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A STUDY OF THE CORRELATION BETWEEN INTELLIGENCE AND READING COMPREHENSION

THE CASE OF MIDDLE SCHOOL 4th YEAR LEARNERS

Dissertation submitted to the Institute of Foreign Languages in partial fulfilment of the requirements for the Degree of Magister in Didactics: Reading and Writing Convergences.

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DEDICATION

This project is dedicated to my grandparents, Mohammed and Fatima SAIDOUNI; my parents, Salim and Zahia BADER; my sisters, Nouha and Romeila BADER; and my brother-in-law Issam BENSIKHELIFA who have been constantly considerate and supportive and have graciously put up with the inconvenience and negligence that I have afflicted upon them in the course of the study.

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ABSTRACT

This study is an attempt to integrate intelligence into reading comprehension. It aims at investigating whether the 15-year-olds who possess higher intellectual abilities comprehend texts that are written in English as a Foreign Language better than those with lesser intellectual abilities.

A pilot study has been carried out involving 50 pupils enrolled in classes at fourth year middle school level in Constantine. It has been completed in two parts; the first part has been devoted to the assessment of pupils' general intelligence and the second part to their reading comprehension of narrative and expository texts. The results have indicated that both tests were not really sound and user-friendly. Thus, global and local revisions have been indispensable.

The statistical study of the main study has been completed, like the pilot one, in two parts. The first part has included 95 pupils of the same school, and a comparative analysis has been done on their scores on a group intelligence test (vocabulary, similarities and differences, series, reasoning, problem-solving, decision making). The second part involved the same pupils and the same number (95 pupils that were included in the first part), and concerned the students' reading comprehension of two texts (expository and narrative).

A variety of tables and diagrams is used to show differences in the pupils' performance on the intelligence test and the reading comprehension exercises.

The correlation between the two variables (intelligence and reading comprehension) showed very significant results in the areas of intelligence and reading comprehension that would be useful for education and curriculum developers in designing curriculum changes to meet the needs of all pupils.

LIST OF ABBREVIATIONS

CA……...Chronological Age

EFL……English as a Foreign Language

FL……...Foreign Language

Fw…….Word Fluency

G……General Factor of Intelligence

Gc……..Crystallised Intelligence

Gf……..Fluid Intelligence

I……Inductive Reasoning

IQ…….Intelligence Quotient

IT…….….Inspection time

K:m …….Spatial-Mechanical-Practical Abilities

L2…….Second Language

Ma……Associative Short-Term Memory

MA……Mental Age

MCQ…….Multiple Choice Questions

MI……..Multiple Intelligences

N……..Numerical Facility

P……...Perceptual Speed

R……...practical problem reasoning

Rs…….Deductive Reasoning

S……...Spatial Relations

SSR……..Sustained Silent Reading

V……..Verbal Comprehension

VE……Verbal Efficiency

V:ed…….Verbal-Educational Abilities

WM……..Working Memory

LIST OF SYMBOLS

∑ ……Sum

M……Mean

N……Number of Cases

r……..Correlation Coefficient

SD*x*……Standard Deviation of X Scores

SD*y*…….Standard Deviation of Y Scores

***x*.....Deviation of x Scores from the Mean**

***y*…….Deviation of y Scores from the Mean**

***xy*……..Cross-Products**

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INTRODUCTION

I. Statement of the Research Problem

Comprehension can be said to represent the reason for reading. If readers can read the words but do not understand what they are reading, they are not really reading. In fact, as they read, good readers are active; this is a hallmark of an efficient reader. To make sense of what they read, they need to engage in complicated processes. This would justify the interest of cognitive psychologists who have devoted a considerable amount of effort in trying to understand the cognitive processes involved in such a complex skill as reading. In the context of a foreign language, novice readers are, most of time, handicapped by insufficient vocabulary or a forgotten rule. For this reason, this study has focused mainly on the cognitive strategies used by readers, regardless of their knowledge of vocabulary and English language structure, in order to make sense of the text and know how to get the most of it. Thus, it is possible that some intellectual capacities like the ability to reason logically and solve problems effectively bear on the readers' extraction of meaning from print. This paper seeks to examine the cognitive strategies that help learners make sense of what they read in order to make them readers who are in control of their own comprehension.

II. Purpose of the Study

Reading is a quest for meaning which presents particular challenges for English as a Foreign Language learners and that requires a lot of skills. In fact, this cognitive activity requires the readers to be active participants in the construction of meaning. Starting from this point, the present study is intended to investigate the impact of Algerian pupil's intellectual

abilities on their comprehension of foreign language texts. In other words, we attempt to integrate 15-yaer-olds intelligence as a property of mind that encompasses many related abilities, such as the capacities to reason, plan, solve problems and think abstractly (as characteristics of good and active readers) in getting meaning out of a text written in English as a Foreign Language.

III. Research Questions

The primary question of this study is:

- Are highly intelligent pupils able to comprehend a print written in English as a Foreign Language better than those who are intellectually less capable?

Supporting questions include:

- Which specific intellectual abilities best explain reading comprehension?
- How can readers, at early levels, read effectively even with the possession of poor vocabulary?
- What differentiates good from poor comprehenders?

IV. Hypothesis

Our study is directed by one main hypothesis related to the concept of intelligence as a predictor of young learners' reading comprehension. Thus, we hypothesise that Algerian 15-year-old pupils who own high cognitive abilities are more capable of comprehending a text written in English as a Foreign Language than those who have lower cognitive abilities. In other words, we predict that Algerian 15-year-olds who are more capable of reasoning

logically, solving problems effectively, planning and thinking abstractly are better comprehenders of a print written in English as a Foreign Language than the readers who are less capable.

V. Objectives of the Study

The steps, necessary to answer the research questions, stated as objectives are:

- Review of the literature to develop a conceptual framework from which the theoretical foundations for the study questions have been constructed.
- Construct and implement the study.
- Analyse the outcomes.
- Draw conclusions from the data generated from the study.
- Suggest some implications that would help teachers and curriculum designers meet the learners' needs.

VI. Instruments

In order to assess pupils' intelligence and reading comprehension, and then to test the hypothesis stated previously, two tests have been administered. The first measure is an intelligence test composed of 27 items that intends to establish an intelligence level rating by measuring a subject's ability to form concepts, solve problems, acquire information, reason, and perform other intellectual operations. We have made our best to get an intellectual test that is appropriate to the participants' age, cultural and educational environment. It is important to mention that this test is designed in Arabic language (except for vocabulary items that are

written in English) because the pupils are at early levels of proficiency in English. The test version provided in this paper is a translation of that test.

The second measure used in this work is a reading comprehension test, which focuses on the pupils' approaching of a written text and aims at assessing their ability to extract meaning from print. This test includes two exercises. The first exercise includes a narrative text followed by four reading comprehension questions about it. The second exercise comprises an expository text joined by three multiple choice questions MCQ.

VII. Population of Interest

The participants in this study are 15-year-olds. They are pupils, from both sexes, who attend an Algerian middle school in Constantine, Khoualdia Salah, in their fourth year. All of them are enrolled in normal education classes. A random sample of 95 pupils was drawn the target population of 15-year-olds to be tested for their general intelligence and reading comprehension.

IIX. Structure of the Study

This paper consists of four chapters: two chapters that represent the theoretical background of the research paper and two chapters that represent its practical part.

Chapter one is the first theoretical background of this research paper. It discusses the main theories of intelligence, starting with the basic foundations of this concept and a brief historical overview of the area. In addition to that, this chapter shows how developments in the field are tied to the methodologies used to study intelligence. Going through these, the chapter

reaches descriptions and analyses of current approaches to intelligence. It concludes with a brief discussion of the main controversies in the area.

The second theoretical foundation of this work, consisting of two sections, is a chapter that deals with reading skills and reading comprehension. In section one, we have discussed the components of reading and the linguists' main views and theories about reading. The second section deals with the five components involved in reading comprehension and some useful strategies that would help readers extract meaning from print effectively.

Chapter three represents the first practical part of this study. In this chapter, we have discussed the statistical study conducted. This part relates to the analysis and interpretation of the data gathered by means of the pupils' intelligence and reading comprehension tests in relation to the research main and secondary questions.

Chapter four is the second practical foundation where the results obtained have been correlated to find out whether the research findings prove or disapprove the study hypothesis stated in this introductory part, that is to check whether there is a positive relationship between the pupils' intellectual abilities and their reading comprehension.

There are some implications for education and curriculum developers that, we hope, will help structure the classroom by meeting the needs of students helping them build on their strengths and improve on their weaknesses in the areas of intelligence and reading. The focus on teaching pupils to think effectively has made a great impact on many schools in the world; we hope that in the future, some of the trends in intelligence and reading that have already been developed across North America will be carefully adapted to the Algerian educational context.

CHAPTER ONE

INTELLIGENCE

1.1 Introduction

Intelligence is natural to all of us. We use it with great ease: we can recognise the people around us, walk, read a paper, drive a car; and at the same time listen to a silly joke, go to work, write a memo, make a phone call, play a game of chess, and watch a science fiction movie on TV in the evening. This makes us wonder how all that is possible. How can the mind or the brain manage to make this work? A mixed success is the result of thousands of years of philosophers' trying their luck on this question.

Of all the areas of Psychology, intelligence is probably the most controversial. At the same time, it is also one of the oldest areas of the discipline, dating back to the 1880's with the work of Francis Galton on individual differences in sensory functioning. It is impossible to capture in a single chapter the immense body of theorising and research that has been devoted to the topic of intelligence. The aims of this chapter are considerably more modest: a) to give a brief historical overview of the area; b) to show how developments in the field are tied to the methodologies used to study intelligence; and c) to describe current approaches to intelligence. This chapter attempts to trace the developments of the construct, from Spearman's (1904) early conceptions of intelligence as mental energy to the much broader conceptions of modern day theorists. As will be seen, it is not an easy construct to understand but it cannot be ignored because, along with personality, it is one of the most fundamental aspects of the human psyche.

What sets the area of mental abilities apart is the perceived importance of these abilities in our daily lives. We accept that we are physically stronger or weaker than other people, but few of us care much about the possibility that someone is stronger or weaker than we are. It doesn't make a great deal of difference to our lives. In the cognitive domain, however, we are constantly compared with others: we compete with each other at a cognitive level for the best courses at universities, the best jobs, and for the best partners in life. Gottfredson (1997) states that "…no other ability has been shown to have such generality or pervasiveness of effect as does intelligence" (p.6).

The ancient Greeks are aware of the concept of intelligence, the Chinese before them, and every culture since. Newspapers often contain stories on some new wonder drug or some new training programme that can increase intelligence. The popular media are also fascinated by displays of intelligence: children who can perform amazing computational feats, quiz show marvels who can recall facts with astonishing speed, musical and artistic prodigies, and so on. However, to aspire to be clever, some understanding of what the term means is needed. This is not an easy task since intelligence is a controversial topic. There is very little agreement on what does and does not constitute intelligence. As will be seen, it tends to mean different things to different people; it may even mean different things to the same person.

1.2 Definitions of Intelligence

1.2.1 Commonsense Notions of Intelligence

The term of *intelligence* is often used in different ways by different people, or even by the same person in different contexts, and this often causes confusion. Despite this fact, it is important to understand commonsense notions of intelligence, first because they are a great source of inspiration, and second because, ultimately, the scientific study of intelligence must

relate to them: It must provide a better understanding of precisely these concepts. Commonsense notions often specify certain capabilities typical of intelligent beings. They include, among others, thinking and problem solving; the competence to speak, read, and write; intuition and creativity; learning and memory; emotions; surviving in a complex world; and consciousness. They also include the distinction of degrees of intelligence.

The previous list represents what people, in general, think about intelligence, at commonsense notions of intelligence. Now it is possible to look at quotations that represent the opinion of experts.

1.2.2 Experts' Definitions

A satisfactory definition of intelligence always proves elusive. A symposium of 17 experts in the field, convened by the editor of the *Journal of Educational Psychology* in 1921 to discuss the meaning of intelligence, comes up with almost as many interpretations as there are experts present. Pfeifer and Scheier (1999: p.6) summarise the responses got back where intelligence is variously described as "ability to learn" (Buckingham), as "the power of good responses from the point of view of truth or fact" (Thorndike), as "the ability to carry on abstract thinking" (Terman), as "the ability of the individual to adapt himself adequately to relatively new situations in life" (Pintner), as "a biological mechanism by which the effects of a complexity of stimuli are brought together and given a somewhat unified effect in behaviour" (J. Peterson), as "involving two factors- the capacity for knowledge and the knowledge possessed" (Henmon), as "the capacity to acquire capacity" (Woodrow).

Carroll (1993) reports that a similar symposium convened in 1986 by Sternberg and Detterman to update the findings of the 1921 symposium. Twenty-five experts at the 1986 symposium come up with almost as many views of intelligence. Intelligence is described as "a

quality of adaptive behaviour" (Anastasi), as "the end product of development in the cognitive-psychological domain", as "a societal concept that operates in several domains- academic, technical, social, and practical" (Carroll), as "error-free transmission of information through the cortex" (Eysenck), as "acquired proficiency" (Glaser), as "mental self-government" (Sternberg). Carroll (1993) reports that "the symposium did not produce any definitive definition of intelligence, nor was it expected to" (p. 36). This second symposium does, however, reflect some of the newer views of intelligence, such as metacognition (the ability to understand and control oneself), emphasising the fact that views of intelligence are changing over time.

Although the definitions are different, they all make certain points that are important. Terman talks about the ability for abstract thinking. By contrast, Peterson refers to biological mechanisms. A crucial point: some mention the environment, some don't. In many investigations of intelligence, the environment is largely neglected.

In 1988, Mark Snyderman and Stanley Rothman published a book, The IQ Controversy, containing the answers of over 600 experts in the fields of intelligence testing, educational psychology, developmental psychology, behavioural genetics, sociology and education, cognitive science, counselling psychology and occupational psychology to questions about intelligence, 99.3 percent agree on the importance of abstract thinking and reasoning, 97.7 percent on problem-solving ability and 96.0 percent on the capacity to acquire knowledge. This does not suggest a lack of agreement, and indeed these definitions agree well with common sense- we tend to call someone intelligent who can reason clearly, think well in abstract terms, solve mental problems, and learn rapidly (Snyderman and Stanley, 1988, cited in Eysenck, 2000: 8).

How various displays of apparently intelligent behaviour relate to the concept of intelligence is still problematical. To keep matters as uncomplicated as possible, this chapter will deal with the definition that seems to be appropriate to the context of the present research.

1.2.3 Operational Definition

Intelligence is a human intellectual competence that entails a set of skills of logical reasoning, problem solving and critical thinking, which enable the individual to adapt himself to a given situation and resolve genuine and novel problems by producing effective product. As mentioned to by Gottfredson (1997: 13), intelligence "involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience."

1.3 Psychological Approaches to Intelligence

We can describe three different psychological perspectives on intelligence (Kail and Pellegrino, 1985: 5). The psychometric, the information processing, and the cognitive developmental perspective. No single approach is comprehensive to represent a clear picture of what human intelligence is. For this purpose, it is needed to know how each perspective views intelligence and deepen our understanding of it.

The psychometric approach is the traditional approach to intelligence that focuses on how well people perform on standardised aptitude tests (IQ represents how a person performs on an intelligence test compared to other people; for more details, c.f. section 1.5). Theorists like Spearman, Thurstone and others who use the psychometric approach to understand individual differences in intelligence feel that sensory, perceptual and motor processes are the basic elements of intelligence. Exploratory factor analysis is the primary analytic tool used in

this approach. However, psychometricians differ greatly in the number of factors they propose. Results of psychometrically oriented investigations have generally converged on the understanding that a limited number of broad factors typically underlie performance on mental tests, and when further analysed, these broad factors yield a single higher-order general ability factor.

The information processing perspective, in contrast to the psychometric approach, provides elaborate descriptions and theories of the specific mental activities that comprise intelligence, and emphasises several kinds of intelligence, and the strategies people use to solve problems, not merely whether they get the right answers. Borrowing from cognitive psychology, the information processing approach looks beyond the broad factors of the psychometric perspective to the specific processes that combine to yield overall test performance. Despite the abundance of information processing research, a revolutionary theory of cognitive abilities based on processes rather than on broad ability factors is not imminent. That is not to say, however, that information processing research does not make valuable contributions to our understanding of cognitive abilities. On the contrary, information processing research focuses attention on variables such as processing speed and memory capacity. These variables are currently at the forefront of cognitive abilities research.

Despite the apparent differences between the psychometric and information processing approaches, they should not be considered as opposing or incompatible views. It is advantageous to consider them as complementary approaches. The information processing approach is entwined with, and indeed relies on, the psychometric approach. The validity of information processing parameters is to a large extent dependent upon the validity of the psychometric abilities to which they are related, or from which they are derived. In fact, it is argued that, to some extent, the information processing approach is merely an extension of the

psychometric approach; some variables studied in the information processing approach are not that different from those already included in early psychometric investigations. For example, speed exists as a variable in psychometric studies from the early stages. However, it is only in recent years, with the advances of computerised technology, that accuracy in the measurement of speed is achieved. It is tenable to suppose that further advances in the understanding and measurement of cognitive abilities could arise from the combined efforts of the psychometric and information processing approaches.

The cognitive developmental approach is associated with the Piagetian theory of intellectual development (Miller, 1983). The great Swiss psychologist Jean Piaget asserts that children are not born with a cognitive structure. He argues that children's cognitive understanding of the world emerges with experience; in other words, it develops. Knowledge, then, is a process rather than a "state." A child knows or understands an object by interacting with it, and from this interaction he expands his ability to comprehend. According to Piaget, just as all children grow and mature physically in the same basic sequence, they also develop cognitively in a process that is the same for all children, regardless of cultural upbringing.

1.4 Theories of Intelligence

There are too many theories of intelligence to cover in a single chapter but some are much more influential than others. These are summarised in the following section.

1.4.1 Spearman's Theory

The figure normally associated with the origins of the concept of intelligence is Francis Galton who is the first one to use tests of sensory discrimination to measure intellectual ability, often judged by teachers' ratings, in late 1980's. The idea of using such simple tests

would strike many people today as being naïve but Galton is anything but naïve. Howard (1991: 36) reports the letter written by Galton, at the age of four, to his sister:

My Dear Adele,

> I am four years old and can read any English book. I can say all the Latin substantives and adjectives and active verbs besides 52 linesof Latin poetry. I can cast up any sum in addition and can multiply by 2, 3, 4, 5, 6, 7, 8, 9, 10, 11. I can also say the pence table. I read French a little and I know the clock.

Quite clearly, Galton is far from suffering from a lack of intelligence himself: the logic of using sensory measures is sound enough. All information comes to use via the senses and the quality of our mental processes will depend to some extent on the quality of the sensory input. It followed, therefore, that those with better sensory discrimination processes could well have better quality mental processes as well. Logic not withstanding, Galton's simple tests do not discriminate between so-called "intelligent" and "non-intelligent" people. Nevertheless, his views are influential and most of his contemporaries follow his lead in exploring intelligence through basic sensory functions. Charles Spearman, one of the leading figures in the history of intelligence, begins his illustrious career using these same sensory discrimination tests.

The first real breakthrough in the field of intelligence stems from a practical problem in the French educational system. Following the introduction of universal education in this country, there is a need to identify students who have learning difficulties. Given the task of developing psychological and physical diagnostic procedures for determining retardation, Alfred Binet takes the unusual step of developing a thirty-problem test that measures several abilities related to intellect, such as judgement and reasoning. The break from measures of sensory ability is important because, unlike the earlier sensory tests, scores on Binet's test do

correspond with other ratings of intelligence. The popularity of Binet's tests proves to be a much-needed stimulus for research on the nature of intelligence itself. In one of those accidents of history, about the time of Binet test publication (1904), one of the major figures in the field of intelligence, Charles Spearman, begins publishing articles on his theory of intelligence. As Brody (1992: 8) put it, “Spearman provided a theory and Binet provided a test.”

Spearman (1904, 1927) proposes a theory of intelligence that becomes known as the one-factor theory. In keeping with his engineering background, Spearman sees intelligence as comprising a central pool of energy that is required for all cognitive tasks. This is the first of his factors, a general factor that he labels 'g'. In addition to the general factor, each task has something unique to itself, a specific factor. Spearman likens the second of his factors to engines, with an engine for every task. Thus, when a person attempts a mathematical problem, it is 'g' that provides the energy for the operation and a specific mathematical engine that is responsible for the execution of the task. People differ in the amount they have of each and these differences explain the variation we observe between individuals on cognitive tasks.

Spearman's two-factor theory of intelligence is extremely influential because he develops techniques for measuring the extent to which a test measured 'g' - its "loading" or "saturation". Some tests measure it very well, others hardly at all. Spearman knows, for example, that 'g' could not be measured very well by tests of sensory discrimination, as Galton tries to do. It could be measured by tests of comprehension, memory, and reasoning. Spearman recognises that the best predictors of academic ability are tests that required the "eduction of relations and correlates" which he defined as follows:

> The eduction of relations … when a person has in mind any two or more ideas… he has more or less power to bring to mind any relations that sensibly hold between them. It is instanced whenever a person becomes aware, say that beer tastes something like weak quinine … or that the proposition " all A is B' proves the proposition "Some A is B". The eduction of correlates … when a person has in mind any idea together with a relation, he has more or less power to bring up into mind the correlative idea. For example, let anyone hear a musical note and try to imagine the note a fifth higher (Spearman, 1927: 165-166).

The problem is that Spearman describes processes that could not be observed directly. What he can observe directly were the scores that people obtain on tests that he develops to measure 'g'. He can also observe, as others did before him, whether there is any correspondence between scores on tests of 'g' and academic achievement. One of Spearman's major criticisms of earlier work on intelligence is that it does not use quantitative indices of the degree of relationship between different measures. Spearman is the first to use correlations as the raw data upon which a theory of intelligence is based.

For Spearman (1927), the correlations among the tests he uses are the data his theories have to explain. One thing strikes Spearman quite forcibly: there are no inverse correlations among his cognitive measures. He uses the term "positive manifold" to describe the tendency for all cognitive tasks to be positively correlated. To observe that two tests are positively correlated is one thing, to explain it is another. One explanation for the observation of a correlation is that performance on the two tests is driven by the same underlying ability. In fact, this is one of the foundations of theory building in the field of individual differences, of

which intelligence forms a part. Spearman's observation that all cognitive tests are positively correlated led him to claim that despite obvious differences in the content of the tests (e.g., some measuring word knowledge, others spatial ability), they all rely to some extent upon 'g'. Thus, to a very large extent, Spearman's two-factor theory is driven by his attempt to explain the phenomenon of positive manifold. He does so by stressing the importance of a dominant single factor. As I mentioned earlier, the specific factors are added to the theory to account for differences due to unique operations called for by each test.

It is important to recognise the empirical basis for Spearman's theory. There is no doubting the fact that cognitive tests do tend to be positively correlated. Where subsequent theorists differ from Spearman is in their accounts of what it is that all tests have in common and how much emphasis should be placed on the general factor. Spearman's description of 'g' as mental energy is disputed by one of his contemporaries, Godfrey Thompson, who argues that there is a large set of independent bonds or units in the mind. Any test of ability samples some of these bonds. The correlations that Spearman explains in terms of sharing a central energy source are explained by Thompson as tasks sharing the same bonds. Thus, if two tests sample a large number of bonds, by the laws of chance some of these will be the same and it is the sharing that accounts for the observed correlations. Thompson explains the obvious individual differences in intelligence by claiming that each individual possesses only a subset of the universe of bonds and that individuals differed in the number of bonds or units of intelligence they possess (Brody, 1992).

Other accounts of the tendency for all cognitive tasks to be positively correlated arise over the years. For the most part, they follow Spearman's direction in looking for a single entity that is shared by all cognitive tasks. Hunt (1980), for example, likens the concept of attention to that of 'g'. As Hunt knows, however, the comparison does not help to clarify the

nature of intelligence because attention is just as elusive a concept as intelligence. An alternative interpretation of 'g' is that it reflects the ability of the individual to organise processing strategies to face new kinds of mental problems. This account of intelligence is reflected in the work of information processing theorists who stress the importance of metacognition as a component of intelligence (e.g., Sternberg, 1979). What follows from metacognition as self-monitoring and inventiveness can be thought of as hallmarks of intelligent behaviour.

In a similar vein, it is suggested that the primary intelligence differences between persons lie in the degree to which people are able to develop and use information processing strategies (Belmont *et al.,* 1982). They postulate a process called "Executive Functioning" which monitors and controls these strategies. Detterman (1982) points out that Executive Functioning is analogous to the general intelligence factor since its effects should be evident in every sort of mental test or cognitive task.

The debate between Spearman and Thompson is characteristic of other debates that are present in the history of this branch of the discipline of psychology. The problem with correlational data is that different interpretations are always possible and both Spearman's and Thompson's theories are able to account for the data generated by early studies of intelligence. Before long, however, it becomes evident that Spearman's theory of a single factor of intelligence that accounts for all observed correlations among tests could not be correct. It soon becomes increasingly obvious that groups of tests tend to have more in common with each other than their 'g' loadings suggest they would. A set of spatial tests, for example, which might not be very good measures of 'g', tend to be highly correlated with each other. The same could be said for groups of verbal tests, numerical tests, and so on. As the data accumulate, it becomes clear that Spearman's two-factor theory of intelligence could not account for the data.

The only possible explanation is that tests could be correlated for reasons other than their dependence on 'g'.

1.4.2 Thurstone's Theory of Primary Mental Abilities

Despite his awareness of the evidence accumulating against his two-factor theory, Spearman continues to emphasise the importance of the general factor. The real challenge to his theory comes in the person of the American psychologist, Thurstone, who uses his own versions of the new technique of factor analysis to demonstrate that there is not one underlying ability but a number of independent abilities.

With his challenging theory of Primary Mental Abilities, a 'middle-of-the-road' position, Thurstone argues that *g* is a statistical artifact resulting from the mathematical procedures used to study it. His designed studies in the 1930s and 1940s demonstrate a simple structure of nine common factors that collectively account for most of the reliable individual differences variance obtained with different tests said to be indicative of major features of intelligence. The process features of these factors suggest that they indicate *primary abilities* of inductive reasoning (I), deductive reasoning (Rs), practical problem reasoning (R), verbal comprehension (V), associative short-term memory (Ma), spatial relations (S), perceptual speed (P), numerical facility (N), and word fluency (Fw) (Thurstone, 1938).

In fact, in his analysis of mental test data from samples comprising people with similar overall IQ scores, Thurstone finds that they have different profiles of primary mental abilities, further supporting his model and suggesting that his work has more clinical utility than Spearman's unitary theory. However, with the administration of his tests to an intellectually heterogeneous group of children, Thurstone fails to find that the seven primary abilities are entirely separate; rather he finds evidence of *g*. Thurstone manages an elegant mathematical

solution that resolves these apparently contradictory results, and the final version of his theory is a compromise that accounts for the presence of both a general factor and the seven specific abilities. This compromise helps lay the groundwork for future researchers who propose hierarchical theories and theories of multiple intelligences (Ruzgis, 1994).

Many studies are designed to replicate the findings of Thurstone and most did. This paper also indicates new common factors that very much expand the primary mental abilities system. The system goes from nine primary abilities to over 60 such abilities. Summaries of replicated common factors indicating such abilities are provided (Carroll, 1993; Guilford, 1982; and Horn, 1985).

The evidence of replicated primary ability factors thus suggests that a system of more than 60 different abilities is needed to describe human cognitive capabilities. Some investigators opinionate that intelligence comprises many more than this number of capabilities.

1.4.3 Hierarchical Models of Intelligence

The first well-acknowledged hierarchical model of intelligence is proposed by Phillip E. Vernon, a colleague of Spearman's. Vernon (1950) describes a structure which places 'g' at the top of an inverted tree-like scheme. Immediately below 'g' are two other broad abilities, v:ed (verbal-educational) and k:m (spatial-mechanical-practical). Branching out from each of these are narrower group factors. For example, verbal ability is viewed as a narrow group factor located under the v:ed broad group factor and spatial ability is a narrow group factor under the k:m group. More specific abilities are located at a lower level still. Although, his model allows various kinds of group factors, some broader than others, Vernon still feels that 'g' is the major determinant of individual differences in performance on cognitive tasks.

At about the same time of the development of Vernon's is hierarchical theory of intelligence, another major figure emerges who is to initiate the work that leads to what is now widely regarded as the dominant model of intelligence in the world today. Raymond Cattell (1963) works on both factor analysis and theories of intelligence. Like Vernon, Cattell believes that there is more than one higher-order factor. His view is that there are two kinds of intelligences: "fluid" (General Fluid: Gf) and "crystallised" (General Crystallised: Gc) (McGrew, 1997; Bickley ***et al.***, 1995). Fluid intelligence is measured by tests that are assumed to measure the psychobiological capacity of the individual to acquire knowledge. Reasoning processes are an important part of this ability. Crystallised intelligence is defined by tests that are assumed to measure the influence of schooling and acculturation while tests of general knowledge and vocabulary measure Gc. Thus, in a sense, Gc represents the store of an individual's knowledge and skills whereas Gf represents the processes that help the individual to acquire these knowledge and skills. The model proposed by Cattell bears some similarities to the model put forward by Donald Hebb (1949), who suggests that there are three kinds of intelligence: Intelligence A, that which we are born with, representing our innate potential; intelligence B, representing the functioning of the brain as a result of the development that occurs; and intelligence C, representing measured intelligence. The first two of these are similar to Cattell's ***fluid*** and ***crystallised*** intelligences. Cattell gives a more complete account of his theory. In doing so, he is careful to look for more than just statistical evidence that the structure he proposes is valid. Gf is said to have a more biological basis than Gc. Indeed, it is defined by one author as "one's native, biologically endowed ability" (Howard, 1991: 38). Thus, in the early stages of life, Gf helps to shape Gc. Later in life, as the brain begins to deteriorate, Gf shows a decline. That is, it becomes harder for people to engage in the abstract

reasoning processes that form the basis of some kinds of knowledge. Gc, on the other hand, is less affected by physical deterioration of the brain and certain types of knowledge can continue to develop virtually throughout one's lifespan.

Cattell is not the first to propose a distinction between two broad abilities of this type but his theory generates predictions, such as age-related decline in Gf, that are supported by empirical findings. His theory also attracts capable adherents, such as his student John Horn, who are able to take the model to new levels of development. Horn (1985; Horn and Noll, 1997) maintains the distinction between Gf and Gc but reinterprets their meaning somewhat, especially Gf. Horn does not believe that Gf is a biological ability factor and he does not believe that there is a causal pathway leading from Gf to Gc, even early in life. Instead, both Gf and Gc are characterised by processes of reasoning, concept formation, and problem solving. The main difference is that Gf depends relatively little on the effects of formal education and cultural experiences (Boyle *et al.,* 1995). The complexity of the Gf/Gc model increases considerably when compared with the first description by Cattell (1963).

Horn's model seeks to explain much of what is already known about intelligence. To begin with, it is a hierarchical model. It contains no 'g' at the top of the hierarchy. Horn has a particular aversion to the notion of a general factor of intelligence, especially because of the way in which the concept of 'g' is used to promote racist views. As Carroll (1993, 1997) points out, however, if 'g' is ignored or denied, the theory does not really have an explanation for the correlation (about .50) that exists between Gf and Gc. Brody (1992) raises this same criticism.

Horn's second-order factors consist of 9 broad factors that may not be represented in a tree-like structure but rather in something that bears more resemblance to a chart. The left hand side of the chart would show a vertical line depicting the sequence of development from infancy to adulthood whilst the right hand side would represent another vertical line

representing the complexity of the processes at each level. Gf and Gc appear at the top of the hiearchy and they are characterised by what Horn calls "deep processing" operations. Spearman's eduction of relations and correlates exemplifies the types of cognitive processes one would find at this level. At the next level down, the various perceptual organisational processes are found: visual abilities, auditory abilities, and processes related to speed of information processing. The placement of these second-order factors below Gf and Gc implies that they are less complex and that in a developmental sense, these abilities are mastered before one would master the Gf and Gc abilities. Short term and long term memory functions are to be found at lower levels in Horn's model. The description of these functions as "Association processing" refers to the type of mental operation that is predominant at this stage of development, forming associations among facts, ideas, and so forth. At the very bottom level, are the sensory functions, the very sort of thing assessed by Galton in a vain attempt to measure intelligence. The model shows why these attempts are unsuccessful: the complex functions that are known now to be more central to intelligence are at the top of the hierarchy, whilst the sensory functions are at the bottom. Horn assumes that there would be little correlation among measures taken at the bottom of the hierarchy and substantial correlations among measures taken at the top. Galton indeed finds that sensory discrimination measures fail to correlate with teachers' ratings of intelligence. Binet, who samples tasks from the top of the model, finds impressive correlations between his measures and measures of intelligence. The model, however, also partially supports the logic of Galton's quest. Galton looks at sensory measures because he thinks that good quality sensory input leads to good quality mental processes. Horn's model suggests that good quality input is a necessary but not sufficient condition for good quality mental processes. The input has to be processed and organised as it makes its way up the information processing hierarchy. Detection is just the

first of the steps and there is no guarantee that someone who is good at this level will also be good at the other levels.

Horn's model has the desirable characteristic of being an open model, one that invites further developments. The inclusion of perceptual organisation factors, for example, leads to the recognition of the auditory organisation factor (Horn and Stankov, 1980). Stankov reasons that if there can be spatial abilities, then there should also be auditory abilities. Obvious examples occur in the field of music but Stankov discovers a range of other tasks, some of them involving distortions of speech that depend on this factor. Stankov and his colleagues are now actively exploring the bases of individual differences in other sensory domains, notably touch. Indeed, the model is extended through the inclusion of a tactile-kinesthetic ability that has much in common with broad visualisation and fluid intelligence (Bradley *et al.*, 1997). Bradley and his co-workers use tasks that require participants to identify objects by shape and texture, to perform a bead memory test blindfolded, to detect letters and figures traced on their fingers, and a variety of other tactile tasks. Their findings suggest other ways in which intelligence can be assessed, perhaps less culturally biased methods. Research is active on other aspects of the Gf/Gc model as well. Attempts are made to determine the status of other supposed factors such as attention (Stankov, 1983), the ability to divide one's attention (Fogarty,1987), the status of mental imagery ability (Burton, 1998), factors relating to cognitive style, and some very interesting recent work on cognitive speed factors (Burton and Fogarty, 1996). The results of this work will extend the model further. Carroll (1993: 62), in his extraordinary review of factor analytic studies of human cognitive abilities, has this to say about the Gf/Gc model:

> The Cattell-Horn model, as summarised by Horn (1985, 1988), is a True hierarchical model covering all major domains of intellectual functioning. Numerous details remain to be filled in through further research, but among available models it appears to offer the most well-founded and reasonable approach to an acceptable theory of the structure of cognitive abilities.

Up to this point, the chapter's focus is primarily on the contributions of early workers in the field of intelligence. There are a number of reasons for this. The first is that this early work is still very relevant to our modern understanding of the concept of intelligence. Furthermore, it tends to concentrate on a narrow range of themes, it shows a reasonably clear development of the concept, and is thus easier to explain in a limited space. Another reason is that the practice of intelligence testing today is still very largely shaped by the work of these earlier researchers. Some of the most popular tests in use today are modelled on the theories developed by Binet, Spearman, Thurstone, Vernon, and Cattell. As we shall see in the concluding sections of this chapter, researchers have broken away from the relatively narrow approaches of the past. Some are now calling for the recognition of different intelligences, the sort that cannot be captured by standard psychometric tests. Developmental psychologists, such as Piaget, have long argued that we should spend more time looking at the processes by which all children come to think intelligently, rather than focusing on why they differ among themselves. Researchers have argued that to base the concept of intelligence solely on the interpretation of patterns of correlation obtained from batteries of cognitive tests leads to a neglect of many important aspects of mental ability. Some of the alternative approaches are described in the next section.

1.4.4 Gardner's Theory of Multiple Intelligences

Intelligence in one domain does not necessarily imply intelligence in another. Starting from this point, Gardner (1999: 203) argues that "the monopoly of those who believe in a single general intelligence has come to an end." In his theory of multiple intelligences that has its roots in cognitive science, Gardner (1983; Gardner, Karolyi and Ramos-Ford, 2003; Gardner and Walters, 1986; Guilford, 1967; and Sternberg, 1986, 1997, 2000) reject the notion of a general ability. He claims that there are eight ways to demonstrate human intelligence, and each has its own unique characteristics, tools and processes that represent a different way of thinking, solving problems and learning. He suggests that everybody possesses the different types of intelligences to different degrees, and that they operate together in an orchestrated way. The theory suggests that even though different intelligences do tend to be stronger in some people, everybody has the capacity to activate all the intelligences; in different situations, distinct intelligences or a combination of intelligences may be used.

The eight intelligences relevant to the MI theory can be defined and summarised as follows. Verbal-linguistic intelligence (Gardner, 1983: 77; Armstrong, 1994:2; and Armstrong, 1999) represents the capacity to use words effectively, whether orally or in writing. Musical intelligence (Gaffney, 1995: 6; Lazear, 1991: 15; and Nelson, 1995: 26) represents the capacity to perceive, discriminate, transform, and express musical forms. Logical-mathematical intelligence (Gardner, 1999; and Haggerty, 1995) represents the capacity to use numbers effectively and to reason well. Visual-spatial intelligence (Armstrong, 1994: 6; Armstrong, 1999; and Gaffney, 1995: 8) is the ability to perceive the visual-spatial world accurately and to perform transformations on those perceptions. Bodily-kinesthetic intelligence (Gaffney, 1995: 7) includes the ability to use the body to express ideas and feelings, and the facility in using one's hands to produce or transform things. Intrapersonal

intelligence (Gaffney, 1995: 8) is the ability to act adaptively on the basis of self-knowledge. Interpersonal intelligence (Gaffney, 1995: 8; and Armstrong, 1994: 6; Armstrong, 1999) is the ability to perceive and make distinctions in the moods, intentions, motivations, and feelings of other people. Naturalist intelligence (Barkaman, 1997: 1; Campbell, 1997: 1; and Hoerr, 1997: 1) is the ability to observe patterns in nature, identify and classify objects, and understand natural and human-made systems.

Although these eight intelligences are generally regarded as independent, several researchers (e.g., Bennett, 1996, 1997; Furman, 2001) have grouped them into conceptual clusters. One scheme suggested by Campbell, Campbell, and Dickinson (2004) is to classify the eight intelligences into three broad categories. The category of person-related intelligences consists of intrapersonal and interpersonal intelligences. The category of object-related intelligences consists of logical-mathematical, visual-spatial, bodily-kinesthetic, and naturalist intelligences, as these abilities are controlled and shaped by the objects encountered by individuals in their environments. Finally, the category of object-free intelligences consists of verballinguistic and musical intelligences, which are not shaped by the physical world but are dependent on language and musical systems. Regardless of the classification, this pluralistic view of human cognitive abilities suggests that the theory of multiple intelligences (MI) provides one useful framework for understanding individuals' basic competencies, as well as their unique strengths.

Gardner proposes this theory of multiple intelligences, in which he argues for the distinct nature of each type of intelligence, but his separation of the different facets of intelligence is unrealistic. The components of the human brain are connected by neurons, making each aspect of the mind related. Willingham (2004) contends that the mind cannot be separated into completely independent processes. Mathematical reasoning is considered

distinct from linguistic intelligence, but most people would assert that the two independent functions of the mind substantially overlap with one another. Given the relationship between the two processes, one can reasonably imagine every feature of mathematical and linguistic intelligence as interdependent with a single unique element for each process (Willingham, 2004). If the unique feature is damaged, only the corresponding process would be affected, supporting the distinct nature of the intelligences. Yet, if one of the overlapping components is damaged, both processes would suffer, which is indisputable evidence for the interdependence of cognitive functions. For Willingham, a theory of intelligence that does not incorporate the relationships among different mental functions, such as the theory of multiple intelligences, oversimplifies reality.

1.4.5 Sternberg's Triarchic Theory

Robert Sternberg's (1985) triarchic theory proposes that there are three fundamental aspects of human intelligence - analytic, creative, and practical. Analytic intelligence is what is typically measured by intelligence tests. Problems testing this type of intelligence usually a) have a single correct answer, b) come with all the information needed to solve them, and c) have little intrinsic interest. Practical problems, in contrast, tend to a) require a definition of the problem, b) be poorly defined, c) have several solutions, d) require everyday experience, and e) require motivation and personal involvement. Sternberg is not the first to make a distinction between analytic and practical intelligence, Neisser (1976) did so much earlier, but research supporting the distinction could not emerge before the 1980s. Ceci and Liker (1986) in a study of expertise in betting on horse races, find that handicappers∗ use quite complex

∗ A handicapper: newspaper columnist who estimates the chances that horses, jumping over obstacles, have to win races.

interactive models with as many as seven variables. Despite the seemingly obvious reliance of this type of ability on mathematical skills, level of performance is not correlated with IQ scores. There are other examples of complex skills being displayed in the workplace by people who do not score well on IQ tests. One criticism of these examples, however, is that they involve highly learned skills. In separate writings, Sternberg emphasises the importance of coping with novel (what he calls "nonentrenched") situations as a hallmark of intelligence. Ackerman (1988) shows that intelligence plays a smaller and smaller role as a task ceases to be novel and becomes more automatic. It is sometimes difficult to say whether people displaying high levels of skills in a workplace situation are displaying practical intelligence or highly overlearned skills. Motivation is also a major consideration.

Whilst there may be some question about the status of practical intelligence, there is no disputing the status of what Sternberg calls "creative intelligence". Research show that creative people tend to a) be experts in their field, b) have the capacity to think differently about problems, and c) be motivated by intrinsic (e.g., satisfaction) rather than extrinsic (e.g., money) rewards. Anastasi and Urbina (1997) report that correlations between tests of intelligence and creativity tend to be low, although an average or above average intelligence is necessary but not sufficient for creativity to emerge. Unfortunately, it is very difficult to measure creativity and Sternberg's recognition of creative intelligence in his model does not really take us any closer to understanding its nature.

1.4.6 Piaget's Theory

Humans are not born with complete reasoning systems, complete motor systems, or even complete sensory systems. Instead, they undergo a process of development where they are able to perform more difficult tasks in more complex environments en route to the adult

state. This is a gradual process, in which earlier forms of behaviour disappear or are modified into more complex types of behaviour (De Grandmont and Ndayisaba, 1999; and Langer, 1998). The adaptive advantage of the earlier forms appears to be that they prepare and enable more advanced forms of behaviour to develop within the situated context they provide.

Piaget has a dominating influence on our understanding of children's intellectual development (Scholnick, 1999: 23). Most people today are familiar with the theories of cognitive development this psychologist put forward. Piaget is not interested in individual differences in intelligence but in the means by which all children learn to act in an intelligent manner. His theory is constructed primarily on the basis of observational data. The four stages of cognitive development, as referred to by Miller (1983), give an insight into what he considers intelligence to be.

1.4.6.1 Sensori-Motor Stage

The sensory-motor stage, which is only of indirect interest to our concerns, extends from birth to about 2 years of age. In this period, the child learns about his or her relationship to various objects. This period includes learning a variety of fundamental movements and perceptual activities. Knowledge involves the ability to manipulate objects such as holding a bottle. In the later part of this period, the child starts to think about events which are not immediately present. In Piaget’s terms, the child is developing meaning for symbols.

1.4.6.2 Pre-Operational Stage

Piaget divided this stage into preoperational phase and the intuitive phase. In the preoperational phase, children use language and try to make sense of the world but have a much less sophisticated mode of thought than adults. They need to test thoughts with reality

on daily basis and do not appear to be able to learn from generalisations made by adults. Compared to adults, the thinking of a child in the preoperational phase is very concrete and self-centred. The child's reasoning is often crude, and s/he is unable to make very simple logical extensions. For example, a child would be astounded when he hears that his baby sister would become a girl when she gets older.

In the intuitive phase, the child slowly moves away from driving conclusions based solely on concrete experiences with objects. However, the conclusions drawn are based on rather vague impressions and perceptual judgements. Also, children develop the ability to classify objects on the basis of different criteria, learn to count and use the concept of numbers, and start to see relationships if they have extensive experience with the world. Unaware og the process and categories they are using, children are still preoperational. Introspection and metathought are still impossible.

1.4.6.3 Concrete Operational Stage

At around age seven, the child starts to enter to concrete operational stage. In this stage, a person can do mental operations but only with real (concrete) objects, events or situations. S/he can do mental experiments and can correctly classify different objects by some category, such as size. The child understands conservation of amounts. This can be illustrated with results of one of Piaget's experiments (Philips, 1981). Two identical balls of clay are shown to a child who agrees they have the same amount of clay. While the child watches, one ball is flattened. When asked which ball has less clay, the preoperational child assumes that the flattened ball has less clay. The concrete operational child, however, is able to answer this question. S/he becomes adept at addition and subtraction but can do other mathematics only

by rote learning. In the concrete operational stage, children also become less self-centred in their perceptions of the universe. Logical reasons behind actions are understood.

1.4.6.4 Formal Operational Stage

The final stage in Piaget's theory is the formal operational stage, which may start as early as age eleven or twelve, but often later. A formal operational thinker can do abstract thinking and starts to enjoy abstract thought. This person becomes inventive with ideas and has a vested interest, more and more, in such thinking. S/he can formulate hypotheses without actually manipulating concrete objects, and when more adept can test the hypotheses mentally (Philips, 1981). This testing of logical alternatives doesn't require recourse to real objects. In addition to that, this person is capable of learning higher math and then applying this mathematics to solve new problems. The formal operational thinker is able to think ahead to plan the solution to unusual problems and to do combinatorial thinking and generate many possibilities. Finally, the formal operational person is capable of metacognition, that is, thinking about thinking.

For Piaget, the concrete operational stage ends at age eleven or twelve. There is considerable evidence that these ages (eleven and twelve) are the earliest that this stage ends at and that many adults remain in this stage throughout their lives. Most estimates are that from 30 to 60 per cent of adults are in the concrete operational stage (Pintrich, 1990). However, these people can be fully functioning adults. Thus, a person who may be a successful hard worker, a good and loving parent, and a good citizen, but be limited to concrete operational thought. Piaget's theories at the concrete and formal operational stages measure abilities only in a very limited scientific, logical, algebraic sense. His theories do not address ethical or moral development.

It is interesting to compare this sequence with Horn's (1985) version of the theory of fluid and crystallised intelligence. The two versions of the development of intelligence are not dissimilar. Both show a developmental sequence wherein humans begin by dealing with sensory data, move to a stage where they form associations, and then ultimately progress to abstract levels of thinking. However, it would be a mistake to think of Piaget's model purely in terms of this progression from sensory perception to abstract thought. His model is rather complex and incorporates an explanation of how a human being actually acquires information and develop knowledge structures. The driving force behind intellectual progression is the struggle to make sense of individual's experience. People do this by building schemas, mental models that represent their view of the world. Once a schema is formed, it can be used to *assimilate* new information. If the information is incompatible with the schema, they may be forced to alter the schema itself and restore equilibrium through a process that Piaget labels *accommodation*. This is how learning occurs. At the same time, children are acquiring an increasingly complex range of cognitive operations, to the point where as adults we are capable of thinking about thinking itself.

Although not all researchers in cognitive development agree with Piaget's scheme and all of his conclusions, he can be credited for having tremendous impact on people's understanding of intelligence, and the way children develop their understanding of the world around them. His account of intelligence certainly represents a different point of view to the one espoused by the factor analysts, who develop their theories on the basis of individual differences observed in performance on cognitive tests. Piaget makes it clear that children are not miniature adults who reason as adults do; they understand and interpret their environment in terms of their cognitive development. This is important to realise if we want to understand our children and ourselves better.

1.5 History of Intelligence Testing

Intelligence testing began in earnest in France, when in 1904 psychologist Alfred Binet was commissioned by the French government to find a method to differentiate between children who were intellectually normal and those who were inferior. The purpose was to put the latter into special schools. There, they would receive more individual attention and the disruption they caused in the education of intellectually normal children could be avoided (Linden and Linden, 1968).

This led to the development of the *Binet Scale*, also known as the *Binet- Simon Scale* in recognition of Theodore Simon's assistance in its development. The test had children do tasks as follows: commands, copy patterns, name objects, and put things in order or arrange them properly. Binet gave the test to Paris schoolchildren and created a standard based on this data. For example, if 70 percent of 8-year-olds could pass a particular test, then success on the test represented the 8-year-old level of intelligence. Following Binet's work, the phrase "Mental Age," or "MA," is used to describe a child's performance on a test of mental ability. Later, in 1912, William Stern introduced "Intelligence Quotient," or "IQ" that entered the vocabulary. The IQ is the ratio of "mental age" or "MA" to "chronological age" or "CA," multiplied by 100, with 100 being average. So, a child of 6 (CA) with a mental age of 6 will have an IQ=100 (Linden and Linden, 1968).

It constituted a revolutionary approach to the assessment of individual mental ability. However, Binet himself cautioned against misuse of the scale or misunderstanding of its implications. According to Binet (Armstrong, 1987), the scale was designed with a single purpose in mind: it was to serve as a guide for identifying students who could benefit from extra help in school. His assumption was that a lower mental age indicated the need for more teaching, not an inability to learn. It was not intended to be used as a general device for

ranking all pupils according to mental worth. Binet also noted that the scale, properly speaking, does not permit the measure of intelligence because intellectual qualities cannot be measured as linear surfaces are measured. Since, according to Binet, intelligence could not be described as a single score, the use of his Intelligence Quotient as a definite statement on a child's intellectual capability would be a serious mistake. In addition, Binet feared that intelligence measurement would be used to condemn a child to a permanent "condition" of stupidity, this negatively affecting his or her education and livelihood.

Gould (1981) assumes that Binet's scale had a profound impact on educational development in the United States and elsewhere. However, the American educators and psychologists who championed and utilised the scale and its revisions failed to heed Binet's caveats concerning its limitations. Soon, intelligence testing assumed an importance and respectability out of proportion to its actual value.

Later, Goddard, director of research at Vineland Training School in New Jersey, according to Linden and Linden (1968; and Gould, 1981), decided that the Binet test would be a wonderful way to screen students for his school. He translated Binet's work into English and advocated a more general application of the *Bine-Simont Scale*. He classified people as being normal, idiots or imbeciles. Idiots could only develop to a mental age of three to seven years, while imbeciles could not progress to more than a three-year-old level. Goddard developed a new term, "morons," to describe people who were somewhere between normal and idiots. Unlike Binet, Goddard considered intelligence a solitary, fixed and inborn entity that could be measured.

While Goddard extolled the value and uses of the single IQ score, Lewis M. Terman, who also believed that intelligence was hereditary and fixed, worked on revising the *Bine-Simont Scale.* His final product, published in 1916 as the *Stanford Revision of the Binet-Simon*

Scale of Intelligence (also known as the *Stanford-Binet*), became the standard intelligence test in the United States for several decades (Linden and Linden, 1968).

By the 1920's, mass use of the *Stanford-Binet Scale* and other tests had created a multimillion-dollar testing industry. According to Buros (1974), 2467 tests measuring some form of intellectual ability were in print, 76 of which were identified as strict intelligence tests. Booysen *et al.* (1996) argue that in the 1980's, teachers gave over 500 million standardised tests to children and adults across the United States. In 1989, the American Academy for the Advancement of Science listed the IQ test among the twenty most significant scientific discoveries of the century. IQ proved to be effective in making the distinction between students who had the ability to succeed in regular classes and those who were mentally challenged and needed special instruction, and continues to be a successful, although not perfect, predictor of academic success.

1.6 Intelligence and Achievement

1.6.1 Intelligence and General School Achievement

There has been considerable debate regarding the relationship between intelligence and academic achievement. Some researchers view intelligence and achievement as identical constructs. In fact, intelligence and academic achievement tests often contain some items or tasks that appear to access information that is taught in school (i.e., vocabulary, arithmetic, etc…), and there has been considerable debate regarding the separateness or distinctiveness of intelligence and academic achievement (Andrews *et al.*, 1997; and Dawis and Lubinski, 1992). For example, Ceci (1991) asserts that, "the contents of achievement tests and the contents of so-called intellectual aptitude tests as they are currently constructed are highly similar and inseparable both theoretically and statistically" (p. 708). This apparent overlap in test

coverage, among other factors, has led those psychologists to view intelligence and achievement as identical constructs. Others believe that the relationship between intelligence and achievement is reciprocal, mutually influencing each other (Brody, 1997). In fact, this interactivist view is exemplified by Stanovich (1986) as the "tendency of reading itself to cause further development in other related cognitive abilities, i.e., IQ, such that "the rich get richer and the poor get poorer" (p. 21). Finally, some researchers assert that intelligence is causally related to achievement (Bornstein and Naglieri, 2003; Canivez and Lei, 2007; Jensen, 2000). In fact, from a theoretical perspective, the construct of intelligence is expected to precede and influence the development of academic achievement, independent of childhood conduct problems as well as family and social circumstances (Fergusson, Horwood, and Ridder, 2005), because "school learning itself is *g*-demanding" (Jensen, 1998, p. 279).

This debate is not new. The same questions regarding the relationship between intelligence and achievement have been asked for decades. As cogently stated by Campbell Crano, and Kenny (1972), "does the acquisition of specific skills or the learning of specific information (achievement) result in an increased ability for abstraction (intelligence), or is the progression more accurately described as one in which intelligence causes achievement?" (p. 259). Unfortunately, most attempts to answer this question have been correlational in nature, resulting in equivocal conclusions (Ceci, 1991). True experiments are required to answer these questions (Campbell and Cook, 1979), but are probably impossible to conduct. Consequently, longitudinal designs where both intelligence and achievement tests are repeated across time have been recommended (Campbell et al., 1972).

1.6.2 Intelligence and Reading Achievement

To understand what we do when we read is to understand the workings of the human mind. This is position that has always been taken by many psychologists and linguists (Adams, 1990; Beale and Singh, 1992; Carver, 2000; Cummingham, Freeman and Stanovich, 1984; Huey, 1968; Hulme and Stothard, 1996; and McGuiness, 2005).

Following Huey (1968) assertion, there is a correlation between reading comprehension and intelligence. Reading is the fluent recognition of words and grasping of implied meaning by relating words and sentences to each other, the text, and the reader's background intelligence. Intelligence, used when reading, is abstract reasoning, the capacity to acquire knowledge, and problem solving. For many students with difficulties in reading comprehension, reading is a difficult and frustrating process. Because students with reading comprehension difficulties have an extremely frustrating experience in school and life; educators, parents, and the public are concerned. Huey (1968) asserts that if one is to improve reading comprehension, an increasing knowledge in intelligence and its assessment is of utmost importance. In fact, a need exists to analyse the relationship between intelligence and reading comprehension, especially for students with reading comprehension difficulties, in order to determine the underlying intelligence areas related to reading comprehension. It is possible to ask the following questions: Is there a correlation between reading comprehension and full-scale intelligence? Is there a correlation between reading comprehension and verbal competence? Is there a correlation between reading comprehension and problem solving? Is there a correlation between reading comprehension and perceptual reasoning? Is there a correlation between reading comprehension and working memory? Is there a correlation between reading comprehension and processing speed? Which area of intelligence, as measured by intelligence tests, verbal competence, problem solving, perceptual reasoning,

working memory, or processing speed is most highly correlated with reading comprehension, as measured by reading comprehension tests?

The link between intelligence and reading achievement seems obvious, but it is only relatively recently that researchers have turned their attention to intelligence, suggesting that individual differences in intelligence could underlie differences in reading comprehension. In fact, research trying to find an association between intelligence and reading comprehension has revealed supporting evidence (Conderman and Strobel, 2006; Edwards and Oakland, 2006) that intelligence is closely related to reading comprehension.

1.7 Conclusion

Despite the progress in the understanding of intelligence, still there is a long way to go. Intelligence is a construct that is so complex, and it may never be understood completely. In a field where so many issues are unresolved and so many questions unanswered, the confident tone that characterises most of the debate on these topics is clearly out of place. The study of intelligence needs self-restraint, reflection, and a great deal more research. The questions that remain are socially as well as scientifically important. There is no reason to think them unanswerable, but finding the answers will require a shared and sustained effort as well as the commitment of substantial scientific resources. Just such a commitment is what we strongly recommend.

CHAPTER TWO

READING AND READING COMPREHENSION

Introduction

Although there are differences in the views of literacy, there is a general agreement as to its importance and to its value and goals in an educational setting. Literacy issues have become increasingly important not only as school issues but as issues in the larger society. Castell and Luke (1983) equate literacy with mastery over the processes by which culturally significant information is transmitted. In general, linguists are primarily concerned with the structure and processing of spoken language. In this chapter, however, the focus will be on written language.

Reading is cognitive psycholinguistic activity, a complex developmental challenge that is intertwined with many other developmental accomplishments: attention, memory, language, and motivation, for example. It is no wonder, then, that researchers from a variety of disciplines, including cognitive psychology, developmental psychology, and education, are active in research on reading. This reflects the fact that the study of reading is both theoretically interesting and practically important. Thus, a large amount of research is carried out on reading.

The goal of the chapter is to review what is known about the processes involved in reading, comprehending the written discourse.

Section I: Reading

2.1 Definition of Reading

Reading is viewed as a *complex* activity. It is an interactive process between the reader, interacting dynamically, and the text. Huey (1968: 6) asserts that to analyse reading is to describe "very many of the most intricate workings of the human mind." Gates (1949: 3) expresses a similar view, stating that reading is "a complex organization of patterns of higher mental processes...[that]...can and should embrace all types of thinking, evaluating, judging, imagining, reasoning, and problem-solving." Even in this century, the complex view of reading continues to be advanced, as evidenced in a landmark report commissioned by the US National Academy of Education (Anderson, Hiebert, Scott, and Wilkinson, 1985: 7) that likens reading to "the performance of a symphony orchestra."

In contrast, while acknowledging the complexity of its components, reading can be viewed as quite simple in its gross anatomy. Voicing this view, Fries (1963: 118) argues that while reading certainly does involve the host of higher mental processes, "every one of the abilities listed may be developed and has been achieved *by persons who could not read*...[as] they are all matters of the uses of language and are not limited to the uses of reading." In this simple view, what distinguishes reading is that the reader exercises such abilities in response to graphic rather than acoustic signals. Stated simply, this view holds that reading consists of only two components, one that allows language to be recognised through a graphic representation, and another that allows language to be comprehended.

In addition to Fries (1963), there are others who propose such a simple view of reading. To cite a few, Calfee and Venezky (1970: 273) hold:

> Competency in reading is defined by two factors: overall reading ability as measured by a general reading test which, we will assume, taps basic reading skills, and the w-o ratio - the ratio of comprehension of written materials to that of oral materials.

Commenting on the proposed ratio of written to oral comprehension, Carroll (1977: 5) notes:

> ...if the ratio is high, the youngster is able to read up to the level of his language comprehension, but if the ratio is low, one may infer that the youngster is having trouble with decoding or some other aspect of his behavior in the presence of printed language.

2.2 Components of Reading

According to Gough & Tunmer (1986), reading may be decomposed into two components, decoding (word recognition) and linguistic comprehension:

2.2.1 Decoding

Skilled word recognition is simply the ability to rapidly derive a representation from printed input that allows access to the appropriate entry in the mental lexicon. Such recognition, which accomplishes a connection between a graphically based coding of letters (a graphemic coding) and the mental lexicon, allows retrieval of semantic information at the word level. As Hay and Spencer (1998: 222) put it:

> Word recognition is an essential component in the mastery of reading ….and considerable evidence suggests that the major difficulty confronting the beginning reader is the development of rapid, automatic word recognition skills…..Efficient readers use a variety of orthographic data to recognise word units, such as individual letters, letter clusters, morphemes, word stems, and word patterns.

Two general types of mechanisms are proposed as explanations of word recognition. One, *phonological coding*, is based on knowledge of the *cipher*, which captures the letter-sound correspondence rules of the language. The second hypothesis, *direct access*, proposes that word recognition is accomplished by mapping the graphic representation of the word directly onto its representation in the mental lexicon. Of these two, direct access is the only alternative that will permit reading non-alphabetic orthographies. However, in alphabetic systems, either system is at least theoretically possible. Indeed, one must consider whether both systems might be operative at different developmental stages or whether both might be operative at the same developmental stage but employed under different contexts (Gough and Hillinger, 1980).

Decoding takes on many meanings in both the word recognition literature and the educational instruction literature. Some researchers use decoding as a synonym for phonics (e.g. Chall, 1967). Other researchers use the term to describe the conversion of letter strings into phonetic codes (e.g. Perfetti, 1985). For still others, decoding specifically denotes word recognition that is accomplished through phonological coding (e.g. Gough & Tunmer, 1986).

2.2.2 Linguistic Comprehension

Under the simple view (Gough and Hoover, 1990), linguistic comprehension is the ability to take lexical information (i.e. semantic information at the word level) and derive sentence and discourse interpretations. Reading comprehension involves the same ability, but one that relies on printed information arriving through the eye (it is dealt with in the 2nd section of this chapter).

Linguistic comprehension is a careful comprehension that is intended to extract complete meanings from presented material as opposed to comprehension aimed at only extracting main ideas, skimming, or searching for particular details.

The simple view of reading makes two claims: first, that reading consists of word recognition and linguistic comprehension; and second, that each of these components is necessary for reading, neither being sufficient in itself. As noted by Gough & Tunmer (1986: 7):

> Reading equals the *product* of decoding and comprehension, or $R = D \times C$, where each variable ranges from 0 (nullity) to 1 (perfection). We trust that it is clear that by comprehension we mean, not reading comprehension, but rather *linguistic* comprehension, that is, the process by which, given lexical (i.e. word) information, sentences and discourses are interpreted.

In short, component skills analysis seeks to understand reading as a set of theoretically distinct and empirically isolable constituents. According to Brown *et al.* (1990), decomposition of reading ability holds that individual differences in reading ability will be restricted to variation in its two components.

2.3 Models of Reading

Just as there are various ways of viewing literacy, there are also various theories and models surrounding the process of reading. Relying on the decomposition of reading, theorists argue over bottom-up (letter to semantic) versus top-down (semantic to letter) approaches to reading. Some of their theories are concerned primarily with decoding of print (Adams, 1990; Goodman, 1967; and Laberge and Samuels, 1974). Other theories are more involved with comprehension (Rummelhart, 1985) or reader-text interaction (Rosenblatt, 1985).

2.3.1 Bottom-up Models

It is a traditional view which holds that novice readers acquire a set of hierarchically ordered subskills that sequentially build toward comprehension ability. Reading in this view is basically a matter of decoding a series of written symbols into their aural equivalents in the quest for making sense of the text. It is a model which takes in stimuli from the outside world -- letters and words, for reading -- and deal with that information with little recourse to higher-level knowledge.

In the words of Davies, the bottom-up models are "Models of the reading process that describe the process as a sequence of discrete 'steps', in which the direction of processing is from 'bottom-level' features of text to 'higher levels', that is, from the identification of letters to sounds, to words, to sentences and finally to meaning and thinking" (Davies, 1995: 169). Gough (1972), in his turn, assumes that the bottom-up models focus on how readers extract information from the printed page, claiming that readers deal with letters and words in a relatively complete and systematic fashion (see figure 2.1).

It is easy to remark that the proponents of this model emphasise on the importance of decoding in the reading process. Allington clearly states it by arguing that “All readers must

acquire automatic and proficient strategies for the integrative use of the multiple cue sources available in written text" (1991: 372). That is, when a reader is unable to decode, creating meaning from print becomes a daunting task.

This model of reading has almost always been under attack as being insufficient and defective for the main reason that it relies on the formal features of the language, mainly words and structure. Although it is possible to accept this rejection for the fact that there is over-reliance on structure in this view, it must be confessed that knowledge of linguistic features is also necessary for comprehension to take place. To counteract over-reliance on form in the traditional view of reading, the cognitive view is introduced.

2.3.2 Top-down Models

These are models of the reading process that, being in direct opposition to bottom-up models, " predict that the processing sequence proceeds from predictions about meaning to attention to progressively smaller units, for example, letters, visual features" (Davies, 1995: 175). In other words, minimal attention is paid to letter-sound correspondences, and what seems too important is the individual's uptake of information that is guided by his prior knowledge and expectations.

Theories that stress top-down processing hold that readers form hypotheses about which words they will encounter and take in only just enough visual information to test their hypotheses (e.g., Goodman 1967, Smith 1971). Carrell and Eisterhold argue that top-down processing helps the listeners/readers to resolve ambiguities or to select between alternative possible interpretations of the incoming data (1983: 557).

Researchers, however, are still investigating the ways through which these two kinds of knowledge interact with each other during the process of reading. Jeanne S. Chall, an

advocate of the phonics approach, is known for her continued struggle with the war between "those advocating phonics instruction [bottom-up processing] and those advocating whole language [top-down processing], which relies in part on instruction using sight words" (Abraham,2002:1). Chall (1967) argues that a "systematic direct teaching of decoding should be part of initial reading instruction" (Orasanu, 1986: 114). Carrell and Eisterhold (1983: 562) state that accessing appropriate content schemata depends initially on "the graphic display" which "must be somehow reconstructed by the reader as meaningful language." Therefore, readers can improve reading comprehension by expanding their vocabularies and gaining greater control over complex syntactic structures. Contemporary insights believe that grammar facilitates learning and its presentations to learners should be through "contextualization of linguistic forms in situations of natural use" (Hedge, 2003: 159).

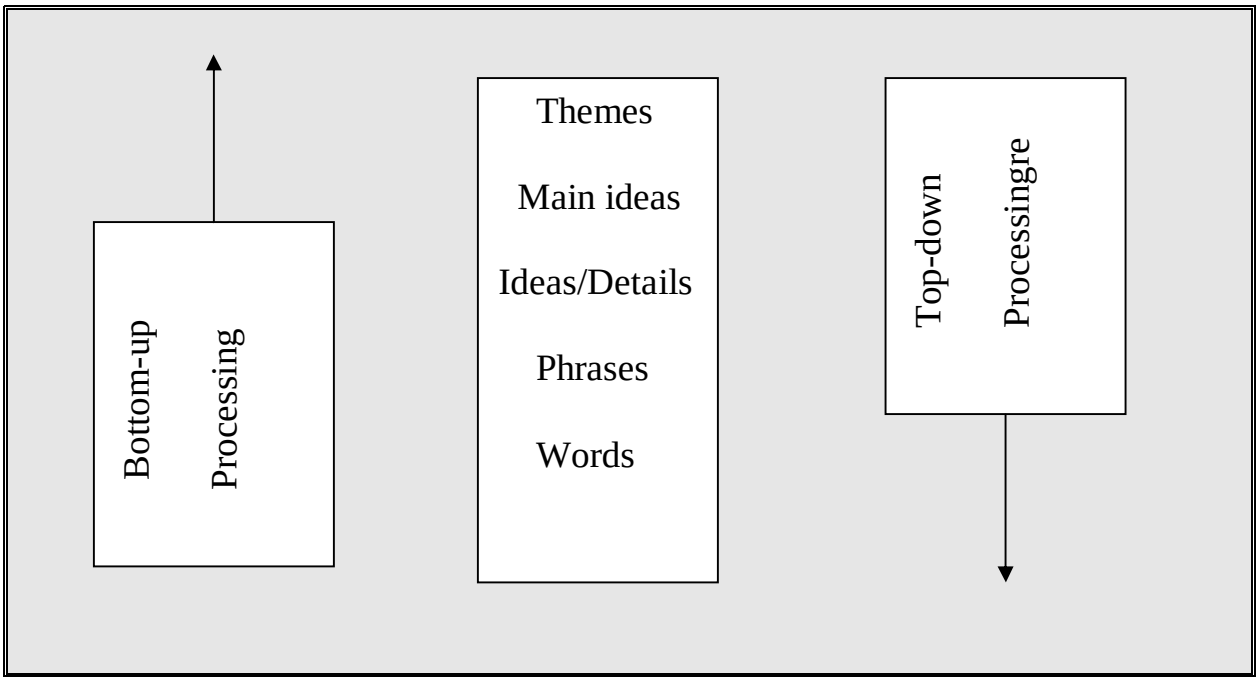


Figure 2.1 Bottom-up and Top-down Processing in Reading

2.3.3 Interactive Models

These are models of reading where bottom-up and top-down processes work together to ensure the accurate and rapid processing of information. It is a model that is proposed by Rummelhart who seeks to account for both bottom-up and top-down processing. Rummelhart (1985) examines reading as an interactive process which includes various components from letter-level knowledge, letter-cluster knowledge, lexical-level knowledge, syntactic-level knowledge, and semantic-level knowledge. Decoding skills are generally thought of as mainly involving the initial components while comprehension involves the higher level components. In other words, this model of reading involves aspects of automaticity- that is, a reader becomes more proficient in decoding, less attention is devoted to this skill so that more attention is freed to examine comprehension issues.

2.3.4 Transactional Models

The transactional theory of reading is a model developed by Louise Rosenblatt. Some of the advantages of this approach are summed up by the following quotation:

> Instead of ... the dualistic, mechanistic, linear, interactional view, in which the text, ... and the personality of the reader ... can be separately analyzed, with the impact of one on the other studied in a vacuum, we need to see the reading act as an event involving a particular individual and a particular text, happening at a particular time, under particular circumstances, in a particular social and cultural setting, and as part of the ongoing life of the individual and the group. We can still distinguish the elements ... not as separate entities, but as aspects of phases of a dynamic process, in which all elements

take on their character as part of the organically-interrelated situation (Rosenblatt, 1985:100).

Rosenblatt regards theories that emphasise reading as decoding or that privilege the reader above the text as dualist (Rosenblatt 1998: 918) and rejects them to emphasise the situated *relationship* between a reader and a text as being critical for the outcome of reading. Reading is treated as an event (Rosenblatt 1994: 16), thus providing an approach consistent with the need to consider the *process* of knowledge transfer. Furthermore, the transactional approach links her theory to broader theories of behaviour and scientific method that emphasise the inter-connectedness of human activity.

2.4 Types of Reading

2.4.1 Extensive Reading

Pointed out to by Brumfit (1977, quoted in Nuttal, 1982: 23) as 'reading for fluency,' extensive reading brings about many conflicting definitions (Hedge, 2003: 202). Some use it to refer to "skimming and scanning activities," others associate it to quantity of material. Hafiz and Tudor (1989: 5), in considering extensive reading, assume that this type of reading, being of a great pedagogical value, emphasises the importance of the learners' exposure to large quantities of meaningful and interesting L2 material. In the long run, this would produce a beneficial effect on the learners' command of the L2.

Hedge (2003) believes that extensive reading varies according to learners' motivation and school resources. He also states that it enables them to achieve their independency by reading either in class or at home, through sustained silent reading (SSR). Carrell and Eisterhold (1983: 567) argue that SSR activity can be effective in helping learners become self-directed agents seeking meaning, provided a SSR program is "based on student-selected

texts so that the students will be interested in what they are reading. Students select their own reading texts with respect to content, level of difficulty, and length."

2.4.2 Intensive Reading

In intensive (or reflected) reading, learners usually read a page to explore the meaning and to be acquainted with writing mechanisms. During this type of reading, the learner gains text comprehension to, then, be able to form a critical view and is, thus, able to state well-founded opinion about the content, the arguments, the language used, the message, the intention and the form of a text. Intensive reading focuses on details and analysis. For Nuttal (1982: 23), it requires "the student to pay great attention to the text. The aim of intensive reading is to arrive at a profound and detailed understanding of the text."

Hafiz and Tudor (1989: 5) differentiate between extensive and intensive reading, asserting that in intensive reading activities, learners are in the main exposed to relatively short texts which are used either to exemplify specific aspects of the lexical, syntactic or discoursal system of the L2, or to provide the basis for targeted reading strategy practice; the goal of extensive, on the other hand, is to "flood" learners with large quantities of L2 input with few or possibly no specific tasks to perform on this material.

Section II: Reading Comprehension

The purpose of reading is comprehension, or to get meaning from a written text. Without comprehension, reading is a frustrating, pointless exercise in word calling. It is no exaggeration to say that how well learners develop the ability to comprehend what they read has a profound effect on their entire lives.

2.1 Definition of Reading Comprehension

Defining reading comprehension is a contentious (controversial) process. Discourse processing researchers almost unanimously define comprehension as the formation of an internally consistent mental representation of text, through the process that combines information from text with the reader's prior knowledge. For example, the RAND Reading Research Group (Snow, 2002: 11) define reading comprehension as the process of getting meaning out of the written language. In considering reading comprehension, the RAND emphasises the importance of three elements: a) the reader who is doing the comprehending, including all the capacities, abilities, knowledge and experiences he brings to the act of reading, b) the text that is to be comprehended and which is broadly construed to include any printed text, and c) the activity in which comprehension is a part and purposes, processes, and consequences associated with the act of reading are included.

However, as Harris and Hodges (1995) point out, researchers are split between those who feel a comprehender's mental representation must match that intended by the author, and those from a more literary bent (e.g., Lee, 2001) who feel that any internally consistent representation is a sign of comprehension. The majority of psychological researchers cited in this literature review adopt the former definition, explicitly or implicitly.

2.2 Components of Reading Comprehension

2.2.1 Background knowledge

It is all the world knowledge that the reader brings to the act of reading. It includes school-based knowledge and personal knowledge, episodic (events), declarative (facts) and procedural (how-to) knowledge (Alexander and Judy, 1988. Kintsch, 1988). Researchers have used one of two general approaches for investigating the relationship between background knowledge and reading comprehension—1) Is general background knowledge (or world knowledge) related to general reading comprehension? (e.g., on an IQ test; Harrison *et al.*, 1995) or 2) Is background knowledge about a specific topic related to comprehension of a specific passage about that topic (e.g., Stevens, 1980). Not surprisingly, fewer researchers have used the former approach, since developing acceptable, representative tests of general knowledge is a difficult task.

2.2.2 Inferencing

It is the logical process of combining information within sentences in text, between sentences in text, or between prior knowledge and text. For example, in order to understand who the word “he” is referring to in text, the reader must combine information in that sentence with information in a previous sentence that referred to a male. Readers also use inference processes to figure out the meaning of an unknown vocabulary word (Baumann *et al.*, 2003). Likewise, readers constantly add information from background knowledge to what they read in order to understand it. However, readers are often not aware of these processes. One important distinction made in the psychological literature is between on-line and off-line inferences (ones that are made only during later retrieval; Graesser *et al.*, 1994; 1997). On-line

inferences (like those made during concurrent think-aloud protocols) may include those made automatically as well as those made deliberately, strategically, and effortfully. Off-line inferences (like those made when answering post-reading questions or during retrospective protocols) are always seen as deliberate, strategic, and effortful. On-line inferences are the ones of highest theoretical interest to psychologists (e.g., Long *et al.*, 1999), presumably because they represent the situation in most reading contexts. Off-line inferences are of great interest to educational psychologists, since school-related reading often includes reading passages followed by questions that require inferences (e.g., Hare *et al.*, 1989).

2.2.3 Strategies

Proficient readers use cognitive and metacognitive reading strategies such as setting goals before they begin to read, asking themselves questions and answering them while reading, summarising, and reflecting on what they read. Alexander and Judy (1988: 376) define strategies as "goal-directed procedures that are planfully or intentionally evoked . . . . [that] aid in the regulation, execution, or evaluation of a task." Strategies help proficient readers understand better what they read. Readers are not necessarily aware of using these strategies, although they are able to verbalise many of them when asked to think aloud during reading, and are able to identify some of them on questionnaires. Some research suggests, however, that while good readers can accurately self-report strategies, poor readers have weaknesses in metacognitive processes that lead them to inaccurately self-report strategy use (Baker & Cerro, 2000). Strategies can be taught to children who struggle with comprehension, which improves their understanding of texts.

2.2.4 Vocabulary

It is often defined as knowledge of a word's meaning. However, there are many aspects of word knowledge, most of which have received little attention from researchers. Nagy and Scott (2000) point out that knowledge about any single word is multidimensional (e.g., giving a definition, knowing the part of speech, being able to use the word correctly), incremental (not all-or-nothing), polysemous (many words have more than one meaning), interrelated (e.g., understanding a definition requires understanding other words in the definition), and heterogeneous (e.g., the knowledge one can have about function words, technical terms, and concrete nouns varies). In addition to word knowledge, vocabulary knowledge includes knowing the meanings of affixes (prefixes and suffixes), understanding relationships between words, and strategies for figuring out new words (Diakidoy *et al.*, 1993). The majority of research on vocabulary and reading comprehension focuses on single meanings of words.

2.2.5 Word Reading

It includes both a reader's sight words (stored in long-term memory) and word attack skills. The latter include decoding, analogy, and morphological strategies (e.g., using prefixes and suffixes; Anderson *et al.*, 1993). Measures of word reading often include real words and nonsense words or pseudowords (e.g., blum or grame) that follow regular spelling-sound patterns in English. Especially with older students, nonsense words are thought to reveal students' true word attack skills, since any real word could already be a sight word for the student (Dickinson *et al.*, 1996). Word reading is distinct from vocabulary knowledge in that a reader may be able to read a word but not know its meaning, or may know the meaning of a word if it is spoken out loud but may not be able to pronounce the word in its written form.

2.3 Reading Comprehension Strategies

In English learning classes, most attention is often paid to dictionaries and the teacher. In order to read actively, this routine has to be interrupted. In fact, readers need to dialog with what they are reading without having the teacher who comes between them; this is a challenge to the EFL teacher.

Studies on good readers identify a number of comprehension strategies to be highly useful. These strategies range from the simple to the complex. The following strategies are chosen from the array of strategies examined by researchers (Dole *et al.*, 1991) to help learners understand what they read.

2.3.1 Activating and Using Background Knowledge

This strategy requires readers to activate their background knowledge and to use that knowledge to help them understand what they read. Background knowledge is made up of a person's experiences with the world (including what he or she reads), along with his or her concepts for how written text works, including word identification, print concepts, word meaning, and how text is organised. Researchers establish that readers' existing knowledge is critical in determining their ability to comprehend what they read (Anderson and Pearson, 1984).

One of the most important contributions made by cognitive scientists to the understanding of how comprehension works is schema theory (Anderson *et al.*, 1977). This theory is based on how people organise and activate their knowledge.

According to schema theory, as people learn about the world, they develop a large network of knowledge structures, or schemas, with each schema connected to many others. These schemas grow and change as a person acquires new information through experience and

reading. For example, a very young child's schema for *dog* might contain only her or his understanding of the family pet- something white, furry, and fun to play with. As the child gains more experiences with a variety of dogs in a variety of settings, the dog schema will expand and be refined. It may connect to other schema- types of dogs; colours of dogs; foods dogs eat; dangerous dogs; and who veterinarians are.

When they apply schema theory to reading comprehension, cognitive scientists find that good readers constantly connect their background knowledge to the new knowledge they encounter in a text. In fact, they appear to activate a schema as soon as they begin to read. The initial schema then activates others, thus directly affecting how readers understand and react to a text (Anderson and Pichert, 1977).

Schemas that are related to text organisation are especially important to comprehension. According to Anderson et *al.* (1987), having knowledge of a text's organisation improves students' understanding of that text.

2.3.2 Generating and Asking Questions

This strategy involves readers asking themselves questions throughout the reading of a text. The ability of readers to ask themselves relevant questions as they read is especially valuable in helping them to integrate information, identify main ideas, and summarise information. As argued by Willoughby et *al.* (1995), asking the right questions allows good readers to focus on the most important information in a text.

2.3.3 Making Inferences

This strategy requires readers to evaluate or draw conclusions from information in a text. Authors do not always provide complete descriptions of, or explicit information about a topic, setting, character, or event. However, they often provide clues that readers can use to "read between the lines"- by making inferences that combine information in the text with their background knowledge.

Anderson and Pearson (1984) assert that when readers are taught how to make inferences, they improve their abilities to construct meaning. Indeed, research indicates that the ability to make inferences is crucial to successful reading.

2.3.4 Predicting

This strategy involves the ability of readers to get meaning from a text by making informed predictions. Good readers use predicting as a way to connect their existing knowledge to new information from a text to get meaning from what they read (Gillet and Temple, 1994). Before reading, they may use what they know about an author to predict what a text will be about. The title of a text may trigger memories of texts with similar content, allowing them to predict the content of the new text.

During reading, good readers may make predictions about what is going to happen next, or what ideas or evidence the author will present to support an argument. They tend to evaluate these predictions continuously, and revise any prediction that is not confirmed by the reading.

2.3.5 Summarising

This strategy involves the ability of readers to pull together, or synthesise information in a text so as to explain in their own words what the text is about. Diamond et *al.* (2000) consider summarising as an important strategy because it enables readers to recall text quickly. It also makes readers more aware of text organisation, of what is important in a text and of how ideas are related.

Depending on the type of text being read, Summarising may involve such things as condensing the steps in a scientific process, or the stages of development of an art movement (in an expository text); or connecting and synthesising events in a story line or identifying the factors that motivate a character's actions and behaviour.

2.3.6 Visualising

Visualising involves the ability of readers to make mental images of a text as a way to understand processes or events they encounter during reading. This ability can be an indication that a reader understands a text. Pressley (1976) suggests that readers who visualise as they read are better able to recall what they have read than are those who do not visualise.

When applied to narrative texts, visualising the setting, characters, or actions in the plot helps readers develop a clear understanding of what is happening. In addition to that, it can be applied to the reading of expository texts, with readers visualising steps in a process or stages in an event or creating an image to help them remember some abstract concept or important name (Bales and Gambrell, 1986).

2.3.7 Comprehension Monitoring

This involves the readers' ability to know when they understand what they read, when they do not understand, and to use appropriate strategies to improve their understanding when it is blocked. According to Dole *et al.* (1991), comprehension monitoring is a form of metacognition using which good readers are aware of and monitor their thought processes as they read. In contrast, poor readers "just do it."

The strategies employed by good readers to improve understanding are called "repair" or "fix-up" strategies. Paris *et al.* (1991) explain that specific repair strategies include rereading, reading ahead, clarifying words by looking them up in a dictionary, or asking someone for help.

In general, good readers use a variety of strategies such as the ones just discussed to construct meaning as they read. However, not all good readers use the same strategies; good readers tend to develop and practise those strategies that are most useful to them. Further, good readers are flexible in their strategy use: they switch from one strategy to another as they read; they have conscious control of their strategy use, and know which strategies to use and when to use them. In general, good readers need little or no explicit instruction.

Unfortunately, not all readers are good. Some readers need organised, explicit instruction that teaches them to use specific strategies for understanding text. The good news is that these specific comprehension strategies, mentioned in this chapter, can be taught and learnt- and that their deliberate use by readers improves comprehension.

2.4 Conclusion

The written form of language, like its spoken form, is very important. This implies that investigations of language and language processing should focus on written and spoken language and there is a lot to be gained from these studies. This chapter presents evidence that the study of written language processing is interesting and informative, and that there are many questions to be answered about how children can best read and be taught to do so.

It can be seen from this chapter that to further improve reading standards, several things are needed. We need to provide teachers with research-based training in reading comprehension, so that they understand the likely causes of failure and know which kinds of strategies it is appropriate to teach to improve different aspects of children's comprehension. We need teachers who are both professional and expert in their understanding and their teaching. Only this can release the necessary creativity needed for teachers to be adaptable and well-informed in their teaching of reading skills.

This chapter attempts to aid readers in identifying both strengths and weaknesses in reading comprehension. It is noteworthy that the use of even one of the techniques described in this chapter is shown to improve students' comprehension of text. Equally important, comprehension instruction is best when it focuses on a few well-taught, well-learned strategies. It is possible to point to a litany of effective techniques; however, this does not mean that using a litany of techniques will be effective.

CHAPTER THREE

INVESTIGATING INTELLIGENCE AND READING COMPREHENSION IN SECONDARY SCHOOL FOURTH YEAR PUPILS

This study is undertaken in order to determine the intellectual abilities and the reading comprehension of secondary school pupils in Constantine, Algeria. Hopefully, during the course of this study, some of my long held beliefs would be answered; and these beliefs are cast in the form of predictions which may be proved or disproved in the course of my research. The predictions made are that secondary school pupils, aged 15 years (c.f. section 3.2, for more details), that would score higher in the administrated intelligence test would score higher in the reading comprehension exercises. In other words, I predict that the most intelligent pupils who are more capable than others to reason logically, solve problems effectively, plan and think abstractly, would be the best comprehenders of the foreign language written texts. In this study, sex differences have not been given any predictions as far as intelligence and reading comprehension are concerned.

3.1 Pilot Study

The pilot study, in this investigation, is indispensable. It is a significant research step which is as important as the main study. It has helped us, in many terms, to see the weaknesses of intelligence and reading comprehension measures.

In the design of the intelligence test used in this study, we have depended on the theories of intelligence mentioned in the literature review. In fact, we have not considered the different theories of intelligence as being opposed to each other. On the contrary, we

considered them as being complementary. In addition to that, the design of intelligence test would have been difficult without an analysis of the school curricula content of the sample's pupils for what they learn at school has a great influence on their intellectual abilities, and it would give us an idea about the type of cognitive activities they are able to go through. Thus, we have relied heavily on the content of curricula of subjects like mathematics and English as a foreign language.

The intelligence test, researcher-developed, that has been used in the pilot study contains 60 items. This test has been administered to middle school pupils, aged 15 years, in order to measure their verbal and nonverbal intelligence. The verbal portion consists of a vocabulary subtest which measures knowledge of words and their meanings. The matrices subtests assess the fluid thinking- the ability to solve new problems by perceiving relationships and completing analogies. It is important to point out to the fact that this test has been designed in Arabic; the pupils at their level would not be able to take an intelligence test in English.

As far as the reading comprehension test is concerned, the two exercises (texts and questions) used have been taken from "On the Move" (Arab, 2006: 37-38, 147), the fourth year English pupils' schoolbook. Aiming at meaning extraction from the text, the exercises have been taken and administered the way they are designed in the book, i.e with no modifications. In the first exercise, the pupils have been required to read a narrative text and answer reading comprehension questions about it. In the second exercise, they have been queried three multiple choice questions about an expository text.

We have administered both tests to a range of 50 pupils (18 % of the population; c.f., for more details about the target population and the size of the sample, section 3.2.), selected randomly, from both sexes, from a total population that consists of 290 secondary school

pupils, frequenting a secondary school in Sidi Mabrouk, Constantine, Algeria. Having the same age of the sample's individuals (15-year-olds), the participants in the pilot study are attenders of the same school, but they do not belong to the study sample. It is also noteworthy that these 50 pupils are not in special education classes.

We have decided that administering both tests on two Monday mornings would be the best way to avoid many disturbances. We have a point in thinking like that because we believe that on Monday, pupils would find it neither difficult to prepare for a new day to begin the week nor too tired because of their whole week schoolwork. So, they have taken both tests in their classroom sessions, starting at 8 o'clock with the 1st group (25 pupils) and 9 o'clock with the 2nd group (25 pupils). In addition to that, we have decided, for both tests, that the administration time would not exceed one hour. To tell the truth, we have been limited by the sessions' duration.

I have been, as a test-administrator, assisted by a teacher of English as a Foreign Language. She has mainly supervised the pupils in order to avoid having them cheating. This way, we would make sure that the answers are individual and would reflect, to some extent, individual abilities.

The analysis of the intelligence test has helped us have better insights into this measure. Many items have been found to be too easy and others too difficult for the participants (as shown in table 3.1.). Thus, we have decided to adjust some of them to the level of the respondents and to discard some others. The items that have been judged to be appropriate to the learners' level and that have been kept to be used in the main study are items 11, 12, 14, 15, 16, 17, 18, 21, 25, and 26 (c.f. Appendix 1).

N° of Item	Item Category	N° of correct Answers	Degree of Difficulty	Item's Status
01	Similarities& Differences(verbal)	43 → 85%	Too easy	Discarded
02	Vocabulary (verbal)	47 → 93%	Too easy	Discarded
03	Similarities& Differences(verbal)	44 → 88%	Too easy	Discarded
04	Problem-solving (verbal)	42 → 83%	Too easy	Discarded
05	Series (verbal)	7 →13%	Too difficult	Discarded
06	Reasoning (verbal)	45 → 90%	Too easy	Discarded
07	Reasoning (verbal)	14→26.5%	Too difficult	Kept with modifications
08	Series (verbal)	41 → 80.5%	Too easy	Discarded
09	Reasoning (verbal)	8 →16%	Too difficult	Discarded
10	Reasoning (verbal)	5 →10%	Too difficult	Discarded
11	Reasoning (verbal)	47 → 93%	Too easy	Discarded
12	Series (verbal)	34 → 67%	Average	Kept to be used in the main study intelligence test
13	Series (verbal)	43 → 86%	Too easy	Discarded
14	Similarities& Differences (verbal)	12 → 23%	Too difficult	Discarded
15	Reasoning (verbal)	38 → 75%	Average	Kept to be used in the main study intelligence test
16	Similarities& Differences(verbal)	9 →19%	Too difficult	Discarded
17	Reasoning (verbal)	12 → 23%	Too difficult	Discarded
18	Reasoning (verbal)	8 →14.5%	Too difficult	Discarded
19	Vocabulary (verbal)	42 →83%	Too difficult	Discarded

20	Reasoning (verbal)	41 →81%	Too easy	Discarded
21	Reasoning (verbal)	13 → 26%	Too difficult	Discarded
22	Series (verbal)	8 →14.5%	Too difficult	Kept with modifications
23	Problem-solving (verbal)	6 →11%	Too difficult	Discarded
24	Problem-solving (verbal)	4 → 8%	Too difficult	Discarded
25	Series (verbal)	14 → 28%	Too difficult	Discarded
26	Similarities& Differences (verbal)	11 →21%	Too difficult	Discarded
27	Similarities& Differences(verbal)	32 → 64%	Average	Kept to be used in the main study intelligence test
28	Series (verbal)	36 →71%	Average	Kept to be used in the main study intelligence test
29	Similarities& Differences (verbal)	46 → 91%	Too easy	Discarded
30	Problem-solving (verbal)	2 → 4%	Too difficult	Discarded
31	Similarities& Differences (verbal)	47 → 93%	Too easy	Kept with modifications
32	Reasoning (verbal)	9 →19%	Too difficult	Discarded
33	Similarities& Differences (verbal)	4 → 8%		Discarded
34	Series (verbal)	40 → 79%	Easy	Kept to be used in the main study intelligence test
35	Problem-solving (verbal)	8 →16%	Too difficult	Discarded
36	Reasoning (verbal)	14 → 28%	Too difficult	Kept with modifications
37	Reasoning (verbal)	11 → 21%	Too difficult	Discarded
38	Problem-solving (verbal)	16 →31%	Difficult	Kept to be used in the main study intelligence

				test
39	Vocabulary (verbal)	43 → 86%	Too easy	Discarded
40	Reasoning (verbal)	7 →13%	Too difficult	Discarded
41	Problem-solving (verbal)	3 → 5%	Too difficult	Discarded
42	Reasoning (verbal)	44 →88%	Too easy	Discarded
43	Problem-solving (verbal)	16 → 32%	Difficult	Kept to be used in the main study intelligence test
44	Reasoning (verbal)	44 → 87%	Too easy	Discarded
45	Problem-solving (verbal)	4 → 8%	Too difficult	Discarded
46	Reasoning (verbal)	8 →16%	Too difficult	Discarded
47	Series (verbal)	5 →10%	Too difficult	Kept with modifications
48	Series (verbal)	13 → 26%	Too difficult	Discarded
49	Similarities& Differences (verbal)	46 → 91%	Too easy	Discarded
50	Similarities& Differences (verbal)	7 →13%	Too difficult	Discarded
51	Problem-solving (verbal)	1→ 0.5%	Too difficult	Discarded
52	Series (non-verbal)	4 → 7%	Too difficult	Discarded
53	Similarities& Differences(non-verbal)	26 → 52%	Average	Kept to be used in the main study intelligence test
54	Series (non-verbal)	11 → 22%	Too difficult	Discarded
55	Series (non-verbal)	9 →19%	Too difficult	Discarded
56	Reasoning (non-verbal)	6 →12%	Too difficult	Discarded
57	Series (non-verbal)	13 → 26%	Too difficult	Discarded
58	Series (non-verbal)	32 → 63%	Average	Kept to be used in the main study intelligence test
59	Series (non-verbal)	9 →18%	Too difficult	Discarded

60	Decision Making (verbal)	35 →69%	Average	Kept to be used in the main study intelligence test

Table 3.1 The First Results of the Intelligence Test of the Pilot Study

The analysis of the reading comprehension exercises has helped us uncover this measure's weaknesses. The pupils' responses have demonstrated that the first exercise proved, to a certain extent, to be adjusted to the level of the majority of the pupils. The second exercise, however, proved to be too difficult for the majority of the pupils. This is reflected in the wrong answers they have given, even on the part of the most intelligent pupils (as shown on table 3.2.).

N° of Question	Question Type	N° of Correct Answers	Degree of Difficulty	Questions' Status
Question01 (exercise 01)	Constructed response question	37 → 75%	Average	Kept to be used in the main study reading comprehension test
Question 02 (exercise 01)	Constructed response tests	40 → 79%	Average	Kept to be used in the main study reading comprehension test
Question 03 (exercise 01)	Constructed response tests	33 → 65%	Average	Kept to be used in the main study reading comprehension test
Question 04 (exercise 01)	Constructed response tests	15 → 30%	Difficult	Kept to be used in the main study reading comprehension test
Question 01	Multiple-choice	12 → 24%	Too difficult	Discarded

(exercise 01)	Question			
Question 02 (exercise 02)	Multiple-choice Question	11 → 21%	Too difficult	Discarded
Question 03 (exercise 02)	Multiple-choice Question	5 →10%	Too difficult	Discarded

Table 3.2 The First Results of the Reading Comprehension Test of the Pilot Study

The items we have kept to be used in the main study test are not enough to be used in an intellectual abilities' measure. Thus, we have designed new items, taking into consideration the results of the first test, to get, at the end, a 27-item-test.

Since we have found that the text does not contain a lot of unfamiliar words, we have decided to keep the text and the problem is mainly that of forming the comprehension questions. Thus, we have put new comprehension questions that are, in comparison to the original questions, more affordable.

To make sure that there has been no room for any doubt about the difficulty of the new measures, we have decided that 50 pupils (not the same 50 participants in the first part of the pilot study) would take the new tests of intelligence and reading comprehension (after modifications).

The test has been administered in the very same conditions it has been given the first time (the same day, the same administration time, the same sessions, etc.). The results obtained are presented in table 3.3. and table 3.4.

N° of Item	Item Category	N° of Correct Answers	Degree of Difficulty
01	Vocabulary (verbal)	40 → 80%	Easy
02	Vocabulary (verbal)	38 → 76%	Easy
03	Vocabulary (verbal)	28 → 56%	Average
04	Vocabulary (verbal & non-verbal)	34 → 67%	Average
05	Vocabulary (verbal)	15 → 30%	Difficult
06	Vocabulary (verbal)	20 → 40%	Difficult
07	Silmilarities & Differences (non-verbal)	48 → 99%	Too easy
08	Silmilarities & Differences (non-verbal)	48 → 99%	Too easy
09	Silmilarities & Differences (non-verbal)	40 → 80%	Easy
10	Silmilarities & Differences (non-verbal)	30 → 59%	Average
11	Silmilarities & Differences (verbal)	34 → 67%	Average
12	Silmilarities & Differences (non-verbal)	16 → 31%	Difficult
13	Entertaining Item (verbal)	24 → 48%	Average
14	Series (non-verbal)	40 → 80%	Easy
15	Series (non-verbal)	38 → 76%	Easy
16	Series (non-verbal)	26 → 52%	Average
17	Series (non-verbal)	24→ 48%	Average
18	Series (non-verbal)	14 → 28%	Difficult
19	Reasoning (verbal)	40 → 80%	Easy
20	Reasoning (verbal)	31 → 61%	Average
21	Reasoning (verbal)	34 → 68%	Average
22	Reasoning (verbal)	14 → 28%	Difficult

23	Problem-solving (verbal)	42 → 83%	Too Easy
24	Problem-solving (verbal)	38 → 76%	Easy
25	Problem-solving (verbal)	32 → 64%	Average
26	Problem-solving (verbal)	10 → 20%	Too Difficult
27	Decision Making (verbal)	34 → 68%	Average

Table 3.3 The Second Results of the Intelligence Test of the Pilot Study

N° of Question	Question Type	N° of Correct Answers	Degree of Difficulty
Question01(exercise01)	Constructed response tests	40 → 80%	Easy
Question02(exercise01)	Constructed response tests	40 → 79%	Average
Question03(exercise01)	Constructed response tests	33 → 65%	Average
Question04(exercise01)	Constructed response tests	15 → 30%	Difficult
Question01(exercise02)	Multiple-choice Question	39 → 78%	Average
Question02(exercise02)	Multiple-choice Question	30 → 60%	Average
Question03(exercise02)	Multiple-choice Question	19→ 38%	Difficult

Table 3.4 The Second Results of the Reading Comprehension Test of the Pilot Study

From the analysis of table 3.3 and table 3.4, we notice that the new measures, neither too difficult nor too easy, are sound and user-friendly. Thus, they can be administered to the main study's sample (95 participants).

3.2 Subjects in the Main Study

Middle school attenders, the participants are 95 fourth year middle school pupils of both sexes, aged 15 years, selected to be at a wide range of intellectual abilities and reading comprehension proficiency. They are drawn from a middle school (about 290 students), Salah KHOUALDIA, located in Sidi Mabrouk, Constantine, Algeria. None of the pupils are in Special Education classes.

Information sheet that has been presented to the teacher explains that the purpose of the study is to determine why some learners have more difficulty than others comprehending a written print by investigating how their performance on an intelligence test is related to their reading ability. It states that the data obtained in the study would be confidential.

3.3 Procedure and Materials

The field work of this study has taken place in the previously mentioned middle school. Divided into 3 groups of 32, 34, and 29 pupils, subjects have been administered tests in their school classrooms, being the available quiet area in the school, with my assistance, as a test-maker, and a teacher of English as a Foreign Language, as a supervisor.

The assessment of the pupils' intellectual abilities and their reading comprehension has taken place at a time which is convenient to the subjects, the classroom teacher, and the school. Completed few days after the spring break, two tests are given to the learners in two Monday mornings. This choice is based on the fact that pupils then would be into their mid-

week routine and not be distracted by either the beginning of the week, end of the week or end of the school day. So, on the first Monday, they take an intelligence test; and on the following Monday, they take a reading comprehension test. In each day, the test begins at around eight o'clock to last not more than one hour.

Telling the pupils that the test scores would not be included in their academic marks would lead to a decrease in the students' anxiety and stress when taking the two tests. It is expected, however, that this would lead to a lack of seriousness in dealing with the tests' questions. So, we have seen that a reward, as an extrinsic motivation for the students to do their best, is needed. Thus, students have been told that three MP3 players would be offered to the top three pupils, i.e the three pupils who will get the highest scores in both tests.

3.4 Instruments

Two test instruments are used in this study to assess the pupils' intelligence and reading comprehension.

3.4.1 Intelligence Tests

Used as a psychoeducational evaluation within a school system, the first test instrument is a comprehensive measure of general intelligence, verbal and non-verbal. The test evaluates intelligence not as one phenomenon but as a combination of many variables. It provides an estimate of global cognitive functioning as well as information about functioning within more specific domains. Thus, this study's intellectual test includes problem-solving strategies, a central component of the information-processing approach to intelligence, as well as achievement in the academic subjects, like vocabulary and arithmetic.

In fact, to establish norms for the intelligence test used in this study, a reliance on an analysis of schoolbooks and the intelligence theories mentioned in the theoretical part is essential for the design of the intelligence test.

The intelligence test of the main study is composed of 27 items that are put in a progressive order of difficulty, from the least difficult to the most difficult item. We included in this test measures of both verbal and non-verbal intelligence.

3.4.2 Reading Comprehension Tests

With the reading comprehension test that is administered to pupils in this study, we aim at providing an evaluation of pupils' natural written language understanding. The goal of the reading comprehension task is to find answers to a set of questions from ***a single related document.*** This test consists of two reading comprehension exercises. The first exercise, taken from the pupils' schoolbook (Arab, 2006:147) includes short-answer questions. It requires the pupils to read a narrative text of 114 words, taken from their schoolbook of English, and answer four open-ended questions about it. The second exercise, also taken from the pupils' schoolbook (Arab, 2006:37-38), takes the form of multiple-choice diagnostic reading skill test. Typically, this test asks the pupils to read an expository text of 113 words that is taken from their schoolbook of English, and demonstrate their understanding of that text by opting for one of the suggested answers.

The text documents used in the reading comprehension tests are a collection of facts (information). Crucially, the reading comprehension task is neither too easy nor too hard, as the ones presented in this paper show. Since the participants are at their very early levels of EFL reading, the facts are explicitly stated in the text. In general, they are "easy" facts which may be found in a single sentence. Very few are the "difficult" facts which are spread across

several sentences. Obviously, the performance of the reader depends upon the type of fact s/he has to extract: explicit or implicit, easy or difficult, etc. (by no means is this list complete). In addition, the performance varies greatly depending on various additional factors including known vocabulary, sentence length, etc. Despite the great variations in the performances of different readers, there are facts that are simply harder to extract than others.

3.5 Data Analysis

3.5.1 Intelligence Tests

3.5.1.1 Detailed Performance of the Users

3.5.1.1.a. Vocabulary Items (scored on 07 pts) (c.f. Appendix 1)

Item 1 (0.5pt)

The pupils have been asked whether the words “small”, “disbelieve” and “ugly” make up the opposites of words that start with a “B”. The pupils were supposed to circle the letter “a” if the answer is true, and “b” if the answer is “false”.

- All the pupils (95 pupils → 100% → p: 1-95) have given the right answer (a).

Item 2 (0.5pt)

Pupils have been required to rearrange the words of four groups to get a meaningful sentence for each group.

- 67 pupils (~ 70.5 %) have given four meaningful sentences.

- 28 pupils (~ 29.5 %) have given two meaningful sentences.

<u>Identification of the respondents using their numbers:</u>

-p:1-4,7,10-14,16-18,31-28,31,35-44,46,47,51-56,58-61,65-68,70-75,78,80,83-90,92,94,95.

-p:5,6,8,9,15,19,20,29,30,32,33,34,45,48-50,57,62-64,69,76,77,79,81,82,91,93.

Item 3 (1 pt)

Pupils have been asked to draw an arrow to link between an expression from group "A" with the one that best fits it from group "B".

- 48 pupils (~ 51%) have given the four correct links.

-13 pupils (~13%) have given two correct links.

- 23 pupils (~24%) have given one correct link.

Identification of the respondents using their numbers:

-p:1-4,7,10,12-14,17,18,21-26,28,31,35,36,37,39,40,43,44,46,51-56,58,59,71-75,78,80,85-88,90,94.

-p:11,16,27,38,41,42,47,70,83,84,89,92,95.

-p:5,6,8,9,15,19,20,29,30,32-34,45,48-50,57,76,77,79,81,91,93.

Item 4 (1pt)

Pupils have been expected to write under each of the presented pictures the number of the sentence that best expresses it between parentheses.

-93 pupils (~98%) have made all the correct links.

-2 pupils (~2%) have not given any answer.

Identification of the respondents using their numbers:

-p:1-90,93-95.

-p:91,92.

Item 5 (2 pts)

Pupils have been required to find out the meaning of the underlined words (put in complete, meaningful sentences) according to the context in which they occur. Four words were suggested.

-23 pupils (~24%) have guessed the meaning of four words.

-2 pupils (~2%) have guessed the meaning of three words.

-29 pupils (~30%) have guessed the meaning of two words.

-35 pupils (~37%) have guessed the meaning of one word.

-6 pupils (~7%) gave only wrong answers.

Identification of the respondents using their numbers:

-p:4,12-14,17,18,24,28,35,36,40,43,46,54-56,59,68,75,80,85,86,90.

-2,53.

-p:6,7,9,16,19,22,23,25,27,33,39,42,45,48,50,58,61,63,65,67,70-73,76,82,89,93,94

-p:1,3,5,10,11,20,21,26,29-32,34,37,38,41,44,47,49,51,52,60,64,66,74,77-79,81,83,84,87,88,92,95.

-p:8,15,57,62,69,91.

Item 6 (2 pts)

Pupils have been given incomplete sentences and were asked to complete them so that they make a sense.

-27 pupils (~29%) have completed the four sentences.

-16 pupils (~17%) have completed three sentences.

-22 pupils (~23%) have completed two sentences.

-30 pupils (~31%) have completed one sentence.

Identification of the respondents using their numbers:

-p:4,7,12,13,14,17,18,22-25,28,35,39,46,54-56,58,59,65,67,68,71-73,75.

-p:2,3,21,26,36,40,43,44,52,53,66,74,85-87,90.

-p:6,9,11,19,33,37,38,41,45,47,48,50,63,76,77,80,82-84,88,93,95.

-p:1,5,8,10,15,16,20,27,29,30-32,42,49,51,57,60-62,64,69,70,78,79,81,89,91,92,94.

3.5.1.1.b. Similarities and differences (scored on 7pts) (c.f. Appendix 1)

Item 7 (0.5 pt)

The pupils have been asked to identify the picture that is least like the other three.

-All the pupils (95 pupils → 100% → p: 1-95) have given the correct answer (b).

Item 8 (0.5pt)

The pupils have been asked to identify the picture that is least like the other three.

-All the pupils (95 pupils → 100% → p: 1-95) have given the correct answer (c).

Item 9 (1pt)

The pupils have been asked to identify the picture that is least like the other three.

-All the pupils (95 pupils → 100% → p: 1-95) have given the correct answer (b).

Item 10 (1pt)

The pupils have been asked to identify the geometric figure that is least like the other three.

-60 pupils (~63%) have answered correctly the question by opting for (b).

-12 pupils (~12%) have given a wrong answer (c).

-23 pupils (~24%) have given a wrong answer (d).

Identification of the respondents using their numbers:

-p:1,3,5,7,10-13,16,18,20-22,24,26-29,31,32,34,35,37-39,41,42,44,47,49,51,52,54-56,60,61,64-71,73-75,77-81,83,84,87-89,94,95.

-p:2,4,8,15,17,30,46,57,59,62,91,92.

-p:6,9,14,19,23,25,33,36,40,43,45,48,50,53,58,63,72,76,82,85,86,90,93.

Item 11 (2 pts)

The pupils have been asked to identify the element (means of transport) that is least like the other three.

-43 pupils (~45%) have given the correct answer (b).

-16 pupils (~17%) have given a wrong answer (a).

-36 pupils (~38%) have given a wrong answer (b).

Identification of the respondents using their numbers:

-p:2-4,7,12-14,17,18,21-26,28,35,36,39,40,44,46,52-56,58,59,65-68,71-75,80,85-87,90.

-p:16,20,27,34,37,42,49,61,70,79,88,89,91,92,94,95.

-p:1,5,6,8-11,15,19,29-33,38,41,43,45,47,48,50,51,57,60,62-64,69,76-78,81-84,93.

Item 12 (2pts)

The pupils have been asked to identify the figure that is least like the other three.

-30 pupils (~32%) have given the right answer (d).

-26 pupils (~27%) have given a wrong answer (b).

-39 pupils (~41%) have given a wrong answer (a).

Identification of the respondents using their numbers:

-p:2,4,12-14,14,18,23-25,28,35,36,40,43,46,53,54-56,58,59,68,71,72,75,80,85,86,90.

-p:1,3,5-10,31-34,37,38,57,60-64,79,81-84,87.

-p:11,15,16,19,20-22,26,27,29,30,39,41,42,44,47-52,65-67,69,70,73,74,76-78,88-95.

Item 13 (not scored)

The pupils have been asked to answer briefly four questions that relate to the same joke. In fact, this item is not scored; it is given just to make pupils have fun, cool down the atmosphere and avoid possible boredom during taking the intelligence test.

3.5.1.1.c. Series (scored on 7 pts) (c.f. Appendix 1)

Item 14 (0.5 pt)

The pupils have been asked to give the following number in a series.

-All the pupils (95 pupils → 100% → p: 1-95) have given the correct answer (b).

Item 15 (0.5 pt)

The pupils have been asked to give the following number in a series.

-89 pupils (~94 %) have given the correct answer (c).

-6 pupils (~6 %) have given a wrong answer (a).

Identification of the respondents using their numbers:

-p:1-11,13-17,19-34,36-53,55,57-67,69-95.

-p:12,18,35,54,56,68.

Item 16 (1.5 pt)

The pupils have been asked to give the following number in a series.

- 75 pupils (~79%) have given the right answer (d).

-20 pupils (~21%) have given a wrong answer (b).

Identification of the respondents using their numbers:

-p:1-7,9,11-14,17-26,28,29,32-41,43-50,52-56,58-60,63-68,71-77,79-88,90,95.

-p:8,10,15,16,27,30,31,42,51,57,61,62,69,70,78,89,91-94.

Item 17 (2pt)

The pupils have been asked to give the following number in a series.

-44 pupils (~46 %) have given the correct answer (b).

-51 pupils (~54%) have given a wrong answer (c).

Identification of the respondents using their numbers:

-p:1,2,8,10-13,15,16,18,20,24,27,28,30,31,34,35,38,41,42,47,49,51,53-57,60-62,68-70,75,78-80,83,84,89,94,94,95.

-p:3-7,9,14,17,19,21-23,25,26,29,32,33,36,37,39,40,43-46,48,50,52,58,59,63-67,71-74,76,77,81,82,85-88,90-93.

Item 18 (2.5 pts)

The pupils have been asked to give the following figure in a series.

-44 pupils (~46%) have given the right answer (c).

-51 pupils (~54%) have given a wrong answer (b).

Identification of the respondents using their numbers:

-p:2,3,4,7,12-14,17,18,21-26,28,35,36,39,40,43,44,46,52-56,58,59,65-68,71-75,80,85-87,90.

-p:1,5,6,8-11,15,16,19,20,27,29-34,37,38,41,42,45,67-51,57,60-64,69,70,76-79,81-84,88,89,91-95.

3.5.1.1.d. Reasoning (scored on 7pts) (c.f. Appendix 1)

Item 19 (1 pt)

The pupils have been asked to complete the following analogy by choosing the second part of the second pair.

France is to Europe as Algeria is to…

-The correct answer is Africa.

-All the pupils (95 pupils → 100% → p: 1-95) have given the correct answer (c).

Item 20 (1.5 pt)

In order to choose the best conclusion of the syllogism, the pupils have been asked to answer using "true" to show that the conclusion is a good one, or "false" to show that the conclusion is based on poor reasoning.

-74 pupils (~78%) have given the correct answer (a).

-21 pupils (~22%) have given a wrong answer (b).

Identification of the respondents using their numbers:

-p:1-5,7,8,10,11,13-17,20-32,34-36,38,40-44,46,47,49,51-53,55,57-62,64-67,69-75,77-81,83-87,89,90,94,95.

-p:6,9,12,18,19,33,37,39,45,48,50,54,56,63,68,76,82,88,91-93.

Item 21 (2 pts)

In order to choose the best conclusion of the syllogism, the pupils have been asked to answer using “true” to show that the conclusion is a good one, or “false” to show that the conclusion is based on poor reasoning.

-36 pupils (~38%) have known that the conclusion of the syllogism is based on a poor reasoning and answered “false”: (b).

-59 pupils (~62%) have thought that the conclusion is a good one and answered “true”: (a).

Identification of the respondents using their numbers:

-p:2,3,7,12,13,16,18,21,22,24,26,27,28,35,37,39,42,44,52-56,61,65-68,70,73-75,80,87-89.

-p:1,4-6,8-11,14,15,17,19,20,23,25,29-34,36,38,40,41,43,45-51,57-60,62-64,69,71,72,76-79,81-86,90-95.

Item 22 (2.5 pts)

In order to choose the best conclusion of the syllogism, the pupils have been asked to opt for one of the four propositions.

-28 pupils (~29%) have given the correct answer (d).

-28 pupils (~29%) have given a wrong answer (c).

-39 pupils (~42%) have given a wrong answer (b).

Identification of the respondents using their numbers:

-p:3,4,12,13,17,18,21,24,26,35,36,40,43,44,46,52,54-56,59,66,68,74,75,85-87,90.

-p:1,2,5,8,11,15,16,19,20,22,23,25,27-34,39,41,45,47-51,67.

-p:6,7,9,10,14,37,38,42,53,57,58,60-65,69-73,76-84,88,89,91-95.

3.5.1.1.e. Problem-solving (scored on 7pts) (c.f. Appendix 1)

Item 23 (1 pt)

Pupils have been asked to calculate how many feet 9 chicken, 2 dogs and 3 cats have.

- 85 pupils (~89%) have given the correct answer (b).

-10 pupils (~11%) have given a wrong answer (d).

Identification of the respondents using their numbers:

-p:1-3,5-13,15,16,18-22,24,26-45,47-57,60-70,73-95.

-p:4,14,17,23,25,46,58,59,71,72.

Item 24 (1.5 pt)

Pupils have been asked to think about the following problem and answer by "true" or "false". Amine has 480 DA, but he wants to buy an MP3 reader that costs 1200DA. So, he needs to borrow 570DA from Malik and 150DA from Mohamed.

-To solve this problem, the pupils have to go through a subtraction and addition:

1200- 480 = 720DA, and 570+ 150 = 720DA

-Since the results of the two operations are the same, the answer is "true", i.e. Amine can borrow the needed amount of money (720DA) from Malik and Mohamed.

-34 pupils (~36%) have given the correct answer (a).

-61 pupils (~64%) have given the wrong answer (b).

Identification of the respondents using their numbers:

-p:1,3,4,7,10-14,17,18,20-26,28,31,34-41,43,44,46,47,49,51,52,54-56,58-60,65-68,71-75,78-80,83-88,90,94.

-p:2,5,6,8,9,15,16,19,27,29,30,32,33,42,45,48,50,53,57,61-64,69,76,77,81,82,89,91-93,95.

Item 25 (2pts)

Pupils have been asked to solve the following problem by opting for one of the four propositions. Abd Errahim helps his gymnastics trainer. This latter asks him to bring back 16 balls from the equipment room. Abd Errahim can carry only 3 balls per time. How many times is he required to go to the equipment room and come back bringing all the balls?

-To solve this problem, the pupils have to go through an operation like follows:

16 ÷ 3= 5.33 balls

-This means that Abd Errahim has to go and come back more than 5 times to the room. 5 ½ is not possible, 6 times is the best answer.

-Another possibility to solve this problem would be to go through two operations:

15 ÷ 3 = 5 times and 16- 15 = 1 ball so:

-Abd Errahim has to go to the room and come back with three balls five times and once carrying one ball.

-17 pupils(~18%) have given the correct answer (d).

-4 pupils (~4%) have given a wrong answer (a).

-35 Pupils (~37%) have given a wrong answer (b).

-39 pupils (~41%) have given a wrong answer (c).

<u>Identification of the respondents using their numbers:</u>

-p:1,2,11,16,27,38,41,42,47,53,60,61,70,83,84,89,95.

-p:44,86,91,94.

-p:3-10,17-26,43,46,71-82,87,90,92.

-p:12-15,28-37,39,40,45,48-52,54-59,62-69,85,88,93.

Item 26 (2.5 pts)

The pupils have been asked to solve the following problem, by opting for one of four propositions. A group of women met one afternoon in a cafeteria to drink tea. They brought their cats along with them. All in all, there were 22 heads and 72 feet. How many women and cats were there in the room?

-To solve this problem, pupils need to find out the sum of feet and heads for every option like follows:

a- 6 women and 16 cats → [(6 × 2) + (16 × 4)] + [6 + 16] = 76 feet and 22 heads

b- 7 women and 15 cats→ [(7 × 2) + (15 × 4)] + [7 +15] = 74feet and 22 heads

c- 8 women and 14 cats→ [(8 × 2) + (14 × 4)] + [8 + 14] = 72 feet and 22 heads

d- 9 women and 13 cats→ [(9 × 2) + (13 × 4)] + [(9 + 13] = 70feet and 22 heads

-So, pupils must opt for answer “c”.

-20 pupils (~21%) have given the correct answer (c).

-23 pupils (~25%) have given a wrong answer (a).

-26 pupils (~27%) have given a wrong answer (b).

-26 pupils (~27%) have given a wrong answer (d).

<u>Identification of the respondents using their numbers:</u>

-p:4,12-14,18,23-25,27,35,46,54-56,58,59,68,71,72,75.

-p:1,2,8,9,15,22,26,29,60-65,69,70,74,82,85,88,89,94,95.

-p:3,6,10,16,20,21,28,33,36-45,57,67,73,83,84,90,92,93.

-p:5,7,11,17,19,30-32,34,47-53,66,76-81,86,87,91.

3.5.1.1.f. Decision Making (scored on 5 pts) (c.f. Appendix 1)

Item 27

Pupils have been required to Put "+" for the good actions and "-" for the bad actions. A justification in one sentence for each answer was required.

1- I work in groups to help my friends for a better understanding of the lessons.

2- I am in the classroom and I have remarked that I have forgotten my dictionary. I take the dictionary of my friend without asking for his permission: He's my gentle friend.

3- My cousins invited me in for dinner. All of sudden, I needed an urgent phone call. Asking for their permission is not obligatory.

4- I revise my lessons just before taking the examination: I want to remember everything.

5- Sitting an examination in mathematics, my friend asks for my help to solve some problems. I did not hesitate, of course, because he is my best friend, and it is good to help others.

-67 pupils (~71%) have given five good answers with appropriate justifications.

-9 pupils (~10%) have given four good answers with appropriate justifications.

-17 pupils (~18%) have given three good answers with appropriate justifications.

-2 pupils (~1%) have given two good answers with appropriate justifications.

Identification of the respondents using their numbers:

-p:1-4,7,8,11-18,21-28,30,35-44,46,47,52-62,65-75,80,83-90,95.

-p:10,20,31,34,49,51,78,78,94.

-p:5,6,9,19,29,32,33,45,48,50,63,64,76,77,81,82,93.

-p:91,92.

3.5.1.2 Discussion

Vocabulary Items

Item 1

In item 1, the pupils have been supposed to check whether the words “small”, “disbelieve” and “ugly” make up the opposites of words starting with the letter “b”. All the pupils have realised that “small”, “disbelieve” and “ugly” form the opposites of “big”, “believe” and “beautiful”, respectively. The success of 100% of pupils in this item has been expected for two reasons. The first one is that, at the respondents’ level, these words are familiar and commonly used. The second reason is that item 1 is the first item in the test, which means the easiest one.

Item 2

This item evaluates the pupils’ ability to recognise different words’ categories and their functions. This is necessary since they have had to rearrange different words, with different categories and functions, to get a sentence, in every set of words, that makes a sense. The words used are familiar enough to have a high number of pupils (67) who have reorganised correctly all the groups of words and got four meaningful sentences.

Item 3

In item 3, the pupils have been required to match two synonymous sentences that belong to two different groups with an arrow. This item reveals the pupils capacity to comprehend sentences as patterns of expression. The vocabulary used in the sentences of this item is adjusted to the pupils’ level; it contains approximately no unfamiliar words. In fact,

this would explain the fact that all the pupils have given from one to four correct links; they should differ in the vocabulary each one possesses.

Item 4

Our purpose in putting this item is to measure the pupils' comprehension of verbal and non-verbal items. To this end, the pupils have been given six pictures with six sentences. First of all, they have had to understand what is expressed in the pictures and to grasp the meaning of sentences, in order to be able to make correct picture-sentence matches. 98 % of the pupils have managed to give all the good links, and thus show to have a good primary ability as labelled by Thurstone (1938) as "verbal comprehension". The remaining pupils who have not really succeeded in this item show to have very limited abilities in extracting meaning from the print.

Item 5

In item 5, the pupils have been presented with four sentences. In each one, there is a word (a verb or an adjective) that is underlined. The pupils have been asked to guess the meaning of these words using the context in which they occur. Despite the fact that the vocabulary used in these sentences is simple, six pupils have failed guessing the meaning of the underlined words. This may be due to the fact that they have approximately no guessing abilities. The rest of the pupils (93%) have been able to guess the meaning of some words (from one to four).

Item 6

Since it is left to the end of the series of vocabulary items, item six is more demanding. The pupils have been asked to complete the sentences they were presented with. To be able to do so, the pupils have had first to understand what is expressed in the first part and to think about a logical completion of every sentence. Some pupils (27) have been able to comprehend the given part of the sentence and succeeded in completing it correctly, with approximately no mistakes. In fact, this group of pupils have showed that they possess well developed vocabularies, and used the written language fluently: they have been able to spell words accurately and easily. Other pupils, however, have been able to understand the meaning of the incomplete sentences, but they have been unable to complete it for, it seems, they suffer from a poor vocabulary (they responded using some Arabic words between parentheses).

Similarities and Differences Items

Items 7,8,9

In the non-verbal items 7, 8 and 9, pupils have been asked to find out the picture that is least like the three. For example, in item 7, they had to recognise that there is no water under the body of one of the four crocodiles. In the items 8 and 9, the difference between the four pictures becomes less clear, to demonstrate an increase in the level of the task difficulty. In these three items, all the pupils (100%) have responded positively. They can be considered as spatial ability pupils who enjoy solving non-verbal, artistic problems, as expressed in Gardner's theory of multiple intelligences (1983).

Item 10

With this item, again, the pupils have been required to discover the difference that exists between four geometric figures. They have had to notice that figure (b) is the only one which has no line. The geometric figures are simple and the pupils are familiar with them. Unfortunately, this does not guarantee a big number of correct answers; only 60 % of the sample's pupils have given the right answer. The difference between the figures has not been that clear for the rest of the pupils.

Item 11

Getting more difficult, the ninth item has required the respondents to find out, between four means of transport, a difference which is less obvious. In fact, the difference, with this item, is no more visual; it is conceptual. This would explain the decrease in the number of pupils who have responded correctly; only 43 % of the pupils have remarked that the steam boat is the only means which uses no essential oil.

Item 12

In item 12, the pupils have had to find the intruder among four geometric figures. They have been expected to recognise that in each of the four paired figures (circles, squares, lozenges and triangles), two figures are interlocked while the two triangles of the fifth pair (d) are not interlocked. Despite the fact that the difference is visual, not conceptual, only 32% of the pupils have paid attention to the difference that exists between the five pairs of figures.

Item 13

Contrarily to the other items in this test, item 13 is neither meant to measure the pupils' intelligence nor to be marked. It is designed and put in this position to help the pupils relax and get ready to carry on with the remaining items.

Series Items

Items 14, 15, 16, 17

In these items, the pupils have had to rely on some cognitive abilities to find out, logically, the last number in the series of numbers they have been presented with. For example, in item 14, they are to recognise that to move from one number to another, one has to add 1 then 2 then 3 then 4 then 5 then 6 to circle the answer (c). Thus, the relationship between the numbers in this series is easy to explore. Expectantly, all the pupils (100%) have performed the task successfully. They have showed an interest in doing activities in sequential order, and have demonstrated their possession of the primary ability that is labelled by Thurstone (1938) as "numerical facility N". However, the number of successful pupils decreases as one moves from one item to the following. This is quite normal since the items are organised in a progressive order, from the simplest to the most complex one.

Item 18

In item 18, the respondents have been presented with a series of figures (circles with an arrow up-headed), and they have been required to find out the figure that best completes the series. They have had to make use of their logical-spatial abilities. 44 pupils have given the correct answer (c).

Reasoning Items

Item 19

In this item, the test takers have been presented with an analogy having the second part of its second pair missing. The simplicity of this analogy has resulted in the success of all the pupils in giving the correct answer (c).

Item 20, 21, 22

Items 20, 21, 22 have presented the pupils with syllogisms, and they have had to give the correct conclusion for each of the syllogisms. Given that the children at the age of 15 develop sophisticated reasoning abilities, according to Piaget's theory of cognitive development (Langer, 1998; Scholnick, 1999), the respondents have had to reason logically and clearly. In fact, it is not always time and there is a scarce evidence for that theory especially with the formal operational stage. Thus, we still need evidence that most adolescents or formal operational thinkers can reason that way- they should be able to reason logically. In item 20, for instance, 78 % of the pupils have been able, more than the others, to see the logical relationships between the elements (persons) used in the syllogism; they have showed their interest in exploring patterns and relationships. Getting more complex, the items 21 and 22 have been responded to successfully by smaller numbers of pupils.

Problem-Solving Items

Item 23, 24

In items 23 and 24, the respondents have been asked to solve simple problems. To manage the problems, the students have had to rely on what they already know. They have had recourse to some rules they have been taught in their mathematics' lessons. This is explained

by Piaget to be an advanced thinking through problems. A high number of pupils (85) have showed to be able to solve the problem in item 23 successfully. Expectantly, the number of good answers in item 24 has decreased to 34. The reason is that items get more difficult.

Item 25, 26

The problems the pupils have been presented with in items 25, 26 show a higher degree of difficulty for many reasons. First of all, the problems contain more details in comparison to the previous ones. In addition to that, the operations and the strategies the pupils have been required to go through are more complicated and not very clear. As a result, the number of the successful pupils who applied their general information needed to adapt to that specific situation has decreased. However, the pupils that have managed the problems have showed a considerable interest and a good understanding of higher math concepts and great opportunities and capacities to solve problems and reason logically and clearly. These abilities are described by Cattell (1963) as “fluid intelligence”.

Decision Making Item

Item 27

In item 27, the pupils have been given some statements that hold moral messages. What the respondents have been asked to do is to identify the actions that are labelled “positive actions” and those described as “negative actions”. More than that, they have had to give a justification for every “-” or “+” they put. In fact, this item evaluates what Sternberg (1985), in his theory of intelligence, labels “practical intelligence”. It refers to the way pupils recognise situations in their environment and solve practical problems; it assesses their ability to distinguish between wrong and right actions. Before making any decision, the pupils have

to understand the problem in the first place; they need to filter relevant from irrelevant information, relate new information to existing knowledge, and compile information into a meaningful picture. As far as the responses of the pupils are concerned, the correct judgements of pupils range from two to five. It is noticed that the majority of pupils have given similar justifications, and possessed what Piaget (Langer, 1998; Scholnick, 1999) calls "an increased independence for thinking through situations". However, many pupils (53) have been mislead as far as statement (4) is concerned. They have answered that revising lessons just before the examination helps one to understand more the lesson and remember the smallest details about it. It is clear that this is what these specific respondents do before the examination, and this would explain the judgement they have made.

3.5.2 Reading Comprehension Tests

3.5.2.1 Detailed Performance of the Users

3.5.2.1.a. Exercise 1 (scored on 20pts) (c.f. Appendix 1)

The pupils have been asked to read carefully a narrative text that is about the story of two bikers who died in a tragic road accident. After that, they have had to answer four 'Wh' questions about that text.

Question 1 (5 pts)

The pupils have been asked about the place where the accident occurred.

-35 pupils (~37%) have given a complete answer, writing that the accident occurred on a sharp bend on the Airport Road.

-18 pupils (~19%) have given an incomplete answer. They wrote that the accident occurred on the Airport Road, without precisions.

-41 pupils (~43.5%) have answered incompletely, writing that the accident occurred on the road.

-1 pupil (~0.5%) has left it blank and gave no answer at all.

Identification of the pupils using their numbers:

-p:3,5,7,8,13,15-17,19,24,29,30-32,35,38,39,44,45,48,52,55,57,61-64,72,76,77,79,87,90,93,95.

-p:6,9,10,20,26,33,42,49,50,51,66,69,78,81,82,86,89,92.

-p:1,2,7,11,12,14,18,21-23,25,27,28,34,36,37,40,41,43,46,47,53,54,56,58,59,60,65,67,68,70,71,73,75,80,83,84,85,88,94.

-p:91.

Question 2 (5pts)

The pupils have been asked to find out what the bikers were doing while they were overtaking their lorry.

-57 pupils (~60%) have given a complete answer. They have written that the bikers were talking while they were driving.

-35 pupils (~37.5%) have answered wrongly. They have written that the bikers were overtaking a lorry while they were riding.

-2 pupils (~1%) have answered mistakenly, writing that the bikers were in the direction of Heathrow Airport while they were riding.

-1 pupil (~0.5%) has been mistaken. He has answered that the bikers were travelling while they were riding.

Identification of the respondents using their numbers:

-p:1,2,4,7,11-14,16,18,21-28,31,34-38,40,41,43,46,47,52-56,58-62,65,67-75,79,80,84-86,88,90,95.

-p:3,5,6,8,9,10,15,19,20,29,30,32,33,42,44,45,48-51,57,63,64,66,7678,81,83,87,89,92-94.

-p:17,39.

-p:91.

Question 3 (5pts)

The pupils have had to answer a question about the duration of the traffic block.

-81 pupils (~86%) have answered correctly. They have written that the traffic block lasted more than two hours.

-13 pupils (~13.5%) have answered mistakenly. For them, the traffic block lasted exactly two hours.

-1 pupil (~0.5%) have answered wrongly, writing that the bikers blocked the traffic.

Identification of the respondents using their numbers:

-p:1-9,11-15,17-19,21-29,32-37,39-41,43-48,50,52-56,58-60,62-77,80-88,90-95.

-p:10,20,30,31,38,42,49,51,57,61,78,79,89.

-p:16.

Question 4 (5pts)

The pupils have been asked to make guesses about the identity of some characters that were not mentioned explicitly in the text. This way, the answer is less objective: there are many answers that can be accepted.

-17 pupils (~18.5%) have given an acceptable answer: “we”.

-16 pupils (~17%) have given an acceptable answer: “the journalists”.

-7 pupils (~7.5%) have given an acceptable answer: “the writer, the narrator”.

-2 pupils (~1%) have given an acceptable answer: “the nurses, the doctors who came in an ambulance”.

-53 pupils (~56%) have just left it blank.

Identification of the respondents using their numbers:

-p:2,4,13,22,23,25,28,36,40,43,46,56,58,67,73,80,86.

-p:7,14,26,52,53,55,62,66,68,69,71,72,74,85,90,95.

-p:12,18,21,54,59,65,75.

-p:24,35.

-p:1,3,5,6,8-11,15-17,19,20,27,29,30-34,37-39,41,42,44,45,47-51,57,60,61,63,64,70,76-79,81-84,87-89,91-94.

3.5.2.1.b. Exercise 2 (scored on 20pts) (c.f. Appendix 1)

The pupils have been asked to read an expository text about the different foods that are consumed by Nepalese people. To answer the questions, the pupils have had to mark the single best answer for each.

Question 1 (6pts)

The pupils have been asked to give a title to the text they read.

-65 pupils (~68.5%) have given the appropriate title of the text: “The Nepalese Different Foods”.

-10 pupils (~10.5%) have answered mistakenly that the text is better entitled “The Nepalese People”.

-20 pupils (~21%) have answered wrongly that the text is better entitled “The Nepalese Country”.

Identification of the respondents using their numbers:

-p:1,-7,9-15,17,18,20,22-29,32-34,36,37,39-51,53-56,58-60,63,66,67,70,71,73,75,77,78,80,83,84,86-89,93,94.

-p:5,6,8,16,31,52,68,72,85,91.

-p:7,19,21,30,35,38,57,61,62,,64,65,69,74,76,79,81,82,90,92,95.

Question 2 (7pts)

The pupils have been asked to find out the growing requirements of some crops in Nepal like potatoes.

-71 pupils (~75%) have answered correctly. They chose answer (b): “cool temperatures”.

-23 pupils (~24.5%) have been mistaken. They have circled answer (a): “warm temperatures”.

-1 pupil (~0.5%) has chosen wrongly answer (c): “low temperatures”.

Identification of the respondents using their numbers:

-p:2-8,10,12-14,16-26,28,30,31,35,36,38-40,43,44,46,49,51-59,61,64-68,71-76,78-83,85-87,89-92,94,95.

-p:1,9,11,15,27,29,32-34,37,42,45,47,48,50,60,62,69,70,77,84,88,93.

-p:63.

Question 3 (7pts)

The pupils have been asked about the factor that bears on the consumption of some types of meat in Nepal.

-66 pupils (~67%) have made the good choice. They have opted for answer(c): “Religion”.

-22 pupils (~24%) have answered wrongly. They have found that the best answer is (b): “special occasions”.

-7 pupils (~8%) have been mistaken. They have chosen answer (a): “region”.

Identification of the respondents using their numbers:

-p:1-4,7,10-14,16-18,20-25,27,28,30,31,34-44,46,47,49,51,53-61,65,67,68,70-75,78-80,84-90.

-p:5,8,15,19,26,29,32,45,48,50,52,62,64,66,69,76,77,81,82,91,93,95.

-p:6,9,33,63,83,92,94.

3.5.2.2 Discussion

Exercise 1

The pupils have been required to demonstrate their understanding of a story narrated in a short text.

Question 1

The pupils have been asked about the place where the accident occurred. Given that “where” question results are not quite variable because location expression, in the given text, includes specific place name, we have expected a high number of correct answers. The responses of the pupils have differed in terms of their precision. To tell the truth, only 37% of the pupils have given complete, precise answers. Unfortunately, that is not the case for all the pupils. Many pupils (41%) have answered simply that the accident occurred in the road. We noticed that their answers contain the words of the answer (road), but the sentence as a whole does not really answer the question. In this case, we can not make sure whether the pupil’s answer is based on his understanding of the text; accidents occur generally on the road. One

pupil has given no answer. This may be due to the fact that he has not understood the point at all.

Question 2

The pupils have been required to extract the appropriate information so as to answer the question that asks about what the bikers were doing while they were overtaking the lorry. Although it has been clear for the pupils that what is required in the question "what" is an action, not all of them have succeeded in the answer. 60 % of the pupils have extracted the appropriate information and have showed language accuracy. The remaining pupils (30%), however, have given answers (they were overtaking the lorry, they were in the direction of Heathrow Airport, they were travelling) that do not contain even a keyword to the answer. It seems that they do not know what the word "overtaking" means.

Question 3

In this question, the information required is the duration of the traffic block. One pupil has not understood that the question is about the time the traffic block lasted; he has answered that the bikers blocked the traffic. For the remaining pupils, it has been clear that what is required from them is a time extraction. However, this does not mean that all of them have given the correct answer. 13.5 % of the pupils have thought that the traffic block lasted exactly two hours. This answer shows that the respondents answered hastily, without precision. The successful respondents have showed a good comprehension of the idea and precision in the answer.

Question 4

"Who" queries aim at a person and a name extraction. Unlike the previous questions, this one requires more than a mere extraction of easy facts from the text. The pupils have been supposed to guess the identity of some characters that are not mentioned explicitly in the text, they are just referred to using the personal pronoun "we". Thus, many logical answers have been accepted. Some pupils (18.5%) have answered simply that those who arrived on the scene of the accident are "we". Another group of pupils (16) has written that the journalists are the ones who came on the scene to make their report. For some others (7.5%), these persons are simply the narrator or the writer of the story. Two pupils have been more imaginative readers; they have proposed that the persons who came on the scene were the doctors and the nurses who hurried in an ambulance. The task, however, has not been that easy for the other pupils; 56% of the respondents have not answered the question. This shows that they lack imagination, logical skills and common sense reasoning in comparison to the other pupils.

Exercise 2

Similarly to the first text, the pupils have been asked to read an expository text and find answers to a set of three multiple-choice questions.

Question 1

In question 1, the pupils have been queried about the title they could give to the text they read. In other words, they have been asked about the general idea of the text. 68.5% of the pupils have understood that the text is about the Nepalese different foods. The other pupils have been mistaken; they have opted for the two other answers that are wrong. This may be explained by the fact that they have rushed in their decision. They have read some words that

are mentioned in the proposed titles and found them in the text, and thus have thought that these titles are more appropriate. Another possibility would be that they have not cared about understanding the text and have chosen one answer randomly.

Question 2

The pupils, in here, have been asked a question that demands more details. They have been expected to find out the needed temperatures for potatoes to grow in Nepal. 75 % of the respondents have understood that in order to grow, potatoes need cool temperatures. About 24.5% have answered that the warm temperatures are required to grow potatoes. This indicates that the learners have answered hurriedly when they have found that the words “warm” and “temperatures” are mentioned in the very same paragraph. One pupil has opted for “low temperatures” as an answer despite the fact that it is not mentioned neither explicitly nor implicitly.

Question 3

The last question of this exercise has required the pupils to find out the factors that come to bear on meat consumption in Nepal. Here again, many respondents have been mislead because, in addition to the correct answer, one wrong answer (special occasions) is mentioned in the paragraph that deals with meat consumption. They have even chosen one answer (region) that is not mentioned at all in the text. The successful comprehenders of this part have not been more than 67% of the pupils.

CHAPTER FOUR

CORRELATING INTELLIGENCE WITH READING COMPREHENSION

This correlational study is undertaken in order to test the hypothesis stated in the introduction of this paper. In other words, we need to prove that there is a positive correlation between intelligence and reading comprehension.

To be able to examine the nature of the relationship between intelligence and reading comprehension, the use of the correlation coefficient (r) is indispensable.

4.1 The Correlation Coefficient

4.1.1 Defining the Correlation Coefficient

A correlation coefficient "r" expresses the degree of correspondence, or relationship, between two sets of scores. It is a relation between two or more variables that shows that increases in the magnitude of one variable is accompanied by increases or decreases in the magnitude of the other variable. Pearson's Moment-Product Correlation Coefficient is the most common correlation coefficient and it is used in this study.

4.1.2 The Correlation Coefficient Formula

The equation for the correlation coefficient (r) is:

$$r\,(xy) = \frac{\sum xy}{(N)(SDx)(SDy)}$$

$\sum \rightarrow$ the sum

x= (X – Mx) → the deviation of x scores from the mean (Mx is the mean of x scores: the sum of x scores divided by the number of cases N)

y= (Y- My) → the deviation of y scores from the mean (My is the mean of y scores: the sum of y scores divided by the number of cases N)

xy→ the cross-products (multiplication of x and y deviations).

N → the number of cases.

SDx= $\sqrt{\frac{\sum x^2}{N}}$ → Standard deviation of X scores

SDy= $\sqrt{\frac{\sum y^2}{N}}$ → Standard deviation of Y scores

4.1.3 Interpretation of "r" Values

The value of r (XY) ranges from "-1" to "+1". A perfect positive correlation has a value of "+1", and a very strong positive correlation approaches "+1" (e.g. 0.90). Obviously, a perfect negative correlation has a value of "-1", and a strong negative correlation approaches "-1". Having (r) that equals "o" would be explained by the absence of any relation between X and Y.

4.2 Global Correlation between Intelligence and Reading Comprehension

In order to get the global correlation between intelligence and reading comprehension, we need to refer back to the formula of the correlation coefficient. In this study, X represents the pupils' scores obtained in the intelligence test, and Y represents their scores in the reading comprehension exercises. Thus, to calculate the correlation between intelligence and reading

comprehension, we replaced *x*, *y*, N, SD*x* and SD*y* by their values in the previously mentioned formula.

Pupil	**X**	**Y**	***X***	***y***	x^2	y^2	***xy***
P1	23.5	25	-0.15	-1.76	0.22	3.09	0.264
P2	31.5	36	7.85	9.24	61.62	85.37	72.534
P3	26	30	2.35	3.24	5.52	10.49	7.614
P4	32	36	8.35	9.24	69.72	85.37	77.154
P5	14.5	17	-9.15	-9.76	83.72	7.41	89.304
P6	12.5	15	-11.15	-11.76	124.32	138.29	131.124
P7	29	34	5.35	7.24	28.62	52.41	38.734
P8	16	17	-7.65	-9.76	58.52	7.41	74.664
P9	12.5	14	-11.15	-12.76	124.32	162.81	-1.61
P10	19	23	-4.65	-3.76	21.62	14.13	17.484
P11	22	25	-1.65	-1.76	2.72	3.09	2.904
P12	36	38	12.35	11.24	152.52	126.33	138.814
P13	38	39	14.35	12.24	205.92	149.81	175.644
P14	31	37	7.35	10.24	54.02	104.85	75.264
P15	16	16	-7.65	-10.76	58.52	115.77	82.314
P16	21	24	-2.65	-2.76	7.02	7.61	7.314
P17	32	30	8.35	3.24	69.72	10.49	27.054
P18	36	37	12.35	10.24	152.52	104.85	126.464
P19	12.5	17	-11.15	-9.76	124.32	7.41	108.824
P20	18	23	-5.65	-3.76	31.92	14.13	21.244
P21	26	32	2.35	5.24	5.52	27.45	12.314
P22	29	36	5.35	9.24	28.62	85.37	49.434
P23	31	35	7.35	8.24	54.02	67.89	60.564
P24	38	40	14.35	13.24	205.92	175.29	189.994
P25	31	36	7.35	9.24	54.02	85.37	67.914
P26	26	31	2.35	4.24	5.52	17.97	9.964
P27	21	25	-2.65	-1.76	7.02	3.09	4.664
P28	33.5	35	9.85	8.24	97.02	67.89	81.164
P29	14.5	16	-9.15	-10.76	83.72	115.77	98.454
P30	16	19	-7.65	-7.76	58.52	60.21	59.364
P31	19	24	-4.65	-2.76	21.62	7.61	12.834
P32	14.5	16	-9.15	-10.76	83.72	115.77	98.454
P33	12.5	14	-11.15	-12.76	124.32	162.81	142.274
P34	18	25	-5.65	-1.76	31.92	3.09	9.944
P35	36	34	12.35	7.24	152.52	52.41	89.414
P36	30	35	6.35	8.24	40.32	67.89	52.324
P37	20.5	25	-3.15	-1.76	9.92	3.09	5.544
P38	22	24	-1.65	-2.76	2.72	7.61	4.554
P39	29	30	5.35	3.24	28.62	10.49	17.334
P40	30	36	6.35	9.24	40.32	85.37	58.674

P41	22	25	-1.65	-1.76	2.72	3.09	2.904
P42	21	23	-2.65	-3.76	7.02	14.13	9.964
P43	30	35	6.35	8.24	40.32	67.89	52.324
P44	26	30	2.35	3.24	5.52	10.49	7.614
P45	12.5	16	-11.15	-10.76	124.32	115.77	119.974
P46	32	35	8.35	8.24	69.72	67.89	68.804
P47	22	25	-1.65	-1.76	2.72	3.09	2.904
P48	12.5	16	-11.15	-10.76	124.32	115.77	119.974
P49	18	23	-5.65	-3.76	31.92	14.13	21.244
P50	12.5	14	-11.15	-12.76	124.32	162.81	142.274
P51	19	23	-4.65	-3.76	21.62	14.13	17.484
P52	26	27	2.35	0.24	5.52	0.05	0.564
P53	31.5	37	7.85	10.24	61.62	104.85	80.384
P54	36	38	12.35	11.24	152.52	126.33	138.814
P55	38	40	14.35	13.24	205.92	175.29	189.994
P56	36	35	12.35	8.24	152.52	67.89	101.764
P57	16	19	-7.65	-7.76	58.52	60.21	59.364
P58	31	35	7.35	8.24	54.02	67.89	60.564
P59	32	38	8.35	11.24	69.72	126.33	93.854
P60	23.5	25	-0.15	-1.76	0.02	3.09	0.264
P61	21	24	-2.65	-2.76	7.02	7.61	7.314
P62	16	18	-7.65	-8.76	58.52	76.73	67.014
P63	12.5	14	-11.15	-12.76	124.32	162.81	142.274
P64	14.5	17	-9.15	-9.76	83.72	7.41	89.304
P65	29	32	5.35	5.24	28.62	27.45	28.034
P66	26	31	2.35	4.24	5.52	17.97	9.964
P67	29	36	5.35	9.24	28.62	85.37	49.434
P68	36	32	12.35	5.24	152.52	27.45	64.714
P69	16	18	-7.65	-8.76	58.52	76.73	67.014
P70	21	25	-2.65	-1.67	7.02	3.09	4.664
P71	29	37	5.35	10.24	28.62	104.85	54.784
P72	29	34	5.35	7.24	28.62	52.41	38.734
P73	29	35	5.35	8.24	28.62	67.89	44.084
P74	26	32	2.35	5.24	5.52	27.45	12.314
P75	38	36	14.35	9.24	205.92	85.37	132.594
P76	12.5	17	-11.15	-9.76	124.32	7.41	108.824
P77	14.5	16	-9.15	-10.76	83.72	115.77	98.454
P78	19	23	-4.65	-3.76	21.62	14.13	17.484
P79	18	24	-5.65	-2.76	31.92	7.61	15.594
P80	33.5	36	9.85	9.24	97.02	85.37	91.014
P81	14.5	15	-9.15	-11.76	83.72	138.29	107.604
P82	12.5	15	-11.15	-11.76	124.32	138.29	131.124
P83	22	20	-1.65	-6.76	2.72	45.69	11.157
P84	22	25	-1.65	-1.76	2.72	3.09	2.904
P85	30	32	6.35	5.24	40.32	27.45	33.274

P86	30	36	6.35	9.24	40.32	85.37	58.674
P87	26	30	2.35	3.24	5.52	10.49	7.614
P88	20.5	25	-3.15	-1.76	9.92	3.09	5.544
P89	21	23	-2.65	-3.76	7.02	14.13	9.964
P90	30	34	6.35	7.24	40.32	52.41	45.974
P91	09	12	-14.65	-14.76	214.62	217.85	216.234
P92	10	15	-13.65	-11.76	186.32	138.29	160.524
P93	12.5	16	-11.15	-10.76	124.32	115.77	119.974
P94	19	20	-4.65	-6.76	21.62	45.69	31.434
P95	22	27	-1.65	0.24	2.72	0.05	-0.396
∑	**2247.5**	**2542.5**	**0**	**0**	**6150**	**5580.533**	**6556.526**
M	**23.65**	**26.76**					

$$SDx = \sqrt{\frac{\sum x^2}{N}} = \sqrt{\frac{6150}{95}} = 8.04$$

$$SDy = \sqrt{\frac{\sum y^2}{N}} = \sqrt{\frac{5580.533}{95}} = 9.74$$

$$r\,(xy) = \frac{\sum xy}{(N)(SDx)(SDy)} = \frac{6556.526}{95 \times 8.04 \times 9.74} = \frac{6556.526}{7439.412} \longrightarrow$$

$$r\,(xy) = 0.88$$

Table 4.1 Computation of Pearson Product-Moment Correlation Coefficient "r" between Intelligence and Reading Comprehension

The method demonstrated on table 4.1 is not the quickest but illustrates the meaning of the correlation coefficient "r" clearly. We notice that next each pupil's number are his or her scores in the intelligence test (X) and the reading comprehension test (Y). The sums and the means of the 95 scores are given under the respective columns. The third column shows the deviation (x) of each intelligence score from the intelligence mean; and the fourth column, the deviation (y) of each reading comprehension score from the reading comprehension mean.

These deviations are squared in the next two columns, and sums of the squares are used in computing the standard deviations of the intelligence and reading comprehension

scores by the method described in this chapter. Rather than dividing each *x* and *y* by its corresponding SD to find standard scores, we perform this division only once at the end, as shown in the correlation formula in the table. The cross-products in the last column (*xy*) have been found by multiplying the corresponding deviations in the *x* and *y* columns. The computation of the correlation coefficient "r", the sum of these cross-products is divided by the number of cases (N) and by the product of the two standard deviations (SD*x* SD*y*).

Since, with our one-tailed test (i.e. directional test), we predicted a positive correlation between intelligence and reading comprehension, at 0.05 level of significance, with 92 degree of freedom, the critical value of r is 0.173. Since the value of "r" obtained is 0.88 (as shown in table 4.1), we can say that the results of the coefficient of the correlation between intelligence and reading comprehension are very significant, and are well in the direction of our hypothesis.

The following scatter graph represents the results clearly:

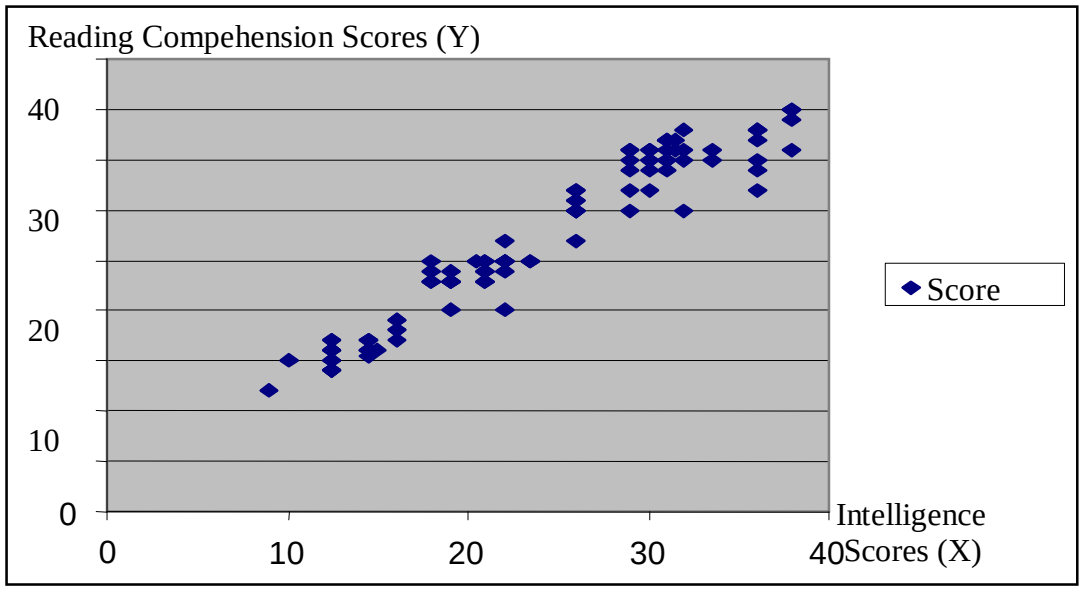


Figure 4.1 Global Correlation between Intelligence and Reading Comprehension

Each point of this diagram indicates the score of one person in both intelligence (horizontal axis) and reading comprehension (vertical axis). It is noted that the 95 cases in the group are distributed along a diagonal running from the lower left- to the upper right-hand corner of the diagram. This distribution indicates the strong positive correlation between intelligence and reading comprehension, since it shows that, approximately, each pupil occupies the same relative position in both variables (high intelligence → high reading comprehension, low intelligence → low reading comprehension). However, there is one point that needs to be polished up. When we look at the scatter graph, we see that some points are somehow separated from the diagonal group. In fact, they represent some exceptional pupils. Thus, it is worth mentioning that although our predictions (the pupils who own higher intellectual abilities comprehend better) are proved, there are some pupils who did not correlate as expected. In other words, there are some respondents who scored less in the intelligence test than others and scored in the reading comprehension exercise better than the pupils who are considered to be more intelligent. For instance, if we consider the case of the two pupils (p35 and p36, as shown in table 4.2), we notice that p35 scored 36/40 in the intelligence test and p36 scored 30/40. Unexpectedly, p36 comprehended better than p35, even if he scored less in the intelligence test less than p35 (similar case for p26-p39, p53-p75, p67-p67,…). However, these special cases do not affect the significance of the results.

N° of Pupil	Intelligence Score	Reading comprehension Score	N° of Pupil	Intelligence Score	Reading comprehension Score
01	23.5/40	25/40	**49**	18/40	23/40
02	31.5/40	36/40	**50**	12.5/40	14/40
03	26/40	30/40	**51**	19/40	23/40
04	32/40	36/40	**52**	26/40	27/40
05	14.5/40	17/40	**53**	31.5/40	37/40

06	12.5/40	15/40	**54**	36/40	38/40
07	29/40	34/40	**55**	38/40	40/40
08	16/40	17/40	**56**	36/40	35/40
09	12.5/40	14/40	**57**	16/40	19/40
10	19/40	23/40	**58**	31/40	35/40
11	22/40	25/40	**59**	32/40	38/40
12	36/40	38/40	**60**	23.5/40	25/40
13	38/40	39/40	**61**	21/40	24/40
14	31/40	37/40	**62**	16/40	18/40
15	15/40	16/40	**63**	12.5/40	14/40
16	21/40	24/40	**64**	14.5/40	17/40
17	32/40	30/40	**65**	29/40	32/40
18	36/40	37/40	**66**	26/40	31/40
19	12.5/40	17/40	**67**	29/40	36/40
20	18/40	23/40	**68**	36/40	32/40
21	26/40	32/40	**69**	16/40	18/40
22	29/40	36/40	**70**	21/40	25/40
23	31/40	35/40	**71**	31/40	37/40
24	38/40	40/40	**72**	31/40	34/40
25	31/40	36/40	**73**	29/40	35/40
26	26/40	31/40	**74**	26/40	32/40
27	21/40	25/40	**75**	38/40	36/40
28	33.5/40	35/40	**76**	12.5/40	17/40
29	14.5/40	16/40	**77**	14.5/40	16/40
30	16/40	19/40	**78**	19/40	23/40
31	19/40	24/40	**79**	18/40	24/40
32	14.5/40	16/40	**80**	33.5/40	36/40
33	12.5/40	14/40	**81**	14.5/40	15.5/40
34	18/40	25/40	**82**	12.5/40	15/40
35	36/40	34/40	**83**	22/40	20/40
36	30/40	35/40	**84**	22/40	25/40
37	20.5/40	25/40	**85**	30/40	32/40
38	22/40	24/40	**86**	30/40	36/40
39	29/40	30/40	**87**	26/40	30/40
40	30/40	36/40	**88**	20.5/40	25/40
41	22/40	25/40	**89**	21/40	23/40
42	21/40	23/40	**90**	30/40	34/40
43	30/40	35/40	**91**	09/40	12/40
44	26/40	30/40	**92**	10/40	15/40
45	12.5/40	16/40	**93**	12.5/40	16/40
46	32/40	35/40	**94**	19/40	20/40
47	22/40	25/40	**95**	22/40	27/40
48	12.5/40	16/40			

Table 4.2 Intelligence and Reading Comprehension Global Scores

With our significant results, it is possible to predict a pupil's relative standing in reading comprehension from a knowledge of his or her score in intelligence. In other words, our hypothesis is confirmed. Yet, our sample has limited generalisability.

4.3 Partial Correlations

The aim of the following partial correlations is to find out specific abilities that, making up the general intelligence, influence, positively, the children's reading comprehension.

4.3.1 Correlation between Vocabulary Scores and Reading Comprehension Scores

With our one-tailed test (i.e. directional test), at 0.05 level of significance, with 92 degree of freedom, the critical value of 'r' is 0.173. since the value of 'r' obtained (r=0.36) is well above this value required, there exists a moderate degree of positive relationship between vocabulary scores and reading comprehension scores. The results are represented in the scatter graph below:

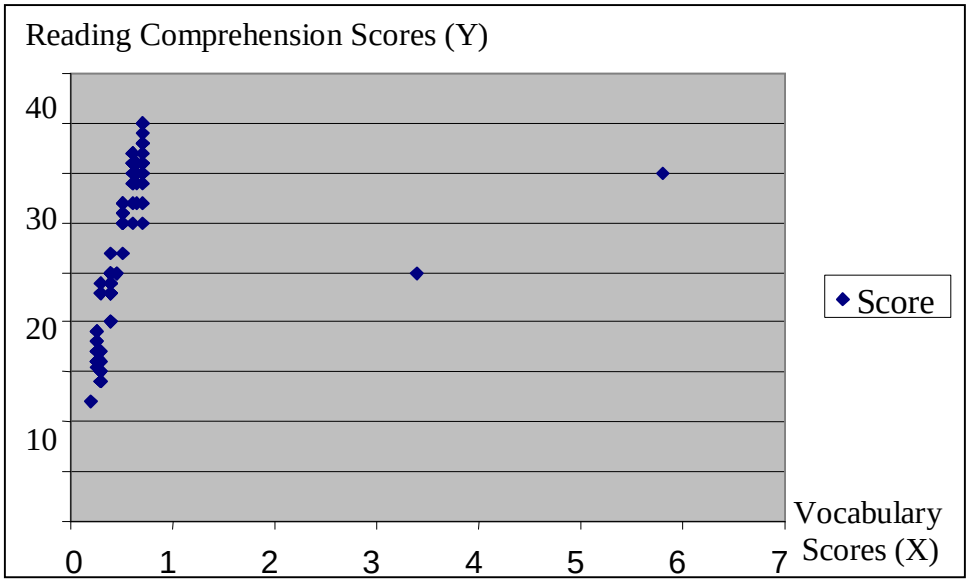


Figure 4.2 Correlation between Vocabulary Scores and Reading Comprehension Global Scores

Each point of this diagram indicates the score of one person in both vocabulary items (horizontal axis) and reading comprehension exercises (vertical axis). Looking at this scatter graph, we notice that the running of points is not diagonal; it is more likely to be described as vertical. This means that the pupils have scored well in their reading comprehension exercises with little need to high vocabulary scores. In other words, pupils did not rely heavily on their crystallised intelligence Gc (Cattell, 1965) to comprehend the written print; their vocabulary lacunae has not prevented them from extracting meaning from the texts. Thus, it is possible to interpret these results asserting that there is some tendency for those pupils doing well in vocabulary items to perform well on the reading comprehension test and vice versa, although the relation is not close.

With a consideration of the results obtained in this partial correlation, we can conclude that vocabulary is moderately correlated with reading comprehension. It is not a major predictor of reading comprehension of pupils, at least in this sample.

4.3.2 Correlation between Similarities and Differences Scores and Reading Comprehension Scores

With the computation of the correlation coefficient "r" between the similarities and differences items and reading comprehension exercises, we have obtained a coefficient "r" that equals 0.48 (here again, c.f. Appendix3). With our one-tailed test (i.e. directional test), at 0.05 level of significance, with 92 degree of freedom, the critical value "r" is 0.173. Since the value of "r" obtained (r=0.48) is above this value required, there exists a moderate degree of positive relationship between the ability to distinguish similarities and differences between things and reading comprehension scores. The results are better demonstrated in the following scatter diagram:

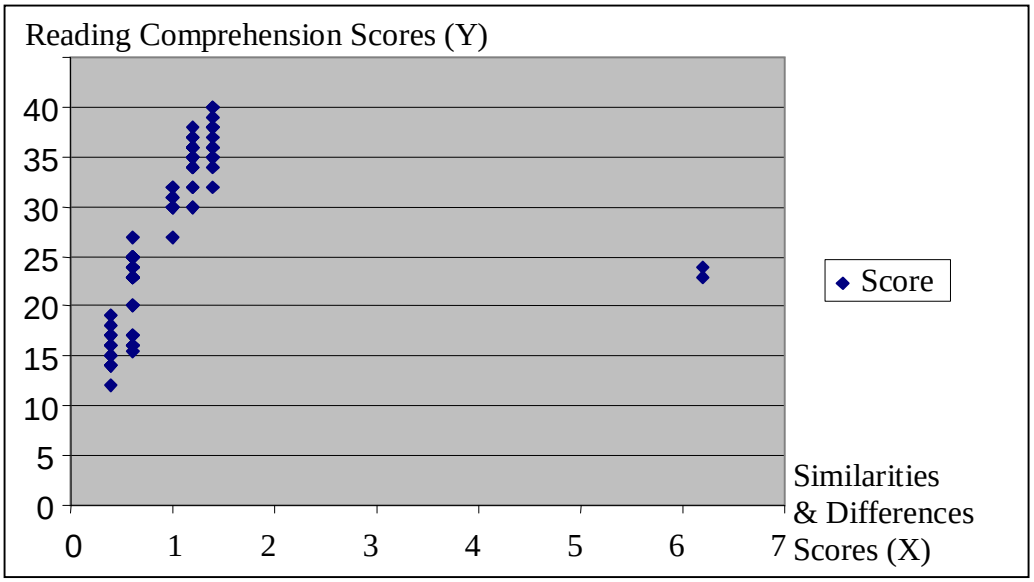


Figure 4.3 Correlation between Similarities and Differences Scores and Reading Comprehension Global Scores

Each point of this diagram indicates the score of one person in both similarities and differences items (horizontal axis) and reading comprehension exercises (vertical axis). With an analysis of the above graph, we notice that the group of points is to a certain extent, not really, diagonal. This indicates that the systematic increase in the score obtained in the items of similarities and differences is not systematically accompanied by an increase in the reading comprehension score. So, the correlation between the pupils' ability to distinguish similarities and differences between elements in the specific intelligence items and their reading comprehension is not strong; it is moderate.

Thus, it is possible to conclude that this ability is not a good predictor of reading comprehension in 15-year-olds.

4.3.3 Correlation between Series Scores and Reading Comprehension Scores

Series items seem to be highly correlated with reading comprehension exercises, since the value of product-moment correlation coefficient obtained is 0.87 (c.f. Appendix3). We draw this conclusion starting from the point that since with our one-tailed test, at 0.05 level of significance, with 92 degree of freedom, the critical value "r" is 0.173; and the value of "r" obtained (r=0.87) is well above this value required. For a clarification of the results, we can consider the following diagram:

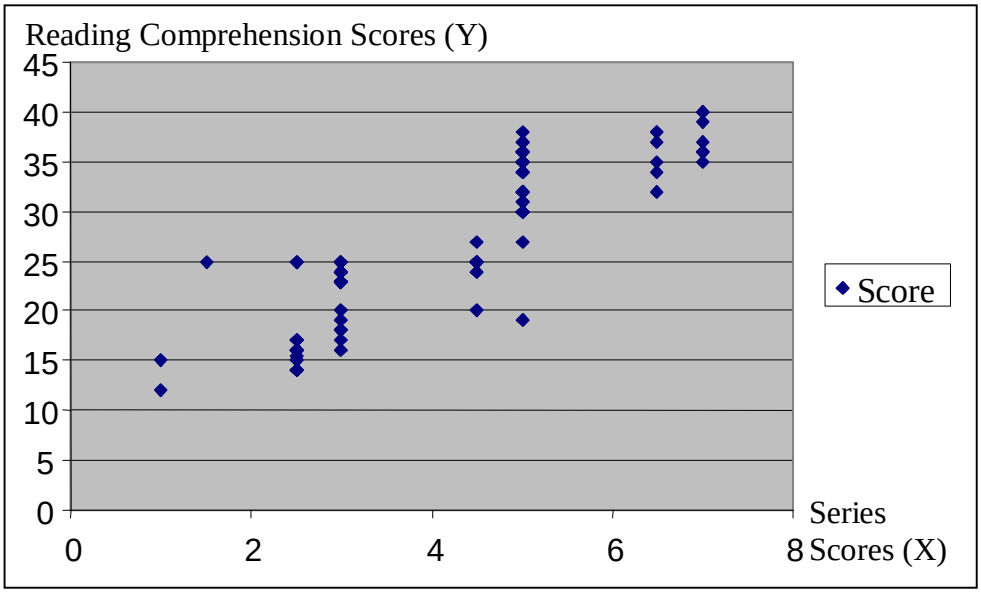


Figure 4.4 Correlation between Series Scores and Reading Comprehension Global Scores

Each point of this diagram indicates the score of one person in both series items (horizontal axis) and reading comprehension exercises (vertical axis). The points in the following diagram start from the lower left- in the direction of the upper right-hand corner of the diagram. This indicates that increases in the series scores are generally followed by increases in the reading comprehension exercises. Thus, it is possible to establish that the pupils who performed well on series items have a tendency to perform better in the reading comprehension exercises.

It is possible to conclude, then, that the pupils' ability to reason and deal with series of verbal and non-verbal elements is a good predictor of their reading comprehension.

4.3.4 Correlation between Reasoning Scores and Reading Comprehension Scores

The correlation coefficient "r" obtained in this correlation equals 0.92 (c.f. Appendix 3). With our one-tailed test, at 0.05 level of significance, with 92 degree of freedom, the critical value "r" is 0.173. Since the value of "r" obtained (r=0.92) is well above this value required, reasoning items are highly correlated with reading comprehension exercises. The following graph represents the results of the correlation:

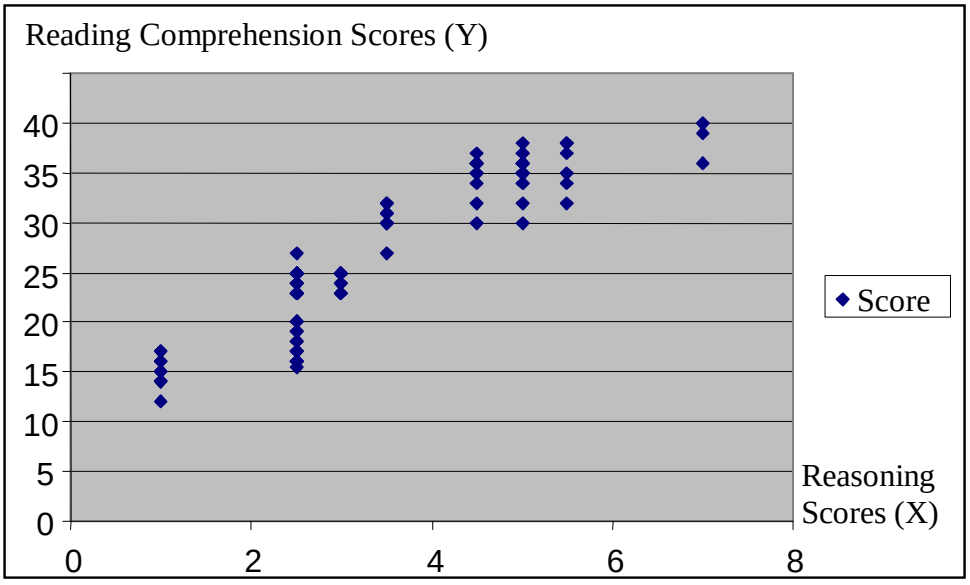


Figure 4.5 Correlation between Reasoning Scores and Reading Comprehension Global Scores

Each point of this diagram indicates the score of one person in both reasoning items (horizontal axis) and reading comprehension exercises (vertical axis). We notice that the group of the points is diagonal. This implies that the increases in the scores of the reading comprehension exercises are strongly related to the reasoning scores. Thus, it is obvious that the pupils' reasoning abilities, also labelled by Cattell (1963) as 'fluid intelligence', influence their reading comprehension. This can be better explained by the fact that the pupils who

possess high reasoning abilities apply their reasoning skills in order to analyse and draw inferences from written language. For example, the pupils who own good reasoning abilities are able, more than the others, to discriminate between relevant and irrelevant information that is to be selected to answer a reading comprehension question. Here, it is clear that the good comprehenders use strategies to resolve matters of meaning that approximate to a logical process of deduction and inference. Thus, the good comprehenders are those who can think clearly.

So, with consideration of the significant results obtained in this correlation, we can establish that a strong positive relationship between reasoning abilities and reading comprehension skills exists. Thus, reasoning is a strong predictor of reading comprehension.

4.3.5 Correlation between Problem-solving Scores and Reading Comprehension Scores

With our one-tailed test (i.e. directional test), at 0.05 level of significance, with 92 degree of freedom, the critical value "r" is 0.173. Since the value of "r" obtained is "0.80" (c.f. Appendix 3), which is well above the value required, the correlation between problem-solving items and reading comprehension exercises is high. The following scatter graph allows us to make some analyses of the result obtained:

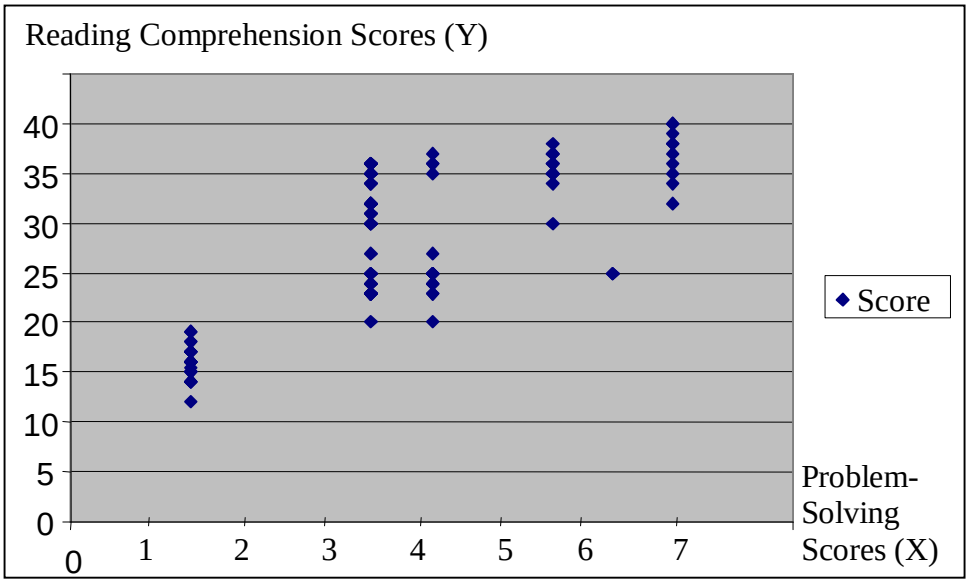


Figure 4.6 Correlation between Problem-solving Scores and Reading Comprehension Global Scores

Each point of this diagram indicates the score of one person in both problem-solving items (horizontal axis) and reading comprehension exercises (vertical axis). We notice that the group of points is, once again, diagonal. This means that both problem-solving and reading comprehension go hand in hand. That is, higher scores in problem-solving items lead to a high degree of reading comprehension. This can be better explained by the fact that understanding a paragraph is like solving a problem in mathematics. It consists of selecting the right elements in the situation and putting them together in the right relations, and also with the right amount of weight of each. The pupils' logical-mathematical intelligence, so called by Gardner (1983, 1999) direct the pupils' attention to the precision of language and precision of thought in the presented piece of writing (the organisation of the paragraphs, sentences, or transitions). Thus, it is clear that problem-solving strategies are useful for the resolution of many problems in reading like comprehending the text being read.

So, we assume that, with relation to the results obtained, the pupils' reading comprehension can be well predicted from a knowledge of the problem-solving skills they possess.

4.3.6 Correlation between Decision-making Scores and Reading Comprehension Scores

With our one-tailed test (i.e. directional test), at 0.05 level of significance, with 92 degree of freedom, the critical value "r" is 0.173. Since the value of "r" obtained in the correlation between decision-making items and reading comprehension exercises equals 0.73 (c.f. Appendix 3) and is well above the value required, we conclude that respondents' abilities to deal with real life situations seem to be highly correlated with comprehending foreign written language. The following diagram is a representation of the results of this correlation.

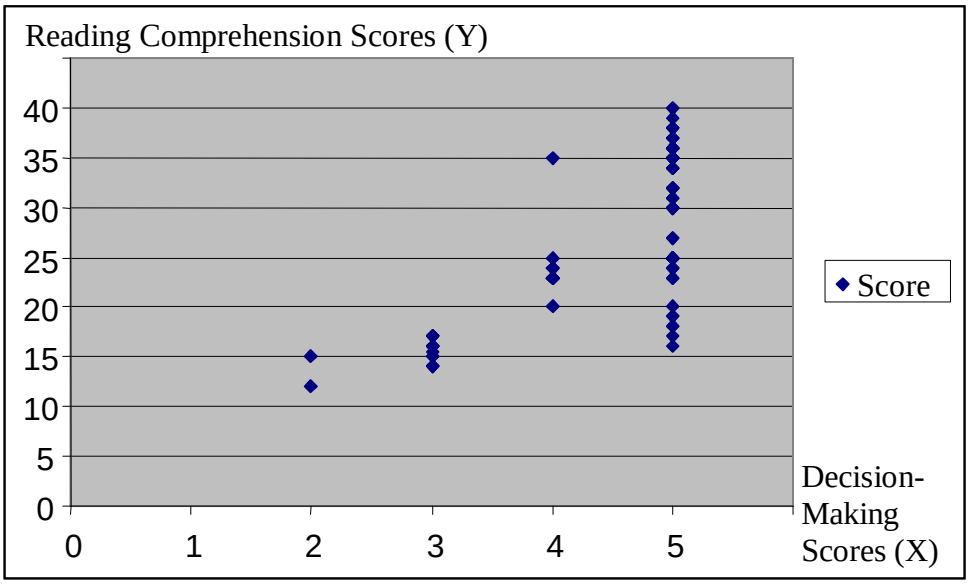


Figure 4.7 Correlation between Decision-making Scores and Reading Comprehension Global Scores

Each point of this diagram indicates the score of one person in both real-life situations solving items (horizontal axis) and reading comprehension exercises (vertical axis). We can remark that, generally, the pupils who performed well on reading comprehension exercises are those who have high scores in solving real-life problems. In fact, this can be better explained by the fact that individuals who effectively solve everyday, practical problems are able to recognise that the problem exists, to define that problem clearly and to formulate strategies for solving it. This would justify the success of some pupils (best performers), in the study sample, in justifying their choices.

Thus, the effective use of these skills to solve practical, everyday problems can be viewed as a good indicator of the pupils' understanding of written language.

4.4 Consistency with Past Research

The fact that intelligence is found to be a significant predictor of reading comprehension in English as a Foreign Language in this paper is consistent with previous findings. In fact, many studies have pointed out to the fact that differences between good and poor comprehenders are explained on the basis of measures of readers' intellectual abilities. These findings hold that variation in comprehension skill can largely be accounted for by variation in intellectual abilities. In addition to that, it is proved that tests of cognitive abilities mirror reading comprehension skill. In other words, they claim that intelligence is the key to reading comprehension.

Floyd, Gregg and Keith (2004) have extended a research examining the effects of cognitive abilities on reading comprehension. The participants were aged between 14 and 19. Their significant results ($r = 0.84$) lead them to conclude that the ability to perceive logical

relationships and to solve problems using novel stimuli (Fluid Reasoning), surfaced as significant predictors of reading comprehension. The results of their investigation indicate that some abilities (e.g., phonemic awareness represented by Auditory Processing) are not important predictors of reading comprehension abilities when considered in concert with other aptitudes. In addition, these results convey that the aptitudes described in the simple view of reading may be too limited in scope. That is, other abilities, such as short term or working memory ability and novel reasoning ability add important information when predicting reading comprehension.

In several studies, IQ has been a protective factor. In a longitudinal analysis, Constable *et al.* (2003) found that two groups of impaired readers began school with similar reading skills and socioeconomic characteristics. Those students who possessed higher cognitive abilities became significantly better readers as young adults. Swanson (2001) found that IQ exercised similar effects on the pupils' reading achievement. These studies indicate, once again, that intelligence is a good predictor of reading comprehension.

Glutting *et al.* (2006) studied the relationship between intelligence and reading comprehension using analyses of 498 participants scores on the W*echsler Intelligence Scale for Children-Fourth Edition* (WISC-IV) and the *Wechsler Individual Achievement Test-Second Edition* (WIAT-II). Observed WISC-IV subtest scores (Verbal Comprehension, Perceptual Reasoning, Working Memory, and Processing Speed) indicated that there was a significant influence of general factor 'g' on reading achievement ($r = 0.55$). Thus, when using observed scores to predict reading achievement, it may be necessary to consider the Full Scale IQ.

Other investigations aimed at exploring the nature of the relationship between cognitive abilities and reading comprehension. This link was studied by Naglieri (1996) and

Naglieri and Ronning (2000) to determine whether there are significant correlations between the variables and to determine the size of the coefficient. It has been hypothesised that there exists a significant correlation between intelligence and reading comprehension. The former study (Naglieri, 1996) involved a large sample of 2125 pupils of 8-16 years old who were administered a nonverbal test of intelligence (Matrix Analogies Test-Short Form) and a measure of reading achievement (Multilevel Academic Survey Test-Reading). The latter study (Naglieri, 2000) involved approximately 22,000 children who were administered a nonverbal measure of ability called the Naglieri Nonverbal Ability Test (NNAT) and measures of reading included in the Stanford Achievement Test Ninth Edition (SAT-9). Results of both studies demonstrated that the tests used were strongly correlated and showed that an average correlation between reading and intelligence of 0.57 (in the first study) and 0.56 (in the second study). Thus, the hypothesis that intelligence and reading comprehension are strongly related was supported, and the relationship between intelligence and reading achievement was found to be substantial.

Overall, the present research confirms the positive correlation between reading comprehension and intelligence that are found in the above-named studies.

CONCLUSION

Our study has been concerned with investigating the effect of Algerian 15-year-olds intellectual abilities on their reading comprehension. It has allowed us to examine the relationship between intelligence and reading comprehension in relation to the research question: Are highly intelligent pupils able to comprehend a print written in English as a Foreign Language better than those who are intellectually less capable?

We have travelled far, sometimes on new roads and sometimes on old, in an attempt to clarify concepts like intelligence and reading comprehension. The review of the literature, in this paper, has helped us a great deal in the construction of the measures used in this small research.

Two tests have been administered to 95 participants to assess their intellectual capacities and their abilities to extract meaning from the print. The pupils who have participated in this study are 15-year-old attenders of an Algerian middle school, belonging to ordinary classes.

The results obtained in this study have allowed us to provide some conclusive observations in relation to the hypothesis and the research questions stated in the introductory part of this paper.

In this study, the pupils' intelligent behaviours have proved to be highly related with their comprehension of a text written in English as a FL.

Pupils who have demonstrated a good text comprehension are learners who own good thinking abilities. Instead of blurting the first answer that comes on their mind, these pupils take time to reflect on an answer before giving it. In fact, these are effective readers who are

flexible in their thinking and who explore and increase their use of alternative strategies of problem-solving; not considering that *their* way to solve a problem is the *only* way. The good problem-solvers are those pupils who are not interested in whether their answer is correct, but those who are challenged by the process of finding an answer. That is why we find them collecting evidence to indicate their problem-solving strategy is working, and if one strategy doesn't work, they know how to back up and try another. They use systematic methods of analysing a problem, that of extracting meaning from the print, knowing ways to begin, knowing what steps must be performed, what data need to be generated or collected.

Also, it has been shown that the pupils who possess good logical-mathematical aptitudes are more able to direct their attention to the precision of language and precision of thought in a piece of writing.

In a nutshell, we hold that intelligence has a predictive power in forecasting success in reading comprehension. In fact, the pupils' intellectual abilities (cognitive competencies) make it easier for these readers to grasp effectively what is conveyed in a written discourse.

Studies of intelligence and reading comprehension are as old as the fields themselves. Several investigations and empirical studies have tackled these issues in an attempt to broaden the general understanding of intelligence and reading comprehension. In this dissertation, we have used conventional definitions of intelligence and reading comprehension. However, there is continued debate as to whether these definitions are broad enough to capture all that it means to act intelligently and read effectively. Thus, we have attempted to go to great lengths to offer suggestions that integrate theory into practice and provide other teachers with some ideas and approaches to their own classrooms and curricula. We hope that the link between intelligence and reading comprehension, investigated in this piece of research, would lead to

applied programs that would help raise children's reading comprehension by giving them strategies to improve their intelligence.

PEDAGOGICAL IMPLICATIONS

Since the present study provides further support that intellectual abilities can be useful in predicting children's reading comprehension capacities, which is consistent with previously published reports, several implications can be drawn on the basis of the findings in this study.

It is important to point out to the fact that pupils *can* learn to think better if schools concentrate on teaching them *how* to do so. In fact, teaching children to think critically and creatively is very important for their educational achievements. Reading comprehension is one of these achievements that are in a real need for teaching thinking skills. Thus, one possible implication points out to the need to develop thinking skills programs that develop critical, creative and constructive thinking skills. These programs should be effective in increasing students' cognitive performance. They may be organised by whether they involve infusing thinking skills into the established curriculum or provide a separate thinking skills course. To tell the truth, teaching precise thinking skills would build foundations for successful reading comprehension.

Reasoning, this ability that distinguishes humans from other species on this planet, is not, unfortunately, a part of the focus of the public education curriculum in Algeria, at this point in time. Currently, this ability is only available in specific curricula in universities. Since, in this study, reasoning and reading comprehension seem to be interdependent, another possible implication would be to teach reasoning, in schools, as a step toward building good reading comprehension. In fact, without denying the role of more crystallised reading skills, we need the pupils to take an active role in the reading process by teaching them how to reason about text material during reading. In other words, we want to make them understand

and evaluate what they read. To this end, we may need to combine reading exercises with language-based reasoning activities (analogies, syllogisms, words in context), and include regular writing exercises to provide pupils with opportunities to practise and demonstrate their developing language and reasoning abilities. These can be useful especially for organising group activities or oral exercises. Creative activities can help generate an atmosphere of curiosity about language and reading.

It was proved in this study that reading is a problem-solving activity par excellence. In fact, FL readers have no rich oral experience and have vocabulary lacunae in the foreign language; they have just to compensate for the lack of such an experience by having recourse to some cognitive abilities. Thus, it is important to point out to the fact that to read more efficiently, children must be taught practical problem-solving strategies. To this end, we need a program that concentrates on problem-solving components like decoding skills and arithmetic operations. Here, the teachers are supposed to teach these cognitive strategies (guessing from context, making inferences from the text, skimming ahead to fill in the contexts, etc.) as well as to demonstrate a variety of situations in which learners might profitably use the strategies taught. For example, we may involve pupils in activities in which they are encouraged to discuss the rationales leading to their conclusions, consider other points of view, and analyse various cognitive processes.

It is also useful to teach learners decontextualisation, i.e taking something learnt in one setting and applying it to another. In this way, pupils will stop considering each new task as if it were approached for the very first time. They would rather be able to explain what they are doing now in terms of analogies with or references to previous experiences. They learn how to call upon their store of knowledge and experience as sources of data to support, theories to

explain, or processes to deal with each new challenge. Thus, it is important, in this context, to provide perplexing situations, discrepancies and intriguing phenomena to pupils.

It is noteworthy that the effectiveness of any educational program, like the ones suggested in this paper, is partially dependent on many factors. First of all, taking into consideration the positive relationship between teacher training and pupils' achievement, it would be important to claim that teacher training is a key factor in any programs' success. Thus, the application of any school program must be accompanied by a strong teacher training, which is considered to be as important as the program content in bringing about the pupils' learning gains. Another important factor would be the learning climate. In fact, it is important to establish and maintain a positive, stimulating, encouraging classroom climate (high expectations, teacher warmth and encouragement, pleasant physical surroundings, etc.) for teaching pupils aspects of cognitive functioning (the foundations of reasoning, understanding language, verbal reasoning, problem solving, decision making), so that children will feel free to experiment with new ideas and approaches. These aspects, unfortunately, are often overlooked and should be included in reading instruction.

It is fairly obvious that if the goals and methods of EFL instruction are oriented toward a cognitive model, EFL readers' comprehension would not be completely handicapped by insufficient vocabulary or a forgotten rule. In other words, we are no more checking the students' rote memory of words or rules; we are, instead, helping the readers become alert to the problems in their understanding of what they read and adopt a range of strategies to fix these problems, and thus become better readers.

We hope that these implications will help educators and curriculum developers structure the classroom by meeting the needs of children, helping them build on their strengths in cognitive abilities and improve on their weaknesses in reading comprehension of texts written in English as a Foreign Language.

LIMITATIONS OF THE PRESENT STUDY

Due to many reasons, this study contains potential limitations that moderate the implications of the research findings. Thus, the results of this investigation must be considered within the limits of its design, sample, and methods.

One major limitation is that intelligence testing would give better results if children's intellectual abilities are assessed individually. This is true because in individual tests, the test-maker can consider both the processes of the child's problem-solving and his performance (how and what). In fact, it seems that, in the tests analysis, we did not go beyond the numbers. We need at least to use numbers to understand what makes the person tick, to integrate those test scores with the kind of child we're looking at, and to blend those behaviours with the scores to assess this child as a whole and to make useful recommendations. This was impossible within the middle school. The reason is that we were restricted by the time available to give the intelligence test; we were not allowed to spend more than one hour session with each group of test-takers (this is the duration of an ordinary classroom session).

Another limitation relates to the measurement of reading comprehension in this study. We have used multiple-choice questions and constructed response questions. We are aware of the fact that these different measures do not necessarily assess the same things. For example, multiple choice questions are efficient to score, but may not do a good job of assessing higher-level comprehension skills. Also, poor performance on constructed response questions may reflect writing more than reading problems. In other words, there may be some respondents whose answers are not correctly constructed but who have understood the text well.

It is critical to examine the situations around which the tests used in this investigation are given. Many factors go in to the test itself. Other major factors are cultural backgrounds, parenting practices and the home environment. To issue a truly standardised test, the testing environment should be the same for everyone involved (the sample used is composed of children who have the same age, but it is not completely homogeneous). No matter how carefully written, standardised intelligence tests have particular cultural biases, and are almost always based on language ability and mathematical prowess. These traits are important and desirable, but they may not be the only factors in determining a person's intelligence.

Intelligence in everyday life requires a broader range of abilities than is measured by conventional tests. The problem with these conventional tests, including the one used in this paper, is that they spotlight children who have certain abilities (abstract-analytical ones), but leave in the dark children with other kinds of abilities, such as creative and practical abilities (Sternberg, 1985). As a result, it is possible that these children never get the opportunity to show what they really can do. Not only do we disenfranchise these children, but we provide almost limitless opportunities for those individuals who do not necessarily have the broader range of abilities they will need to take advantage of the opportunities they receive.

A further limitation would be the administration and the interpretation of the tests. Since the test-maker is not an expert researcher and practitioner who is trained in standardised assessment, it is possible that another researcher would go through different administration of tests and give interpretations of their results' that differ from those presented in this paper. Moreover, as a test-developer, I was alert to the presence of different forms of error and attempted to remove or reduce their presence as best efforts to ensure the tests are psychometrically sound.

An additional limitation would be the effect of psychological factors as stress and anxiety that the test-taker may feel during his taking of the test. A person may not have had breakfast, could possibly be ill that day or is having a panic attack regarding taking the test. Consequently, these will affect his/her performance and the results would not reflect clearly his abilities.

RECOMMENDATIONS FOR FUTURE RESEARCH

Due to the unavailability of longer periods of time, it was not possible to conduct a large-sample evaluation of intelligence and reading comprehension. Consequently, though the results are encouraging, I am guarded about generalising them (c.f. the section on limitations of the present study). I believe that more complex experiments would generate more conclusive statistics about the impact of intelligence on acquiring reading comprehension skills in a foreign language.

Additional research can be devoted to using one intelligence theory like Luria (Das *et al.*, 1975; Das *et al.*,1994; and Das and Naglieri, 1988) PASS Theory of Intelligence (Planning, Attention, Simultaneous and Successive processes) to predict reading achievements. This model is based on the belief that intelligence should be conceptualised as coginitive processes. These general processes are believed to have domain-specific counterparts which are applied in areas such as reading. Related to each domain-specific process, there exists task specific knowledge, such as word attack and word recognition skills in reading (Das, Kirby, and Naglieri, 1994). Using this theory of intelligence, more specifically, the question may be phrased as: What is the relationship between planning, attention, simultaneous and successive processes and reading achievements? This would reinforce the findings of this research. In fact, it would be an interesting project to use the PASS theory of intelligence in order to predict reading achievements at early levels, in kindergarten for example. Since intelligence is a good predictor of children's reading achievements, early assessment and detection of reading problems, from a knowledge of their intelligence, is extremely important so that children who are behind in reading can catch up

with their peers. This way, pupils who have similar reading difficulties would be put together in the same school groups and would be taught, using special programs, how to read and think about what they read.

An additional important project would be to focus on a specific method or programme of teaching thinking skills, and carry out a longitudinal study that would show the progress of children as far as their reading achievements are concerned. We propose, for example, the use of some programs like CORT (Cognitive Research Trust). This programme is intended to develop critical, creative, and constructive thinking skills over a three-year period (Baum 1990). It identifies ten thinking skills programmes that have proven effective in increasing pupils' cognitive performance. It is possible to propose another programme, like Problem Solving and Comprehension Programme (Austin and Worsham, 1983). This programme concentrates on four problem-solving components- decoding skills, vocabulary, basic arithmetic operations, and precise thinking, and pupils work in problem solver-reader pairs. The programme may be used in conjunction with other thinking skills programmes.

APPENDIX 1

THE RESEARCH INSTRUMENTS

A STUDY OF THE CORRELATION BETWEEN INTELLIGENCE

AND READING COMPREHENSION

THE CASE OF MIDDLE SCHOOL FOURTH YEAR PUPILS

A Project Carried Out by Achouak BADER

KHOUALDIA Middle School,

April 2007, Constantine,

Algeria

Dear pupils,

You are kindly invited to take part in a research on "The Relation between Intelligence and Reading Comprehension".

We reassure you about the confidentiality of your private information, the answers given, and the results obtained.

Your contribution through the two tests will be very much appreciated.

PART ONE: INTELLIGENCE TESTS

Family name:…….First name:…….Date of birth:……..

Item 01: The words “small”, “disbelieve” and “ugly” make up the opposites of words that start with a “B”.

a-True b-False

Item 02: Rearrange the words of every group to get a meaningful sentence.

1- people/ that/ some/ stupid/ think/ computers/ are

2- able/ man/ to/ moon/ to/ is/ travel/ the

3- a / training/ workshop/ finish/ I/ when/ will/ I/ open

4- will/ hard/ if/ succeed/ work/ I/ I/ my/ Brevet/ in/ exam

Item 03: Draw an arrow to link between an expression from group A with the one that best fits it from group B.

A			**B**
-She is as sweet as sugar	*	*	-He is thin
-She is as cool as cucumber	*	*	-She very kind
-This exercise is a piece of cake	*	*	-She is calm
-He is as skinny as a string bean	*	*	-It is very easy

PLEASE GO ON TO THE NEXT PAGE

Item04: Under each of the following pictures, write the number of the sentence that best expresses it between parentheses.

(…)

(…)

(…)

(…)

(…)

(…)

(1)-Our father is very glad to accompany us to school.

(2)-These lessons are driving me crazy.

(3)-I have prepared myself to go to the mosque for El Djoumouâa (Friday) prayer.

(4)-She was shopping for Aîd El Fitr.

(5)- The hairdresser has arranged Uncle Ali’s hair in a funny way.

(6)-I am very tired. I don’t want to shower.

PLEASE GO ON TO THE NEXT PAGE

Item 05: Find out the meaning of the underlined words according to the context in which they occur.

1-You're looking for your mobile (phone). Perhaps Karim has seen it. Ask him.

a-Buying b-Making c-Searching d-Giving

2-It is illegal to steal. You can go to prison.

a-Obligatory b-Against law c-Possible d-Beneficial

3-It is impolite to interrupt people that talk to each other. Next time wait for your turn to speak.

a-See b-Speak c-Listen d-Talk

4-This mathematical equation is difficult. I am incapable of doing it.

a-Able b-Unhappy c-Unable d-Possible

Item 06: Complete the following sentences so that they make a sense.

1-I won't stop revising until I…….

2-When I finish my studies in middle school, I…….

3-As soon as the bell rings, we……

4-I……..while waiting for the film to start.

5-I'll buy my books before I……

PLEASE GO ON TO THE NEXT PAGE

Item 07: Which one of the following four pictures is least like the other three?

a-  b-  c-  d- 

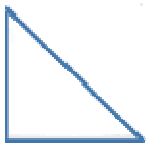
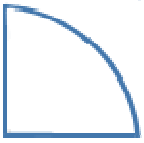
Item 08: Which one of the following four pictures is least like the other three?

a-  b-  c-  d- 

Item 09: Which one of the following four pictures is least like the other three?

a-  b-  c-  d- 

Item 10: Which one of the following four figures is least like the other three?

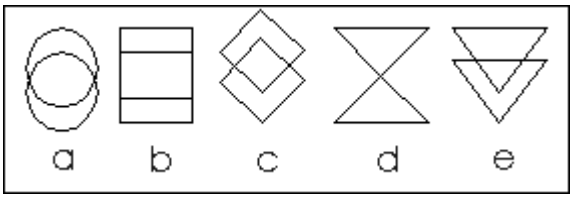
a-  b-  c-  d- 

Item 11: Which one of the following four elements is least like the other three?

a- Plane b- Stream boat c- Car d- Train

PLEASE GO ON TO THE NEXT PAGE

Item 12: Which one of the following four figures is least like the other four?



Item 13: Answer briefly the following questions.

-How do you do in order to enter a giraffe into a refrigerator?

-How do you do in order to enter an elephant into a refrigerator?

-The lion organises a meeting where all the animals are invited. They came all of them except for one. Guess who he is?

-There is a river that is infested by crocodiles…How do you do in order to cross it?

Item 14: What would be the next number in this series?

2-3-5-8-12-17- ??

a-22 b-23 c-24 d-25 e-26

Item 15: What would be the next number in this series?

3-5-10-12-24-26- ?

a-48 b-50 c-52 d-54 e-56

PLEASE GO ON TO THE NEXT PAGE

Item 16: What would be the next number in this series?

15-12-13-10-11-8- ?

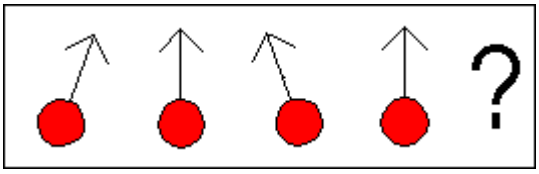
a-5 b-6 c-7 d-8 e-9

Item 17: What would be the next number in this series?

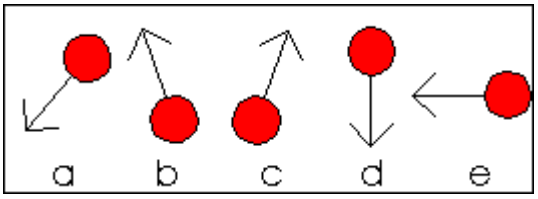
100-200-50-100-25- ?

a-400 b-100 c-200 d-50

Item 18: What would be the next figure in this series?



In order to answer the question, choose one of the following five figures:



Item 19: France is to Europe as Algeria is to…

a-America b-Asia c-Africa d-Australia

PLEASE GO ON TO THE NEXT PAGE

Item 20: Nazim is taller than Ahmed

Kamel is taller than Nazim

So, Ahmed is the smallest boy.

a-True b-False

Item 21: All the pupils are boys.

All the boys are intelligent.

So, some pupils are intelligent.

a-True b-False

Item 22: Saif is faster than Firas

Amine less fast than Saif.

So, we conclude that:

a-Amine is faster than Firas

b-Amine is less fast Firas

c-Amine is as fast as Firas

d-It is impossible to say who is faster amongst Firas and Amine.

PLEASE GO ON TO THE NEXT PAGE

Item 23: How many feet do nine chicken, two dogs and three cats have?

a-14 b-38 c-56 d-46

Item 24: Amine has 480 DA, but he wants to buy an MP3 reader that costs 1200DA. So he needs to borrow 570DA from Malik and 150DA from Mohamed.

a-True b-False

Item 25: Abd Errahim helps his gymnatics trainer. This latter asks him to bring back 16 balls from the equipment room. Abd Errahim can carry only 3 balls per time. How many times is he required to go to the equipment room to bring back all the balls?

a- 4 ½ b- 5 c- 5 ½ d- 6

Item 26: A group of women met one afternoon in a cafeteria to drink tea. They brought their cats along with them. All in all, there were 22 heads and 72 feet. How many women and cats were there in the room?

a- 6 women and 16 cats

b- 7 women and 15 cats

c- 8 women and 14 cats

d- 9 women and 13 cats

PLEASE GO ON TO THE NEXT PAGE

Item 27: Put "+" for the good actions and "-" for the bad actions. A justification in one sentence for each answer is required.

1- I work in groups to help my friends for a better understanding of the lessons…….

-…….

2- I am in the classroom and I have remarked that I have forgotten my dictionary. I take the dictionary of my friend without asking for his permission: He's my gentle friend……

-……...

3- My cousins invited me in for dinner. All of sudden, I needed an urgent phone call. Asking for their permission is not obligatory……

-……..

4- I revise my lessons just before taking the examination : I want to remember everything…….

-……...

5- Sitting an examination in mathematics, my friend asks for my help to solve some problems. I did not hesitate, of course, because he is my best friend, and it is good to help others……

-……...

PART TWO: READING COMPREHENSION TESTS

Exercise one: Read the text very carefully and answer the questions below:

Yesterday morning at 9.30 a.m., two bikers died in a tragic accident on a sharp bend on Airport Road. The bikers were talking to each other while they were overtaking a lorry which was travelling in the direction of Heathrow Airport. Apparently they were having morning exercise in preparation for the Tour de France. The motorcyclists were coming from Heathrow Airport while looking at low flying landing plane. “They were riding very fast,” an eyewitness said. The collision between the motorcyclists and the bikers blocked the traffic for more than two hours. Two policemen were investigating the accident when we arrived on the scene.

Comprehension Questions:

1. Where did the accident occur?

2. What were the bikers doing while they were riding?

3. How long did the traffic block last?

4. Who arrived on the scene when the police was investigating the accident?

PLEASE GO ON TO THE NEXT PAGE

Exercise two: Read the following text very carefully and interpret the facts below:

People eat different foods in different places. Let's take the example of Nepal. Nepal has no sea. Most people in Nepal are farmers. They grow grains, fruits and other crops in the lowlands. The temperatures are very warm there. Rice and corn grow in terraced fields in the cooler hill regions. Potatoes and barley are the staple or chief crops at higher elevations. Temperatures are coolest there.

The Nepalese raise goats, cattle and yaks for dairy produce. They eat meat only on special occasions. Religious rules affect which meats people in Nepal eat: Hindus, who make up almost 90 percent of the population do no eat beef, and Muslims do not eat pork.

Comprehension Questions

1- The title of this text is…

a- The Nepalese People.

b- The Nepalese Different Foods.

c- The Nepalese Country.

PLEASE GO ON TO THE NEXT PAGE

2- Some crops like potatoes need…

a- warm temperatures.

b- cool temperatures.

c- low temperatures.

3-The type of meat Nepalese eat is affected by…

a- the region.

b- some special occasions.

c- the religion.

APPENDIX 2

INTELLIGENCE AND READING COMPREHENSION SCORES

PART ONE: Intelligence Scores (Global and Partial)

Scores of Items 1-16

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	Item 14	Item 15	Item 16
P1	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P2	0.5	0.5	1	1	1.5	1.5	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P3	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	2	0	0.5	0.5	1.5
P4	0.5	0.5	1	1	2	2	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P5	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P6	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	0	0	0	0.5	0.5	1.5
P7	0.5	0.5	1	1	1	2	0.5	0.5	1	2	2	0	0.5	0.5	1.5
P8	0.5	0.25	0.25	1	0	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0
P9	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0.5
P10	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P11	0.5	0.5	0.5	1	0.5	1	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P12	0.5	0.5	1	1	2	2	0.5	0.5	1	1	2	2	0.5	0	1.5
P13	0.5	0.5	1	1	2	2	0.5	0.5	1	1	2	2	0.5	0.5	1.5
P14	0.5	0.5	1	1	1	2	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P15	0.5	0.25	0.25	1	0	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0
P16	0.5	0.5	0.5	1	1	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P17	0.5	0.5	1	1	2	2	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P18	0.5	0.5	1	1	2	2	0.5	0.5	1	1	2	2	0.5	0	1.5
P19	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0.5
P20	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P21	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	2	0	0.5	0.5	1.5
P22	0.5	0.5	1	1	1	2	0.5	0.5	1	2	2	0	0.5	0.5	1.5
P23	0.5	0.5	1	1	1	2	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P24	0.5	0.5	1	1	2	2	0.5	0.5	1	1	2	2	0.5	0.5	1.5
P25	0.5	0.5	1	1	1	2	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P26	0.5	0.5	1	1	0.5	1.5	0.5	0.5	1	1	2	0	0.5	0.5	1.5

P27	0.5	0.5	0.5	1	1	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P28	0.5	0.5	1	1	2	2	0.5	0.5	1	1	2	2	0.5	0.5	1.5
P29	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P30	0.5	0.25	0.25	1	0	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0
P31	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P32	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P33	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0.5
P34	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P35	0.5	0.5	1	1	2	2	0.5	0.5	1	1	2	2	0.5	0	1.5
P36	0.5	0.5	1	1	2	1.5	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P37	0.5	0.5	1	1	0.5	1	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P38	0.5	0.5	0.5	1	0.5	1	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P39	0.5	0.5	1	1	1	2	0.5	0.5	1	2	2	0	0.5	0.5	1.5
P40	0.5	0.5	1	1	2	1.5	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P41	0.5	0.5	0.5	1	0.5	1	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P42	0.5	0.5	0.5	1	1	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P43	0.5	0.5	1	1	2	1.5	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P44	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	2	0	0.5	0.5	1.5
P45	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0.5
P46	0.5	0.5	1	1	2	2	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P47	0.5	0.5	0.5	1	0.5	1	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P48	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0.5
P49	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P50	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0.5
P51	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P52	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	2	0	0.5	0.5	1.5
P53	0.5	0.5	1	1	1.5	1.5	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P54	0.5	0.5	1	1	2	2	0.5	0.5	1	1	2	2	0.5	0	1.5
P55	0.5	0.5	1	1	2	2	0.5	0.5	1	1	2	2	0.5	0.5	1.5
P56	0.5	0.5	1	1	2	2	0.5	0.5	1	1	2	2	0.5	0	1.5
P57	0.5	0.25	0.25	1	0	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0
P58	0.5	0.5	1	1	1	2	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P59	0.5	0.5	1	1	2	2	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P60	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P61	0.5	0.5	0.5	1	1	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P62	0.5	0.25	0.25	1	0	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0
P63	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	0	0	0	0.5	0.5	1.5
P64	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P65	0.5	0.5	1	1	1	2	0.5	0.5	1	2	2	0	0.5	0.5	1.5
P66	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	2	0	0.5	0.5	1.5
P67	0.5	0.5	1	1	1	2	0.5	0.5	1	2	2	0	0.5	0.5	1.5
P68	0.5	0.5	1	1	2	2	0.5	0.5	1	1	2	2	0.5	0	1.5
P69	0.5	0.25	0.25	1	0	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0
P70	0.5	0.5	0.5	1	1	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P71	0.5	0.5	1	1	1	2	0.5	0.5	1	2	2	0	0.5	0.5	1.5

P72	0.5	0.5	1	1	1	2	0.5	0.5	1	2	2	0	0.5	0.5	1.5
P73	0.5	0.5	1	1	1	2	0.5	0.5	1	2	2	0	0.5	0.5	1.5
P74	0.5	0.5	1	1	0.5	1.5	0.5	0.5	1	1	2	0	0.5	0.5	1.5
P75	0.5	0.5	1	1	2	2	0.5	0.5	1	1	2	2	0.5	0.5	1.5
P76	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	0	0	0	0.5	0.5	1.5
P77	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P78	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P79	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P80	0.5	0.5	1	1	2	2	0.5	0.5	1	1	2	2	0.5	0.5	1.5
P81	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P82	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P83	0.5	0.5	0.5	1	0.5	1	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P84	0.5	0.5	0.5	1	0.5	1	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P85	0.5	0.5	1	1	2	1.5	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P86	0.5	0.5	1	1	2	1.5	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P87	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	2	0	0.5	0.5	1.5
P88	0.5	0.5	1	1	0.5	1	0.5	0.5	1	1	0	0	0.5	0.5	1.5
P89	0.5	0.5	0.5	1	1	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P90	0.5	0.5	1	1	2	1.5	0.5	0.5	1	0	2	2	0.5	0.5	1.5
P91	1	0.25	0.25	0	0	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0
P92	1	0.5	0.5	0	0.5	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0
P93	0.5	0.25	0.25	1	0.5	0.5	0.5	0.5	1	0	0	0	0.5	0.5	0.5
P94	0.5	0.5	1	1	0.5	0.5	0.5	0.5	1	1	0	0	0.5	0.5	0
P95	0.5	0.5	0.5	1	0.5	1	0.5	0.5	1	1	0	0	0.5	0.5	1.5

Table App. 2.1 Intelligence Scores (items 1-16)

Scores of Items 17-27 and Global Scores

	Item 17	Item 18	Item 19	Item 20	Item 21	Item 22	Item 23	Item 24	Item 25	Item 26	Item 27	Global Scores
P1	2	0	1	1.5	0	0	1	1.5	2	0	5	**23.5/40**
P2	2	2.5	1	1.5	2	0	1	0	2	0	5	**31.5/40**
P3	0	2.5	1	0	0	2.5	1	1.5	0	0	5	**26/40**
P4	0	2.5	1	1.5	0	2.5	0	1.5	0	2.5	5	**32/40**
P5	0	0	1	1.5	0	0	1	0	0	0	3	**14.5/40**
P6	0	0	1	0	0	0	1	0	0	0	3	**12.5/40**
P7	0	2.5	1	1.5	2	0	1	1.5	0	0	5	**29/40**
P8	2	0	1	1.5	0	0	1	0	0	0	5	**16/40**
P9	0	0	1	0	0	0	1	0	0	0	3	**12.5/40**
P10	2	0	1	1.5	0	0	1	1.5	0	0	4	**19/40**
P11	2	0	1	1.5	0	0	1	0	2	0	5	**22/40**
P12	2	2.5	1	0	2	2.5	1	1.5	0	2.5	5	**36/40**
P13	2	2.5	1	1.5	2	2.5	1	1.5	0	2.5	5	**38/40**
P14	0	2.5	1	1.5	0	2.5	0	1.5	0	2.5	5	**31/40**
P15	2	0	1	1.5	0	0	1	0	0	0	5	**15/40**
P16	2	0	1	0	2	0	1	0	2	0	5	**21/40**
P17	0	2.5	1	1.5	0	2.5	0	1.5	0	2.5	5	**32/40**
P18	2	2.5	1	0	2	2.5	1	1.5	0	2.5	5	**36/40**
P19	0	0	1	0	0	0	1	0	0	0	3	**12.5/40**
P20	2	0	1	1.5	0	0	1	1.5	0	0	4	**18/40**
P21	0	2.5	1	0	0	2.5	1	1.5	0	0	5	**26/40**
P22	0	2.5	1	1.5	2	0	1	1.5	0	0	5	**29/40**
P23	0	2.5	1	1.5	0	2.5	0	1.5	0	2.5	5	**31/40**
P24	2	2.5	1	1.5	2	2.5	1	1.5	0	2.5	5	**38/40**
P25	0	2.5	1	1.5	0	2.5	0	1.5	0	2.5	5	**31/40**
P26	0	2.5	1	0	0	2.5	1	1.5	0	0	5	**26/40**
P27	2	0	1	0	2	0	1	0	2	0	5	**21/40**
P28	2	2.5	1	1.5	2	0	1	1.5	0	0	5	**33.5/40**
P29	0	0	1	1.5	0	0	1	0	0	0	3	**14.5/40**
P30	2	0	1	1.5	0	0	1	0	0	0	5	**16/40**
P31	2	0	1	1.5	0	0	1	1.5	0	0	4	**19/40**
P32	0	0	1	1.5	0	0	1	0	0	0	3	**14.5/40**
P33	0	0	1	0	0	0	1	0	0	0	3	**12.5/40**
P34	2	0	1	1.5	0	0	1	1.5	0	0	4	**18/40**
P35	2	2.5	1	0	2	2.5	1	1.5	0	2.5	5	**36/40**
P36	0	2.5	1	1.5	0	2.5	1	1.5	0	0	5	**30/40**
P37	0	0	1	0	2	0	1	1.5	0	0	5	**20.5/40**
P38	2	0	1	1.5	0	0	1	0	2	0	5	**22/40**
P39	0	2.5	1	1.5	2	0	1	1.5	0	0	5	**29/40**

P40	0	2.5	1	1.5	0	2.5	1	1.5	0	0	5	**30/40**
P41	2	0	1	1.5	0	0	1	0	2	0	5	**22/40**
P42	2	0	1	0	2	0	1	0	2	0	5	**21/40**
P43	0	2.5	1	1.5	0	2.5	1	1.5	0	0	5	**30/40**
P44	0	2.5	1	0	0	2.5	1	1.5	0	0	5	**26/40**
P45	0	0	1	0	0	0	1	0	0	0	3	**12.5/40**
P46	0	2.5	1	1.5	0	2.5	0	1.5	0	2.5	5	**32/40**
P47	2	0	1	1.5	0	0	1	0	2	0	5	**22/40**
P48	0	0	1	0	0	0	1	0	0	0	3	**12.5/40**
P49	2	0	1	1.5	0	0	1	1.5	0	0	4	**18/40**
P50	0	0	1	0	0	0	1	0	0	0	3	**12.5/40**
P51	2	0	1	1.5	0	0	1	1.5	0	0	4	**19/40**
P52	0	2.5	1	0	0	2.5	1	1.5	0	0	5	**26/40**
P53	2	2.5	1	1.5	2	0	1	0	2	0	5	**31.5/40**
P54	2	2.5	1	0	2	2.5	1	1.5	0	2.5	5	**36/40**
P55	2	2.5	1	1.5	2	2.5	1	1.5	0	2.5	5	**38/40**
P56	2	2.5	1	0	2	2.5	1	1.5	0	2.5	5	**36/40**
P57	2	0	1	1.5	0	0	1	0	0	0	5	**16/40**
P58	0	2.5	1	1.5	0	2.5	0	1.5	0	2.5	5	**31/40**
P59	0	2.5	1	1.5	0	2.5	0	1.5	0	2.5	5	**32/40**
P60	2	0	1	1.5	0	0	1	1.5	2	0	5	**23.5/40**
P61	2	0	1	0	2	0	1	0	2	0	5	**21/40**
P62	2	0	1	1.5	0	0	1	0	0	0	5	**16/40**
P63	0	0	1	0	0	0	1	0	0	0	3	**12.5/40**
P64	0	0	1	1.5	0	0	1	0	0	0	3	**14.5/40**
P65	0	2.5	1	1.5	2	0	1	1.5	0	0	5	**29/40**
P66	0	2.5	1	0	0	2.5	1	1.5	0	0	5	**26/40**
P67	0	2.5	1	1.5	2	0	1	1.5	0	0	5	**29/40**
P68	2	2.5	1	0	2	2.5	1	1.5	0	2.5	5	**36/40**
P69	2	0	1	1.5	0	0	1	0	0	0	5	**16/40**
P70	2	0	1	0	2	0	1	0	2	0	5	**21/40**
P71	0	2.5	1	1.5	2	0	1	1.5	0	0	5	**31/40**
P72	0	2.5	1	1.5	2	0	1	1.5	0	0	5	**31/40**
P73	0	2.5	1	1.5	2	0	1	1.5	0	0	5	**29/40**
P74	0	2.5	1	0	0	2.5	1	1.5	0	0	5	**26/40**
P75	2	2.5	1	1.5	2	2.5	1	1.5	0	2.5	5	**38/40**
P76	0	0	1	0	0	0	1	0	0	0	3	**12.5/40**
P77	0	0	1	1.5	0	0	1	0	0	0	3	**14.5/40**
P78	2	0	1	1.5	0	0	1	1.5	0	0	4	**19/40**
P79	2	0	1	1.5	0	0	1	1.5	0	0	4	**18/40**
P80	2	2.5	1	1.5	2	0	1	1.5	0	0	5	**33.5/40**
P81	0	0	1	1.5	0	0	1	0	0	0	3	**14.5/40**
P82	0	0	1	0	0	0	1	0	0	0	3	**12.5/40**
P83	2	0	1	1.5	0	0	1	0	2	0	5	**22/40**
P84	2	0	1	1.5	0	0	1	0	2	0	5	**22/40**

P85	0	2.5	1	1.5	0	2.5	1	1.5	0	0	5	**30/40**
P86	0	2.5	1	1.5	0	2.5	1	1.5	0	0	5	**30/40**
P87	0	2.5	1	0	0	2.5	1	1.5	0	0	5	**26/40**
P88	0	0	1	0	2	0	1	1.5	0	0	5	**20.5/40**
P89	2	0	1	0	2	0	1	0	2	0	5	**21/40**
P90	0	2.5	1	1.5	0	2.5	1	1.5	0	0	5	**30/40**
P91	0	0	1	0	0	0	1	0	0	0	2	**09/40**
P92	0	0	1	0	0	0	1	0	0	0	2	**10/40**
P93	0	0	1	0	0	0	1	0	0	0	3	**12.5/40**
P94	2	0	1	1.5	0	0	1	1.5	0	0	4	**19/40**
P95	2	0	1	1.5	0	0	1	0	2	0	5	**22/40**

Table App. 2.2 Intelligence Scores (items 17-27)

PART TWO: Reading Comprehension Scores (Global and Partial)

	Ex. 1 Q1	Ex.1 Q2	Ex.1 Q3	Ex.1 Q4	Ex.2 Q1	Ex.2 Q2	Ex.2 Q3	Global Scores
P1	2	5	5	0	6	0	7	**25/40**
P2	3	5	5	3	6	7	7	**36/40**
P3	5	0	5	0	6	7	7	**30/40**
P4	3	5	5	3	6	7	7	**36/40**
P5	5	0	5	0	0	7	0	**17/40**
P6	3	0	5	0	0	7	0	**15/40**
P7	5	5	5	5	0	7	7	**34/40**
P8	5	0	5	0	0	7	7	**17/40**
P9	3	0	5	0	6	0	0	**14/40**
P10	3	0	0	0	6	7	7	**23/40**
P11	2	5	5	0	6	0	7	**25/40**
P12	3	5	5	5	6	7	7	**38/40**
P13	5	5	5	4	6	7	7	**39/40**
P14	2	5	5	5	6	7	7	**37/40**
P15	5	0	5	0	6	0	0	**16/40**
P16	5	5	0	0	0	7	7	**24/40**
P17	5	0	5	0	6	7	7	**30/40**
P18	2	5	5	5	6	7	7	**37/40**
P19	5	0	5	0	0	7	7	**17/40**
P20	3	0	0	0	6	7	7	**23/40**
P21	3	5	5	5	0	7	7	**32/40**
P22	3	5	5	3	6	7	7	**36/40**
P23	2	5	5	3	6	7	7	**35/40**
P24	5	5	5	5	6	7	7	**40/40**
P25	3	5	5	3	6	7	7	**36/40**
P26	3	5	5	5	6	7	0	**31/40**
P27	2	5	5	0	6	0	7	**25/40**
P28	2	5	5	3	6	7	7	**35/40**
P29	5	0	5	0	6	0	0	**16/40**
P30	5	0	0	0	0	7	7	**19/40**
P31	5	5	0	0	0	7	7	**24/40**
P32	5	0	5	0	6	0	0	**16/40**
P33	3	0	5	0	6	0	0	**14/40**
P34	2	5	5	0	6	0	7	**25/40**
P35	5	5	5	5	0	7	7	**34/40**
P36	2	5	5	3	6	7	7	**35/40**
P37	2	5	5	0	6	0	7	**25/40**
P38	5	5	0	0	0	7	7	**24/40**
P39	5	0	5	0	6	7	7	**30/40**
P40	3	5	5	3	6	7	7	**36/40**
P41	2	5	5	0	6	0	7	**25/40**

P42	3	0	0	0	6	7	7	**23/40**
P43	2	5	5	3	6	7	7	**35/40**
P44	5	0	5	0	6	7	7	**30/40**
P45	5	0	5	0	6	0	0	**16/40**
P46	2	5	5	3	6	7	7	**35/40**
P47	2	5	5	0	6	0	7	**25/40**
P48	5	0	5	0	6	0	0	**16/40**
P49	3	0	0	0	6	7	7	**23/40**
P50	3	0	5	0	6	0	0	**14/40**
P51	3	0	0	0	6	7	7	**23/40**
P52	5	5	5	5	0	7	0	**27/40**
P53	2	5	5	5	6	7	7	**37/40**
P54	3	5	5	5	6	7	7	**38/40**
P55	5	5	5	5	6	7	7	**40/40**
P56	2	5	5	3	6	7	7	**35/40**
P57	3	0	0	0	0	7	7	**19/40**
P58	2	5	5	3	6	7	7	**35/40**
P59	3	5	5	5	6	7	7	**38/40**
P60	2	5	5	0	6	0	7	**25/40**
P61	5	5	0	0	0	7	7	**24/40**
P62	3	5	5	5	0	0	0	**18/40**
P63	3	0	5	0	6	0	0	**14/40**
P64	5	0	5	0	0	7	0	**17/40**
P65	3	5	5	5	0	7	7	**32/40**
P66	3	5	5	5	6	7	0	**31/40**
P67	3	5	5	3	6	7	7	**36/40**
P68	3	5	5	5	0	7	7	**32/40**
P69	3	5	5	5	0	0	0	**18/40**
P70	2	5	5	0	6	0	7	**25/40**
P71	2	5	5	5	6	7	7	**37/40**
P72	5	5	5	5	0	7	7	**34/40**
P73	2	5	5	3	6	7	7	**35/40**
P74	3	5	5	5	0	7	7	**32/40**
P75	3	5	5	3	6	7	7	**36/40**
P76	5	0	5	0	0	7	0	**17/40**
P77	5	0	5	0	6	0	0	**16/40**
P78	3	0	0	0	6	7	7	**23/40**
P79	5	5	0	0	0	7	7	**24/40**
P80	3	5	5	3	6	7	7	**36/40**
P81	3	0	5	0	0	7	0	**15.5/40**
P82	3	0	5	0	0	7	0	**15/40**
P83	2	0	5	0	6	7	0	**20/40**
P84	2	5	5	0	6	0	7	**25/40**
P85	3	5	5	5	0	7	7	**32/40**
P86	3	5	5	3	6	7	7	**36/40**

P87	5	0	5	0	6	7	7	**30/40**
P88	2	5	5	0	6	0	7	**25/40**
P89	3	0	0	0	6	7	7	**23/40**
P90	5	5	5	5	0	7	7	**34/40**
P91	0	0	5	0	0	7	0	**12/40**
P92	3	0	5	0	0	7	0	**15/40**
P93	5	0	5	0	6	0	0	**16/40**
P94	2	0	5	0	6	7	0	**20/40**
P95	**5**	**5**	**5**	**5**	**0**	**7**	**0**	**27/40**

Table App. 2.3 Reading Comprehension Global Scores

APPENDIX 3

COMPUTATION OF PEARSON PRODUCT MOMENT CORRELATION COEFFICIENT

Correlation coefficients may be computed in various ways. The most common is the Pearson Product-Moment Correlation Coefficient. This correlation coefficient takes into consideration not only the persons position in the group, but also the amount of his deviation above or below the group mean (it is explained how to calculate it in Chapter Four).

The tables below represent the computation of a Pearson Product-Moment Correlation Coefficient "r" between the intelligence partial scores and reading comprehension global scores of 95 pupils.

Pupil	**X**	**Y**	***x***	***y***	***x²***	***y²***	***xy***
P1	4	25	-0.73	-1.76	0.53	3.09	0.554
P2	6	36	1.27	9.24	1.61	85.37	11.734
P3	5	30	0.27	3.24	0.07	10.49	0.874
P4	7	36	2.27	9.24	5.15	85.37	20.974
P5	2.5	17	-2.23	-9.76	4.97	7.41	21.764
P6	3	15	-1.73	-11.76	2.99	138.29	20.344
P7	6	34	1.27	7.24	1.61	52.41	9.194
P8	2.5	17	-2.23	-9.76	4.97	7.41	21.764
P9	3	14	-1.73	-12.76	2.99	162.81	22.074
P10	4	23	-0.73	-3.76	0.53	14.13	2.744
P11	4	25	-0.73	-1.76	0.53	3.09	1.284
P12	7	38	2.27	11.24	5.15	126.33	25.514
P13	7	39	2.27	12.24	5.15	149.81	27.784
P14	6	37	1.27	10.24	1.61	104.85	13.004
P15	2.5	16	-2.23	-10.76	4.97	115.77	23.994
P16	4	24	-0.73	-2.76	0.53	7.61	2.014
P17	7	30	2.27	3.24	5.15	10.49	7.354
P18	7	37	2.27	10.24	5.15	104.85	23.244
P19	3	17	-1.73	-9.76	2.99	7.41	16.884
P20	3	23	-1.73	-3.76	2.99	14.13	6.504
P21	5	32	0.27	5.24	0.07	27.45	1.414
P22	6	36	1.27	9.24	1.61	85.37	11.734
P23	6	35	1.27	8.24	1.61	67.89	10.464

P24	7	40	2.27	13.24	5.15	175.29	30.054
P25	6	36	1.27	9.24	1.61	85.37	11.734
P26	5	31	0.27	4.24	0.07	17.97	1.144
P27	4	25	-0.73	-1.76	0.53	3.09	1.284
P28	7	35	2.27	8.24	5.15	67.89	18.704
P29	2.5	16	-2.23	-10.76	4.97	115.77	23.944
P30	2.5	19	-2.23	-7.76	4.97	60.21	15.074
P31	4	24	-0.73	-2.76	0.53	7.61	2.014
P32	2.5	16	-2.23	-10.76	4.97	115.77	23.994
P33	3	14	-1.73	-12.76	2.99	162.81	22.074
P34	3	25	-1.73	-1.76	9.99	3.09	3.044
P35	7	34	2.27	7.24	5.15	52.41	16.434
P36	6.5	35	1.77	8.24	3.13	67.89	14.584
P37	4.5	25	-0.23	-1.76	0.05	3.09	0.404
P38	4	24	-0.73	-2.76	0.53	7.61	2.014
P39	6	30	1.27	3.24	1.61	10.49	4.114
P40	6.5	36	1.77	9.24	3.13	85.37	16.354
P41	4	25	-0.73	-1.76	0.53	3.09	1.284
P42	4	23	-0.73	-3.76	0.53	14.13	2.744
P43	6.5	35	1.77	8.24	3.13	67.89	14.584
P44	5	30	0.27	3.24	0.07	10.49	0.874
P45	3	16	-1.73	-10.76	2.99	115.77	18.614
P46	7	35	2.27	8.24	5.15	67.89	18.704
P47	4	25	-0.73	-1.76	0.53	3.09	1.284
P48	3	16	-1.73	-10.76	2.99	115.77	18.614
P49	3	23	-1.73	-3.76	2.99	14.13	6.504
P50	3	14	-1.73	-12.76	2.99	162.81	22.074
P51	4	23	-0.73	-3.76	0.53	14.13	2.744
P52	5	27	0.27	0.24	0.07	0.05	0.064
P53	6	37	1.27	10.24	1.61	104.85	13.004
P54	7	38	2.27	11.24	5.15	126.33	25.514
P55	7	40	2.27	13.24	5.15	175.29	30.054
P56	7	35	2.27	8.24	5.15	67.89	18.704
P57	2.5	19	-2.23	-7.76	4.97	60.21	17.304
P58	6	35	1.27	8.24	1.61	67.89	10.464
P59	7	38	2.27	11.24	5.15	126.33	25.514
P60	4	25	-0.73	-1.76	0.53	3.09	1.284
P61	4	24	-0.73	-2.76	0.53	7.61	2.014
P62	2.5	18	-2.23	-8.76	4.97	76.73	19.534
P63	3	14	-1.73	-12.76	2.99	162.81	22.074
P64	2.5	17	-2.23	-9.76	4.97	7.41	21.764
P65	6	32	1.27	5.24	1.61	27.45	0.654
P66	5	31	0.27	4.24	0.07	17.97	1.114
P67	6	36	1.27	9.24	1.61	85.37	11.734
P68	7	32	2.27	5.24	5.15	27.45	11.894

P69	2.5	18	-2.23	-8.76	4.97	76.73	19.534
P70	4	25	-0.73	-1.67	0.53	3.09	1.284
P71	6	37	1.27	10.24	1.61	104.85	13.004
P72	6	34	1.27	7.24	1.61	52.41	9.194
P73	6	35	1.27	8.24	1.61	67.89	10.464
P74	5	32	0.27	5.24	0.07	27.45	1.414
P75	7	36	2.27	9.24	5.15	85.37	20.974
P76	3	17	-1.73	-9.76	2.99	7.41	16.884
P77	2.5	16	-2.23	-10.76	4.97	115.77	23.994
P78	4	23	-0.73	-3.76	0.53	14.13	2.744
P79	3	24	-1.73	-2.76	2.99	7.61	4.774
P80	7	36	2.27	9.24	5.15	85.37	20.974
P81	2.5	15	-2.23	-11.76	4.97	138.29	26.224
P82	3	15	-1.73	-11.76	2.99	138.29	20.344
P83	4	20	-0.73	-6.76	0.53	45.69	4.934
P84	4	25	-0.73	-1.76	0.53	3.09	1.284
P85	6.5	32	1.77	5.24	3.13	27.45	9.274
P86	6.5	36	1.77	9.24	3.13	85.37	16.354
P87	5	30	0.27	3.24	0.07	10.49	0.874
P88	4.5	25	-0.23	-1.76	0.05	3.09	0.404
P89	4	23	-0.73	-3.76	0.53	14.13	2.744
P90	6.5	34	1.77	7.24	3.13	52.41	12.814
P91	2	12	-2.73	-14.76	7.45	217.85	40.294
P92	3	15	-1.73	-11.76	2.99	138.29	20.344
P93	3	16	-1.73	-10.76	2.99	115.77	18.614
P94	4	20	-0.73	-6.76	0.53	45.69	4.934
P95	4	27	-0.73	0.24	0.53	0.05	-0.175
$\sum$	**450**	**2542.5**	**0**	**0**	**5174.118**	**5580.533**	**2461.668**
M	**4.73**	**26.76**					

$$SDx = \sqrt{\frac{\sum x^2}{N}} = \sqrt{\frac{5174.118}{95}} = 7.38$$

$$SDy = \sqrt{\frac{\sum y^2}{N}} = \sqrt{\frac{5580.533}{95}} = 9.74$$

$$r\,(xy) = \frac{\sum xy}{(N)(SDx)(SDy)} = \frac{2461.668}{95 \times 7.38 \times 9.74} = \frac{2461.668}{6828.714} \longrightarrow$$

$r(xy) = 0.36$

Table App. 3.1 Computation of Pearson Product-Moment Correlation Coefficient "r" between Vocabulary Scores and Reading Comprehension Global Scores

Pupil	**X**	**Y**	***x***	***y***	***x²***	***y²***	***xy***
P1	3	25	-1.16	-1.76	1.34	3.09	2.041
P2	6	36	1.84	9.24	3.38	85.37	17.001
P3	5	30	0.84	3.24	0.70	10.49	2.721
P4	6	36	1.84	9.24	3.38	85.37	17.001
P5	3	17	-1.16	-9.76	1.34	7.41	11.321
P6	2	15	-2.16	-11.76	4.66	138.29	25.401
P7	6	34	1.84	7.24	3.38	52.41	13.321
P8	2	17	-2.16	-9.76	4.66	7.41	21.081
P9	2	14	-2.16	-12.76	4.66	162.81	27.561
P10	3	23	-1.16	-3.76	1.34	14.13	4.361
P11	3	25	-1.16	-1.76	1.34	3.09	2.041
P12	7	38	2.84	11.24	8.06	126.33	31.921
P13	7	39	2.84	12.24	8.06	149.81	34.761
P14	6	37	1.84	10.24	3.38	104.85	18.841
P15	2	16	-2.16	-10.76	4.66	115.77	23.241
P16	3	24	-1.16	-2.76	1.34	7.61	3.201
P17	6	30	1.84	3.24	3.38	10.49	5.961
P18	7	37	2.84	10.24	8.06	104.85	29.081
P19	2	17	-2.16	-9.76	4.66	7.41	21.081
P20	3	23	-1.16	-3.76	1.34	14.13	4.361
P21	5	32	0.84	5.24	0.70	27.45	4.401
P22	6	36	1.84	9.24	3.38	85.37	17.001
P23	6	35	1.84	8.24	3.38	67.89	15.161
P24	7	40	2.84	13.24	8.06	175.29	37.601
P25	6	36	1.84	9.24	3.38	85.37	17.001
P26	5	31	0.84	4.24	0.70	17.97	3.561
P27	3	25	-1.16	-1.76	1.34	3.09	2.041
P28	7	35	2.84	8.24	8.06	67.89	23.401
P29	3	16	-1.16	-10.76	1.34	115.77	12.481
P30	2	19	-2.16	-7.76	4.66	60.21	16.761
P31	3	24	-1.16	-2.76	1.34	7.61	3.201
P32	3	16	-1.16	-10.76	1.34	115.77	12.481
P33	2	14	-2.16	-12.76	4.66	162.81	27.561
P34	3	25	-1.16	-1.76	1.34	3.09	2.041
P35	7	34	2.84	7.24	8.06	52.41	20.561
P36	6	35	1.84	8.24	3.38	67.89	15.161
P37	3	25	-1.16	-1.76	1.34	3.09	2.041
P38	3	24	-1.16	-2.76	1.34	7.61	3.201
P39	6	30	1.84	3.24	3.38	10.49	5.961
P40	6	36	1.84	9.24	3.38	85.37	17.001
P41	3	25	-1.16	-1.76	1.34	3.09	2.041
P42	3	23	-1.16	-3.76	1.34	14.13	4.361
P43	6	35	1.84	8.24	3.38	67.89	15.161
P44	5	30	0.84	3.24	0.70	10.49	2.721

P45	2	16	-2.16	-10.76	4.66	115.77	23.241
P46	6	35	1.84	8.24	3.38	67.89	15.161
P47	3	25	-1.16	-1.76	1.34	3.09	2.041
P48	2	16	-2.16	-10.76	4.66	115.77	23.241
P49	3	23	-1.16	-3.76	1.34	14.13	4.361
P50	2	14	-2.16	-12.76	4.66	162.81	27.561
P51	3	23	-1.16	-3.76	1.34	14.13	4.361
P52	5	27	0.84	0.24	0.70	0.05	0.201
P53	6	37	1.84	10.24	3.38	104.85	18.841
P54	7	38	2.84	11.24	8.06	126.33	31.921
P55	7	40	2.84	13.24	8.06	175.29	37.601
P56	7	35	2.84	8.24	8.06	67.89	23.401
P57	2	19	-2.16	-7.76	4.66	60.21	16.761
P58	6	35	1.84	8.24	3.38	67.89	15.161
P59	6	38	1.84	11.24	3.38	126.33	20.681
P60	3	25	-1.16	-1.76	1.34	3.09	2.041
P61	3	24	-1.16	-2.76	1.34	7.61	3.201
P62	2	18	-2.16	-8.76	4.66	76.73	18.921
P63	2	14	-2.16	-12.76	4.66	162.81	27.561
P64	3	17	-1.16	-9.76	1.34	7.41	11.321
P65	6	32	1.84	5.24	3.38	27.45	9.641
P66	5	31	0.84	4.24	0.70	17.97	3.561
P67	6	36	1.84	9.24	3.38	85.37	17.001
P68	7	32	2.84	5.24	8.06	27.45	14.881
P69	2	18	-2.16	-8.76	4.66	76.73	18.921
P70	3	25	-1.16	-1.67	1.34	3.09	2.041
P71	6	37	1.84	10.24	3.38	104.85	18.841
P72	6	34	1.84	7.24	3.38	52.41	13.321
P73	6	35	1.84	8.24	3.38	67.89	15.161
P74	5	32	0.84	5.24	0.70	27.45	4.401
P75	7	36	2.84	9.24	8.06	85.37	26.241
P76	2	17	-2.16	-9.76	4.66	7.41	21.081
P77	3	16	-1.16	-10.76	1.34	115.77	12.481
P78	3	23	-1.16	-3.76	1.34	14.13	4.361
P79	3	24	-1.16	-2.76	1.34	7.61	3.201
P80	7	36	2.84	9.24	8.06	85.37	26.241
P81	3	15	-1.16	-11.76	1.34	138.29	13.641
P82	2	15	-2.16	-11.76	4.66	138.29	25.401
P83	3	20	-1.16	-6.76	1.34	45.69	7.841
P84	3	25	-1.16	-1.76	1.34	3.09	2.041
P85	6	32	1.84	5.24	3.38	27.45	9.641
P86	6	36	1.84	9.24	3.38	85.37	17.001
P87	5	30	0.84	3.24	0.70	10.49	2.721
P88	3	25	-1.16	-1.76	1.34	3.09	2.041
P89	3	23	-1.16	-3.76	1.34	14.13	4.361

P90	6	34	1.84	7.24	3.38	52.41	13.321
P91	2	12	-2.16	-14.76	4.66	217.85	31.881
P92	2	15	-2.16	-11.76	4.66	138.29	25.401
P93	2	16	-2.16	-10.76	4.66	115.77	23.241
P94	3	20	-1.16	-6.76	1.34	45.69	7.841
P95	3	27	-1.16	0.24	1.34	0.05	-2.78
∑	**396**	**2542.5**	**0**	**0**	**5959.008**	**5580.533**	**3517.620**
M	**4.16**	**26.76**					

$$SDx = \sqrt{\frac{\sum x^2}{N}} = \sqrt{\frac{5959.008}{95}} = 7.92$$

$$SDy = \sqrt{\frac{\sum y^2}{N}} = \sqrt{\frac{5580.533}{95}} = 9.74$$

$$r\,(xy) = \frac{\sum xy}{(N)(SDx)(SDy)} = \frac{3517.620}{95 \times 7.92 \times 9.74} = \frac{3517.620}{7328.376} \longrightarrow$$

$$r\,(xy) = 0.48$$

Table App. 3.2 Computation of Pearson Product-Moment Correlation Coefficient "r" between Similarities and Differences Scores and Reading Comprehension Global Scores

Pupil	**X**	**Y**	***x***	***y***	***x²***	***y²***	***xy***
P1	4.5	25	0.3	-1.76	0.95	3.09	0.528
P2	7	36	2.8	9.24	7.84	85.37	25.872
P3	5	30	0.8	3.24	0.64	10.49	2.592
P4	5	36	0.8	9.24	0.64	85.37	7.392
P5	2.5	17	-1.7	-9.76	2.89	7.41	16.592
P6	2.5	15	-1.7	-11.76	2.89	138.29	19.992
P7	5	34	0.8	7.24	0.64	52.41	5.792
P8	3	17	1.2	-9.76	1.44	7.41	-11.712
P9	2.5	14	-1.7	-12.76	2.89	162.81	21.692
P10	3	23	1.2	-3.76	1.44	14.13	4.512
P11	4.5	25	0.3	-1.76	0.95	3.09	-0.528
P12	6.5	38	2.3	11.24	5.29	126.33	-25.852
P13	7	39	2.8	12.24	7.84	149.81	34.727
P14	5	37	0.8	10.24	0.64	104.85	8.192
P15	3	16	1.2	-10.76	1.44	115.77	-12.912
P16	3	24	1.2	-2.76	1.44	7.61	-3.312
P17	5	30	0.8	3.24	0.64	10.49	2.592
P18	6.5	37	2.3	10.24	5.29	104.85	23.552
P19	2.5	17	-1.7	-9.76	2.89	7.41	16.592
P20	3	23	1.2	-3.76	1.44	14.13	-4.512
P21	5	32	0.8	5.24	0.64	27.45	4.192
P22	5	36	0.8	9.24	0.64	85.37	7.392
P23	5	35	0.8	8.24	0.64	67.89	6.592
P24	7	40	2.8	13.24	7.84	175.29	37.072
P25	5	36	0.8	9.24	0.64	85.37	7.392
P26	5	31	0.8	4.24	0.64	17.97	3.392
P27	3	25	1.2	-1.76	1.44	3.09	-2.112
P28	7	35	2.8	8.24	7.84	67.89	23.072
P29	2.5	16	-1.7	-10.76	2.89	115.77	18.292
P30	7	19	2.8	-7.76	7.84	60.21	-21.728
P31	3	24	1.2	-2.76	1.44	7.61	-3.312
P32	2.5	16	-1.7	-10.76	2.89	115.77	18.292
P33	2.5	14	-1.7	-12.76	2.89	162.81	21.692
P34	3	25	1.2	-1.76	1.44	3.09	-2.112
P35	6.5	34	2.3	7.24	5.29	52.41	16.652
P36	5	35	0.8	8.24	0.64	67.89	6.592
P37	2.5	25	-1.7	-1.76	2.89	3.09	2.992
P38	4.5	24	0.3	-2.76	0.95	7.61	-0.828
P39	5	30	0.8	3.24	0.64	10.49	2.592
P40	5	36	0.8	9.24	0.64	85.37	7.392
P41	4.5	25	0.3	-1.76	0.95	3.09	-0.528
P42	3	23	1.2	-3.76	1.44	14.13	-4.512
P43	5	35	0.8	8.24	0.64	67.89	6.592
P44	5	30	0.8	3.24	0.64	10.49	2.592

P45	2.5	16	-1.7	-10.76	2.89	115.77	18.292
P46	5	35	0.8	8.24	0.64	67.89	6.592
P47	4.5	25	0.3	-1.76	0.95	3.09	-0.528
P48	2.5	16	-1.7	-10.76	2.89	115.77	18.292
P49	3	23	1.2	-3.76	1.44	14.13	-4.512
P50	2.5	14	-1.7	-12.76	2.89	162.81	-21.692
P51	3	23	1.2	-3.76	1.44	14.13	-4.512
P52	5	27	0.8	0.24	0.64	0.05	0.192
P53	7	37	2.8	10.24	7.84	104.85	28.672
P54	6.5	38	2.3	11.24	5.29	126.33	25.852
P55	7	40	2.8	13.24	7.84	175.29	37.072
P56	6.5	35	2.3	8.24	5.29	67.89	18.952
P57	3	19	1.2	-7.76	1.44	60.21	-9.312
P58	5	35	0.8	8.24	0.64	67.89	6.592
P59	5	38	0.8	11.24	0.64	126.33	8.992
P60	1.5	25	-2.7	-1.76	7.29	3.09	4.752
P61	3	24	1.2	-2.76	1.44	7.61	-3.312
P62	3	18	1.2	-8.76	1.44	76.73	-10.512
P63	2.5	14	-1.7	-12.76	2.89	162.81	21.692
P64	2.5	17	-1.7	-9.76	2.89	7.41	16.592
P65	5	32	0.8	5.24	0.64	27.45	4.192
P66	5	31	0.8	4.24	0.64	17.97	3.392
P67	5	36	0.8	9.24	0.64	85.37	7.392
P68	6.5	32	2.3	5.24	5.29	27.45	12.052
P69	3	18	1.2	-8.76	1.44	76.73	-10.512
P70	3	25	1.2	-1.67	1.44	3.09	-2.112
P71	5	37	0.8	10.24	0.64	104.85	8.192
P72	5	34	0.8	7.24	0.64	52.41	5.792
P73	5	35	0.8	8.24	0.64	67.89	6.592
P74	5	32	0.8	5.24	0.64	27.45	4.192
P75	7	36	2.8	9.24	7.84	85.37	25.872
P76	2.5	17	-1.7	-9.76	2.89	7.41	16.592
P77	2.5	16	-1.7	-10.76	2.89	115.77	18.292
P78	3	23	1.2	-3.76	1.44	14.13	-4.512
P79	3	24	1.2	-2.76	1.44	7.61	-3.312
P80	7	36	2.8	9.24	7.84	85.37	25.872
P81	2.5	15	-1.7	-11.76	2.89	138.29	19.992
P82	2.5	15	-1.7	-11.76	2.89	138.29	19.992
P83	4.5	20	0.3	-6.76	0.95	45.69	-2.028
P84	4.5	25	0.3	-1.76	0.95	3.09	-0.528
P85	5	32	0.8	5.24	0.64	27.45	4.192
P86	5	36	0.8	9.24	0.64	85.37	7.392
P87	5	30	0.8	3.24	0.64	10.49	2.592
P88	2.5	25	-1.7	-1.76	2.89	3.09	2.992
P89	3	23	1.2	-3.76	1.44	14.13	-4.512

P90	5	34	0.8	7.24	0.64	52.41	5.792
P91	1	12	-3.2	-14.76	-3.2	217.85	47.232
P92	1	15	-3.2	-11.76	-3.2	138.29	37.632
P93	2.5	16	-1.7	-10.76	2.89	115.77	18.292
P94	3	20	1.2	-6.76	1.44	45.69	-8.112
P95	4.5	27	0.3	0.24	0.95	0.05	0.072
$\sum$	**399.5**	**2542.5**	**0**	**0**	**1958.102**	**5580.533**	**3654.566**
M	**4.20**	**26.76**					

$$SDx = \sqrt{\frac{\sum x^2}{N}} = \sqrt{\frac{1958.102}{95}} = 4.54$$

$$SDy = \sqrt{\frac{\sum y^2}{N}} = \sqrt{\frac{5580.533}{95}} = 9.74$$

$$r\,(xy) = \frac{\sum xy}{(N)(SDx)(SDy)} = \frac{3654.566}{95 \times 4.54 \times 9.74} = \frac{3654.566}{4200.650} \longrightarrow$$

$r(xy) = 0.87$

Table App. 3.3 Computation of Pearson Product-Moment Correlation Coefficient "r" between Series Scores and Reading Comprehension Global Scores

Pupil	**X**	**Y**	***x***	***y***	***x²***	***y²***	***xy***
P1	2.5	25	-0.89	-1.76	0.79	3.09	1.566
P2	4.5	36	1.11	9.24	1.32	85.37	10.256
P3	3.5	30	0.11	3.24	0.01	10.49	0.356
P4	5	36	1.61	9.24	2.59	85.37	14.876
P5	2.5	17	-0.89	-9.76	0.79	7.41	8.686
P6	1	15	-2.39	-11.76	5.71	138.29	4.206
P7	4.5	34	1.11	7.24	1.23	52.41	8.036
P8	2.5	17	-0.89	-9.76	0.79	7.41	8.686
P9	1	14	-2.39	-12.76	5.71	162.81	30.496
P10	2.5	23	-0.89	-3.76	0.79	14.13	3.346
P11	2.5	25	-0.89	-1.76	0.79	3.09	1.566
P12	5.5	38	2.11	11.24	4.45	126.33	23.716
P13	7	39	3.61	12.24	13.03	149.81	44.186
P14	5	37	1.61	10.24	2.59	104.85	16.486
P15	2.5	16	-0.89	-10.76	0.79	115.77	9.576
P16	3	24	-0.39	-2.76	0.15	7.61	1.076
P17	5	30	1.61	3.24	2.59	10.49	5.216
P18	5.5	37	2.11	10.24	4.45	104.85	21.606
P19	1	17	-2.39	-9.76	5.17	7.41	23.326
P20	2.5	23	-0.89	-3.76	0.79	14.13	3.346
P21	3.5	32	0.11	5.24	0.01	27.45	0.576
P22	4.5	36	1.11	9.24	1.23	85.37	10.256
P23	5	35	1.61	8.24	2.59	67.89	13.266
P24	7	40	3.61	13.24	13.03	175.29	47.796
P25	5	36	1.61	9.24	2.59	85.37	14.876
P26	3.5	31	0.11	4.24	0.01	17.97	0.466
P27	3	25	-0.39	-1.76	0.15	3.09	0.686
P28	4.5	35	1.11	8.24	1.23	67.89	9.0146
P29	2.5	16	-0.89	-10.76	0.79	115.77	9.576
P30	2.5	19	-0.89	-7.76	0.79	60.21	6.906
P31	2.5	24	-0.89	-2.76	0.79	7.61	2.456
P32	2.5	16	-0.89	-10.76	0.79	115.77	9.576
P33	1	14	-2.39	-12.76	5.71	162.81	30.496
P34	2.5	25	-0.89	-1.76	0.79	3.09	1.566
P35	5.5	34	2.11	7.24	4.45	52.41	15.276
P36	5	35	1.61	8.24	2.59	67.89	13.266
P37	3	25	-0.39	-1.76	0.15	3.09	0.686
P38	2.5	24	-0.89	-2.76	0.79	7.61	2.456
P39	4.5	30	1.11	3.24	1.23	10.49	3.596
P40	5	36	1.61	9.24	2.59	85.37	18.876
P41	2.5	25	-0.89	-1.76	0.79	3.09	1.566
P42	3	23	-0.39	-3.76	0.15	14.13	1.466

P43	5	35	1.61	8.24	2.59	67.89	13.266
P44	3.5	30	0.11	3.24	0.01	10.49	0.356
P45	1	16	-2.39	-10.76	5.71	115.77	25.716
P46	5	35	1.61	8.24	2.59	67.89	13.266
P47	2.5	25	-0.89	-1.76	0.79	3.09	1.566
P48	1	16	-2.39	-10.76	5.71	115.77	25.716
P49	2.5	23	-0.89	-3.76	0.79	14.13	3.346
P50	1	14	-2.39	-12.76	5.71	162.81	30.496
P51	2.5	23	-0.89	-3.76	0.79	14.13	3.346
P52	3.5	27	0.11	0.24	0.01	0.05	0.026
P53	4.5	37	1.11	10.24	1.23	104.85	11.366
P54	5.5	38	2.11	11.24	4.45	126.33	23.716
P55	7	40	3.61	13.24	13.03	175.29	47.796
P56	5.5	35	2.11	8.24	4.45	67.89	17.386
P57	2.5	19	-0.89	-7.76	0.79	60.21	6.906
P58	5	35	1.61	8.24	2.59	67.89	13.266
P59	5	38	1.61	11.24	2.59	126.33	18.096
P60	2.5	25	-0.89	-1.76	0.79	3.09	1.566
P61	3	24	-0.39	-2.76	0.15	7.61	1.076
P62	2.5	18	-0.89	-8.76	0.79	76.73	7.796
P63	1	14	-2.39	-12.76	5.71	162.81	30.469
P64	2.5	17	-0.89	-9.76	0.79	7.41	8.686
P65	4.5	32	1.11	5.24	1.23	27.45	5.816
P66	3.5	31	0.11	4.24	0.01	17.97	0.466
P67	4.5	36	1.11	9.24	1.23	85.37	10.256
P68	5.5	32	2.11	5.24	4.45	27.45	11.056
P69	2.5	18	-0.89	-8.76	0.79	76.73	7.796
P70	3	25	-0.39	-1.67	0.15	3.09	0.686
P71	5	37	1.61	10.24	2.59	104.85	16.486
P72	5	34	1.61	7.24	2.59	52.41	11.656
P73	4.5	35	1.11	8.24	1.23	67.89	9.146
P74	3.5	32	0.11	5.24	0.01	27.45	0.576
P75	7	36	3.61	9.24	13.03	85.37	33.356
P76	1	17	-2.39	-9.76	5.71	7.41	23.326
P77	2.5	16	-0.89	-10.76	0.079	115.77	9.576
P78	2.5	23	-0.89	-3.76	0.79	14.13	3.346
P79	2.5	24	-0.89	-2.76	0.79	7.61	2.456
P80	4.5	36	1.11	9.24	1.23	85.37	10.256
P81	2.5	15	-0.89	-11.76	0.79	138.29	10.466
P82	1	15	-2.39	-11.76	5.71	138.29	28.106
P83	2.5	20	-0.89	-6.76	0.79	45.69	6.016
P84	2.5	25	-0.89	-1.76	0.79	3.09	1.566
P85	5	32	1.61	5.24	2.59	27.45	8.436
P86	5	36	1.61	9.24	2.59	85.37	14.876
P87	3.5	30	0.11	3.24	0.01	10.49	0.356

P88	3	25	-0.39	-1.76	0.15	3.09	0.686
P89	3	23	0.39	-3.76	0.15	14.13	-1.466
P90	5	34	1.61	7.24	0.59	52.41	11.656
P91	1	12	-2.39	-14.76	5.17	217.85	35.276
P92	1	15	-2.39	-11.76	5.17	138.29	28.106
P93	1	16	-2.39	-10.76	5.17	115.77	25.716
P94	2.5	20	-0.89	-6.76	0.79	45.69	6.016
P95	2.5	27	-0.89	0.24	0.79	0.05	0.213
$\sum$	**322.5**	**2542.5**	**0**	**0**	**1932.102**	**5580.533**	**3846.512**
M	**3.39**	**26.76**					

$$SDx = \sqrt{\frac{\sum x^2}{N}} = \sqrt{\frac{1932.102}{95}} = 4.51$$

$$SDy = \sqrt{\frac{\sum y^2}{N}} = \sqrt{\frac{5580.533}{95}} = 9.74$$

$$r\,(xy) = \frac{\sum xy}{(N)(SDx)(SDy)} = \frac{3846.512}{95 \times 4.51 \times 9.74} = \frac{3846.512}{4173.103} \longrightarrow$$

$$r\,(xy) = 0.92$$

Table App. 3.4 Computation of Pearson Product-Moment Correlation Coefficient “r” between Reasoning Scores and Reading Comprehension Global Scores

Pupil	**X**	**Y**	***x***	***y***	***x²***	***y²***	***xy***
P1	4.5	25	1.85	-1.76	3.42	3.09	-3.256
P2	3	36	0.35	9.24	0.12	85.37	3.234
P3	2.5	30	-0.15	3.24	0.02	10.49	-0.486
P4	4	36	1.35	9.24	1.82	85.37	12.474
P5	1	17	-1.65	-9.76	2.72	7.41	16.104
P6	1	15	-1.65	-11.76	2.72	138.29	19.404
P7	2.5	34	-0.15	7.24	0.02	52.41	-1.086
P8	1	17	-0.65	-9.76	2.72	7.41	16.104
P9	1	14	-1.65	-12.76	2.72	162.81	21.054
P10	2.5	23	-0.15	-3.76	0.02	14.13	0.564
P11	3	25	0.35	-1.76	0.12	3.09	-0.616
P12	5	38	2.35	11.24	5.52	126.33	26.414
P13	5	39	2.35	12.24	5.52	149.81	28.764
P14	4	37	1.35	10.24	1.82	104.85	13.824
P15	1	16	-1.65	-10.76	2.72	115.77	17.754
P16	3	24	0.35	-2.76	0.12	7.61	0.966
P17	4	30	1.35	3.24	1.82	10.49	4.374
P18	5	37	2.35	10.24	5.52	104.85	24.064
P19	1	17	-1.65	-9.76	2.72	7.41	16.104
P20	2.5	23	-0.15	-3.76	0.02	14.13	0.564
P21	2.5	32	-0.15	5.24	0.02	27.45	-0.786
P22	2.5	36	-0.15	9.24	0.02	85.37	-1.386
P23	4	35	1.35	8.24	1.82	67.89	11.124
P24	5	40	2.35	13.24	5.52	175.29	31.114
P25	4	36	1.35	9.24	1.82	85.37	12.474
P26	2.5	31	-0.15	4.24	0.02	17.97	-0.636
P27	3	25	0.35	-1.76	0.12	3.09	-0.616
P28	3	35	0.35	8.24	0.12	67.89	2.884
P29	1	16	-1.65	-10.76	2.72	115.77	17.754
P30	1	19	-1.65	-7.76	2.72	60.21	12.804
P31	2.5	24	-0.15	-2.76	0.02	7.61	0.414
P32	1	16	-1.65	-10.76	2.72	115.77	17.754
P33	1	14	-1.65	-12.76	2.72	162.81	21.054
P34	2.5	25	-0.15	-1.76	0.02	3.09	0.264
P35	5	34	2.35	7.24	5.52	52.41	17.014
P36	2.5	35	-0.15	8.24	0.02	67.89	-1.236
P37	2.5	25	-0.15	-1.76	0.02	3.09	0.264
P38	3	24	0.35	-2.76	0.12	7.61	-0.966
P39	2.5	30	-0.15	3.24	0.02	10.49	-0.486
P40	2.5	36	-0.15	9.24	0.02	85.37	-1.386
P41	3	25	0.35	-1.76	0.12	3.09	-0.616
P42	3	23	0.35	-3.76	0.12	14.13	-1.316
P43	2.5	35	-0.15	8.24	0.02	67.89	-1.236
P44	2.5	30	-0.15	3.24	0.02	10.49	-0.486

P45	1	16	-1.65	-10.76	0.72	115.77	17.754
P46	4	35	1.35	8.24	1.82	67.89	11.124
P47	3	25	0.35	-1.76	0.12	3.09	-0.616
P48	1	16	-1.65	-10.76	2.72	115.77	17.754
P49	2.5	23	-0.15	-3.76	0.02	14.13	0.564
P50	1	14	-1.65	-12.76	0.72	162.81	21.054
P51	2.5	23	-0.15	-3.76	0.02	14.13	0.564
P52	2.5	27	-0.15	0.24	0.02	0.05	-0.036
P53	3	37	0.35	10.24	0.12	104.85	3.584
P54	5	38	2.35	11.24	5.52	126.33	26.414
P55	5	40	2.35	13.24	5.52	175.29	31.114
P56	5	35	2.35	8.24	5.52	67.89	19.364
P57	1	19	-1.65	-7.76	2.722	60.21	12.804
P58	4	35	1.35	8.24	1.82	67.89	11.124
P59	4	38	1.35	11.24	1.82	126.33	15.174
P60	4.5	25	1.85	-1.76	3.42	3.09	-3.256
P61	3	24	0.35	-2.76	0.12	7.61	-0.966
P62	1	18	-1.65	-8.76	2.72	76.73	14.454
P63	1	14	-1.65	-12.76	2.72	162.81	21.054
P64	1	17	-1.65	-9.76	2.72	7.41	16.104
P65	2.5	32	-0.15	5.24	0.02	27.45	-0.786
P66	2.5	31	-0.15	4.24	0.02	17.97	-0.636
P67	2.5	36	-0.15	9.24	0.02	85.37	-1.386
P68	5	32	2.35	5.24	5.52	27.45	12.314
P69	1	18	-1.65	-8.76	2.72	76.73	14.454
P70	3	25	0.35	-1.67	0.12	3.09	-0.616
P71	4	37	1.35	10.24	1.82	104.85	13.824
P72	4	34	1.35	7.24	1.82	52.41	9.774
P73	2.5	35	-0.15	8.24	0.02	67.89	-1.236
P74	2.5	32	-0.15	5.24	0.02	27.45	0.786
P75	5	36	2.35	9.24	5.52	85.37	21.714
P76	1	17	-1.65	-9.76	2.72	7.41	16.104
P77	1	16	-1.65	-10.76	2.72	115.77	17.754
P78	2.5	23	-0.15	-3.76	0.02	14.13	0.564
P79	2.5	24	-0.15	-2.76	0.02	7.61	0.414
P80	3	36	0.35	9.24	0.12	85.37	3.234
P81	1	15	-1.65	-11.76	2.72	138.29	19.404
P82	1	15	-1.65	-11.76	2.72	138.29	19.404
P83	3	20	0.35	-6.76	0.12	45.69	-2.366
P84	3	25	0.35	-1.76	0.12	3.09	-0.616
P85	2.5	32	-0.15	5.24	0.02	27.45	-0.786
P86	2.5	36	-0.15	9.24	0.02	85.37	-1.386
P87	2.5	30	-0.15	3.24	0.02	10.49	-0.486
P88	2.5	25	-0.15	-1.76	0.02	3.09	0.264
P89	3	23	0.35	-3.76	0.12	14.13	-1.316

P90	2.5	34	-0.15	7.24	0.02	52.41	-1.086
P91	1	12	-1.65	-14.76	2.72	217.85	24.354
P92	1	15	-1.65	-11.76	2.72	138.29	19.404
P93	1	16	-1.65	-10.76	2.72	115.77	17.754
P94	2.5	20	-0.15	-6.76	0.02	45.69	1.014
P95	3	27	0.35	0.24	0.12	0.05	0.084
$\sum$	**252.5**	**2542.5**	**0**	**0**	**2549.078**	**5580.533**	**3834.443**
M	**2.65**	**26.76**					

$$SDx = \sqrt{\frac{\sum x^2}{N}} = \sqrt{\frac{2549.078}{95}} = 5.18$$

$$SDy = \sqrt{\frac{\sum y^2}{N}} = \sqrt{\frac{5580.533}{95}} = 9.74$$

$$r\,(xy) = \frac{\sum xy}{(N)(SDx)(SDy)} = \frac{3834.443}{95 \times 5.18 \times 9.74} = \frac{3834.443}{4793.054} \longrightarrow$$

$$r\,(xy) = 0.80$$

Table App. 3.5 Computation of Pearson Product-Moment Correlation Coefficient "r" between Problem-solving Scores and Reading Comprehension Global Scores

Pupil	**X**	**Y**	***x***	***y***	***x²***	***y²***	***xy***
P1	5	25	0.56	-1.76	0.31	3.09	-0.985
P2	5	36	0.56	9.24	0.31	85.37	5.174
P3	5	30	0.56	3.24	0.31	10.49	1.814
P4	5	36	0.56	9.24	0.31	85.37	5.174
P5	3	17	-1.44	-9.76	2.07	7.41	14.054
P6	3	15	-1.44	-11.76	2.07	138.29	16.934
P7	5	34	0.56	7.24	0.13	52.41	4.054
P8	5	17	0.56	-9.76	0.13	7.41	-5.465
P9	3	14	-1.44	-12.76	2.07	162.81	18.374
P10	4	23	-0.44	-3.76	0.19	14.13	1.654
P11	5	25	0.56	-1.76	0.31	3.09	-0.985
P12	5	38	0.56	11.24	0.31	126.33	6.294
P13	5	39	0.56	12.24	0.31	149.81	6.854
P14	5	37	0.56	10.24	0.31	104.85	5.734
P15	5	16	0.56	-10.76	0.31	115.77	-6.025
P16	5	24	0.56	-2.76	0.31	7.61	-1.54
P17	5	30	0.56	3.24	0.31	10.49	1.814
P18	5	37	0.56	10.24	0.31	104.85	5.734
P19	3	17	-1.44	-9.76	2.07	7.41	14.054
P20	4	23	-0.44	-3.76	0.19	14.13	1.654
P21	5	32	0.56	5.24	0.31	27.45	2.934
P22	5	36	0.56	9.24	0.31	85.37	5.174
P23	5	35	0.56	8.24	0.31	67.89	4.614
P24	5	40	0.56	13.24	0.31	175.29	7.414
P25	5	36	0.56	9.24	0.31	85.37	5.174
P26	5	31	0.56	4.24	0.31	17.97	2.374
P27	5	25	0.56	-1.76	0.31	3.09	-0.985
P28	5	35	0.56	8.24	0.31	67.89	4.614
P29	3	16	-1.44	-10.76	2.07	115.77	15.494
P30	5	19	0.56	-7.76	0.31	60.21	-4.345
P31	4	24	-0.44	-2.76	0.19	7.61	1.214
P32	3	16	-1.44	-10.76	2.07	115.77	15.494
P33	3	14	-1.44	-12.76	2.07	162.81	18.374
P34	4	25	-0.44	-1.76	0.19	3.09	0.774
P35	5	34	0.56	7.24	0.31	52.41	4.054
P36	5	35	0.56	8.24	0.31	67.89	4.614
P37	5	25	0.56	-1.76	0.31	3.09	-0.985
P38	5	24	0.56	-2.76	0.31	7.61	-1.545
P39	5	30	0.56	3.24	0.31	10.49	1.814
P40	5	36	0.56	9.24	0.31	85.37	5.174
P41	5	25	0.56	-1.76	0.31	3.09	-0.985
P42	5	23	0.56	-3.76	0.31	14.13	-2.105
P43	5	35	0.56	8.24	0.31	67.89	4.614
P44	5	30	0.56	3.24	0.31	10.49	1.814

P45	3	16	-1.44	-10.76	2.07	115.77	15.494
P46	4	35	-0.44	8.24	0.19	67.89	-3.625
P47	5	25	0.56	-1.76	0.31	3.09	-0.985
P48	3	16	-1.44	-10.76	2.07	115.77	15.494
P49	4	23	-0.44	-3.76	0.19	14.13	1.654
P50	3	14	-1.44	-12.76	2.07	162.81	18.374
P51	4	23	-0.44	-3.76	0.19	14.13	1.654
P52	5	27	0.56	0.24	0.31	0.05	0.134
P53	5	37	0.56	10.24	0.31	104.85	5.734
P54	5	38	0.56	11.24	0.31	126.33	6.294
P55	5	40	0.56	13.24	0.31	175.29	7.414
P56	5	35	0.56	8.24	0.31	67.89	4.614
P57	5	19	0.56	-7.76	0.31	60.21	-4.345
P58	5	35	0.56	8.24	0.31	67.89	4.614
P59	5	38	0.56	11.24	0.31	126.33	6.294
P60	5	25	0.56	-1.76	0.31	3.09	-0.985
P61	5	24	0.56	-2.76	0.31	7.61	-0.985
P62	5	18	0.56	-8.76	0.31	76.73	-4.905
P63	3	14	-1.44	-12.76	2.07	162.81	18.374
P64	3	17	-1.44	-9.76	2.07	7.41	14.054
P65	5	32	0.56	5.24	0.31	27.45	2.934
P66	5	31	0.56	4.24	0.31	17.97	2.374
P67	5	36	0.56	9.24	0.31	85.37	5.174
P68	5	32	0.56	5.24	0.31	27.45	2.934
P69	5	18	0.56	-8.76	0.31	76.73	-4.905
P70	5	25	0.56	-1.67	0.31	3.09	-0.985
P71	5	37	0.56	10.24	0.31	104.85	5.734
P72	5	34	0.56	7.24	0.31	52.41	4.054
P73	5	35	0.56	8.24	0.31	67.89	4.614
P74	5	32	0.56	5.24	0.31	27.45	2.934
P75	5	36	0.56	9.24	0.31	85.37	5.174
P76	3	17	-1.44	-9.76	2.07	7.41	14.054
P77	3	16	-1.44	-10.76	2.07	115.77	15.494
P78	5	23	-0.44	-3.76	0.19	14.13	1.654
P79	4	24	-0.44	-2.76	0.19	7.61	1.214
P80	4	36	0.56	9.24	0.31	85.37	5.174
P81	5	15	-1.44	-11.76	2.07	138.29	16.934
P82	3	15	-1.44	-11.76	2.07	138.29	16.934
P83	3	20	0.56	-6.76	0.31	45.69	-3.785
P84	5	25	0.56	-1.76	0.31	3.09	-0.985
P85	5	32	0.56	5.24	0.31	27.45	2.934
P86	5	36	0.56	9.24	0.31	85.37	5.174
P87	5	30	0.56	3.24	0.31	10.49	1.814
P88	5	25	0.56	-1.76	0.31	3.09	-0.985
P89	5	23	0.56	-3.76	0.31	14.13	-2.105

P90	5	34	0.56	7.24	0.31	52.41	4.054
P91	2	12	-2.44	-14.76	5.95	217.85	36.014
P92	2	15	-2.44	-11.76	5.95	138.29	28.694
P93	3	16	-1.44	-10.76	2.07	115.77	15.494
P94	4	20	-0.44	-6.76	0.19	45.69	2.974
P95	5	27	0.56	0.24	0.31	0.05	0.134
$\sum$	**422**	**2542.5**	**0**	**0**	**2628.422**	**5580.533**	**3552.966**
M	**4.44**	**26.76**					

$$SDx = \sqrt{\frac{\sum x^2}{N}} = \sqrt{\frac{2628.422}{95}} = 5.26$$

$$SDy = \sqrt{\frac{\sum y^2}{N}} = \sqrt{\frac{5580.533}{95}} = 9.74$$

$$r\,(xy) = \frac{\sum xy}{(N)(SDx)(SDy)} = \frac{3552.966}{95 \times 5.26 \times 9.74} = \frac{3552.966}{4867.078} \longrightarrow$$

$$r\,(xy) = 0.73$$

Table App. 3.6 Computation of Pearson Product-Moment Correlation Coefficient "r" between Decision-making Scores and Reading Comprehension Global Scores

APPENDIX 4

SUGGESTIONS FOR ADMINISTERING INTELLIGENCE AND READING COMPREHENSION

1. These tests should be given in a relaxed environment that allows individuals to carefully make a forced choice selection.

2. The examiner should be pleasant, positive and encouraging.

3. The researcher should reassure the participants about the confidentiality of the results.

4. Directions to the participants should be read verbatim, rather than given from memory in order to provide continuity.

5. Do not assist participants in making their selections unless they do not get the point. Then, carefully and objectively describe the point.

6. Some of the subjects, especially younger pupils may not realise that they have to select one of the answers lettered "a", "b", "c", or "d". It is necessary to repeat often: "Be sure to read carefully all propositions and select the *best one*."

7. If an individual changes his or her answer, be sure the other answer is erased on the answer sheet.

8. If working with a handicapped individual, the examiner may point to each of the choices asking for a finger response of "1" for “a”, "2" for “b”, "3" for “c”, and "4" for “d”; or shake the head once for "a", twice for "b", three times for "c", or four times for "d".

10. The tests are to be given on a normal school day (not just before the pupils are to be dismissed on a Thursday morning or on the same day that the pupils are about to go to the theatre or visit the Zoo on a field trip).

11. In testing any school-age child, one should bear in mind that every test presents an implied threat to the individual's prestige. Some reassurance should therefore be given at the out set. It is helpful to explain, for example, that no one is expected to finish or to get all the items correct. The examinee might otherwise experience a mounting sense of failure as she or he advances to the more difficult items or is unable to finish the test in the time allowed.

12. In order to have the participants answer the questions seriously, it is useful to motivate them extrinsically. The examiner can tell them that some surprises are to be given to the best respondents.

REFERENCES

1. Abraham, Paul. (2002). Skilled Reading: Top-down, Bottom-up. *Field Notes*, 10 (2). [On-Line]. Retrieved on Nov 12, 2006 from http://www.sabes.org/ resources/ fieldnotes/vol10/fn102.pdf
2. Ackerman, P.L. (1988). Determinants of Individual Differences During Skill Acquisition: Cognitive Abilities and Information Processing. *Journal of Experimental Psychology: General, 117*, 288-318.
3. Ackerman, P.L.; and Heggestad, E.D. (1997). Intelligence, Personality, and Interests: Evidence for Overlapping Traits. *Psychological Bulletin, 121* (2), 219-245.
4. Adams, M. (1990). Beginning to Read: Thinking and Learning about Print. Urbana-Champaign: University of Illinois.
5. Alexander, P. A.; and Judy, J. E. (1988). The Interaction of Domain-Specific and Strategic Knowledge in Academic Performance. *Review of Educational Research, 58 (4),*375-404.
6. Allington, R. (1991). Beginning to Read: A Critique by Literacy Professionals and a Response by Marilyn Jager Adams. *The Reading Teacher, 44*, 370-395.
7. Anastasi, A.; and Urbina, S. (1997). Psychological Testing (7th Ed.). Upper Saddle River, NJ: Prentice-Hall.
8. Anderson, R. C.; Diakidoy, I-A. N.; and Nagy, W. E. (1992). The Acquisition of Morphology: Learning the contribution of suffixes to the meanings of derivatives. *Journal of Reading Behavior, 25(2),* 155-170.

9. Anderson, R. C.; Goetz, E. T.; Reynolds, R. E.; and Schallert, D. L. (1977). Frameworks for Comprehending Discourse. *American Educational Research Journal, 14,* 367–382.

10. Anderson, T. H.; Armbruster, B. B.; and Ostertag, J. (1987). Does Text Structure/ Summarization Instruction Facilitate Learning from Expository Text? *Reading Research Quarterly, 22,* 331–346.

11. Anderson, R. C.; and Pichert, J. W. (1977). Taking Different Perspectives on a Story. *Journal of Educational Psychology, 69,* 309–315.

12. Anderson, R. C.; and Pearson, P. D. (1984). A Schema-Theoretic View of Basic Processes in Reading. In P. D. Pearson, R. Barr, M. L. Kamil, and P. Mosenthal (Eds.), Handbook of Reading Research (pp. 255–292). New York: Longman.

13. Anderson, R. C.; Hiebert, E. H.; Scott, J. A.; and Wilkinson, I. A. G. (1985). Becoming a Nation of Readers: The Report of the Commission on Reading. Urbana, IL: University of Illinois, Center for the Study of Reading.

14. Andrews, T.J.; Flanagan, D. P.; and Genshaft, J.L. (1997). The Functional Utility of Intelligence Tests with Special Education Populations. In: D.P. Flanagan, J.L. Genshaft and P.L. Harrison (Eds.), Contemporary Intellectual Assessment: Theories, Tests, and Issues (pp. 457–483). New York: Guilford.

15. Armstrong, T. (1994). Multiple Intelligences in the Classroom. Alexandria, VA: Association for Supervision and Curriculum Development.

16. Armstrong, T. (1999). Seven Kinds of Smart. New York: Plume.

17. Austin, G. R.; and Worsham, A. W. (1983). Effects of Teaching Thinking Skills on SAT Scores. *Educational Leadership, (41), 3,* 50-51.

18. Baker, L.; and Cerro, L. C. (2000). Metacognitive Skills and Reading. In G. Schraw, and J. C. Impara (Eds.), Issues in the Measurement of Metacognition (pp. 99-146). Lincoln, NE: Buros Institute.

19. Bales, R. J.; and Gambrell, L. B. (1986). Mental Imagery and the Comprehension-Monitoring Performance of Fourth and Fifth-Grade Poor Readers. *Reading Research Quarterly, 21,* 454–464.

20. Barkman, R. (1997). Patterns and the Eighth Intelligence. [On-Line]. Retrieved on July 16, 2006 from http:// www.newhorizons.org/trm_mipattern.html

21. Baum, R. (1990). Finishing Touches—10 Top Programs. *Learning, (18),6,* 51-55.

22. Baumann, J. F.; Boland, E. M.; Edwards, E. C.; Kame'enui, E. J.; and Olejnik, S. (2003). Vocabulary Tricks: Effects of Instruction in Morphology and Context on Fifth-Grade Students' Ability to Derive and Infer Word Meanings. *American Educational Research Journal, 40(2),* 447-494.

23. Beale, I. L. & Singh, N. N. (1992). Learning Disabilities: Nature, Theory and Treatment. New York: Splinger-Verlag.

24. Belmont, J.M.; Buttefield, E.C.; and Ferretti, R.P. (1982). To Secure Transfer of Training, Instruct Self-Management Skills. In D.K. Detterman, and R.J. Sternberg (Eds.), How and How Much Can Intelligence Be Increased? Norwood, N.J.: Ablex Publishing Corporation.

25. Bennett, M. (1996). Men's and Women's Self-estimates of Intelligence. *Journal of Social Psychology, 136,* 411–412.

26. Bennett, M. (1997). Self-estimates of Ability in Men and Women. *Journal of Social Psychology, 137,* 540–541.

27. Bettelheim, B., & Zelan, K. (1981). La Lecture et l'Enfant. Paris: Edition Robert Laffont (My translation).

28. Bickley, P. G.; Keith, T. Z.; and Wolfe, L. M. (1995). The Three Stratum Theory of Cognitive Abilities: Tests of the Structure of Intelligence Across the Lifespan. *Intelligence*, 20, 309-328.

29. Bornstein, B. T.; and Naglieri, A. J. (2003). Intelligence and Achievement: Just How Correlated Are They? *Journal of Psychoeducational Assessment, 21, 3, 244-260.*

30. Boyle,G. J.; Cattel, R. B.; and Stankov, L. (1995). Models and Paradigms in Personality and Intelligence Research. In D.H. Saklofske, and M. Zeidner (Eds.), International Handbook of Personality and Intelligence. New York: Plenum Press

31. Bradley, D.; Pallier, G.; Roberts, R.D.; and Stankov, L. (1997). Charting the Cognitive Sphere: Tactile-Kinesthetic Performance within the Structure of Intelligence. *Intelligence, 25*(2), 111-148.

32. Brody, N. (1992). Intelligence (2nd Ed.). San Diego, Calif.: Academic Press.

33. Brody, N. (1997). Intelligence, Schooling, and Society. *American Psychologist, 52, 1046–1050.*

34. Brown, T. L.; Carr, T. H.; Evans, M. A.; and Vavrus, L. G. (1990). Cognitive Skill Maps and Cognitive Skill Profiles: Componential Analysis of Individual Differences in Children's Reading Efficiency. In T. H. Carr, and B. A. Levy (Eds.), Reading and its Development (pp. 1-55). San Diego: Academic Press.

35. Brown, A. L.; and Palincsar, A. S. (1984). Reciprocal Teaching of Comprehension Fostering and Comprehension-Monitoring Activities. *Cognition and Instruction, 2,* 117–175.

36. Burton, L. (1998). A Factorial Analysis of Visual Imagery and Spatial Abilties. Unpublished PhD thesis, University of Southern Queensland, Australia.

37. Burton, L.; and Fogarty, G. (1996). A Comparison of Measures of Preferred Processing Style: Method or Trait Variance? *Journal of Mental Imagery, 20* (4), 87-112.

38. Calfee, R. C.; and Venezky, R. L. (1970) The Reading Competency Model. In H. Singer, and R. B. Ruddell (Eds.), Theoretical Models and Processes of Reading (pp. 273-91). Newark, DE: International Reading Association.

39. Campbell, B. (1997). The Naturalist Intelligence. [On-Line]. Retrieved on may 23, 2006 from http:// www.cyberspace.com/~building/article-eightintel.html#author

40. Campbell, B.; Campbell, L.; and Dickinson, D. (2004). Teaching and Learning Through Multiple Intelligences (3rd ed.). Boston: Allyn & Bacon.

41. Campbell, D. T.; and Cook, T. D. (1979). Quasi-experimentation: Design and Analysis Issues for Field Settings. Chicago: Rand McNally.

42. Campbell, D. T.; Crano, W. D.; and Kenny, D. A. (1972). Does Intelligence Cause Achievement? A Cross-lagged Panel Analysis. *Journal of Educational Psychology, 63, 258–275.*

43. Canivez, G. L.; and Lei, P. W. (2007). Psychometric Intelligence and Achievement: A Cross-lagged Panel Analysis. Intelligence, 35, 1, 59-68.

44. Carrell , P. L.; and Eisterhold, J.C. (1983). Schema Theory and ESL Reading Pedagogy. *TESOL Quarterly, 17(4),* 553-573.

45. Carroll, J. B. (1977). Developmental Parameters of Reading Comprehension. In J. T. Guthrie (Ed.), Cognition, Curriculum and Comprehension (pp. 1-15). Newark, DE: International Reading Association.

46. Carroll, J. B. (1993). Human Cognitive Abilities: A Survey of Factor Analytic Studies. Cambridge: Cambridge University Press.

47. Carroll, J. B. (1997). The three-stratum theory of cognitive abilities. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 122-130). New York: Guilford Press.

48. Carver, R. P. (2000). The Causes of High and Low Reading Achievement. Mahwah, New Jersey: Lawrence Erlbaum Associates.

49. Castell, S.; and Luke, A. (1983). Defining 'Literacy' in North American Schools: Social and Historical Conditions and Consequences. *Journal of Curriculum Studies, 15,* 373-389.

50. Cattell, R. B. (1963). Theory of Fluid and Crystallized Intelligence. A Critical Experiment. *Journal of Educational Psychology, 52*, 1-22.

51. Ceci, S.J. (1991). How Much Does Schooling Influence General Intelligence and its Cognitive Components? A Reassessment of the Evidence. *Developmental Psychology, 27, 703–722.*

52. Ceci, S.J.; and Liker, J. (1986). A Day at the Races: A Study of IQ, Expertise, and Cognitive Complexity. *Journal of Experimental Psychology: General, 115,* 255-266.

53. Chall, J. S. (1967). Learning to Read: The Great Debate. New York: McGraw-Hill.

54. Conderman, G.; and Strobel, D. (2006). Problem Solving with Guided Repeated Oral Reading Instruction. *Intervention in School and Clinic, 42, 1, 34-39.*

55. Constable, R.T.; Fulbright, R.K.; Mencl, W.E.; Shaywitz, B.A.; Shaywitz, S.E.; and Skudlarski, P. (2003). Neural Systems for Compensation and Persistence: Young Adult Outcome of Childhood Reading Disability. *Biological Psychiatry*, 54, 25–33.

56. Cummingham, A. E.; Feeman, D. J.; and Stanovitch K. E. (1984). Intelligence, Cognitive Skills, and Early Reading Progress. *Reading Research Quarterly, 19, 3*, 278-303.

57. Das, J. P.; Kirby, J. R.; and Naglieri, J. A. (1994). Assessment of Cognitive Processes. Boston, M. A.: Allyn & Bacon.

58. Das, J. P.; Jarman, R F.; and Kirby, J. (1975). Simultaneous and Successive Synthesis: An Alternative Mode1 for Cognitive Abilities. *Psychological Bulletin, 82,* 87-103.

59. Das, J. P.; and Naglieri, J. A. (1988). Planning-Arousal-Simultaneous-Successive (PASS): A Model for Assessment. *Journal of School PsychoIogy, 26,* 35-48.

60. Davies, F. (1995). Introducing Reading. London: Penguin Books.

61. De Grandmont & J. Ndayisaba (1999). Les Enfants Différents. Québec: Les Editions LOGIQUES (My translation).

62. Dawis, R. V.; and Lubinski, D. (1992). Aptitudes, Skills, and Proficiencies. In: M.D. Dunnette and L.M. Hough (Eds.), Handbook of Industrial and Organizational Psychology (pp.1-59). Palo Alto, CA: Consulting Psychology Press.

63. Detterman, D.K. (1982). Does 'g' Exist? *Intelligence, 6,* 99-108.

64. Diamond, L.; Gutlohn, L.; and Honig, W. (2000). Teaching Reading Sourcebook for Kindergarten through Eighth Grade. Novato, CA: Arena Press/ National Reading Panel.

65. Dole, J. A.; Duffy, G. G.; Pearson, P. D.; and Roehler, L. R. (1991). Moving from the Old to the New: Research on Reading Comprehension Instruction. *Review of Educational Research, 61,* 239–264.

66. Edwards, O. W.; and Oakland, T. D. (2006). Factorial Invariance of Woodcock-Johnson III Scores for African Americans and Caucasian Americans. *Journal of Psychoeducational Assessment, 24, 358-366.*

67. Eysenck, H. J. (2000). Intelligence: A New Look. New Jersey: Transaction Publishers.

68. Fergusson, D. M.; Horwood, L. J.; and Ridder, E. M. (20005). Show Me the Child at Seven II: Childhood Intelligence and Later Outcomes in Adolescence and Young Adulthood. *Journal of Child Psychology and Psychiatry, 46, 850–85.*

69. Floyd, R. G.; Gregg, N.; and Keith, T. Z. (2004). Explaining Reading Comprehension Across Childhood, Adolescence, and Early Adulthood is Somewhat Simple. Paper presented at the annual meeting of the American Educational Research Association in April 2004. San Diego, California.

70. Fogarty, G. (1987). Timesharing in Relation to Broad Ability Domains. *Intelligence, 3,* 207-231.

71. Fries, C. C. (1963). Linguistics and Reading. New York: Holt, Rinehart & Winston.

72. Gaffney, K. (1995). Multiple Intelligences and the Arts. [On-Line]. Retrieved on 18 May, 2006 from http://www.njcommunity.org/artgenesis/chyrsali.html

73. Furman, A. (2001). Self-estimates of Intelligence: Culture and Gender Difference in Self and Other Estimates of Both General (g) and Multiple Intelligences. *Personality and Individual Differences, 31,* 1381–1405.

74. Gardner, H. (1983). Frames of Mind: The Theory of Multiple Intelligences. New York: Basic Books Publishers.

75. Gardner, H. (1999). Intelligence Reframed. New York: Basic Books.

76. Gardner, H.; Karolyi, C. V.; and Ramos-Ford, V. (2003). Multiple Intelligences: A Perspective on Giftedness. In N. Colangelo & G. A. David (Eds.), Handbook of Gifted Education (3rd ed., pp. 100–112). Boston: Allyn & Bacon.

77. Gardner, H.; and Walters, J. (1986). The theory of multiple intelligences: Some issues and answers. In R. J. Sternberg & R. Wagner (Eds.), *Practical intelligences* (pp. 163–182). New York: Cambridge University Press.

78. Gates, A. I. (1949). Character and Purposes of the Yearbook. In N. Henry (Ed.), The Forty-Eighth Yearbook of the National Society for the Study of Education: Part II. Reading in the Elementary School (pp. 1-9). Chicago: University of Chicago Press.

79. Gillet, J. W.; and Temple, C. (1994). Understanding Reading Problems: Assessment and Instruction (4th Ed.). New York: Harper Collins.

80. Glutting, J. J.; Konold, T. R.; McDermott, P. A.; and Watkins, M. W. (2006). Distinctions without a Difference: The Utility of Observed Versus Latent Factors from the WISC-IV in Estimating Reading and Math Achievement on the WIAT-II. The Journal of Special Education, 40, 2, 103-114.

81. Goodman, K. (1967). Reading: A Psycholinguistic Guessing Game. In N. A. Johnson (Ed.), Current Topics in Language. Cambridge, MA: Winthrop.

82. Gottfredson, L. S. (1997). Foreword to "Intelligence and Social Policy". *Intelligence, 24(1),* 1-12.

83. Gough, P. B. (1972). One Second of Reading. In J. F. Kavanagh, and I. G. Mattingly (Eds.), Language by Ear and by Eye (pp. 331-58). Cambridge, MA: MIT Press.

84. Gough, P. B.; and Hillinger, M. L. (1980). Learning to Read: An Unnatural Act. *Bulletin of the Orton Society* 30, 179-96.

85. Gough, P. B.; and Hoover, W. (1990). The Simple View of Reading. Reading and Writing: *An Interdisciplinary Journal, 2,* 127-160.

86. Gough, P. B.; and Tunmer, W. E. (1986). Decoding, Reading and Reading Disability. *Remedial and Special Education* 7, 6-10.

87. Graesser, A. C.; Millis, K. K.; and Zwaan, R. A. (1997). Discourse comprehension. *Annual Review of Psychology, 48(1),* 162-189.

88. Graesser, A. C.; Singer, M.; and Trabasso, T. (1994). Constructing Inferences during Narrative Text Comprehension. *Psychological Review, 101(3),* 371-395.

89. Gretchen, L. R. (1997). EQ Emotional Intelligence Workshop. [On-Line]. Retrieved on April 21, 2006 from http://www.aha4kids.com/EQ_workshop.html

90. Guilford, J. P. (1967). The Nature of Human Intelligence. New York: McGraw-Hill.

91. Guilford, J. P. (1982). Cognitive Psychology's Ambiguities: Some Suggested Remedies. *Psychological Review, 89,* 48-59.

92. Hafiz, F. M.; and Tudor, I. (1989). Extensive Reading and the Development of Language Skills. *ELT Journal, 43(1),* 4-13.

93. Haggerty, B. (1995). Nurturing Intelligences: A Guide to Multiple Intelligences Theory and Teaching. Menlo Park, CA: Addison- Wesley Publishing Company.

94. Hare, V. C.; Rabinowitz, M.; and Schieble, K. M. (1989). Text Effects on Main Idea Comprehension. *Reading Research Quarterly, 24(1),* 72-88.

95. Harris, T. L.; and Hodges, R. E. (1995). The Literacy Dictionary: The Vocabulary of Reading and Writing. Newark, DE: International Reading Association.

96. Harrison, M. R.; Stanovich, K. E.; and West, R. F. (1995). Knowledge Growth and Maintenance across the Life-Span: The Role of Print Exposure. *Developmental Psychology, 31(5),* 811-826.

97. Hay, I.; and Spencer, R. (1998). Initial Reading Schemes and their High Frequency Words. *Australian Journal of Language and Literacy*. [On-Line]. Retrieved on July 12, 2006 from http://www.questia.com

98. Hebb, D.O. (1949). The Organization of Behaviour. N.Y.: Wiley.

99. Hedge, T. (2003). Teaching & Learning in the Language Classroom. UK: Oxford University Press.

100. Hoerr, T. R. (1997). The Naturalist Intelligence. [On-Line]. Retrieved on July 12, 2006 from http://www.newhorizons.org/trm_hoerrmi.html

101. Horn, J.L. (1985). Remodelling Old Models of Intelligence. In B.B. Wolman (Ed.), Handbook of Intelligence: Theories, Measurements and Applications. New York: Wiley.

102. Horn, J. L., & Noll, J. (1997). Human cognitive capabilities: Gf-Gc theory. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 53- 93). New York: Guilford Press.

103. Horn, J.L.; and Stankov, L. (1980). Human Abilities Revealed through Auditory Tests. *Journal of Educational Psychology, 72*, 19-42.

104. Howard, R. (1991). All about Intelligence. Kensington, NSW: New South Wales University Press.

105. Huey, E. B. (1968). The Psychology and Pedagogy of Reading. Cambridge, MA: MIT Press.

106. Hulme, C.; and Stothard, S.E. (1996). A Comparison of Reading Comprehension and Decoding Difficulties in Children. In C. Cornoldi & J.V. Oakhill (Eds.), Reading Comprehension Difficulties: Processes and Remediation. Mahwah, NJ: Lawrence Erlbaum Associates.

107. Hunt, E. (1980). Intelligence as an Information-Processing Concept. *British Journal of Psychology, 71*, 449-474.

108. Jensen, A.R. (1979). "g": Outmoded Theory or Unconquered Frontier? *Creative Science and Technology, 11*, 16-29.

109. Jensen, A. R. (1998). The G Factor: The Science of Mental Ability. Westport, CT: Praeger.

110. Jensen, A. R. (2000). The G Factor and the Design of Education. Paper presented at the annual meeting of the American Psychological Association, Washington, DC.

111. Kail, R.; and Pellegrino, J. W. (1985). Human Intelligence: Perspectives and Prospects. New York: W. H. Freeman & Company.

112. Kintsch, W. (1988). The Role of Knowledge in Discourse Comprehension: A Construction Integration Model. *Psychological Review, 95(2),* 163-182.

113. Laberge, D.; and Samuels, J. (1974). Toward a Theory of Automatic Information Processing in Reading. *Cognitive Psychology, 6,* 293-323.

114. Langer, J. (1998). Piaget, Evolution, and Development: Jean Piaget Symposium Series. Mahwah, N.J.: Lawrence Erlbaum Associates.

115. Lazear, D. (1991). Seven Ways of Teaching: The Artistry of Teaching with Multiple Intelligences. Palatine, IL: Skylight Publishing.

116. Lee, C. (2001). Is October Brown Chinese? A Cultural Modeling Activity System for Underachieving Students. *American Educational Research Journal, 38(1),* 97-141.

117. Long, D. L.; Oppy, B. J.; and Seely, M. R. (1999). The Strategic Nature of Less Skilled Readers' Suppression Problems. *Discourse Processes, 27(3),* 281-302.

118. Lubart, T. I.; and Sternberg, R. J. (1999). The Concept of Creativity: Prospects and Paradigms. In R. J. Sternberg (Ed.), Handbook of Creativity (pp. 3–15). Cambridge: Cambridge University Press.

119. McDermott, M. (1997). Multiple Intelligences: The Eight Learning Styles. [On-Line]. Retrieved on 18 May ,2006 from: http://family.disney.com/Categories/Lear.../dony107multintel/dony107multintel12.htm

120. McGrew, K. S. (1997). Analysis of the Major Intelligence Batteries According to a Proposed Comprehensive Gf-Gc Framework. In D. P. Flanagan, J. L. Genshaft, and P. L. Harrison (Eds.), Contemporary Intellectual Assessment: Theories, Tests, and Issues (pp. 131-150). New York: Guilford Press.

121. McGuiness, D. (2005). Language Development & Learning to Read: The Scientific Study of How Language Development Affects Reading Skill. Cambridge: Mass. MIT Press.

122. Miller, P.H. (1983). Theories of Developmental Psychology. New York: W. H. Freeman.

123. Nagy, W. E.; and Scott, J. A. (2000). Vocabulary Processes. In M. L. Kamil, P. B. Mosenthal, P. D. Pearson, and R. Barr (Eds.), Handbook of Reading Research (Vol. 3, pp. 483-502). Mahwah, NJ: Lawrence Erlbaum Associates.

124. Naglieri, J. A. (1996). An Examination of the Relationship between Intelligence and Reading Achievement Using the MAT-SF and MAST. *Journal of Psychoeducational Assessment, 14, 1, 65-69.*

125. Naglieri, J. A. (2000). The Relationship between General Ability Using the Naglieri Nonverbal Ability Test (NNAT) and Stanford Achievement Test (SAT) Reading Achievement. *Journal of Psychoeducational Assessment, 18, 3, 230-23.*

126. Naglieri, J. A.; and Ronning, M. E. (2000). The Relationship between General Ability Using the Naglieri Nonverbal Ability Test (NNAT) and Stanford Achievement Test (SAT) Reading Achievement. *Journal of Psychoeducational Assessment, 18, 3, 230-239.*

127. Neisser, U. (1976). General, Academic, and Artificial Intelligence. In L.B. Resnick (Ed.), The Nature of Intelligence (pp. 295-346). Norwood, NJ: Ablex.

128. Nelson, K. (1995). Nurturing Kid's Seven Ways of Being Smart. *Instructor, 105, 1,* 26-30.

129. Nuttal, C. (1989). Teaching Reading Skills in a Foreign Language. Oxford: English Language Book Society/ Heinemann Educational Books.

130. Orasanu, J. M. (1986). Reading Comprehension: From Research to Practice. New Jersey: Lawrence Erlbaum Associates.

131. Paris, S. C.; Turner, J. C.; and Wasik, B. A. (1991). The Development of Strategic Readers. In R. Barr, M. L. Kamil, P. B. Mosenthal, and P. D. Pearson (Eds.), Handbook of Reading Research (Vol. 2, pp. 609–640). New York: Longman.

132. Perfetti, C. A. (1985). Reading Ability. New York: Oxford University Press.

133. Perfetti, C. A. (1989). There Are Generalized Abilities and One of them Is Reading. In L. B. Resnick (Ed.), Knowing, Learning, and Instruction: Essays in Honor of Robert Glaser (pp. 307-335). Hillsdale, NJ: Lawrence Erlbaum Associates.

134. Pfeifer, R.; and Scheier, C. (1999). Understanding Intelligence. Cambridge: Mass MIT Press.

135. Philips, J.L. (1981). Piaget’s Theory: A Primer. San Fransisco: W.H. Freeman.

136. Pintrich, P.R. (1990). Implications of Psychological Research on Student Learning and College Teaching for Teacher Education. In W.R. Houston, M. Haberman, and J. Sikula (Eds.), Handbook of Research on Teacher Education (p.p. 857-926). New York: MacMillan

137. Pressley, G. M. (1976). Mental Imagery Helps Eight-Year-Olds Remember What They Read. *Journal of Educational Psychology, 68,* 355–359.

138. Rosenblatt, L. M. (1985). Viewpoints: Transaction versus Interaction - a Terminological Rescue Operation. *Research in the Teaching of English*, 19, 96-107.

139. Rosenblatt, L. M. (1994). The Reader, the Text, the Poem. The Transactional Theory of the Literary Work. Carbondale and Edwardsville: Southern Illinois University Press.

140. Rosenblatt, L. M. (1998). Readers, Texts, Authors. *Transactions of the Charles S. Peirce Society*, XXXIV, 885-921.

141. Rummelhart, D. E. (1985). Toward an Interactive Model of Reading. In H. Singer, and R. Ruddell (Eds.), Theoretical Models of Reading. Newark, NJ: International Reading Associaton.

142. Ruzgis, P. (1994). Thustone, L.L. (1887-1955). In R. J. Sternberg (Ed.), Encyclopedia of Human Intelligence (pp. 1081-1084). New York: MacMillan.

143. Scholnick, E. K. (1999). Conceptual Development: Piaget's Legacy. Mahwah, N.J.: Lawrence Erlbaum Associates.

144. Smith, F. (1971). Understanding Reading: A Psycholinguistic Analysis of Reading and Learning to Read. New York: Holt, Rinehart and Winston.

145. Snow, C. (2002). Reading for Understanding: Toward an R&D Program in Reading Comprehension. Santa Monica, CA: RAND.

146. Spearman, C. (1904). General Intelligence, Objectively Determined and Measured. *American Journal of Psychology, 15*, 201-293.

147. Spearman, C. (1927). The abilities of Man. New York: MacMillan.

148. Stankov, L. (1983). Attention and Intelligence. *Journal of Educational Psychology, 75*, 471-490.

149. Stanovich, K. E. (1986). Matthew Effects in Reading: Some Consequences of Individual Differences in the Acquisition of Literacy. *Reading Research Quarterly 21, 360–407*.

150. Sternberg, R.J. (1979). The Nature of Mental Abilities. *American Psychologist, 34*, 214-230.

151. Sternberg, R.J. (1985). Beyond IQ: A Triarchic Theory of Human Intelligence. NY: Cambridge University Press.

152. Sternberg, R. J. (1986). A Triarchic Theory of Intellectual Giftedness. In R. J. Sternberg & J. E. Davidson (Eds.), Conceptions of Giftedness (pp. 223–243). Cambridge, MA: Cambridge University Press.

153. Sternberg, R. J. (1997). A Triarchic View of Giftedness: Theory and Practice. In N. Colangelo & G. A. Davis (Eds.), Handbook of Gifted Education (2nd ed., pp. 43–53). Boston: Allyn & Bacon.

154. Sternberg, R. J. (2000). Patterns of Giftedness: A Triarchic Analysis. *Roeper Review, 22,* 231–235.

155. Stevens, K. (1980). The Effect of Background Knowledge on the Reading Comprehension of Ninth Graders. *Journal of Reading Behavior, 12(2),* 151-154.

156. Swanson, H. L. (2001). Research on Interventions for Adolescents with Learning Disabilities: A Meta-analysis of Outcomes Related to Higher-order Processing. *Elementary School Journal, 101, 331–348.*

157. Thurstone, L. L. (1938). Primary Mental Abilities. *Psychometric Monographs, 1*, 9-121.

158. Vernon, P.E. (1950). The Structure of Human Abilities. London: Methuen.

159. Willingham, D. T. (2004). Reframing the Mind: Howard Gardner Became a Hero among Educators Simply by Redefining Talents as "Intelligences". *Education Next, 4,* 18-24.

160. Willoughby, T.; Woloshyn, V. E.; and T. Wood, E. (1995). Cognitive Strategy Instruction for Middle and High Schools. Cambridge, MA: Brookline Books.

Materials

Arab, S.A.; and Riche, B. (2006). On the Move. Algeria: The National Authority for School Publications.

RESUME

Notre étude à pour but d'intégrer l'intelligence dans la compréhension d'un discours écrit. Ce travail essaye de montrer que les élèves de 15 ans qui possèdent des capacités intellectuelles élevées parviennent à comprendre un texte écrit en Anglais comme une langue étrangère mieux que ceux qui possèdent des capacités intellectuelles moins élevées.

Un travail pilote a été réalisé avec l'implication de 50 élèves de quatrième année moyenne. Il a été accompli en deux parties : la première partie a visé l'évaluation de l'intelligence générale des élèves et la deuxième partie a été consacrée à l'évaluation de leurs capacités à assimiler le sens de deux textes différents. Les résultats ont indiqué que les deux tests n'étaient pas vraiment valides. Cependant, des révisions globales et locales ont été indispensables.

L'étude statistique de cette recherche a été accomplie, comme pour le travail pilote, en deux parties. Dans la première partie étaient inclus 95 élèves (qui n'ont pas participé dans le travail pilote), et une étude comparative a été faite avec considération des scores que les élèves ont obtenu dans le test d'intelligence de groupe (vocabulaire Anglais, similarités et différences, séries, raisonnement, résolution de problèmes mathématiques, prendre des décisions). Dans la deuxième partie étaient inclus les mêmes élèves avec le même nombre (les 95 participants dans la première partie), suivie d'une évaluation de leur compréhension de deux textes différents.

Une variété de tableaux et de diagrammes a été utilisée pour démontrer les différentes performances des élèves dans le test intellectuel et celui de la compréhension d'un discours écrit.

Les résultats significatifs de cette recherche ont fait ressortir une forte corrélation entre les deux variantes. Il en ressort que l'influence de l'intelligence s'est révélée assez positive pour la compréhension d'un texte. Cette conclusion peut être utile pour les éducateurs et les programmeurs de cours dans la considération des besoins des apprenants.

ملخــص

يهدف هذا البحث إلى إدماج الذكاء في فهم النص. خصصت هذه الدراسة لإثبات صحة ما يلي: التلاميذ البالغين من العمر15 سنة و الذين يملكون قدرات ذهنية عالية يستطيعون فهم النص المكتوب باللغة الإنجليزية بصورة أحسن من التلاميذ الذين يملكون قدرات ذهنية أقل نموا.

حققت الدراسة النموذجية لهذه المذكرة حيث تضمنت 50 تلميذا في المستوى السنة الرابعة إكمالي. أنجزت هذه الدراسة على مرحلتين حيث أن المرحلة الأولى هدفت إلى تقييم ذكاء التلاميذ، بينما اختصت المرحلة الثانية بقياس مدى نجاح التلاميذ في فهم النصين المقدمين. النتائج المحصل عليها أشارت إلى أن رائزي الذكاء و فهم النص ليسا على قدر كبير من السريان؛ المراجعة الإجمالية و الجزئية للمقياسين أضحت ضرورية.

الدراسة الإحصائية أنجزت، كما هو الحال بالنسبة للدراسة النموذجية، على مرحلتين. المرحلة الأولى تضمنت 95 تلميذا (غير المشاركين في الدراسة النموذجية)، حيث تمكننا من إجراء تحليل تشبيهي على النتائج المحصل عليها من طرف التلاميذ في رائز الذكاء (مفردات اللغة الانجليزية، أوجه التشابه و الاختلاف، سلاسل، تدليل، حل المسائل الرياضية، اتخاذ القرارات). المرحلة الثانية تضمنت تقييم قدرات هؤلاء المتمدرسين على فهم نصين مكتوبين باللغة الإنجليزية كلغة أجنبية ثانية (نص مرفوق بأسئلة مفتوحة وأخر مرفوق بأسئلة إختيارية).

مجموعة من الجداول و الرسومات البيانية استعملت لتوضيح محاصيل التلاميذ في رائزي الذكاء و فهم النصين المكتوبين باللغة الإنجليزية.

النتائج المحصل عليها في هذه الدراسة تشير إلى وجود ارتباط قوي بين المتغيرتين. بهذا فإن النتائج قد أقامت

الدليل على أن الذكاء يشكل تأثير ايجابيا كبيرا على فهم التلاميذ للنص المكتوب. هذا الاستنتاج قد يكون على

قدر كبير من المنفعة للمدرسين و المبرمجين في سلك التعليم لتلبية حاجات التلاميذ التعليمية.