. Ideally, one would wish to see a Piagetian-type study carried out in a cultural group by a member of that group, using situations and tasks entirely relevant to that culture. Piaget's theory would at last become emic rather than etic (Berry, 1969). In the meantime, however, there is still room for less ambitious but worthwhile cross-cultural Piagetian research.

REFERENCES

Ainsworth, M. D. (1967). "Infancy in Uganda: infant care and the growth of love." Johns Hopkins University Press, Baltimore.

Bell, S. M. (1970). *Child Dev.* **41**, 291–311.

Berry, J. W. (1966). *Inter. J. Psychol.* **1**, 207–229.

Berry, J. W. (1969). *Int. J. Psychol.* **4**, 119–128.

Berry, J. W. (1971). *Can. J. behav. Sci.* **3**, 324–336. (Reprinted in Berry and Dasen, 1974).

Berry, J. W. (1975a). *Ned. Tijdschr. Psychol.* **30**, 51–84.

Berry, J. W. (1975b). Nomadic style and cognitive style. Paper presented to the I.S.S.B.D. Conference, Surrey, England, July 13–17, 1975.

Berry, J. W. and Dasen, P. R. (1974). "Culture and Cognition: Readings in cross-cultural Psychology." Methuen, London.

Bovet, M. C. (1974). *In* "Culture and Cognition" (Eds J. W. Berry and P. R. Dasen), pp. 311–334. Methuen, London.

Bovet, M. C., Dasen, P. R. and Inhelder, B. (1974). *Archs Psychol.* **41** (Vol. 1972), 363–386.

Bower, T. G. R. and Paterson, J. G. (1972). *Cognition* **1**, 47–65.

Campbell, D. T. (1961). *In* "Psychological Anthropology" (Ed. F. L. K. Hsu), pp. 333–352. Dorsey, Homewood, Illinois.

Carlson, J. (1976). *In* "The developing individual in a changing world" (Eds K. Riegel and J. Meacham). Mouton, The Hague. In press.

Casati, I. and Lézine, I. (1968). "Les étapes de l'intelligence sensori-motrice. Manuel." Centre de Psychologie Appliquée, Paris.

Cole, M. and Bruner, J. S. (1971). *Am. Psychol.* **26**, 867-876. (Reprinted in Berry and Dasen, 1974).

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

Cole, M., Gay, J., Glick, J. and Sharp, D. W. (1971). "The Cultural Context of Learning and Thinking." Basic Books, New York.

Corman, H. H. and Escalona, S. K. (1969). *The Merrill-Palmer Quarterly* **15**, 351–361.

Dasen, P. R. (1970). "Cognitive development in Aborigines of Central Australia." Unpublished PhD thesis. Australian National University, Canberra.

Dasen, P. R. (1972a). *J. Cross-cult. Psychol.* **3**, 23–39.

Dasen, P. R. (1973a). *Can. Psychol.* **14**, 149–166.

Dasen, P. R. (1973b). *Early Child Development and Care* **2**, 345–354.

Dasen, P. R. (1974a). *In* "Culture and Cognition" (Eds J. W. Berry and P. R. Dasen), pp. 381–408. Methuen, London.

Dasen, P. R. (1974b). *Archs Psychol.* **41** (Vol. 1972), 341–361.

Dasen, P. R. (1975a). *J. Cross-cult. Psychol.* **6**, 156–172.

Dasen, P. R. (1975b). *Int. J. Psychol.* **10**, 165–180.

Dasen, P. R. (1975c). *In* "Dips in Learning and Development Curves" (Eds J. Mehler and T. Bever). In press.

Dasen, P. R. (1976). "Piagetian Psychology: Cross-Cultural Contributions." Gardner Press (Halsted, Wiley), New York. In press.

Dasen, P. R., de Lacey, P. R. and Seagrim, G. N. (1973). *In* "The Psychology of Aboriginal Australians" (Eds G. E. Kearney, P. R. de Lacey and G. R. Davidson), pp. 97–104. Wiley, Sydney.

Décarie, T. (1967). "Intelligence et affectivité chez le jeune enfant." Delachaux et Niestlé, Neuchâtel.

de Lacey, P. R. (1970). *J. Cross-cult. Psychol.* **1**, 293–304.

de Lemos, M. M. (1966). "The development of the concept of conservation in Australian Aboriginal children." Unpublished PhD thesis. Australian National University, Canberra.

de Lemos, M. M. (1969). *Int. J. Psychol.* **4**, 255–269.

Droz, R. and Rahmy, M. (1972). "Lire Piaget." Dessart, Bruxelles.

Flavell, J. H. (1963). "The Developmental Psychology of Jean Piaget." Van Nostrand, Princeton, New Jersey.

Flavell, J. H. and Wohlwill, J. F. (1969). *In* "Studies in cognitive development" (Eds D. Elkind and J. H. Flavell), pp. 67–120. Oxford University Press, New York and London.

Furth, H. G. (1968). "Piaget and knowledge: Theoretical foundations." Prentice-Hall, Englewood Cliffs, New Jersey.

Ginsburg, H. and Opper, S. (1969). "Piaget's theory of intellectual development: an introduction." Prentice-Hall, Englewood Cliffs, New Jersey.

Gladwin, T. (1970). "East is a Big Bird." Harvard University Press, Cambridge, Mass.

Goldberg, S. (1970). *H.D.R.U. Reports.* **15**, Lusaka, Zambia.

Golden, M. and Birns, B. (1968). *Merrill Palmer Quarterly* **14**, 139–149.

Graburn, N. H. H. (1969). "Eskimos without Igloos." Little, Brown, Boston.

Greenfield, P. M. (1966). *In* "Studies in cognitive growth" (Eds J. S. Bruner, R. R. Olver and P. M. Greenfield), pp. 225–256. Wiley, New York.

Greenfield, P. M. (1976). *In* "The developing individual in a changing world" (Eds K. Riegel and J. Meacham). Mouton, The Hague. In press.

Greenfield, P. and Childs, C. (1976). *In* "Piagetian Psychology: Cross-Cultural Contributions" (Ed. P. R. Dasen). Gardner Press, Halsted, Wiley, New York. In press.

Guerry, V. (1970). "La vie quotidienne dans un village baoulé." INADES, Abidjan.

Heron, A. (1971). *J. Cross-cult. Psychol.* **2**, 325–336.

Heron, A. (1974). *In* "Readings in cross-cultural psychology" (Eds J. L. M. Dawson, W. J. Lonner), pp. 94–101. Hong Kong University Press.

Heron, A. and Dowel, W. (1973). *J. Cross-cult. Psychol.* **4**, 207–219.

Heron, A. and Dowel, W. (1974). *Int. J. Psychol.* **9**, 1–9.

Heron, A. and Simonsson, M. (1969). *Int. J. Psychol.* **4**, 281–292.

Hyde, D. M. G. (1970). "Piaget and conceptual development." Holt, Rinehart and Winston, London.

Inhelder, B. and Piaget, J. (1958). "The growth of logical thinking." Routledge and Kegan Paul, London.

Inhelder, B., Sinclair, H. and Bovet, M. (1974). "Les structures de la connaissance: apprentissage et développement." P.U.F., Paris. ("Learning and the development of cognition." Harvard University Press, Cambridge, Mass., 1974.)

Kamara, A. and Easley, J. A. Jr. (1976). Is the rate of cognitive development uniform across cultures? A methodological critique with new evidence from Themne children. *In* "Piagetian Psychology: Cross-Cultural Contributions" (Ed. P. R. Dasen). Gardner Press (Halsted, Wiley), New York. In press.

Kearney, G. E. (1973). *In* "The Psychology of Aboriginal Australians" (Eds G. E. Kearney, P. R. de Lacey and G. R. Davidson), pp. 16–25. Wiley, Sydney.
Kelly, M. R. (1970). *T.P.N.G. J. of Educ.*, 55–60.
Kilbride, J. E. and Kilbride, P. L. (1975). *J. Cross-cult. Psychol.* **6**, 88–107.
Konner, M. J. (1972). *In* "Ethological studies of child behaviour." (Ed. N. Blurton-Jones), pp. 285–304. Cambridge University Press, London.
Lefebvre, M. and Pinard, A. (1972). *Rev. Can. Sci. Comp.* **4**, 1–12.
Lefèvre, A. (1970). *Perspectives psychiatriques* **30**, 39–56.
Levine, R. A. (1970). *In* "Carmichael's Manual of Child Psychology." (Ed. P. H. Mussen), Vol. II, pp. 559–612. Wiley, New York.
Levine, R. A. and Price-Williams, D. R. (1974). *Ethnology* **13**, 25–44.
Lewis, M. and Johnson, N. (1971). *Child Dev.* **42**, 1053–1055.
Lézine, I., Stambak, M. and Casati, I. (1969). "Les étapes de l'intelligence sensori-motrice. Monographie no. 1." Centre de Psychologie Appliquée, Paris.
Lloyd, B. B. (1972). "Perception and cognition from a cross-cultural perspective." Penguin Books, Harmondsworth, Middlesex.
Lovell, K. (1961). *Br. J. educ. Psychol.* **52**, 143–154.
Modgil, S. (1974). "Piagetian research: a handbook of recent studies." N.F.E.R., Windsor, Berks.
Mohseni, N. (1966). "La comparaison des réactions aux épreuves d'intelligence en Iran et en Europe." Thèse inédite, Université de Paris.
Opper, S. (1971). "Intellectual development in Thai children." Unpublished PhD thesis, Cornell University, Ithaca, New York.
Paraskevopoulos, J. and Hunt, J. McV. (1971). *J. Genet. Psychol.* **119**, 301–321.
Piaget, J. (1936). "La naissance de l'intelligence chez l'enfant." Delachaux and Niestlé, Neuchâtel. ("The origins of intelligence in the child." Routledge and Kegan Paul, London, 1953.)
Piaget, J. (1937). "La construction du réel chez l'enfant." Delachaux and Niestlé, Neuchâtel. ("The child's construction of reality." Routledge and Kegan Paul, London, 1955.)
Piaget, J. (1965). "Etudes sociologiques." Droz, Genève.
Piaget, J. (1972). *Hum. Devel.* **15**, 1–12.
Piaget, J. and Inhelder, B. (1941). "Le développement des quantités chez l'enfant. Conservation et atomisme." Delachaux and Niestlé, Neuchâtel. ("The Child's Construction of Quantity." Routledge and Kegan Paul, London, 1974.)
Piaget, J. and Inhelder, B. (1948). "La représentation de l'espace chez l'enfant." P.U.F., Paris. ("The child's conception of space." Routledge and Kegan Paul, London, 1956.)
Piaget, J. and Inhelder, B. (1963). *In* "Traité de Psychologie Expérimentale, Vol. VII, l'Intelligence" (Eds P. Fraisse and J. Piaget), pp. 109–155. P.U.F., Paris.
Pinard, A., Morin, C. and Lefebvre, M. (1973). *Int. J. Psychol.* **8**, 15–24.
Price-Williams, D. R. (1961). *Acta psychol.* **18**, 293–305.
Price-Williams, D. R., Hammond, D. W. and Egerton, C. (1976). *In* "Piagetian Psychology: Cross-Cultural Contributions" (Ed. P. R. Dasen). Gardner Press (Halsted, Wiley), New York. In press.
Prince, J. R. (1969). "Science Concepts in a Pacific Culture." Angus and Robertson, Sydney.
Super, C. M. (1973). Infant care and motor development in rural Kenya: some preliminary data on precocity and deficit. Paper presented at the 1st IACCP conference in Africa, Ibadan, Nigeria.

Uzgiris, I. C. and Hunt, J. McV. (1975). "Assessment in infancy." University of Illinois Press, Urbana.
Valantin, S. (1970). "Le développement de la fonction manipulatoire chez l'enfant Sénégalais au cours des deux premières années de la vie." Thèse de doctorat inédite, Université de Paris.
Wachs, T. D., Uzgiris, I. C. and Hunt, J. McV. (1971). *Merrill Palmer Quarterly* **17**, 183–217.
Warren, N. (1972). *Psychol. Bull.* **78**, 353–367.
Werner, E. E. (1972). *J. Cross-cult. Psychol.* **3**, 111–134.
Za'rour, G. I. (1971). *J. Cross-cult. Psychol.* **2**, 165–172.
Zempléni, J. (1970). *Revue Neuropsychiat. infant.* **18**, 785–798.
Zempléni, A. and Zempléni, J. (1972). *In* "Milieu et Développement" (Eds F. Duyckaerts, C. B. Hindley, I. Lézine, M. Reuchlin and A. Zempléni), pp. 151–213. P.U.F., Paris.