ORAL LANGUAGE AND LIFE-CYCLE CONCEPTS OF GRADE FOUR
ENGLISH PRIMARY LANGUAGE AND ENGLISH
SECOND LANGUAGE STUDENTS

by

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B.Sc. Hon., University of Toronto, 1974

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS

in

THE FACULTY OF GRADUATE STUDIES
Department of Science Education

We accept this thesis as conforming
to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA
August, 1978
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ABSTRACT

ORAL LANGUAGE AND LIFE-CYCLE CONCEPTS OF GRADE FOUR
ENGLISH PRIMARY LANGUAGE AND ENGLISH SECOND
LANGUAGE STUDENTS

This clinical study aimed at exploring the following issues:

1) whether English Primary Language and English Second Language students have similar ideas on the Life-Cycle of the Mealworm Beetle;

2) which words and phrases these two groups use to convey key aspects of that Life-Cycle;

3) to what extent does the type and frequency of words and phrases used, vary with the student's ability to communicate orally in English.

Two Interview Conditions were used, the Verbal Condition and the Verbal Manipulative Condition.

Results indicated that the ideas of students fell into four patterns regardless of whether subjects were English Second Language or English Primary Language. A list of words and phrases used by the subject has been identified, according to the language background of the sample and this list suggests that the type and frequency of nouns, verbs, adjectives and adverbs varied according to the language sub-group (ESL/EPL) and Interview Condition (Verbal/Verbal Manipulative).

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ACKNOWLEDGEMENT

I wish to express my gratitude to my adviser Professor G.H. Cannon especially for the tremendous interest, encouragement, support and guidance he has offered me from the beginning, and to the members of my committee Dr. B. Carlisle and Dr. G. Erickson for the assistance, time and cooperation they so willingly invested in my project.

I would like to say special words of appreciation to the principals, teachers and students who participated so freely in this study, to Carmen for the fantastic job of typing she was able to do in the short time available, to Barbara for her technical assistance. To my many friends such as Jan, Adam, José, Dennis, Bruce who gave of their time and expertise, sincere thanks.

Without the continuing moral support of David and Nikki, I could not have done this. Thank You.
Financial support for this study was provided through Discretionary Grant No. 225 - Educational Research Institute of British Columbia.
CHAPTER ONE

NATURE OF THE STUDY

THE GENERAL PROBLEM

The much-discussed problem of how language and thought are related has gained considerable attention in recent times. This has been so especially since the contributions of Jean Piaget and Lev Vygotsky have been publicised. Despite the large number of studies generated as a result of the Piagetian perspective on language and cognitive development in children, many aspects of the precise way that language and thought affect each other remain indistinct, and need further clarification and exploration. This is probably because of the intricate nature of the problem itself.

Traditionally, educators have shown great concern with the language-thought controversy particularly as it applied to the teaching of elementary school children. Understanding the mechanism by which a child makes sense of his world provides a channel through which the child may be helped to acquire through experience those cognitive structures which he lacks.
To know a thing, Piaget (1964) says, is to act on it. This statement implies that thought has an essential operative component. However it follows that such personal knowledge and understanding has to be symbolised to be communicated. Therefore the precise nature of interaction between the operative function and the symbolic function should deserve considerable attention. This study intends to focus in on the way in which the mental operations of thought are related to the oral language of expression. In order for such an abstruse question to have applicability in the educational context, the investigator needs to explore the setting, employ the tools available to educators, and confront educational issues.

1.1 Primary Intent of the Study

The primary aim of this study is to elicit the ideas on Insect Life-Cycles, in particular that of Tenebrio molitor (the Mealworm Beetle), held by elementary school children, in order to analyse the oral language of those students who express their understanding of these scientific concepts using English as a Primary Language, and those who use English as a Second Language. It is likely that such results would lead to conjectures or inferences on the degree to which use of oral language facilitates or impedes cognitive processes in the elementary school student. Such findings may be of special
specific interest to those involved in science education of immigrant children.

**Specific Problem for Investigation**

More specifically, the following issues will be investigated:

1) Do students who employ English as a Primary Language (EPL) and those who use English as a Second Language (ESL) have similar notions on the Life Cycle of the Mealworm Beetle.

2) Which words and phrases do these two groups of students use for conveying key aspects of the Life Cycle such as physical identity, size, duration of events.

3) To what extent does the type and frequency of words and phrases used to delineate these various aspects, vary with the student's native ability to communicate orally in English?

4) To what extent does the type and frequency of these concept-related words and expressions vary depending on the context, that is, whether during the interview the individual is allowed to interact with live specimens or not.

5) To what extent are the two language groups able to employ meaningful scientifically acceptable vocabulary to convey their ideas.

**The Need for the Study**

About thirty percent of the elementary school population in British Columbia consists of students who use English as a Second Language at their schools. Meeting the linguistic needs of these students is a demanding task for educators. In many of the elementary schools
in B.C. students learning English as a Second Language receive specialist help on an individual or small-group basis. This necessitates their withdrawal from the regular classroom for a considerable part of the day. It is commonly assumed that such specialist attention would best meet their requirements as far as language is concerned. However this system has certain drawbacks. Hester and Wight (1977) contend that taking these students away from the classroom for specialist assistance elsewhere causes them to be drawn away from "those English speakers that provide their most powerful models, i.e. their peer-groups". The situation is further complicated for them by the obvious expectation of their parents and teachers, that they engage themselves in learning - not just learning language. This means that the intellectual and cognitive growth of these children should also be a prime concern of any programs designed for them.

Considerable time and effort is devoted by teachers in elementary school in helping children acquire scientific concepts as these provide the necessary foundation for understanding more complicated principles in later life. It is expected that the teacher would use the available materials appropriately and present her ideas verbally in such a manner that students can receive, understand and apply that information.
Complex conceptual schemes such as "Life Cycles" are introduced to students in B.C. as early as the second year in school. By the fifth year of elementary school the prescribed curriculum implies that the student should have already developed an intuitive appreciation for the continuity of the growth process, and a recognition that the identity of a living organism remains constant through time despite changes in its physical appearance. As is the case for science achievement in this area, acquisition of these concepts is generally measured by teachers in terms of the degree to which the student can meaningfully reproduce scientific terminology after assimilating precisely the concept conveyed by the term.

Several research findings (McCabe, 1977; Smith, 1970; Tatham, 1970; Williams, 1968) indicate that elementary school students are able to perform better when instruction is provided using materials that match their own oral language patterns. A study such as this should provide guidelines for elementary science teachers for devising more effective ways of using their own language of instruction to match the level of oral English usage of their students. Such information might provide some insight as to the extent to which oral communication is a handicap or facilitator of scientific concept formation.
Definitions

At this point it will be necessary to clarify some of the terms that appear and reappear throughout this discussion:

"Second Language": The word "second" as used in "second language" appears more frequently in the literature than the term "foreign" to indicate a language that is "second-learnt" as opposed to one that is "first-learnt". As used in this discussion, the first language is the "mother-tongue" and usually represents the primary medium of communication of the mature person or, the language most frequently used at home by the young child. The term "second language" will refer to a non-fluent speaker of the language dominant outside of the home (at school or at work). One can distinguish then between a "foreign language" and a "second language" on the basis of the user's motive and attitude. A foreign language may be used to gain an understanding of the culture of another community. A second language is more frequently used to relate to the needs of the user himself. The latter is used simply as another medium for expressing individual customs and culture in another milieu. For effective use of the second language the attitude of the user would probably need to be active and creative.
Bilingual:

This term is quite complex. To be classed as 'bilingual', a person must normally have some minimal ability to use two different languages. Bloomfield (1935, in Christopherson, 1973, p. 56) defines personal bilingualism as "native-like control of two languages". The precise meaning of 'native-like' in this case is not evident. Its meaning may fluctuate from "some exposure" to a "maximum degree of proficiency". Haugen (1956) takes the opposite view and characterises as bilingual, individuals possessing at least minimal facility with two different languages. Lambert (Lambert, Havelka and Gardner, 1959) has clarified the picture somewhat by introducing the term "balanced bilingual". This is intended to describe individuals who appear "fully competent in both languages". Bilingualism is best considered as a continuum rather than an all-or-none property. Throughout this study the term 'bilingual' will refer to an individual who uses two different languages habitually with a high level of fluency and proficiency in both. This is in direct opposition to a second-language user who has habitual but non-fluent use of another language.

Concept:

This refers to a system of knowledge about events in the world of the individual. The organization of a
concept usually changes with time and experience.

Vygotsky's (1962) definition is noteworthy and somewhat controversial:

> a concept is a complex genuine act of thought that cannot be taught by drilling but can be accomplished only when the child's mental development has reached the requisite level (p.82).

Klausmeier et al (1974) use the word "concept" to denote the mental constructs of an individual. In another sense (Klausmeier et al, 1976) it is used to represent "ordered information about the properties of one or more things - objects". The term "concept" when used in this paper refers to an organized body of knowledge, intuited by the individual on a particular topic, e.g. the concept of time, the concept of size.

Summary

In this chapter the author has presented the specific intent of the study and attempted to justify its relevance by placing it in the "broader picture". Because this investigation appears to be more exploratory than conclusive in nature, it is likely to raise more provoking issues than those for which it will prescribe definitive solutions.
NOTES FOR CHAPTER ONE

1. The term "concept-related" refers to words used by subjects that clearly specify characteristic aspects of the concept. Words such as "beetle-baby" and "larva" are considered concept-related. There were two contexts used in this study:

1) Verbal Condition - in which the subject had a fairly unstructured discussion with the Experimenter. No specimens, pictures or other materials were available for the subject's use.

2) Verbal Manipulative Condition - in which the subject had access to, and freely manipulated, live specimens while responding orally to the Interviewer.

2. "Scientifically acceptable" words are terms that appear frequently in texts or are used by teachers to describe Life Cycles. Examples of these are such words as "larva", "pupa", "adult", "life-cycle". On the other hand words such as "beetle-baby" are not usually considered by teachers as "scientifically acceptable".

3. Elementary Science, Teachers Curriculum Interim Guide 1977, produced by Curriculum Development Branch, Ministry of Education British Columbia, p.14 indicates that the following topics are dispersed throughout the curriculum in the following manner:

Year 1 - Animals in the classroom
Year 2 - Brine Shrimp, Life of Beans and Peas
Year 3 - Seeds and Seedlings
Year 4 - Eggs and Tadpoles, starting from Seeds
Year 5 - Mosquitoes

Subsumed in all these topics are ideas of Life Cycles. Refer to programs in use for treatment:

STEM Science - Addison-Wesley
Exploring Science - Laidlaw (Doubleday)
Elementary Science Study - Materials Based Units
Teaching Primary Science.
4. The word "concept" has been extensively defined in the literature on that subject. A clear relevant summary may be read in Nelson's (1974) article entitled: "Concept, Word and Sentence: Interrelations in Acquisition and Development".
CHAPTER TWO

THEORETICAL BACKGROUND

INTRODUCTION:

The general question of children's oral language production in response to a conceptual task or problem, with which this study is concerned, belongs generally speaking to the realm of language development. It pertains especially to the relationship between linguistic and non-linguistic factors in development of language. This question of the relative influence of the one on the other falls within the domain of that thorny issue which has been traditionally encountered in the literature as the relationship between language and thought. There is a large number of well-conducted research studies on this topic and so, it will be necessary to be quite selective in the research reviewed here. The first part of this chapter will refer to the work done in the general area of understanding, thinking and speaking in young children. Then some of the more classical research, such as that of Vygotsky and Piaget, will be reviewed, in addition to some of the more recent studies on the topic. The rest of the chapter
will be concerned with a synthesis of the literature on bilingualism and cognition that pertains to education.

The specific problem does draw somewhat from theories of language acquisition and development of the syntactic, semantic and pragmatic features of child language. However, it will not be considered practicable to provide here any extensive discourse on the processes that contribute to language development.

**Understanding and Oral Communication**

The relationship between understanding, talking and thinking has been barely investigated in the literature. More attention has been given to what language children produce than the processes underlying why and how this occurs. However this problem may be essentially a methodological one since neither thinking nor understanding are directly observable without speech - with which neither is synonymous.

Bloom and Lahey (1978) propose the hypothesis that understanding and speaking represent mutually dependent but different underlying processes, with a resulting shifting influence between them in the course of language development (p.238).

There is some degree of similarity between the understanding - speaking dilemma and the perception-production
problem. Some of the arguments presented to explain the latter have been (1) factors affecting recognition and recall (Mandler, 1967) (2) the particular knowledge of attributes needed for reproduction and not necessarily for recognition (Maccoby & Bee, 1965), and (3) the need to conjure up mentally the appropriate image as a basis for reproduction (Piaget & Inhelder, 1971). These arguments may also be useful in interpreting the development of the relationship between understanding, thinking and talking.

Piaget and Inhelder (1971) have claimed that making an utterance involves for the child the mental construction of a "symbolic image". It is not clear how these mental images relate to what the child hears or says. It would appear that the relative difficulty between speaking and understanding relies on the manner in which the child interacts with the context of the task presented. On the other hand, Bloom & Lahey (1978) suggest that the mental image which precedes the utterance is probably less difficult cognitively than the perceptual schema needed to receive and interpret what is heard. These latter researchers propose that at least three factors affect the understanding and production of language:

There is first of all, the child's immediate consciousness - what the child thinks about when in the process of perceiving an utterance or producing an utterance ... The second
component that contributes to the meaning of messages - the child's memory or conceptual information about the world... Finally the child needs to know some scheme for linguistic processing.... in order to process linguistic forms to extract meaning from messages, and to use linguistic forms to represent information in messages (p.254).

It would be interesting to present more about the factors that contribute to understanding and producing messages and how these relate to both linguistic and cognitive development - but such a lengthy discussion would not be pertinent to this study.

Influence of Language Development on Cognition

The theories proposed to explain interaction between language and cognition generally fall into two categories, those that envisage the child as a passive recipient of environmental change and those that ascribe to the child an active role in the process of shaping cognition through language.

J.B. Watson with whom the psychological school of behavioristic thought originated declared that thought was a form of subvocal speech (Smith et al. 1947) and so he attempted to detect slight movements of the larynx with sophisticated equipment. However, it is not necessary to resort to such complicated experimental technique to support the contention that all thought could not be dependent on language. It is common knowledge that the deaf are capable of extensive thought
processes.

Studies With The Deaf

Youniss and Furth (1965) compared deaf and hearing subjects on the basis of their ability to solve conceptual tasks involving transitivity. Even when a perceptual component was added to these tasks, the investigators found that deaf children performed the task as well as those children who could hear. This evidence may be interpreted to suggest that the concept of transitivity is acquired independently of language. A variety of other conceptual tasks has been presented to deaf subjects (Furth, 1964; Kates, Kates, Michael and Walsh, 1961; Piaget and Inhelder, 1959, 1969). All these studies provide strong support for the fact that deaf and hearing children perform just as well on concept formation tasks, though there is a considerable developmental lag evident in the case of the deaf. This developmental deficit however, is not necessarily a stable one, since external factors such as training and academic instruction are likely to have significant effect in promoting concept formation.

Linguistic Relativity

The idea that culture and language are closely interrelated is not new on the academic scene. It has been investigated under various titles. Olmsted (1950) refers to
"ethnolinguistics" whereas Hymes (1964) discusses "anthropological linguistics". Both refer to the same issue.

The famous Whorfian thesis of linguistic relativity has aroused considerable controversy because it departed significantly from the traditional behaviorific approach. Although it has been ascribed to Sapir and Whorf it appears to draw from the philosophy of Neo-Humboldtians of Europe, such as Ernst Cassirer (Diebold, 1965, p.260). The Whorfian viewpoint (Whorf, 1956) is that the language of a culture sets limits on the perceptions and conceptions of a linguistic community. Therefore, if the speaker of one language has a linguistic category of objects available in his language, which no other language community has, these objects are likely to be viewed differently. This thesis has considerable implications for those who speculate on the effects of bilingualism and multilingualism on cognition. As indicated by Haugen (1956) and Alatis (1970), it seems true for some bilinguals that a person's perception of the world varies with the language that person speaks. Fearing (1954) thinks that this strong form of the Whorf hypothesis tends to overemphasise the way in which language shapes thought and neglects the prominent role of thought in shaping language.

Whorf (1956) has also postulated a causal relationship between language and cognitive structure. Picture a
child who has to learn to discriminate between the colours "red" and "green". The red blocks which he has are used to build barns, the green blocks to build houses. The child is unable to place the blocks correctly unless visual discrimination is involved. In building barns and houses this child is learning to perceive colour for "green" represents a category. More importantly, the colour words are being used as symbols in a particular frame of reference. Therefore language can cause cognitive structure for it deals with experience by categorising experience.

Roger Brown (1958) opposes the strong form of the Whorf-Sapir hypothesis that language determines thought. He has suggested a weaker form of that hypothesis. This intimates that language does provide a certain predisposition to modes of thinking. Various experimental studies lend support to Brown's contention (Brown & Lenneberg, 1954, 1958; Lantz & Stefflre, 1964). Brown (1976) himself remarks:

The fascinating irony of this research is that it began in a spirit of strong relativism and linguistic determinism and has come to a position of cultural universalism and linguistic insignificance.

Referential Function of Language

The problem of "reference" referred to previously, that is, the relationship between "word" and "object", 

and its role in cognition has not come about recently. Otto Marx (1967) has indicated that early Greek philosophers were just as concerned as present-day researchers with the "naming" aspect of language.

One of the earliest experimental investigations into the nature of the word-object relationship has been done by Lenneberg (1967). He attempted to identify the "behaviour" of words by using the colour space which he defined as the entire universe of colour possible. Thus he was able to look at the way in which colour words of any particular language mapped onto this colour space. Many other experiments involving colour naming and cognition have also been conducted (Lantz & Stefflre, 1964; Beilin & Kay, 1969).

These results indicate that identical perceptions of colour can be placed in different categories depending on the language of the perceiver. Languages vary in their expression of aspects of colour such as hue, brightness and even spectrum. For e.g. both English and French have words for colour perceived as "brown" (F. brun). But, in French the words "brown paper" (gris) and "brown bread" (cassonade) have separate descriptive labels from other brown objects. This suggests that they are not really perceived as being "brown" (Fox, 1973) and so it would appear that the way a referent is communicated in a language community is closely related to the way that
community perceives and conceives of that referent.

Olson (1970) has an alternative explanation for the function of reference in language use. He claims that the choice of words that a speaker makes does not result from linguistic and semantic restrictions but from the knowledge that the speaker has of those referents. A single word may be symbolised by many referents (Olson, 1970, p.258). A word is not only part of a referent. The relation between the word and the object has to be more complex than mere labelling. Meaning (reference) mediates between word, sign, percept, code and the object, event or referent. This is in accord with the Ogden & Richards' (1923) conception of the relation between words and referents.

If words do not merely name things, or name referents, then "there's more information in an utterance than in the perception of an event out of context" (Olson, 1970, p.265). The speaker expresses what is perceptual for him. For the listener, this is received as information about the referent and its set of alternatives. For example, a child hearing the teacher utter the following sentence: "A quadrilateral is a four-sided figure" knows from that sentence what a quadrilateral is and what a quadrilateral is not. The knowledge of the word "quadrilateral" and its meaning become clearly identified according to its "four-sidedness". This has significant implications for concept teaching in science.
Nelson (1973) expands the notion of reference further by making a clear distinction between words in the presyntax vocabularies of children that do and do not refer to objects. She categorises words into "referential" words and "expressive" words. The former are generally nouns and the latter all other words used. Although this is an interesting finding Bloom and Lahey (1978) express difficulty in interpreting this finding definitively on account of the nature of Nelson's research design. Maybe Nelson's study has value in so far as it indicates that children do not use referential words exclusively in oral communication.

Verbal Mediation of Thought

The importance of language in shaping thought through a mediating function has received much attention from psychologists who ascribe to the passive stimulus-response model of behaviour (Kendler, 1963; Spiker, 1963). Flores (1966) has described a mediator as being regularly defined in terms of generative intermediary responses to stimulations which set off an observable response through associative pathways p.5).

According to Flavell (1966, cited in Oleron, 1977, p.53) who has conducted studies on verbal mediation "the use of mediation appears to be a strategy employed by a subject to solve the problem presented". If necessary "thinking"
can be substituted for "mediation".

Bryant (1967) has done similar experiments with mentally retarded children who are normally considered handicapped in the number of verbal connections they can make spontaneously. He found that, when forced to verbalize, these subjects exhibited no significant difference in performance on recognition experiments from that of normal subjects. These results, Cromer (1976) contends, may not necessarily accrue from the mediating properties of verbalization. They may result solely on account of the attention-focussing property of the verbal labels used. In any event, this study and others like it may be interpreted to mean that verbalization and language facilitate performance on certain tasks.

**Vygotsky's Perspective**

Vygotsky's ideas on concepts and language reflect his discontent with stimulus-response theory as a basis for experimental work in cognition. Vygotsky (1962) examined concept development through the process of mediation and then made the observation that children "explain" the names of objects by their attributes. Any switch in names necessitates a corresponding exchange in the characteristic feature of the object embedded in the child's mind. Thus "the structure of speech does not mirror conceptual thought, and grammar precedes logic".
Phillips (1977) claims that the stages of development of concepts used by Vygotsky have been borrowed in part from Piaget and Claparède; and bear a remarkable resemblance to Inhelder's recent description of these. According to Vygotsky (1962), the process of concept formation begins for the child when he has to group a number of objects in order to solve a problem which the adult mind will encounter by forming a new concept. The child regroups his knowledge by a process of trial and error, "mistaking" his subjective interpretations for real connections. This results in his syncretic thought. This syncretism allows the child to cast aside later his supposed ignorance, and group things according to the bonds that actually exist. Therefore word meanings constantly change with the child's development and his ability to generalize.

At a time when behaviorists were presenting their experimental framework for viewing concept development, Vygotsky's theory provided a viable and controversial alternative.

Concept formation is a process in which all elementary mental functions participate in specific combinations. The development is furthered and guided by the use of words as the means of actively centering attention, of abstracting certain traits, synthesising them, and symbolising them by a sign (Phillips, 1977, p.38).
Vygotsky's theory has tremendous implications for this study since it provides a firm rationale for studying the development of scientific concepts and uncovering the relationship between instruction language and the development of scientific concepts.

Influence of Cognition on Language

Piaget's Perspective

Piaget's work in this area is well-known. In this section some of the aspects of his work which pertain directly to this investigation will be outlined. In his theory of language and thought in the child as expressed in his book by the same name, Piaget (1924) makes the basic assumption that there is a direct link between language and thought which is not thought to be independent of language. Its equivalent is verbal thought. Later on in 1963, Piaget expresses his position on language and thought more clearly:

"Language is....a necessary but not sufficient condition for the construction of logical operations (Piaget, 1964, p.113)

In order to support his opinion that language is not a sufficient condition he asserts that language is inadequate for transmission of complete operational structures (Piaget, 1963, p.58). By analysing the intellectual functioning of children he has hypothesised that operational thought develops from activity and thus influences language
development:

"The structures (of thought) are rooted in action and in sensori-motor mechanisms more basic than linguistic functioning (p. 112).

However, as the thought structures become elaborated, elaboration of language also becomes necessary.

Language is a necessary condition for formal operational thought as these structures are not solely "rooted in action". For the complicated propositional operations of formal logic, language is required.

More recent work (Ferreiro, 1971; Sinclair de Zwart, 1967) done at Geneva have prompted Piaget to further refine his perspective on language and thought. In the preface to Ferreiro's work he says that verbal output is dependent upon operations:

In this case, operations would assume an active but external role in linguistic progress... genuinely linguistic transformations are only reflections of the logical structures which produced them (Ferreiro, 1971).

Oléron (1977) in reviewing Piaget's contribution in this respect affirms that throughout his work Piaget has provided a number of arguments which discard the necessity of language for cognitive development. His initial position on the necessity of language for thought must have been a "straw man".
First Language Acquisition and Cognition

The early grammars of children learning different languages are quite similar. Chomsky (1965) has proposed the existence of deep structural language universals. McNeill (1966) contends that there is a "language acquisition device" functioning in child language development. These statements lend considerable support to the hypothesis that development of language in the human is innate.

Piaget (Ginsburg and Oppen, 1969) has proposed another dimension along which language might develop, that is, the development of symbolic function. On the basis of his observations of child play and imitation he has suggested the following three stages:

1) A pre-symbolic stage.
2) A symbolic stage: the child uses symbols which have only personal significance.
3) A further stage in which signs are used. These symbols are arbitrary but they may be used by the child to denote what they really signify.

Thus language is envisaged as the development of an external agent in the child's developing thought that is able to serve his own needs by converting his own symbols into societal meanings. This suggests that unless teachers begin with the child's own structure the teacher's adult language is likely to cause confusion to the child leading him to verbalise a concept which he does not really understand.
Vygotsky's (1962) view of first language acquisition challenges the validity of the last statement for he alludes that words have some general vague meaning for children even before they can speak. Language helps sculpt their thought and so, presenting concepts in the adult way should assist the child's spontaneous concepts to become organized in an adult logical fashion. It appears that teachers should be careful about use of their own language structure in the classroom since they may be inadvertently fostering misconceptions or postponing concept acquisition.

Meaning and Cognition

Determination of word meaning or reference is a particularly difficult task for a young child. Piaget (1959) suggests that language is only one of the many systems developing in the young child. It is neither a tool of thought (Vygotsky, 1962) nor a sculptor of perception (Whorf, 1956). Language development follows cognitive development. This causes one to reflect on whether there would be any special consequences for the developing child who attempts to function in more than one language. Ben Zeev (1972) agrees that for the bilingual child the conceptual conflict which Piaget says acts as a trigger to the process of accommodation is increased, and so cognitive development may be enhanced.
For the child just learning to function in another language, the second language being a highly structured system of symbols, language development and development of appropriate new cognitive structures may not be synchronous. Taylor (1974) predicts that it would be easier to learn a second language together with the first than later on. This is because it is difficult, she claims, "to differentiate an already developed cognitive network into two relatively distinct ones since new labels and syntactic processes would have to be built into the network where perfectly satisfactory ones already exist" (Taylor, 1974, p.119). Thus young children acquiring their first language will be expected to have less difficulty acquiring a second language than those who have already mastered the first. Taylor is here referring to preschoolers. This theory may have far-reaching implications but more research is needed to determine whether it holds true for older children, or whether some concepts are learned more easily than others, and the conditions under which this learning may occur.

Second Language Acquisition and Cognition

Recent studies in the area of first language acquisition (Brown, 1973; Cazden, 1972; Slobin, 1971) have prompted a rethinking of theories of second language
acquisition. Hatch and Wagner-Gough (1975) have shown that the second language learner patterns are basically similar in natural situations to that of first language development. Ervin-Tripp (1974) found that children over-generalised in French as a second language in much the same way as they did in their first language, English. Dulay and Burt (1972; 1974) detected in their work with Chinese-speaking and Spanish-speaking children that both groups when exposed to speech of their English-speaking peers, acquired the same "words" in the same order. This finding implies universal language processing strategies. Wode (1976) suggested that uniformity of strategy is likely if second language acquisition proceeds according to specific principles. However he has not specified the nature of these principles or their interaction.

BILINGUALISM

Bilingualism and Cognition

Researchers have been investigating the influence of bilingualism on cognition since the beginning of this century. Early studies sought to determine whether or not bilingualism affected performance on standardised tests of general mental ability. Lambert (1977) reports that the majority of these older studies indicated that intelligence was adversely affected by the presence of
bilingualism. Bilingual students were reported as being slow at school and socially insecure. Lambert himself (p.15) has questioned the reliability of such findings on the basis of their lack of adequately rigorous controls.

His own work, done more recently (Lambert & Anisfield, 1969) has produced surprising results which suggest that bilinguals have a "more diversified structure of intelligence, as measured, and more flexibility in thought" (p.16). A number of well-conducted research studies done later on (Ben Zeev, 1972; Gowan; Ianco-Worrall, 1972; Torrance; Wu & Aliotti, 1970) offer strong support to Lambert's contention that bilingualism enhances flexibility of thought.

It is important to note that in all of the above cases, bilingualism refers to what Lambert (1977) calls, the "additive" form of bilingualism in which a "second socially relevant language is added to one's repertory of skills" ...such as, French being added to English for English-speaking Canadian children. These results then may not necessarily apply to the more "subtractive" form of bilingualism in which an ethnic minority group is subtly prompted to relinquish their first language through social pressures or national educational policy.
The Non-Fluent Bilingual

Segalowitz and Gatbonton (1977) define the non-fluent bilingual as

the second-language user who possesses sufficient skill with a language for successful basic communication but who nevertheless is perceived by others and by himself as not possessing nativelike control of the language (p.77).

Their work with second-language users has direct bearing on this study.

Following on studies done by others (Gumperz, 1972; Hymes, 1971; Labov, 1970) with monolinguals, Segalowitz and Gatbonton decided to investigate the speech patterns of second-language users with varying levels of proficiency. They hoped to determine whether a population of second-language users did "constitute the shared code of a speech community". They hypothesised that the number and variability of nonnativelike elements and structures in the speech of non-fluent bilinguals would depend on how much skill they possessed with the second language.

By looking at "correct" versus "incorrect" pronunciation of language sounds, they were able to:

"describe some of the speech patterns of a second-language-using population in a way that includes the speech of all members of that group regardless of their level of proficiency"

(Segalowitz & Gatbonton, 1977, p.82).
What is of consequence for this discussion is that they were able to relate linguistic variation to language development systematically. They used for their studies a sample of French-Canadian males who spoke English. Replication of their study with bilingual populations varying in language and cultural background may lead to further clarification of second-language acquisition and its relationship to cognition.

Bilingualism and Education

More and more children in immigrant populations throughout the world are being educated in second and even third languages. Consequently, it has become necessary for administrators and educators to continually reconsider policy on the role of language in education. Furthermore, the common-sense view that language of instruction plays a valuable role in education, and the close relationship perceived between verbal function and measured intelligence, suggests that issues of bilingualism should be of great concern to educators in elementary schools.

A recent assessment of English Language Arts in British Columbia has indicated that:

dramatic shifts in performance also accompanied changes in variables concerned with place of birth (Canadian/non Canadian) and language spoken at home (Evanechko et al., 1976, p.16).
Students who performed best on assessment tests were those born in Canada who spoke English at home. Those who were English-speaking but not Canadians by birth were next best. Those students who were not born in Canada who spoke a language other than English at home, scored "significantly lower than average for the Province". However, the longer such students had lived in Canada the better their scores appeared to be.

Such results tend to indicate that students who speak English as a Second Language need special assistance in order to understand and acquire those scientific concepts, principles and problems encountered at school in a native English-speaking milieu. The problem of providing special academic assistance for these children at school is a crucial one for curriculum developers and teachers especially.

Summary

The studies reviewed in this chapter have been selected to provide the general theoretical framework of this study. They should help clarify this theoretical position with respect to the possibilities it provides for investigation of the specific problem in its educational context. In laying a foundation for the intended problem the opinions and studies of many researchers have been presented in this chapter with emphasis on the
following points of interest.

1) The crucial role played in early environment in language development and cognitive development.

2) The interrelatedness of cognitive processes with language processes.

3) The necessity of verbalisation in concept development.

4) The significance of the naming process in oral language.

5) The use of the child's words as a valid index of language and concept development.

6) The effect of bilingualism on intellectual growth.
CHAPTER THREE

METHODS OF COLLECTING AND TREATING DATA

INTRODUCTION

The intent of this study is to collect ideas that Grade Four English Language and English Second Language Users have about the Life-Cycle of the Mealworm Beetle, and to analyse the oral language each group uses to express these ideas. Any study which involves a comparison of language in children, whether cross-cultural, longitudinal or otherwise necessitates setting up of a situation in which the researcher can obtain observable and measurable records of the child's ability to use oral language. This means that the setting and technique of investigation should simulate, as far as is practicable, the environment within which the child usually functions naturally and comfortably.

The chapter will be divided into two sections. In the first part there will be a summary of the stratified sampling techniques used for sample selection along with the clinical interview procedure and protocols. This will be followed by an outline of the intended manner of treating the data collected, both concept analysis and language analysis.
PREPARATION FOR DATA COLLECTION

Pilot Studies

There were two pilot investigations done so as to determine how appropriate the sample protocols were for probing the research problem. Six children of varying language background and academic ability were informally interviewed about Insect Life Cycles. As a result the content and procedure for interviewing was modified accordingly. Grade Four students were considered appropriate for the final sample and another pilot study was undertaken. This time the interviewer spoke to each of ten Grade Four students at Our Lady of Perpetual Help School. These interviews were audiotaped, transcribed and analysed. As a result, the final form of protocols and materials was assembled for the major investigation in which gross structural components of the child's oral language would be analysed, in the terms of the concepts expressed.

DATA COLLECTION

School Selection

Stratified sampling was used to obtain twenty-four students from Grade Four classes of three elementary schools in Vancouver. Britannia, Moberley and Strathcona Elementary Schools were selected mainly because each had
a significant population of English Second Language Users. Also, these schools were close enough to UBC to make transfer of materials and equipment convenient for interviews at each school during school hours.

Sample Selection

After obtaining the permission of the Vancouver School Board, the interviewer contacted the Grade Four teachers of the schools involved and arranged to select a sample from each school by testing. Part I of the Hidden Figures Test (See Appendix F) was administered by the interviewer herself to each of 162 students in Grade Four classes at the three schools. It was felt that this non-verbal group measure was appropriate since administration of it should help maintain uniformity in the chosen sample, with respect to cognitive development. Although the literature does not bear strong evidence of causation, there is some indication of correlation, in that performance on perceptual tests of this nature is closely related to level and of conceptual development (Witkin, 1975).

The completed tests were coded according to school, class, sex and language of the subject. Tests were scored allowing one point for each correct item. The total number of possible correct items was sixteen. Subjects obtaining
less than eight points were excluded from the sample.

A table of random numbers was then used to select from that group eight subjects, four with English as a Primary Language and four with English as a Second Language, from each of the three schools. This provided a final sample of twenty-four subjects, twelve English Primary Language Users and twelve English Second Language Users.

The Subjects

The final group of participants was drawn from:

1) two adjacent Grade Four classes at Britannia
2) the Open Area and one self-contained class at Moberley Elementary, and,
3) two separate classrooms at Strathcona.

These boys and girls ranged in age from nine years, five months old to eleven years, eight months of age. The three participating teachers varied in age, sex, years of teaching experience and educational philosophy.

Rigorous sampling procedures were used to ensure selection of a sample without any particularly systematic bias. However the interviewer thought it necessary that subjects possessed certain characteristics in common. It was thought that the level of English usage of the average Grade Four student in Vancouver was sufficient to ensure that participants could understand and respond to interview questions. For this reason, no "new immigrants" were included in this study.
It was important that the subjects be able to think somewhat "logically", that is, the subject should not have to rely completely on concrete operational structures. Also, none of the students should have been taught at school about the Life Cycle of the Mealworm Beetle. In this way it would be more likely that the ideas expressed during the interview would indicate to a greater extent what the students felt and thought about the topic than what they had previously learned about it. This is akin to the "tabula rasa", as it were, which the average elementary teacher encounters in her science students.

The Interview Schedule

Interviews were conducted at the three respective schools in rooms set aside from the general run of the school. Each subject was interviewed individually on two occasions. The one interview called the Verbal Condition consisted of an oral discussion between the interviewer and subject with regard to twelve questions on the Life-Cycle of the Mealworm Beetle. The other interview consisted also of an oral discussion pertaining to the same questions as before but in this case the subject could examine and manipulate the live specimens present in order to respond.

The order of interviews was randomized for the groups so as to minimize order effects. See Appendix A).
addition, to minimise effects of recall the two interview sessions for each child were conducted two weeks apart.

Both Verbal and Verbal Manipulative interviews were audio and videotaped. This was done as unobtrusively as possible by a technician, in the same room as the interviewer and the subject. It was felt that both verbal and verbal manipulative conditions were necessary as these represent the two main "educational strategies" used by science teachers in elementary school. Besides, the merit of the one strategy over the other has been the subject of considerable controversy in the literature of science teaching (Craig, 1971; Hawkins, 1965).

Interview Technique

To analyse children's language without formal standardised tests suggests setting up a comfortable informal situation in which the child is able to produce language spontaneously and this language is recorded. The problem with this approach is that an extremely large volume of data is collected but the situation or context for language use varies all the time making subsequent analysis difficult.

Another approach would be to elicit the language of the child in a particular context by questioning. This has been employed in this study because it is more practical and relevant to the nature of the research problem.
It follows, though, that other factors become crucial, namely, the type of question asked, how it is asked and the role of the person asking such questions.

The interview technique used here derives essentially from Piaget's (1969) "clinical method". However the interview itself tended to be somewhat more structured. The interviewer requested information on twelve specific aspects of the Life-Cycle of the Mealworm Beetle (See Appendix C). These questions were asked of each student in the manner and the time permitted by natural flow of conversation. It was essential that the interviewer probe each response to get at the child's reasoning process or to help focus attention on the task at hand.

The interviewer had to be careful to pose open-ended questions using the child's own words. Interviews were conducted according to the "General Guidelines for Interviews" summarised by Witz and Goodwin (1970). This meant that it was necessary to "encourage verbal output" by asking for explanations, to avoid asking questions that permitted yes-or-no answers, and to provoke "the child's own summaries and general statements" (p.2). Frequently the interviewer made short notes on the responsiveness of subjects during the interviews.

**TREATMENT OF DATA**

The data collected was transcribed and analysed in two steps. First a concept analysis was done. The purpose
TABLE 3.1

FLOW CHART OF PROCEDURES FOR ANALYSIS OF INTERVIEW DATA

Transcription of tapes

Concept Analysis:
1. Identification of Conceptual Patterns
2. Classification of Subject by Conceptual Pattern
3. Identification of Response Mode

Segmentation of transcripts

Coding of C-Units and M-Units

Identification of Key Words and Modifiers

Coding Word Count for C-Units and M-Units

Classification of words and Modifiers

Coding nouns, verbs, adjectives and adverbs in C-Units per lists of words and modifiers

List of Descriptive Inferential
Modifiers

Computer Processing using SPSS CROSSTABS

List of nouns, verbs, adjectives, and adverbs

Summary and Interpretation of Data Sheets produced by above Computer Program
of this was to identify the specific ideas and response mode of the subjects. Then the oral language content analysis was made to indicate what words each subject used to express the notions relating to the concept. These two methods of analysis will be discussed separately here.

Concept Analysis

What matters in this study is not the mere identification of the notions held by the subjects on the Life Cycle of the Mealworm Beetle. What is even more important is finding a means of uncovering the rationale which the children themselves offer for having such ideas. This information is necessary in order to present as complete a picture as possible of "their way of looking at things". It is this sort of knowledge which will constitute an effective starting-point for classroom instruction.

There have been a number of techniques proposed in the related literature for analysing interview data to extract underlying patterns of conceptualisation (Erickson, 1975). Many of these apply to developmental studies of concept formation or acquisition.

Piaget's method has aroused considerable controversy. Instead of using an explicit systematic form of analysis, he has attempted in his way, to glean, in a subjective sense the way his subjects come to think about a topic at
various stages of development. In attempting to replicate some of his work other researchers have tried to use more specific and systematic procedures for analysis (Goldsmid and Bentler, 1968; Khifong, 1971).

Other researchers (Flanders, 1970; Smith et al, 1970) have found it useful and appropriate to devise methods of segmenting a transcript conveniently on the basis of one or more definable criteria. Witz (1970) has proposed a well-elaborated methodology for analysing conceptual frameworks. However most of these methods seem to imply, as that of Piaget does, that providing the child with the language necessary to deal with the concept is sufficient to enhance its development.

It is not appropriate to the problem under investigation to treat this data in the way of Khifong or Witz. What is needed is a means of teasing out the individual idiosyncratic viewpoints of each respondent and then searching for patterns of similarity and variation in these. This sort of "post hoc" analysis draws essentially from Piaget's approach, except that, whereas his studies were mainly developmental and cross-sectional in nature, this is not the case here. This sample is assumed to be basically similar in age and overall cognitive development.

In looking at the way children in this study viewed the Life-Cycle concept and used oral language to express these views, this study is attempting also to hypothesise
the kinds of verbal thought strategies these children use. These are said (Tough, 1977) to include the "recognition of underlying principles and cause and effect relationships" (p.55). It is not enough therefore to rely exclusively on a framework for reference such as Piaget's which views language as the vehicle of symbolisation (Inhelder and Piaget, 1964). It becomes necessary to resort to a theoretical viewpoint which ascribes more meaning and function to language. For this reason, the interview data was analysed according to the system which Tough (1977) has used.

Scoring Content of Responses

A subject's response could be either correct or incorrect. It was correct if the ideas embodied in it agreed in principle with the notions prevalent in texts and frequently expressed by teachers on the topic.

For example in response to a question such as:

"Can you tell how I get eggs from young beetles", a response which indicates that "young" cannot reproduce until they are "mature" was scored correct. The following response would be scored correct.

"No [because] this stage is a baby. A baby can't have eggs. I can get eggs from [the adult]. I can leave it [the baby] and wait until they grow up and they get babies....."
Scoring Response Mode

Perhaps more important than scoring content, was the identification of the mode of reasoning used by each subject in arriving at a particular response. According to Tough (1977, pp.134-140) children's responses could fall into any of three distinct reasoning modes, namely Explanatory and Relevant, Pre-emptive, and Syncretic.

An Explanatory and Relevant response is one that recognises the problem posed, identifies a causal and dependent relationship and further provides a logical explanation that is relevant to the problem. A Pre-Emptive explanation is the sort of response in which a child provides a "non-solution" in response to a question, either because he has not recognised the problem posed, or he has used an inappropriate reasoning mode to explain the problem. A Syncretic response is the least "logical" in the adult sense. Such a response is evidently a judgement based on "dominant attributes or personal feelings". It is not explanatory in nature.

Oral Language Analysis

Since the 1930's psychologists have exhibited considerable interest in children's language. As a result, several recognised measures are available for comparison of language in different groups of children. These have included analysis of vocabulary (O'Rourke, 1974), assessing
syntactic and structural features of language for remediation (Crystal et al., 1976) and determining the mean length of utterances and frequency with which certain types of words are used by children (Hunt, 1965; Loban, 1967; Templin, 1957).

Loban (1967) began a longitudinal study in 1957 which traced the stages and growth of children's oral and written language from kindergarten through grade twelve. This study was also concerned with finding language features worthy of further study and, with developing appropriate methods of semantic and structural analysis. Loban found that in the early elementary years it was necessary for classroom and research evaluation of oral language, that the following counts be determined:

1) length of communication unit
2) average number of dependent clauses per communication unit (p.123).

His methods of analysis and treatment of data have formed the broad framework for language analysis in this study, despite a significant difference in the intent of both studies. Unlike Loban's, this study will not examine language usage in children over time. What is of consequence here is the categorisation and description of language components used to express certain scientific notions. For this purpose some of Loban's methods are appropriate.
Segmentation of Oral Language

Following the methodology of Loban (1976) two basic units of segmentation have been used here, the communication unit (later called the C-unit) and the maze unit (later called the M-unit).

The Communication Unit

This is an effective means of quantifying oral language which allows for the calculation of the average number of words per communication. Loban says that a communication unit may be defined semantically or structurally. Watts (1948) defines it as "the natural linguistic unit - a group of words which cannot be further divided without loss of their essential meaning". Loban contends that this is a difficult definition to apply because it is not clear what Watts means by "essential meaning". Hunt (1965) uses the same type of segmentation but calls it a "T-unit", which he defines structurally as "each independent clause with its modifiers".

Transcripts were segmented into C-units. As with Loban there were three instances in which a C-unit could occur:

Each independent grammatical predication.
Each answer to a question, provided that the answer lacks only the repetition of the question elements to satisfy the criterion of independent prediction.
Each word such as "yes" or "no" when given in answer to a question such as "Have you ever been sick?" (p.9).
The Maze Unit

This is defined by Loban as "a series of words (or initial parts of words), or unattached fragments which do not constitute a communication unit and are not necessary to the communication unit" (p.10). Often in trying to express an idea a speaker becomes entangled in his own words and fumbles around "meaninglessly" before making the appropriate statement. These "fumbles" are called "mazes" and have been scored as such in this study. After segmenting the transcripts into maze units and communication units, each unit was numerically coded for easy interpretation later on. (Refer Appendix E for sample). This resulted in a string of triplets further identified by the number and type of concept-related words each contained. Then it was possible to calculate the number of C-units and M-units of a subject, and the mean number of words per C-unit and M-unit. These measures would be used to indicate the level of fluency and verbal planning of a subject.

Identification of Concept-Related Words

After segmentation the transcripts were perused to detect "key" words and phrases used by subjects to express some aspect of the concept. Words such as "egg", "larva", "pupa" are obviously related to the Life-Cycle concept. Despite the frequency with which these words are used by teachers, and in textbooks, students find any number of
substitute words which they use frequently in the same context as those above. Any such words were taken to be concept-related words.

Analysis of the transcripts in this manner led to preparation of a list of concept-related key words elicited from the subjects during interviews. The words listed were grouped into nouns, verbs, adjectives and adverbs according to their use in dialogue. (Refer to Appendix G).

Once these words were identified for the group it was necessary to determine to what extent each individual, and their language group made use of certain words. Further coding of these words in the transcripts according to the list allowed computation of frequency of use of individual words. This measure could then be taken as an indication of the relative ease of expression exhibited by each language group.

Identification of Modifiers

In much the same way as concept-related key words were identified for the sample, concept-related key phrases were pulled out. These modifiers have been classified according to the various sub-concepts they describe, such as identity, size, time, growth. They have been further grouped as Descriptive or Inferential. For e.g. a phrase such as "crinkled and cramped" is clearly solely descriptive in function, whereas one such as "strong enough to make eggs" or "different from all other worms" indicate some inter-
interpretative function other than mere description. The latter have been termed Inferential. Two impartial judges were asked to classify the modifiers on this basis. The final list (refer Appendix H ) reflects a consensus of opinion.

Naming the Life-Cycle

Questions 1 to 10 were analysed for modifiers and key words as described above. Questions 11 and 12 attempted to unravel the student's own conceptualisation of the Life-Cycle of the Mealworm Beetle as a whole. Question 12 in particular which asked the student to:

Suppose this were a story, what name would you give it? What would that story tell?

was analysed only for the names which students provided for the process. These generally indicate their overall understanding and their ability to generalise about significant aspects of the life-cycle and express their abstractions succinctly. This information is presented in Chapter Four.

LIMITATIONS OF THE METHODOLOGY

The large volume of data that usually results from a clinical interview seems to suggest that a particular method of analysis is needed. A flexible mode is preferable and it is essential that the analyst approaches the task with a minimum of preconceived notions so that patterns that actually exist can be uncovered. This does not
presuppose rejection of a theoretical position.

The clinical setting has become more acceptable as a means of data collection since Piaget, and with it the type of analysis implied by its methodology. Piaget's approach in his extensive work on children's thinking has been disputed in the literature for various methodological reasons. These claims have been appropriately summarised by Deadman (1976):

i) He is indifferent to problems of sampling, reliability and statistical significance.

ii) He fails to present adequate normative data on age level, sex, I.Q.

iii) He fails to use a uniform experimental procedure for all subjects.

iv) He fails to give details of his methodology and method of analysis.

v) He fails to designate unambiguous criteria for classifying responses of all his subjects.

vi) Cross-sectional studies are used instead of longitudinal thus relying on logical inference for identifying stages of development. (pp. 18-19).

Yet Piaget's clinical method is meritorious. It allows description of certain characteristics which are unidentifiable in terms of the traditional hypothetico-deductive paradigm. His approach provides an effective means of describing and categorising thought processes in children.
Summary

The methods of data treatment summarised in this chapter were intended to identify the following gross measures:

1) The conceptual content of ideas held by subjects on the particular topic.

2) The type of reasoning offered for these ideas.

3) The length and type of utterances made to express these ideas in conversation.

4) The type of words used to designate certain aspects of the concept.
NOTES FOR CHAPTER THREE

1. These children ranged in age from 8 years to 11 years old. They lived near to the University of British Columbia and all of them had at least one parent who attended that institution.

2. The author feels indebted to the principals, teachers and students of these schools for their time, interest, enthusiasm and cooperation with regard to this study. Each teacher provided a list of students and their second language. This was defined by the Interviewer as the language which those students used most frequently at home with their family. During the informal chat at the beginning of each interview this was verified by the interviewer. (See Appendix C). Children who spoke English only at home and at school were classed as English Primary Language users (EPL) Those for whom English was not the dominant language at home were classified as English Second Language users (ESL).

3. "New immigrants" refers here to any students who had first come to Canada from a non-English-speaking country not more than six months prior to interviewing.

4. Piaget's stage theory of cognitive development is well-known. Children beyond the age of 8 years or so are thought to have usually completed the concrete operational level of cognitive development which is assumed to precede the formal operational adult level of cognition. Concrete operational thought structures are thought to be bound by 'content' as opposed to logic and therefore the former is more restricted to manipulation of things. A good discussion of Piaget's stage theory can be found in his book entitled "The Growth of Logical Thinking". A critique of various aspects of his stage theory may be found in "Piaget and Knowing" edited by Geber (1977). It was felt that, in order to look at the way language and cognitive development interact in the educational context, the subjects should possess some ability to reason logically. The grade four students selected ranged in age from nine and a half years old to eleven and a half and so they would be, according to Piaget's theory, in transition to the adult logic of the formal operational stage.
Also, as far as language is concerned, grade four students were chosen because at that age and stage, participants of the pilot studies seemed well able to express their ideas without hindrance. Generally, many of the basic features needed for good oral language expression, such as use of pronouns, clauses, connectors, intonation have been acquired (Loban 1976, pp. 79-85).

5. Only one of the teachers had briefly talked about Insect Life-Cycles in class that year. None of them had referred to or instructed their classes on the Life-Cycle of the Mealworm Beetle.

6. A fuller discussion of these Response Modes, with examples, is provided in Tough (1977, 134-140).

7. The reader is encouraged to refer to Appendix B, pp. 100-107 of Loban's book, Language Development for a complete description of the uses of C-Units and M-Units in language analysis.
CHAPTER FOUR

ANALYSIS OF LIFE-CYCLE CONCEPTS

INTRODUCTION

This chapter will contain a classification and summary of the children's views on the growth cycle of the Mealworm Beetle, Tenebrio molitor. Both the content of their ideas and the mode of reasoning will be presented. The first part of this discussion will centre on the conceptual patterns implied in responses of the subjects. Although there is usually considerable variation in the ideas expressed by any sample, it is likely that commonality will emerge when the data is examined critically and carefully.

The content of responses given during interviews is likely to be interesting but the rationale offered for these viewpoints, even more so. The explanations are likely to be suggestive of the cognitive strategies and mechanisms of the subjects, and so it seems necessary to mention this type of information. Looking at their conceptual patterns and analysing their oral language of expression should help clarify the manner in which language and thought variables interacted for subjects under the conditions evident in this study.
IDENTIFICATION OF CONCEPTUAL PATTERNS

Initially, analysis was done by looking closely at the answers provided to questions posed during interviews. The patterns which emerged from these suggested that subjects possessed four different interesting viewpoints with respect to the Life-Cycle of the Mealworm Beetle. It appeared that they all readily recognised that the beetle itself was the adult form and that this adult beetle was a living animal capable of reproducing itself. Almost all of the subjects alluded to sex as a criterion to prove whether reproduction occurred. One subject even suggested determination of the age and sex of an adult specimen in this manner:

This [adult] is about four years old. You can test them - like that one's five - like you count these things [segments]. Like a tree - there's these things like cuts that you can see how old, that is. Do the same for beetles .... If it's a girl it has a thing in the back like that ....

All the conceptual patterns identified subscribed to the cyclic nature of growth. The sample, as a whole seemed to view the growth process as continuous and regenerative. However their ideas on the events that constitute such a cycle differed to a great extent.

Their ideas indicated that the many cycles they "see" differ considerably from the "real" one. The four main viewpoints will be described below as Conceptual Patterns One to Four. Subjects have been grouped according to similarity of viewpoint.
### TABLE 4.1

**SUMMARY OF LIFE-CYCLE CONCEPTS IDENTIFIED**

<table>
<thead>
<tr>
<th>Conceptual Patterns</th>
<th>Conceptual Content</th>
<th>Number of Subjects</th>
<th>Proportion of Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>EPL</td>
<td>ESL</td>
</tr>
<tr>
<td>Cycle 1</td>
<td>This appears to embody ideas suggestive of obvious features of the human reproductive system in which offspring &quot;start off as babies&quot; and grow into adults.</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Cycle 2</td>
<td>&quot;grown-up baby&quot;</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Cycle 3</td>
<td>&quot;different&quot; form from adult</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Cycle 4</td>
<td>adult larva</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

### TABLE 4.2

**DISTRIBUTION OF SUBJECTS ACCORDING TO CONCEPTUAL PATTERN**

<table>
<thead>
<tr>
<th>Subject Group</th>
<th>Cycle 1</th>
<th>Cycle 2</th>
<th>Cycle 3</th>
<th>Cycle 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPL</td>
<td>5, 6</td>
<td>2,4,10,12</td>
<td>1,3,9</td>
<td>7,8,11</td>
</tr>
<tr>
<td>ESL</td>
<td>9</td>
<td>1,2,3,5,6,7,8,10,11</td>
<td>4</td>
<td>12</td>
</tr>
</tbody>
</table>
DISTRIBUTION OF ENGLISH PRIMARY LANGUAGE USERS
BY CONCEPTUAL PATTERN

DISTRIBUTION OF ENGLISH SECOND LANGUAGE USERS
BY CONCEPTUAL PATTERN
Conceptual Pattern One

The patterns themselves appeared to be hierarchical in the adult logical sense varying from "simple" to "complex" - from cycles with a great expressed similarity to the human growth cycle evidently based purely on prevalent experience, to cycles which implied broader abstraction and generalization to include other forms of animal life. The cycle which follows is the simplest one encountered.

It reflects the prevailing notion that the Mealworm Beetle undergoes a growth cycle identical to what the subject considers the human cycle to be. The organism begins life as a "baby" and grows by increasing in size to a large individual of the same form and appearance as the parent which can later reproduce when full-grown.
One girl with English as a First Language made the point thus

You can raise little ones and they'll grow and have babies. You can start with grown-up ones and they'll have babies and the mother dies and the child grows up and has babies.... The baby always looks just like the adult and the adult just like the baby because it always takes care of the young ones.... It's just like human beings - like a mother has babies and they grow up and have babies again....

Another English-speaking boy presented a similar argument to the interviewer. The same idea was expressed by a user of English as a Second Language:

The babies should look like it [adult] but a little smaller.... The babies should look the same as they do but a little smaller.... I think they come from the stomach of the lady-one....

This viewpoint is particularly interesting because of the conspicuous absence of an "egg" stage from the growth process. This thinking may result because, aside from Man, many of the common animals children see around them and are familiar with are domesticated mammals. As a rule these give birth to live young and so, they are viewed as producing "babies" rather than "eggs". Even though an egg is a biological precursor of growth of a "baby", it is likely that its presence is not considered at all by the child because it remains within the body of the parent where it changes form and grows to a considerable size and complexity
before expulsion as a "baby".

The egg is viewed, it seems, not as a necessary starting-point for life but as a discrete entity with its own special characteristics. In order to account for the existence of an egg which is not "laid" by the parent, the student is required to envisage the egg as a living entity because it contains life. Such a view of life appears to be "unreal" for these subjects.

The other feature of this Conceptual Pattern that deserves mention is the subjects' preoccupation with size as a central, and perhaps sole criterion of change in growth. The three subjects in this group, when asked to identify the constituent organisms in the growth cycle of the group placed these in order solely on the basis of size:

... the little beetle then the older beetle...
... the small beetle then the medium-sized beetle then the big beetle.

This kind of statement was prevalent even when the actual live specimens were present in the Verbal Manipulative Interview Condition. These subjects excluded nonbeetle-like objects from the Beetle Life-Cycle and grouped beetle-like specimens on the basis of their size and similarity in appearance to the adult. A small larva was placed with a large one and this constituted a cycle different from that of the beetle because specimens unlike the adult beetle in appearance were not viewed as having come from a beetle at all.
Conceptual Pattern Two

The majority of English Second Language Speakers seem to fall in this group. It also contains a larger number of first language users than any other group. It would appear this is the "popular" viewpoint of the sample.

This cycle is essentially similar in nature to conceptual pattern one but its starting-point is distinctly different. The egg is readily seen as the start of the process. It gives rise to a smaller version of the adult which increases in size until it is "grown-up" and can "have babies".

One student expressed her ideas in this fashion:

[The eggs] look all the same. I think they'll wait till spring and they'll hatch. The egg will crack and the baby-beetle will come out. It will look like the mother-beetle.... It'll look for food then they'll grow and grow. They'll become a beetle like [meaning like an adult].

Another English Second Language user explained:

Eggs will hatch and baby beetles will come out. The egg will be bigger than the little ones.... so the baby can grow up and get out of it... The babies start growing - 'like we do - from eating... They start growing into a big beetle... and then have babies again. The babies grow up to be a big one like the mother. When they're just born they look very small.

Native English speakers had similar notions.

The one that is normal size and is the mother can have eggs... I suppose the egg would hatch sometime... The eggs would open up and the beetle will come out. A newborn beetle will come out... When they're just born they look like little insects. I think they're sort of like ants... The baby beetle grows until it is the standard size... then it'll be a mother or father... then it'll have more babies...
This conceptual pattern, although not "correct" does indicate some better appreciation on the part of the subject for a complicated growth process from egg to adult. Although it is not the form of the growth cycle that applies to Tenebrio Molitor, such a cycle is fairly common among insects and is presented in texts as Incomplete Metamorphosis. Common insects such as grasshoppers, cockroaches grow from the egg to a nymph which is a smaller version of the adult. It may be argued that such a viewpoint then could be considered as somewhat logical - but mistaken. It is important to note though, that smallness of size as a criterion of youth, and resemblance to the parent are still being adhered to tenaciously.

These ideas were prevalent even when subjects saw and manipulated specimens that did "obviously" come from the parent but did not resemble it. This tends to suggest that these subjects are still attempting to explain the process in terms of external similarities - in terms of what is most familiar within their experience, and are therefore missing hidden or implied patterns. They appear still quite unable to view other alternative explanations as real ones, even in the presence of information that conflicts with their viewpoint. (Verbal Man. Condition).

Conceptual Pattern Three

Only 16.67 percent of the entire sample adhered to this line of thought. These were mostly (75%) native English
speakers who expressed the notion that growth was a continuous process during which the offspring changes from egg to some other form and then to the adult. This other form may have been "worm-like" or otherwise but essentially it was different-looking from the adult. It was not identical in appearance to the adult but later "grew up" to look like the adult in form and structure.

This was described graphically by one of the English Primary Language Users:

They hatch... and the baby comes out. After a while it looks different from the bigger beetle. It doesn't have a shell around it yet - it isn't the same shape....it's soft... It's different because it doesn't have the same body texture....It grows slowly, gradually - I think it gets bigger. It grows a shell when it grows up into a beetle.

An English Second Language User expressed similar notions, but more succinctly:

...It will grow up to a worm and grow up to a beetle...."

This subject clearly was not referring to a worm in the true biological sense of the word (Annelid) but a "worm-like" creature because he had made the point earlier on:

...Can't get beetles from worms
Worms come from worms"....

Another subject too expressed a similar viewpoint but his facility with English enabled him to provide further clarification:

The egg hatches and a little worm comes out and it goes bigger into a beetle.
It's not a worm, it's like a worm because worms are large and round. I've seen a worm before and they are dark and these are light brown...They're beetles but they look like worms..."
One other native English-speaking subject explains her ideas in this way:

They look a lot different from beetles when they're babies... The body is called a mealworm... I don't know why I call them mealworms. Mealworms look different from beetles. It's [Mealworm] only a baby. The others are adult... I saw a mealworm once or twice...A mealworm is not a beetle - it's smaller. It would grow into a beetle...

This would tend to indicate that either these students recognise that offspring do not have necessarily the identical form of the parent throughout the growth cycle, or perhaps they have identified an anomaly implicit in the nature of the specimens they have handled and have attempted to solve that by providing an alternative explanation. This happens to be in adult sense, logical but incomplete. However this trend of thought constitutes a progression from the narrow pattern of thinking of the previous group and is closer, but not entirely compatible with the "real" view of the Life-Cycle of the Mealworm Beetle.

Conceptual Pattern Four

Again only 16.67 percent of the entire sample fell within this category. They were able to express recognition of a growth cycle for the Mealworm Beetle that bore the essential features of the known scientifically acceptable Life Cycle of the Mealworm Beetle.

It appeared that, for these subjects, the egg was the starting point, as well as any other point or "stage" in the
cycle. From the egg offspring grew through "stages" to adulthood. During these stages of growth offspring varied in appearance (shape, size, colour) from the parent whose form they eventually grew to resemble.

The thought patterns and problem solving strategies of these subjects had to be more complex because they had to progress beyond simple recognition of external similarities and extract from the materials the hidden or implicit similarities and relate these logically.

Thus they were able to come to the conclusion that, firstly, the many types of specimens in the one container were all produced by beetles. Secondly, they appeared to conclude that the events connected with production and presence of these seemingly "different" organisms were not isolated and did really constitute a continuous chain of events or cycle. These subjects could appreciate the whole pattern of development whereas others were only able to distinguish discrete parts of that sequence.

The only English Second Language student who subscribed to this line of thought explained his notions in this fashion:

...egg comes from a beetle...looks like a small silkworm egg...it changes to a beetle...
I know because insects have four stages...
A stage tells how it changes. Egg is first stage...They change from something like a ball. Egg grows...then this [larva] ...then this [pupa]... then beetle, this one..."

Although the notion is expressed, that there is a series of changes in form from egg to adult, attempting to use
scientific terms such as "larva" and "pupa" proved confusing at first for this subject in the Verbal Condition:

They [eggs] turn into, I think it's "pupae" or "larvae". It'll change gradually. The form will change. The egg changes into a different shape. The beetle that's inside is working while it's in the egg, getting bigger and it changes its form... It's [larva] is white - the shape of a beetle but its legs are stuck together to its body.... It grows.... It (egg) turns into a "larvae" and into a "pupae" and then into a beetle ... Scientists give the name "larvae".

When this subject could examine the specimens he appeared to sort out his own ideas:

The egg grows larger into a "larvae" then into a "pupae" then into a beetle. These are stages of its life - development. First it's an egg, then a larvae, then a pupae, then a beetle. Then the beetle sheds its skin. Then it crawls out bigger...

This subject was not as articulate but she has a similar notion:

The egg comes from the mother - from one like this one [adult beetle]. It changes - they will turn into a baby-beetle. It changes into one of these [larva]... then it breaks out of this [larva] and changes into this baby [pupa]... [If you looked at the egg next week] you might see this [larva]. [In another week] you would see this [pupa]...then this[beetle]...It comes from the eggs.

LIFE-CYCLE OF TENEBRIO MOLITOR

The life-cycle of the Mealworm Beetle is common to many insects such as butterflies, bees, moths. It has a four stage pattern of egg, larva, pupa, adult.
The larvae are light brown and cylindrical in shape. As they grow they moult. Usually the skin splits down the back near the head and a new soft larva comes out. Mealworms normally have harder skins than butterflies and so they moult about ten to twenty times, unlike butterflies which molt about five times.

The eggs usually take about a week before they hatch into mealworms and the larval stage lasts for several months. The pupal stage takes between seven to twenty-one days before becoming a young adult and the adult survives for a few months during which time the female lays hundreds of eggs. Mealworms are fascinating creatures and are easy to keep and grow in the regular classroom.

INTERESTING ASPECTS OF THE MEALWORM-LIFE CYCLE

Reproduction

Some of the questions asked by the interviewer attempted to tease out such notions that subjects had on reproduction as; Did they think that young animals could reproduce? At what point in the life of an organism would they expect it to reproduce. (Refer Questions 1-4, 9-10, Appendix C).

It was interesting to find that just about the entire sample was very clear on certain basic ideas. The female specimen is responsible for bearing offspring but a male specimen is needed, though the function of the male is not quite clear.
...tells about...how it turns into a beetle and how it mates. That's one thing I don't know they do. When they mate a few weeks later one starts laying eggs and the other, I think, guards them....

Most of the students interviewed expressed the conviction that offspring could not reproduce until they were mature.

Only females can have babies....I don't know how to tell how old...A beetle-baby can't have eggs. It's too young....[female beetles can have eggs] when they're about six months and they're grown up.

and again:
[The black adults are] old enough to have young ....because they're oldest.

Frequently, though, size was used as a criterion of age and maturity:

The babies would be small in size and adults would be a little bigger....I think that's the only way you can tell... A young beetle can't have young because it's not old enough...." 

Interesting notions such as these are likely to form the frame of reference with which the child views the entire process of growth in the Mealworm Beetle.

Naming the Life Cycle

The titles and their accompanying explanations provided in Tables 4.3 and 4.4 clearly indicate the individual understandings each subject had of the growth process of the Mealworm Beetle and which aspects they viewed as being most important and relevant. There are obvious group and individual differences in ideas and their manner of expression.
<table>
<thead>
<tr>
<th>Subject</th>
<th>Titles</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The stages of a Beetle</td>
<td>that the baby beetle has to hatch out of its egg and grow up to be an adult - how a beetle looks when it's little and it's growing</td>
</tr>
<tr>
<td>2</td>
<td>A Beetle's Life</td>
<td>because it tells about beetles, how they're born and so</td>
</tr>
<tr>
<td>3</td>
<td>All about Beetles</td>
<td>how the beetle grows older from this size to that tells that beetles are small and when they grow up they can have babies</td>
</tr>
<tr>
<td>4</td>
<td>How a Baby Beetle would grow to be an adult</td>
<td>it's showing you how the young beetle and it's larger and goes into an adult - like how a silkworm grows</td>
</tr>
<tr>
<td>5</td>
<td>Discussion on insects</td>
<td>not about beetles because I have here beetles and insects</td>
</tr>
<tr>
<td>6</td>
<td>All about Beetles</td>
<td>tells about how they grow, how they have babies and how they eat</td>
</tr>
<tr>
<td>7</td>
<td>Life Stages Life-Cycles of Beetles</td>
<td>tells the whole life-like a race, the stage - the growth - what stages it turns into and how it turns into a beetle</td>
</tr>
<tr>
<td>8</td>
<td>The Beetle's Life-Cycle</td>
<td>because we use those words in other insects and because it's an insect - how an animal changes from egg to an adult</td>
</tr>
<tr>
<td>9</td>
<td>How Mealworms grow</td>
<td>because that's what they're first called</td>
</tr>
<tr>
<td>10</td>
<td>Baby Beetles Changing a Beetle</td>
<td>how it [baby] turns into a beetle - how the lady beetles have babies</td>
</tr>
<tr>
<td>11</td>
<td>How a Baby Beetle grows</td>
<td>tells how the eggs grow into a full-grown beetle - that bugs change, tells that the eggs can change - starts from small then goes bigger</td>
</tr>
<tr>
<td>12</td>
<td>A Baby Beetle grows Beetle eggs turn into Beetles</td>
<td>how a beetle grows up from the young beetle to a normal beetle</td>
</tr>
<tr>
<td>Subject</td>
<td>Title</td>
<td>Explanation</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
<td>-------------</td>
</tr>
<tr>
<td>1</td>
<td>No response</td>
<td>no response</td>
</tr>
<tr>
<td>2</td>
<td>How Beetles grow up</td>
<td>no response</td>
</tr>
<tr>
<td>3</td>
<td>Growing Insects</td>
<td>tells how a beetle gets babies</td>
</tr>
<tr>
<td>4</td>
<td>Beetles Worms</td>
<td>no response</td>
</tr>
<tr>
<td>5</td>
<td>Beetles</td>
<td>how they hatch and grow and how they change their colours when they're growing up</td>
</tr>
<tr>
<td>6</td>
<td>How the Beetles grow</td>
<td>it means about beetles - how the beetle live and they die and grow again</td>
</tr>
<tr>
<td>7</td>
<td>How Beetles grow All about Beetles</td>
<td>how they grow</td>
</tr>
<tr>
<td>8</td>
<td>How Beetles grow</td>
<td>happens over and over again from the egg to the full-grown one and in-between</td>
</tr>
<tr>
<td>9</td>
<td>How an Insect grows</td>
<td>how it first ... then it.... small all the way to big until they die</td>
</tr>
<tr>
<td>10</td>
<td>Beetles</td>
<td>the life of a beetle</td>
</tr>
<tr>
<td>11</td>
<td>How Mother Beetles have their Babies How a Beetle hatches</td>
<td>because it tells how a beetle hatches</td>
</tr>
<tr>
<td>12</td>
<td>A Beetle's life How a Beetle Changes</td>
<td>how a beetle changes from stages to a beetle because it tells all the stages they change in</td>
</tr>
</tbody>
</table>
The information contained in those tables does not necessitate further comment.

**MODE OF REASONING**

**TABLE 4.5**

**DISTRIBUTION OF SAMPLE BY MODE OF REASONING**

<table>
<thead>
<tr>
<th>Identification Numbers of</th>
<th>Identification Numbers of</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Primary Language Group</td>
<td>English Second Language Group</td>
</tr>
<tr>
<td>Syncretic</td>
<td>6</td>
</tr>
<tr>
<td>Pre-Emptive</td>
<td>1,2,3, 4,5,9,10,12</td>
</tr>
<tr>
<td>Explanatory and Relevant</td>
<td>7,8,11</td>
</tr>
</tbody>
</table>

The response mode most consistently used in response to questions and probes was taken to be the reasoning mode that was prevalent for that subject. Comparison of Tables 4.2 and 4.5 reveal that there is a strong positive correlation between the Conceptual Patterns of the Sample and their Reasoning Mode. The most prevalent mode is the Pre-Emptive in which students (75%) offer semi-logical explanations for the ideas they hold. Only 8.33 percent of the sample still employ a syncretic mode of reasoning while 16.67 percent have progressed to a somewhat more adult logical way of reasoning.
CHAPTER FIVE

ORAL LANGUAGE CONTENT ANALYSIS

Up to this point the discussion has focussed on the statement of the problem, it's context, the method of investigation to be used in this study. This Chapter will summarise the results of the analysis of oral language, pertinent to the Life-Cycle of the Mealworm Beetle. The substance of the ideas held by the children has been already presented separately in Chapter Four. Later on, an interpretation of both the concept and the language results will be presented in Chapter Six.

Measurement of Oral Language

In order to obtain information on the specific research questions stated in Chapter One, it was necessary to examine the following attributes for English Primary Language Users and English Second Language Users in the sample:

- proportion of communication units to maze units used in response to the interview questions
- average number of words per communication unit
- average number of concept-related nouns, verbs, adjectives, adverbs used in communication
- frequency of use of certain concept-related terms
- type of modifiers used to express various aspects of the concept.
These results have been summarised in the text and tables that follow.

Mazes and Maze Words Used in Communication

Loban (1976) claims that "given as a percentage of total spoken words, the number of words in mazes is actually a simple and straightforward device for measuring the subject's repetitions and language tangles". A few interesting points emerge when Tables 1 and 2 are examined in the light of the above statement.

It is apparent from the data presented in Tables 5.1 and 5.2 that the average number of maze units used for each sub-group varies depending on the Interview Condition. On the basis of Loban's statements English Primary Language Users show a bit less confusion, hesitation and are more proficient at communicating when the live specimens are available. However a most interesting feature is evident. English Second Language Users exhibit a higher percentage of mazes in the Verbal Manipulative Condition than in the Verbal Condition. It is opposite for the English Primary Language Users. English Second Language Users seem to use their language somewhat more precisely when they have no specimens to refer to. When they have to rely solely on verbal communication they exhibit about just as much hesitation, language tangles as Primary Language Users do, with materials. Furthermore, looking at the English Second Language Group as a whole, although the number of maze units
### TABLE 5.1

**PROPORTION OF MAZES IN TOTAL COMMUNICATION FOR ENGLISH PRIMARY LANGUAGE USERS**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Verbal Interview</th>
<th>Condition</th>
<th>Verbal Manipulative</th>
<th>Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No of C-Units</td>
<td>No of Mazes</td>
<td>% Mazes</td>
<td>No of C-Units</td>
</tr>
<tr>
<td>1</td>
<td>28</td>
<td>8</td>
<td>22.22</td>
<td>29</td>
</tr>
<tr>
<td>2</td>
<td>24</td>
<td>12</td>
<td>33.33</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>6</td>
<td>20.00</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>23</td>
<td>4</td>
<td>14.81</td>
<td>23</td>
</tr>
<tr>
<td>5</td>
<td>29</td>
<td>8</td>
<td>21.62</td>
<td>30</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>5</td>
<td>18.51</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>34</td>
<td>7</td>
<td>17.07</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>14</td>
<td>2</td>
<td>12.50</td>
<td>16</td>
</tr>
<tr>
<td>9</td>
<td>16</td>
<td>9</td>
<td>36.00</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>21</td>
<td>7</td>
<td>25.00</td>
<td>14</td>
</tr>
<tr>
<td>11</td>
<td>28</td>
<td>8</td>
<td>22.22</td>
<td>15</td>
</tr>
<tr>
<td>12</td>
<td>24</td>
<td>8</td>
<td>25.00</td>
<td>17</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>22.36%</td>
<td>21.42</td>
</tr>
</tbody>
</table>

### TABLE 5.2

**PROPORTION OF MAZES IN TOTAL COMMUNICATION FOR ENGLISH SECOND LANGUAGE USERS**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Verbal Interview</th>
<th>Condition</th>
<th>Verbal Manipulative</th>
<th>Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No of C-Units</td>
<td>No of Mazes</td>
<td>% Mazes</td>
<td>No of C-Units</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>3</td>
<td>13.04</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>6</td>
<td>27.27</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>2</td>
<td>9.09</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>17</td>
<td>4</td>
<td>19.05</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>5</td>
<td>19.23</td>
<td>21</td>
</tr>
<tr>
<td>6</td>
<td>21</td>
<td>4</td>
<td>16.00</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>30</td>
<td>4</td>
<td>11.76</td>
<td>25</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
<td>7</td>
<td>30.43</td>
<td>26</td>
</tr>
<tr>
<td>9</td>
<td>27</td>
<td>11</td>
<td>28.94</td>
<td>22</td>
</tr>
<tr>
<td>10</td>
<td>14</td>
<td>2</td>
<td>12.50</td>
<td>17</td>
</tr>
<tr>
<td>11</td>
<td>13</td>
<td>5</td>
<td>27.77</td>
<td>21</td>
</tr>
<tr>
<td>12</td>
<td>22</td>
<td>6</td>
<td>21.42</td>
<td>14</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>19.70%</td>
<td>19.00</td>
</tr>
</tbody>
</table>
### TABLE 5.3(a)

MAZE WORDS AS PERCENTAGE TOTAL WORDS USED

<table>
<thead>
<tr>
<th>Subject</th>
<th>English Primary Language %</th>
<th>English Second Language %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24.33</td>
<td>16.50</td>
</tr>
<tr>
<td>2</td>
<td>45.50</td>
<td>29.36</td>
</tr>
<tr>
<td>3</td>
<td>37.33</td>
<td>12.50</td>
</tr>
<tr>
<td>4</td>
<td>23.20</td>
<td>14.38</td>
</tr>
<tr>
<td>5</td>
<td>27.41</td>
<td>30.32</td>
</tr>
<tr>
<td>6</td>
<td>32.22</td>
<td>25.30</td>
</tr>
<tr>
<td>7</td>
<td>21.04</td>
<td>21.88</td>
</tr>
<tr>
<td>8</td>
<td>15.53</td>
<td>46.42</td>
</tr>
<tr>
<td>9</td>
<td>55.59</td>
<td>34.52</td>
</tr>
<tr>
<td>10</td>
<td>35.88</td>
<td>20.21</td>
</tr>
<tr>
<td>11</td>
<td>19.39</td>
<td>37.50</td>
</tr>
<tr>
<td>12</td>
<td>28.59</td>
<td>28.57</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>30.49%</strong></td>
<td><strong>26.45%</strong></td>
</tr>
</tbody>
</table>

### TABLE 5.3(b)

MAZE WORDS AS PERCENTAGE TOTAL WORDS

VERBAL MANIPULATIVE

<table>
<thead>
<tr>
<th>Subject</th>
<th>English Primary Language %</th>
<th>English Second Language %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29.04</td>
<td>25.62</td>
</tr>
<tr>
<td>2</td>
<td>50.73</td>
<td>6.45</td>
</tr>
<tr>
<td>3</td>
<td>30.51</td>
<td>19.23</td>
</tr>
<tr>
<td>4</td>
<td>11.11</td>
<td>29.14</td>
</tr>
<tr>
<td>5</td>
<td>19.16</td>
<td>22.10</td>
</tr>
<tr>
<td>6</td>
<td>34.22</td>
<td>15.73</td>
</tr>
<tr>
<td>7</td>
<td>48.15</td>
<td>22.27</td>
</tr>
<tr>
<td>8</td>
<td>9.75</td>
<td>25.21</td>
</tr>
<tr>
<td>9</td>
<td>13.04</td>
<td>54.31</td>
</tr>
<tr>
<td>10</td>
<td>30.30</td>
<td>39.65</td>
</tr>
<tr>
<td>11</td>
<td>46.11</td>
<td>23.61</td>
</tr>
<tr>
<td>12</td>
<td>9.22</td>
<td>31.81</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>27.61%</strong></td>
<td><strong>26.26%</strong></td>
</tr>
</tbody>
</table>
varies with the Interview Condition, the average proportion of maze words to total words used for both Verbal and Verbal Manipulative interviews appears to be constant (See Table 3a, b). This would indicate that both English Second Language and English Primary Language Users are guilty of making more language tangles (longer mazes) than false starts (shorter mazes).

A less obvious but crucial point that emerges from the data is that, generally speaking, the proportion of mazes for both language sub-groups is not significantly different. The mean proportion of mazes used for both interviews for English Primary Language Users was 21.18% while the proportion of mazes to total utterances is 20.55% for Second Language Users. This indicates that the two sub-groups do not vary greatly in their overall language proficiency despite slight individual differences depending on whether live specimens are present or not.

Length of Communication Units

It is valid to assume that the average length of a communication unit may be determined by the average number of words in that unit (Loban, 1976). This measure is useful in a study such as this because it could clearly indicate how fluently the subjects are able to use oral language to express their ideas.
Fluency in adults generally symbolizes to what extent they are able to put together their words and express themselves readily with an unbroken easy stream of words. Children are not expected to have perfected the rhetorical skills of adults, but by Grade Four, their parents and teachers expect them to respond with appropriate polish using the vocabulary at their command. Thus, it is reasonable to examine their language for evidence of fluency and proficiency.

In this study, as with Loban's developmental study of language in children from K-12, the average number of words per communication unit is used as a basic measure of fluency. It may be argued that this measure merely indicates the use of a large number of words unnecessary for efficient communication. But this is not the case here. The transcripts were carefully screened for repetitions, tangles and irrelevances and these were separated out and counted as maze words. Also, because this interview situation required responses to particular questions, each subject had to use his words to focus on the specific aspects of the concept alluded to in the questions or probes. The general consistency in a number of communication units per subject across interviews lends support to the reliability of this measure (See Tables 5.1 and 5.2).

The data itself is interesting. Tables 5.4 and 5.5 indicate that the average number of communication units used in
both interviews is much higher for English Primary Language Users than for English Second Language Users (190.08 in the Verbal Condition for English Primary Language versus 125.33 for English Second Language. Of the total number of C-Units used by the entire sample, 53.91% came from native English speakers and 46.09% from Second Language Users. Although significant, this is not a dramatic difference and indicates that the latter are fairly competent in their use of oral language.

Therefore the quality or degree of elaboration of the C-Unit itself for each language group becomes crucial. The average number of words in a communication unit ranges for English Primary Language Users as a group, from 4.93 to 10.83 regardless of the interview condition with a medium point of 7.88 words per C-Unit. The same measure for English Second Language Users varies from 4.20 to 10.04 with a median of 7.12 words per communication unit. Both groups have the same mean number of words per communication unit for the Verbal Manipulative Interview. This is an interesting feature when compared with the Verbal Condition in which native speakers use a slightly longer, perhaps more elaborated unit than the Second Language User (7.72 versus 6.35 - See Table 5.4 and 5.5). The individual differences within each group are even more desirable and merit further discussion in Chapter Six.
### TABLE 5.4
AVERAGE NUMBER OF WORDS PER COMMUNICATION UNIT - ENGLISH PRIMARY LANGUAGE USERS

<table>
<thead>
<tr>
<th>Subject</th>
<th>Verbal Condition</th>
<th>Words per C-Unit</th>
<th>Manipulative Condition</th>
<th>Words per C-Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>227</td>
<td>8.11</td>
<td>171</td>
<td>5.90</td>
</tr>
<tr>
<td>2</td>
<td>188</td>
<td>7.83</td>
<td>101</td>
<td>7.76</td>
</tr>
<tr>
<td>3</td>
<td>146</td>
<td>6.08</td>
<td>246</td>
<td>6.15</td>
</tr>
<tr>
<td>4</td>
<td>192</td>
<td>6.61</td>
<td>152</td>
<td>6.60</td>
</tr>
<tr>
<td>5</td>
<td>294</td>
<td>10.13</td>
<td>232</td>
<td>7.73</td>
</tr>
<tr>
<td>6</td>
<td>162</td>
<td>6.72</td>
<td>148</td>
<td>7.40</td>
</tr>
<tr>
<td>7</td>
<td>289</td>
<td>8.50</td>
<td>169</td>
<td>8.45</td>
</tr>
<tr>
<td>8</td>
<td>87</td>
<td>7.92</td>
<td>111</td>
<td>6.94</td>
</tr>
<tr>
<td>9</td>
<td>115</td>
<td>7.19</td>
<td>120</td>
<td>6.00</td>
</tr>
<tr>
<td>10</td>
<td>109</td>
<td>5.19</td>
<td>69</td>
<td>4.93</td>
</tr>
<tr>
<td>11</td>
<td>212</td>
<td>7.57</td>
<td>104</td>
<td>6.93</td>
</tr>
<tr>
<td>12</td>
<td>260</td>
<td>10.83</td>
<td>128</td>
<td>7.52</td>
</tr>
</tbody>
</table>

Average | 190.08 | 7.72 | 145.91 | 6.86 |

### TABLE 5.5
AVERAGE NUMBER OF WORDS PER COMMUNICATION UNIT - ENGLISH SECOND LANGUAGE USERS

<table>
<thead>
<tr>
<th>Subject</th>
<th>2nd Language</th>
<th>Verbal Condition</th>
<th>Words per C-Unit</th>
<th>Manipulative Condition</th>
<th>Words per C-Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chinese</td>
<td>84</td>
<td>4.20</td>
<td>90</td>
<td>5.30</td>
</tr>
<tr>
<td>2</td>
<td>Hindi</td>
<td>89</td>
<td>5.56</td>
<td>116</td>
<td>5.27</td>
</tr>
<tr>
<td>3</td>
<td>Chinese</td>
<td>98</td>
<td>4.90</td>
<td>42</td>
<td>4.20</td>
</tr>
<tr>
<td>4</td>
<td>Chinese</td>
<td>119</td>
<td>7.00</td>
<td>141</td>
<td>6.71</td>
</tr>
<tr>
<td>5</td>
<td>Korean</td>
<td>131</td>
<td>6.24</td>
<td>141</td>
<td>6.71</td>
</tr>
<tr>
<td>6</td>
<td>Chinese</td>
<td>186</td>
<td>8.86</td>
<td>75</td>
<td>6.25</td>
</tr>
<tr>
<td>7</td>
<td>Punjabi</td>
<td>207</td>
<td>6.90</td>
<td>164</td>
<td>6.56</td>
</tr>
<tr>
<td>8</td>
<td>Punjabi</td>
<td>105</td>
<td>6.56</td>
<td>261</td>
<td>10.04</td>
</tr>
<tr>
<td>9</td>
<td>Punjabi</td>
<td>220</td>
<td>8.15</td>
<td>201</td>
<td>9.14</td>
</tr>
<tr>
<td>10</td>
<td>Chinese</td>
<td>75</td>
<td>5.36</td>
<td>105</td>
<td>6.18</td>
</tr>
<tr>
<td>11</td>
<td>Chinese</td>
<td>85</td>
<td>6.54</td>
<td>110</td>
<td>5.24</td>
</tr>
<tr>
<td>12</td>
<td>Chinese</td>
<td>105</td>
<td>4.77</td>
<td>75</td>
<td>5.36</td>
</tr>
</tbody>
</table>

Average | 125.33 | 6.25 | 126.75 | 6.86 |
The results obtained here are somewhat lower than those obtained for the same measure by Loban (1976, p.27). In his study, the average number of words in a C-Unit for Grade Four subjects, ranged from 7.55 to 9.28. There was less variation in his group and his group mean seems slightly higher. This is justifiable in terms of the differences in methodology between the two investigations. Loban's study attempted to assess general oral and written language usage by questioning the sample on such popular topics as games, television, favourite magazines and books. This type of situation lends itself to a freer use of oral language. As he remarks (1976, p.19) "it is very likely that in a school situation and with an adult, some children shift the register of their speech, their usage, to some degree". He cites this as a limitation of his study. Furthermore he used high, low and random groups of students based on the Kuhlman-Anderson Intelligence Test (p.4). This criterion itself would be likely to limit variation within his sample.

There is another important difference between the two studies that would likely result in the slight discrepancy in obtained values. The interview schedule used here, although quite flexible in structure, did still require subjects to respond to a particular topic of which they probably had little formal knowledge and limited experience.
Such a situation would be expected to limit the flow of meaningful communication units and increase the flow of false starts, repetitions and language tangles (mazes).

**Concept-Related Vocabulary**

Greater variety and depth of vocabulary is a frequently used commonsense measure of language proficiency. James Brown (1959, p.80) claims that:

"If our word supply is inadequate our communication is of necessity inadequate too...."

In general many educators agree that good vocabulary development is necessary for social and academic achievement.

Two crude measures of vocabulary use are employed in this investigation. The first is simply a comparison of the number of nouns, verbs, adjectives and adverbs used, that are pertinent to expression of important aspects of the Life-Cycle concept. The other is the frequency of use of specific words.

The number of these words is shown in Tables 5.6 and 5.7. The proportion of nouns etc., to total words per C-Unit has not been considered as meaningful a measure to this study as the proportion of these words, since the latter may lead to erroneous interpretation of the data. Although Loban did use proportion exclusively and not number in his study of verbs, he concurs with the
following example to illustrate the point of comparison:

For instance:

Norma was petting a stray cat: 2 verbs in 6 words = 30% verbs

Our neighbour's pet dog must have been fighting an angry wild skunk: 4 verbs in 12 words = 30% verbs

The number of verbs increases, but the percentage remains the same (p.140).

Hence the total number of concept-related words is displayed (Tables 5.6 and 5.7) as a proportion of total word count for communication units. Also, the proportion of total concept-related words which consists of nouns, verbs etc. is given for both interviews.

A few points here deserve mention. The mean number and proportion of nouns and verbs is considerably higher for the Primary Language Users than for the Second Language Group. The reverse is true for the number and proportion of adjectives used. Native English Speakers use more adjectives than Second Language Users to discuss the Life-Cycle of the Mealworm Beetle. This results in a higher proportion for the Second Language Group of total concept-related words which are nouns and verbs (84.45 percent), than that for the Primary Language Group (82.12%). In such a case as this where the average number of words per C-Unit does not increase considerably, but a difference does exist in the number of adjectives used it may be assumed that the particular subject of group (EPL) has access to a more elaborated use of oral language. Despite this, it is surprising to find an overall higher percent concept-related
### TABLE 5.6

**CONCEPT RELATED WORDS OF ENGLISH PRIMARY LANGUAGE USERS**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Nouns</th>
<th>Verbs</th>
<th>Adjectives</th>
<th>Adverbs</th>
<th>Total C-R Words</th>
<th>Total Word Count for Words</th>
<th>% C-R Words</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Word Count for C-Units</td>
<td>% C-R Words</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>51</td>
<td>46</td>
<td>13</td>
<td>3</td>
<td>113</td>
<td>398</td>
<td>28.39</td>
</tr>
<tr>
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<td>13</td>
<td>3</td>
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<td>47</td>
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<td>28</td>
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<td>392</td>
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<td>11</td>
<td>47</td>
<td>38</td>
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<td>-</td>
<td>98</td>
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<td>31.01</td>
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<td>47</td>
<td>25</td>
<td>16</td>
<td>-</td>
<td>88</td>
<td>388</td>
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<td>36.17</td>
<td>35.58</td>
<td>15.83</td>
<td>1.1</td>
<td>94.68</td>
<td>335.25</td>
<td>29.15%</td>
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</table>

### TABLE 5.7

**CONCEPT-RELATED WORDS OF ENGLISH SECOND LANGUAGE USERS**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Nouns</th>
<th>Verbs</th>
<th>Adjectives</th>
<th>Adverbs</th>
<th>Total C-R Words</th>
<th>Total Word Count for C-Units</th>
<th>% C-R Words</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total C-Unit</td>
<td>Total</td>
<td>% C-R Words</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>21</td>
<td>22</td>
<td>17</td>
<td>-</td>
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<td>31</td>
<td>11</td>
<td>-</td>
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<td>41</td>
<td>37</td>
<td>7</td>
<td>-</td>
<td>85</td>
<td>260</td>
<td>32.69</td>
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<tr>
<td>5</td>
<td>47</td>
<td>35</td>
<td>16</td>
<td>-</td>
<td>98</td>
<td>272</td>
<td>36.03</td>
</tr>
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<td>6</td>
<td>40</td>
<td>21</td>
<td>18</td>
<td>-</td>
<td>79</td>
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<td>30.27</td>
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<td>7</td>
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<td>37</td>
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<td>-</td>
<td>92</td>
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<td>9</td>
<td>48</td>
<td>49</td>
<td>16</td>
<td>-</td>
<td>113</td>
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</tr>
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<td>10</td>
<td>20</td>
<td>19</td>
<td>7</td>
<td>-</td>
<td>46</td>
<td>180</td>
<td>25.55</td>
</tr>
<tr>
<td>11</td>
<td>34</td>
<td>22</td>
<td>17</td>
<td>-</td>
<td>73</td>
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<tr>
<td>12</td>
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<td>31</td>
<td>3</td>
<td>-</td>
<td>65</td>
<td>180</td>
<td>36.11</td>
</tr>
<tr>
<td>Average</td>
<td>36.67</td>
<td>30.25</td>
<td>12.25</td>
<td>.08</td>
<td>79.25</td>
<td>252.10</td>
<td>32.34%</td>
</tr>
</tbody>
</table>

Average % C-R Words Used

<table>
<thead>
<tr>
<th>Subject</th>
<th>Nouns</th>
<th>Verbs</th>
<th>Adjectives</th>
<th>Adverbs</th>
<th>Total C-R Words</th>
<th>Total Word Count for C-Units</th>
<th>% C-R Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21</td>
<td>22</td>
<td>17</td>
<td>-</td>
<td>60</td>
<td>174</td>
<td>34.48</td>
</tr>
<tr>
<td>2</td>
<td>28</td>
<td>31</td>
<td>11</td>
<td>-</td>
<td>70</td>
<td>205</td>
<td>34.14</td>
</tr>
<tr>
<td>3</td>
<td>22</td>
<td>16</td>
<td>14</td>
<td>1</td>
<td>53</td>
<td>140</td>
<td>37.85</td>
</tr>
<tr>
<td>4</td>
<td>41</td>
<td>37</td>
<td>7</td>
<td>-</td>
<td>85</td>
<td>260</td>
<td>32.69</td>
</tr>
<tr>
<td>5</td>
<td>47</td>
<td>35</td>
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<td>-</td>
<td>98</td>
<td>272</td>
<td>36.03</td>
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<td>21</td>
<td>18</td>
<td>-</td>
<td>79</td>
<td>261</td>
<td>30.27</td>
</tr>
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<td>7</td>
<td>62</td>
<td>43</td>
<td>12</td>
<td>-</td>
<td>117</td>
<td>371</td>
<td>31.54</td>
</tr>
<tr>
<td>8</td>
<td>46</td>
<td>37</td>
<td>9</td>
<td>-</td>
<td>92</td>
<td>366</td>
<td>25.14</td>
</tr>
<tr>
<td>9</td>
<td>48</td>
<td>49</td>
<td>16</td>
<td>-</td>
<td>113</td>
<td>421</td>
<td>26.84</td>
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<td>10</td>
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<td>19</td>
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<td>46</td>
<td>180</td>
<td>25.55</td>
</tr>
<tr>
<td>11</td>
<td>34</td>
<td>22</td>
<td>17</td>
<td>-</td>
<td>73</td>
<td>195</td>
<td>37.43</td>
</tr>
<tr>
<td>12</td>
<td>31</td>
<td>31</td>
<td>3</td>
<td>-</td>
<td>65</td>
<td>180</td>
<td>36.11</td>
</tr>
<tr>
<td>Average</td>
<td>36.67</td>
<td>30.25</td>
<td>12.25</td>
<td>.08</td>
<td>79.25</td>
<td>252.10</td>
<td>32.34%</td>
</tr>
</tbody>
</table>
words per C-Unit for English Second Language (ESL) (32.34%) than for English Primary Language (EPL) (29.16%) subjects. It is likely that a large portion of these concept-related words would in the case of the English Second Language group consist of unelaborated subject-predicate sequences. Adverbs are used infrequently by both language groups but when they occur their use is more prevalent for English Primary Language Users than for English Second Language Users.

Frequency of Use of Concept-Related Vocabulary

The lists of nouns, verbs, adjectives and adverbs used by the sample as a whole are included in Appendices. Of these the words used most frequently by the entire sample are shown in order of preference.

Of these, the words which the Second Language group used most prevalently are shown in Table 5.9 in their order of preference. The words with (*) asterisks are those used exclusively by Second Language Users. There seems to be less variety in the type of words used by English Second Language Users than those used by English Primary Language Users. English Second Language Users appear to resort more frequently to their own words or word combinations, e.g. "girl-beetle", "man-one" instead of the usually acceptable words available to the native speaker, "female", "male". For English Second Language Users, such words as "lady", "boy", "girl"
<table>
<thead>
<tr>
<th>Nouns</th>
<th>Verbs</th>
<th>Adjectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Most prevalent</strong></td>
<td><strong>Verb</strong></td>
<td><strong>Adjective</strong></td>
</tr>
<tr>
<td>beetle</td>
<td>grow</td>
<td>bigger</td>
</tr>
<tr>
<td>egg</td>
<td>have babies</td>
<td>small</td>
</tr>
<tr>
<td>baby</td>
<td>look like</td>
<td>little</td>
</tr>
<tr>
<td>one</td>
<td>have</td>
<td>big</td>
</tr>
<tr>
<td>mother</td>
<td>come out of</td>
<td>different</td>
</tr>
<tr>
<td>baby-beetle</td>
<td>hatch</td>
<td>young</td>
</tr>
<tr>
<td>worm</td>
<td>get</td>
<td>black</td>
</tr>
<tr>
<td>female</td>
<td>grow-up</td>
<td>smaller</td>
</tr>
<tr>
<td>adult</td>
<td>come from</td>
<td>grown-up</td>
</tr>
<tr>
<td>insect</td>
<td>die</td>
<td>brown</td>
</tr>
<tr>
<td>lady</td>
<td>change</td>
<td>white</td>
</tr>
<tr>
<td>father</td>
<td>turn into</td>
<td>full-grown</td>
</tr>
<tr>
<td>size</td>
<td>lay</td>
<td></td>
</tr>
<tr>
<td>shell</td>
<td>grow into</td>
<td></td>
</tr>
<tr>
<td>shape</td>
<td>change into</td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>be like</td>
<td></td>
</tr>
<tr>
<td></td>
<td>go</td>
<td></td>
</tr>
<tr>
<td>mother-beetle</td>
<td>get eggs</td>
<td></td>
</tr>
<tr>
<td>mealworm</td>
<td>crack</td>
<td></td>
</tr>
<tr>
<td>animal</td>
<td>get older</td>
<td></td>
</tr>
<tr>
<td>girl</td>
<td>become</td>
<td></td>
</tr>
<tr>
<td>larva</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pupa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>beetle-baby</td>
<td></td>
<td></td>
</tr>
<tr>
<td>beetle-mother</td>
<td></td>
<td></td>
</tr>
<tr>
<td>boy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>caterpillar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Least prevalent     | man-one              |              |
# TABLE 5.9

**WORDS COMMONLY USED BY ENGLISH SECOND LANGUAGE USERS**

<table>
<thead>
<tr>
<th>Nouns</th>
<th>Verbs</th>
<th>Adjectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Most prevalent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>egg</td>
<td>grow</td>
<td>small</td>
</tr>
<tr>
<td>baby</td>
<td>look like</td>
<td>little</td>
</tr>
<tr>
<td>beetle</td>
<td>have babies</td>
<td>bigger</td>
</tr>
<tr>
<td>one</td>
<td>come out of</td>
<td>big</td>
</tr>
<tr>
<td>mother</td>
<td>have</td>
<td>different</td>
</tr>
<tr>
<td>baby-beetle</td>
<td>hatch</td>
<td>black</td>
</tr>
<tr>
<td><em>lady</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>worm</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>beetle-baby</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>beetle-mother</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>boy</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Least prevalent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>girl-beetle</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>man-one</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
are popularly used in order to differentiate among beetles.

Use of Modifiers

It seems that when a child is unable to categorise an event readily in terms of his own experience, he is forced to refer to events which he considers analogous to that particular event. The analogies he uses therefore provide clues to the way he intuitively refers to such an event.

Just as it was necessary to identify the crucial concept-related words frequently used by the sample as a whole, so too, it is important to list (as shown in Appendix ) the phrases used by the subjects to express important and interesting aspects of the concept.

These modifiers, which are for the most part phrases, have been categorised firstly on the basis of the aspect of the concept they have been used to clarify, such as, identity, size, duration of events, change in time (growth). The second criterion for classification is the type of phrase itself, i.e. whether the modifier is purely descriptive or otherwise (inferential).

A descriptive phrase is defined here as one which clarifies certain qualitative features of the conceptual aspect to which it refers. These phrases are not necessarily comparative in that they only specify the set of characteristics inclusive or exclusive of the particular feature being discussed. All other phrases have been classified as
inferential. To be classed as such a phrase has to be "more than descriptive". It must pertain to a feature that is implied rather than explicit. Hence it also divulges to some extent the speaker's underlying notions about the conceptual aspect to which that phrase alludes.

For instance, such phrases such as:
   all living things
   just like the adult
   young and small
have been classified as descriptive. Other modifiers like, for e.g.
   like chickens hatch out of an egg
   too small to have babies
   from the egg to the full-grown one
   and in-between
have been taken to be inferential.

Generally speaking all subjects tended to use more descriptive than inferential phrases. This was expected since the topic chosen was not one that was especially familiar to the sample. The number of phrases used to explain the identity of the beetle and its offspring was by far greater than those used to elaborate on the size or growth of those organisms. The greater proportion of phrases listed for the sample came from native English speakers (56.94% for EPL vs. 43.06% for English Second Language Users, ESL). Of these, approximately (15.85%) 16 percent were Inferential. The rest were descriptive. As
a group, the English Second Language Users employed less modifiers than English Primary Language Users. In addition to this, the phrases used by the former (ESL) were also for the most part descriptive. Only 14.51 percent were Inferential. The most interesting feature of this portion of the data is the actual nature of words and phrases used by these children (Appendices G, H). However a syntactical analysis of their content is beyond the scope of the present study.
CHAPTER SIX

CRITICAL REVIEW OF LANGUAGE AND CONCEPT FINDINGS

An attempt will be made here to synthesise the findings presented separately in Chapter Four and Five. In mapping the features of oral language usage onto the conceptual content of the subject's ideas, it is hoped that some interesting and significant relationships may be brought to light.

RELATIONSHIP BETWEEN ORAL LANGUAGE USAGE AND CONCEPTUAL PATTERNS OF LIFE-CYCLE CONCEPTS

The Tables and Figures that follow serve to illustrate any trends evident in the way students use their oral language and the nature of the ideas they express on the Life-Cycle of the Mealworm Beetle. In Table 6.1 is summarised the mean number of communication units, mazes, and words per communication unit according to the group of subjects adhering to the same Conceptual Pattern of Life-Cycle Concepts.

It appears that there is no well-defined relationship between the number of communication units or mazes which a subject uses and the conceptual content of his ideas.
Neither verbosity nor exactness of expression appears characteristic of any particular Conceptual Pattern. This is consistently true for the English Primary Language Group as well as the English Second Language Users (Refer to Tables 6.2, 6.3). It is common-sense expectation that amount of communication would not be significant in this respect. It would be more likely that the type of words and reasoning used in communication would be pertinent.

<table>
<thead>
<tr>
<th>Oral Language Measure</th>
<th>Conceptual Pattern One</th>
<th>Conceptual Pattern Two</th>
<th>Conceptual Pattern Three</th>
<th>Conceptual Pattern Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean number of C-Units</td>
<td>25.87</td>
<td>19.13</td>
<td>22.58</td>
<td>19.58</td>
</tr>
<tr>
<td>Mean number of mazes</td>
<td>9.88</td>
<td>5.10</td>
<td>6.08</td>
<td>5.33</td>
</tr>
<tr>
<td>Mean number of words per C-Unit</td>
<td>8.20</td>
<td>6.65</td>
<td>6.75</td>
<td>6.35</td>
</tr>
</tbody>
</table>

The mean number of words per communication unit has been used in this study as some indication of fluency of
### TABLE 6.2
COMPARISON OF ORAL LANGUAGE MEASURES AND
CONCEPTUAL PATTERNS FOR ENGLISH
PRIMAR Y LANGUAGE USERS

<table>
<thead>
<tr>
<th>Oral language measure</th>
<th>Conceptual Pattern One</th>
<th>Conceptual Pattern Two</th>
<th>Conceptual Pattern Three</th>
<th>Conceptual Pattern Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of C-Units</td>
<td>25.25</td>
<td>19.87</td>
<td>26.16</td>
<td>21.16</td>
</tr>
<tr>
<td>Number of mazes</td>
<td>6.75</td>
<td>5.88</td>
<td>7.16</td>
<td>5.66</td>
</tr>
<tr>
<td>Number of words per C-Unit</td>
<td>8.00</td>
<td>7.16</td>
<td>6.57</td>
<td>7.77</td>
</tr>
<tr>
<td>Proportion of concept-related words per C-Unit</td>
<td>25.60%</td>
<td>25.92%</td>
<td>30.73%</td>
<td>30.36%</td>
</tr>
<tr>
<td>% Nouns</td>
<td>36.54%</td>
<td>46.89%</td>
<td>42.09%</td>
<td>51.41%</td>
</tr>
<tr>
<td>% Verbs</td>
<td>43.27%</td>
<td>33.85%</td>
<td>41.14%</td>
<td>36.97%</td>
</tr>
<tr>
<td>% Adjectives</td>
<td>20.19%</td>
<td>19.26%</td>
<td>16.77%</td>
<td>11.62%</td>
</tr>
</tbody>
</table>

### TABLE 6.3
COMPARISON OF ORAL LANGUAGE MEASURES AND
CONCEPTUAL PATTERNS FOR ENGLISH
SECOND LANGUAGE USERS

<table>
<thead>
<tr>
<th>Oral language measure</th>
<th>Conceptual Pattern One</th>
<th>Conceptual Pattern Two</th>
<th>Conceptual Pattern Three</th>
<th>Conceptual Pattern Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of C-Units</td>
<td>24.50</td>
<td>18.38</td>
<td>19.00</td>
<td>18.00</td>
</tr>
<tr>
<td>Number of mazes</td>
<td>13.00</td>
<td>4.32</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Number of words per C-Unit</td>
<td>8.39</td>
<td>6.15</td>
<td>6.92</td>
<td>4.93</td>
</tr>
<tr>
<td>Proportion of concept-related words per C-Unit</td>
<td>26.84%</td>
<td>32.49%</td>
<td>32.69%</td>
<td>36.11%</td>
</tr>
<tr>
<td>% Nouns</td>
<td>42.48%</td>
<td>46.58%</td>
<td>42.31%</td>
<td>47.69%</td>
</tr>
<tr>
<td>% Verbs</td>
<td>43.36%</td>
<td>35.80%</td>
<td>30.77%</td>
<td>47.69%</td>
</tr>
<tr>
<td>% Adjectives</td>
<td>14.16%</td>
<td>17.62%</td>
<td>26.92%</td>
<td>4.62%</td>
</tr>
</tbody>
</table>
expression. From the data presented here the fluency of subjects that adhere to Conceptual Pattern One seems significantly greater than that of other subjects. It is likely that this group in explaining the Life-Cycle of the Mealworm Beetle in terms of the human growth cycle apparently stumbled on a topic familiar to them. This would lead to an increase in easy production of oral language in the form of illustrations and analogies to justify their position. For the other subjects, attempting to use intuition less, and more logically deductive solutions about conflicting information they have detected, would tend to reduce fluency in communication. It is notable too that subjects in the first group, Conceptual Pattern One have a larger mean number of mazes. These subjects tended to be more repetitious. However, the number of language tangles for all other groups of subjects does not vary greatly. This variation probably indicates a more reflective type of expression as sometimes associated with problem-solving techniques.

**RELATIONSHIP BETWEEN CONCEPT-RELATED VOCABULARY AND CONCEPTUAL PATTERNS OF LIFE-CYCLE CONCEPTS**

The data indicates a steady increase in the proportion of concept-related words across Conceptual Patterns, with a general tendency to an increased proportion of nouns. Because this life-cycle has four stages, and it is
necessary to name the organisms which represent each stage, it seems reasonable to assume that a subject describing a process with four stages, the true cycle, would need to use more nouns, that is to explain his view, than a subject who proposes a simpler cycle with less or no such stages. Therefore, it appears that the positive relationship observed between overall number of words used to relate specific aspects of the concept and the patterns of belief identified, is of particular interest. Furthermore the fact that students who used English as a Second Language tended to use consistently a higher proportion of concept-related words than native English-speakers indicates that their precise use of certain words appears to compensate for any supposed deficit in oral language.

<table>
<thead>
<tr>
<th>Oral Language Measure</th>
<th>Conceptual Pattern One</th>
<th>Conceptual Pattern Two</th>
<th>Conceptual Pattern Three</th>
<th>Conceptual Pattern Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Proportion of Concept-related words per C-Unit (%)</td>
<td>26.22</td>
<td>29.20</td>
<td>31.71</td>
<td>33.23</td>
</tr>
<tr>
<td>Proportion of Nouns (%)</td>
<td>39.63</td>
<td>46.74</td>
<td>42.19</td>
<td>46.95</td>
</tr>
<tr>
<td>Proportion of Verbs (%)</td>
<td>43.31</td>
<td>34.81</td>
<td>37.67</td>
<td>44.79</td>
</tr>
<tr>
<td>Proportion of Adjectives (%)</td>
<td>17.06</td>
<td>18.45</td>
<td>20.13</td>
<td>8.26</td>
</tr>
</tbody>
</table>
Significance of Vocabulary

At this point it is interesting to discuss the words used to designate the many stages in the Life-Cycle of the Mealworm Beetle. Instead of using the classic nouns that appear frequently in textbooks, words such as "larva", "mealworm", "pupa", subjects tended to substitute their own words. Subjects with Conceptual Patterns one and two frequently used such terms as "beetle-baby", "baby-beetle", "small beetles", "babies", "baby-ones" to denote the offspring of the beetle. In Conceptual Patterns three and four where subjects attempted to differentiate between multiple forms of offspring, other words such as "nymph", "worms", "caterpillars", "silkworms" were used to describe the larvae.
and pupae. One English-speaking student used the terms "larva" and "pupa", explaining that they were "scientific words". One girl used the term "mealworm" but her description of a "mealworm" made it clear that she was uncertain of its correct use and meaning.

The majority of English-speaking subjects (Conceptual Patterns one and two) repeatedly used the term "baby-beetle", whereas English Second Language speakers used "baby-beetle" as well as "beetle-baby". These terms as well as other word combinations such as "beetle-mother", "baby-one" were frequently used by English Second Language Users in preference to the standard scientific terminology such as "egg", "mealworm" etc. This ability to compose their own words apparently did not hinder their expression of ideas and appropriate use of oral language. All of the word combinations such as those mentioned above which were used to differentiate or name organisms were classified as nouns. Because of the structure of these word-combinations it seems appropriate to postulate and account for the less frequent occurrence of adjectives in the language of English Second Language subjects. Consequently the claim cannot be made here with certainty that such subjects employed a less elaborated code of oral language but rather, that they had a uniquely appropriate way of using their words to depict relevant features of the Life-Cycle of the Mealworm Beetle.

Throughout both sets of interviews only two subjects made mention of the "life-Cycle" of the beetle. Both of
these were English-speaking and one subscribed to Conceptual Pattern four. The word "stage" was used by four subjects to denote different conditions of growth. Generally speaking subjects referred to "the way the beetle changed" or "how it grew" and what it "became" or "turned into" at various times. It is interesting that although so few of the sample used standard scientific terminology, they all, seemed to have an acceptable understanding of the continuous and regenerative aspects of the growth cycle in spite of the particular cycle proposed.

SIGNIFICANCE OF VERBAL REASONING STRATEGY

Bereiter et al (1977, p.3) claim that by linking certain ideas "an intuitive reasoner is disposed to make certain valid and certain invalid conclusions". Furthermore these researchers interpret Piaget (1967) to mean that "certain conclusions are evoked by verbal statements". If it is assumed that intuitive reasoners are insensitive to logically connected and logically unconnected assertions, then the two subjects who fell into the Syncretic Response Mode category are justifiably intuitive reasoners.

According to Bereiter et al (1977), in looking at verbal reasoning by grade and response type, grade four students had a significantly higher proportion of logically correct responses than grade two, but slightly less
than Grades six and eight. Grade two students tended to be intuitive reasoners whereas older children tended to reason deductively. Deductive reasoners follow a systematic way of making a judgement based on logically conclusive information. Seemingly, this ability develops in middle or late childhood.

The foregoing statements will support the lag in verbal reasoning observed in this sample. Syncretic subjects are intuitive reasoners. Those that are classed in the Explanatory and Relevant Mode are deductive reasoners. The Pre-Emptive Mode consists of subjects in the process of developing a deductive reasoning strategy.

This appears to be consistent with the notions expressed by Phillips (1977) in discussing Vyhotisky's contribution:

The development of a scientific concept begins with a verbal statement.

(p.38)

The child therefore moves from earlier intuitive stages of reasoning to a stage where certain attributes and aspects of events can be abstracted and generalised by him, and these generalisations appropriately applied to other circumstances.

SIGNIFICANCE OF MATERIALS

It is clear from results in Chapter Five (Refer Tables 3a, 3b, 4.5 ) that each interview condition
functioned in a different manner for each of the two sample sub-groups. Since difference in Interview Condition was directly related to presence of materials, any change in performance between the Verbal and the Verbal Manipulative would result from the presence or absence of materials.

Whereas there was a clear decrease in the flow of words for English Primary Language Group (in the Verbal Manipulative Condition), there was a slight increase in number of words for English Second Language group over that of the Verbal Condition. This is an interesting feature. At first glance it appears that the presence of materials - live specimens acts to stimulate and facilitate oral language flow for Second Language Users. Maybe this is so because by viewing and handling specimens they can more readily "find" or compose the appropriate words. Hilyard (1977) supports the claim that at first children "learn to draw inferences from information which assumes or maps onto their prior knowledge" and also learn "to draw the necessary implications from information which contradicts their prior world knowledge". Williams and Adams (1976, p.145) in their study, found that "if bilingual students are to be taught in their nondominant language... the discovery method should be considered a viable teaching method", despite the fact that the verbal
teaching method is effective for both bilingual and unilingual subjects.

As to the question of decreased word-count for English Primary Language Users in the Verbal Manipulative Interview, it is likely that this resulted from a significantly higher average number of mazes in the Verbal Condition. It appears then that without the materials this group gets involved in more language tangles in order to explain their point of view. The materials therefore function to make their use of oral language more efficient, relevant and precise. This dramatic difference in maze count is not evident for English Second Language Users probably because when using their nondominant language they think carefully before speaking, that is, they make continual efforts at precision. This hypothesis receives support from the generally slower rate of speech observed in English Second Language Users - sometimes visibly muttering to themselves before speaking aloud to the Interviewer.

Whether the presence of materials functions alternatively to provide the needed "prior world knowledge", or to facilitate use of appropriate concept-related words for oral expression cannot be determined here. It is sufficient to note that their use, in this case, live specimens, was directly related to some significant change in performance for each language sub-group.
CONCLUSIONS AND RECOMMENDATIONS

In Chapter One the general and specific problems for investigation were outlined. This was followed by a justification of the theoretical position applicable to the problem - the interaction of oral language and biological concepts.

The study itself evolved from the responses of subjects to research and probe questions on the Life-Cycle of the Mealworm Beetle, Tenebrio molitor. These interviews were examined, and general patterns or conceptual schemes of individual subjects were identified and grouped together on the basis of their similar conceptual content. This allowed further analysis of oral language content and verbal reasoning mode for the responses of two sub-groups of the sample. Some aspects of the results presented respectively in Chapters Four and Five have been critically reviewed in Chapter Six.

Conclusions

Although this study was not intended to provide definite solutions to any particular problem, or to test a
particular explicitly-stated hypothesis, the findings that have resulted from this exploratory investigation may be of special interest to elementary school teachers. Based on the results obtained here a number of conclusions may be offered in response to the issues stated in Chapter One (p.1).

Firstly, students who employ English as a Primary Language (EPL) and those who use English as a Second Language (ESL) have similar notions on the Life-Cycle of the Mealworm Beetle. No one group was found to have ideas that were exclusively their own, though the trend indicated that a larger number of ESL students than EPL students ascribed to certain patterns of ideas.

Secondly, a list has been provided in Appendices G and H of words and phrases used by the entire sample to describe certain underlying components of the Life-Cycle concept, such as size, physical identity, duration of events. There is also indication as to which of the listed words and phrases were more frequently used by ESL subjects than EPL subjects.

Thirdly, a perusal of the above list gives clear indication as to the "unscientific" nature of most of the vocabulary used by both sub-groups to express their viewpoints.

Fourthly, the appropriate Tables and Figures in Chapters Four and Five suggest that the type and frequency
of nouns, verbs, adjectives, and the type of modifiers did differ for each language sub-group and, that differences in these measures were also related to the interview condition, Verbal or Verbal-Manipulative. It appeared that the presence of materials functioned differently for each group of subjects in the sample.

**Implications for Further Research:**

This study, being exploratory in nature revealed a number of interesting research questions on oral language of expression and scientific concept attainment in unilinguals and bilinguals. Many of the suggested studies will have tremendous educational significance.

The tentative findings of this study point to some issues that need to be researched further:

1) To what extent does the syntactic structure of the dominant language of a non-fluent bilingual student present a hindrance or predisposition for his attainment of particular scientific concepts.

2) To what extent does the oral language of non-native English-speaking students constitute a common code or to what extent does their oral English Language usage depend on the nature of their dominant language.
For example it was evident from data in Table 5.5 that on the average the Punjabi-speaking group had a higher word count than Chinese-speaking students. This type of problem is an interesting one to explore.

3) To what extent does the syntactic structure of the dominant dialect of a bidialectical student present an hindrance or predisposition for his attainment of particular scientific concepts?

4) To what extent and when should science instruction be conducted in the student's dominant language or dialect in order to maximise assimilation of certain scientific concepts?

5) To what extent do significant changes in the development of scientific concepts over time in middle childhood parallel language development and verbal reasoning strategies?

6) What teaching strategies best suit a group of students depending on their language, dialect or cultural background?

7) How should teachers adequately assess achievement in science for students with a second language or second dialect? To what extent should assessment rely on overall language proficiency and fluency?
8) Should the curriculum of the second language student be reorganised around his experience and interests to facilitate scientific concept learning? What is the nature of the way in which materials function for the second language user?

Many of the questions stated above pertain to the relationship of language and thought but specifically to the interaction between language of communication and language of expression, and attainment of scientific concepts. There is a paucity of research relating to biological concept development in the middle grades. Many researchers have succeeded in clarifying to some extent how language and thought processes act and interact in the young child, but the educational significance of much of this information for the older child (10-14 years) has been to a large extent ignored.

It is even more important for educators to determine specifically what strategies are best for the conceptual development of which members of their school population. Recently, there has been a considerable interest in the language and cognitive processes of bilinguals. This renewed interest raises a number of parallel questions for the child who speaks a dialect at home - the child
who belongs to a different speech community. This problem has been receiving increased attention recently by British Educators (Hester and Wight, 1977).

Science has also reached its pinnacle of importance in this highly technological 20th century. Many of the bilingual or bidialectical students at schools throughout Canada have been reared in cultures in which the nature of the indigenous traditional thought and its ideology is in direct conflict with the nature of Western scientific thought prevalent in their schools. It is likely that such students have to struggle to accommodate to this 'new' way of thinking in order to achieve academic success. Consequently the need for research studies such as those mentioned above has become even more pressing for science education and the solution of its modern-day problems.

Because of the nature of this study, it has implications for researching the problems associated with use of English as a medium of science instruction for English Second Language students in Canada. Many of these children have migrated here from developing countries where the language of instruction is also a language or dialect other than the one they use frequently at home. This dilemma therefore has to be confronted by developed as well as developing nations. It is not enough to seek solutions in developed countries and impose these on
developing systems of the Third World. Rather, it is of utmost importance that the question itself be explored fully and individual solutions sought at its source.
APPENDIX A

INTERVIEW SCHEDULE

<table>
<thead>
<tr>
<th>Subject</th>
<th>Language Group</th>
<th>Interview 1 - Week 1 Condition</th>
<th>Interview 2 - Week 3 Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ESL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>2</td>
<td>EPL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>3</td>
<td>EPL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>4</td>
<td>EPL</td>
<td>VM</td>
<td>V</td>
</tr>
<tr>
<td>5</td>
<td>ESL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>6</td>
<td>ESL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>7</td>
<td>ESL</td>
<td>VM</td>
<td>V</td>
</tr>
<tr>
<td>8</td>
<td>ESL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>9</td>
<td>EPL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>10</td>
<td>EPL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>11</td>
<td>EPL</td>
<td>VM</td>
<td>V</td>
</tr>
<tr>
<td>12</td>
<td>EPL</td>
<td>VM</td>
<td>V</td>
</tr>
<tr>
<td>13</td>
<td>ESL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>14</td>
<td>ESL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>15</td>
<td>ESL</td>
<td>VM</td>
<td>V</td>
</tr>
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<td>16</td>
<td>ESL</td>
<td>VM</td>
<td>V</td>
</tr>
<tr>
<td>17</td>
<td>EPL</td>
<td>VM</td>
<td>V</td>
</tr>
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<td>V</td>
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<td>19</td>
<td>EPL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>20</td>
<td>EPL</td>
<td>VM</td>
<td>V</td>
</tr>
<tr>
<td>21</td>
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</tr>
<tr>
<td>22</td>
<td>EPL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>23</td>
<td>ESL</td>
<td>V</td>
<td>VM</td>
</tr>
<tr>
<td>24</td>
<td>ESL</td>
<td>VM</td>
<td>V</td>
</tr>
</tbody>
</table>

Legend

EPL - English Primary Language User
ESL - English Second Language User
V - Verbal
VM - Verbal Manipulative
APPENDIX B

LIST OF MATERIALS FOR VERBAL MANIPULATIVE INTERVIEWS

4 Glass petri dishes
1 Large clear plastic container for culture
1 Actively growing culture of Mealworm Beetles
1 Small glass bottle
1 Large clear plastic tray
  spatula, tweezers, labels, masking tape, grease-proof pencil
Portable video and audio tape equipment
APPENDIX C

PROTOCOL LIFE-CYCLE OF TENEBRIONID
MOLITOR

Name: School Verbal _______
Date: ESL ____ EPL ____ Verbal Manipulative ________

1. Can beetles have young?
2. Can all beetles have young?
3. Can you tell what I need to start growing beetles?
4. Can you tell whether a beetle is old enough to have young?
5. Can you tell what the young of beetles look like?
6. Can you tell what happens (to the egg?)
7. Can you tell what happens (to the larva?)
8. Can you tell what happens to the (young beetle) as it grows?
9. Can you tell how I can get beetles from (beetle-eggs?)
10. Can you tell how I can get eggs from (young beetles?)
11. Can these (egg, larva, pupa, adult) be put in order to show how a beetle grows?
12. Suppose this were a story what name would you give this story? What does this story tell?

Comments:
APPENDIX D

GENERAL GUIDELINES FOR INTERVIEWS

1. General Time Plan of Interviews

We assume that the general time pattern of the inter­view is like this:

\[ \begin{array}{cccc}
1 & 2 & 3 & 4 \\
\text{noise} & \text{child's initial} & \text{noise plus} & \text{new conception} \\
\text{conception is} & \text{new aspects} & \text{is dominant} \\
\text{dominant for} & \text{of the} & \text{for some time} \\
\text{some time} & \text{situation} & \text{time} \\
\end{array} \]

1. First, we want to determine the child's initial conception.

a) Let the child introduce his own terminology to describe the balance, its behaviour, and his actions on it. In particular, be sensitive to:

i) Whether the child speaks of the two arms or sides or whether he speaks of the whole beam.

ii) Whether the child speaks of the motion of the balance ("making it go up or down") or of the state of the balance ("it will be up here," or "it will be level").

iii) Whether the child speaks of putting on, hanging, hooking on or adding more weights.

b) Continue to use substantially the child's terminology, not your own.

c) Try to frame your questions around the child's actions on the apparatus and your actions on the apparatus.

But:

b'. You may use some unfamiliar terminology and,
c'. You should present the child with tasks that he does not react to properly (gives unusual response, is insecure, or wrong), a few times during this initial period.

2. Mix the types of questions to avoid building too much "set" and thereby allowing control of the interview to be relinquished to unwanted influences. Avoid "runs" of very similar configurations. (Be sure the questions are unambiguous). Mix especially these types of questions:
   a) Achieve equilibrium vs. "Will it balance?"
   b) Difficult vs. easy;
   c) Where child observes the construction of the configuration (puts on or watches you put on washers) vs. where child doesn't observe the steps in construction but has to judge strictly from the appearance of the configurations;
   d) Where attention is focused on positions near the centre vs. where attention is focused near the ends of the balance.

3. If the child's initial conception has been explored thoroughly, introduce new elements (new aspects and problem situations), at a high rate.

4. After learning has taken place and a new conception seems to have been reached, explore it as in I.3.

II. General remarks on how to interact with the child.

1. Maximize the number of usable expressive acts.
   a) Encourage verbal output.
      i) Ask explanations, especially at critical points.
      ii) Avoid questions that permit yes or no answers. Say, for example:
Show me.
Show me with your hand.
If you were the balance.....
Show me with your hands the way you just started to.

2. Make sure the relationship between your questions and actions and those of the child are clear.

a) Give the child time to react after a question (maximum of five seconds); avoid immediate reformulation of the question.

b) If you aren't sure the child is doing something in response to your question, ask. For example:

Is that what I asked you to tell me (to do)?

3. Be highly appreciative when the child takes an initiative, especially one related to the situation at hand, or more generally, any pertinent aspect of the apparatus. Follow through on his ideas.

4. Be especially sensitive to levels of generality and presuppositions you might have in forming your questions and what might be implied by them.

a) Use the most general phrases with the fewest presuppositions which you think expresses the task. Only if the child has trouble connecting, become more specific. For example:

What will happen?...vs. How will it go? vs. Which way will it go?
Show me. vs. Show me with your hands.
Where do you put it? vs. On what side (hook) do you put it?

But caution:

b) Pay special attention to what implications your questions might have in light of your presuppositions.

Given the balance in equilibrium, say one washer on each end: What will happen if you put it (a washer) somewhere else? vs. What if you moved it in here?
Ill Miscellaneous

1. Focus your attention on the child at all times. Avoid getting too involved in the child's reactions to your question, i.e., maintain a little bit of reserve. Also avoid situations that would focus the child's attention on you, thereby disturbing the task context.

2. Be sure questions are absolutely clear. Clear up any unclear statements of the child. If necessary, ask him to repeat himself again.

3. When there is reasonable doubt that a particular response is consistent with the rest of the child's repertoire, he should be given a second opportunity to see if the response is repeated.

Klaus G. Witz and David R. Goodwin
July 20, 1970.
APPENDIX E

EXCERPT OF TRANSCRIPT: SEGMENTATION OF FLOW
OF ORAL LANGUAGE

"... I think so./ The big ones can have babies./ Only females can have babies./ Males don't have babies cause it's just like men don't have babies/... (Find a thing to put them in and feed them - the beetles - black ones) You can raise the little ones/ and they'll grow and have babies./ You can start with grown-up ones and they'll have babies/ and the mother dies/... They must be black/ (They don't have to be grown-up)/ The child grows up and has babies./ (Probably the big ones - because the big one will probably be grown-up and the little ones will be babies).

/------/ indicates a communication-unit
(------) indicates a maze-unit

To facilitate simple descriptive analysis using an (SPSS) computer program package, it became essential to code transcripts in a manner that could be read by the computer to produce the necessary summary statistics. Each C-Unit/M-Unit was coded by a triplet. This began with a '2'in
the case of a C-Unit and a '1' in the case of a maze.
For e.g. a C-Unit with 11 words would be coded '211'.
A M-Unit with 20 words would be encoded '120'.

A C-Unit such as this:
"/The egg comes from the mother/"
would be coded:

```
206 316 409 333
```

C-Unit: with 6 words in all
containing a noun listed as #16
a verb listed as #9
and another noun listed as #33
This is a test of your ability to tell which one of five simple shapes can be found in a more complex pattern. At the top of each page in this test are five simple shapes lettered A, B, C, D, and E. Beneath each row of shapes is a page of patterns. Each pattern has a row of letters beneath it. The correct answer is shown by a circle around the letter of the shape of the shape which you are to find in the pattern. When you have found the shape of the pattern, use the pencil supplied to outline it as shown in the examples below.

NOTE: There is only one of these figures in each pattern, and this figure will always be right side up and exactly the same size as one of the five lettered figures.

Now try these 2 examples.

The figures below show how the figures are included in the problems. Figure A is in the first problem and figure D in the second.

You will have 10 minutes for each of the two parts of this test. Each part has 2 pages. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

DO NOT TURN THIS PAGE UNTIL ASKED TO DO SO.
### APPENDIX G (A)

**LIST OF CONCEPT-RELATED WORDS**

#### 3. NOUNS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>adult</td>
</tr>
<tr>
<td>2.</td>
<td>animal</td>
</tr>
<tr>
<td>3.</td>
<td>baby</td>
</tr>
<tr>
<td>4.</td>
<td>baby-beetle</td>
</tr>
<tr>
<td>5.</td>
<td>*baby-egg</td>
</tr>
<tr>
<td>6.</td>
<td>*baby-worm</td>
</tr>
<tr>
<td>7.</td>
<td>beetle</td>
</tr>
<tr>
<td>8.</td>
<td>*beetle-baby</td>
</tr>
<tr>
<td>9.</td>
<td>*beetle-mother</td>
</tr>
<tr>
<td>10.</td>
<td>*boy</td>
</tr>
<tr>
<td>11.</td>
<td>bug</td>
</tr>
<tr>
<td>12.</td>
<td>caterpillar</td>
</tr>
<tr>
<td>13.</td>
<td>cocoon</td>
</tr>
<tr>
<td>14.</td>
<td>cycle</td>
</tr>
<tr>
<td>15.</td>
<td>*daddy-beetle</td>
</tr>
<tr>
<td>16.</td>
<td>egg</td>
</tr>
<tr>
<td>17.</td>
<td>father</td>
</tr>
<tr>
<td>18.</td>
<td>*father-beetle</td>
</tr>
<tr>
<td>19.</td>
<td>female</td>
</tr>
<tr>
<td>20.</td>
<td>form</td>
</tr>
<tr>
<td>21.</td>
<td>insect</td>
</tr>
<tr>
<td>22.</td>
<td>girl</td>
</tr>
<tr>
<td>23.</td>
<td>*girl-beetle</td>
</tr>
<tr>
<td>24.</td>
<td>lady</td>
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(*) indicates words used exclusively by English Second Language Subjects.
APPENDIX G(B)

4. VERBS

1. *be (instead of "become")
2. be like
3. become
4. break
5. break out
6. break open
7. *break up
8. come
9. come from
10. come out (of)
11. change
12. change from
13. change into
14. change like
15. *change to be
16. crack
17. crack open
18. die
19. get
20. *get cracked
21. get eggs
22. *get old
23. get older
24. get out
25. *give
26. *give
27. give eggs
28. go
29. *go out
30. grow
31. grow into
32. *grow like
33. grow up
34. happen over and over
35. have
36. have babies
37. hatch
38. *hatch from
39. *hatch into
40. keep going on
41. lay
42. look like
43. make
44. produce
45. push
46. turn into
47. uncurl
48. start
49. start off
50. start with
51. start to have
52. stay alive

* indicates etc...
APPENDIX G (c)

5. ADJECTIVES

1. alive
2. big
3. bigger
4. black
5. blackish-brown
6. *broader
7. brown
8. crinkled
9. *curved
10. darker
11. *dead
12. different
13. *"eensy-weensy"
14. full-grown
15. *funny-looking
16. grown-up
17. hard
18. *large
19. *larger
20. light
21. little
22. long
23. *medium-size
24. middle-sized
25. newborn
26. older
27. oldest
28. round
29. skinny
30. small
31. *smaller
32. *shorter
33. soft
34. squished
35. white
36. young
37. younger

ADVERBS

1. Already
2. eventually
3. finally
4. gradually
5. probably
6. slowly
APPENDIX H (A)

LIST OF CONCEPT-RELATED MODIFIERS

1. **IDENTITY**

D1. a little bump on the egg
I2. a little different from the beetles
D3. all living things
D4. all the same
D5. all in a bunch
I6. almost the same as the mother's
I7. as strong as the mother
D8. *babies like it
D9. crinkled and cramped
D10. *different from the mother
I11. different from all other worms
D12. different kinds of insects
I13. exactly the same as
D14. *from the bottom where the legs are
I15. *grown-up like the black beetle
D16. just babies
D17. just born
D18. just like the adult
D19. just like the baby
D20. *kind of round
D21. *kind of yellow
D22. *like an ant
D23. *like a boy or girl
D24. *like a boy
D25. like a caterpillar
D26. like a fly
D27. *like a lady
D28. like a little insect
D29. like a worm but hairy with lots of legs
D30. like babies
D31. like butterflies inside a cocoon
D32. like chicken eggs
D33. like human beings
D34. like sand
D35. like the mother or father
D36. like the mother-beetle
D37. like worms
D38. more like a beetle
D39. moving a little
D40. not the same form
D41. newborn beetle
D42. *only mother
D43. *only grown-ups
D44. only the babies
D45. one kind of
I46. same body structure
I47. same body texture
I48. *same thing as the mother
D49. something like a ball
D50. something like the parents
D51. the life of a beetle
D52. *the same life as
D53. *very brown-like
D54. very few of them
D55. yellow skin with stripes

* indicates etc...
D = descriptive
I = Inferential
APPENDIX H (B)

2. SIZE

I1. a bit smaller than the adult
D2. a certain size
D3. about an inch
D4. about one centimetre
D5. as big as that one
D6. as big as the mother
I7. big enough
D8. *big like the mother
D9. bigger and bigger
D10. bigger than the little beetle
I11. because of its size
I12. because they're younger they're smaller
D13. bigger and bigger
I14. *just smaller than the big ones
D15. little smaller
D16. normal size
D17. only smaller
D18. really small
D19. right size
I20. same as the adult except a little smaller
I21. *same as the big one but smaller
D22. same size as the mother
D23. *sort of like ants
I24. *strong enough to make eggs
I25. the size they're supposed to be
I26. *too small to have babies
D27. young and small

* =indicates etc...
D =descriptive
I =Inferential
APPENDIX H(c)

3. **TIME**

1. D about one week
2. D about two or three months
3. D after a few days
4. D after a while
5. D day after day
6. D first ... then
7. D for a couple of months
8. D for a little while
9. D for a long time
10. D in another few days
11. D one day
12. D quite a while
APPENDIX H(d)

4. GROWTH

D1. a part of this growing up
D2. babies growing inside her stomach
D3. *big by eating
D4. bigger like the mother or father
D5. *by eating and stretching
D6. *by food
I7. *changing by growing bigger
D8. eggs inside them
I9. from egg to adult
D10. *from light to dark
I11. from mealworms to beetles
D12. *from small then goes bigger
I13. *from the egg to the full-grown one and in-between
D14. *from the stomach of the lady-one
I15. *growing from eating
I16. *growing half-way
D17. inside of this
D18. inside the egg
D19. into little beetles
D20. into a full-grown beetle
I21. like chickens hatch out of an egg
I22. *like how a silkworm grows
D23. like we grow
D24. not grown yet
I25. *small all the way to big until they die
I26. too young

* indicates etc...
D = descriptive
I = inferential
BIBLIOGRAPHY


