

SPATIAL ABILITY IN ZAMBIAN CHILDREN WITH SPECIAL REFERENCE TO
INTERSEXUAL DIFFERENCES AND THE CONCEPT OF FIELD DEPENDENCE.

GERDA SIANN

1970



This study* investigated intersexual differences in spatial ability amongst Zambian children aged between five and eighteen years. The results were viewed in the light of cross-cultural research. Particular attention was paid to the concept of field dependence. It was found that intersexual differences on certain tests of spatial ability are shown by Zambian children in favour of boys but that these differences are less pronounced than they are in the West. Modifications of these differences were obtained by manipulation of certain stimulus variables. The results were interpreted as offering support for the hypothesis that differences in spatial ability are attributable in the main to differential practice. The concept of a general underlying cognitive style determining differences in spatial ability was not regarded as being supported by the results.

* The writer would like to gratefully acknowledge the assistance of Dr. Robert Serpell of the University of Zambia in the planning, conducting and writing up of this study. She would also like to thank the staff of the Human Development Research Unit of the University of Zambia and in particular Mrs. Kateya and Mrs. Nguluwe. Finally she would like to thank the principals, staff and pupils of Kamwala Secondary School, Muleya Primary School, Woodlands Primary School and the Pre-school Centre, Lusaka.

Spatial ability in Zambian children with special reference to
intersexual differences and the concept of field dependence.

<u>Index</u>	<u>Page</u>
Chapter 1. Background to the experimental work	1
Section 1. i. Intersexual differences in spatial ability	1
Section 1. ii. The effect of stimulus modification on intersexual differences	11
Section 1. iii. Cross-cultural results bearing on the concept of field dependency	13
Chapter 2. The experiments - aims, subjects tasks, procedures and hypotheses.	22
Section 2. i. Experiment 1	23
Section 2. ii. Experiment 2	28
Section 2. iii. Experiment 3	35
Section 2. iv. Tabular summary of the three experiments	46
Chapter 3. Experimental results on intersexual differences and their modification	47
Section 3. i. Table of results	47
Section 3. ii. Topic 1: Intersexual differences in spatial ability.	49
Section 3. iii. Topic 2: Modification of intersexual differences in spatial ability	54
Section 3. iv. Topic 3: Intersexual differences on the vocabulary test	60
Section 3. v. Topic 4: Intersexual differences on the digit span test	61

Section 3. vi. Summary of experimental results on intersexual differences	62
Chapter 4. Experimental results bearing on the concept of field dependence	64
Section 4. i. Results bearing on field dependence	64
Section 4. ii. Topic 5: Measuring RFT	65
Section 4. iii. Topic 6: What underlies performance at RFT	72
Section 4. iv. Topic 7: Intersexual differences on RFT	73
Section 4. v. Topic 8: Correlation between RFT and EFT	75
Section 4. vi. Topic 9: Results bearing on the concept of sensotypes	78
Section 4. vii. Topic 10: Intercorrelations between four tests used in experiment 3.	83
Section 4. viii. Summary of experimental results bearing on the concept of field dependence	86
Chapter 5. Spatial ability and field dependence in Zambian children	89
Section 5. i. Intersexual differences and their modification - some conclusions	89
Section 5. ii. Field dependency in Zambian children	93
Section 5. iii. The determinants of differences in spatial ability	98
Appendix: Some cross-cultural findings	105
References	114

SPATIAL ABILITY IN ZAMBIAN CHILDREN WITH SPECIAL REFERENCE TO INTERSEXUAL DIFFERENCES AND THE CONCEPT OF FIELD DEPENDENCY.

CHAPTER 1: Background to the experimental work.

The objects of this study have been threefold. In the first instance, I was concerned to establish whether there were any intersexual differences on certain measures of spatial ability amongst Zambian children. Secondly if these differences were established, I wanted to examine the effect on them of certain stimulus modifications. Finally I wanted to examine the concept of field dependency (Witkin, 1962, 1966, 1967) in relation to performance of Zambian children on certain tests including measures of spatial ability.

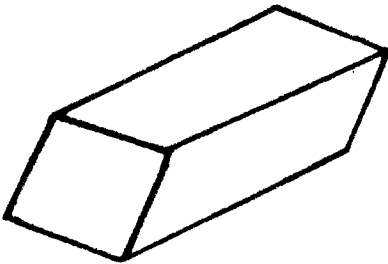
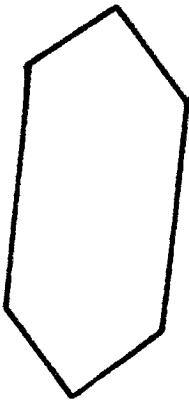
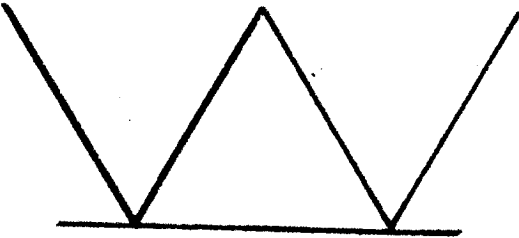
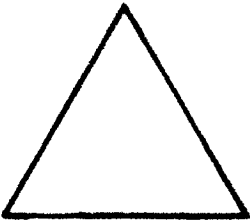
Section 1. i. Intersexual differences in spatial ability.

There has been a general concensus amongst psychologists in the United States of America and Western Europe, that women and girls perform at a lower level than men and boys on measures of what has been referred to as 'k' (Vernon, 1969) or 'spatial ability' (Smith, 1964, Maccoby, 1967). Fruchter (1954) reports seven studies showing the superiority of boys over girls in tests of what he calls spatial ability. Three of these studies were American, three were British and one was French. Witkin (1967) referring to results from Embedded Figures Tests,¹ (hereafter referred to as EFTs), quotes results with both adults and children from America, Britain, France and Holland

1. In embedded figure tests, the subject is required to find a particular simple pattern in a larger more complex one with which it shares many of its contours (See Figure 1 for an example).

FIGURE 1, Experiment 1: Embedded shape series (ES 1)

Above: illustrative example Below: item 2.



showing male superiority on this measure. Finally Sandström (1953) working with Swedish undergraduates, reported the superiority of males in the ability to localise points in space.

Werdelin (1958, 1961,²) performed large scale factorial investigations into mathematical ability and spatial ability. In addition he made a comprehensive review of the relevant literature and concluded that the critical ability operating in most tests of spatial ability was the ability to visualise - "the ability to effect purposeful and deliberate changes in the properties of visualised, imagined but concrete, objects and structures (conversion, diversion or other form of change)" (1958, pp 281-2). It should be noted that this concept of visualisation is fairly close to the concept offered by Podell and Phillips (1959) as being the underlying dimension in tests of spatial ability - 'spatial decontextualization'.

Sherman (1967) points out that whereas all researchers have not been in agreement about the numbers and names of the space factors, those investigated so far all appear to be closely related. The view to be presented here is in accordance with that of Werdelin (1958) that in the general intellectual field studied in the West there has been a spatial or visual sub-field that has been defined by tests of visual character.

2. Both the Werdelin tests are Swedish publications and I have unfortunately not been able to obtain the original of the second and have been forced to rely on Sherman's (1967) reference to it.

Thus for the purposes of this study, it will be taken as an established fact that there are intersexual differences in favour of males on tests of spatial ability in Western Europe. These differences are regarded as being established by the age of about eleven (Maccoby, 1967, Fruchter, 1954) and indeed no differences have been as yet shown below the age of about eight years.

It is to be a major submission of this study that whereas these differences have been established in Western Europe, there is no necessity to expect that the same pattern will be found in other cultures.

It is postulated that the main reasons for intersexual differences in spatial ability are (i) differential expectation and (ii) differential practice. Further it is suggested that tests of spatial ability used have tended to be sex-biased. With respect to differential expectation it has been traditional in Western Europe to regard the professions of engineering and architecture, both of which require a large measure of spatial ability, as not particularly suited to women.³ Those women architects that I have had contact with have found a great deal of prejudice within the profession. Girls are not expected to perform as well as boys at mathematics, particularly geometry.

3. It should be noted that in Eastern Europe the same prejudice does not appear to hold and in both the U.S.S.R. and Yugoslavia there are substantial numbers of women architects and engineers. For example, in the Republic of Uzbekistan there are 17,000 women engineers and technicians. (Information from the U.S.S.R. Embassy, Lusaka.)

This difference in expectation leads to two main types of effects. In the first case girls themselves are led to expect a lower rate of performance from themselves at tests involving geometric shapes than their boy peers are, thus differences in motivational levels occur. Secondly as Sherman (1967) has also pointed out this difference in expectation leads to differences in practice. This may even be seen in choice of toys. It is exceptional for girls to receive constructional toys (e.g. Leggo and Meccano) for presents. Yet in discussions with two Nursery School teachers of wide experience I found that both had observed that girls play as frequently with toys of this nature as boys do. In general within the school system in Western countries these differences in practice are further entrenched; boys tend to attend woodwork and technical drawing classes whereas girls attend classes in domestic science.

That spatial tasks tend to be sex-biased is a suggestion that was put forward tentatively at the outset of this study. I had noticed that many women were able to draft clothing patterns with great speed and efficiency and that the ability tapped on a task such as this is surely spatial in nature. With this in mind one of the tests utilised in each of the three experiments is designed to have items specifically significant to each sex. A certain measure of support for this approach was found in the work of Milton (1958), who showed that where problems were made more appropriate to the feminine role, or less appropriate to the masculine role, previously observed

differences in achievement in favour of males diminished significantly.

Thus the following account is offered for the origin of the observed intersexual differences in favour of males in tests of shape perception; in the first instance the content of spatial tests is seen as sex-biased in that in the West, tests of spatial ability have tended to be composed primarily of geometric shapes which are associated with professions such as draughtmanship, architecture and engineering traditionally in the West reserved for men. Thus the expectation of doing well at these tasks is higher for boys than girls thus causing intersexual differences in motivation. Further expectations on behalf of boys and girls by their mentors is also different, thus causing differences in practice opportunities. As children move upwards in the school system these differences in practice tend to become more pronounced. Thus the observed emergence of the intersexual difference after several years schooling.

This account of the emergence of observed intersexual differences in space perception differs markedly from that offered by Witkin and his associates (1962, 1966, 1967). Their viewpoint will be expanded in greater detail in Section 1. iii. Witkin sees performance at tasks involving space perception as being determined primarily by the 'cognitive style' of the individual. Cognitive styles themselves are manifestations in the cognitive sphere of "still broader dimensions of personal functioning" (1967, p 234) and are the end products of particular socialisation practices. Subjects who perform well at spatial

tasks, are able to perceive items as discrete from the organised ground - they are 'field independent' and this articulated approach characterises the whole psychological functioning of the individual. This viewpoint differs radically from the one offered above which sees performance at spatial tasks as being task specific and amenable to improvement by learning or manipulation of motivational variables. Witkin explains the inferior performance of girls on spatial tasks in two main ways. Firstly it is conjectured that the socialisation practices for girls are different to that of boys and less inclined to produce field independence - specifically girls are given less training for independence than boys, also less stress is placed on achievement and assertiveness for girls than boys and thus the girls follow a pattern of socialisation thought by Witkin and his associates to produce field dependent individuals. Witkin (1966) suggests further that because feminine sexual organs are "hidden" (p 107) whereas men's are visible, girls find it more difficult to achieve a clear concept of their own bodies "thereby fostering greater reliance on the field - that is, more field-dependent perception" (p 107). However the main emphasis is on the differing socialisation practices for boys and girls.

In this way Witkin accounts for the observed superiority of males over females on measures of spatial perception in the United States of America and Western Europe.

With respect to non-Western cultures, it is my own contention that the same intersexual differences as shown in the West will not necessarily be shown provided the tests are not sex-biased.

Witkin, however, expects that the majority of cultures, based as he considers they are, on similar patterns of differential socialisation for boys and girls, will produce similar results on spatial tests in favour of boys. In addition he considers that biological differences such as the one referred to earlier⁴ predispose to a difference in ability to articulate visual fields (and thus to perform well in spatial tests) in favour of boys.

However evidence from outside the United States of America and Western Europe on intersexual differences in space perception is thus far inconsistent. Neither Berry (1966) nor MacArthur (1967) found intersexual differences on EFT for Eskimos. Davila et al reported by Witkin (1967) found no intersexual differences in Mexico on 'field dependency' which means performance at EFT or possibly at the rod-and-frame tests with eight to twelve year-old children. (In the rod-and-frame test the subject is seated in a completely darkened room and required to adjust a luminous rod in a tilted luminous frame to a position he perceives as upright, while the frame remains at its original position of tilt. The closer the rod is adjusted to the tilt of the frame and the further away from true vertical, the more field dependent the response. This test will be hereafter referred to as the RFT.)

Irvine (1963) working in Rhodesia with school children,

4. Another biological difference predisposing to better field articulation for boys is that their bodies are different from the person a child is closest to - their mothers - whereas the bodies of girls are the same (Witkin, 1967).

in a first report, indicated that after a factor-analytical study of 1,615 subjects a factor labelled 'visual perception' was found which showed ability to do well at tests that use line diagrams and pictures. This factor was associated with maleness. However Vernon (1969) quotes a later work of Irvine's (1968) which reported no difference between boys and girls in Rhodesia and Zambia on non-verbal tests.

Okonji (1969) showed no difference on EFT for a sample of undergraduates between men and women, and where an intersexual difference was shown for a rural sample there was an interaction with education (Okonji, 1969, p 300). This difference was in favour of men. Berry (1966) also showed an intersexual difference in favour of men on "four out of eight" tests with two samples from Sierre Leone (no further details of these results are given) but as he also showed in the same study a high correlation between the spatial tests used and education for the samples from Sierre Leone, and there is no indication that men and women were matched on this variable (not very likely particularly on the rural sample who were Moslem) it is possible that an interaction between sex and education held in this study as well as Okonji's.

Finally Witkin quotes a personal communication from Hong Kong indicating an intersexual difference in favour of males on EFT.

The present view that differences in spatial ability can occur as a result of differences in practice, received some support from the observation that intersexual differences in

favour of boys are found in the West where boys are 'streamed' into classes where spatial skills are relevant (e.g. woodwork, technical drawing) whereas in Central Africa, where few schools offer such courses intersexual differences are not shown amongst school children (Vernon, 1969). Further support for practice as a cause of differences in spatial ability is shown in studies where improvement with non-specific coaching is shown on spatial tests. (Sherman, 1967, McFie, 1961).

Witkin's view that differences in spatial ability (including intersexual differences) are dependent on differences on a personality variable is supported by Dawson (1967). In a study which will be referred to in more detail later, Dawson showed that two tribes with differing socialisation practices showed differences in spatial ability in the direction predicted by Witkin. Dawson suggests that personality and education/acculturation act together on spatial ability - personality limiting the scope of the educational factor.

Wober (1966) suggests the converse, postulating that within a learned cultural approach to perception, personality factors operate. In particular cultures, particular sensory modalities are dominant and differences within the cultures between individuals are due to a personality variable-analytic ability. This variable is measured optimally by visual tests for Westerners and tests involving proprioception for West Africans. Thus Wober accepts analytic ability as determined by a personality variable but sees the variable as operating within a learned cultural approach.

The present view is that spatial skills are dependent on

learning and may be task specific. In general the main cause of differences in spatial ability is seen as differential learning. However differences between cultures may be caused in three main ways. In the first case ecological factors may contribute to differences. In the second case different cultures may encourage exploratory behaviour and a constructive approach to problem solving to a different degree. This factor is close to Witkin's emphasis on socialisation practices as being the main causes of differences in spatial ability. Thirdly differences between cultures may also be caused by the degree of familiarity individuals in that culture have with the stimulus objects used in the test and in the types of performance required by the test.

The experiments to be presented attempt to answer the following questions relevant to intersexual differences in spatial ability and its causes:

- (1) Are there intersexual differences in performance at spatial tests for Zambian children and for expatriate control groups?
- (2) If these differences exist can they be modified?
- (3) Does performance at spatial tests in Zambia correlate highly with performance at other tests such as verbal tests. If this is shown, given the fact that elsewhere in non-Western cultures it has been shown that educational attainment is an important variable associated with spatial ability (Berry, 1966, Okonji, 1969) does it suggest that in the West relative homogeneity of education leaves scope for more subtle variations in spatial ability? In other words in the West the spatial tests used, devised as they are, for Western subjects, are more sensitive than

they are in non-Western societies where the tests may tend to measure mainly educational variance.

Summary on Section 1. i.

From the evidence presented it may be seen that there are well-established intersexual differences on tests of spatial ability in favour of males in the West. However cross-cultural evidence is inconclusive. The view presented here was that intersexual differences shown on tests of spatial ability in the West are based on three main factors:- (I) differential expectations (II) differential practice (III) sex-biased tests. Issue is taken with Witkin who sees the intersexual differences on spatial ability as indicative of differences in overall cognitive style. The present view is that spatial ability may well be task specific (consider the ability of many women to draft clothing patterns or knit complicated fair-isle patterns).

Section 1. ii. The effect of stimulus modification on intersexual differences.

Although as far as I have been able to discover no attempt has as yet been made to modify spatial test stimuli in order to diminish intersexual differences, such an approach has been made in the cognitive field. That there is an initial sexual bias in problems of the type devised by Duncker, was first established as follows by Milton (1958). He asked 60 Stanford undergraduates (30 males, 30 females) to report on the type of problems they encountered in everyday life, the resulting problems were categorised by two independent judges for each sex group. Following this, typical problems based on Duncker

were given to two other independent judges with instructions to categorise them into the categories developed in the initial survey, and for one judge 77% of the problems were masculine and for the other judge 83%. Chi-square was significant beyond the .01 level in both cases and interjudge reliability was .72. Following this, two parallel sets of problems were devised. One set in the form conventional to problem solving literature, the other more appropriate to the feminine role and these were presented to 50 undergraduates (25 male, 25 female). An analysis of variance indicated significant effects for sex and for sex x problem content ($p < .01$, $p < .05$) i.e. males were overall superior, but less so on the 'feminine' than the 'masculine' tasks.

In the present study in all three experiments to be reported an attempt was made to present to subjects two similar sets of stimuli - the one set more appropriate to males and the other to females (see 2.i, 2.ii, 2.iii). It was hoped that this would modify intersexual differences (if any) in two ways. Firstly it was thought that the sight of stimuli such as babies and cooking utensils would arouse the motivation of girls to an extent that was equivalent to the conjectured higher level that the sight of geometric and other objects raises the motivational level of boys (in the West anyway). Secondly it was hoped that differential practice would operate in favour of the girls by the use of stimuli such as dummies (pacifiers) and safety pins since in Zambia mostly girls care for younger siblings.

Section 1. iii. Cross-cultural results bearing on the concept of field dependency.

Field independence was defined by Witkin (1962, 1967) as the ability to separate an item from its context, and he has described it as a highly analytical approach to the perception of visual material. However he has also developed an extension of this concept to other levels of psychological functioning, claiming that a tendency towards either a more global (field dependent) or a more articulated (field independent) mode of visual perception is a consistent feature of any individual's manner of dealing with a wide range of perceptual and intellectual tasks and indeed to his method of dealing with his emotional functioning as well. For field independent persons will use "structured specialised defences" and controls in dealing with the channeling of impulse and the expenditure of energy whereas field dependent persons will use defences such as "massive repression and primitive denial" (1967, p 235). In short in Witkin's terminology field independent persons are more 'differentiated'⁵ than field dependent persons over their whole range of psychological functioning and they also have a more articulated body concept and a more developed sense of

5. Witkin's view of differentiation is very complex (see 1962, pp 7-23) but it may be briefly summed up as follows. (A) a high degree of differentiation implies a high degree of specialisation in the 'individual's psychological system' (B) a relatively higher degree of complexity of integration in the individual's psychological system.

identity. Evidence for this extension of a concept originally applicable to mode of visual perception is from studies of (mainly Jewish) New York schoolboys although a lesser amount of evidence comes from a study in Topeka (Kansas).

Witkin uses two main measures of field dependency the EFT and the RFT although he considers that Koh's blocks also produce a good measure of field dependency. For the purposes of this study, two main types of finding about field dependency will be considered; firstly in relation to Western studies and secondly in relation to cross-cultural studies. The first finding relates to intersexual differences in field dependency. It will be recalled from Section 1. i that Witkin found that in America and Western Europe, girls and women scored lower than boys and men on spatial tests such as the EFT. Further as will be discussed in greater detail below, Witkin also reported that in the West females scored lower than males on RFT. From this Witkin concluded that females are as a whole more field dependent than males and less 'differentiated' and analytical in cognitive style as well as in mode of perceptual functioning. He ascribes this to differences in early socialisation practices for boys and girls and also to biological differences.

The second type of finding relates to the correlation between results on EFT and on RFT. Obviously it is an important foundationstone of the concept of field dependency that the correlation between the two should be high and positive. Further the extension of the concept of field dependency into

that of cognitive style depends equally well on a high positive correlation between the two main indicators of cognitive style.

With respect to findings of intersexual differences on field dependency, the main results on one measure, EFT were listed in Section 1. i and will be summarised in Tables Ia and Ib below. With respect to RFT significant intersexual differences in America and Western Europe, are given by Witkin for England, United States of America, Holland, France and Italy. Cross-cultural results are few. Witkin quotes a study by Kato (1965) in Japan showing intersexual differences in favour of men. Okonji showed (1969) a difference in favour of men for an undergraduate sample in Nigeria but not for a rural sample ($p < .05$, t-test), for the 76 undergraduates. Du Preez (1968) showed no differences for a sample of 24 females and 38 males in South Africa using Xhosa subjects. Dawson using performance at a 3-D test as a measure of field dependency reported a significant intersexual difference in Sierre Leone in favour of males; he interpreted this as offering support for the greater field dependence of women (1967). However evidence reviewed by Hudson (1967) on pictorial depth perception in Africa indicates that the salient variable in 3-D perception is acculturation. There is no indication that 3-D perception is dependent on general perceptual style. A further criticism of this interpretation of Dawson's intersexual difference is that the comparison is between women who were students at a teacher training college and men who were apprentices. It is highly likely that the men are

either a selected or a self-selected group in terms of technical abilities.

With respect to intercorrelations between RFT and EFT the only Western results available are from Witkin (1962). They are American and are summarised in Table 2. However it may be noted that of the three coefficients available on women subjects only one is significant. The only cross-cultural data available is that of Okonji (1969) and Wober (1966, 1967) both from Nigeria. Wober found a non-significant correlation for males and Okonji a non-significant correlation for a rural sample of adults, though he found a significant correlation for undergraduates of both sexes.

Table Ia: Significant intersexual differences in favour of males in measures of field dependency in the West.

(all results summarised by Witkin, 1962, 1967)

<u>Country</u>	<u>EFT</u>	<u>RFT</u>
U.S.A.	yes	yes
England	yes	yes
Holland	yes	yes
France	-	yes
Italy	-	yes
Israel	yes*	

* not indicated whether EFT or RFT.

Table Ib: Cross-cultural results on intersexual differences on measures of field dependency. (Where differences are indicated these are in favour of males in all cases.)

<u>Country</u>	<u>Source</u>	<u>EFT</u>	<u>RFT</u>
Eskimos	Berry	no	-
	McArthur	no	-
Nigeria (rural)	Okonji	yes**	no
(undergraduates)	Okonji	no	yes
Sierre Leone	Berry	yes**	-
South Africa	Du Preez	-	no
Japan	Kato (Witkin)	-	yes
Hong Kong	Witkin	yes	-
Mexico	Davila (Witkin)	no*	

* not indicated whether EFT or RFT

** Interaction with education.

Reservations on Witkin's concept of field dependency have been expressed both by Wober (1966, 1967) and Sherman (1967). Wober has put forward the concept of 'sensotypes' in his interpretation of his findings on performance at EFT and RFT in Africa. According to Wober, the prevailing pattern of childhood intake and proliferation of information varies from culture to culture. Americans are regarded as being of a visual sensotype i.e. their salient sensory modality is the visual one, whereas Africans have a more proprioceptive sensotype - their salient modality is proprioception. For this reason Wober considers that tests involving proprioceptive skills are

Table 2: Correlation of EFT and RFT

<u>Country</u>	<u>Age</u>	<u>Sex</u>	<u>Coeff</u>	<u>n</u>	<u>sig lev</u>	<u>Source</u>
U.S.A.	adults	male	.64	51	.01	Witkin
"	"	"	.63	35	.01	"
"	"	"	.42	30	.05	"
"	"	female	.21	51	ns	"
"	"	"	.30	35	ns	"
"	"	"	.37	30	.05	"
"	10 yrs	mixed	.31	60	.05	"
"	12 "	"	.51	50	.01	"
"	13 "	"	.55	59	.01	"
"	15 "	"	.31	50	.05	"
"	17 "	"	.42	48	.01	"
Nigeria	adults (rur)	mixed	-.21	65	ns	Okonji
"	" (undergrad)	"	.47	76	.01	"
Nigeria	adults	male	.21	86	ns	Wober
"	"	"	.18	88	ns	"

better indicators of the basic 'analytic functioning' than tests involving visual skill in West Africa. He has shown, using workers in a Nigerian factory that RFT did not correlate significantly with EFT. Further he has shown in a cross-study comparison that Nigerians did better at RFT than Americans when the frame was straight but the chair was tilted. It may be noted that Wober does not take issue with

the concept of a basic underlying cognitive style but differs from Witkin only in postulating that tests that are proprioceptive rather than visual in character are better measures of the basic style in West Africa.

Sherman (1967) in a cogent review of relevant data on intersexual differences, on tests of spatial ability as well as of Witkin's work, argues that the underlying cause for intersexual differences on EFT and RFT is the inferiority of women to men on 'visualisation', and that the generalisation of this difference on spatial tasks to the total cognitive style is unwarranted. The present writer agrees with both these points and would point out with respect to the second that the population from which the extension of the field dependency concept was made was a very restricted one.

Thus the following main criticisms of Witkin's concept of field dependency and its extension are made. Firstly while for samples of male and of mixed Americans the correlation between EFT and RFT have been high and positive, in only two out of three cases did this effect hold either for female Americans or for African subjects. Thus for the latter two groups evidence for a general perceptual variable underlying performance at these two tests is not very substantial. Secondly it was suggested by Sherman (1967) that where a high correlation has been shown for EFT and RFT the common variance may be as well due to a 'visualisation' factor as to a personality variable.

Finally it has been suggested that the population from whom the extension of the field dependency variable to a general personality variable was made, was of a restricted nature. In addition Wober's concept of sensotypes has been described and a test of this hypothesis for Zambian subjects will be described in the next chapter.

The experiments to be described in the next chapter were designed with the following points bearing on Witkin's concept of field dependency in mind:-

(1) Are there intersexual differences on (a) EFT and (b) RFT in Zambia either for Zambian children or an expatriate control group?

(2) Is there a significant positive correlation between RFT and EFT either for Zambian children or for the control group of expatriate children?

(3) If no correlation is shown between the above two variables, does this suggest a modification of Witkin's interpretation of RFT results?

(4) Is Wober's hypothesis about differing sensotypes for Americans and Africans supported by this study?

Specifically I wished to test the same two hypotheses tested by Wober himself in his 1967 cross-study comparison that African subjects (in this case Zambian) would have better scores on tests where proprioception was important (a) relative to their test scores on tests dependent on visuality (b) relative to scores of Westerners on proprioceptive tests.

(5) Witkin (1962) noted that field dependency scores (i.e. EFT and RFT mainly) do not correlate at all with the digit span subtest in the W.I.S.C. and do not correlate with verbal ability, in the United States of America. Does this same pattern hold for the expatriate children tested? Does it hold for the Zambian children? Or in the case of the Zambian children is there an underlying educational variable causing a high correlation between EFT (spatial ability) and verbal ability? This is suggested by the work of Vernon (1969, 1965).

Summary on Section 1. iii.

A brief presentation was made of Witkin's concept of field dependency and its extension to both an overall cognitive style and certain personality variables. Two major fields of study with respect to field dependency were described (i) intersexual differences (ii) intercorrelations between EFT and RFT. Wober's theory of sensotypes was described. This theory postulated that the strongest sensory modality for the African is proprioception whereas for the Westerner it is vision. Thus he considers that tests of analytical ability designed for an African population should be based on proprioception rather than vision. Reference was made to Sherman's criticism of Witkin for over-generalisation. Finally five points were made that were to be investigated in the experimental work that is now to be described.

CHAPTER 2: The experiments - aims, subjects, tasks, procedures and hypotheses.

In this chapter a brief description of the different types of schools found in Zambia will be made. Following this the experimenters involved in the three experiments will be described. Then the design of the three experiments will be described in detail. Finally at the end of the chapter a tabular summary of the three experiments will be made.

Before independence in Zambia, schools fell into two main types - fee-paying and non-fee-paying catering thus for the two main racial groups. Teaching in the non fee-paying primary schools was mainly in the vernacular and the teachers were of a far lower educational level than those teaching at the fee-paying schools. After independence (1964) the difference in teaching standards between the two types of primary schools remained. In addition the fee-paying schools are now well integrated although the majority of Zambian children attending the fee-paying schools are from the middle class. Senior schools (except for a few non-governmental schools) are now non fee-paying and admission to them is gained by means of a countrywide, objectively marked entrance examination held at the end of the primary school. Although the structure and content of this examination has been designed to allow children from both rural and urban backgrounds and irrespective of their socio-economic class equal opportunity some doubt has been expressed by teachers at the secondary schools as to

whether these objectives are being reached.

In all three experiments to be described the present writer, who is a white non-Zambian female will be described as E 1. In experiment one the second experimenter, who will be described as E 2 was a black Zambian male. In experiment two E 3 was a white, non-Zambian female and E 4 was a black Zambian female. In experiment three, E 5 was a black Zambian female. (The only experimenter to take part in all three experiments was E 1)

In all three experiments with the following exceptions - in experiment one the EFT test and the overlapping geometric forms (which were identical to those used by Ghent (1956)) and in experiment three the digit span test (which was from the W.I.S.C.) - all test stimuli were devised by the writer.

Section 2. 1. Experiment 1

Aims This experiment was concerned with two main purposes:

- (1) Using two tests of spatial ability to investigate whether there were any intersexual differences among Zambian children aged about five to eight years.
- (2) If intersexual differences were established to investigate whether these could be related to the differential significance to either sex of certain stimulus objects.
- (3) A subsidiary aim was to compare the results obtained using the same stimuli used by Ghent (1956) with results obtained by Ghent with American children in the same age

range. This aim and the results bearing on it will be dealt with in the appendix.

The design may be summarised as follows:-

2 x 2 x 4

Male/female x Grade I/Grade II x ES1/OGS1/ORS1 'boy-sig'/
ORS1 'girl-sig' (subsidiary factor is U.S.A. replication)

Subjects

All the subjects in this experiment were black Zambian children. There were 47 altogether. Thirteen boys and thirteen girls were from a volunteer-run non-governmental school, situated in a Lusaka shanty town. This school acted as a 'pre-school' in that all the children in this group would at the end of one or two years in the school be expected to gain a place in a non fee-paying Grade II⁶. These children will be referred to as the Grade I sample and they were all aged between five and six years. The tests were done at the beginning of the school year and therefore these children had been relatively unexposed to school. One boy and one girl were not able to answer even the enquiry regarding their names and were thus dropped from the study.

6. The obtaining system of entry into primary school in Lusaka is as follows for non fee-paying schools. Places may not be reserved before but on the first day of the school year, parents queue up at the schools, hoping to gain entry for their children at the school of their choice. This results in some children not obtaining places at five years of age. It was children such as these who attended the 'pre-school'. In the normal course of events most children failing to get a place the year they are five are able to get one the next year.

The Grade II sample was of twelve boys and nine girls and was drawn from a non fee-paying government school serving the same area as did the 'pre-school'. They had just completed one year of schooling and were in the age range of seven to eight. No exact ages were immediately available for any of the children in either grade.

Tasks

The subjects were tested on three tasks. The first, which will be referred to as ES 1 (embedded shapes, experiment 1) was four embedded shapes as used by Ghent (1956). An example of these and the illustrative item used, can be seen in Figure 1. The second task will be referred to as OGS 1 (overlapping shapes, experiment 1). There were four patterns composed of overlapping geometric shapes, also as used by Ghent (1956). In an overlapping shape task the subject is presented with a pattern composed of overlapping shapes and also a multiple array of shapes containing, among the distractors, each of the overlapped shapes. The subject is required to indicate which of the multiple choice shapes form the overlapping pattern. An example of the OGS 1 series can be seen in Figure 2.

The third task will be referred to as ORS 1 (overlapping realistic shapes, experiment 1). Presentation and procedure is as described above for OGS 1. There were four overlapping shapes designed to be of more significance to boys. These will be designated as 'boy-sig' shapes. Similarly there were

four 'girl-sig' shapes. 'Boy-sig' shapes consisted of the following stimuli:- knife, revolver, spear, rifle (item 1); car, bicycle, helicopter, plane (item 2); guitar, football, football boot, catapult (item 3); screwdriver, hammer, spanner, nail, spade (item 4). 'Girl-sig' shapes consisted of the following stimuli:- necklace, comb, hairbrush, hairslide (item 1); baby, nappy pin, dummy, bottle (item 2); large spoon, traditional pot, frying pan, bucket (item 3); needle, cotton reel, ball of wool, pair of scissors (item 4). An example of the ORS 1 series can be seen in Figure 3.

In both OGS 1 and both series of ORS 1, three of the items consisted of four overlapping shapes and one of five.

Procedure

All subjects were tested individually. Both E 1 and E 2 were present and E 2 presented the stimuli speaking in either Nyanja or Bemba, depending on which language the child was most familiar with. All instructions were standardised in Nyanja and Bemba.

Presentation of the ORS 1 series was randomised and alternated with series OGS 1 as the first test presented. Neither OGS 1 or ES 1 was randomised in order to replicate Ghent's (1956) presentation. In addition ES 1 was always presented last for the same reason.

In the case of the ORS 1 and OGS 1 series, the same demonstration overlapping card consisting of both realistic and geometric overlapping shapes was used. Thus procedure

FIGURE 2, Experiment 1: overlapping geometric shape series
(OGS 1)

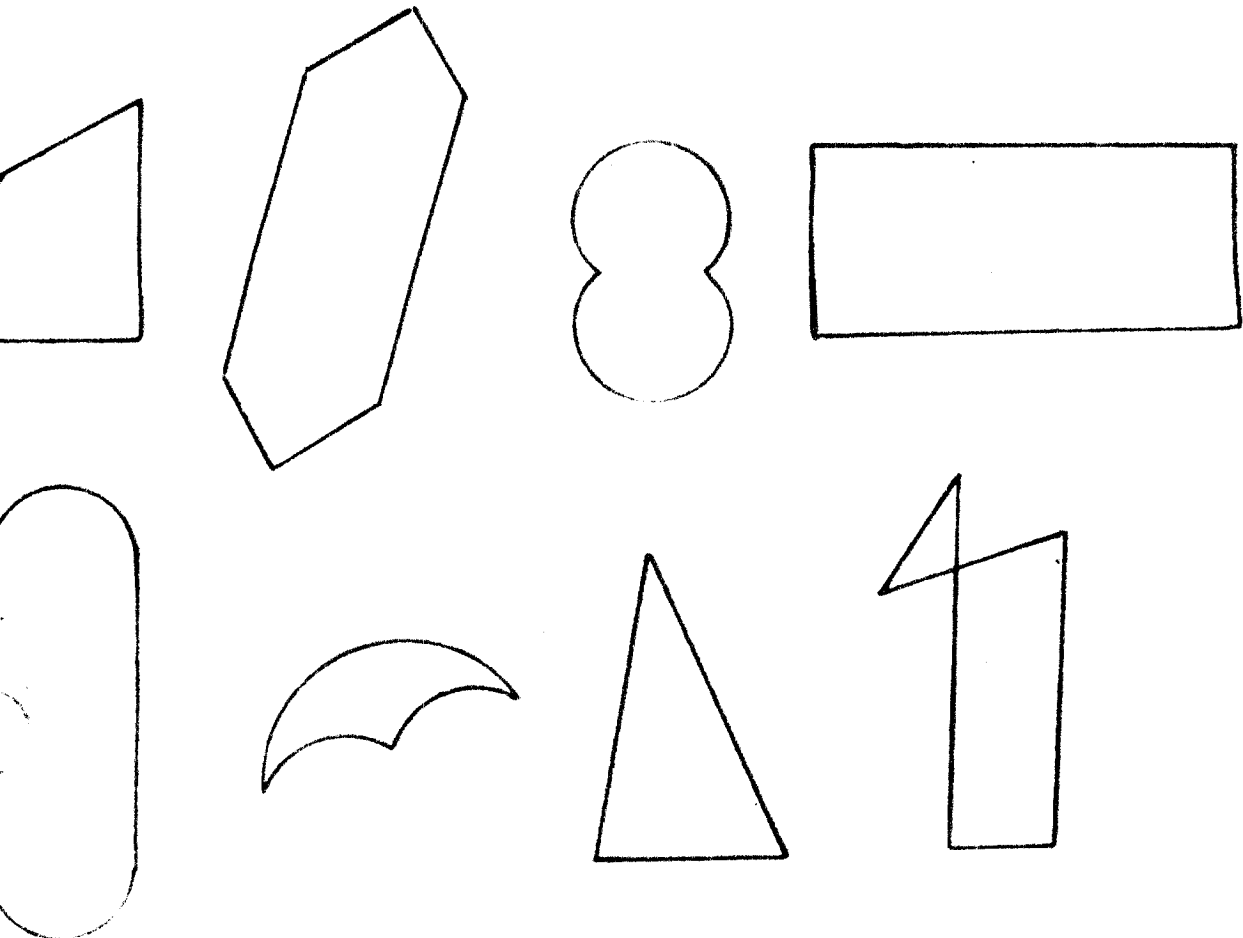
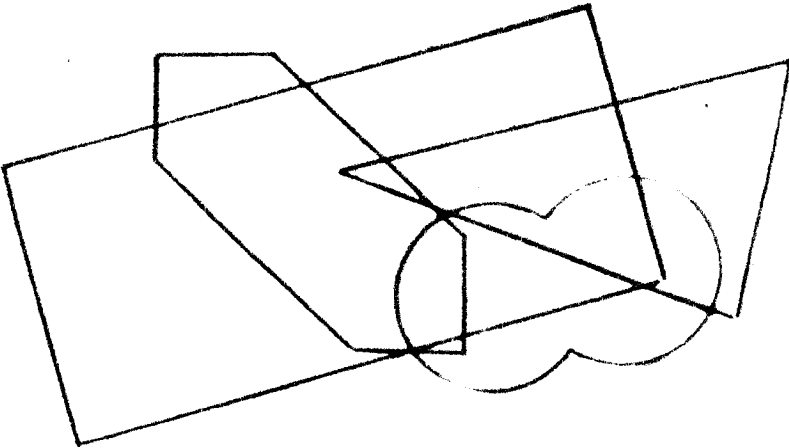
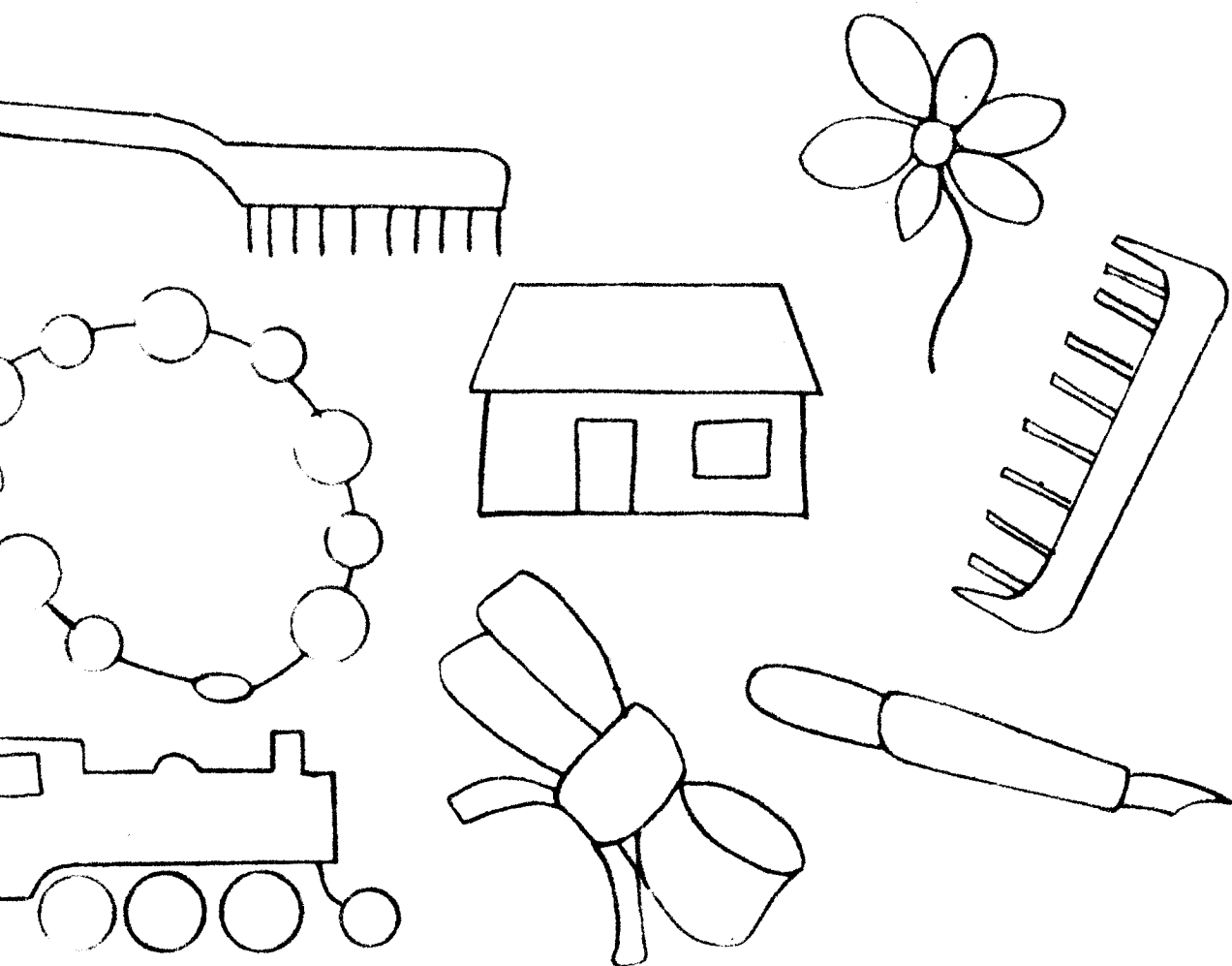
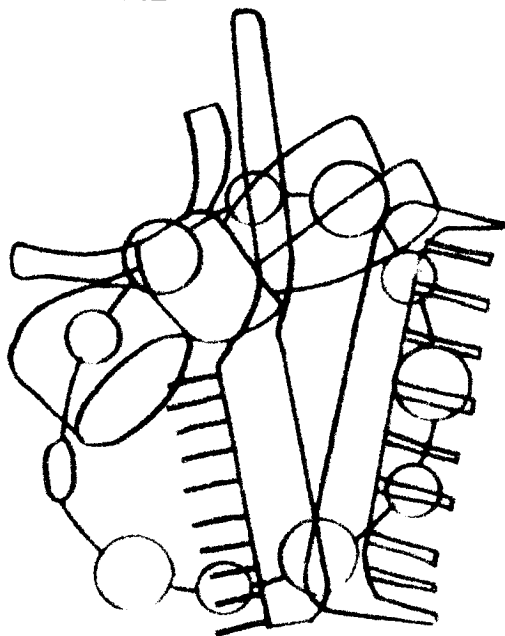


FIGURE 3, Experiment 1: overlapping realistic ('girl-sig')
shape series (ORS 1)



started with this illustrative card followed by either the ORS 1 or the OGS 1 series, and directly thereafter followed by the second of these two series. The subject was required to point out with his finger any stimulus in the multiple choice array which he perceived as overlapped in the pattern card. Then he was required to trace its outline on the pattern (all cards were covered with a protective, transparent plastic cover). Scoring rules were strictly adhered to. Scores were in terms of omissions. If an item were wrongly pointed to, no comment was made and the subject traced it as usual. If the subject saw his error and subsequently identified the correct stimulus and traced it correctly, he was not penalised. If he did not rectify his error it was scored as an omission. As was noted above instructions were standardised but had sometimes to be repeated during the demonstration. Before testing commenced all subjects could trace the three items on the demonstration card correctly.

In the ES 1 series the subject was required to trace with his finger the simple shape embedded in the larger, more complex one. Again standardised instructions were used and by the end of the demonstration, the subject could trace the two demonstration shapes in all cases.

All the subjects were brought to the Human Development Research Unit (hereafter H.D.R.U.) laboratories at the University of Zambia and were told they were going to help E 1 with her drawings.

Hypotheses to be tested in experiment 1

(1) Intersexual differences in spatial ability in favour of boys exist on tests of the embedded shape and overlapping shape variety for Zambian children aged between five and eight years of age.

(2) Intersexual differences on tests of the ORS type will be related to the type of stimulus - boys will tend to do better on the 'boy-sig' shapes and girls on the 'girl-sig' shapes.

It was expected that hypothesis 1 would not be confirmed and hypothesis 2 would be confirmed.

Section 2. ii. Experiment 2Aims

This experiment was concerned with three main purposes:-

(1) Using two tests of spatial ability to establish whether there were any intersexual differences in spatial ability among Zambian children aged between seven and a half and ten years of age.

(2) If these intersexual differences were established for the Zambian children to test whether these could be related to the differential significance to either sex of certain stimulus objects.

(3) A non-Zambian control group drawn from the same school as the one Zambian sample was drawn from, was also tested on the same three tests, and it was also intended to discover whether there were any intersexual differences

amongst this group.

(4) A subsidiary aim was to test the effect of rotated and unrotated embedded shapes on both the Zambian and non-Zambian samples. This aim and the results will be discussed in the Appendix.

(5) A further subsidiary aim was to compare the performance of the Zambian fee-paying and the Zambian non fee-paying groups. This aim and the results will also be discussed in the Appendix.

The design may be summarised as follows:-

2 x 3 x 4

Male/female x ZNFP/ZFP/NZFP x ES2/OGS2/ORS2 'boy-sig'/ORS2
'girl-sig' (subsidiary factor is rotated/unrotated within OGS2)

Subjects

The subjects fell into three groups, all were in Grade II and both the schools they were drawn from were in Lusaka.

Group ZFP consisted of eight boys and eight girls from a Lusaka fee-paying school who were all black Zambians.

Group NZFP consisted of eight boys and eight girls drawn from the same school as the ZFP sample and were all white non-Zambians.

Group ZNFP consisted of eight boys and eight girls drawn from a non fee-paying Lusaka school and were all black Zambians.

The ZFP group all lived in low-density areas of Lusaka. All except one had at least one motor car in the family and all except two spoke English at home. All were well dressed and

all had attended the same school for all their school life. These children may be considered to be drawn from what has come to be called the 'elite' of Zambian society. However little is known of the 'socialisation' process in 'elite' homes. From discussion with the children and from a limited personal experience of visiting homes such as these the following general comments may tentatively be made. Children from homes such as these tend to have a reasonable supply of toys (reasonable in comparison with the average middle class Western home) but perhaps somewhat less books. Unfortunately the only work done thus far in Zambia that is at all relevant, concerns a Lusaka medium density housing area (Munro, 1968) where, although the general standard of affluence was well above that of the present ZNFP group, it was considerably lower than that of the ZFP group. Further the educational level of the parents in Munro's group was far below that of the present ZFP group. Munro (1968) concluded of his group that, although the parents were able to afford shop-bought toys and books, few had any and these were of the simplest variety. It would seem a reasonable inference that the ZFP group in the present study lay somewhere between the group studied by Munro and the non-Zambian group in terms of toys and books that would be conducive to learning skills that would facilitate and encourage spatial ability.

The ZNFP sample attended a school that serves an area of high density houses and also serves a shanty town area. Few

of the children in this group wore shoes and none were well dressed. None spoke English at home and none had cars at home. These children were from a poorer economic group than that surveyed by Munro and it may be assumed that few had any of even the most elementary toys or books. However it may be assumed that, like most Zambian children, they had homemade toys such as wire cars, guitars and catapults. The non-Zambian NZFP group, who all attended the same school as the ZFP group, all spoke English at home, all had cars and all came from middle-class homes.

The ages of the ZFP group were as follows:- boys, mean age 93 months, s.d. 4.9 months, girls, mean age 97 months, s.d. 10.7 months. The ages of the non-Zambian group were as follows:- boys, mean age 92 months, s.d. 2.5, girls, mean age 91 months, s.d. 4.1. The precise ages of the ZNFP sample were not known but an informed estimate put them all at over 108 months.

Tasks

The first task was an embedded shape task (ES 2). Ghent's embedded shape test which had been used in experiment 1 was discarded because it was felt that it had been far too difficult for younger children of experiment 1 where the mean score in terms of correct items was 1.1 out of a possible 4. ES 2 had eight items of which three had rotated solutions, three had unrotated solutions and two had more than one solution of which at least one was rotated and at least one

FIGURE 4, Experiment 2: embedded shape series (ES 2)

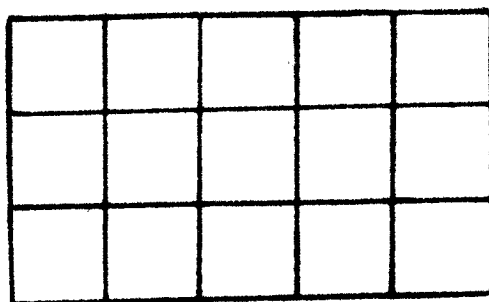
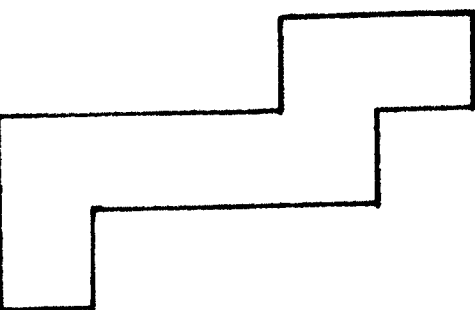
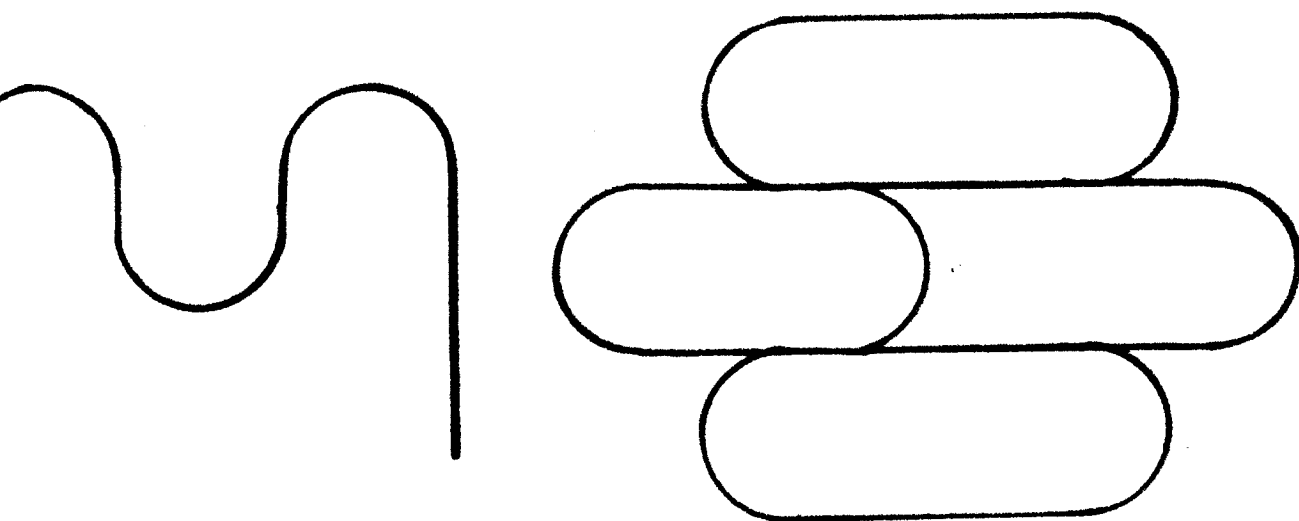
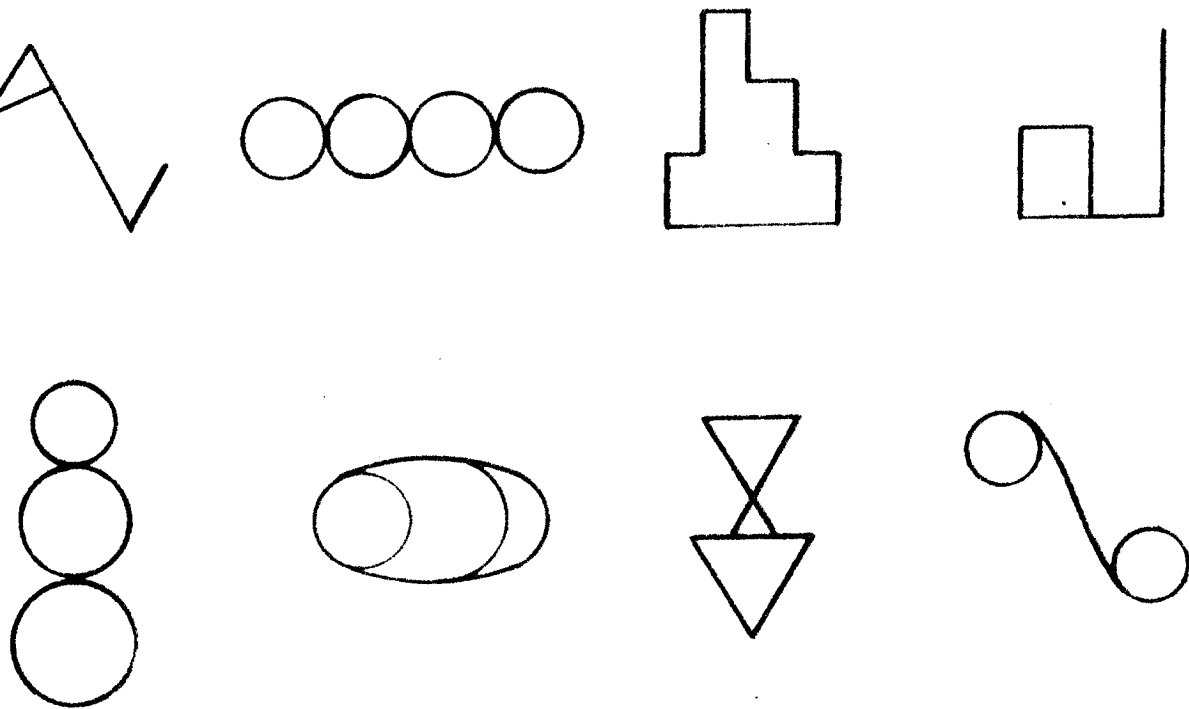
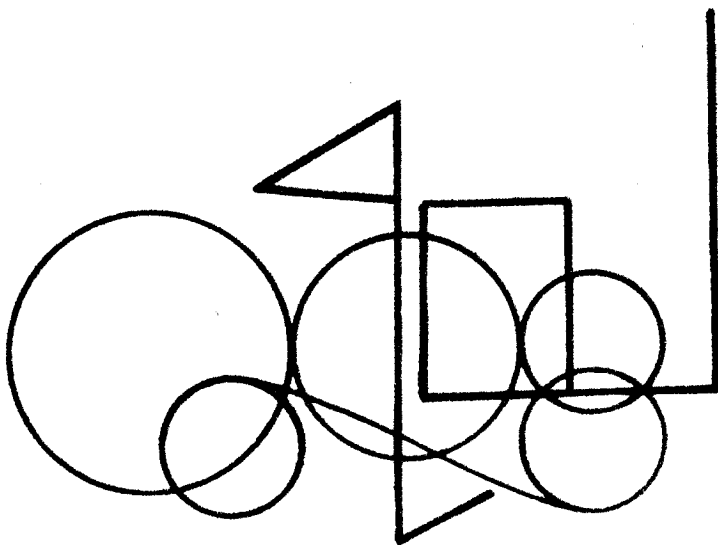
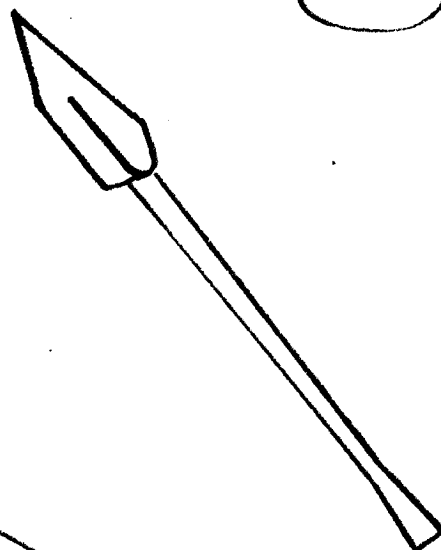
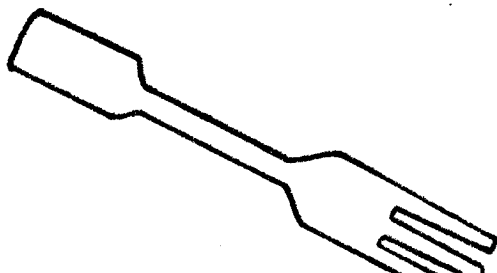
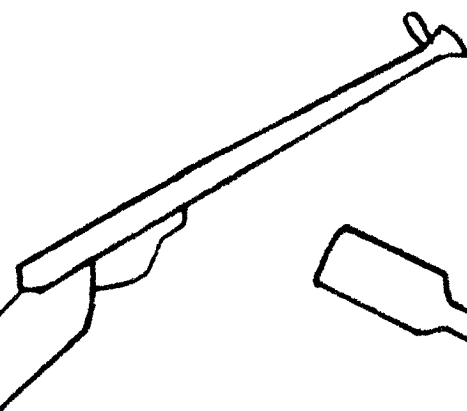
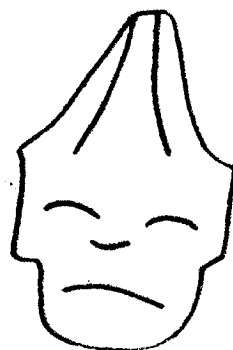
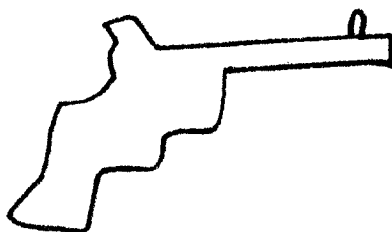
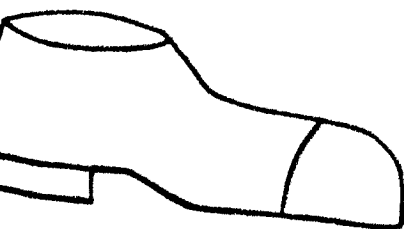
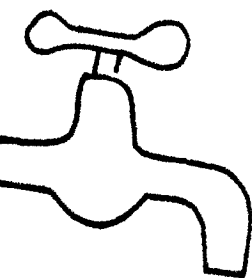
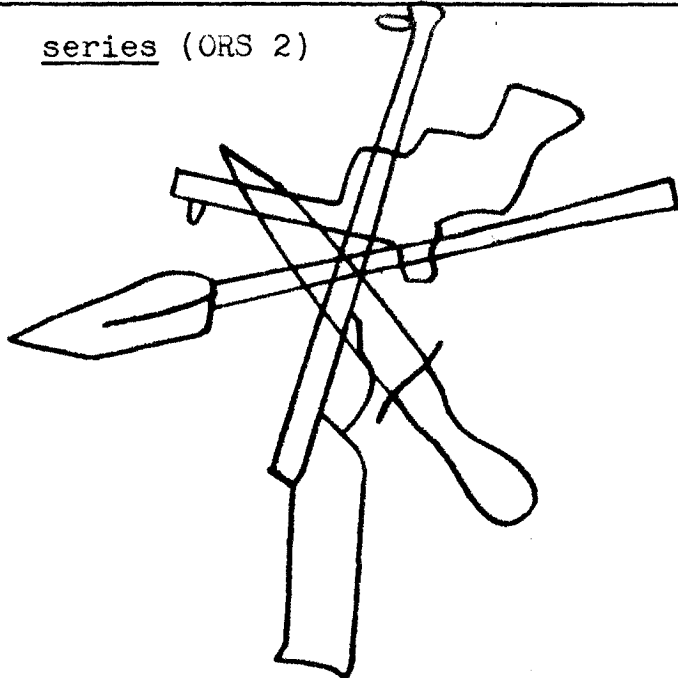


FIGURE 5, Experiment 2: overlapping geometric shape series (OGS 2)



series (ORS 2)



unrotated. An example of this series can be seen in Figure 4.

The second task was an overlapping geometric series (OGS 2). An example of this can be seen in Figure 5. There were eight items.

The third task was an overlapping realistic shape series (ORS 2). As in experiment 1, half the items (four) were designed to be of greater significance to girls and half to boys. Three of the four 'boy-sig' items were identical to the first three of experiment 1 and the fourth was similar differing only because the nail was omitted. For the 'girl-sig' series, items 1 and 2 were identical with items 1 and 2 used in experiment 1, item 3 consisted of ball of wool, cotton reel, pair of scissors, needle and thread and item 4 of bucket, traditional pot, handbag, saucepan. An example of this series can be seen in Figure 6.

In ORS 2 and OGS 2 four shapes were overlapped in each item. Below the overlapped item in each case was a multiple choice array of eight objects consisting of four correct objects and four distractors.

Procedure

The children were tested in groups of eight (four boys and four girls and in addition when the children were tested from the fee-paying school, four Zambians and four non-Zambians). They were fetched from school and brought to the H.D.R.U. laboratories. Two experimenters were present in each case and for groups ZFP and NZFP instructions were given in English

by E 1 (white, non-Zambian female) with E 3 (white, non-Zambian female) assisting, and for group ZNFP instructions were given in Nyanja by E 4 (black, Zambian female) with E 1 assisting. The children were told they were coming to help E 1 with her drawings.

Half the administrations received booklets containing the overlapping series first and half received booklets containing the embedded series first. All the children did all three series. Within the combined ORS 2 and OGS 2 booklet, order of presentation of the two overlapping series was rotated between administrations. This was possible because for both series the same two illustrative examples containing both realistic and geometric shapes were used.

For both the embedded and overlapping series, an enlargement of the illustrative examples was held up and the correct stimuli traced out for the children. The children then completed their copies of the illustrative examples. Testing was not started until E 1 was satisfied that all the children had completed the illustrative examples successfully. The children were required to trace out each item they perceived on the overlapping picture using a different colour for each item. Each child had been given four felt-tip pens at the start of the experiment. Three minutes were allotted for each of the overlapping patterns. In the case of the ES 2 series, the children were required to trace out the embedded shapes in any colour they liked, and two minutes were allowed for

each page, where each page contained two figures.

Strict rules of scoring were adhered to. Scoring the ES 2 series was straightforward but scoring the overlapping series was more difficult⁷. The children all appeared to enjoy the tasks and all said they would be happy to come again.

Hypotheses to be tested in experiment 2

The first two hypotheses are identical to the first two of experiment 1:-

(1) Intersexual differences in spatial ability in favour of boys exist on tests of the embedded shape variety and the overlapping shape variety for Zambian children aged between seven and a half and ten years of age.

(2) Intersexual differences on tests of the ORS type will be related to the type of stimulus - boys will tend to do better on the 'boy-sig' shapes and girls on the 'girl-sig' shapes for Zambian children.

In addition the following two hypotheses are to be tested:-

(3) Intersexual differences in spatial ability in favour of boys exist on tests of the embedded shape variety and the overlapping shape variety for non-Zambian children resident in

7. (a) Only two omissions of minor components allowed (e.g. in the bicycle there are fifteen components).

(b) If the children used the same colour twice within any overlapping picture (they had been told not to and only a few instances of this occurred), if the two items were both correctly traced and non-contiguous this was not penalised.

(c) If the children used the same colour twice within any picture and the items were contiguous but traced correctly only one point was lost.

Zambia aged between seven and a half and eight and a half.

(4) Intersexual differences on tests of the ORS type will be related to the type of stimulus for the non-Zambian children - boys will tend to do better on the 'boy-sig' shapes and girls on the 'girl-sig' shapes.

It was expected that hypothesis 1 would be rejected and hypothesis 2 confirmed. With respect to hypothesis 3 no particular expectation was held in that intersexual differences on spatial ability in the West are sometimes not well established until about eleven years of age (Fruchter, 1954). Hypothesis 4 was not expected to be confirmed as the stimuli had been selected with a Zambian population in mind.

Section 2. iii. Experiment 3

Aims

This experiment was concerned with the following eight purposes:-

(1) Using embedded shape tests of spatial ability to establish whether there were any intersexual differences in spatial ability among Zambian children aged between about eleven and eighteen years of age.

(2) If these intersexual differences were established for the Zambian children to test whether these could be related to the differential significance to either sex of certain stimulus objects.

(3) Using embedded shape tests of spatial ability to establish whether there were any intersexual differences in

spatial ability among non-Zambian children living in Zambia aged about thirteen.

(4) To establish whether there were intersexual differences in either the Zambian or the non-Zambian sample on a digit-span memory test and a vocabulary test.

(5) To investigate whether there were any intersexual differences on RFT for either the Zambian or the non-Zambian sample.

(6) To investigate whether the Zambians did better relative to (a) the non-Zambians (b) to their own scores on tests dependent on visuality, when proprioception was important (in this case in the RFT trials where the chair was tilted).

(7) To establish whether the pattern of intercorrelations between the five tests used (two embedded shape tests, RFT, digit-span, vocabulary) was similar to that found by Witkin (1962) in United States of America for (a) the Zambians (b) the non-Zambians.

(8) A subsidiary aim which will be discussed in the Appendix was to establish the effect on both the samples of certain stimulus modifications within the EFT used.

The design may be summarised as follows:-

2 x 4 x 7

Male/female x Zam Grade VI/Zam Form 1/Zam Form 3/4/non-Z
Grade VII x ES 3/DS/VT/RFT/SES 'abstract'/SES 'boy-sig'/SES
'girl-sig'. (subsidiary factors are rotated/unrotated and
curved/straight within ES 3)

Subjects

64 children were tested altogether. There were three groups of Zambian children and one non-Zambian group. All groups consisted of eight boys and eight girls. Boys and girls were matched for age and also where there was more than one stream, for that form at that school, for stream.

The oldest Zambian sample (mean age seventeen years and range from fifteen years eight months to seventeen years seven months)⁸ was selected from the only co-educational school in the Lusaka area containing sufficient Zambians; it was a government school. Even at this school however, it was necessary to sample from the combined third and fourth forms to obtain sufficient girls. This will be referred to as the Form 3/4 sample.

The second oldest Zambian sample came from the same senior school and was drawn from the first year. The mean age was fourteen and a half years and the range was from twelve years two months to sixteen years four months. This will be referred to as the Form 1 group. The youngest Zambian group were drawn from a primary school that served the same medium density housing area that the senior school was situated in. This was the area surveyed by Munro (1968).

8. In some cases exact ages were not immediately available. It is also realised that the age ranges are rather wide, but this was unavoidable and reflects a tendency within classes in Zambian schools where children are old enough to have been at school before independence (1964).

However despite the fact that both the senior and the primary school served the same area, it is suspected that due to the nature of the secondary school selection examination, on the whole children of higher rather than lower socio-economic class gain admission to senior school. This youngest Zambian sample will be referred to as the Grade VI sample. The mean age was twelve and a half years and the range was from ten to fourteen years. Thus it will be seen that the three Zambian samples differed in age, number of years at school and to a lesser extent in class.

The non-Zambian sample was drawn from an independent co-educational senior school. As the only other co-educational senior school in the Lusaka area, the one from which the Zambian sample was drawn, contained only a handful of non-Zambians. The mean age of this group was thirteen and the range was twelve years two months to fourteen years four months. Thus in age this sample was similar to the Zambian Grade VI sample but the non-Zambians had been at school for one year longer. They were in Grade VII. This sample will be referred to as the non-Zambian sample.

Tasks

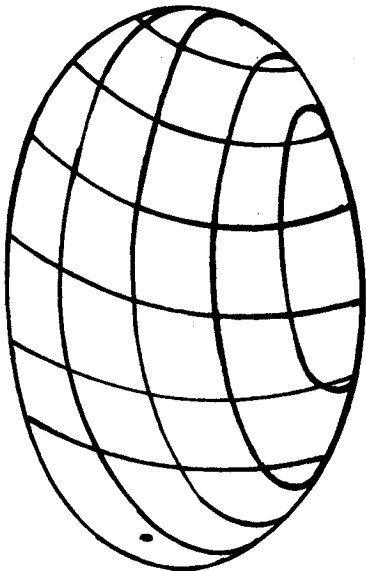
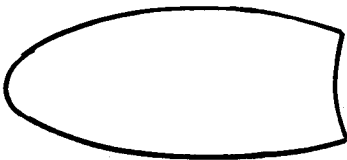
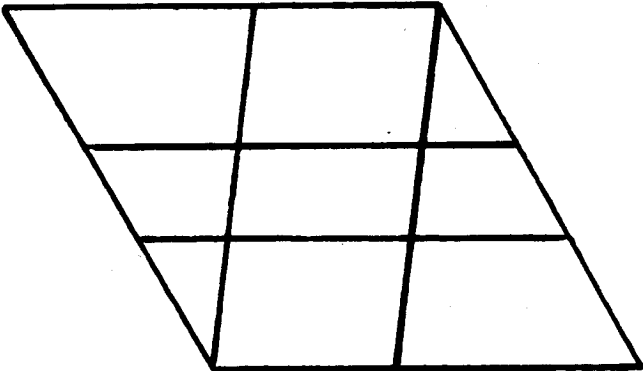
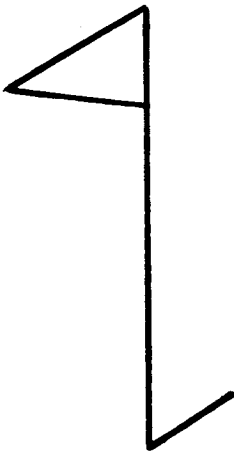
There were five tasks.

Task one was an embedded shape test (ES 3). An example of two items from this test can be seen in Figure 7. There were sixteen items, half of which had rotated solutions and half unrotated solutions. In addition half of the items were

FIGURE 7. Experiment 3: embedded shape series (ES 3)

Top: rotated solution straight line item

Bottom: rotated solution curved item.



composed of curves only and half of straight lines only.

Task two was also an embedded figure task. In this task however, pictures were used and these were in colour. There were six pictures each containing two embedded shapes. Two pictures (woman sewing at machine, woman with baby) were designed to be of more significance to girls ('girl-sig'), and two to boys (football match, young man in sports car) and the last two pictures were abstract designs. This task will be referred to as the SES (sex significant shapes)⁹.

Task three was the RFT. This has been described before in Chapter 1. All the subjects performed seven tasks, half following schedule A below and half schedule B below (Tables 3a and 3b). Thus all subjects did three trials each with chair tilted and three trials each with chair erect. In addition there was a 'control' position with chair, rod and frame erect, for each subject. For each subject in the four tilted frame conditions, the rod started in the same direction as the frame in two of the trials and the opposite direction in two of the trials. In addition although the subject when tilted was always tilted to the left (three trials), for each subject in one trial the frame was tilted to the same side and in another the frame was tilted to the other, in the third tilted trial the frame was always erect.

9. These pictures were painted by Katy Martin to whom the writer is greatly indebted.

The apparatus used was a Marietta rod and frame consisting of a 40 inch rod in a 42 inch x 42 inch square frame with rounded corners. Both components were made of $\frac{3}{4}$ inch tubing coated with luminous paint. The subject was seated about ten feet away. The room used measured seven feet by sixteen feet on the floor and was nine and a half feet high. The ventilation although poor was adequate for the time of testing.

Table 3a: Subject, rod and frame position in RFT for half the subjects - Schedule A

<u>Subjects position**</u>	<u>Frame position*</u>	<u>Rod starting position*</u>
left	left	left
left	erect	right
left	right	left
erect	erect	erect
erect	left	right
erect	erect	left
erect	right	right

** subject always tilted 18° to floor

* rod and frame always tilted 28° to vertical

Task four consisted of the digit-span test from the W.I.S.C. This task requires the subject to repeat after the experimenter a list of numbers starting off with three and continuing to nine (forward) and starting off at two and continuing to eight (backwards).

Table 3b: Subject, rod and frame position in RFT for half the subjects: Schedule B

<u>Subjects position**</u>	<u>Frame position*</u>	<u>Rod starting position*</u>
erect	erect	erect
erect	right	left
erect	erect	<i>right</i>
erect	left	left
left	right	right
left	erect	left
left	left	right

** subject always tilted 18° to floor

* rod and frame always tilted 28° to vertical

Task five required the subject to explain or define a list of words. The first fifteen of these words were taken from a list of vocabulary considered suitable for Grades I, II or III by the English Medium Centre in Lusaka. The rest were matched, bearing in mind local conditions, to the W.I.S.C. List of Wechsler (items 15-30) noun for noun, adjectives for adjectives etc. It is of course realised that for Zambians this task being in a second language cannot be regarded as being a parallel test to the W.I.S.C. subtest used with American children. However it was included in order to obtain some measure of verbal ability for comparison with Witkin's correlation of verbal ability with EFT and RFT. The

words used were:- bicycle, knife, hat, paper, gun, hospital, radio, dog, clock, flower, kick, engine, nurse, story, brave, nonsense, wife, dislike, ignore, invitation, coin, memory, component, treachery, rebellion, recede, affliction, dilatory, imminent, flout.

Task four will be referred to as DS and task five as VT.

Procedure

For ES 3, SES VT and DS, all subjects were tested individually by E 1 although in the case of the Grade VI sample, E 5 was present to translate into Nyanja. In the case of the RFT E 5 was present for all groups, both to assist in removing the mask and tilting the chair and to translate where necessary (Grade VI and sometimes in the case of Form I subjects), and again all subjects were tested individually. RFT was administered at the H.D.R.U. in a specially prepared room. The other four tasks were administered in one session at the schools in the case of the Form 3/4, Form 1 and non-Zambian sample and at the H.D.R.U., in the case of the Grade VI sample. Sequencing of the four tests was rotated.

The ES 3 task was administered as in experiment 1 with the subject required to trace the outline of the figure with his finger. In the case of the SES, the subject merely pointed to the embedded shape, as this was considered sufficient identification in the case of the coloured pictures, for all items except the one abstract picture which was traced with

the finger. Within ES 3 curved/straight line, rotated/unrotated items were randomised. Sequencing of 'boy-sig', 'girl-sig', and abstract items in SES was rotated.

The VT and DS were administered and scored according to the rules laid down in the W.I.S.C. manual.

It had been decided to make the instruction described by Witkin (1948) for the RFT more explicit for the Zambian samples (and of course for the non-Zambian control group) as it was felt that those described by Witkin(1948) were insufficient for children to whom the terms used were relatively unfamiliar. Before entering the room, the subject was told the following:- "We are going to blindfold you and take you into a dark room. Then your blindfold will be removed. You will then be able to see a frame like this." (holding up a ten inch by ten inch frame which had been cut out of cardboard) "In the frame there will be a rod"(moving a pencil within the frame), "both the frame can move and the rod can move" (illustrating this with model). "I want you to tell me when the rod is straight up-and-down (or vertical) like this." At this stage E 1 held up a plumb-line. Then the walls were pointed out as "being straight up-and-down with the floor"¹⁰ and the process was halted until the subject identified another vertical object in the room correctly. E 1 then continued "Remember I want

10. It is realised that the phrase "with the floor" might have tended to produce more field dependent responses. Instructions would have been improved by omitting this phrase.

you to tell me when the rod is pointing straight up and down like the walls here, not when it is pointing in the same way as the frame."

Then the subject was taken into the darkened room and the seven trials administered. On the first response the subject was questioned as to whether he was sure that the rod now pointed in the same direction as the walls outside.

Hypotheses to be tested in experiment 3

The first four hypotheses to be tested are identical to those of experiment 2 except with respect to the age range tested, and that SES replaces ORS 2.

(1) Intersexual differences on tests of the embedded shape variety in favour of boys exist for Zambian children aged about eleven to eighteen years of age.

(2) Intersexual differences on tests of the SES variety will be related to the type of stimulus, boys will do better at 'boy-sig' items and girls at 'girl-sig' items for Zambian children.

(3) Intersexual differences in spatial ability in favour of boys exist on embedded shape tests for non-Zambian children resident in Zambia aged about thirteen years.

(4) Intersexual differences on tests of the SES variety, will be related to the type of stimulus - boys will tend to do better on the 'boy-sig' items and girls at the 'girl-sig' items, in the case of the non-Zambian children.

It was expected that hypotheses 2 and 3 would be confirmed

and 1 and 4 rejected.

In addition the following hypotheses were made:-

(5) On the verbal test intersexual differences exist in favour of girls for all children.

(6) On the digit span test intersexual differences exist for all children.

(7) On the RFT intersexual differences exist in favour of boys for all groups/samples.

(8) A positive correlation exists between performance on RFT and EFT for all groups.

(9) Zambian children will do better on RFT trials with the chair tilted relative to (a) their scores with the chair straight (b) relative to non-Zambians.

(10) The pattern of intercorrelations between EFT, RFT, VT and DS will follow that shown by Witkin for American children, for both Zambians and non-Zambians.

Hypothesis 5 was expected to be confirmed for non-Zambians but not for Zambians.

Hypothesis 6 was expected to be rejected for all groups.

Hypothesis 7 was expected to be confirmed for Zambian but not for non-Zambians.

Hypothesis 8 was expected to be confirmed for non-Zambians but rejected for Zambians (in line with Wober's and Okonji's (rural sample) results).

Hypothesis 9 was expected to be confirmed (in line with Wober's study).

Hypothesis 10 was expected to be confirmed for non-Zambians but rejected for Zambians.

Section 2. iv: Tabular summary of the three experiments

Table 4: Experimental variables and hypotheses by experiment

<u>Variables</u>	<u>Experiment 1</u>	<u>Experiment 2</u>	<u>Experiment 3</u>
Age	yes	yes	yes
Cross-cultural (Zambian/non-Zambian)	no (by replication in U.S.A. only)	yes	yes
Sex	yes	yes	yes
Socio-economic	no	yes**	no*
<u>Stimulus effects**</u>			
(i) rotated/unrotated	no	yes	yes
(ii) curved/straight	no	no	yes
(iii) overlapping/ embedded	yes	no	no
<u>Hypotheses</u>			
(1) and (2)	yes	yes	yes
(3) and (4)	-	yes	yes
(5) to (10)	-	-	yes

* Although it was not intended that socio-economic class should be a variable it has been pointed out that selection for senior school in Zambia is not free of class bias.

** These results will be discussed in the Appendix.

CHAPTER 3: Experimental results on intersexual differences and their modification.

Initially three tables are to be presented (Tables 5a, 5b and 5c) summarising the experimental results for each experiment. Following this the following topics will be discussed in the light of the experimental results of the three experiments:-

- (1) intersexual differences in spatial ability.
- (2) modification of intersexual differences in spatial ability.
- (3) intersexual differences on the verbal test.
- (4) intersexual differences on the digit span test.

Section 3: i. Tables of results

Table 5a: Results of experiment 1

	(Mean omission scores*)			
	<u>OGS</u>	<u>ORS ('boy-sig')</u>	<u>ORS ('girl-sig')</u>	<u>ES</u>
<u>Grade I</u>				
boys	3.2	7.4	8.9	2.5
girls	4.6	11.3	10.8	3.4
<u>Grade II</u>				
boys	1.2	2.4	4.0	2.7
girls	2.1	6.3	6.0	3.0
all boys	2.2	4.9	6.5	2.6
all girls	3.5	9.2	8.8	3.2

* In experiment 1 scoring was in terms of omission scores in order to parallel Ghent.

Table 5b: Results of experiment 2

	(Mean items correct)			
	<u>OGS</u>	<u>ORS ('boy-sig')</u>	<u>ORS ('girl-sig')</u>	<u>ES</u>
<u>Grade III Zam FP</u>				
boys	29.3	11.6	8.1	2.3
girls	29.0	11.6	9.8	2.3
<u>Grade III Zam NFP</u>				
boys	29.0	11.4	7.1	3.4
girls	28.3	8.2	7.2	1.6
<u>Grade III Non-Zam FP</u>				
boys	31.4	12.4	13.0	4.4
girls	29.8	11.6	13.4	3.6
all boys	29.9	11.8	9.4	3.3
all girls	29.0	10.5	10.2	2.5

Table 5c: Results of experiment 3 (excluding RFT results (mean items correct))

	<u>ES</u>	<u>SES</u>	<u>SES</u>	<u>SES</u>	<u>VT</u>	<u>DS</u>
		<u>'boy-sig'</u>	<u>'girl-sig'</u>	<u>'abstract'</u>		
<u>Form 3/4</u>						
boys	8.7	3.2	3.2	2.5	32.5	9.7
girls	8.0	1.6	3.4	2.2	27.9	9.2
<u>Form 1</u>						
boys	7.1	3.1	3.2	3.6	25.6	10.1
girls	7.9	3.9	3.4	2.4	21.5	9.4
<u>Grade VI</u>						
boys	4.5	2.6	2.7	2.0	10.6	7.9
girls	2.7	1.4	2.9	0.6	10.4	7.5
<u>Non-Zambians</u>						
boys	11.1	3.8	3.9	4.0	32.5	9.7
girls	8.5	3.4	4.0	3.6	39.0	11.2
<u>All Zambians</u>						
boys	6.8	3.0	3.1	2.7	22.9	9.2
girls	6.2	1.6	3.2	1.7	19.9	8.7

Section 3. ii. Topic 1: Intersexual differences in spatial ability

In this section results of the four embedded shape tests (ES 1, ES 2, ES 3, SES 'abstract' items) and the two overlapping geometric shape tests (OGS 1 and OGS 2) will be examined with respect to intersexual differences. In general these were predicted in favour of boys for non-Zambians but were not predicted for Zambians.

Experiment 1

Zambian subjects

On OGS 1 the Grade 1 sample showed no significant intersexual difference and neither did the Grade II sample using a t-test.

On ES 1 the Grade I sample did show a significant intersexual difference in favour of the boys ($t=3.28$, $df=22$, $p<.01$) but no significant difference was shown for the Grade II sample on ES 1.

Experiment 2

Zambian subjects

On both OGS 2 and ES 2 neither of the Zambian samples showed a significant intersexual difference using a t-test.

Non-Zambians

On ES 2 no intersexual difference was shown but on OGS 2 there was a significant intersexual difference in favour of the boys ($t= 2.16$, $df=14$, $p<.05$).

Experiment 3

Zambian subjects

On ES 3 a 2×3 analysis of variance (sex x age level) showed no effect for sex. A ($2 \times 3 \times 3$) analysis of variance on SES showed an interaction for sex x type ($F=7.2$, $df=2/180$, $p<.01$) and a Tukey test on the means (Snedecor, 1956, p 251) showed that boys did significantly better than girls at the 'abstract' items at the .05 level.

Non-Zambian subjects

On a $2 \times 2 \times 2$ (sex x rotated/unrotated x curved/straight items) analysis of variance a significant effect was shown for sex in favour of boys ($F=7.19$, $df=1/56$, $p<.01$) on ES 3. No effect was shown for sex on the 'abstract' items of SES. However it should be noted that a ceiling effect was evident - all the boys scored four out of a possible four. Tables 6a and 6b summarise the significance tests done on intersexual differences in spatial ability.

Discussion of results bearing on hypotheses 1 and 3

Hypothesis 1 was that intersexual differences (in favour of boys) exist on tests of spatial ability for Zambian children aged between five and eighteen. Hypothesis 3 was that intersexual differences on tests of spatial ability in favour of boys exist for non-Zambian children aged between seven and thirteen.

There were ten statistical tests of the hypothesis that Zambian boys would perform better on spatial tests than Zambian

Table 6a: Significance tests on intersexual differences on spatial tests for Zambians

<u>Test</u>	<u>Experiment</u>	<u>Grade</u>	<u>Boys means</u>	<u>Girls means</u>	<u>Sig level</u>	<u>Stat. test</u>
OGS 1*	1	I	3.2	4.6	ns	t
OGS 1*	1	II	1.2	2.1	ns	t
OGS 2	2	III (FP)	29.3	29.0	ns	t
OGS 2	2	III (NFP)	29.0	28.3	ns	t
ES 1*	1	I	2.5	3.4	.01	t
ES 1*	1	II	2.7	3.0	ns	t
ES 2	2	III (FP)	2.3	2.3	ns	t
ES 2	2	III (NFP)	3.4	1.6	ns	t
ES 3	3	VI & Form 1 & Form 3/4	6.8	6.2	ns	A. of V.
SES 'abstract'	3	VI & Form 1 & Form 3/4	11.1	8.5	.05	A. of V.

* Experiment 1 results in terms of omission scores

Table 6b: Significance tests on intersexual differences on spatial tests for non-Zambians.

<u>Test</u>	<u>Experiment</u>	<u>Grade</u>	<u>Boys means</u>	<u>Girls means</u>	<u>Sig level</u>	<u>Stat. test</u>
OGS 2	2	III	31.4	29.8	.05	t
ES 2	2	III	4.4	3.6	ns	t
ES 3	3	VII	11.1	8.5	.05	A. of V.
SES ('abstract')	3	VII	4.0	3.6	ns	A. of V.

girls and only two of these enabled the null hypothesis to be rejected. This was in line with the present writer's hypothesis that in non-Western cultures the intersexual differences observed in the West for spatial ability would not hold if there were no differences in educational practice for the two sexes. On the other hand it should be borne in mind that even in the West intersexual differences are not regarded as well-established until about eleven years of age. The interpretation offered by the present writer of these results is as follows:- among the younger children there was in general no tendency for an intersexual difference in spatial ability. The significant difference observed for the youngest group (Grade I) on ES 1 may possibly be accounted for as follows:- students at the school from which this sample was drawn did not have any experience with male teachers in their school, whereas the Grade II sample had experience both of male teachers and a male head teacher. Experimenter 2 who conducted this experiment was a male. It is thus a possibility that by the time the last task (ES 1) was reached, the situation for the Grade I girls had become very stressful in view of the traditional shyness expected in Zambia from young girls in the presence of unfamiliar adult males. For this reason in the later two experiments only female experimenters were used. This explanation is consonant with Vernon's claim (quoted by Wober, 1969) that the performance of Africans on tests such as the EFT, is more susceptible to motivational and attitudinal effects than the performance of Western subjects.

The significant difference observed for the older subjects in experiment 3 on the 'abstract' items of SES indicates a tendency among the older subjects for boys to perform better at certain spatial tasks. This tendency thus analogises although to a lesser extent the tendency observed in the West. Thus the expectation that in non-Western cultures no intersexual differences would be observed did not receive confirmation from this last result. It does seem clear however that intersexual differences are not as well-established as in the West but it is thought that as Western patterns of differential education and expectation for the two sexes become more established in Zambia, so the tendency for superior performance of boys on conventional tests of spatial ability will become more marked.

Hypothesis 3 which stated that intersexual differences in spatial ability in favour of boys exist amongst non-Zambian children received confirmation in two out of four statistical tests. However as was pointed out above a ceiling effect undoubtedly held for the 'abstract' items of SES as none of the boys made any errors and only two girls made errors (one making two and one making one). The non-significant effect shown for ES 2 in experiment 2 (boys mean 4.4, girls mean 3.6) was in the predicted direction but as the children were aged about seven and a half years it is consonant with the tendency shown elsewhere in the West for differences not to be well established until eleven years of age or thereabouts.

Section 3. iii. Topic 2: Modification of intersexual differences in spatial ability

Hypothesis 2 was that Zambian boys would perform better at 'boy-sig' shapes and that Zambian girls would perform better at 'girl-sig' shapes i.e. that there would be an interaction between type of item and sex. Hypothesis 4 was that the same effect would hold for non-Zambians. It was expected that hypothesis 2 would be confirmed but that hypothesis 4 would be rejected because the stimuli had been selected with a Zambian population in mind.

There are three tests to be considered ORS 1, ORS 2 and SES.

Experiment 1

Zambian subjects

The Grade I sample showed a distinct intersexual difference on an analysis of variance (2×2 , sex \times type of card) ($F=10.75$, $df=1/44$, $p < .01$) but the interaction between type of card and sex was not significant.

However all the differences were in the direction of the hypothesis i.e. boys did better at the 'boy-sig' items and girls at the 'girl-sig' items. A t-test showed that the boys did significantly better at the 'boy-sig' shapes than the girls did at the 'boy-sig' shapes ($t= 2.93$, $df=22$, $p < .01$) but no significant difference between the sexes was shown by a t-test between the boys and girls on the 'girl-sig' shapes. Further a Fisher exact probability test performed on the following categories:- boy/girl, number doing better at 'boy-sig' items/

number doing equally well or better at 'girl-sig' items, was significant at the .025 level thus showing an interaction between sex and type of card.

The Grade II sample showed analogous results. Again although an analysis of variance showed a significant effect for sex ($F=7.8$, $df=1/41$, $p<.01$) no significant interaction was shown on the analysis of variance for sex and type of item.

However all the differences were again in the expected direction. T-tests performed as above showed the same effects - boys doing significantly better at 'boy-sig' items than girls did ($t=2.28$, $df=19$, $p<.05$) but no significant difference between the performance of the two sexes at 'girl-sig' shapes. Further a Fisher exact probability test performed on the following categories:- boy/girl, number doing better or equally well at 'boy-sig' items/number doing better at 'girl-sig' items, was significant at the .05 level.

Experiment 2

Zambian subjects

A 2 x 2 (sex x type of card) analysis of variance performed on the Zambian non fee-paying sample, showed a significant effect for type of item, 'boy-sig' items being easier ($F=6.06$, $df=1/31$, $p<.05$) but none for sex. Neither was there a significant interaction. However the differences were again in the direction of the hypothesis and again a t-test showed that the boys did significantly better at the 'boy-sig' items ($t=3.47$, $df=14$, $p<.01$) than the girls but not at the 'girl-

sig' items. A Fisher exact probability test was not significant.

A 2 x 2 analysis of variance performed as above on the Zambian fee-paying sample showed a significant effect for type of item ('boy-sig' items were easier, $F=6.20$, $df=1/31$, $p < .05$) but none for sex. Neither was the interaction significant. Furthermore t-tests on the types of items also revealed no significant differences for sex.

Non-Zambian subjects

For the non-Zambian sample a 2 x 2 analysis of variance (sex x type of item) revealed no significant effects for sex or type of item or interaction and t-tests performed on type of items showed no difference between sexes.

Experiment 3

Zambian subjects

A 2 x 3 x 3 (sex x age x type of item) analysis of variance (see Table 7 for a summary of the analysis) showed significant effects for sex, age and type of item and also a significant interaction between sex and type of card. Following on the F test Tukey's tests on means was done and revealed significant effects for the following:- boys were significantly better than girls at both 'boy-sig' items and 'abstract' items but not at 'girl-sig' items. Further girls found both 'boy-sig' items and 'abstract' items more difficult than they found 'girl-sig' items (all at .05 level of probability). However boys did not find either 'girl-sig' items or 'abstract' items more difficult than 'boy-sig' items.

Table 7: Summary table for analysis of variance on SES
(sex x age x type of item)

Experiment 3, Zambian subjects

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>Mean Sq.</u>	<u>F</u>	<u>sig level</u>
Between sex	19.5	1	19.5	18.7	.005
" ages	20.8	2	10.4	10.0	.005
" type	24.6	2	12.3	11.8	.005
sex/age	0.4	2	0.2	< 1	ns
age/type	7.6	4	1.9	1.8	ns
sex/type	14.4	2	7.2	6.9	.025
age/sex/type	3.0	4	0.8	< 1	ns
Within sets	131.1	<u>126</u>	1.0		
		143			

Non-Zambian subjects

A 2 x 3 analysis of variance (sex x type of item) showed no significant effects for sex, type of item or interaction.

Discussion of results bearing on hypotheses 2 and 4

Hypothesis 2 postulated the existance of an interaction between sex and type of card for Zambians and hypothesis 4 an interaction of the same type for non-Zambians. However the expectation was that hypothesis 2 would be confirmed but hypothesis 4 rejected because the stimuli had been selected with a Zambian population in mind.

Table 8 summarises the results just presented that bear on

these hypotheses.

Table 8: Summary of effects on performance of different types of items for the two sexes.

<u>Experiment</u>	<u>Sample</u>	<u>'boy-sig'</u> <u>items</u>	<u>'girl-sig'</u> <u>items</u>
1	Zam Grade I NFP	boys> girls	boys=girls
1	Zam Grade II NFP	boys> girls	boys=girls
2	Zam Grade III NFP	boys> girls	boys=girls
2	Zam Grade III FP	boys=girls	boys=girls
2	non-Zam Grade III FP	boys=girls	boys=girls
3	Zam Form 3/4/1/Grade VI NFP	boys> girls	boys=girls
3	non-Zam Grade VII FP	boys=girls	boys=girls

Code: '>' = sig-diff

'=' = ns diff

In general, with the exception of the Grade III fee-paying sample in experiment 2, a significant interaction was shown between sex and type of item for all Zambian subjects. Thus as was predicted hypothesis 2 receives substantial confirmation. This effect was not shown for non-Zambians and thus hypothesis 4 was not confirmed as had also been expected. Bearing this in mind, the fact that the only Zambian sample not showing an interaction was the fee-paying 'elite' sample becomes easier to interpret. The stimuli had been chosen with a non-elite population in mind i.e. a population similar

to that described by Munro (1968) where, for instance, as was mentioned earlier, girls generally tend to younger siblings. All the other Zambian samples who all showed an interaction between sex and type of stimuli may be inferred to be similar to Munro's population.

Reviewing the results over the whole ORS and SES series, and omitting the non-Zambian and 'elite' Zambian samples, the following further effect is seen in all cases, the boys did significantly better over the whole 'sex-significant' series. Breaking this significant difference down in each case, it became apparent that this was so because the boys were better at their stimuli than the girls at theirs (see t-tests and Tukey's tests cited in the previous sub-section). There are three possible explanations for this and all three will now be discussed.

Firstly according to Witkin (1962) boys may be better at tests involving articulation of the visual environment. This however does not account for the interaction effects between sex and type of item just described.

Secondly, it is possible that the boys and girls under discussion would perform equally well on a set of realistic 'neutral stimuli' and that the writer being a woman had devised 'sex-significant' stimuli where the 'boy-sig' stimuli were more difficult in terms of "complexity" (Hochberg, 1967). Thus the boys were given an advantage in that the 'girl-sig' series theoretically more difficult for them in terms of cues

related to significance or meaningfulness, were easier for all subjects than the 'boy-sig' items in terms of complexity.

Finally it is possible that in Zambia, as in the West, boys perform better at spatial tasks. However the differences in intersexual performance are modifiable by the type of stimulus used. This suggests that certain of the variance in intersexual differences on spatial tests may be task specific.

It may thus be concluded that while modification of the stimuli has been shown to differentially affect performance for the two sexes, a tendency for boys to do better at certain spatial tasks has been shown.

Section 3. iv. Topic 3: Intersexual differences on the vocabulary test

Hypothesis 5 stated that intersexual differences in verbal ability exist for both Zambian and non-Zambian children. It was expected that this hypothesis would be rejected for Zambian children and confirmed for non-Zambian children. There is only one task that bears on this hypothesis and that is VT used in experiment 3. For Zambians an analysis of variance (2×3 , sex \times age) showed no significant effects for sex.

A t-test performed on the means of the non-Zambian sample showed a significant difference in favour of the girls ($t=4.13$, $df=14$, $p < .005$).

Discussion on hypothesis 5

The result for the non-Zambian sample is in line with well-established intersexual differences in favour of girls on tests of verbal ability in the West. However the finding of no intersexual difference with the Zambian sample is not in line with other research done in this part of Africa (Rhodesia and Zambia). Irvine (according to Vernon, 1969) has shown that boys "perform appreciably better on vocabulary and attainment tests which depend heavily on language" (p 180). However Irvine's work was done a few years ago and over this brief period, with independence, far more girls are attending school, the drop-out rate is lower for girls (Vernon, 1969) and the expectation that girls do equally well at school as do boys has become established. It is the writer's contention that abilities other than spatial (in this case verbal), may equally well be predicated by expectation (as was discussed in Chapter 1).

Section 3. v. Topic 4: Intersexual differences on the digit span test

Hypothesis 6 stated that intersexual differences in digit-span performance exist for both Zambians and non-Zambians; the expectation was that this hypothesis would be rejected.

A 2 x 3 (sex x age) analysis of variance showed no

significant effect for sex for the Zambian sample and a t-test showed no significant intersexual difference for non-Zambians.

Discussion on hypothesis 6

In line with results in the West (Witkin, 1962, Wechsler, 1958) no intersexual differences were shown on the digit-span test for either Zambian or non-Zambian subjects.

Section 3. vi. Summary of experimental results on intersexual differences

In general most of the expectations put forward in Chapter 2 and discussed in this chapter have been confirmed.

On the whole the differences in spatial ability between the sexes amongst Zambians have been related to experimental conditions (the effect of the unfamiliar male experimenter on the youngest girls in experiment 1)¹¹ or stimulus conditions (the effect of the 'sex-significant' stimuli). However the fact that boys tended to do relatively better than girls did at the stimuli designed to be more meaningful to either sex, and the fact that the boys did significantly better than the girls at the 'abstract' items of SES in experiment 3 indicates a tendency for boys to do better at certain spatial tasks. This tendency may be hypothesised to be due to differential practice and expectation, which operating to a lesser extent than they do in the West, show a less clear-cut difference. However an alternative explanation is offered

11. This effect is discussed by Frijda and Jahoda (1966) as the 'alien authority figure'

by Witkin's hypothesis that differing socialisation practices for boys and girls tend to produce different levels of ability to articulate the visual environment. As was expected non-Zambians showed an increasing tendency with age for boys to do better than girls at spatial tasks.

Further in performance at a verbal test, non-Zambians showed the same intersexual patterns shown elsewhere in the West, while Zambians, as had been expected, do not. However as was pointed out the Zambians were being tested in a second language, while all but two of the sixteen non-Zambians had English as their vernacular (both the two who did not however had the last two years of their primary schooling at the same English medium school which they were currently attending).

Finally for both Zambians and non-Zambians there were no intersexual differences in performance at the digit-span test.

CHAPTER 4: Experimental results bearing on the concept of field dependency

In this chapter results on RFT and EFT will initially be summarised in Table 9. Following on this, the following topics will be discussed in the light of the results:-

- (1) Measuring RFT
- (2) What underlies performance at RFT
- (3) Intersexual differences on RFT
- (4) Correlation between RFT and EFT
- (5) Results bearing on the concept of sensotypes
- (6) Intercorrelations between four tests used in

experiment 3.

Section 4. i. Results bearing on field dependence

Table 9: Results of experiment 3 - RFT and EFT scores

<u>Sample</u>	<u>RFT chair erect</u> (Average over 3 trials)	<u>RFT chair tilted</u>	<u>EFT</u>
Form 3/4 boys	9.9	11.6	8.7
Form 3/4 girls	9.5	12.3	8.0
Form 3/4 mixed	9.6	11.9	8.4
Form 1 boys	13.8	14.8	7.1
Form 1 girls	18.2	18.3	7.9
Form 1 mixed	16.0	16.5	7.5
Grade VI boys	16.0	15.5	4.5
Grade VI girls	13.1	14.8	2.8
Grade VI mixed	14.5	15.2	3.6
Zam all boys	13.2	14.0	6.8
Zam all girls	13.6	15.1	6.2
Zam mixed	13.4	14.5	6.5
Non-Zam boys	0.9	1.9	11.1
Non-Zam girls	6.4	6.3	8.5
Non-Zam mixed	3.6	4.1	9.3

(RFT results scored by Witkin's method)

Section 4. ii. Topic 5: measuring RFT

Witkin (1962) recommended that the method of scoring RFT that has the highest 'construct validity' is to calculate the mean absolute error on degrees from the true vertical. The scores in Table 9 have been calculated in this manner. However this method does not take into account the direction of the frame. In Figure 8 this implies that the subject who moves the rod from O-O' to A-A' is as field dependent as the person who moves the rod to B-B'. But a field dependent person is defined as a person who is dominated by the visual field as a whole. It seems to the present writer that in this case the subject moving to position B-B' is more dominated by the whole of the visual field (the frame and rod) than the subject who moves to position A-A'. For this reason it seems that if field dependency is measured parametrically as though the underlying variable were continuously distributed, direction should be taken into account. However when the present RFT results were initially analysed, it was noticed that a great many subjects appeared to have made 'rotated'¹² errors i.e. the rod

12. Following on the work of John (1964) and Serpell (1969) on certain types of orientation errors, the following two main types of orientation errors are distinguished. In the first case a response may represent a deliberate attempt to orient the response in a different way to the standard (a 'rotated' response. In the second case smaller degrees of displacement may arise from an inaccurate attempt to orient in the standard position ('disoriented' response) Serpell showed that with Zambian children who were asked to copy the placing of a pencil, the greater majority of orientation errors consisted of attempts to place the pencil in a different orientation to that of the standard - errors were rotated rather than disoriented.

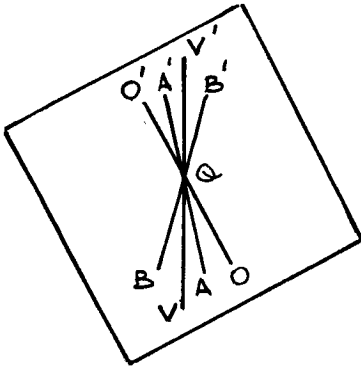
had been moved into a position where it was perpendicular not to true horizontal (i.e. vertical) but where it was perpendicular to the frame. For this reason and because the method recommended by Witkin (above) was questioned, a non-parametric method of scoring RFT was devised.

As was described in Chapter 2, each subject performed seven trials; three of these were with the frame erect and four of these were with the frame tilted. The first three will be henceforth referred to as the 'control' trial and the latter four as the 'experimental' trials. Of the four experimental trials two were with the chair tilted and two were with the chair erect. When the RFT results were plotted (see Figure 9) it appeared that a large number of responses were, as was mentioned before, rotated. (In addition to the type of response where the rod was made perpendicular to the frame, described below, there were six responses where the rod was made parallel to the 'horizontal' sides of the frame. In Figure 2 these have been plotted as 'rotated' however they were scored according to Witkin as 62° i.e. the angular displacement from the vertical.)

From Figure 9 it will be noticed that there are two major points of inflection at V_e (the vertical response) and at 28 (the rotated response) and a minor one at 16-18. Following on this it was decided to examine whether there was any justification for dividing the responses into three categories:

- (1) 'v' responses falling into the range $(V_e - 7) < V_e < (V_e + 7)$

Figure 8: Two possible responses on RFT receiving equal scores according to Witkin (1962).



V-V' Vertical direction

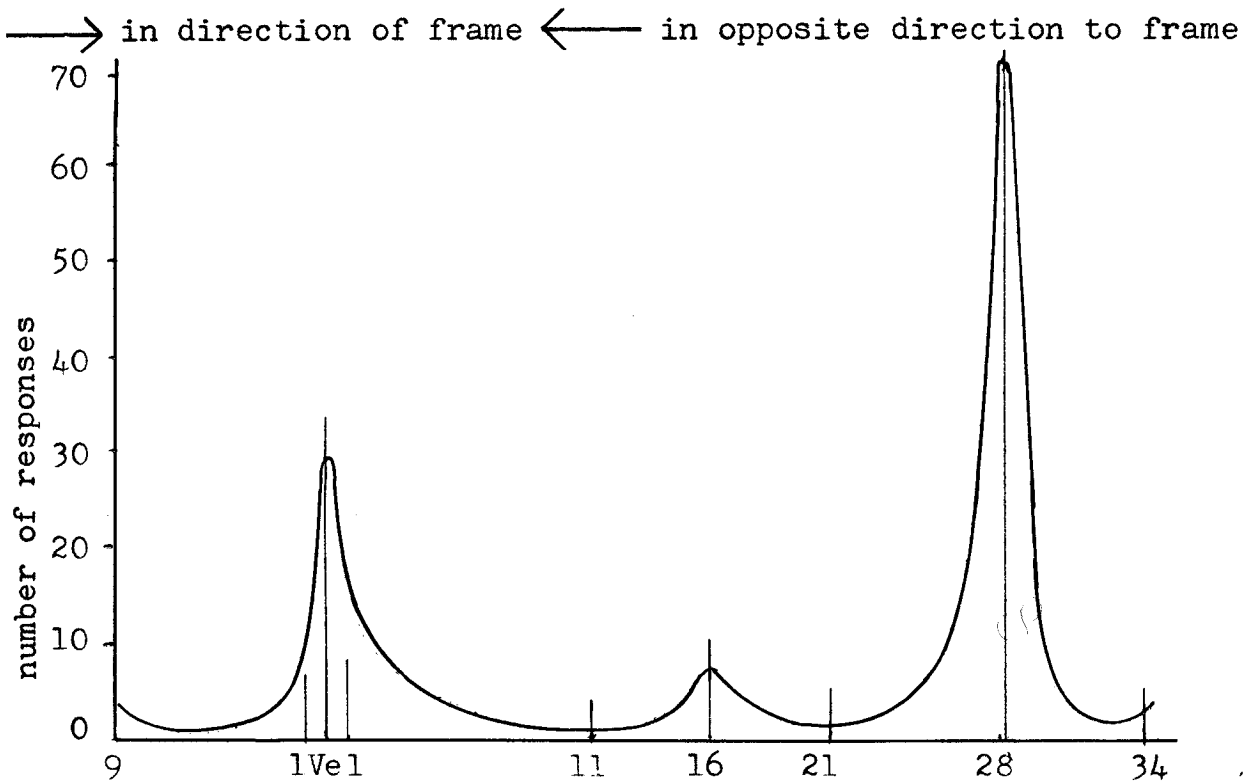
O-O' Original rod position

A-A' First subject's response

B-B' Second subject's response

Angle A'QV' = Angle B'QV'

Figure 9: Responses of the 64 subjects on the four 'experimental' trials plotted according to degree of displacement from vertical.



Rotated responses are at '28' on the x-x' ordinate

vertical responses are at Ve on the x-x' ordinate

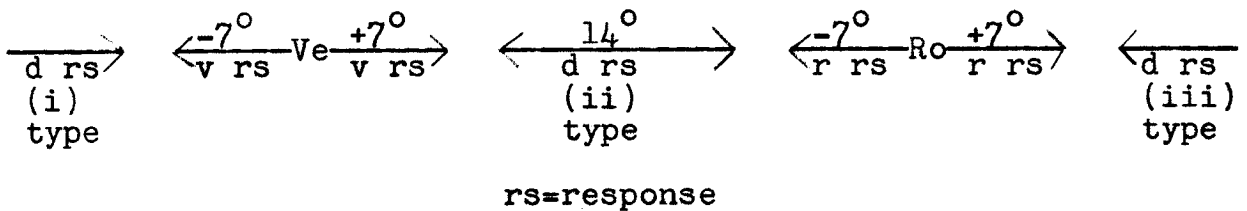
(2) 'r' responses. If R_0 is the position of the rod when it is perpendicular to the frame ('28' on Figure 2) then 'r' responses fall into the following range $(R_0-7) < r < (R_0+7)$

(3) 'd' responses. These responses fall into the following three ranges (i) $d < (V_e-7)$ (ii) $(V_e+7) < d < (R_0-7)$ (iii) $d > (R_0+7)$

Thus in Figure 10 the responses are shown along a continuum (although the underlying variable is regarded as being discontinuous).

Figure 10: Distribution of three types of RFT responses

(\longrightarrow direction of tilt of frame)



If the three types of response are interpreted as follows:-
 'v' responses are aimed at making the rod vertical, 'r' responses are aimed at making the rod perpendicular to the frame and 'd' responses are disoriented then the following prediction can be made. Subjects who make one or more 'd' responses might be expected to be less accurate in their judgements of the rod position than subjects who make only 'r' or only 'v' or both 'r' and 'v' responses. To test this the following hypothesis was set up:- subjects in group 1

(only 'r' or only 'v' or both 'r' and 'v' responses) should have lower mean deviations from V_e on the 'control' trials (when the frame is erect) than subjects who fall into group 2 (one or more 'd' responses).

A t-test was done and the null hypothesis was rejected at the .025 level ($t=2.32$, $df=62$). It was concluded that it is justified to group the subjects into three discrete categories according to their four experimental responses as follows:-

V subjects who make four 'v' responses ($n=14$)

R subjects who make four 'r' responses ($n=23$)

D subjects who make at least one 'd' response ($n=25$)¹³.

(In addition two subjects were unclassifiable making two 'r' and two 'v' responses each.)

It will be seen that this approach differs radically from that of Witkin who would interpret a 'd' (ii) response as 'less field dependent' than a 'r' response whereas this approach regards the 'r' response as being aimed at a different orientation than the standard and the 'd' (ii) response as disoriented.

A further test of this concept of discrete categories was made. The 24 subjects falling into group 2 (one or more 'd' response) were further sub-divided into the following two sub-groups:- subjects who make mainly 'v' responses, referred

13. No subjects fell into category 'd' (iii) therefore according to Witkin's method of scoring all D subjects in this experiment are less field dependent than all R subjects.

to as Dv subjects (n=13) and subjects who make mainly 'r' responses, (Dr subjects, n=10). In addition two subjects were unclassifiable as making mainly 'r' or 'v' responses. (This method of splitting up group 2 or D subjects, is justified according to Witkin's concept of a continuous underlying variable, but not according to the non-parametric method which regards all D subjects as subjects who make disoriented responses). A t-test was made of the control means of Dr and Dv subjects but yielded non-significant differences (mean of Dv=1.08, mean of Dr=1.00). This result suggests that all subjects making at least one 'd' response fall into one category with respect to accuracy in placing the rod.

Thus the last t-test showed that in terms of accuracy in setting the rod R and V subjects are identical and significantly better than D subjects, the second t-test indicated no difference between Dr and Dv subjects on this measure. Thus the tests indicate that the discrete category system receives independent validation from the control measure. In addition these tests have implied characteristics of the three types of subjects (R, V and D) which are not easily accounted for in terms of a continuous underlying variable.

Table 10 shows the distribution of subjects into the three categories by sample. According to Witkin D subjects are less field dependent than R subjects. Thus the EFT scores of D subjects should be significantly better than the EFT scores of R subjects. I shall now examine this for the four samples.

Table 10: Subjects falling into three categories on RFT by

<u>group</u>			
<u>Sample</u>	<u>No. of V subjects</u>	<u>No. of R subjects</u>	<u>No. of D subjects</u>
Form 3/4	2	4	10
Form 1	0	10	6
Grade VI	0	10*	6
non-Zam	12	2	2

* includes two subjects with two 'r' and two 'v' responses each.

Owing to the similar distribution of Form 1 and Grade VI into the three categories I shall group them both together. Mean ES 3 score for D subjects was 6.4 and the mean ES 3 score for the R subjects in this combined sample was 6.8. This direction is in the opposite direction of Witkin's hypothesis but is not significant. For the Form 3/4 sample the D subjects mean ES 3 score was 8.9 and of the R subjects was 7.5. This is in the direction of Witkin's hypothesis but not significantly so. For the non-Zambians the direction was away from Witkin's hypothesis but not significantly so (D subjects mean 8.0, R subjects mean 9.0).

Thus it appears that R subjects do not differ significantly from D subjects with respect to their EFT scores and this is contrary to Witkin's expectation. Having considered in this section certain evidence in support of the writer's non-parametric scoring procedure for RFT, I shall now consider

the variable underlying performance at RFT.

Section 4. iii. Topic 6: What underlies performance at RFT

Witkin has made three main submissions about performance at RFT.

(1) The first is that RFT measures the degree of dominance for the subject of the visual field.

(2) The second is that this degree of dominance is determined by a general personality variable.

(3) Thirdly this personality variable, which determines not only performance at tasks involving visual perception but also general cognitive functioning and life-style, is determined itself by the early socialisation patterns imposed on the individual. With the first contention, no issue is taken by the present writer.

However that the variable underlying performance at RFT is a personality variable is not accepted. It is submitted on the contrary that performance at RFT is determined by the relevant experience of the individual. Specifically it is held that for some individuals the concept of verticality has only been related to visual cues, others have related the concept of verticality to proprioceptive cues as well as visual cues. The former subjects in the RFT task situation are completely dominated by the visual cues, they are the subjects who make the rotated response - the latter type of subject in the RFT task situation is able to make use of the proprioceptive cues as well and makes a vertical response. It is further held

that training to relate the concept of verticality to proprioceptive cues will improve performance at RFT. It is suggested that a study be made along these lines. The D subjects are regarded as disoriented and their responses are seen as randomly distributed. In this respect the large number of Form 3/4 subjects falling into this class may be related to the following anecdotal evidence. After the RFT trials a large number of subjects in this group asked E 5 in the vernacular why E 1 was trying to "confuse" them. It appears to the present writer that although the subjects all gave correct examples of vertical objects before the beginning of the trials, and although E 1 always said at the start of the trials, "remember the rod should be straight up-and-down like the walls here and not like the frame" once inside the RFT room these subjects suspected a catch of some sort. This was implicit in their questioning of E 5 afterwards. The following interaction with E 1 is suspected. E 1 was white as were the great majority of teachers at the school the subjects attended. In addition the subjects were aware the experiments were psychological in nature and despite comment to the contrary obviously suspected that their 'intelligence' was being tested. This interaction is similar to the interaction with race discussed by Wober (1969).

Detailed results on RFT will now be discussed.

Section 4. iv. Topic 7: Intersexual differences on RFT

Hypothesis 7 was that intersexual differences in favour of

boys exist among both Zambian and non-Zambian children.

The only experiment in which RFT was used was experiment 3 and results relevant to intersexual differences are summarised in Table 11.

Table 11: Intersexual differences on RFT

<u>Sample</u>	<u>No. of V subjects</u>	<u>No. of R subjects</u>	<u>No. of D subjects</u>	<u>Parametric score</u>
Zam boys	1	12	10	13.6
Zam girls	1	10	12	14.5
non-Z boys	8	0	0	1.4
non-Z girls	4	2	2	6.6

Zambian subjects

The dispersion of subjects into the three non-parametric categories is nearly identical for both sexes (there is no significant difference in the means on the parametric measure either). Therefore for the Zambian subjects the null hypothesis is accepted - there is no intersexual difference on RFT scores.

Non-Zambian subjects

Combining the two non-V categories, on a Fisher exact probability test, a probability level of .05 is obtained and thus the null hypothesis is rejected for non-Zambians (on the parametric measure the difference in means is in the direction of the hypothesis as well. $t=2.20$, $df=14$, $p<.05$).

Discussion of hypothesis 7

Results on this were as predicted - intersexual differences

for non-Zambians were shown in line with differences shown elsewhere in the West. Zambians did not show an intersexual difference.

It was postulated in the previous section that subjects making 'v' responses on RFT were those who had learned to relate cues other than visual (proprioceptive) to the concept of verticality. In line with the earlier discussion on the origin of intersexual differences in spatial ability, the same genesis is proposed for intersexual differences on RFT. In the West boys have more opportunity to learn about verticality - in constructing models of various sorts, in woodwork classes¹⁴ etc. In Zambia these intersexual differences in practice are not yet as well established and thus intersexual differences are not revealed in RFT.

Section 4. v. Topic 8: Correlation between RFT and EFT

Hypothesis 8 stated that a positive correlation exists between RFT and EFT for both Zambians and non-Zambians. It was predicted that this hypothesis would be accepted for non-Zambians

14. This contention that Zambians have less opportunity to relate verticality to body cues is directly contrary to the position of Wober (1966) and Beveridge (1938). The present position does not deny that African cultures "contain considerable emphasis on sensory phenomena, apart from the visual world" (Wober, 1966, p 182). It is suggested however that the type of experience gained (e.g. from dancing), while it is undoubtedly proprioceptive in nature, is not directly related to the demands of the RFT task. In this task, in order to make a 'vertical' response the subject must rely on proprioceptive cues to help him make a judgment (is it erect or vertical?). Some subjects may regard this judgment as a purely visual decision.

and rejected for Zambians. Table 12a compares EFT and RFT scores for Zambians and Table 12b for non-Zambians.

Table 12a: Comparison of ES 3 scores for discrete categories on RFT for Zambian subjects.

(correlation coefficient using parametric scores between RFT and ES 3 = .290, $n=48$, $p < .05$)

	<u>No. of V subjects</u>	<u>No. of R subjects</u>	<u>No. of D subjects</u>
ES 3 scores below integral score nearest median	2	11	10
ES 3 scores above score nearest median	0	11	12

(Two subjects scoring two 'r', two 'v' responses not included)

Table 12b: Comparison of ES 3 scores for discrete categories on RFT for non-Zambian subjects.

(correlation coefficient using parametric scores between RFT and ES 3 = .145, $n=16$)

	<u>No. of V subjects</u>	<u>No. of non-V subjects</u>
ES 3 scores below integral score nearest median	4	3
ES 3 scores above integral score nearest median	8	1

Zambian subjects

Using discrete categories there is no evidence of a significant correlation between ES 3 and RFT (χ^2 is not significant). Using the parametric method of scoring there

is a significant correlation but this correlation is lower than the RFT correlation with the verbal test (.324) or the ES 3 correlation with the verbal test (.705).

Non-Zambian subjects

Using discrete categories a Fisher exact probability test is not significant and the correlation coefficient calculated from parametric scores is not significant either.

Discussion of hypothesis 8

The prediction that a significant correlation would be shown for non-Zambian subjects which was based on results from United States of America was not fulfilled.

The interpretation offered of the non-correlation between ES 3 and RFT scores is as follows. There is no underlying variable predicated performance at both these tasks. Performance at ES 3 is seen as being determined by spatial ability which may be task specific and is dependent on experience and expectation. On the other hand performance at RFT, while also being ultimately determined by experience and expectation, is immediately predicated by whether the subject has learned to associate the concept of verticality with proprioceptive as well as spatial cues.

The non-correlation observed for non-Zambian subjects is similar to the non-correlation shown by American women in two out of three studies of Witkin. It is suggested that for men experience which is conducive to high performance levels on tests such as EFT and RFT often occurs together (e.g. woodwork)

whereas for women this may not be so. Geometry lessons for example may predispose to good performance at EFT but not at RFT. No explanation is offered as to why the non-Zambian children tested in experiment 3 did not show a positive correlation between RFT and ES 3 whereas their American counterparts did. Zambian children did show a correlation between RFT and ES 3 that was significant and positive but lower than the correlations with VT for both RFT and EFT (significantly in the case of the correlations between EFT and VT and EFT and RFT, $z=2.30$, $p<.05$).

Section 4. vi. Topic 9: Results bearing on the concept of sensotypes

Wober (1966, 1967) has put forward the concept of sensotypes in dealing with experimental results on RFT from Africa. This concept was based on three main types of experimental findings.

Firstly he considered the non-significant correlation between RFT and EFT. In two studies using male employees of large companies in Nigeria, Wober obtained the following non-significant correlations (1966) $r=0.21$, $n=86$ and $r=0.184$, $n=88$ (1967). In the 1966 study RFT was shown to correlate significantly ($p<.05$) with job efficiency as rated by managers.

Secondly, in a cross-study comparison of his own and Witkin and Asch (1948), Wober (1967) noted the following within sample difference on RFT trials when the frame is tilted. American performance is adversely affected by tilting the chair

whereas Nigerians perform at the same level when the frame is tilted whether or not the chair is tilted.

Thirdly Wober (1967) noted the following between sample difference comparing his data again with that of Witkin and Asch (1948) when the frame is erect. Nigerians did better than Americans with the frame erect and the chair tilted at a .01 level of significance ($t=3.54$, Wober's calculations).

He considered that the latter two results provided support for his 1967 hypothesis that African subjects have "better scores on tests where proprioceptivity is important" (a) relative to their own scores on tests dependent on visuality (b) relative to scores of Westerners on similar tests.

He concluded that RFT measures field dependency both in United States of America and Africa, but in different ways (i) in relation to visual skills in United States of America and (ii) in relation to somatic skills in Africa. Hence in this way he explains both the significant correlation between RFT and EFT in the United States of America and the non-significant correlation in Africa. He appears not to have rejected the concept of an underlying cognitive style but considers that in Africa where he considers the salient sensory modality to be somatic, tests involving proprioceptive skill are better indicators of cognitive skills than tests involving visual skills, hence the positive correlation between RFT and job efficiency in the 1966 study.

In this study it was decided to test the hypothesis quoted

above. This hypothesis has been referred to as hypothesis 9.

Hypothesis 9a

This hypothesis states that Africans do better on tests where proprioceptivity is important compared to their performance on tests where visuality is more important.

If the RFT test with frame erect but chair tilted is regarded as a test where proprioceptivity is important and RFT with frame tilted and chair erect is regarded as a test where visuality is important (and it is thought that this is what Wober implies in the 1967 study) then a direct test of the hypothesis can be made from the results of experiment 3.

Measuring parametrically¹⁵ Zambians score 1.0 for the 'proprioceptive' test and 20.0 for the 'visual' test; thus Zambians perform considerably better on the proprioceptive test. So do non-Zambians with a mean score of 0.7 for 'proprioception' and 6.5 for 'visual' test. (It is not possible to perform either an analysis of variance or a t-test on this comparison as although the frame erect responses were normally distributed, Figure 9 showed that responses for frame tilted conditions were trimodal.)

Hypothesis 9 may also be tested as follows:- Africans should be less adversely affected in RFT trials when the chair is tilted than the non-Zambians in comparison to each sample's

15. When the frame is erect the non-parametric measure becomes irrelevant.

scores when the chair is erect, (see Table 13 for parametric scores).

Table 13: RFT scores under two different chair conditions for two cultural groups

	<u>Zambian</u>	<u>non-Zambian</u>
Chair tilted	14.5	4.1
Chair erect	13.6	3.6

A t-test is again not suitable but a χ^2 test performed on Table 14 yields a non-significant value of χ^2 .

Table 14: Comparison of Zambians and non-Zambians doing worse when the chair is tilted

	<u>Zambian</u>	<u>non-Zambian</u>
No. doing worse when chair is tilted	25	7
No. doing equally well or better	23	9

This test result is thus not in the direction of the hypothesis - approximately half of the subjects in both cultural groups are adversely affected.

Hypothesis 9b

This hypothesis states that Africans do better than Westerners where proprioceptivity is important. Comparing (as Wober, 1967 did) RFT trials with frame erect but chair tilted

a t-test (applicable as the frame erect responses are normally and continuously distributed) reveals no significant difference between the two cultural groups.

Discussion of hypothesis 9

Hypothesis 9b, that Africans do better on tests where proprioceptivity is important than Westerners do, has been rejected. Hypothesis 9a, that Africans do better on a test where proprioceptivity is important than they do on a test where visuality is important, has been confirmed but as the same effect was shown to hold for Westerners, this result has not offered any support for the concept of sensotypes.

In general the results reviewed have not offered support for the concept of sensotypes. Wober's finding of a non-significant correlation between RFT and EFT was supported in the case of non-parametric scoring and the correlation was shown to be lower than the correlation with VT for both RFT and EFT in the case of parametric scoring. Thus this finding of Wober's has been replicated. But since a non-significant correlation was also obtained for the non-Zambian sample, the result is hard to interpret in cross-cultural terms.

The present findings that (1) Zambians do not do better than Westerners on tests where proprioceptivity is important and (2) that Zambians are affected to the same degree as Westerners by tilting the chair are not in agreement with Wober's findings and two possible explanations are offered for this. In the first case, it is possible that although

the somatic sensotype occurs in West Africa it does not do so in Zambia. Secondly it is suggested that on a test such as the RFT it is probably not advisable to make direct cross-study comparisons due to the number of experimental variables (accuracy both of measuring instrument and experimenter, instructions and degree of darkness of room) that are involved and cannot be strictly replicated.

Section 4. vii. Topic 10: Intercorrelations between the four tests used in experiment 3

According to Witkin's findings in the United States of America the following patterns of correlation should hold between the tests used in experiment 3:-

- (1) RFT should have a high positive correlation with EFT
- (2) RFT and EFT should not correlate with VT
- (3) DS should not correlate with VT, EFT or RFT.

Hypothesis 10 stated that the same patterns of intercorrelation would be shown in Zambia. It was predicted that hypothesis 10 would be accepted for non-Zambians but rejected for Zambians.

Zambian subjects

Table 15a summarises the relevant correlation (RFT scored parametrically in order to analogise Witkin's findings).

It will be noted that although RFT and EFT correlate significantly and positively they both correlate at a higher level with VT (significantly in the case of EFT and VT as was noted earlier). DS correlates significantly with EFT and VT but not with RFT.

Table 15a: Intercorrelation between four tests used in
experiment 3 for Zambians (n=48)

	<u>VT</u>	<u>DS</u>	<u>RFT</u>	<u>EFT</u>
VT	1.000	.598**	.324*	.705**
DS		1.000	.133	.476**
RFT			1.000	.290*
EFT				

** sig at .01 level

* sig at .05 level

Non-Zambian subjects

Table 15b summarises the relevant correlations with RFT scored parametrically.

Table 15b: Intercorrelation between four tests used in
experiment 3 for non-Zambians (n=16)

	<u>VT</u>	<u>DS</u>	<u>RFT</u>	<u>EFT</u>
VT	1.00	.271	-.427	.104
DS		1.00	-.246	.027
RFT			1.00	.145
EFT				

none of these coefficients are significant.

In general the pattern noted by Witkin in the United States of America for non-Zambians is followed. Although (1) RFT and

EFT did not correlate, whereas they did in the U. S. A., (2) as in the U. S. A., RFT and EFT did not correlate with VT and (3) as in the U.S.A., DS did not correlate with VT, RFT or EFT.

Discussion on hypothesis 10

As was predicted the non-Zambian children showed in general the same pattern of intercorrelations shown by Witkin (1962) in the United States of America.

The cross-cultural results however should be viewed with extreme caution. Measuring verbal ability in a second language cannot be regarded as an equivalent process to measuring verbal ability in the vernacular and thus on VT there is no really adequate comparison between Zambian and non-Zambian subjects. On the DS test E 1 was careful to speak slowly and enunciate clearly and there is no reason to suppose (particularly in view of the fact that even when speaking the vernacular, Zambians use English numerals) that this test was easier for the non-Zambians than for the Zambians. An analysis of means on the digit span confirmed this as the only Zambian group differing significantly from the non-Zambians ($t=4.0$, $df=30$, $p<.001$, difference in favour of the non-Zambians) was the primary school (Grade VI sample). For Zambians however DS correlated significantly with both VT and EFT indicating that for them it measured something other than concentration or attention. Another possible interpretation is that all three tests were measuring mainly attention or concentration. However this does not appear likely because the subjects were all tested individually and it was assured that all were attending closely to the tasks.

It appears from Table 15a that a common factor contributes to performance on the three tests VT, EFT and DS. The Zambian sample was too small for a factor analysis to be done, but the factor may be tentatively identified as a general ('g' cf Vernon, 1965) factor.

Section 4. viii. Summary of experimental results bearing on the concept of field dependency

In this chapter results from experiment 3 bearing directly on the concept of field dependency have been described and discussed.

A new method of scoring RFT has been proposed for two reasons. Firstly it was felt that the non-directional method recommended by Witkin resulted in certain difficulties of interpretation when the angular displacement from the vertical is scored as equal irrespective of whether the error is in the direction of the frame or away from the frame. Secondly a graph of the responses made when the frame was tilted indicated that the underlying distribution was discontinuous and trimodal. Three different types of response were differentiated - vertical, rotated and disorientated. Subjects were classified as V, R or D scorers depending on their pattern of responses.

The non-parametric method of scoring was used in significance tests in preference to the parametric method and this was justified by two analyses. The first showed that in terms of accuracy in setting the rod, R and V subjects were significantly more alike than R and D or V and D. Secondly in

terms of EFT scores R and D subjects showed no significant difference. Thus there is little evidence from this study for Witkin's approach that in terms of spatial ability, V subjects are better than D subjects are better than R subjects.

It was agreed with Witkin that RFT measures the degree of dominance of the visual field; however it was not accepted that the variable determining the degree of dominance is a personality variable. Instead it was proposed that the degree of dominance of the field is determined by the degree to which the subject relates the concept of verticality to proprioceptive cues.

Intersexual differences on RFT were shown in favour of boys for non-Zambians but there were no differences among Zambians. It was suggested that the reason for this is that in the West, differential practice aiding the skills used in RFT favour boys rather than girls. This pattern of differential practice for the two sexes does not appear to hold in Zambia.

No correlation was found between RFT and EFT either for Zambians or non-Zambians. It was suggested that where significant positive correlations have been shown, these are not due to an underlying variable but due to the fact that the opportunity of learning skills involved in both the tests occurs simultaneously within the cultures.

Wober's concept of sensotypes received little support from this study. Zambian subjects did not do better than a Western control group where proprioceptive skills were important.

Further while Zambian scores on a proprioceptively biased test were higher than their scores on a similar visually biased test, the same effect was shown to hold to a similar extent for the control group.

Finally the pattern of intercorrelations between VT, DS, RFT and EFT was considered. It was found that with the exception of no correlation between RFT and EFT the same pattern showed by Witkin (1962) to hold in the United States of America held for non-Zambians. For Zambians the common variance showed between EFT, DS and VT was conjectured to be due to a general factor. EFT was shown to correlate more highly with VT than with RFT, a result more consonant with a general educational account of ability on this test than with a personality-mediated field-dependence account.

CHAPTER 5: Spatial ability and field dependence in Zambian children

In this chapter, some conclusions reached as a result of the three experiments presented, will be put forward. As in the previous sections, the emphasis will be threefold. In Section 5.i. the two topics of intersexual differences in spatial ability and their modification will be dealt with, with respect to Zambia. In Section 5.ii. the topic of field dependency in Zambia will be dealt with. Finally in Section 5.iii. an attempt will be made to synthesise two views of the determinants of differences in spatial ability in Zambia and elsewhere.

Section 5. i. Intersexual differences and their modification - some conclusions

In the first chapter of this study the following points were put forward.

(a) In the West intersexual differences in favour of boys on certain tests of spatial ability have been well documented.

(b) Cross-cultural studies have not been in agreement on evidence for intersexual differences in spatial ability. It was conjectured by the writer that because of the proposed genesis of intersexual differences shown in the West (see point c below) these differences were not necessarily to be expected in Zambia on tests of spatial ability.

(c) The genesis of intersexual differences on tests of spatial ability in favour of males, was postulated as follows.

The cultural expectations of differential roles for boys and girls lead to the following effects. Firstly parents 'and teachers' expectations lead to differential opportunities for practice relevant to the acquisition of spatial skills (construction toys for boys, dolls for girls, technical drawing classes for boys, domestic science for girls). Secondly the child itself acquires differential expectations of success at spatial tasks involving geometric shapes (the type of stimulus mainly used in tests of spatial ability) depending on its sex and this in turn affects motivation. Further those girls who opt for careers in engineering, architecture, physics or applied mathematics, encounter prejudice which acts as a deterrent with a consequent feedback entrenching differential cultural expectations. Finally it was suggested that tests of spatial ability were sex-biased in their utilisation in the main of geometric shapes.

(d) It appeared therefore that modifying stimuli in spatial tests, so as to differentially affect the performance of the two sexes, might be possible. Thus all three experiments presented contained a series of stimuli designed to attempt this.

I shall now discuss the results of the three experiments with these four points in mind.

(a) Intersexual differences in spatial ability among Non-Zambian children.

Intersexual differences in spatial ability were shown in three (OGS 2, ES 3, RFT) out of five tests. It should further

be noted that the children tested in experiment 2 were younger than the age where intersexual differences in spatial ability have been shown to be firmly established in the West. In addition in experiment 3 on the SES series ('abstract' shapes) where no intersexual differences were shown, it is highly likely that a ceiling effect was obtained.

(b) Intersexual differences on the Zambian sample

On the hypothesis that intersexual differences in spatial ability in favour of boys exist among Zambian children, the null hypothesis was rejected in only two (ES 1, Grade I, SES 'abstract' shapes, Form 3/4/1/Grade VI sample) out of eleven possible tests. However it must be remembered that even in the West, intersexual differences are not regarded as firmly established before the age of eleven, and children in the first two experiments were younger than this. In the case of the significant intersexual difference on ES 1 with Grade I, in favour of boys, this difference has been ascribed to the cumulative effect of the following:- the experimenter was a strange male, the traditional shyness expected of young Zambian girls with strange males, the fact that the subjects in Grade I attended a school with no male teachers, and finally the fact that ES 1 was always administered last in experiment 1.

But there are indications of an emerging intersexual difference in favour of boys in these tests of spatial ability with Zambian children. The first indication is the significant superiority of boys on the 'abstract' shapes of test SES and

the second is that whereas the girls did equally well compared to the boys at the 'girl-sig' items on the 'sex-significant' series, the boys all did significantly better on the 'boy-sig' items. (This holds for all the Zambian samples except the fee-paying Grade II in experiment 2.)

(c) Genesis of the intersexual differences

The genesis of intersexual differences in spatial ability cannot be directly tested from the experimental results, but in Section 5.ii. two views (mine and Witkin's) will be contrasted in the light of the available evidence. However the suggestion that spatial tests may be sex biased was tested indirectly below.

(d) 'Sex-sig' test results

For the Zambian subjects for whom the 'sex-sig' stimuli had been designed, a significant interaction between sex and type of stimulus were shown in experiment 1 (both groups) on a Fisher exact probability test and for experiment 3 (all groups combined) on an analysis of variance. In experiment 2 no effect for type of stimulus and sex was shown for the 'elite' group. However it has been pointed out that this group was inferred to be transitional between the non fee-paying Zambian group and the non-Zambian group (for whom the stimuli were not appropriate) in cultural background, and no effect had been either found or predicted, for the non-Zambian group. For the non fee-paying Zambian sample on experiment 2 no significant interaction was observed but the boys did significantly better than the girls

at the 'boy-sig' items but not at the 'girl-sig' items.

Conclusion on intersexual differences in spatial ability in Zambia

It would appear that there are indications of an emerging intersexual difference in spatial tasks in favour of boys in Zambia. This has been regarded as a function of the increasing Westernisation of intersexual differences in practice and expectation; however, another possible source of the intersexual differences may be different socialisation practices for boys and girls. It has been further argued that differences in spatial ability may be task specific and a certain amount of evidence for this has been shown in that the 'sex-sig' series used indicated that by manipulating stimuli, modifications in intersexual differences can be made.

Section 5. ii. Field dependency in Zambian children

(a) Evidence for a general perceptual style

As has been discussed earlier Witkin, (1962, 1966, 1967) has postulated the existence of an underlying perceptual style. Subjects he termed 'field independent' are able to articulate perceptual fields (including visual ones) well and quickly whereas subjects termed 'field dependent' perceive all perceptual fields in a global way and have difficulty in articulating them. He postulated that performance on one or more of the following tests, RFT, EFT or Koh's blocks, is an indication of the degree of field dependence of the individual. Three lines of evidence bearing on the concept of an underlying perceptual style will now be reviewed in the light of the data from the present experiments and other relevant studies.

Correlation between RFT and EFT

It was noted before that a significant positive correlation between EFT and RFT offers support for the concept of field dependency. As has been already discussed evidence from this study showed there was no correlation between RFT and EFT for Zambian subjects when RFT was scored non-parametrically. Even when scored parametrically the significant positive correlation obtained was significantly lower than that obtained between EFT and a verbal test. Thus for Zambian children this does not offer evidence of an underlying perceptual style predicated performance at RFT and EFT. This supports the non-correlation found in Nigeria by Wober (1966, 1967) and Okonji (1969) with a rural sample.

However no significant correlation between RFT and EFT was shown for the non-Zambian sample either. This is not in accordance with Witkin's (1962) results using children of the same age in the United States of America or with Okonji's (1969) with an undergraduate sample in Nigeria. However in the United States of America Witkin (1962) did not show a significant correlation in two out of three samples with women. There are three possible explanations as to why correlations are shown on some samples (mainly Western) and not on others (mainly African).

Firstly Wober has offered the concept of sensotypes that has already been described. (Wober's argument seems to rely on the notion that the skill required within a sensotype is that

of resisting what is universally perceptually compelling.) Thus visually differentiated subjects can resist (rather than tend to rely on) the visual frame; proprioceptively differentiated subjects can detect and compensate for the tilt of their bodies. However as was noted this study did not support this concept for Zambians.

Secondly the present writer has suggested that the skill required in RFT is that of relating proprioceptive cues to a type of skill that has hitherto been dependent on visual cues. Subjects who have had experience in relating both sorts of cues to the type of performance demanded will do well at the test. In the West for instance, woodwork probably offers such opportunity to men but not to women. If, for example, many of Okonji's undergraduates were engineering, physics or applied mathematics students, this may have helped to account for the correlation (and also incidentally it might have helped to account for the intersexual difference on RFT if many more in these groups were male than were female).

Thirdly it is possible that a greater proportion of rotated RFT responses within samples might account for non-correlation. I have not been able to obtain numerical descriptions of rotated responses in Witkin's work although it is obvious that they did occur from this remark in the 1948 study. "To some (subjects) the tilted frame tended to appear upright most of the time, and the rod was therefore adjusted to its main axis in making it V and H". Consideration of the

rural means and s.d.'s of Okonji's study seem to point to a high preponderance of rotated solutions. (In his study the frame was rotated through 28° and scoring was parametric.) The means for the males and females were respectively 23.32 and 23.0 and the s.d.'s were 10.00 and 7.88.

It may be concluded that evidence for a general underlying perceptual style based on the correlation between RFT and EFT is inconclusive for Western samples (the non-Zambian and United States of American females) and that none has as yet been shown in Africa.

The possibility of task-specific spatial ability

If a basic style underlies performance on embedded shape tests, then it should not be possible to manipulate stimulus variables in such a way as to differentially affect performance levels for different subjects. However present results on the 'sex-sig' series indicated that when this was done - by changing the type of embedded item - the performance of the two sexes was differentially affected.

Coaching effects

Finally another finding from studies both within and without Africa is relevant to the concept of an underlying perceptual style. If such a style exists and governs articulation of perceptual fields, then improvement in the articulation of perceptual fields should only be possible if the ability to articulate or analyse is modified. Therefore coaching that does not specifically aim at improving overall

analytic ability, should not increase performance level at spatial tests.

However evidence exists that this is not so. In the United States of America Sherman (1967) has summarised two relevant studies. In the first Brinkman coached an experimental group in visualisation and estimation, and found an improvement significant at the .001 level when compared with a control group on pre- and post-test scores on the Form A of the Differential Aptitude, Space Relations Test. Secondly Blade and Watson found that after a year of engineering studies, gains for engineering students were significantly greater than gains of control groups of both other students and potential students on the College Entrance Examination Board Spatial Relation Test. Finally within Africa, McFie (1961) showed that after a year's training at a trade school Uganda youths showed a significant improvement at Koh's blocks.

Conclusion on whether the concept of an underlying perceptual style (field dependency) is relevant in Zambia

It has been shown that evidence from within this study does not support the existence of an underlying perceptual style governing performance at embedded shape tests and RFT. This finding has been shown elsewhere in Africa as well. In addition evidence from coaching studies has been cited both from within and outside Africa, which also raises questions about the plausibility of the concept of an underlying visual perceptual style. Thus differences observed in Zambia in the

spatial tests used are ascribed by the present writer to differences in spatial ability where spatial ability has been shown to be modifiable by manipulation of stimulus variables and theoretically should be modifiable by coaching.

Section 5. iii. The determinants of differences in spatial ability

(a) two views on the genesis of differences in spatial ability

Two alternative views have been put forward in this study regarding the genesis of differences in spatial ability. The first viewpoint to be discussed is that of Witkin (1962, 1966, 1967). In this discussion I shall use the phrase 'field dependency' although the preceding discussion indicated that it was not appropriate for use in Zambia.

Witkin contends that spatial ability as measured on Koh's blocks, RFT and EFT, is dependent on the analytical ability of the individual or his degree of differentiation. The more analytical or differentiated the individual, the more he is able to articulate any perceptual field including the visual one involved in all three tests just listed. Whether an individual is less, rather than more differentiated (or analytical) or less, rather than more field dependent depends on his socialisation. Social influences encouraging field independence and a more differentiated cognitive style "... are the extent and opportunity the child receives to achieve separation, particularly from the mother, to move towards self-differentiation" (p 235, 1967). Other influences are the

way the child internalises methods of controlling impulse and the personality characteristics of the parents. In effect, the ability at spatial tasks is intimately linked to the personality of the subject.

He considers that the intersexual differences noted in the West on RFT and EFT are to a minor extent dependent on differences springing from the biological differences between the sexes (these were referred to in detail in Chapter 1), but in the main are dependent on differences in sex-role which encourage a more analytical general approach in boys than they do in girls. From this difference in general cognitive style, intersexual differences in field dependency spring. Thus he accounts for the fact that no intersexual differences were found amongst the Eskimos on field dependency by regarding Eskimo society as a society where sex-roles are not clearly differentiated. However the present study done in Zambia which is a strongly differentiated society with respect to sex-roles has not demonstrated differences between the sexes on RFT, a major indicator of field dependency. This leaves the sex-role explanation open to question.

Direct tests of certain facets of Witkin's theory have been done by Dawson in Sierre Leone (1967). Dawson isolated two tribes whose socialisation practices differed from each other in such a way that consequent differences in field dependency could be predicted for the tribesmen, the Temne and the Mende. The latter were predicted to be more field dependent than the former.

Measuring them on three tests of spatial ability (EFT, Koh's blocks and a 3-D test) he found the Mende scored higher on EFT ($p < .001$) and the 3-D test ($p < .05$) but not on Koh's blocks. Secondly he showed on an analysis of variance, subjects who rated their mothers as stricter, performed worse on all three tests of spatial ability. (This was in line with Witkin's prediction about the effect of severity of mother's discipline on field dependence.) This study offers strong support for Witkin's proposal that certain socialisation practices encourage a better performance on spatial tasks than certain others do. Berry (1966) showed a similar effect for the self-rating of mother's discipline but to a lesser extent (seven out of twenty tests showed significant effects) on samples of Scots, Eskimos and Temne.

The alternative point of view suggested on the genesis of differences in spatial ability is not linked to an underlying general cognitive style. This view ascribes differences in spatial ability to any or all of the following effects:-

(a) socialisation. It is accepted that certain homes may encourage or discourage behaviour that is conducive to good performance in a task situation. Where this view differs from that of Witkin is that it is thought that an approach conducive to good performance in task situations may be learned at a later stage than early childhood. Further it is held that the constructive approach to a task situation is not necessarily linked to any underlying variable that governs the whole emotional and

general cognitive life of the individual. While it is accepted that where this link was shown by Witkin to hold for American middle class boys, it has not yet been shown to extend to other cultures. This viewpoint is close to that suggested by Okonji (1969).

(b) practice. Evidence for this comes from the coaching studies quoted in Section 5. ii.

(c) motivation. Evidence for this comes from the work of Vernon in Tanzania (Wober, 1969) where it was shown in the administration of Raven's matrices that Swahili experimenters, regardless of the language they used or their social role, were superior to English experimenters.

(d) test effects. Evidence for this comes from the modification of performance by the 'sex-sig' stimuli described in the present three experiments.

(e) education. A correlation between EFT and other spatial tests with education has been demonstrated by inter alia Berry (1966) and Okonji (1969) and Dawson (1967).

Finally it has been suggested that ability at spatial tasks may be task specific. Anecdotal evidence for this is seen in Zambia where uneducated female domestic servants are often seen to dressmake and draft complicated patterns with great ease. It is suggested that were these women required to perform EFT, they would perform poorly despite their obvious spatial skill utilised in dressmaking. It is hoped to perform a study of this nature.

Section 5.iii. The determinants of differences in spatial ability

(b) Synthesising the two viewpoints

Before discussing a possible synthesis, some findings made by Berry (1966) in an excellent cross-cultural study of the Temne of Sierra Leone and the Eskimos, using the Scots as a control group, will be briefly described. For each of the three cultural groups, two samples were tested, a rural and an urban. In the case of the Temne and Eskimo samples the urban sample was regarded as 'transitional' ('transitional' between traditional and Western ways of life). Each of the six groups did four spatial tests. It was hypothesised at the start of the study that the Eskimos would score higher than the Temne on the four spatial tasks for comparable degrees of Westernisation for the following reasons. Ecological - the Eskimo ecology was more demanding than the Temne ecology being bare and bleak and demanding a degree of visual organisation for the hunting on which the Eskimos depend. The Temne on the other hand live in a varied and colourful environment and being farmers do not travel much. Language - the Eskimos language contains far more geometrical-spatial terms than the Temne. Arts and crafts - the Eskimo make more, and more sophisticated arts and crafts than the Temne. Socialisation - the socialisation practices of the Eskimos are more like those postulated by Witkin as predisposing towards a high degree of field independency than the socialisation practices of the Temne.

Results showed within culture effects on spatial ability for Westernisation (significant effects on seven out of eight tests), education (significant effects on eighteen out of twenty four

tests), and to a lesser extent for self-ratings of mother's discipline (significant effects for seven out of twenty tests).

Between cultures, the Eskimos scored significantly higher on all four tests of spatial ability. Berry himself points out however the difficulty of unravelling the "respective contribution of the ecological demands and the cultural aids" (p 228).

While the present writer agrees with Berry that it is difficult to assess the relative contributions of the different variables involved on the genesis of differences in spatial ability, the following suggestions tentatively proposed in the first Chapter (p 10) are presented.

The main differences in spatial ability are viewed as being determined by differential learning, practice, expectation and education. Nevertheless the work of Witkin in America and Dawson in Sierre Leone suggests that differences in the early home environment may predicate differences in spatial ability. While Witkin sees the home environment and particularly the disciplining measures and attitudes of the mother as causing differences in a generalised approach to emotional and cognitive functioning, the present writer sees differences in the home encouraging exploratory behaviour to a lesser or greater extent and this emphasises behaviour in a task situation less or more constructively.

Between cultures variations in tests of spatial ability are ascribed to:-

- (1) socialisation practices - the degree to which the home

encourages curiosity and exploratory activities. Thus the following remark of Vernon's (1967), may be relevant to the differences in spatial ability shown by Berry for the Eskimos and the Temne sample "..... African parents seem more apt to frustrate than to encourage curiosity and exploratory activities or to reward the acquisition of skills".

(2) degree of Westernisation of the culture i.e. the degree to which subjects from the culture concerned are familiar with the test items and underlying concepts required for performing the test successfully.

(3) ecological requirements of the society - the degree to which the ecology demands organised visual skills.

(4) cultural aids - the degree to which the vernacular language contains terms embracing spatial-geometric concepts and the degree to which practice in relevant skills is fostered by the cultural ambience.

APPENDIX: Some cross-cultural comparisons in spatial ability

In the course of the three experiments described in Chapter 2, some cross-cultural comparisons which did not bear directly on the main interests of the study, were made. In the first experiment where no control group was used, a cross-study comparison was made. In the second two experiments a non-Zambian control group was used.

Experiment 1

In experiment 1, two of the three tasks used (OGS 1 and ES 1) were identical to those used by Ghent (1956) in a study which was concerned with the perception of overlapped and embedded forms.

In the description of the tasks given in Chapter 2, the following two points were not described as they were not relevant to the main lines of enquiry of the study:-

(1) In each of the OGS items one of the overlapped shapes was identical to an embedded shape used in ES 1.

(2) In addition to the large overlapped shapes used in OGS 1 there were some smaller embedded subforms which also appeared in the multiple choice array.

Presentation of the two series was in the same order as Ghent and procedure was the same with the following two exceptions:-

(1) Ghent did not appear to have used an illustrative item for the OGS series.

(2) In the OGS series Ghent did not require the children

to trace out the embedded shape but merely required the child to point to it on the multiple choice array.

(Ghent also used an ORS series but this was not designed to be 'sex-sig'. This series was not similar enough to the one used by the present writer to allow for any comparisons on the series.)

Ghent's subjects were American boys and girls (equal numbers of each sex were tested). There were 34 subjects aged between four and eight year old. Ghent did not present any tables with an intersexual breakdown and made no intersexual analyses.

Ghent's results for which cross-cultural comparisons were available from the present study were the following:-

(a) There was a significant improvement with age for both OGS 1 ($p < .02$) and ES 1 ($p < .001$). A χ^2 test was used.

(b) There were nine times as many errors on the ES series as on the equivalent shapes on the OGS series.

(c) The younger children picked up the smaller subforms embedded in the OGS series more frequently than the older children did. In the group of eighteen subjects from four to five years old, twelve chose one or more of the smaller figures while in the group of sixteen subjects aged from six to eight years old only three made such choices ($p < .01$ χ^2 test).

Ghent ascribed these findings as follows:-

(a) Increasing ability with age at OGS 1 is due to an increase in perceptual span.

(b) Ease of OGS compared to equivalent embedded shapes is due to the fact that intersecting boundaries are easier to perceive than shared boundaries. Thus increasing ability at embedded shapes with age is due to increasing ability to perceive boundaries as belonging to more than one figure.

(c) The fact that the smaller children identified the subforms embedded in the OGS series more frequently than the older children did, was ascribed to the fact that the older children saw the objects as frequently but did not report them regarding them as part of the bigger shapes.

The comparable Zambian results were as follows:-

(a) There was a significant improvement with age for OGS ($t=2.58$, $df=41$, $p < .05$) but not for the ES series.

(b) There were over twice as many errors on the embedded shapes as on the equivalent overlapped shapes (130:53)

(c) There was no significant difference in the number of children picking up the smaller subforms with age. Only three Grade I children and two Grade II children picked up one of these; none picked up more than one.

(d) On OGS five to six year old Americans did significantly better than their Zambian age peers ($t=4.22$, $df=40$, $p < .01$) and seven to eight year old Americans also did significantly better than their Zambian age-peers ($t=3.02$, $df=27$, $p < .01$). On ES 1, there was no significant difference between Americans and Zambians in the five to six year old group but there was a significant difference in favour of the Americans for the seven

to eight year old groups ($t=3.42$, $df=27$, $p<.01$).

Discussion of the cross-cultural results on experiment 1

In general the same trends as were shown in the United States of America were shown in Zambia. There was an improvement on OGS with age and the present writer concurs with Ghent in attributing this to increased perceptual span. It is also agreed that the ease of overlapped shapes as compared to their equivalent embedded shapes is attributable to the greater ease of perceiving intersecting than shared boundaries.

The ES task did not have an effective difficulty range for the Zambian children. There were four items and no Zambian child managed to trace one of them correctly; thus there were only three effective items. It is thought that this is the reason that no age difference was shown on the embedded shapes test.

That few Zambian children picked out the smaller subforms embedded in the overlapping series is attributed to the fact that unlike Ghent, the present writer used an illustrative item and this item contained only overlapped forms.

The fact that Zambian children performed on the whole at a lower level than the American children did, is ascribed most plausibly to the lesser pictorial experience of the Zambian children.

Experiment 2

In this experiment two cross-cultural aspects were investigated. The first concerned the ES 2 test specifically with respect to the rotated and unrotated items. The second

concerned the performance of the fee-paying ('elite') Zambian group who were hypothesized to be a 'transitional' group in the sense used by Berry (1966).

Specifically two hypotheses were made:-

(1) There would be a difference in comparative performance at unrotated/rotated items on the ES 2 task between the three groups.

(2) That the order of performance of the three groups would be as follows:- non-Zambians would be better than 'elite' Zambians who in turn would be better than or equal to non fee-paying Zambians on ES 2 and OGS 2.

It was expected that hypothesis 1 would be rejected as it was conjectured that all the groups would find the rotated shapes more difficult than the unrotated items. It was expected that hypothesis 2 would be accepted. Had all the children been the same age, the hypothesized order would have been non-Zambians better than fee-paying Zambians and fee-paying Zambians better than non fee-paying Zambians, but it will be remembered that the non fee-paying Zambians were a year older than the fee-paying Zambians and thus it was thought that their advantage in age might compensate for their comparative lack of pictorial experience.

Results

All the groups found the rotated shapes more difficult than the unrotated shapes and there was no significant difference in the ratios of unrotated/rotated items correct for any of the

three groups. Table 16 summarises the results.

Table 16: Ratios of unrotated/rotated items correct for three groups on ES 2 in experiment 2

Non-Zambians	1.62
Fee-paying Zambians	1.28
Non fee-paying Zambians	1.54

On the ES 2 task the order of performance was as predicted non-Zambians ($t=2.90$, $df=30$, $p < .01$) were better than fee-paying Zambians who were equal in performance to non-fee-paying Zambians. On OGS 2 there was no significant difference between any of the groups.

Discussion of cross-cultural results in experiment 2

The three groups did not differ at all on either performance at OGS 2 or at comparative ease of unrotated as compared to rotated embedded shapes. The non-Zambian group did significantly better than both the Zambian groups at the embedded shapes which is ascribed again to the greater pictorial experience of this group.

A certain amount of research in Africa, reviewed by Serpell (1969) has shown that an extremely high incidence of orientation errors in copying tasks occurs in Africa. However this present result shows no cross-cultural difference in comparative ability at perceiving unrotated/rotated shapes.

Experiment 3

In this experiment two cross-cultural aspects were inves-

tigated. The first concerned the ES 3 task specifically with respect to the rotated and unrotated shapes. The second also concerned the ES 3 task specifically with respect to the curved/straight line shapes.

Two hypotheses were made:-

(1) There would be a difference in comparative performance at unrotated/rotated shapes on the ES 3 test.

(2) Zambian subjects would find the curved shapes of ES 3 easier than the straight line shapes.

It was expected, as in experiment 2, that all subjects would find the rotated shapes more difficult than the unrotated shapes and thus it was expected that hypothesis 1 would be rejected.

It was expected that in line with the ecological hypothesis put forward by e.g. Segall, Campbell, Herskowitz (1966) and Jahoda (1966) that Zambian subjects coming from a less carpentered environment than non-Zambians would find the curved shapes easier.

Results

On an analysis of variance ($3 \times 2 \times 2$, age x rotated/unrotated shape x curved/straight shape) there was a significant effect for rotated/unrotated shapes ($F=15.5$, $df=1/180$, $p < .005$) and a Tukey test showed the rotated shapes to be more difficult at the .05 level, for Zambians. For non-Zambians a similar effect was shown on a $2 \times 2 \times 2$ (sex x rotated/unrotated shape x curved/straight line shape) analysis of variance, a significant

effect was shown for rotated/unrotated shapes ($F=7.19$, $df=1/56$, $p < .025$) with rotated shapes being harder.

No effect was shown for curved/straight line effects for non-Zambians. For Zambians no main effect was shown for curved/straight line shapes but there was a significant interaction with age ($F=7.2$, $df=2/180$, $p < .01$). The Grade VI sample found the straight line shapes easier while the Form 1 and the Form 3/4 sample both found the curved shapes easier using a Tukey test at the .05 level.

Discussion of the cross-cultural results on experiment 3

The two cultural groups followed the same pattern in comparative performance on rotated/unrotated shapes thus replicating the results of experiment 2.

The two older Zambian groups found the curved shapes significantly easier while the non-Zambians showed no difference on the curved/straight line shapes. Thus the ecological hypothesis put forward was confirmed for the two older groups. That the Grade VI sample found the straight line shapes easier is difficult to account for, and no explanation is offered for it.

Conclusion on cross-cultural results

These results briefly reviewed all appear to point to similar trends in spatial ability operating within the cultures. Where a difference in trend was shown (curved/straight line shapes in ES 3,) this has been conjectured to be attributable to an ecological effect..

These results appear to confirm the view offered on the

genesis of spatial differences in the study as a whole - that where differences occur they are attributable mainly to differential practice. Thus the lesser pictorial experience of the Zambians is seen as contributing to their inferior performance at ES 2 in experiment 2. Further the interaction between culture and curved/straight line shapes is similarly attributed to an ecological effect (which is based on differing opportunities for learning relevant skills).

REFERENCES

- Berry, J. W. Temne and Eskimo perceptual skills. International Journal of Psychology, 1966, 1, 207-229.
- Beveridge, W. M. Some racial differences in perception. British Journal of Psychology, 1938, 2, 58-64.
- Blum, D. M. & Chagnon, J. G. The effect of age, sex and language on rotation in a visual-motor task. The Journal of Social Psychology, 1967, 71, 125-132.
- Dawson, J. L. M. Cultural and physiological influences upon spatial-perceptual processes in West Africa. Parts I and II. International Journal of Psychology, 1967, 2, 115-128, 171-185.
- Du Preez, P. D. Social change and field dependence in South Africa. Journal of Social Psychology, 1968, 76, 265-266.
- Edwards, A. L. Experimental Design in Psychological Research. New York: Holt, Rinehart and Winston, 1965.
- Frijda, N. & Jahoda, G. On the scope and methods of cross-cultural research. International Journal of Psychology, 1966, 1, 110-127.
- Fruchter, B. Measurement of spatial abilities: History and Background. Educational and Psychological Measurement, 1954, 14, 387-395.
- Ghent, L. Perception of overlapping and embedded figures by children of different ages, American Journal of Psychology, 1956, 69, 575-87.
- Goodenough, D. R. & Eagle, C. E. A modification of the Embedded Figures Test for use with young children. The Journal of

- Genetic Psychology, 1963, 103, 67-74.
- Hochberg, J. E. Perception, New Jersey: Prentice Hall, inc., 1964.
- Hudson, W. The study of the problem of pictorial depth perception among unacculturated groups. International Journal of Psychology, 1967, 2, 90-107.
- Irvine, S. H. Ability testing in English-speaking Africa. An overview of Predictive and Comparative Studies. Human Problems in British Central Africa, 1963, 34, 44-55.
- Jahoda, G. Geometric illusions and environment: A study in Ghana. British Journal of Psychology, 1966, 57, 193-9.
- John, I. D. A re-examination of the block design rotation effect. Perceptual and Motor Skills, 1964, 19, 175-182.
- Kagan, J., Moss, H. A., & Siegel, I. E. The psychological significance of styles of conceptualization. In J. C. Wright & J. Kagan (Eds.) Basic cognitive processes in children. Monographs of the Society for Research in Child Development, 1963, 28, No. 2.
- MacArthur, R. S. Sex differences in field dependence for the Eskimo. International Journal of Psychology, 1967, 2, 139-140.
- Maccoby, E. E. Sex differences in intellectual functioning. In E. E. Maccoby (Ed.), The Development of Sex Differences. Palo Alto, California: Stanford University Press, 1966, p 25-55.
- McFie J. The effect of education on African performance on a group of intellectual tests, British Journal of Educational Psychology, 1961, 31, 232-240.
- Milton, G. A. Five studies of the relation between sex role

identification and achievement in problem solving. Technical Report No. 3, December, 1958, Yale University, Department of Psychology, Department of Industrial Administration.

Milton, G. A. Sex role identification and problem solving. Journal of Abnormal and Social Psychology, 1957, 55, 208-212.

Munro, D. A survey of pre-school children's environments in a Lusaka suburb. Human Development Research Unit Reports, 1968, 2.

Okonji, M. O. The differential effects of rural and urban upbringing on the development of cognitive styles. International Journal of Psychology, 1969, 4, 293-305.

Podell, J. E. & Phillips, L. A. A developmental analysis of cognition as observed in dimensions of Rorschach and objective test performance. Journal of Personality, 1959, 27, 439-463.

Sandström, E. I. Sex differences in localisation and orientation. Acta Psychologica, 1953, 2, 82-96.

Segall, M. H., Campbell, D. T. & Herskowitz, M. J. The Influence of Culture on Visual Perception. Indianapolis; Bobbs - Mernel, 1966.

Serpell, R. Cross-cultural differences in the difficulty of copying orientation. Human Development Research Unit Reports, 1969, 12.

Sherman, J. A. Problem of sex differences in shape perception and aspects of intellectual functioning. Psychological Review, 1967, 74, 290-299.

- Siegel, S. Non-parametric Statistics for the Behavioural Sciences. New York: McGraw-Hill, 1956.
- Simons, B. & J. Educational Psychology in the U. S. S. R. Stanford, California: Stanford University Press, 1963.
- Smith, M. I. I. Spatial Ability, London: University of London Press, 1964.
- Snedecor, G. W. Statistical Methods. Iowa: Iowa University Press, 1956.
- Vernon, P. E. Intelligence and Cultural Environment. London: Methuen, 1969.
- Vernon, P. E. Abilities and Educational Attainments in an East African Environment, Journal of Special Education, 1967, 1, 335-345.
- Vernon, P. E. Ability Factors and Environmental Influences. American Psychologist, 1965, 20, 723-733.
- Wechsler, D. The Measurement and Appraisal of Adult Intelligence. Baltimore: Williams and Wilkins, 1958.
- Werdelin, I. The Mathematical Ability. Lund: Ohlssons, 1958.
- Witkin, H. A. A cognitive style approach to cross-cultural research. International Journal of Psychology, 1967, 2, 233-250.
- Witkin, H. A. Cultural influences in the development of cognitive style. XVIIIth International Congress of Psychology. Symposium: Cross-cultural studies of mental development, 1966.
- Witkin, H. A. Dyk R. B., Faterson H. F., Goodenough D. R. & Karp, S. A. Psychological Differentiation. London: Wiley and

- Sons, 1962.
- Witkin, H. A. & Asch, S. E. Studies in Space Orientation IV. Further experiments on perception of the upright with Displaced Visual Fields, Journal of Experimental Psychology, 1948, 38, 762-782.
- Robber, J. M. The meaning and stability of Raven's matrices test among Africans. International Journal of Psychology, 1969, 4, 229-235.
- Robber, J. M. Adapting Witkin's Field Independence Theory to accommodate New Information from Africa. British Journal of Psychology, 1967, 58, 29-38.
- Robber, J. M. Sensotypes. Journal of Social Psychology, 1966, 70, 181-189.