SOME ASPECTS OF EDUCATIONAL TESTING
IN THE
COOK ISLANDS

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ABSTRACT

A comparison of test performance between two groups of 120 children divided into 6 age groups from 8 to 13, was made using a battery of educational and performance tests consisting of standardised Western achievement and intelligence tests and some newly developed 'culture fair' instruments. The two groups consisted of Cook Island children living on Mangaia and New Zealand children from a North-western suburb of Christchurch. The New Zealanders performed at a higher level than the Cook Islanders on the educational tests but with the 'culture fair' tests there were no significant differences. Some Cook Island children, particularly the younger ones, experienced difficulty in copying asymmetrical shapes and these children also had significantly lower scores on the other tests. No definite conclusion as to the cause of this copying problem was reached but a possible course of remedial action is suggested. Some general observations about education in developing countries are made.
CHAPTER I

INTRODUCTION

This thesis comprises a cross-cultural comparison between several educational aspects of Cook Island children as compared with New Zealand children.

The Cook Island children all came from the island of Mangaia, the southern most island and second largest of the Cook group. The New Zealand children came from Merrin Primary School, in a north-western suburb of Christchurch. The two groups, each of 120 children, were divided into six age groups, from eight to thirteen, with equal numbers of males and females in each group.

The tests used were educational or performance tests. Some had a western bias and others were examples of what are often called "culture free" tests. Some of the tests were new instruments designed either by Perry (1974) or by the author, especially for use in the Cook Islands.

The author was interested in whether or not Cook Island children differed in their test score profiles from their New Zealand counterparts and if they did what the nature of the difference was. A number of possibilities exist. They may be stated as follows:

(a) Cook Island children and New Zealand children have a similar profile of test scores for the age groups tested.
(b) Cook Island children have a different profile of test scores from New Zealand children and these differences remain for the various age groups tested.

(c) Cook Island children have a different profile of test scores from New Zealand children for the younger age groups but these differences disappear in the older age groups.

(d) Cook Island children have a different profile of test scores from New Zealand children for the older age groups but the profiles are similar at the younger age groups.

These hypotheses will be tested by analysing the results for each test by age, by race and also by sex. The effect of educational versus performance tests will also be considered.

The current research embodies several diverse areas of psychology, as is often the case with cross-cultural studies. For this reason the literature review covers a number of topics. Perception, cognition and intelligence will be considered. It was found that some children mirror imaged in the copying tasks so the psychology of left and right will be reviewed. Because the children are bilingual by the ninth year, bilingual children and intelligence and also Piaget type conservation studies with bilingual children will be looked at. Research methodology has been an area of concern so this
will also be dealt with briefly. Lastly, because socio-cultural change can have a considerable impact, this area will be examined.

The following quote from Jahoda (1978) summarises this author's position:

"Practically all of modern scientific psychology had its origin in Western industrial societies. Much of it, from Binet onwards, was developed in relation to the particular needs of those societies; and a moment's reflection will show that major fields of application such as educational, clinical or occupational psychology are closely tied to the institutions of modern industrial society. It might be thought that this does not apply to the more theoretical aspects of psychology, and this, in fact, has long been tacitly assumed. However, as soon as this assumption is examined it becomes evident that it is open to challenge. The overwhelming majority of subjects on whose behaviour psychological theories are based were college students or school children - hardly a representative sample of humanity at large. The implication is that their behaviour was unaffected by their specific cultural background, which is highly unlikely. One of the important, though extremely difficult, tasks of cross-cultural work is, therefore, to assess the range of applicability of psychological theories or generalisations by testing them with subjects of divergent cultural backgrounds."

Cross-cultural psychology differs from most other areas in that it concerns a mode of approach rather than a specific topic and, therefore, embraces a great many different areas of psychology. Much of the contemporary research is in the areas of perception, cognition and intelligence.

When Piaget (1923), for example, carried out his studies with Genevan children he remained convinced for a long time that the imposing theoretical edifice built on this developmental foundation was essentially biological
in character and, therefore, valid for the human species at large. However, he gradually changed his position, as a result of a series of cross-cultural studies of cognitive development from the 1950's onwards. So by 1966 he had come to adopt a very different standpoint. "In the field of cognition, the main advantage of cross-cultural studies is to allow a dissociation of the socio-cultural and individual factors in development." (Piaget, 1966).

Most Piagetian research has been concentrated on the single theme of conservation. The methods used have not always been comparable but clearly there are many common trends in the findings; thus, no researcher has reported an inability to identify the main stages postulated by Piaget. However, there appear to be wide variations in the sequence in which different kinds of conservation are achieved, and similarly the ages of their emergence seem to diverge widely. Moreover, there is a controversial claim that a substantial proportion of people in some cultures do not get beyond concrete operations. (Ibid)

1. PERCEPTION, COGNITION AND INTELLIGENCE

During the nineteenth century there were numerous reports from travellers, missionaries and ethnographers to the effect that what were then described as 'primitive' people differed from the 'civilized' both in the way they
saw the world and how they thought about it. At the turn of the century the first systematic psychological study, the famous Cambridge expedition to the Torres Straits, was conducted by McDougall, Myers and Rivers (Rivers, 1901). This was the first important cross-cultural study in perception, cognition and intelligence.

(1) Cross-cultural Studies of Perception

Three major lines of research are prominent within this category. The earliest one was the study of geometric illusions in the Torres Straits by Rivers (1901) who demonstrated cross-cultural differences in susceptibility to the illusion. His work was later taken up by Segall, Campbell and Herskovits (1966) who stimulated renewed interest in this problem so that now a great deal of new information has been collected which has a bearing not only within the cross-cultural sphere, but also on theories of geometric illusions in general.

An example of this renewed interest comes from Brislin and Keating (1976) who worked with the Ponzo illusion (Coren and Girgus, 1978) from a vision and ecology standpoint. People who have lived in environments where, characteristically, converging lines in the visual field indicate distance (e.g. railroad tracks, highways) are expected to be especially susceptible to this illusion. Adults in such environments "interpret" distant objects as being larger than they appear (The Law of Size Constancy, Boring, 1942). Apparently when these adults
view the Ponzo illusion there is an unconscious inference that since the nonparallel lines converge, the object close to the apex must be larger than it appears. Although inferences of this kind are typically valid in the three-dimensional world, with the Ponzo such an inference yields judgements that the line nearer the apex is longer than the other line when it is actually equal to or shorter than it. Adults from environments which contain relatively few of these cues should demonstrate more accurate judgements.

Brislin and Keating (1976) reported that Pacific Islanders, whose physical environments contain far fewer strong cues to distance, showed significantly less susceptibility to the Ponzo illusion than people from the United States. The cues to this illusion are largely man made, such as roads or corridors in large buildings and are, thus, not present in most Pacific Island cultures.

This study indicates that at least some predictions from the cross-cultural perception work, based on stimuli presented in two dimensions, are robust when generalised to a three-dimensional situation.

The second of these three major lines of research was opened up by Hudson (1967) who noted the difficulties experienced by people in African cultures in interpreting two-dimensional representations of three-dimensional objects or scenes.

A third aspect relates to the perception of pictures. It has been suggested that the understanding of pictures
depends on prior learning within a pictorial environment such as that in Western Culture (Kennedy, 1974); but there is other evidence, particularly from young children and even animals, which throws serious doubts on such an interpretation. Much of the early evidence is anecdotal, and carefully designed psychological studies are required to establish the facts.

Deregowski (1972) studied preference for drawings of the split type in which, for example, an elephant seen from above would have its legs unnaturally split to the sides. Indications of such a preference have long been apparent in the artistic styles of certain cultures; for example, the Indians of the Northwestern coast of North America. Other instances of the split style in art are rock paintings in the caves of the Sahara and primitive art found in Siberia and New Zealand. What art historians often fail to note is that the style is universal. It can be found in the drawings of children in all cultures, even in those cultures where the style is considered manifestly wrong by adults.

Perhaps the basic difficulty for the lack of perception, by some ethnic groups, of pictorial depth in pictures drawn in accordance with the post Renaissance perspective system of the West, lies in the observer's inability to interpret the pictorial elements. They see individual cues and symbols but are incapable of linking all the elements into a coherent whole. The widespread differences in the ways that pictures can be interpreted
rule out the possibility of making use of drawings as a universal *lingua franca*.

(2) Cross-cultural Studies of Cognition.

Nineteenth century ethnographers shared with laymen the belief that "savages" were incapable of logical thinking. Anthropologists have long since abandoned such notions, and after being misled by the early studies of "racial" intelligence psychologists have followed suit. However, important problems remain since there is no avoiding the fact that children and adults in pre-literate cultures do exhibit differences from Europeans in the way they respond to cognitive tasks. While cross-cultural psychologists are in general extremely reluctant to resort to genetic interpretations of such differences, there is some disagreement about how they might be explained.

One view is that in the absence of environmental stimulation certain mental structures fail to develop so that differences in performance actually reflect a difference in the underlying cognitive processes. An alternative view is that any environment capable of supporting human life is sufficient for the development of cognitive structures shared by all humans, and all that is needed for these to become manifest is a suitable transposition of cognitive tasks into a familiar idiom. The latter view is strongly espoused by Michael Cole (Cole, Gay, Slick and Sharp, 1971) who has advocated what
he calls 'experimental anthropology'. By this he means experiments based on a thorough knowledge of the cultural background of the subjects.

Cole was able to demonstrate, in a relatively straightforward instance, a basic similarity in cognitive functions once the problem had been presented in a manner which took account of the culturally determined experience of the subjects. However, there are many other cases where it is either much more difficult to find culturally equivalent tasks or where, even if they are found, differences persist. The question remains whether one is faced with some fundamental differences in cognitive processes, or whether it is merely that the culture has not provided adequate opportunities for the acquisition of particular cognitive skills. While this issue remains unresolved, Cole and his associates have certainly made a substantial contribution by introducing the research strategy now known as "experimental anthropology".

During the past decade or so a novel and highly promising approach has been developed in cross-cultural studies, based on Witkin's theory of psychological differentiation (1954). The theory holds that differentiation is a global organismic phenomenon, so that, for example, field dependent or field independent cognitive styles manifest themselves throughout all areas of psychological functioning. It has the great advantage from the cross-cultural point of view that its mode of assessment is not tied to any particular context, and can,
therefore, be adapted to the backgrounds of particular cultures.

First employed by Dawson (1963) in Sierra Leone, psychological differentiation has now been widely adopted as a conceptual tool in cross-cultural research. The boldest use of it has been made by Berry (1976) who built upon this foundation a theoretical model linking ecology, culture and behaviour. Starting from previous research about the child-rearing antecedents of cognitive style, which indicated that it develops adaptively in response to the requirements of a particular ecological niche (e.g. hunters/gatherers tend to be field-independent, agriculturalists and pastoralists field-dependent), he developed an elaborate model of eco-cultural and behaviour systems. This not only concerns behaviour in the traditional cultures, but also attempts to take into account modernizing influences.

It should not be assumed that this was a mere theoretical exercise. Berry made predictions about quantitative relationships within various parts of his model, and to test these predictions he collected data from a variety of cultural samples in different parts of the world, ranging from Africa to the Arctic. As is often the case in the testing of such a complex model the outcome has been tentative, but many of Berry's predictions have been confirmed with a remarkable degree of accuracy.
(3) Cross-Cultural Studies of Intelligence

There is a vast amount of literature on Race and Intelligence but in spite of this there is still a great deal of controversy. According to Kamin (1974) the consensus view of most theorists is that about 80 percent of individual variation in I.Q. scores is genetically determined.

Kamin goes on to say that arguments advanced by Jensen (1969), and for that matter Herrnstein (1971), are fundamentally incorrect. There are no data that are sufficient for us to reject the hypothesis that differences in the way in which people answer the questions asked by testers, are determined by their palpably different life experiences.

This conclusion is salient with respect to another possible question. There may well be genetically determined differences among people in their cognitive and intellectual "capacities". To demonstrate this psychologists would have to develop test instruments that would provide adequate measures of such capacities. They have not as yet done this; they have only developed I.Q. tests.

While psychometricians devised tests to measure quantitatively the intellectual abilities of children and adults, Piaget and other developmental psychologists have been engaged in the qualitative measurement of the child's intellectual development. Piaget views intelligence in terms of an organism's adaptation to its environment and
concludes that older children not only know more than younger children, but also conceive of things in a different way.

In New Zealand, there have been relatively few cross-cultural studies using psychometric instruments for measuring intelligence, and even fewer studies using Piagetian measures. The report of the Commission on Education in New Zealand (1962) pointed out that intelligence tests valid for the Maori had not yet been designed. As well, they noted that Maori children when they commenced school were experientially deprived.

Klippel (1975) questioned whether the Maori new entrant really proved to be significantly different from his non-Maori counterpart on tests of the intellectual abilities that are appropriate for the dominant Pakeha culture.

New Zealand is rapidly becoming a land of comparatively favourable economic and educational opportunity for a variety of Pacific Islanders, particularly Polynesians. As yet there has been little systematic study made of how these people fit into the educational system.

In the Klippel study a battery of 14 tests of intelligence, consisting of both psychometric and Piagetian instruments, was used with Pakeha, Maori and Samoan 5 year olds. All tests were administered individually and in a fixed order by testers of the same ethnic group and sex as the testee. In contrast with
many overseas cross-cultural studies comparing European and non-European children, there were few significant differences between the ethnic groups in the level of performance on the fourteen tests included in the battery. However, many of the overseas studies were with children of older age groups, and in the few with five year olds we have no information on the extent to which European and American environments are comparable with the New Zealand situation.

Absence of significant differences between the groups on the memory test in Klippel's data gave some support to Jensen's hypothesis that memory is quite culture-free. However, whether the structure of memory is a universally invariant feature or whether there are no real differences between the racial groups on this factor is so far unknown.

Klippel also suggested that the sex variable confounded the ethnicity effect in the Raven and Haptic Recognition tests; Polynesian males generally performed at a higher level than the Polynesian females. The Pakeha group showed the reverse pattern with females performing better.

Many of the subtests in which there were significant differences between the groups appeared to involve expressive language. This was consistent with Clay's (1971) finding regarding the poorer performance of Polynesian children with oral language skills.

The large number of low intercorrelations of the
fourteen tests used, suggested that a wide variety of skills were being sampled and this was consistent with the belief of Stephens, McLaughlin, Miller and Glass (1972) that Piagetian tasks involved abilities separate from those measured by standard intelligence tests.

Brooks (1976) points out in regard to the Klippel study a disproportionately large number of Maori children may experience problems in school, not because ability development is solely a function of cultural group membership, but because it may be more related to some combination of genetic and environmental variables which are themselves associated with socio-economic status.

2. LEFT, RIGHT AND MIRROR IMAGES

There are some important exceptions to the claim that left-right orientation is merely circumstantial and irrelevant to the recognition of patterns. These exceptions occur primarily in the man-made world (Corballis and Beale, 1976). For example, left-right orientation is clearly important if one is to recognise the letter b as distinct from the letter d. It appears that man may have to overcome a natural inclination to treat left-right mirror images as equivalent. Children have a great deal of difficulty learning to discriminate mirror images. Most children, however, eventually learn.

The problem of left-right discrimination is
difficult for children up to about the age of seven years and most adults are not normally susceptible to left-right confusion. Specific reading disability, or dyslexia, may sometimes be the result of a poorly developed ability to tell left from right.

It has been suggested that the left-right sense may be related to handedness, cerebral lateralization and perhaps to other internal asymmetries. These asymmetries depend primarily on preprogrammed maturational gradients rather than on learning experience. It is not surprising, therefore, that the period of development of left-right skills coincides at least approximately with the maturation of handedness and cerebral lateralization. Children develop and refine the ability to tell left from right between the ages of about four and ten years. Gessell and Ames (1947) showed that right-handedness gradually predominates over cyclic changes in handedness during the early years of life and stabilizes at about the age of eight years.

The ability to tell left from right cannot be attributed entirely to the maturation of asymmetries. At the very least, we require experience to teach us the relevance of the distinction between left and right. Evidence also suggests that the period of most rapid improvement in left-right discrimination often appears to coincide with early instruction in reading and writing, which in Western cultures includes the teaching of response asymmetries.
Although this association might be attributed partly to a spurt in the growth of lateralization, creating a readiness for both reading and other left-right skills, other evidence suggests that specific learning procedures could facilitate the ability to perform left-right discriminations. In the main these procedures seem to achieve their effect by drawing the child's attention to the relevance of his own laterality. He might learn to use his own handedness to code the particular left-right orientation of a stimulus. Moreover, handedness may be influenced by training in the same way that left-to-right visual scanning is apparently learned. Even cerebral lateralization apparently can be influenced by the quality of verbal experience a child receives.

Maturation, then, sets limits on the growth of the left-right sense, but does not rigidly determine it. Furthermore, educational influences are roughly of two kinds. First, there are those influences which develop the child's own laterality. These include the teaching of unimanual skills, instruction in reading and writing, and general exposure to verbal culture. To be effective, however, these influences must be preceded or accompanied by maturation of a left-right gradient. Second, to exploit his left-right sense and to apply it to the world about him, the child must be taught the relevance of left and right and the relation between his own laterality and that of other bodies and objects.
In Western countries especially, reading failure is widespread and has therefore been a cause for great concern among educators and parents. Symptoms vary widely, and no doubt there are many causes. Left-right confusion is unlikely to be the only cause of failure. It is known that damage to the left cerebral cortex, particularly in the parietal lobe, often results in mirror writing and this may also be a cause of left-right confusion. Damage to the cerebral cortex may have resulted before, during, or after birth from a number of causes including diet deficiencies.

Orton (1937) suggested that engrams tend to be laid down normally in the dominant hemisphere and in mirror-reversed fashion in the nondominant hemisphere. This reversal, if it occurs, would result from homotopic transfer from one hemisphere to the other. Thus, the engram for the word CAT would be established primarily in one hemisphere (presumably the left in most people) so that the reverse engram TAJ would then be established secondarily in the other hemisphere. This is highly speculative and there is no evidence to support it.

It is more difficult to discriminate left from right than up from down (Farrell, Jr. 1979). This difficulty is not dependent on the use of linguistic responses, and it occurs in the processing of simple perceptual displays.

Why are left and right harder to tell apart? One possibility is that the perceptual codes for horizontal
stimuli may be less asymmetrical than those for vertical stimuli. By "asymmetrical" we refer to a polar asymmetry in which up and down are viewed as positive and negative poles on the vertical dimension. The left-right problem may be different for different cultures, however, depending on reading direction.

Recent work by Maki, Grandy and Hauge (1979) gives little support to the functional bilateral symmetry hypothesis of the human nervous system. They found no clear evidence that people who have more symmetrical nervous systems (that is left handed and ambidextrous subjects) had more difficulty in telling right from left than people who have less symmetrical nervous systems. They also found little support for the right-left difficulty being perceptual.

This leaves us with a number of theories and no clear cut evidence to support any of them. Perhaps the answer lies in a combination of theories.

It is not just perception and discrimination of left-right and up-down that is important but also the ability to copy shapes, such as letters, with correct orientation. Similarities in response to visual patterns suggest the presence of common perceptual responses. With this possibility in mind investigators have asked about the presence of orientation errors in copying. They consider that these errors might indicate a common response to a significant property of shapes, that is, to their position in space (Serpell, 1971; Shapiro, 1960;
Deregowski, 1972). From this work has emerged the hypothesis that different cultures may show similar types of error although the frequency of error may not be similar.

Goodnow, Young and Kvan (1976), in their study with Chinese and Western children living in Hong Kong, found similar types of orientation error in copying shapes across the two cultures. The main results of their study stem from errors found with three and four year olds. Errors of any kind were rare among the six and seven year olds. Given this common response they argued that any cultural difference in the frequency of orientation errors is not likely to be accounted for in terms of one culture being sensitive to orientation while another is indifferent. Both must be considered sensitive, with the difference lying in the way sensitivity is translated into particular types of action or product. The important problem then becomes the nature of the translation from input to output or the nature of any correction given to an initial graphic or perceptual response.

In such translation or correction processes several factors are probably operating. One is likely to be the definition of a 'good' or 'correct' copy, that is the degree to which children have been alerted to the importance of matching copy to a standard in particular ways. In Western culture, for example, reproducing the orientation of a model is usually more important than reproducing its size. The same criteria may not be oper-
ative in other cultures or, if operating, they may be less strongly emphasized. A second factor is likely to be the degree of agreement between the definition of a 'correct' copy and the preferences an individual brings to the task. These preferences may be judgemental (for example, a shape is regarded as better form when in one orientation than in another), or executive (for example, one path or sequence of strokes is used more often than another). Cultures may vary both in these preferences and in degrees of skill in resisting the influence of preference where they conflict with the requirement of matching the orientation of copy and standard.

3. BILINGUAL CHILDREN

There is an extensive literature on bilingualism; for example, see Taylor (1976). In addition the relationship between language and thought has generated considerable research; for example Vygotsky (1962) and Slobin (1969). Piaget has explored this relationship and has strongly resisted suggestions that the development of cognitive operations is dependent upon the development of language. This general position may be summarized by the assertion that, while language development undoubtedly facilitates thinking by opening up almost unlimited possibilities for symbolization, it is neither necessary nor a sufficient condition for thinking. Piaget maintains that speed and thought have a common source in the
symbolic function, but the larger scope of the symbolic function embraces also other types of symbols, such as deferred imitation and mental images. Language is thus seen as indispensable to thought but not a cause of it. Both speed and thought are dependent on intelligence.

Keats and Keats (1974) set out to determine whether and to what extent logical concepts acquired by bilingual children in one language can be transferred to a second language. By inducing Piaget’s concept of conservation by means of one language in children who do not possess it in either of two languages, the extent of transfer of such concepts to the other language can be determined. It was predicted that if this transfer was relatively complete, concepts could be considered as being relatively independent of the language in which they were acquired. Such a finding would have practical significance for examining the relationships between acquisition of concepts and the language background of migrant children, and ultimate relevance to the appropriateness of various types of educational programmes for such children.

In the Keats and Keats study the concept of conservation of weight was induced in one language and it was found that the language of training was not a significant factor in the acquisition of the concept. Groups of bilingual children acquired a concept whether trained in English or their other language and when tested in the second language were able to give correct responses and improved explanations. This finding can be regarded as
supporting the idea that the concept and the language in which it is expressed can be considered to be independent, and this finding is consistent with Piaget. Moreover, the effect of training is generalised to concepts other than the one that was being acquired.

It has long been assumed that bilingualism has a negative effect on intellectual development (for example, Manuel and Wright, 1929; Rigg, 1928; Seidl, 1937; Smith, 1939). According to these and other sources, the bilingual child must often think in one language and speak in another, with the result that he/she becomes uncertain and confused. In addition, bilingualism is a mental burden causing intellectual fatigue. The bilingual child is handicapped on intelligence tests, especially those demanding language facility.

It seems that the belief that bilingualism was related to intellectual impairment originated from low scores for the bilingual group on intelligence tests that rely on verbal measures. There is no evidence that bilingualism effects intelligence when we regard it in the broader sense of basic, universal cognitive structures.

Peal and Lambert (1962) gave a battery of tests to ten year old bilingual and monolingual children in middle-class schools in Montreal and found that bilingual children scored higher on both verbal and nonverbal I.Q. than did monolingual children. In addition, a factor analysis of 31 variables indicated that the bilingual group possessed a more diversified set of mental traits
than did the monolingual group. Peal and Lambert speculated that since the bilingual child has two symbols for every object, he must conceptualise environmental events in terms of their general properties, without reliance on linguistic symbols. He is thus more skilled than the monolingual child in abstract concepts and relations.

McLaughlin (1977), in an extensive review of the literature, concludes that there is no unequivocal evidence that bilingualism has negative consequences on intelligence, educational attainment, or cognitive functioning. Nor is there unequivocal evidence in favour of positive effects from bilingualism. In spite of the large number of studies dealing with the effects of bilingualism it has not been demonstrated that bilingualism in itself is a critical variable affecting intelligence, educational achievement, or cognitive functioning. Instead, it may be more interesting to look at the effect that intelligence and cognitive abilities have on bilingualism.

4. METHODOLOGICAL CONCERNS

Given the great importance attached to cognitive functioning by Western psychology, it is important that researchers in this field carefully define their aims, research strategies and techniques. This is not always the case, and presents additional problems when we extend this interest to cognitive functioning in other cultural
contexts. Despite this importance, it is safe to say that no single culturally relative or comparative methodology has received general acceptance by psychologists or anthropologists working in the field (Berry and Dasen, 1974).

Perhaps the most basic question is one of aims or goals. Why should psychologists be interested in studying cognitive functioning in a variety of cultural settings? One goal that is rejected by Berry and Dasen is the idea that cross-cultural cognitive psychology is aimed at discovering which peoples are clever, smart or intelligent, and which are not.

Rather, cross-cultural psychology is concerned with attempts to understand the range of the variability, the differences in cognitive processes as a function of cultural (including ecological and social) variables. It also attempts to understand such uniformities as the cross-cultural consistency in cognitive processes, so that valid generalisations may be made about human cognitive functioning.

Thus, we look intensively within cultural systems for the roots of cognitive variations, and across cultural systems for those characteristics of cognitive functioning which are universal for all mankind.

With regard to the hypotheses or laws already established in Western psychology, another, but prior, aim must be sought. We must avoid the assumption that what is known about American university students processing
psycholinguistic materials, is applicable to our understanding of a Cook Islander processing cues and signals in his ecocultural setting.

5. EFFECTS OF SOCIO-CULTURAL CHANGE

Illiterate people have been extensively compared with others who have experienced varying periods of formal schooling. The general finding has been that schooling, however poor and inadequate it may be, appears to have a powerful impact. Not only does it impart a number of cognitive skills which remain underdeveloped within traditional cultures, but also it seems to modify attitudes and motivations. Thus, according to Berry and Dasen (1974) schooling constitutes one of the main agents of socio-cultural change, though it is of course by no means the only one. The effects of social change have been a key theme in cross-cultural studies.

To date there has been little systematic educational or psychological research carried out in the Cook Islands and much of what has been done is, as yet, unpublished. In pre-Christian times a type of intelligence test was used to decide if a boy was suitable to become a chief. This will be discussed further in the next chapter which is devoted both to the history of the education system and to some aspects of the geography which are necessary to set the scene for the current research.
CHAPTER II

GEOGRAPHIC AND EDUCATIONAL ASPECTS
OF THE COOK ISLANDS

A brief description of the geography of the Cook Islands and some history regarding the development of the education system will now be provided, as a knowledge of how the educational system developed will provide a context for interpretation of some of the results of the present research.

1. GEOGRAPHICAL ASPECTS

There are fifteen islands in the Cook Group (Fig. 2-1). They are divided into two groups, the northern and the southern islands. The capital is at Avarua on Rarotonga which is a mountainous, well-forested island with wide plains, where gardens of oranges, coconuts, tomatoes and vanilla are grown.

The second largest island is Mangaia (Fig. 2-2). It is on this island that the current research was undertaken. It is low-lying, and surrounded by an old coral reef. Inside this dead reef are swamps that were once a lagoon.

The first people to settle on Mangaia arrived roughly six hundred years ago from the islands now known as the Society Islands. The people brought with them
COOK ISLANDS

NORTHERN GROUP
Rakahanga

Pukapuka (Danger Is.)
Manihiki
Nassau

Suwarrow (Suvorov)

SOUTHERN GROUP

Aitutaki
Manuae
Takutea
Miliaro
Atiu
Manhi
Rarotonga
Mangaia

Palmerston Atoll

Fig. 2-1
their Polynesian culture which has remained virtually untouched through time, mainly because of their physical isolation and lack of interest in the Western nations who colonised the other islands scattered through the Pacific. In 1891 Mangaia became a British Protectorate.

A few missionaries from the London Missionary Society in the nineteenth century brought Christianity to the islands, which the Mangaians readily adapted to their Polynesian culture.

Cook discovered Mangaia on the 29th of March 1777 and recorded that the island had a "pretty aspect and might be made a beautiful place by cultivation." At the time of Cook's discovery Mangaia had about 3,000 inhabitants and the islanders were among the "most healthy, strong, active and orderly tribes of Eastern Polynesia."

From 1888-1901, the Cook Islands were a British Protectorate and had a British Resident in charge who reported directly to the Governor of New Zealand. From 1901-1965, the islands remained a Protectorate of New Zealand. In 1965 the Cook Islands became a self-governing State in free association with New Zealand.

Mangaia is fully fifteen kilometres in circumference and rises 4,267 metres from the Ocean floor, one of a series of Oligocene and Miocene volcanoes which lie upon the broad crest of an undersea arch surrounding the central southern Cook Islands. Only 5,191 hectares of land appear above the surface of the ocean, reaching a height of 169 metres at the centre of the island. The
slopes of Mangaia are covered with trees of a deep green, which are very thick but not tall.

The present population of about 1,700 lives in three main villages, Oneroa, the largest of the villages, Ivirua and Tamarua. These villages today are an accumulation of individual family units. The separate households recognize close blood relationships and may cooperate more closely with one another than with unrelated households. For the most part there is now little identification with a tribe. However, this decline in tribalism has been compensated for by an increased sense of community which, in turn, has given the Mangaians a feeling that they share the same national identity.

Mangaia, like many of the Cook Islands, has little work for its people and many of the young men and some of the young women live and work in New Zealand. Except for crops grown for subsistence purposes, the bulk of the agricultural production in the southern Cook Group is exported and virtually all of it goes to New Zealand. The major export crop is pineapple, but exports include taro and tomatoes. If the pineapple export is increased this will provide more work for the young people and may attract more of them to stay rather than go to New Zealand.

2. EDUCATIONAL ASPECTS

In pre-Christian times for a person to be in a position to be awarded the title of Toa (chief, but not
by inheritance), he had to show outstanding fighting and strategic ability in war, possess outstanding intelligence and also be selected by the undefeated ruling tribe.

Having received instruction in the ancient and tribal lore and history, warriors aspiring to be Toas went through rigorous qualifying examinations. Permission to attend "are korero" (House of Talk - or Storehouse of Knowledge) was granted if the boy functioned in an outstandingly intelligent manner. Final assessment of the boy rested on the tests which were devised by the teachers, measuring the applicant's practical adaptation of his intellect.

One of these tests consisted of observing the boy's skill in keeping candlenuts burning through the night (Fig. 2-3).

"The baked and dry kernels of the candlenuts "tuitui" (Aleurites moluccana) were strung on the dry midribs of the coconut leaflets. The applicant took some of these with him. When the instruction commenced the pupil lit the top kernel of one of the torches. He held this upright in his hand while the teacher talked to him across the flame. During the recital, the pupil carefully tended the torch. If he held the torch upright the first kernel burned upwards and did not ignite the kernel below it until it was almost used up. If the kernel burnt too much on one side he held the torch at an angle to ensure the even consumption of the one kernel. When it burned down he took care that the second kernel was ignited from it before he removed the charred ember of the used kernel. Sometimes this took a little care, and the recital would cease until the next kernel was alight. If by constant care a single torch lasted until daylight, the teacher approved of the applicant and said that he would be a youth who could consume instruction. He was deemed worthy of continued instruction. The test of one torch proved that the pupil was so inter-
Fig. 2-3  Mangaian boy burning candle nuts
ested that he was able to resist the claims of sleep. Should, however, the youth prove careless and neglectful, the light would speedily be burned out, as would a second and a third. Should three or four torches be used up in the one night's session, it was regarded as an infallible sign of lack of attention and interest in the course of instruction. The student was promptly "ploughed" on his first night's work. His father was informed that the boy would never learn and that further instruction would be wasted on him." (Buck, Peter, 1934).

(1) History of Formal Education

Formal education in the Cook Islands was established by Christian missionaries and for many years was wholly in their hands. During the latter part of the eighteenth century the exploration of the Pacific proceeded rapidly and one result of reports carried back to England was the formation, in connection with the Congregational Church, of the London Missionary Society to evangelize the newly discovered lands. The first Pacific station of the Society was established in Tahiti in 1796 and from it the teaching of Christianity spread across Western Polynesia.

The missionaries from Tahiti began work in the Cook Islands in 1823, establishing a school at Rarotonga. By 1838 there were 700 children in attendance at the school house at Avarua, where they were instructed by the Rev. A. Buzacott and his native assistant. Before long, the missionaries gained a considerable influence over the Maori chiefs and were able to secure the acceptance of mission laws which were often very rigidly enforced. This greatly facilitated the spread of education, since
few were inclined to dispute the church's injunctions in respect to school attendance. In time the London Missionary Society established schools throughout the Cook Islands. A Roman Catholic mission began work in 1895, eventually opening schools in several of the islands.

In 1895 the Federal Parliament passed a Public Schools Act providing for the setting up of schools under the sole control of the local Government. Tuition in these schools was for all children between the ages of five and fifteen. Under this Act, three free secular day schools were opened in Rarotonga. By 1898 there were three public schools and two mission schools on Rarotonga but only mission schools in the other islands.

In the opinion of the British Resident at this time "the essential tasks of the schools was the secular teaching of the children in the English tongue." This contention touches on the issue that has been of great importance in all the island territories, and one on which sharply conflicting views have been, and still are, expressed. Those sharing the opinion just quoted have argued that the literature in the Pacific vernaculars is usually very limited; that English is the key to modern knowledge and to the capacity to cope with the dominant Western culture; and that unless it is very strongly emphasized in the schools the Islanders will never secure an adequate command of it. On the other hand, it has been held that over-emphasis on English and on Western
cultural context results in a highly artificial form of schooling, remote from the immediate needs and interests of the children, and destructive of the native culture.

The islands came within the jurisdiction of New Zealand in 1901, and in 1903 the first compulsory attendance law was passed. This required attendance at school between the ages of six and thirteen on penalty of a fine of one shilling for each unjustified absence.

In 1904 and again in 1905 the London Missionary Society offered their school to the administration. The provision of universal education had become too large a task for voluntary organisations. In the outlying islands the teachers were entirely untrained. However, the Resident Commissioner was opposed to change and the New Zealand Government accepted his advice and decided against taking over the Mission schools.

In 1915 New Zealand Government passed the Cook Islands Act which empowered the Minister to establish public schools and provided for the appointment of New Zealand teachers. Regulations under the Act made it compulsory for children to attend school regularly between the ages of seven and fourteen. The Act resulted in the establishment of a number of new administration schools and the taking over of many of those of the London Missionary Society. The practice was adopted too of sending a few advanced pupils to New Zealand as trade apprentices, under bond to return to the islands.

Until 1922, each school functioned more or less
independently, but in that year a supervisor of schools was appointed to organise teacher training, prepare suitable curricula, and superintend the schools generally.

In 1932 Sir Apirana Ngata, Minister for Maori Affairs, advocated closer union between the Maori schools of New Zealand and those of the Cook Islands, and wanted more Cook Islanders brought to New Zealand for advanced study.

Mr L.E. Beeby made a first-hand study of conditions in 1945. In his report he stated that the greatest problem which all the Pacific Islands faced is the training of native teachers. It is not just a matter of producing a greater number of teachers; but of correcting an attitude towards education deeply ingrained in the native mind in every island. Education tends to be regarded by most native peoples in the Pacific as the memorization of words and symbols, without much reference to their meaning or to their practical application.

An officer for Island Education was appointed almost immediately. The school system is now controlled by a Department of Education headed by a minister. European headmasters have been replaced in all primary schools by Maoris. The reintroduction of the teaching of Maori in the lower classes improved children's general educational progress, and unexpectedly helped towards a better standard of English in the higher classes.
(2) **Present Day Education on Mangaia**

On Mangaia the children speak Maori at home and in the school until they are eight or nine. The islands have no television but they have radio (from Rarotonga) and the local picture theatre is very popular. The majority of the films are many years old. The children and adults appear to read a large number of comics.

The Cook Islands Primary Schools cover Grades 1-6 and the following subjects are taught:

- Mathematics
- English
- Maori
- Social Science
- Nature Study/Science
- Health
- Art and Craft.

The following notes are attached to the 1977 syllabus:

"a) This syllabus is an outline of programmes existing in schools in 1976.
b) Further details of these programmes are available from the books which are part of the programmes.
c) It is recognized that this syllabus is only a guide and that teachers will need to adapt the programmes to suit the abilities of their children.
d) It is further recognised that curriculum renewal in most areas is required if "national education goals" are to be reached."

Written English is introduced for the first time in Grade 3. Until this stage most of the teaching is in Maori, for all subjects. English is used to a limited
extent from Grade 1 and the reading of English from Grade 2. For further details see Fig. 2-4 which is part of page 4 of the Cook Islands Primary School Syllabus (1977).

Children enter High School in Form 1 at the age of twelve. On Mangaia there is only one High School but each village has a primary school (Fig. 2-5). Children are transported to High School, from the outer villages, by bus. The school day begins at 7.30 a.m. and ends at 1 p.m. The year is divided into four terms. Mangaia High School has a Fifth Form and agriculture is taught as a School Certificate subject. Opportunity is provided for the children to sit the New Zealand School Certificate exams and for some papers there is a South Pacific Option. The University Entrance syllabus is not taught at Mangaia High School (strictly speaking Mangaia High School is a Junior High School), and children must go to school in Rarotonga for this. There is no university in the Cook Islands so people must go either to the University of the South Pacific in Fiji or to a New Zealand university. The University of the South Pacific has an extension studies department in Rarotonga.
<table>
<thead>
<tr>
<th>GRADE</th>
<th>DUAL ENGLISH</th>
<th>WRITTEN ENGLISH</th>
<th>BASIC READERS</th>
<th>SUPPLEMENTARY READERS</th>
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<td>NIL</td>
<td>NIL</td>
<td>NIL</td>
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<td>(Age 6)</td>
<td>1, 2, 3</td>
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<td>2</td>
<td>Tate</td>
<td>NIL</td>
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<td>1. Series 'A' Supplementary</td>
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<td>2. Basic Sight Vocabulary</td>
<td>2. Materials based on sight vocabulary and series 'A' Readers above</td>
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<td>5. Ashton Readers and Library Books</td>
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<td>6. Ocean Readers Bk. 1, 2</td>
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<td>4. Ocean Readers Book 3</td>
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<td>3. Ocean Reader Book 6</td>
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<td>5. Journals</td>
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Fig. 2-4
Fig. 2-5  A typical classroom in Oneroa Primary School. The general layout is similar to that of a New Zealand classroom.
CHAPTER III

METHOD

The time available permitted the testing of 120 students from each of the two races. These were divided into six age groups from eight to thirteen years. There were approximately equal numbers of males and females in each group.

In the Cook Islands testing was carried out in two of the three villages on Mangaia during January and February 1978. At Ivirua village both the group and individual testing sessions, for the younger children, were conducted in the church hall. At Oneroa the group testing was carried out in the primary school classrooms. The High School is in the same grounds as the primary school and its medical room was used for the individual testing. The older children from Ivirua attend high school at Oneroa so they were tested at Oneroa. Six weeks were spent on Mangaia and most week days were spent testing.

In New Zealand the testing was carried out at Merrin Primary School, North-west Christchurch, during November and December 1978. The classrooms were used for group tests. Four weeks were required to collect the data.
1. **SUBJECTS**

(1) **Cook Islands**

The Cook Island students were all native born Mangaian. Children not born on the island or those who had had schooling on the other islands or in New Zealand were not included in the sample. Less than two per cent of the students were rejected on these bases.

The sample was selected randomly from the school record cards which also provided the best available information regarding age, education and sex.

One custom in Mangaia is to allow male children, usually favoured sons, to grow their hair until they have a hair-cutting ceremony. This ceremony can occur for the children any time between the age of eight and fifteen. Because of the way the children dress and the length of their hair it can be difficult to tell whether students are boys or girls. Very often the names do not help either. As sex differences on test results were to be analysed it was necessary, where the sex of the student was not recorded on the record card, to confer with the headmaster.

(2) **New Zealand**

The New Zealand students were from Merrin Primary School in North-west Christchurch. This school was chosen because it was a full primary school (Primer 1 to Form 2) and thus provided the full age range of pupils needed for the study. The school draws its pupils from
farming, industrial and professional backgrounds and can be considered to provide a representative sample of New Zealand Pakeha children.

Again the students were selected at random from the school record cards and the relevant information recorded. No difficulty was experienced in determining the sex of the students.

2. THE TEST BATTERY

Each of the tests in the battery used will now be considered in detail. Some of the tests in the battery have been designed, by Perry (1974) or the author, especially for use in the Cook Islands and these will be defined in detail as there are no published manuals.

(1) ACER Spelling

The spelling test used was the Australian Council for Educational Research Spelling Tests (1936) list A. The test was administered according to the instruction manual. All 50 words were used and the results were left as Raw Scores. The only norms available are age-grade norms for Australian children and it was felt that in view of the fact that this was a comparative study there was little point in using these norms. In the rest of this thesis the spelling test is referred to simply as the ACER.
(2) **Burt Reading**

The reading test used was the Graded Vocabulary (Burt, 1921). The 1921 norms and the 1974 norms provide reading ages up to twelve from Raw Scores of up to 90, not the full score of 110 that can be attained on the test. As this study included thirteen year olds it was decided to leave these results as Raw Scores. In the rest of this thesis the reading test is referred to as the Burt.

(3) **Raven**

The Raven Standard Progressive Matrices (Raven, 1960) was used as a test of general intelligence to check that the New Zealand sample was normally distributed on intelligence. That is, it provided a check of intelligence bias that might have occurred as a result of socio-economic status or other sampling bias.

The test was administered according to the instruction manual, Guide to the Standard Progressive Matrices (1960). Henceforth the Standard Progressive Matrices is referred to simply as the Raven.

(4) **Copy**

The Copy test was developed by the author prior to 1978. In the version used in this test battery it involved copying, from two stimulus cards (Fig. 3-1) four symmetrical and four asymmetrical shapes onto a sheet of paper. Half of the students were asked to copy the asymmetrical shapes first, the other half of the students were asked to copy the symmetrical shapes first. The stimulus card
Fig. 3-1  COPY TEST

Symmetrical Shapes

Asymmetrical Shapes
was placed on the left of the sheet of paper and the subject was provided with a pencil and rubber. The student was then asked to copy (as accurately as possible) the four shapes onto the sheet of paper.

A difficulty was encountered at this point. Those testing in the Cook Islands need to take with them everything that they are ever likely to need. The author forgot a pencil sharpener and had to make do with a chisel borrowed from the woodwork shop.

The test was scored for orientation errors only. If a subject copied all eight shapes correctly he received a score of eight. If he had one incorrect orientation, that is a rotation of 90° left or right or a 180° rotation, then he received a score of seven and so on. For example, if the \( \equiv \) shape was copied as \( \equiv \) then it was marked correct, but \( N \), \( U \) or \( Z \) were marked incorrect.

(5) Stick

The Stick test used was developed by Perry (in this case form B was used, 6-16 years). The test has been used over a period of five years by Perry in the Cook Islands and is intended as a measure of general intelligence (Perry 1974, personal communication).

The students are shown a stick pattern, mounted on cardboard, for 30 seconds. The pattern is then removed and the students are asked to make one just like it on the floor in front of them. Two examples are given at the start of the test session. If a student
incorrectly constructs at least one of the examples, the
tester explains why it is wrong and helps the student
to correct it. No information is given, once the test
starts, as to whether a subject is correct or incorrect.
Only the first eight test items were used (Fig. 3-2).
The kneeling position was used as this allows the
students to be arranged one behind the other so they
cannot see what the others have built (Fig. 3-3).

The test is incremented by one mark for each
stick in the correct position. No norms are available
for this test at present.

(6) Coconut Test

The Coconut test was also devised by Perry and has
been used by her extensively in the Cook Islands between
1974 and 1978. The test consists of six three dimensional
jig-saw puzzles constructed from coconuts. The first
coconut has been cut into two pieces, the second into
three pieces, and so on, up to seven pieces. The test
is scored in terms of number of seconds taken to correctly
complete the construction process. A maximum of 360
seconds (six minutes) is allowed for each coconut and the
test is discontinued after two consecutive failures. The
coconuts still have their husks so the outside has a well
defined pattern which can aid in the construction.

The student was told that the task was to construct
a complete coconut from the pieces in front of him/her
in the fastest time possible. The bottom of the coconut
Fig. 3-2  STICK TEST
STICK TEST - TASK 1

TESTER

ARRANGEMENT OF STIMULI -

Task 1 (a) - Testee is given a bag of sticks containing

5 - 6 inch sticks
5 - 3 inch sticks
5 - 1 ½ inch sticks

(b) - Tester then escorts the testee to his testing position.
(c) - A chalk line is drawn indicating where the testee should kneel.
(d) - Testee helps the child place his/her sticks into three separate piles.

6" 3" 1 ½" Chalk line
Sticks Testee in kneeling position

STICK TEST - TASK 2

TESTER

ARRANGEMENT OF STIMULI -

Task 2 (a) - The stick test patterns are glued to square cards. The cards are arranged on the table. Care is taken so only the back of the cards is viewed. EXAMPLE 1 is the top card, then EXAMPLE 2, CARD 1, etc.

(b) - Testee is asked to stand in front of the table.
(c) - 6 to 10 testees can stand comfortably in front of the table. They stand approximately 3 to 4 feet from the table, and are arranged in a straight line.

Test Cards are placed for viewing

Fig. 3-3
was placed in the sand to hold it during construction (Fig. 3-4). Help was given, if necessary, with the first construction.

---

(7) Block Test

The Block test was devised by the author on the same lines as, and as an alternative to, the Perry Coconut test. That is, a series of six three dimensional jig-saw puzzles. It was constructed out of 15 centimetre cubes of *Pinus radiata* timber and completed is about the
same size as a coconut. The first cube was cut into two pieces, the second into three pieces, and so on up to seven pieces. The coconut used the bottom as the base, so the base of the block was painted orange. The grain of the timber could be used in the same way as the markings on the coconut, as an aid to construction (Fig. 3-5 and Appendix).

The test was presented in the same way as the Coconut test with the same instructions. The scoring procedure was as for the Coconut test.

The Block test was included in this research for two reasons. First it provided a check on what influence familiarity with coconuts might have on test scores. The Block test was administered before the Coconut test for all students. Secondly, if the Block test and Coconut test measure the same underlying factor of intelligence it would mean that the Block test could be used in preference to the Coconut test on purely practical grounds. The Block test is easier to handle in that it remains together during construction, it is less likely to be damaged with rough use, and it does not require a tray of sand.

At this stage no validity or reliability data is available for the Stick Test, Copy Test, Coconut Test or Block Test.
Fig. 3-5  Block Testing in the Medical Room of
Oneroa High School
3. TEST PROCEDURE

The group tests (ACER, Burt and Raven) were administered to whole classes at a time, including students who had not been randomly selected as part of the research because it was easier and also it avoided any problems that might have occurred if some children had gone home and said they had been tested and others said they had not. Every effort was made to avoid offending the Mangaians, as this could reduce the validity and reliability of the test results. The Stick test was administered to groups of ten as this was a convenient number of students for one tester to proctor at a time.

In addition to the group test several individual tests, developed by Fisher and Perry, were used. These were the Copy Test, Block Test and Coconut Test.

As well as being individual versus group tests, the tests can be further dichotomised as Educational tests (that is the ACER and the Burt) and Performance tests (that is Stick, Block, Coconut and the Raven). It was expected that the ACER and Burt, as educational tests with a strong Western cultural bias, were likely to show up differences between Cook Islanders and New Zealanders; whereas the performance tests as so called culture-free tests would show little or no difference.

Some practical problems with testing were encountered that would not normally be associated with
testing in New Zealand. Some of these problems have already been discussed, for example determining sex and the risk of offending people. Some problems of a general nature will now be considered.

During January and February, the time of the year the author was on Mangaia, the pineapple crops were ready for export to either Rarotonga or New Zealand. When the pineapples are to be picked and loaded onto the boats the whole family is required to assist with this task. Therefore during this time testing is impossible because of students' absences.

Mangaian children are naturally curious and it is impossible to test without a whole row of faces at the window watching what is being done. This may not be psychometrically desirable but if the children have a general idea of what is happening, they will be less suspicious and more cooperative when their turn comes.

The younger children (eight year olds) do not speak or understand much English and it was sometimes difficult to be certain that they understood what was wanted of them, even though they were eager to help.

When a test makes use of sticks, pencils, or a stopwatch, it is often necessary to retrieve the stopwatch from one of the children. Similarly the sticks and pencils often needed to be retrieved from the pincers of the land crabs, that carried them off in all directions.

All the testing was carried out by the author to avoid problems of rapport and the biasing of results,
especially in the Cook Islands where help would have meant assistance from native teachers. The effects of this would have been difficult to control. A further restriction for the test administration was that most of the tests are Level B tests which means that only those who have successfully completed a basic course in test administration and interpretation may use them (New Zealand Council for Educational Research, 1978).
CHAPTER IV

RESULTS

The data were analysed using the University of Canterbury Burroughs B6700 Computer and the graphs were plotted on an 11 inch Calcomp X-Y Plotter used in conjunction with the B6700. The computer programs were in some cases written by the author and in other cases package programs were used.

The results will be presented under a number of headings, depending on the statistical procedure employed.

1. FREQUENCY POLYGONS

Frequency polygons of the data were plotted to ascertain the shapes of the distributions of test scores (Figs. 4-1 to 4-6). As can be seen the data exhibit considerable deviation from normality. This point will be further considered in section 3 where the statistical tests will be discussed.

Because of a lack of time it was not possible to test the Cook Island children on the Raven or the New Zealand children on the Coconuts. Therefore, there are no frequency polygons for the Cook Islanders on Raven or New Zealanders on Coconuts. The Raven scores in particular are bimodal.

The secondary mode at the 95th percentile on the
ACER SCORES BY RACE

Fig. 4-1
BURT SCORES BY RACE

FREQUENCY

BURT SCORE

--- COOK ISLAND --- NEW ZEALAND

Fig. 4-2
RAVEN SCORES BY RACE

Fig. 4-3
STICK SCORES BY RACE

Fig. 4-4
Fig. 4-5
COCONUT SCORES BY RACE

Fig. 4-6
Raven frequency polygon is because of a larger than expected number of intelligent eight year olds (see Fig. 4-12). Unfortunately it was not practical to collect a new sample of test scores for the eight year olds.

2. SCATTER PLOTS

Scatter plots of Raw Score against Age by Race were produced to show the spread of the scores (Figs. 4-7 to 4-12). The scatter plots also provide a check on any tendency for a particular set of scores to reach a ceiling. That is, it is a check to see whether any of the tests used were too easy. The Stick Test scores for New Zealanders was the only plot to show this ceiling effect.

No scatter plot was produced for the Copy Test because all but one New Zealander and 90 of the Cook Islanders had no copying errors. That is, they obtained the maximum score on this test.

The scatter plot for the Block Test suggested that there may be two distinct clusters of scores (Fig. 4-11), those with scores of less than 400 constituting one group and those with scores greater than 400 constituting the second group. This finding will be investigated more fully in the section referring to the results of the Discriminant Analyses (Section 7).
ACER SCORES BY RACE

Fig. 4-7
BURT SCORES BY RACE

Fig. 4-8
RAVEN SCORE BY RACE

Fig. 4-9

COOK ISLAND  NEW ZEALAND
STICK SCORES BY RACE

Fig. 4-10
BLOCK SCORES BY RACE

Fig. 4-11
COCONUT SCORE BY RACE

Fig. 4-12
3. MEANS AND STANDARD DEVIATIONS

Means and Standard Deviations were calculated for each test by Age and Race. The means are presented as a series of graphs (Figs. 4-13 to 4-19). The standard deviations are presented in the t-test tables (Tables 4-2, 4-4, 4-6, 4-8 and 4-10).

A problem was encountered at this stage that requires some explanation. Because the Block Test and Coconut Test were new tests it was not certain how best to analyse the results. No information was available from Perry on how she intended to treat her Coconut scores.

It seemed sensible to combine the times taken to assemble each of the six items into a single score weighted by the number of items actually completed. After several attempts the following transformation was considered to give the best results: The six time scores were added together and divided by the number of items successfully completed in less than 360 seconds. If a subject was not able to complete an item in 360 seconds (six minutes) his/her score was recorded as 360 seconds.

Whereas this transformation resulted in a single score, it had the disadvantage of being negative-going. That is, the subjects who were best at the test had the smallest scores. This could make for confusion in interpreting the results as tests are generally scored to give positive-going results, that is, a better performance on
ACER SCORES BY RACE

Fig. 4-13
BURT SCORES BY RACE

Fig. 4-14
RAVEN SCORES BY RACE

Fig. 4-15
COPY SCORES BY RACE

Fig. 4-16
STICK SCORES BY RACE

Fig. 4-17
BLOCK SCORES BY RACE

Fig. 4-18
COCONUT SCORES BY RACE

COOK ISLAND

NEW ZEALAND

Fig. 4-19
a test gives a larger score. Because of this all the scores were subtracted from 800 to give positive-going results. The transformations are summarised by the following formula:

\[ \text{SCORE} = 800 - \left[ \frac{\sum_{i=1}^{6} t_i}{n} \right] \]

\( t_i \) = time to complete ith item.
\( n \) = number of Blocks or Coconuts successfully completed.

Inspection of the graphs themselves suggested a number of points that needed to be considered further, and these will now be discussed.

There were indications that there was little or no race difference on the performance tests (Stick Test and Block Test). This suggested trend was only partly supported by the Analyses of Variance and t-tests. This will be dealt with in greater detail when the Analyses of Variance and t-tests are discussed (Section 4).

The educational tests (ACER and Burt) exhibit very large race differences. This was supported by the Analyses of Variance and t-tests (Section 4). However, the way the graphs of these two tests tend to converge at the higher age groups suggested that the race differences may decrease with an increase in age. This idea will be considered further in the section on Analyses of Variance and t-tests (Section 4) and in the Discriminant Analyses (Section 7).
The Raven Progressive Matrices scores have been standardised with a mean of 50 for each age group; thus, the graph of Mean Score by Age for the Raven should have been a straight line on the 50th percentile. However, because of the intelligence bias in the eight year old group this is not the case. This bias was discussed in Section 1.

The points suggested for further consideration will be dealt with by a number of statistical procedures. First, however, some comments on the non-normality of the data are in order.

It is generally accepted that standard tests of hypotheses about means and variances assume that the underlying populations are normally distributed (e.g. Afifi and Azen, 1972, p. 52). If for a particular sample the hypothesis of normality is rejected then statistical inferences may be made in one of several ways. For example, if the sample size is sufficiently large standard parametric tests may still be used as approximations. Another way is to use a nonparametric procedure, and a third way is to find a transformation of the variable which induces normality.

In this case, partly because the sample size was large (n = 240) and partly because tests such as Analyses of Variance and the Student t-distribution have been found to be robust with respect to non-normality (Norris and Hjelm, 1961; Levy, 1977), the standard tests of hypotheses were used.
For some of the Linear Regression Analyses a non-linear (logarithmic) transformation was used. This was used in order to reduce the positively accelerating curves found in Figs. 4-13 and 4-14. The logarithmic transformation had the effect of increasing the F-ratio (Table 4-14) in three of the four sets of data, thus improving the goodness-of-fit.

4. ANALYSES OF VARIANCE AND t-TESTS

A series of two way Analyses of Variance with independent measures on both factors were performed on the data for the ACER, Burt, Copy, Stick, and Block tests. The two factors were Race (two levels, factor A) and Age (six levels, factor B).

For each of the five tests that were the subject of an Analysis of Variance independent sample t-tests were calculated to ascertain the level of significance associated with the Race factor, at each of the six age groups. These t-tests provide a partial answer to the age-race convergence question posed by the graphs showing Mean Score by Age by Race in Section 3.

Each test will now be considered in turn.

(1) ACER

The A factor (race) effect was significant at the .01 level, indicating that there was a race difference in test score. The B factor (Age) effect was also significant at the .01 level. This indicated that there was a
differences in test scores between ages. The interaction between A and B was not significant (Table 4-1).

<table>
<thead>
<tr>
<th>TABLE 4-1. ACER ANOVA SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_A$ (1,19) = 164.52 $&gt; F .99 (1,19) = 8.18 \ p &lt; .01$</td>
</tr>
<tr>
<td>$F_B$ (5,95) = 15.11 $&gt; F .99 (5,95) = 3.2 \ p &lt; .01$</td>
</tr>
<tr>
<td>$F_{AB}$ (5,95) = 2.23 $&lt; F .95 (5,95), \ p &gt; .05$ NS</td>
</tr>
</tbody>
</table>

The t-tests are all significant except at 13 years. Some support is thus given for the convergence of test scores with age for the ACER.

<table>
<thead>
<tr>
<th>Table 4-2 ACER t-TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>Cook Islands</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

(2) Burt

The A factor (Race) effect was significant at the .01 level, indicating that there was a Race difference in test scores. The B factor (Age) effect was also significant at the .01 level. This indicated that there was a
difference in test scores between ages. The AB interaction was also significant.

Table 4-3  BURT ANOVA SUMMARY

<table>
<thead>
<tr>
<th></th>
<th>FA (1.19) = 335.6 &gt; F .99 (1,19) = 8.18 p &lt; .01</th>
<th>FB (5,95) = 17.07 &gt; F .99 (5,95) = 3.2 p &lt; .01</th>
<th>FAB (5,95) = 5.67 &gt; F .99 (5,95) = 3.2 p &lt; .01</th>
</tr>
</thead>
</table>

The t-tests are all significant although for the 13 year olds it is only significant at the .05 level. Little support is given for the convergence of test scores with age on the Burt.

Table 4-4  BURT t-TEST

<table>
<thead>
<tr>
<th>AGE</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cook Islands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>8.10</td>
<td>20.09</td>
<td>32.46</td>
<td>41.90</td>
<td>50.00</td>
<td>60.80</td>
</tr>
<tr>
<td>S.D.</td>
<td>6.98</td>
<td>14.12</td>
<td>13.71</td>
<td>15.65</td>
<td>16.16</td>
<td>17.83</td>
</tr>
<tr>
<td>New Zealand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>62.73</td>
<td>60.75</td>
<td>71.10</td>
<td>69.05</td>
<td>79.36</td>
<td>74.85</td>
</tr>
<tr>
<td>S.D.</td>
<td>15.58</td>
<td>24.45</td>
<td>19.64</td>
<td>18.79</td>
<td>19.32</td>
<td>25.84</td>
</tr>
<tr>
<td>t</td>
<td>14.30</td>
<td>6.43</td>
<td>7.21</td>
<td>4.89</td>
<td>5.21</td>
<td>2.00</td>
</tr>
<tr>
<td>p</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.05</td>
</tr>
</tbody>
</table>

(3) Copy

The A factor (Race) effect was significant at the .01 level, indicating that there was a race difference in test scores. The B factor (Age) and the interaction were not significant.
The t-tests support the Race difference hypothesis, all but the 9 year olds test being significant.

(4) Stick

The A factor (Race) effect was significant at the .01 level indicating that there was a Race difference in test scores. The B factor (Age) effect was also significant at the .01 level. This indicated that there was a difference in test scores between ages. The interaction between A and B was not significant.
The t-test results are only marginally significant for 8 to 11 year olds and not significant for the 12 and 13 year olds. This gives support to the hypothesis that there is a convergence of test score with age and also to the hypothesis that the race differences are of much smaller magnitude on the performance tests.

However, this result must be interpreted with caution. The Stick test showed a ceiling effect for New Zealanders that may have given rise to this result (see Fig. 4-10).

<table>
<thead>
<tr>
<th>Table 4-8</th>
<th>STICK t-TESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Cook Islands</td>
<td></td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>31.55</td>
</tr>
<tr>
<td>S.D.</td>
<td>5.71</td>
</tr>
<tr>
<td>New Zealand</td>
<td></td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>34.33</td>
</tr>
<tr>
<td>S.D.</td>
<td>4.55</td>
</tr>
<tr>
<td>$t$</td>
<td>3.16</td>
</tr>
<tr>
<td>$p$</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>
(5) **Block**

The A factor (Race) effect was significant at the .05 level, indicating that there was a Race difference in test scores. The B factor (Age) effect was significant at the .01 level. This indicated that there was a difference in test scores between ages. The interaction between A and B was not significant.

<table>
<thead>
<tr>
<th>Table 4-9</th>
<th>BLOCK ANOVA SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_A \ (1,19) = 5.68 &gt; F_{.95} \ (1,19) = 4.38 \ p &lt; .05$</td>
<td></td>
</tr>
<tr>
<td>$F_B \ (5,95) = 7.95 &gt; F_{.99} \ (5,95) = 3.2 \ p &lt; .01$</td>
<td></td>
</tr>
<tr>
<td>$F_{AB} \ (5,95) = 0.40 &lt; F_{.95} \ (5,95), \ p &gt; .05$ NS</td>
<td></td>
</tr>
</tbody>
</table>

None of the $t$-tests were significant. This gives support to the hypothesis that on performance tests race differences are less pronounced than they are for educational tests.

<table>
<thead>
<tr>
<th>Table 4-10</th>
<th>BLOCK $t$-TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>8</td>
</tr>
<tr>
<td>Cook Islands</td>
<td>$\bar{X}$</td>
</tr>
<tr>
<td></td>
<td>S.D.</td>
</tr>
<tr>
<td>New Zealand</td>
<td>$\bar{X}$</td>
</tr>
<tr>
<td></td>
<td>S.D.</td>
</tr>
<tr>
<td></td>
<td>$t$</td>
</tr>
<tr>
<td></td>
<td>$p$</td>
</tr>
</tbody>
</table>
(6) Coconut versus Block

This additional two way Analysis of Variance with repeated measures on one factor was performed on the Block and Coconut data for Cook Islanders. The two factors were Age (6 levels, factor A) and Block/Coconut score (2 levels, factor B).

This test was carried out because the Coconut and the Block tests are similar in design and may have measured the same underlying factor of intelligence. The A factor (Age) effect was significant at the .01 level, indicating that there was a difference between test scores and age. The B factor (Block/Coconut) was not significant. This indicated that there was no difference between the scores. That is the Block and Coconut tests do measure the same underlying factor of intelligence for Cook Islanders. It was not possible to check this result with the New Zealanders because of lack of time for data collection. The AB interaction was not significant.

If further research confirms the fact that the Block and Coconut tests measure the same factor this will have the advantage that the Block test will be able to be used without the Coconut test. The Block test is an easier test to administer.

<table>
<thead>
<tr>
<th>Table 4-11  COCONUT/BLOCK ANOVA SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_A (5,190) = 11.127 &gt; F .99 (5,190) = 3.11 , p &lt; .01$</td>
</tr>
<tr>
<td>$F_B (1,38) = 3.539 &lt; F .95 (1,38), p &gt; .05 NS$</td>
</tr>
<tr>
<td>$F_{AB} (5,190) = 0.424 &lt; F .95 (5,190), p &gt; .05 NS$</td>
</tr>
</tbody>
</table>
5. FACTOR ANALYSIS

Three Principal Components Factor Analyses with varimax rotation were carried out to see if the performance tests (Stick and Block) and the educational tests (ACER and Burt) came out as separate factors. The third analysis was carried out as a race comparison.

(1) Cook Islands

The first analysis included the following tests: ACER, Burt, Stick, Copy, Block and Coconut, and was carried out only on the Cook Islands sample. The Rotated Factor Matrix produced three factors.

The ACER and Burt came out as highly loaded on one factor; thus suggesting an educational factor, while the Stick, Block and Coconut tests came out as loading on the third factor, which we have identified as performance. The Copy test came out as loading uniquely on the second factor.

Table 4-12  COOK ISLANDS FACTOR ANALYSIS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor 1 Loading</th>
<th>Factor 2 Loading</th>
<th>Factor 3 Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACER</td>
<td>0.946</td>
<td>0.050</td>
<td>0.144</td>
</tr>
<tr>
<td>BURT</td>
<td>0.850</td>
<td>0.111</td>
<td>0.385</td>
</tr>
<tr>
<td>STICK</td>
<td>0.249</td>
<td>-0.024</td>
<td>0.785</td>
</tr>
<tr>
<td>COPY</td>
<td>0.077</td>
<td>0.968</td>
<td>0.120</td>
</tr>
<tr>
<td>BLOCK</td>
<td>0.204</td>
<td>0.297</td>
<td>0.623</td>
</tr>
<tr>
<td>COCONUT</td>
<td>0.135</td>
<td>0.084</td>
<td>0.804</td>
</tr>
</tbody>
</table>
(2) New Zealand

The analysis included the following tests: ACER, Burt, Raven, Stick, Copy and Block, and was carried out on the New Zealand sample. The Rotated Factor Matrix produced three factors. The ACER, Burt, and Raven were Highly loaded on factor one. The Stick and Block loaded on factor two and the Copy test came out as a third factor. This result is thus similar to that for the Cook Islanders as an educational factor, a performance factor and a copy factor were produced.

Table 4-13 NEW ZEALAND FACTOR ANALYSIS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor 1 Loading</th>
<th>Factor 2 Loading</th>
<th>Factor 3 Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACER</td>
<td>0.893</td>
<td>0.237</td>
<td>0.065</td>
</tr>
<tr>
<td>BURT</td>
<td>0.899</td>
<td>0.227</td>
<td>0.082</td>
</tr>
<tr>
<td>RAVEN</td>
<td>0.562</td>
<td>-0.320</td>
<td>-0.274</td>
</tr>
<tr>
<td>STICK</td>
<td>0.204</td>
<td>0.821</td>
<td>-0.023</td>
</tr>
<tr>
<td>COPY</td>
<td>0.023</td>
<td>-0.121</td>
<td>0.950</td>
</tr>
<tr>
<td>BLOCK</td>
<td>0.026</td>
<td>0.695</td>
<td>-0.086</td>
</tr>
</tbody>
</table>

(3) Race Comparison

The third analysis included only the ACER, Burt, Stick and Block tests, and was used as a comparison between Cook Islanders and New Zealanders. The Cook Islands analysis produced two factors on the Rotated Matrix. ACER and Burt came out as loading highly on factor one and the Stick and Block tests came out as loading highly
on factor two. A similar result was obtained for the New Zealanders.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cook Islands</th>
<th>New Zealand</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACER</td>
<td>0.945</td>
<td>0.957</td>
</tr>
<tr>
<td>BURT</td>
<td>0.864</td>
<td>0.938</td>
</tr>
<tr>
<td>STICK</td>
<td>0.305</td>
<td>0.328</td>
</tr>
<tr>
<td>BLOCK</td>
<td>0.123</td>
<td>-0.051</td>
</tr>
</tbody>
</table>

### Table 4-14: RACE COMPARISON FACTOR ANALYSIS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor 1 Loading</th>
<th>Factor 2 Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACER</td>
<td>0.945</td>
<td>0.130</td>
</tr>
<tr>
<td>BURT</td>
<td>0.864</td>
<td>0.368</td>
</tr>
<tr>
<td>STICK</td>
<td>0.305</td>
<td>0.732</td>
</tr>
<tr>
<td>BLOCK</td>
<td>0.123</td>
<td>0.866</td>
</tr>
</tbody>
</table>

6. REGRESSION ANALYSIS

A regression analysis studies the relationships between the dependent variable (test score) and the independent variable (age). This relationship is the regression function. The best possible straight line is then fitted through the points and the value of \( F \) is calculated. The \( F \) statistic is a measure of the goodness-of-fit of this line.

A regression analysis for each test by Race was
carried out to verify that there was a significant linear relationship between age and test score and also to check the significant age factor (B) from the Analysis of Variance results (Section 4).

Because each of the tests had a different mean and standard deviation the test scores were linearly transformed by converting them to z-scores. The ACER and Burt scores were then non-linearly transformed, by taking $\log_{10}$ of the scores, to reduce the positively accelerating curves found with these tests (see Figs. 4-7 and 4-8).

As the data were not normally distributed in the first place and because $\log_{10}$ will only induce approximate normality, not all of the intercepts were zero. Therefore the intercepts have been reported.

All the linear regressions were found to be highly significant (Table 4-15).
TABLE 4-15  REGRESSION ANALYSIS

<table>
<thead>
<tr>
<th>Test</th>
<th>Race</th>
<th>Intercept</th>
<th>Slope</th>
<th>F</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACER *</td>
<td>Cook Islands</td>
<td>-0.354</td>
<td>0.497</td>
<td>52.41</td>
<td>1.80</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>ACER *</td>
<td>New Zealand</td>
<td>-0.132</td>
<td>0.384</td>
<td>41.52</td>
<td>1.109</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>BURT *</td>
<td>Cook Islands</td>
<td>-0.298</td>
<td>0.599</td>
<td>63.42</td>
<td>1.98</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>BURT *</td>
<td>New Zealand</td>
<td>-0.591</td>
<td>1.898</td>
<td>127.43</td>
<td>1.110</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>RAVEN</td>
<td>Cook Islands</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RAVEN</td>
<td>New Zealand</td>
<td>0.000</td>
<td>-0.431</td>
<td>26.982</td>
<td>1.118</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>STICK</td>
<td>Cook Islands</td>
<td>-0.727</td>
<td>0.603</td>
<td>14.152</td>
<td>1.104</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>STICK</td>
<td>New Zealand</td>
<td>-0.662</td>
<td>0.826</td>
<td>53.165</td>
<td>1.118</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>BLOCK</td>
<td>Cook Islands</td>
<td>0.000</td>
<td>0.346</td>
<td>16.008</td>
<td>1.118</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>BLOCK</td>
<td>New Zealand</td>
<td>0.000</td>
<td>0.364</td>
<td>17.998</td>
<td>1.118</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>COCONUT</td>
<td>Cook Islands</td>
<td>0.000</td>
<td>0.467</td>
<td>32.889</td>
<td>1.118</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>COCONUT</td>
<td>New Zealand</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Log₁₀ of Test Score

7  DISCRIMINANT FUNCTION ANALYSIS

The Discriminant Analysis used was the BMD05M (Dixon, 1976). This program gives a Generalised Mahalanobis D-square which is distributed and can be interpreted as a Chi-square with the appropriate degrees of freedom to test the hypothesis that the mean values are the same for both groups. A classification summary table is provided and also posterior probabilities of group membership for each case.

Three Discriminant Analyses were carried out as follows:
(1) **Block Score Less Than 400**

An examination of the scatter plot of the Block scores indicated that there may be two distinct clusters (Fig. 4-11), the people scoring less than 400 constituting a separate group from the remainder. The Discriminant Analysis was not significant.

\[ \text{D-Square } = 6.916, \ 4 \text{ df, } p > .05 \text{ NS} \]

That is, the Discriminant Analysis does not support the indication that there are two distinct clusters.

(2) **Copy Score Not Equal To Eight**

It was felt that those children who are unable to copy asymmetric shapes may have difficulty with other tests, particularly those involving reading or writing. All those Cook Island children with Copy scores of less than eight were considered to be one group and compared to the second group who had Copy scores of eight.

The Discriminant Analysis shows that the two groups can be statistically partitioned. The implications of this will be discussed later.

The partitioning yielded a

\[ \text{D-Square } = 21.73, \ 5 \text{ df, } p < .001 \]

(3) **Cook Islanders Versus New Zealanders**

As was expected there was a highly significant difference between the two race groups.

The obtained
D-Square = 153.8, 5 df, p < .001

It was noted while studying the posterior probabilities of group membership for each case that for the New Zealand sample those cases that were considered misclassified, were about evenly spread across each age group but that for the Cook Islanders most of those that were considered misclassified, were in the 12 and 13 year age group. This suggests, as do the graphs of Mean Score by Age by Race and the t-tests that the older Cook Island children tend, in terms of their profiles of test scores, to look more like New Zealand children.

A summary of the misclassified cases is presented (Table 4-16).

<table>
<thead>
<tr>
<th>Age</th>
<th>Cook Islands</th>
<th>New Zealand</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>28</td>
</tr>
</tbody>
</table>
To ascertain if there were sex differences, t-tests (independent samples) were carried out for the ACER, Burt, Stick, Copy and Block tests for both the Cook Islanders and the New Zealanders. The only t-test to show a significant sex difference was the Block test (for New Zealanders), the females performing significantly worse on this test (Table 4-18).

Table 4-17  COOK ISLANDS SEX DIFFERENCES

<table>
<thead>
<tr>
<th>Test</th>
<th>ACER</th>
<th>Burt</th>
<th>Stick</th>
<th>Copy</th>
<th>Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \bar{X} )</td>
<td>11.03</td>
<td>37.58</td>
<td>34.29</td>
<td>7.56</td>
<td>584.33</td>
</tr>
<tr>
<td>S.D.</td>
<td>8.90</td>
<td>20.46</td>
<td>5.42</td>
<td>1.03</td>
<td>174.85</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \bar{X} )</td>
<td>8.72</td>
<td>33.53</td>
<td>35.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.D.</td>
<td>7.62</td>
<td>24.95</td>
<td>5.49</td>
<td>0.90</td>
<td>208.78</td>
</tr>
<tr>
<td>t</td>
<td>1.52</td>
<td>0.97</td>
<td>1.16</td>
<td>0.37</td>
<td>0.87</td>
</tr>
<tr>
<td>p</td>
<td>&gt;.05 NS</td>
<td>&gt;.05 NS</td>
<td>&gt;.05 NS</td>
<td>&gt;.05 NS</td>
<td>&gt;.05 NS</td>
</tr>
<tr>
<td>Test</td>
<td>ACER</td>
<td>Burt</td>
<td>Stick</td>
<td>Copy</td>
<td>Block</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>------</td>
<td>-------</td>
<td>------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\bar{X}$</td>
<td>20.59</td>
<td>67.18</td>
<td>37.93</td>
<td>7.98</td>
<td>554.70</td>
</tr>
<tr>
<td>SD</td>
<td>10.11</td>
<td>22.63</td>
<td>5.24</td>
<td>0.12</td>
<td>154.21</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\bar{X}$</td>
<td>21.26</td>
<td>72.10</td>
<td>39.09</td>
<td>7.96</td>
<td>671.99</td>
</tr>
<tr>
<td>S.D.</td>
<td>10.04</td>
<td>20.81</td>
<td>4.80</td>
<td>0.25</td>
<td>103.74</td>
</tr>
<tr>
<td>t</td>
<td>0.36</td>
<td>1.23</td>
<td>1.26</td>
<td>0.45</td>
<td>4.88</td>
</tr>
<tr>
<td>p</td>
<td>$&gt;.05$ NS</td>
<td>$&gt;.05$ NS</td>
<td>$&gt;.05$ NS</td>
<td>$&gt;.05$ NS</td>
<td>$&lt;.001$</td>
</tr>
</tbody>
</table>
CHAPTER V

DISCUSSION

The results, as a whole, do not support any of the hypotheses. However, for the educational tests hypothesis "c" (Cook Island children have a different profile of test scores from New Zealand children for the younger age groups but these differences disappear in the older age groups) is given partial support. The performance tests fare better, in that hypothesis "a" (Cook Island children and New Zealand children have a similar profile of test scores for the age groups tested) is supported.

The results of the educational tests are not surprising when the fact that the younger Cook Island children know little English is taken into account. The education tests, that is the ACER and the Burt, are both tests that require a knowledge of English. Only partial support is given for the convergence of test scores hypothesis. The t-tests for the ACER indicate no significant difference for thirteen year olds. The Burt results fail to support convergence at a statistically significant level. We are left with the graphs of Mean Score by Age by Race suggesting, by visual inspection, that convergence might occur if older children had been tested.

The performance tests, that is the Stick and Block tests, on the other hand do give support to the hypothesis that there are no race differences. Some care needs to
be taken in interpreting the Stick test scores, for as already suggested these results might have been because of a ceiling effect in the test.

The notion of a 'culture fair' test needs to be considered here. The work of Cole and his associates (1971) in Cultural Anthropology suggests that it is possible to demonstrate a basic similarity in cognitive functions once the problem has been presented in a manner which takes account of the culturally determined experience of the subjects. Three-dimensional jig-saw puzzles, using blocks, may not be culturally fair in that New Zealand children have more experience with jig-saw puzzles and blocks than do Cook Island children but, in spite of this, there are no significant differences in test scores. Blocks and Coconuts appear to measure the same underlying factor of intelligence for Cook Islanders, and although New Zealanders were not given the Coconut test, there is no reason to suppose that they would have performed differently from the Cook Islanders.

The Factor Analyses do not give support to the claim of Perry (1977) that the Stick test is a measure of general intelligence. At least this test does not measure the intelligence factor that is measured by the Raven. Rather it appears to be a performance test in that it loads on the same factor as the Block test and Coconut test.

The only sex difference to emerge was in the Block test scores for New Zealanders where the females obtained
a significantly lower mean score. This is in contrast with Klippel's (1975) study in which it was found that generally Pakeha females performed at a higher level than Pakeha males and Polynesians showed the reverse pattern. A test battery, such as the Differential Aptitude tests, may show sex differences on particular tests within the battery. In the Differential Aptitude tests, boys tend to score higher than girls on Mechanical Reasoning and, to a smaller extent, Space Relations, while girls score higher than boys on Clerical Speed and Accuracy, Spelling and Language Usage (Bennett, Seashore and Wesman, 1974).

The Block test may well be measuring an aspect of the Space Relations factor.

The Discriminant Function analysis suggests that there could be a convergence of the total test profile with an increase in age. The data do not completely support this conclusion. However, this lack of support may be because of those Cook Island children with copying errors. A separate Discriminant Analysis confirmed that those children with copying errors also did poorly on the other tests. Although at the older age groups the number of these children is small, it may have been sufficient to account for the dissimilarity of the two profiles. Many of the t-tests just failed to support the hypothesis that there is a convergence of test scores with age.

The significance of the finding that Polynesians have difficulty in copying correctly is not fully clear at this stage. It may be that the children are not
sufficiently alerted to the importance of left-right orientation. The eight year olds have most difficulty with the copying task but it is at this age that they first learn to write. The left-right discrimination is difficult up until the age of about seven for Western children but Western children have a different ecological background that may sensitize them to left-right distinctions at an early age. It may be that Cook Island children are not taught the relevance of left and right, if in fact to them it has any relevance, apart from that which has been forced upon them by the Education system.

Reading failure is widespread and of great concern in Western countries. No doubt there are many causes, left-right confusion being only one of them. Retarded maturation of the cerebral cortex, because of specific diet deficiency or a general diet deficiency, is a possible explanation. A full analysis of the diet of Cook Islanders would be required to answer this question.

By the age of nine the incidence of copying errors is considerably reduced. This is consistent with the evidence that suggests that the period of most rapid improvement in left-right discrimination often appears to coincide with early instruction in reading and writing, which in Western cultures includes the teaching of response asymmetries.

At this stage these children are rapidly becoming bilingual. This does not appear to have any adverse
effect on their test score on either the educational or performance tests. The Linear Regression Analysis would show up any unusual trends here. This finding lends support to the findings of McLaughlin (1977) who concludes that there is no unequivocal evidence that bilingualism has negative consequences on intelligence, educational attainment, or cognitive functioning.

Further research is needed to disentangle the possible causes of this inability to copy. In the meantime it may be possible to gain an improvement in their performance by taking extra steps to impress upon the children having difficulty, the importance of left-right discrimination in reading and writing. Apparently the Perry Stick test is not as good a predictor of left-right confusion as is the Copy test. At this stage findings related to the Copy test are suggestions based on a small number of observations (n = 120). This should be compared with the Stick test, where a larger sample has been gathered.

Drenth (1977) has made some important general observations about educational facilities in developing countries. Many of them seem pertinent to the Cook Islands. There is a shortage of up to date equipment and materials. The number of teachers is often far too small to meet the needs of the schools. Moreover, the level of education and professional training of the teachers is often insufficient as well. There is a lack of opportunity in secondary and tertiary education.
How can any individual's chances of future school success be determined in a reliable, valid and efficient way? In answering this question Drenth makes four points:

1. School performance (preferably measured by means of achievement tests on a nationwide or at least a regional basis) should be used as a criterion for admission to the next level of schooling where an empirically demonstrated or logically plausible relationship exists between required achievements in the previous school and the learning process in the next. The scores should be used in a criterion-referenced and not in a norm-referenced manner.

2. The minimum standards and the cut-off points should be established on educational grounds rather than on the basis of supply and demand.

3. If the number of acceptable students exceeds the number that can possibly be admitted then selection should take place with the use of aptitude or ability tests that have shown a substantial correlation with the relevant criteria for future school performance.

4. Care should be taken that the tests should not be limited to those that cover too narrow a field of scholastic aptitudes.

A further question often asked is "Education for what?" (Taylor (1969), Education Specialist for the South Pacific Commission, had the following to say:

"What education has done in many areas is to create a tremendous mental conflict. Naive, unsophisticated
people have raised their level of aspiration to heights that they cannot hope to achieve in their own generations, have accepted the idea that an advanced education will solve all problems, ensure an adequate income, be a panacea for all ills - and then have been left to their own disillusionment. In many cases the education offered has been little more than a slightly modified metropolitan syllabus from a temperate climate - a syllabus designed for a particular group with specific needs - and this has been transplanted with as few modifications as possible, (so that metropolitan textbooks can be used) on to a group of people whose needs, cognitive processes, language, social structure, culture, and climate are totally different."

Taylor continues:

"There are students in one territory who can write four pages on the Religious Wars of Medieval Europe, but not four lines on their own constitution, or the life and works of some of their own historical figures. In another territory all children at secondary level followed a metropolitan secondary syllabus for the sake of the very small percentage who would finally pass the metropolitan public examination."

The people now are not naive or unsophisticated and more of them are passing the "metropolitan" examinations. The syllabus has changed, a little, to include
agriculture, manual training, culture and Maori language but still these people do not pass the exams in large numbers and those that do still find it hard to get jobs.

The present research has been an attempt to document some of the problems that exist and make tentative suggestions about the solutions. It is, however, just a beginning and much remains to be done.
ACKNOWLEDGEMENTS

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APPENDIX

BLOCK TEST