CROSS-CULTURAL TRAINING STUDIES OF CONCRETE OPERATIONS

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In a discussion of the cross-cultural relevance of development theories, Dasen, Berry, and Witkin (see Chapter six) concluded that Piaget's concrete operations are only "weakly" universal (Dasen, 1979a): not all children attain the last sub-stage of the concrete operational stage, but those who do follow the same sequence of sub-stages. The proportion of children who attain the last sub-stage (here called "Stage 3" differs according to which concepts are being studied, and is determined by various factors, among which are acculturati and eco-cultural demands (Dasen, 1974, 1975a, 1977a). The developmental curves which are obtained by plotting these proportions over age usually show a "delay","time lag" or "developmental gap" when the results obtained in non-Western, traditional societies are compared with those of children in a Western, technological environment. In some cases, the development curves not only show a lag, but also an asymptote (Dasen, 1979b), reflecting the proportion of children who do not seem to attain the last sub-stage, even at older ages. In the context of ecological functionalism, this "lag" is fre of any value judgment as posted out in Chapter six.

An example of such developmental curves is presented in Figure 1. In this case, the concepts assessed is the Conservation of Quantity (Liquids); the sample of children from a Western, technological environment is drawn from Canberry, Australia (Dasen, 1974). The developmental curve showing both a "time lag" and an "asymptote" (without trainin cf. study below) was obtained from a sample of Central Eskimo at Cape Dorset (Dasen, 1975b).

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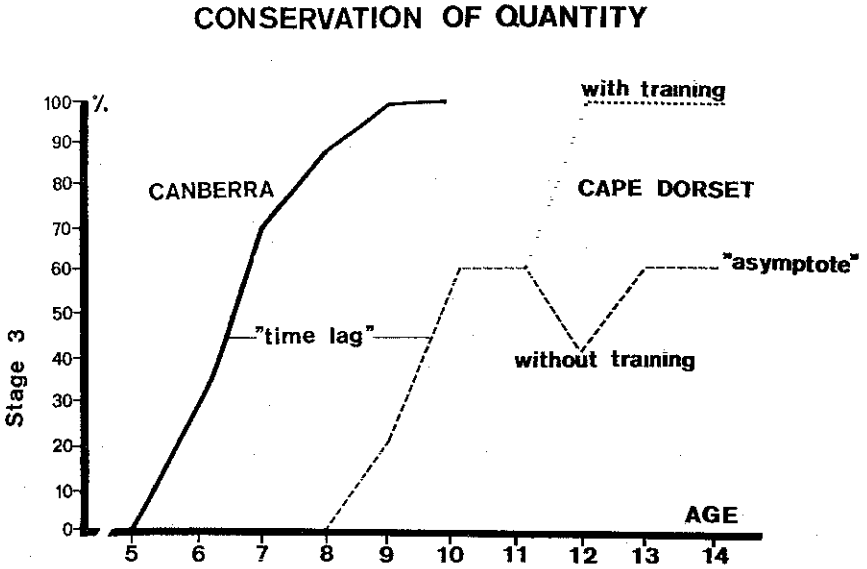

Figure 1: Example of development curves. Conservation of quantity (liquids), percent of Stage 3 performance (full conservation) over age (in years).

The following two questions, concerning the status of these development curves, remain to be answered:

1) To what extent can the developmental "lag" be reduced or bridged ?

2) Are these developmental curves reflecting "performance" or "competence" (Dasen, 1977b) ?

In answer to the first question, a number of studies have shown that the "lag" is reduced or is no longer found in urban environments (e.g., Monseni, 1966; Peluffo, 1967; Poole, 1968; Opper, 1977), in children of the higher socio-economic strata or the so-called "elite" (e.g., Lloyd, 1971), or in children who have been removed from their traditional culture and brought up in a Western context (Dasen, deLacey, and Seagrim,1973; Seagrim, 1977). All these conditions involve

major changes in environment and life-style, which are neither possible to achieve nor desired in most populations. Schooling occasionally has similar effects (e.g., Greenfield, 1966) but usually only reduces the "lag" (e.g., Laurendeau, 1977) and sometimes seems to have no influence at all (e.g., Kiminyo 1977; Kelly, 1977). Would it be possible to reduce the "lag" through a more direct, short-term intervention, without changing anything in the environment and culture ?

Secondly, the "competence/performance distincition" has become one of the major current issues in cross-cultural cognitive psychology (Flavell and Wohlwill, 1969; Cole and Bruner, 1971; Heron, 1974; Bovet, 1974: Dasen, 1977b). There may be a large number of reasons why an individual may have the required skill (or "operational structure" in Piaget's system) to solve a particular problem, but may not use it and these reasons are particularly numerous in a cross-cultural testing situation. Goodnow (1977) has very expertly analysed a number of these, and Cole, et al. (1971) have demonstrated through their "experimental anthropology" how a single performance is not interpretable without various changes in procedures and contexts. Piaget's "method of critical exploration" (also called structural analysis or clinical method), as opposed to standardized tests, provides just the flexibility needed; however the method is difficult to use, and relies on extensive verbal exchange between experimenter and subject.

Another way of going beyond the initial performance is to use a variety of techniques and situations instead of a single task (Greenfield, 1976) training procedures are such a technique.

We can assume that, if very rapid learning is achieved through training, the "competence" or underlying operational structure must have been present, but was not being expressed in the initial task performance and that the training has "actualized" the existing competence (Bovet, 1974). If the training is successful, but improvement in performance occurs more slowly, it is more likely that the operational structure was not present but was built up during training. If no learning occurs, little can be said, since the technique may simply be inadequate in the given situation. In cross-cultural Piagetian studies, examples of "actualization " may be gleaned from results reported by Pinard, Morin and Lefebvre (1973), Bovet (1974), Heron and Kroeger (1975) and Dasen (1975b, 1977a). The problem is to define just how "rapid" the learning has to be in order to reflect "actualization". Dasen, Lavallée and Retschitzki (1979) have attempted the following definition:

a) the change in behaviour has to be important, that is the final sub-stage has to be reached (and has to remain stable over time);
b) this change has to occur under the influence of a minimal amount of stimulation, e.g., simple re-testing (as in a control group) or only one or two training sessions (when three or four are normally needed for successful training).

METHOD

Following this rationale, we have so far carried out eight training studies in three different, non-Western populations. The details of the techniques, samples, and results have been or will be published elsewhere (Dasen, 1975a, 1977b; Dasen, Lavallée and Reschitzki, 1979; Lavallée and Dasen, 1979.) An outline of these studies is presented in Table 1.

Three Piagetian concepts were used:

a) Conservation of Quantity (Liquids);
b) Quantification of Class Inclusion;
c) Spatial Coordinates (Horizontality).

The training procedures for Conservation of Quantity followed those devised by Lefebvre (1971; Lefebvre and Pinard, 1972) for Class Inclusion, they were adapted from Inhelder, Sinclair and Bovet (1974). In both cases, the procedures were designed to create a conflict which leads the child to integrate and coordinate existing schemes into new structures. The technique for Horizontality training was based on a more empiricist model; the child was simply given the repeated opportunity to copy the surface-line of water in a round bottle tilted in various positions, and to establish the parallelism between this line and the reference frame.

The three populations are:

a) Central Eskimo, Baffin Island, Canada (cf. Dasen, 1975a, 1975b);
b) Baoulé (Akan), Ivory Coast, West Africa (cf. Dasen, Inhelder, Lavallée and Retschitzki, 1978);
c) Kikuyu (Bantu), Kenya, East Africa.

The second to last column of Table 1 indicates whether a particular sample is on the asymptotic level of the development curve or not. For studies 1 and 2, this is illustrated in Figure 1: the 9 and 10 year old Eskimo children are on that portion of the curve which shows a steady increase of Stage 3 performance with age, therefore they are not on the asymptotic part. The 11 to 14 year old children, on the other hand, are on the asymptotic part, since no increase in Stage 3 performance occurs after age 10. Note that this classification refers to performance before training.

The last column in Table 1 gives an estimate of the "time-lag", again before training, in number of years. This is a very approximate measure of the distance between the development curve of a particular sample and that of the

Canberra sample. It can be seen in Figure 1, that this distance is approximately 3-4 years for the 10-11 year old Eskimos in study 1; for the 12-14 year old children the estimate is necessarily very approximate, since they are on the asymptotic part of the curve, and is said to be about 6 years. The estimates for the other samples are obtained in a similar fashion.

RESULTS

Table 2 provides a summary of the results. Column 1 in Table 2 shows that a significant training effect was obtained in each case except one, and remained stable over at least one month.* This first analysis takes into account any move along the developmental sequence. If we look at column 2, the proportion of subjects achieving a stable Stage 3 performance (i.e., maintained on Delayed Post-Test), the results differ with age: not surprisingly, the proportion is larger in older children.

In most cases, the developmental "lag" disappears with training (Table 2, column 3). Exceptions are: a) Experiment 1, which was carried out as a pilot-study at the end of field-work for a cross-sectional study (Dasen, 1975b), and was therefore very brief. If training had been continued, the children may well have attained Stage 3 instead of Stage 2 only. b) Experiment 6, in which no child attained a stable Stage 3 performance; however, a highly significant training effect still occurred, since 11 of the 14 children changed their performance by one or two sub-stages. c) Experiments 7 and 8, in which the "lag" does not completely disappear, but is drastically reduced. Thus these exceptions can hardly be said to go against the rule.

The learning of a particular concrete operational concept is of little significance if it is restricted to that particular concept. However, studies 3 and 4 show that a statistically significant generalization occurs to other concrete operational concepts (Table 2, column 4). Training for Conservation of Quantity (Liquids) has an effect on other conservation tasks (Number, Compensation, Substance) as well as on Class Inclusion; training for Class Inclusion generalizes to the Conservation tasks, but not to Horizontality. In studies 6,7 and 8, the generalization to a similar but more difficult problem (square instead of round bottle) is also statistically significant (Log-likelihood ratio test).

The training for the Horizontality concept, although statistically significant if we take all sub-stages into account, appears to be less effective than the training on the other two conept if we expect a Stage 3 performance. This may be because it is

*Friedman Analysis of Variance by Ranks was applied, using sub stages on Pre-Test, Post-Test and Delayed Post-Test in experiments 3 t 8, and both Pre-Test and Post-Test in experiments 1 and 2.

Table 1

Outline of training studies

Study number	Task (Concept)	Population	Age (years)	Experimental (E) Control (C)	Number of subject	Is sample on asymptotic part of development curve ?	Stage-3 "lag" before training (approximate number of years)
1	Conservation of Quantity (Liquids)	Eskimo	10-11	E	4	No (10) Yes (11)	3-4
2	Conservation of Quantity (Liquids)	Eskimo	12-14	E	7	Yes	6
3	Conservation of Quantity (Liquids)	Baoulé	7-9	E	14	No	2
4	Quantification of Class Inclusion	Baoulé	7-9	E	14	No	2
5	Quantification of Class Inclusion	Kikuyu	12-14	E C	13 12	Yes	2-4
6	Horizontality (round bottle)	Baoulé	7-9	E C	14 14	No	1
7	Horizontality (round bottle)	Baoulé	13-14	E	11	Yes	6-7
8	Horizontality (round bottle)	Kikuyu	12-14	E C	20 9	Yes	6

Table 2

Training studies, summary of results

Study number	Training effect (significance level of Friedman ANOVA)	Subjects achieving Stage-3 performance N	%	Stage-3 "lag" after training (approximate number of years)	Generalization to other concepts	Significance level (log-likelihood ratio test)	Actualitation N	%
1	.05	0	0	3	--		0	0
2	.01	7	100	0	--		7	100
3	.02	8	57	0-1/2	Cons. Number Compensation Cons. Substance Class Inclusion	.01 .001 .05 .01	0	0
4	NS[a]	7	50	0	Cons.Number Compensation Cons. Substance Cons. Liquids Horizontality	.05 .01 .02 .001 NS	0	0
5	.01	12	94	0	--		11	85
	.02	5	42				5	42
6	.001	0	0	1	Horizontality (square bottle)	.001	0	0
	NS	0	0		"	NS	0	0
7	.001	9	82		Horizontality (square bottle)	.001	4	36
8	.001	13	65	0-2	Horizontality (square bottle)	.001	1	5
	NS	0	0		"	.01[b]	0	0

[a] Log. likelihood ratio test: .02 between Pre-Test and Post-Test 1, .05 between Pre-Test and Post-Test 2(Delayed Post Test

[b] No Stage 3 performance, but significant change to Intermediate stage.

a difficult concept, apparently even for educated adults (Howard, 1978), or because the training technique is less adequate.

Column 5 shows the proportion of children who display "actualization", as defined above: only studies 2, 5 and 7 show that the operational structure must have been present from the start in at least some of the subjects. These studies deal with older children (12 to 14 years), at an age when the development curves have reached an asymptote.

DISCUSSION

Overall, these studies suggest that the asymptote in the development curves may, in some but possibly not all cases, be explained by the competence-performance distinction. Developmental "lags", on the other hand, seem to reflect a real difference in competence, one which can, however, be bridged by adequate training techniques.

These hypotheses, of course, need further testing. The training experiments summarized in this paper should be seen as pilot studies, suggesting hypotheses rather than substantiating them: the number of subjects was small in each case, a control group was not always available, and the number of concepts tested and trained was limited.

It is generally assumed that the attainment of Piagetian concepts is linked to the successful handling of technological and scientific skills; moderate to high correlations are usually reported between measures based on Piagetan tasks and reading readiness and comprehension, mathematics, and science, particularly physics (Shayer, 1972) and chemistry (Namasaka, 1976; for a general bibliography, cf. Modgil and Modgil, 1976, Vol. 4.) If this is so, and if the development of thise skills is valued, it may be of advantage to devise school curricula which could help to bridge the developmental "lags" in the same way as our experimental procedures have done. Our individual training procedures, based on cognitive conflict and on the child's own discovery of how to overcome this conflict, would have to be adapted for class-room use. Should this be attempted, care should be taken not to teach individual concepts, but to induce processes which generalize to basic operational structures.

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