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## Scientific text structure awareness: A cross-cultural comparison of tertiary students from different language backgrounds

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**Scientific Text Structure Awareness:  
A Cross-Cultural Comparison of Tertiary  
Students from Different Language Backgrounds**

by

**Catherine E. McLoughlin**

**Thesis Submitted in Partial Fulfilment of the  
Requirements for the Award of**

**Master of Applied Linguistics**

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**Date of Submission: 28 October, 1994**

## USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

## ABSTRACT

Research in both first and second language reading has shown that awareness of text structure, or *rhetorical organisation* is related to superior recall of main ideas from expository prose passages. The present study investigates awareness of scientific text structure among tertiary students from different language backgrounds. In this investigation, four reading passages containing two rhetorical text structures found in scientific discourse, *comparison/contrast* and *problem/solution* are employed. Meyer's (1975) hierarchical content structure analysis was used to analyse the texts into top, high, mid and low level ideas corresponding to main and supporting ideas. The research questions were centred around three major areas:

1. whether subjects from different language backgrounds displayed differences in quantity of idea units and main ideas recalled
2. whether differences were related to subjects' awareness of text structure as measured in use of the structure of the original passage in their written recalls
3. whether the different rhetorical structures produced any significant overall differences in quantity and level (main vs. supporting) of ideas recalled by subjects.

Forty five first year university students aged between 18 and 20 studying science participated in the study, with fifteen students in each of the following groups: Australian, Singaporean and Malaysian.

All subjects were given four short passages from *The New Scientist* to read, two each of comparison/contrast and problem/solution. After reading the four passages students were asked to write down all they could recall. They

were also given tasks which asked them to identify passages written in a similar structure and to select the structure which best described the way each of the passages was organised. Written recall protocols were analysed for the number of main idea units recalled and for the degree to which the structure used matched that of the original passage. One way ANOVAs were used to measure differences between groups in the quantity and level of ideas recalled and awareness of text structure. Paired *t* tests were used to ascertain whether the text types, comparison/contrast, problem/solution yielded differences in relative number of idea units and main ideas recalled. Results showed that Australian and Singaporean students recalled significantly more idea units and more main ideas than the Malaysian students. In terms of awareness of text structure for the comparison/contrast passages, there were no differences between groups. However, for problem/solution passages, there was a significant difference between the Malaysian and Australian group, with the former group showing lower levels of awareness. Overall, it was found that students who used the structure of the original passage to organise their writing recalled significantly more main ideas than those who had not. A further interesting finding was that subjects displayed greater awareness of the comparison/contrast than the problem/solution passages and also produced more main ideas for this particular structure.

The findings suggest that students from different language backgrounds are likely to show different responses to rhetorical structures and that this may be reflected in the quantity of ideas recalled from texts, and the ability to discern main ideas. The implication for reading and learning from expository prose is that recognition and use of different patterns of textual organisation cannot be assumed even in advanced and proficient readers at tertiary level.

## Declaration

I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signature: \_\_\_\_\_

Date: 10/7/95 ✓

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I wish to thank my supervisors Dr. Marion Milton and Dr. Graham Mckay for their support and helpful suggestions throughout the writing of this thesis. Advice given to me by Tony Fetherstonhaugh on the presentation of the statistical data was also much appreciated. Finally I wish to express my special thanks to Krzysztof Krakowski for his patient help in formatting the final draft.



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## **Part I**

# **Background and Aims of the Research**

## **Part I**

# **Background and Aims of the Research**

# **Chapter 1**

## **Background & Aims of the Research**

### **INTRODUCTION**

The present study is an empirical investigation of tertiary students' awareness of scientific text structure which encompasses two levels of enquiry. Firstly, it looks at differences between the relative number of main ideas recalled between three groups of subjects from diverse language and cultural backgrounds and whether the subjects demonstrate awareness of text structure in the written recalls of passages they have read. Secondly, it investigates how variations in text structure may influence the extent to which university students comprehend and recall main ideas from expository text. It is therefore a cross-cultural comparison of reading performance and awareness of text structure, and its theoretical underpinnings are interdisciplinary. Findings from cognitive psychology, first and second language reading, and research on learning from prose are integrated and combined to provide essential explanatory and theoretical background.

The thesis is divided into three parts, comprising eight chapters. Part I

outlines the background and aims of the research, placing text comprehension at the forefront. Part II, from Chapters 2 to 4, form the literature review. Because the scope of the investigation incorporates both theory and research findings from several areas of enquiry, the literature review spans several chapters. The different bodies of research which form the theoretical basis of the present study are examined in depth. Throughout the literature review ample consideration is given to empirical investigations on text structure awareness and how it is linked to recall of ideas from text. Thus, a review of research related to text structure awareness is presented in Chapter 2: the findings are discussed and the present research questions are given rationale, purpose and direction by setting them in the context of similar empirical research. Chapter 3 provides the theoretical background, linking the present research to psycholinguistic theories in reading and text comprehension, particularly schema theory.

Chapter 4 establishes the distinctive nature of science text as a type of expository prose. It then looks at various approaches to the analysis of expository text and examines the nature of scientific text and cross-cultural comparisons of discourse structure.

Part III, comprising Chapters 5 and 6, constitute the methodology used in the study. Chapter 5 presents the text analysis procedure adopted in the present study together with a detailed content structure analysis of the texts used.

Chapter 6 presents the research procedure in detail, describing the subjects, materials and tasks. The procedure for collection of data is described, together with details for scoring the tasks and recall protocols.

Part IV encompasses the results and discussion. Chapter 7 presents the results of the research, and Chapter 8 a discussion and analysis of the findings.

## AIMS

Since reading always involves text, a central aspect of the study will be a focus on the analysis of scientific text structure and its effects on reading comprehension. Theoretical and empirical research within the framework of schema theory has shown reading to be an interaction between text and reader. This interaction is a complex and dynamic process of interpretation involving the reader's background knowledge, the situational context and the specific text being read. All of these elements exert a strong influence on the process of comprehension and are acknowledged in the theoretical view underlying this study, *that reading is an interactive process.*

The basic assumption underlying this investigation is that texts only provide direction for readers to construct meanings, and that readers must activate appropriate schemata (knowledge structures) to recall and comprehend texts. The aim is to extend existing research on comprehension of expository prose among adult learners, and to investigate levels of awareness of scientific text structure and recall within a cross-cultural framework. Three groups of subjects from different language backgrounds, i.e., Australian, Malaysian and Singaporean, participated in the study.

All participants in the study were speakers of English, though the Malaysian group had learnt English as a second language and regarded themselves as ESL speakers. On the other hand, both Australian and Singaporean students considered themselves as first language speakers of English, as this was the language they used for everyday interaction and communication.

The choice of Australian, Singaporean and Malaysian students for the study was not merely a matter of convenience, given the fact that both the Singaporean and Malaysian groups constitute the largest proportion of overseas students in Australian tertiary institutions. The participation of subjects

from different backgrounds was a deliberate attempt to highlight the relative importance of language and cultural factors in text comprehension, and to focus on the two dimensions likely to impact on reading comprehension within a schema-theoretic framework. The terminology section will highlight these distinctions further.

The present study explores differences between these readers' knowledge of text structure and how it is related to their recall of ideas from authentic scientific texts. By investigating whether readers of different language backgrounds recognise particular organisational patterns (comparison/contrast, and problem/solution) in text, it also explores whether one particular organisational pattern is more facilitative for recall of main ideas than the other. The method used to investigate readers' awareness and recall of ideas is the written recall protocol, produced by subjects immediately after they have read passages extracted from *The New Scientist*. These protocols are analysed for the number of ideas recalled and for the degree to which the subjects have used the text structure used in the original passage. Statistical procedures are then employed to measure differences emerging between the three groups of subjects in the number of ideas recalled, their awareness of scientific text structure and whether there are any effects discernible for text type.

There have been few studies in reading research attempting a cross-cultural comparison of this kind among tertiary students within a specific disciplinary area, though there is a substantial body of related research.

The area of text comprehension among tertiary students is significant not only because of its obvious links with reading skills and academic success but also because tertiary literacy and study skills have come increasingly into focus in recent years because of the multi-culturalism of university life (Samuelowicz, 1987; Kember & Gow, 1991). Students from a wide and diverse range of cultures and language backgrounds now study at Australian

universities and have to read texts in what is for many, a second language. Empirical research investigating the demands placed on students of different backgrounds through participation in tertiary education is arguably relevant to debates on standards of literacy, academic support for students and teaching approaches which facilitate learning from expository text. The results of the present study may have pedagogical implications signalling the need to increase students' awareness of text structures as a means of improving retention and learning from prose.

The next section presents an overview of reading skills intended to convey the complexity of the reading process and set the context for the present research.

### **OVERVIEW OF THE NATURE OF READING**

The research literature sees reading as a complex cognitive process (Goodman, 1988; Anderson & Pearson, 1984). Simple definitions may therefore misrepresent what reading involves. Observations have demonstrated that skilled reading is *fluent* (Hall, White & Guthrie, 1986) and rapid: the flow of information must be maintained to make vital inferences and connections.

Secondly, reading is *purposeful*: a reader is motivated to read to satisfy a particular need or goal. This may be to find information, do research or for pleasure (Webb, 1982; Baumann, 1984). Reading is *flexible* as it requires the reader to employ a range of strategies to read efficiently. These strategies include adjusting the reading speed, skimming ahead, anticipating and predicting. Goodman (1988, p. 12) presents a succinct overview:

All readers are efficient in using the least amount of effort to achieve effectiveness. To accomplish this efficiency readers maintain constant focus on constructing meaning throughout the process, always seeking

the most direct path to meaning, always using strategies for reducing uncertainty, always being selective about the use of cues available and drawing deeply on prior conceptual and linguistic competence.

Reading *develops gradually*. The reader does not suddenly become fluent; reading is instead the product of long-term practice and gradual improvement. Direct teaching and reading strategy training has shown positive and beneficial results for some students (Irwin, 1991; Palincsar & Brown, 1984).

Reading is *interactive* because many skills and factors come together in the process. This key concept in reading research and instruction will be further discussed and elaborated as it is central to the view of reading adopted here.

## **READING AS INTERACTION**

The literature on reading comprehension makes extensive use of the term interactive. The term can refer to several different conceptions of reading. It is important to clarify these distinctions so that the theoretical foundation of the present research is established. Rumelhart (1977a) has proposed an interactive model of reading which argues that lower-level processes and higher level processes work together interactively as part of the reading process. The lower level processes are skills for word and sentence recognition while the higher level skills refer to the conceptual and inferential skills involved in interpreting and comprehending the message. In the interactive model thus described, the interaction refers to the relation between the various skills.

Interactive models of reading assume that all the skills above are available to actively interpret the text, and they have contributed a great deal to understanding reading in a second language. (See Chapter 3.)

The approach to reading underlying in this research, while acknowledging the contributions that psycholinguistic models, such as Rumelhart (1977a)



make to an understanding of the comprehension process, is based on a view of *reading as an interactive process*. Briefly, to understand the interactive view of comprehension and reading skills, we must understand that the comprehension process is influenced by the total context in which it occurs. It is therefore not possible to separate any act of comprehension from the contextual factors that influence it. According to Irwin (1991, p. 7):

Comprehension is an active process to which each reader brings his or her individual attitudes, interests, expectations, skills, and prior knowledge (reader context). Because the writer's message can never be entirely explicit, the reader must actively infer and interpret what is on the page in the light of what he or she brings to the task.

The *interactive approach* sees reading as a process involving many component skills and factors. This distinguishes it from *interactive models* of reading which concentrate on the interaction of skills at different levels. (See page 49.) The interactive approach shares some features with the socio-cultural reading model of Freebody & Luke (1990). Freebody (1992) views reading as an activity that is intrinsically part of the social organisation and belief system of the culture. The socio-cultural view therefore sees the reading activity as a social practice, and it aims to define the reader in terms of the demands expected in a literate society. While the interactive approach to reading adopted in this study does not treat the social and critical dimension of reading skills there is nevertheless some common ground. It will be argued that the engagement of the reader in the construction of meaning from the text can be supported within the interactive approach adopted here, despite the theoretical limitations of schema theory. (See Chapter 3.)

Research in reading in a second language (L2 reading) has provided many examples and empirical findings to support the interactive approach to reading comprehension. Widdowson (1979) views reading in a second language

as interactive in the sense that it demands a combination of skills, combining contextual and prior knowledge. Carrell (1983) concurs with this view, and extends the idea of interaction to include the interactivity that occurs between the reader and the text. As this view of reading has been widely accepted in first and second language reading research (Eskey, 1988; Irwin, 1991; Dubin, Eskey & Grabe, 1986) it will be adopted as the theoretical basis for the present study.

Nevertheless, other approaches to reading and textual analysis will be discussed in the context of the theoretical questions presented for investigation in the present study. In research on reading and learning from prose, for example, two significant perspectives are apparent. One perspective, from linguistics (van Dijk & Kintsch, 1983; McCarthy, 1992), emphasises the structure of the text while the other, derived from cognitive psychology, focuses on world knowledge that the reader brings to the text (Taylor & Samuels, 1983; Voss & Bisanz, 1985). Another approach to reading, is more aptly described by Kirby (1991, p. 106) as a psychology of learning. This focuses on how learning from text can be facilitated through the provision of extra-textual devices such as advance organisers and diagrams. In this approach, the subjects are skilled readers, usually adults, and the texts are expository rather than narrative. The present research, conducted with adult, proficient readers at university using authentic texts has some features in common with the psychology of learning from reading. However, the present study is less concerned with text manipulation to facilitate learning than with reader background variables that affect recall of ideas from text.

Britton & Black (1985, p. 5) express the view that:

A complete account of text understanding also requires specifying the processes that utilise these text and world knowledge structures to comprehend texts.

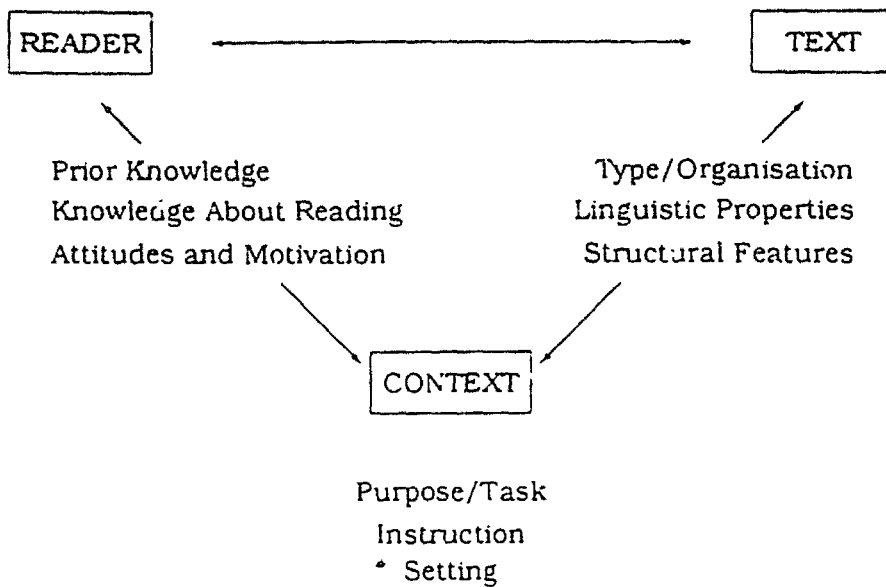


Figure 1.1. Factors That Interact to Influence Reading (Lipson & Wixson, 1991, p. 14).

A combination of these two perspectives, from linguistics and psychology, would focus on the interaction between readers' prior knowledge, reading strategies, and text structure variables. This perspective is integral to the perspective of reading as an interactive process where meaning is constructed from the text, the reader's background knowledge, strategies and motivation and the text itself (Lipson & Wixson, 1991, p. 14). The adoption of an interactive approach to reading starts with the assumption that comprehension is an active process to which each reader brings his or her own individual attitudes, interests, expectations, skills and prior knowledge. (See Figure 1.1.)

Having established that an interactive approach is the view of reading to be adopted in this study, this chapter continues with an overview of the component skills in reading. This aims to highlight the complexity of the reading process and demonstrate that reading requires the interaction of many component skills and factors.

## COMPONENT SKILLS IN READING

As reading is cognitively demanding, one approach that works well is to describe reading as a complex of component skills. This is an approach taken by Carr & Levy (1990) and Haynes & Carr (1990) as they attempt to explain and understand the reading process. Such an approach can be accommodated within the perspective of reading as an interactive process as it seeks to identify the comprehension and conceptual skills required in reading. A component skills approach also serves to emphasise the fact that comprehension is affected by the reader's background knowledge, reading strategies and text structure.

According to Grabe (1991) reading includes the following skills and knowledge areas. *Automatic recognition* skills are recognised as central processes in fluent reading. Many cognitive psychologists now see the development of automaticity in reading, for example word identification skills, as fundamental. Automaticity may be defined as the ability of the reader to process and understand text with little processing capacity. Readers should be able to access lexical items with ease and fluency. Less fluent readers have been found to lack automaticity in lower level processing skills. This point is made quite emphatically by van Dijk & Kintsch (1983, pp. 23-24):

What exactly distinguishes a good reader from a poor reader? The greatest facilitation of word recognition by meaningful contexts is observed with poor readers, not with good readers. Furthermore it is simply not true that good readers take decoding lightly: they fixate almost every content word. It has been found over and over again that the best discrimination between good and poor readers is performance on simple letter and word recognition tasks. What is really wrong with poor readers is that they recognise isolated words inaccurately and too slowly, and compensate for their lack of decoding skills with context-dependent guessing or hypothesis testing.

*Vocabulary and syntactic knowledge* are also critical to reading. Unknown vocabulary and unfamiliar syntax make comprehension difficult. Fluent readers need a good knowledge of language structure and a large recognition vocabulary. Research by Cohen, Glasman, Rosenbaum-Cohen, Ferrera & Fine (1979) found that both technical and nontechnical vocabulary could be problematic for students and that a consequent lack of understanding could lead to inappropriate interpretations of the text.

*Knowledge of formal discourse structure* also contributes to effective reading. There is considerable evidence that knowing how a text is organised influences the comprehension of a text. For example, good readers make better use of the organisation of text than do poor readers. They also write better recalls by recognising and using the same structure as the writer and generally recall information better from certain types of text organisation (Meyer & Freedle, 1984; Richgels, McGee, Lomax & Sheard, 1987). Research in reading English L1 and L2 has been varied, and results show a number of findings. Carrell (1984b) has shown that rhetorical patterns which are tightly organised, such as cause and effect are likely to be more conducive to recall than texts loosely organised around a collection of facts. This area of empirical research is central to the present study, and constitutes one of the major areas of enquiry. (See also Chapters 2 and 3.)

*Content schemata*, otherwise known as prior knowledge of content, or background knowledge has a major influence on reading comprehension (Anderson & Pearson, 1984; Afflerbach, 1990). Reading comprehension is clearly helped if the content domain is already familiar, or the reader has the developed the conceptual skills from prior learning and can apply these to the new reading task. Empirical research by Hayes & Tierney (1982) showed how a text can teach or draw upon background associations to aid the comprehension of a new passage. In this study, a group of American high school students

attempted to learn about a game of cricket from a text that contained analogies from baseball. Another group tried to achieve the same end by reading newspaper articles about cricket. Results demonstrated that students' prior knowledge about baseball and the use of analogous instructional texts was a positive help in interpreting and understanding new texts. With readers from non-English speaking backgrounds, Alderson & Urquhart (1988) found that students' background knowledge in a particular academic field would affect their performance on tests of reading comprehension. In the context of the present study this finding is particularly relevant. All subjects who participated were first year students of science and all were given texts to read from a scientific journal. This was to ensure that the effects of background knowledge would not advantage one group over another. (See Chapter 6.)

*Cultural knowledge* has been shown to influence comprehension. The implicit cultural knowledge presupposed by a text interacts with the reader's own cultural background. Texts which are culturally familiar are likely to be understood more readily than those where content is unfamiliar Steffensen, Joag-Dev & Anderson (1979) and Floyd & Carrelli (1987). One potential source of reading difficulty for a reader are texts which contain implicit cultural knowledge or attitudes which are not congruent with the reader's background knowledge (Kintsch & Greene, 1978). (Cultural content schemata are discussed at length in Chapter 3.)

*Evaluation and synthesis skills* are required by readers in order to evaluate texts and relate textual information to their own knowledge. In addition, they are required to synthesise different sources of information, evaluate texts, appreciate the writer's perspective and take a position in relation to the ideas expressed. This aspect of reading is discussed by Freebody (1992) and Luke (1992) who extend the notion of reading to include reading as a social practice, with the reader as a critical interpreter of knowledge and equipped with higher

order skills such as the ability to recognise ideological positions and socially constructed texts. All of these skills are cognitively demanding.

*Metacognitive knowledge* and skills monitoring are essential to the reading process. Metacognitive knowledge is knowledge about cognition and self-monitoring of one's own learning (Garner, 1987), together with the ability to employ appropriate strategies to achieve specific goals. As related to reading, this would include such skills as previewing headings, self-monitoring, searching for specific information and adjusting reading rate. The ability to use metacognitive skills effectively is widely recognised as a critical component of skilled reading. The research literature is extensive in this area, with scores of empirical studies showing that effective readers have a broader repertoire of metacognitive skills than less fluent readers (Garner, 1987; Carrell, 1989; Kletzien, 1991; Irwin, 1991). Cohen, Glasman, Rosenbaum-Cohen, Ferrera & Fine (1979) have compiled lists of reading strategies which combine cognitive strategy use and monitoring.

A component skills perspective is an appropriate direction for the present research as it provides insights into the reading process and enables the process of comprehension to be analysed into several skills and knowledge areas. It also gives a clearer perspective on reading research by demonstrating that a variety of reader factors and skills interact to influence reading. This perspective is also compatible with the interactive approach to reading, which implies relationships among the various skills. For example, second language reading comprehension has been shown to be related to awareness of text structure, language proficiency, metacognitive awareness and use of reading strategies (Eskey, 1988). By combining a component skills framework with an interactive approach to reading it becomes possible to highlight the theoretical areas which are relevant to the present study, and to review the literature which contributes to an understanding of the research questions.

## TERMINOLOGY

In reading research, the words 'recall' and 'comprehension' are sometimes used interchangeably (Irwin, 1991, p. 11). In practice, it is often impossible to separate recall from comprehension, because it is not possible to tell what a student has comprehended without asking him or her to recall or recognise it in some way. Kirby (1991, p. 107) describes comprehension as the extraction of meaning and "...the recognition of relationships between two or more separate units of information held simultaneously". This view of comprehension will be adopted for the purposes of the present study. Throughout this study, 'comprehension' and 'recall' are used frequently, and the comprehension task set for subjects in the study was to ask them to recall texts immediately following a reading. (Chapter 3 will provide the background to the recall task in reading.)

The term 'L1 reading' will refer to studies relating to first language speakers of English reading in English, while 'L2 reading' will be used for reading in English as a second language. The term "cultural background" does not imply any fixed notion that cultural background can be equated with language background. One of the points that emerges in this study is the distinction between language and culture or country of origin. While all three groups were culturally different, the Singaporean and Australian students shared a similar language background in English insofar as both were educated through English and used it as their main language of communication. In this thesis, the term "different language background" is a descriptor used to identify the subject groups who participated in the study. The term is not to be confused with "cultural background" which sometimes implies a unitary system tying language and cultural background. For instance, it is sometimes assumed that students who are culturally different will have a language deficit, or that they



are English as a second language (ESL) speakers. For the present study language background in English is the major feature under investigation, while the cultural and language differences serve to divide the subjects into three distinct groups. The term 'ESL' will be used to denote 'English as a second language'.

For the present study, text structure is defined as relations between ideas in the text. It also includes signalling words and overall organisational patterns found in texts. The term "scientific text structure" is used throughout the thesis to refer to texts that are commonly found in, but not specific to, scientific texts. The organisational patterns problem/solution, comparison/contrast, problem-solution and description are also features of expository text. As Grabe (1987, p. 116) points out, expository text is the overall text type and scientific is a sub-text within that category. Nevertheless, there is sufficient evidence from the literature reviewed (Trimble, 1985; Cook & Mayer, 1988; Britton & Black, 1985) to justify the inclusion of the textual patterns problem/solution, comparison/contrast in the use of the term "scientific discourse" throughout the thesis. This does not imply that they are specific to scientific discourse. Furthermore, the texts used in the study were extracts from a scientific journal displaying the above-mentioned patterns.

A number of terms are used throughout the text to refer to the organisational patterns in text. These will be explained in the next section. Before presenting the research questions in more detail, the relationship between text structure and comprehension will be described.

## **WHY TEXT STRUCTURE IS CENTRAL TO COMPREHENSION**

The most obvious feature of text is its connectedness. Discourse is the term used to distinguish text from sets of unrelated words (McCarthy, 1992). The term text structure may refer to a number of different conceptualisations (Hatch, 1992). Firstly, text structure may refer to the organisation of ideas in text. It may include general organisational details, such as the plan the writer follows. From the writer's point of view texts are usually organised in such a way as to communicate key ideas. In a straightforward narrative or story, this would consist of a situation that is introduced, expanded and concluded (Mandler & Johnson, 1977).

Text structure can be analysed into two levels: the micropropositional (idea) level and the macropropositional (main idea) level Kirby (1991, p. 118). The former consists of the arguments of the text formed by subjects and predicates, and the cohesive ties which link them together. The latter refer to the main idea elements which give text its overall structure, or organising principle. This level of text structure is crucial to comprehension, and is sometimes conceptualised as the techniques or stylistic devices within and between paragraphs that are employed by a writer to make points and select or present information. A number of ways of describing the organisational plan of the writer have been used. Meyer (1975, p. 23) used the term *content structure*. Trimble (1985, p. 12) used the term *rhetorical techniques*, and McCarthy (1992, p. 78) refers to *textual patterns*. The content structure approach of Meyer (1975) is at the macro-propositional level, but the procedure for analysis built on micro-propositional structures. (See Chapter 5.) Throughout this study terms such as textual patterns and rhetorical organisation are used interchangeably to refer to the overall macro-propositional structure of the text.

Such schemes can be regarded as examinations of the macrostructure of the text; they look at how the text is organised in its totality. Therefore the term text structure also includes organisational patterns spanning different paragraphs. As stated above, for the present research, the term text structure will refer to structures or patterns identified in the text used to organise ideas. It includes relations mentioned in the text and signalling techniques indicating logical relations between ideas. An example of a signalling word used by a writer to cue the reader would be "first", "second", or "the problem is..." (Loman & Mayer, 1983, p. 403).

Analysing text structure is important for a number of reasons. Recent research on the process of reading has demonstrated the importance of awareness of text structure for readers' comprehension and recall of material (Kintsch & van Dijk, 1987; Hare, Rabinowitz & Schieble, 1989). One of the central questions in comprehension research is how fluent readers identify the important information in texts. Winograd & Bridge (1986, p. 25) propose an answer to the question by offering two possibilities.

The first is that authors provide cues in the text which mark or accentuate the ideas they deem important. The second possibility is that as readers gain experience with various text types and develop the background knowledge about various topics, they develop the ability to differentiate the salient information from the less salient information. Most likely it is a combination of the two possibilities: as readers mature, they increase their knowledge of the world and of text structure and also become more efficient at identifying the methods authors use to mark important information.

The experience and background knowledge referred to here can be explained by reference to schema theory (Chapter 3), which emphasises the centrality of background knowledge in the comprehension process. Schema theory suggests that readers with high prior knowledge of the formal structures of the

text, have well-developed schemata, or knowledge structures into which they can fit the information from the text. Therefore, a reader with prior knowledge of the structure of the text is apt to interpret information in the text more readily.

Empirical studies show that skilled readers can rapidly identify the structure of text as they are reading and use it to facilitate comprehension and recall of ideas (van Dijk & Kintsch, 1983). While reading, skilled readers use their awareness of text structure to help them identify the key points being made. Winograd & Bridge (1986) also found that readers who recognised the structure of the passage also tended to recall the most important ideas. In contrast, research with younger, less experienced readers shows that they are not always very skilled in using text structure to facilitate comprehension and recall (McGee, 1982). Further empirical investigations on the impact of text structure structure awareness on recall of information from prose will be presented in Chapter 2.

An overview of the research exploring the relation of text structure to reading comprehension has suggested that poorer readers are likely to be less sensitive to passage structure as measured in either in recall or in stated awareness (Meyer, Brandt & Bluth, 1980; Taylor, 1980). Research has also consistently found that readers remember superordinate ideas rather than subordinate ones (Afflerbach, 1985; van Dijk & Kintsch, 1983; Winograd & Bridge, 1986). Arising from this observation, a number of researchers have attempted to develop theoretical frameworks for determining what is important in narrative and expository texts. Johnson (1970) decided to use subjects' ratings as a guide to important versus unimportant information. Mandler & Johnson (1977) developed models of the internal structure of simple stories and used them to identify important information. Similar methods have been used to analyse expository prose and Meyer's (1975) has proved both

influential and practical as a method of demonstrating why some portions of expository prose are considered more important and therefore remembered more than others. Meyer's (1975, 1985) technique for analysing texts results in a hierarchically arranged tree structure called the content structure. (Examples of the approach adopted are shown in Chapter 4, which describes Meyer's analysis of expository prose.) The content structure displays how the content words are related to each other and in addition, which ideas in the passage are superordinate and which are subordinate.

Meyer (1975) has identified four basic organisational structures commonly found in expository texts (see Figure 2.1):

1. **Attributive:** collection or list of events or components to a given topic; description of details, or specifying the characteristics or attributes of an object, person animal or event.
2. **Covariance:** cause and effect
3. **Response:** presenting a problem and then proposing a solution, or asking a question and providing an answer.
4. **Adversative:** comparison and contrast: comparing two or more events, objects or people in terms of their likenesses or differences.

According to Meyer (1975), these organising principles are also devices used by writers to communicate information in written texts. There is also agreement that expository prose includes these organisational patterns spanning several paragraphs. (See Chapter 4.)

Meyer's (1975) content structure approach examines the hierarchical aspects of text structure, and how the writer interweaves main and supporting details. At the top of the hierarchy there are main ideas, and less important ideas and details elaborate and expand these. A parallel and simple example

of a hierarchical structure may be found in any textbook, where a heading indicates a superordinate idea followed by subordinate ideas and supporting details. This does not correspond to any linear order that the writer may have imposed, but organisational patterns may nevertheless be presented in linear order. It is expected that well-organised text will be structured according to certain patterns, which can be accessed by readers as they try to understand the main points of written text. The content structure approach to the analysis of text specifies the logical connections in a among the ideas in the text as well as the subordination of some ideas to others.

Meyer (1975, 1985) has gathered empirical evidence that the way ideas are organised in the passage can influence comprehension. Ideas which are 'high' in the passage are those expressing main ideas and are recalled better than ideas low in the hierarchy, which are often details. According to Meyer (1975), readers process information from text in a hierarchical manner corresponding to the content structure of the text being read. As stated previously, the content structure shows the pattern of organisation of ideas and the subordination of topics within the text. Moreover, the top-level structures *causation*, *collection of descriptions*, *comparison/contrast*, *problem/solution* are expected to provide readers with a systematic, organised framework for comprehending information from text and retrieving it from memory.

Empirical research indicates that good readers approach texts with knowledge of how texts are conventionally organised and make use of particular strategies to identify and use the 'top-level structure' of a text (Meyer, 1985, p. 25). Other studies adopting Meyer's approach have examined the effects of structure on what the reader comprehends and retains from text. These studies will be discussed in detail in Chapter 2.

According to some researchers working in the area of learning and remembering from prose, (Meyer, Brandt & Bluth, 1980; Barnett, 1984; Connor,

1984; Carrell, 1992) Meyer's (1975) prose analysis system has been successfully used to identify and classify types of structures in expository prose. Such studies suggest the benefits of text structure analysis for conducting reading research. Firstly, by specifying text structure we can compare and evaluate texts with respect to their similarities and differences. In addition, such analysis enables the researcher to identify the type and amount of information a reader can recall from a text. Finally, any variations arising between a text and a readers' recall of the text can provide data on readers' understanding which may become the subject of analysis.

At this point we can summarise the reasons why text structure is important to comprehension. As stated earlier, text structure is the overall plan that a writer uses to organise the ideas in a text. The reader can access and interpret this organisation by looking for signalling words and by relying on both intuitive and explicit knowledge of how texts are constructed. There is evidence that both children and adults have knowledge of logical relations and structures. For example, their expectations of structural aspects of story grammar greatly influence their comprehension. Recall is always better for organised passages than for randomly organised passages. Children may have limited knowledge and exposure to expository text structure and therefore their recall of ideas from such texts may be limited. In addition, readers actively search out the main ideas of a text by using clues and signals offered in the text. Text structure awareness facilitates recall of ideas from text: moreover, awareness promotes better recall, not only quantitatively in terms of more information recalled, but qualitatively, in terms of recognition and recall of main ideas.

The present research is intended to extend and amplify the findings of empirical research on text structure awareness, as research in the area has not produced conclusive evidence as to the effects of discourse knowledge on

learning and recall among university students. There is however, evidence from research that fluent readers approach expository text with some knowledge of how such texts are organised (Meyer, Brandt & Bluth, 1980; van Dijk & Kintsch, 1983) and that they use their knowledge of text structure to organise the information in written recalls. Most empirical studies have been conducted with younger students who are still at developmental stages of reading (McGee, 1982; Kletzien, 1991). While some studies such as Carrell's (1984a, 1992) have investigated the relationship between L2 readers' awareness of text structure and amount of information recalled from texts, there have been no studies other than Connor (1984) which have compared the reading performance and awareness of text structure in expository prose of first and second language readers of English.

### **RESEARCH QUESTIONS**

The distinct line of investigation motivating the present study is research which has shown that awareness of text structure facilitates recall of main ideas and that certain organisational patterns have a greater facilitative effect on recall of information than others. Empirical studies in this area are linked to schema theoretic approaches to reading which focus on the centrality of prior knowledge that the reader brings to the text in the act of reading. One type of background knowledge that readers have is knowledge and expectations about text structure. This is linked to the reader's proficiency in language which enables both knowledge-based and text-based processing to proceed. Reading in L1 and L2 may involve similar cognitive processes, (Wolff, 1987) but nevertheless, readers may have different expectations and knowledge about how text is organised, depending on their cultural and language background.



The focus of the present research is to investigate differences in awareness and recall of texts by three groups from different language backgrounds, all students in first year science courses at university. The present research follows a succession of studies investigating L1 and L2 readers awareness of discourse structure. These studies will be reviewed in Chapter 2. Because previous studies have been conducted mostly with high school students and have relied on text book sources or specially constructed passages, the study used authentic texts selected from *The New Scientist*. The texts were chosen because they exemplified certain types of expository structures, typical of scientific texts (McCarthy, 1992). They are also representative of one type of reading material presented to university students in their first year of study, though the examples used in the research tasks are short articles.

In addition, the study investigates whether the organisational patterns *comparison/contrast* produces more main ideas in written recalls of subjects, compared to *problem/solution*. These forms of textual or rhetorical organisation were selected because of their prominence in the scientific articles surveyed and because previous studies show that they facilitate recall of main ideas more effectively than loosely organised patterns such as description Meyer & Freedle (1984).

The three groups in the study differed with respect to cultural backgrounds, but since the subjects who participated in the study were students at university and, it is assumed, literate and proficient readers, it was expected that they would have well-developed automatic recognition skills together with vocabulary and syntactic knowledge. Empirical studies reviewed in Chapter 2 indicate the role of background knowledge and cultural schemata (knowledge structures and expectations) in reading comprehension. Researchers interested in the reading process have recognised that readers comprehension of a

text is influenced by prior knowledge. An L2 reader who reads a story that presupposes a particular cultural perspective will understand less than a reader who is familiar with the cultural context. Cognitive psychologists Anderson & Pearson (1984) and Rumelhart (1980) have sought to explain the nature of these differences through the construct of schema theory (see Chapter 3). Schemata or knowledge structures provide an interpretative scaffolding which readers can access while constructing meaning from texts. Schema theory has shown that the cultural familiarity of the text may be an important determinant of reading success. In the context of the present study therefore, it might be expected that there would be differences in the reading performance of students from different cultural backgrounds.

While acknowledging the contribution of psycholinguistic research and schema theory in explaining the role of cognitive processes in reading comprehension, many researchers remained sensitive to the role of language competence in reading success. (This literature is reviewed in Chapter 3). The critical interaction of language proficiency and second language reading is well documented in the literature (Devine, 1988; Dubin, Eskey & Grabe, 1986; Eskey, 1988). The ability to use appropriate reading strategies depends on the level of mastery of a language. With respect to the present study, all readers were proficient and fluent in English as they had all satisfied the university requirements in English language. The Australian and Singaporean students both had similar language backgrounds, insofar as both groups were educated in English and both used the language as the primary medium of communication. The Malaysian students regarded themselves as ESI, background, and although they had studied English in high school continued to use Malay as their primary language. It was anticipated that there would be differences in the performance of the Malaysian and Singaporean students on the reading tasks because of these differences. The interaction of cultural background

with language competence is therefore of central importance to the study.

In the study, the following research questions were addressed. For greater clarity the questions are grouped under appropriate headings.

### **Idea Units and Main Ideas Recalled**

1. Are there differences in the number of idea units recalled by each of the three groups from different language backgrounds?
2. Are there differences in the number of top-level (main) ideas recalled by each of the different groups?
3. Do differences in rhetorical organisation of science texts result in differences in number of ideas recalled? (Which structure type promotes better recall of idea units?)
4. Do differences in rhetorical organisation of texts result in differences in number of main ideas recalled?

### **Awareness of Text Structure**

5. Are there any differences among the three groups (Australian, Malaysian, Singaporean) in awareness of text structure? (manifest in use of structure in written recall)
6. Are there differences among the three groups in awareness of text structure? (manifest in a recognition and naming task)
7. Are there any relationships between quantity and quality of ideas recalled and structure awareness? i.e.,
  - (a) Do subjects who use the structure of the original passage in their paraphrases recall more than those who do not?

(b) Do subjects who recognise text structure recall more than those who do not?

8. Is there a relationship between the three measures of structure awareness, use of the structure of the original passage and recognition and naming of text structure for different types of text structure? (Do students who use a structural strategy also recognise and name structurally different texts?)

Part I of the study will present the literature review and theoretical background to the study.

## **Part II**

# **Literature Review & Theoretical Background**

## **Chapter 2**

# **Research on Text Recall and Structure Awareness L1 and L2**

This chapter will present a summary of the findings of empirical investigations on the interaction of text structure awareness with recall of ideas from expository prose. This part of the literature review will provide a background to the research questions. In addition, the results of studies comparing structure awareness and recall of ideas in first and second language readers will be reported. A comprehensive review of all the literature pertaining to text comprehension and awareness of text structure is, however, beyond the scope of this study. Instead, this chapter is organised around a series of questions in order to make the literature review more directly relevant to the research questions. Responses to the questions address the central issue of how fluent readers identify important information in text and what strategies they use. Differences between L1 and L2 readers' awareness will be explored and measures of text awareness and recall discussed.

- What evidence is there that text structure affects comprehension and recall of ideas?

- What particular reading strategies have an effect on comprehension and recall of ideas?
- How do L1 and L2 readers compare in their awareness of text structure and recall of expository text?
- What measures of text structure awareness and recall have been used in previous studies?

The responses to each question will be presented as a summary of findings and the differences between first and second language reading will be discussed in order to highlight particular aspects of reading comprehension for second language speakers of English. This brings into clearer focus the cross-cultural aspects of the present research.

### **EVIDENCE THAT TEXT STRUCTURE AFFECTS COMPREHENSION AND RECALL**

A considerable number of empirical studies in L1 and L2 have dealt with the influence of text structure on comprehension and recall. Chapter 1 presents an overview of the reasons why text structure is important to comprehension. Substantial research evidence suggests that organisational structure of the text as well as prior knowledge are important factors that influence text comprehension (Anderson & Pearson, 1984). Research has examined the effect of text organisational structures on comprehension performance. The results indicate that awareness of text structure and recall of ideas from text are closely related phenomena, as the former facilitates the latter.

Several studies have established that fluent readers can identify and use important information in texts by accessing textual information (Johnson, 1970; Taylor, 1980). Research has found that good readers are more likely to remember main ideas than subordinate ideas, because they are efficient

at identifying text structure and recognising the authors' techniques for signalling important information (Britton, van Dusen, Gulgoz & Glynn, 1989; Meyer, 1975). Throughout the literature on text comprehension, various methods have been used by researchers to identify important ideas, resulting in complex analyses of text structures and hierarchical relationships between ideas (Kintsch & Greene, 1978).

As used in this study, text structure refers to the pattern of relationships among ideas presented in expository writing. This pattern is also referred to as organisational structure, as it shows how ideas are related to one another. Meyer's (1975) technique for analysing prose, called 'content structure' results in a hierarchically arranged tree-structure diagram displaying which ideas in passage are subordinate and which are superordinate. As explained in Chapter 1, Meyer (1975) has gathered evidence that five basic types of expository text type affect comprehension. These five basic types are called causation, comparison/contrast, problem/solution, description and collection. Figure 2.1 (adapted from Richgels, McGee, Lomax & Sheard (1987)) presents the specified organisational components required for the different discourse types. The comparison type points out differences and similarities between two or more topics. The collection and description type may be grouped according to association or time. Causation is more highly organised and shows a causal relation between ideas. In problem and solution there must be some overlap in topic content insofar as one part of the solution must match an aspect of the problem. In each of these structures there is a topic level, a main idea level and a detail level with relations connecting these ideas.

There are two expectations implicit in Meyer's analysis of text structure. The first is that the height of an idea in the hierarchy will predict or explain the comprehensibility or memorability of the particular parts of the text. (Chapter 6 presents examples of content structure analysis and tree structure



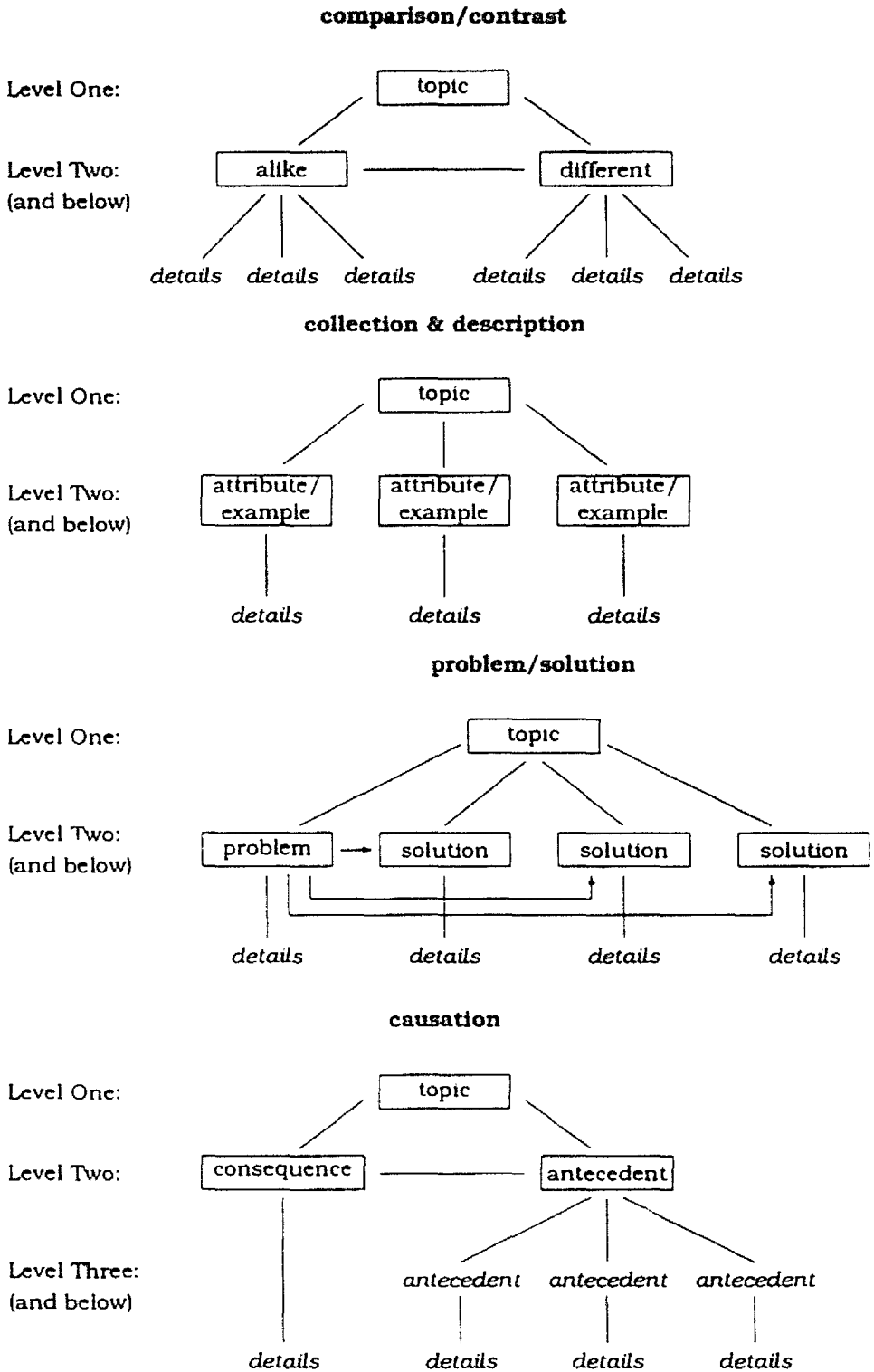


Figure 2.1. Organisational Components Required for the Different Discourse Types (adapted from Richgels, McGee, Lomax & Sheard (1987, p. 183)).

diagrams of the passages used in the present study.) In practical terms this means that by analysing the structure of a text it may be possible to predict which ideas will be recalled from text by readers.

The second expectation is that readers are sensitive to structure and that ideas from high levels in the content structure will be easily recalled. To test these hypotheses, Meyer (1975) designed an experiment to test whether low and high ability readers were sensitive to ideas at different levels of the content structure. After listening to a short passage, students answered several questions. Some questions were taken from idea units high in the structure of the passage, while the detail questions were derived from idea units low in the passage. Results showed that all students regardless of ability answered more main idea questions than detail questions. Meyer concluded from this study that children, like adults, recall significantly more main ideas from the top-level of the structure than from the lower, and that content structure representation can be useful in generating different types of comprehension questions and instructional texts for poorer readers.

Studies examining the effects of text structure on readers' comprehension and recall reflect a developmental dimension, with more mature readers displaying and using text-structure (Englert & Hiebert, 1984; McGee, 1982). According to one explanation (Meyer, Brandt & Bluth, 1980) recall differences could be explained by differences between the text processing strategies used by structure aware students. According to further studies, (Richgels, McGee, Lomax & Sheard, 1987) readers who are not aware of structure in text may read in a random and procedural fashion, recalling ideas at random or as a series of discrete points. This hampers their recall, not only of the main ideas, but also of the 'gist' or perspective of the passage. On the other hand, readers who are aware of discourse structure may use a particular strategy to guide encoding and retrieval of textual ideas. They search for clues that

denote particular text structures and that signal the author's thesis. Efficient readers apply this strategy and 'chunk' the text into components that fit cohesively together. Meyer, Brandt & Bluth (1980, p. 78) called this a "structure strategy". Use of this strategy facilitates recall. Readers using this strategy to access the texts' structure are able to process the text strategically and recall more. Such readers use their prior knowledge of how texts are structured, and predict that texts display logical organisational devices, such as comparison and contrast, cause and effect and so on (Richgels, McGee, Lomax & Sheard, 1987).

Other studies examining the effect of readers' recognition of text structure on comprehension and recall indicate that when readers recognise the structure of text, they are better able to identify important ideas and recall them (McGee, 1982; Meyer, Brandt & Bluth, 1980; Taylor & Samuels, 1983). Kletzien (1991) indicated that both good and poor readers used the strategy of recognition of text or sentence structure on passages of intermediate difficulty. Differences in strategy use emerged only when the groups were presented with passages of increased difficulty. Here, good comprehenders used a variety of strategies, and continued to monitor their strategy use, while poor comprehenders showed a decline in number of strategies used.

### **READING STRATEGIES, TEXT AWARENESS AND RECALL**

Related research comparing good and poor readers shows that proficient readers are more likely to use text structure to guide their recall. In the studies cited above, text structure recognition correlated with reading ability as well as with grade level. Meyer, Brandt & Bluth (1980) found that better readers were more likely to use the structure of the original passage when recalling ideas. More recent studies such as Winograd (1984), Winograd & Bridge

(1986) postulate that fluent readers use textual criteria to determine what is important in text.

(Meyer, 1975) has also demonstrated that readers are aware of certain structural patterns in expository writing. These differences in awareness have been shown to correlate with type and amount of information recalled after reading. Similarly, different rhetorical patterns may affect recall. The more highly organised patterns of comparison/contrast were found to produce more top-level ideas in recall protocols than loosely organised patterns such as description (Carrell, 1992; Meyer & Freedle, 1984).

Research by Meyer & Freedle (1984) investigated whether different types of top-level structures might be inherently more facilitative of recall than others. In the investigation, graduate students read articles with identical middle and low level structures and content. The passages differed only in the way top-level structures were organised in the content structure diagrams. The three types of structure compared in the study were comparison/contrast, causation and collection. It was predicted that information in passages organised with adversative, (comparison/contrast) covariance (cause and effect) structures would be remembered better than information from the passage organised with an attributive (collection) structure. The subjects completed a number of recall tasks after they had listened to the passages. The responses were scored according to the number of idea units recalled and the type of rhetorical structure subjects used to organise their recall protocols. The results showed differences in the amount recalled from different text-structure types. Subjects recalled more ideas from information structured by comparison/contrast and causation than by collection. It was argued that collection was remembered less efficiently because it has fewer organisational components. From these findings, Meyer & Freedle (1984) concluded that differences in the type of structure used to organise textual information affected

the amount of information graduate students learned and remembered.

While the evidence suggests that some organisational structures have a greater facilitative effect on recall than others, the results are sometimes conflicting and because the age of subjects and the particular tasks used for recall have varied from study to study. For example, a text with comparison/contrast structure enhances recall for older age groups (Meyer & Freedle, 1984), but the research with children has found no differences in recall across text organisational structures (Slater, Graves & Piche, 1985). In addition, the facilitative effects of comparison/contrast have been observed to be task dependent according to a study carried out by Hiebert, Englert & Brennan (1983). On a reading recognition task, requiring students to recognise related details and intrusive information, comparison/contrast was found to be most usable and recognisable. On a writing task, however, comparison/contrast was found to be more difficult. This study was carried out with high school students, however, and so its generalisability is limited. Meyer & Freedle (1984) using adult readers found that causation and comparison passages facilitated recall more than descriptive and response passages did. A later study by Richgels, McGee, Lomax & Sheard (1987) found that subjects had more difficulty with the causation structure than with the comparison structure.

Most of the studies cited above were based on Meyer's (1975) five basic organising types of discourse. Meyer & Freedle (1984, p. 140) observe that:

The more organised types of discourse are posited to promote more efficient processing of text. The greater number of organisational components provide a structure with more specified relationships among components for use during instantiation and storage of facts in memory. They also provide more retrieval cues and more specific cues to facilitate memory of stored information.

The strength of this notion can be effectively demonstrated by reference to a number of instructional strategies that have been developed to make readers aware of the rhetorical structure of texts (Armbruster, Anderson & Ostertag, 1987; Barnett, 1984). The objective of teaching these strategies is to help readers use knowledge about the rhetorical structure of texts to guide their organisation and interaction with texts while studying. Other studies involving teaching students to recognise and summarise text structures have had positive effects on comprehension and recall. Slater, Graves & Piche (1985) have developed a technique that focuses on a number of top-level structures found in social science texts. The top-level structures are taken from Meyer (1975). The technique provides students with written examples of four top-level organisational patterns found in written material. Students are then taught to read the material containing each of these patterns. The results of the study showed that students trained in using an outline-grid of top-level structures performed better than students in three other test conditions:

- (a) those who were given a written example of the passages's top-level structure
- (b) those who were instructed to read the passage and then take notes, and
- (c) those who were simply instructed to read the material.

Further studies such as Taylor & Beach (1984), Slater, Graves & Piche (1985), Armbruster, Anderson & Ostertag (1987) have all shown significant facilitative effects of explicit instruction on text structure with first language speakers of English. Carrell (1985a), showed a similar effect by explicit teaching of Meyer's top-level text structures with English a second language students. More recent studies with university students reading French as a second language (Davis, Lange & Samuels, 1988; Raymond, 1993), have indicated that knowledge of structure gained through instruction is beneficial

in assisting comprehension of texts. Davis, Lange & Samuels (1988) provided training in the structure of experimental reports to undergraduate students. Two groups of subjects took part in the study. Subjects were assigned to training on the organisation of a journal article or to a condition where they received no training. The students were then given a recall task following the reading of a scientific article. The results showed that subjects who had undergone training scored significantly better on number of ideas recalled.

Raymond (1993) in a study designed to enhance skills in reading in French as a foreign language confirmed that training in the use of the structure strategy to recall ideas proved as effective as it had done in English language reading studies.

In summary, the empirical research investigating the influence of text structure on readers' processing and recall of ideas has been quite productive. It seems that awareness of text structure can be a positive strategy in the recall of the main ideas of a text, and one which efficient readers turn to when reading. The findings of L2 (ESL) research on text structure will now be reviewed.

### **RESEARCH ON L2 READERS' RECALL OF IDEAS AND AWARENESS OF TEXT STRUCTURE**

In this section, selected L2 reading research in which L2 subjects were the subject of investigation with respect to recall of ideas and awareness of text structure will be presented. The focus will be on studies which have used Meyer's (1975) framework of top-level structural analysis. These confirm the findings of L1 research on text structure awareness and recall. No conflicting findings have been found in the literature.

Carrell (1984b) looked at the effect of rhetorical organisation on reading comprehension. She used two versions of three different passages containing

two story episodes. One of the versions contained the same story episodes (pets, twins, roommates) but the story sequence was changed. ESL students were asked to read the passages and were told prior to reading that they would have to recall them. The results showed a significant main effect for sequencing, that is the subjects recalled 76% of the standard versions and only 68% of the unsequenced stories. It was concluded that recall is enhanced when a story conforms to a reader's schema for stories. Also, subjects who recalled the changed versions of the story showed a strong tendency to recall texts in the schematic temporal order rather than in the input order. This study supports the finding of L1 research that readers have expectations about text structure which enable them to recall text effectively.

In a further study investigating the effects of rhetorical organisation on reading comprehension of second language readers, Carrell (1984b) found that readers' use of top-level structure facilitated recall of important information. The study involved expository texts that conveyed the same content but were structured with either a comparison/contrast, problem/solution, causation, or description top-level rhetorical organisation. Subjects in the study represented four groups of subjects from different L1 language backgrounds. The texts were four versions of the same expository passage, the only difference being the rhetorical organisation. It was found that students from different language backgrounds recalled differential amounts of information, depending on the different organisational structures of texts. The results showed that the more tightly organised patterns of comparison, causation and problem/solution generated better recall than the more loosely organised collection of descriptions. Overall, the study concluded that readers who used the structure of the original passage according to the original text version recalled significantly more than those who did not. This finding is similar to the study conducted by Meyer & Freedle (1984) with L1 subjects. The study



also found that there were some differences among the language groups as to which discourse types promote better recall. For each language group with the exception of the Arabic group, the comparison/contrast, causation and problem/solution discourse types were recalled better.

Connor (1984) explored the difference in recall between first and second language readers. The subjects in the study were advanced level ESL and L1 undergraduate students. Prior to reading the passage, subjects were told that they had to write a paraphrase of the passage. The results showed that there was a significant difference between groups in the recall of ideas. First language speakers of English recalled a significantly greater number of ideas, and in addition, more main ideas than the students of non-English-speaking background.

Carrell (1992) investigated learners' awareness of text structure and their recall of text written in different structures. Carrell's work, which the present study is intended to build on, investigated the written recall protocols of comparison/contrast and collection of descriptions texts. The subjects were forty-five high intermediate proficiency students of English as a second language (ESL). In the study the results of two different measures of recall were compared:

- use of organisation in written recall
- recognition of organisation in response to a probe question.

The results showed that there were no differences in levels of awareness with respect to these different measures. Carrell (1992) also also found that there were differences in quality of ideas recalled as a function of text structure, with comparison/contrast showing better recall than collection of descriptions. In addition, it was found that subjects who used the structure of the original

passage in their written paraphrases recalled more main ideas than those who had not.

In L2, the case for strategy training in recognition of text structure has been made by Carrell (1985b) and by Kern (1993). Both draw on evidence that the rhetorical organisation of a text interacts with the reader's formal schemata that is, the reader's background knowledge of textual organisation, and affects reading comprehension.

In summary, there has been extensive research on L2 readers' comprehension and awareness of text structure. The research reviewed here indicates that:

- L2 readers who demonstrate awareness of text structure and use the organisational pattern of the original text show better recall of main ideas.
- Comparisons of L1 and L2 readers indicate that L2 readers may not be as proficient as L1 readers, though that the reasons for this may be quite complex, and not merely a question of language background.
- Students of different language backgrounds may find certain textual patterns more facilitative of recall than others.

This section has served only to present an overview of the findings of empirical research on L2 recall and comprehension of text. The complex interaction of language proficiency, cultural background and comprehension of text will be taken up in Chapter 3.

### **MEASURING TEXT STRUCTURE AWARENESS AND RECALL OF IDEAS**

Research dealing with the comprehension of important information in written prose shows that a variety of methodologies have been used to measure recall

of ideas. These include free recall (Brown & Smiley, 1978) multiple choice questions, error detection tasks (Englert & Hiebert, 1984), summary tasks (Brown & Day, 1983; Winograd, 1984) and think-aloud tasks (Afflerbach & Johnston, 1984). Each of these methods may have advantages and disadvantages and different methodologies may yield different results, particularly if the reader is asked to perform a task during or after reading. For example delayed recall may yield different results from immediate recall, and readers will remember more if they are given some orientation to the task in advance of reading (Winograd & Bridge, 1986; Lee, 1986). The free recall task has been used widely in L1 reading research (Meyer & Freedle, 1984; Richgels, McGee, Lomax & Sheard, 1987) and in L2 research (Carrell, 1983; Carrell, 1984a; Carrell, 1992; Connor, 1984; Lee & Ballman, 1987).

In the case of L2 comprehension it seems that the written recall task has proved to be the most commonly used means of assessing the readers' comprehension of ideas from text (Lee, 1986). To measure quantity of ideas recalled, the passage given to subjects is first divided into idea units according to Meyer's (1975) content structure analysis. Following a comprehension or recall task, each recall protocol is analysed for the number of ideas recalled. For recall of main ideas, the top-level organisational structure of the original passage will determine which ideas are superordinate and which are subordinate. Meyer's research (1975) has shown that ideas located high or at the top-level in the hierarchical structure of a passage are recalled better than information at lower levels. Readers recall protocols are therefore scored according to the number of top-level ideas recorded as these correspond to main ideas in the text. Because of its widespread use and suitability for both L1 and L2 subjects, careful consideration was given in this study to the selection of written recall task as a measure of comprehension of main ideas. This will be further discussed in the methodology section, Chapter 6.

In studies of text comprehension various tasks have been used to measure subjects' levels of awareness of text structure. The most widely used measure of comprehension is, once again, the written recall of a text which has been either listened to or read (Meyer & Freedle, 1984; Meyer, Brandt & Bluth, 1980; Connor, 1984; Carrell, 1992). Measuring awareness of text structure has followed a similar pattern in both L1 and L2 studies. Researchers have assumed that the more closely the organisation of a recall matches the organisation of a text, the more likely it is that the reader was aware of, and used text organisation when reading and recalling (Richgels, McGee, Lomax & Sheard, 1987). Another way to measure awareness of text structure is to evaluate how students use a particular structure to organise their written compositions. Following a stimulus, for example, several texts of a specific structure on a topic, students are asked to write an essay. These are scored according to how well or closely the composition matches the specified structure (Wittrock, 1986). Another approach is to help students focus on structural organisers to help them build coherent texts (Slater, Graves & Piche, 1985).

Other studies in L2 such as Carrell's (1992) asked students to respond to an open-ended question: 'What plan did the writer use to organise the ideas in this passage?'. Richgels, McGee, Lomax & Sheard (1987) rated subjects responses to interview questions on text structure. This task required subjects to use 'structure talk' and metacognitive awareness, and is regarded as the most cognitively demanding of awareness measures.

Three measures of structure awareness were used in the present study because of the complexity of measuring text awareness and to enable the researcher to inter-relate the findings of the different measures. The measures of awareness used were:

1. use of structure in the organisation of immediate written recalls

2. identification of texts written in a similar structure
3. naming text organisational types with an appropriate descriptor by selecting from a list.

(The original tasks presented to students are on page 132.) Three measures of awareness were used in order to provide a deeper understanding of students' awareness. In particular, it was of interest in the study to determine whether students who used the structure of the original passage in their recalls could also identify and name that particular structure. It might be expected that students at university with high levels of proficiency in reading would be able to identify and perhaps name the structure of a passage they had just read, though they might not have a sophisticated vocabulary related to structure.

The studies reviewed above provide insight into the relationship between awareness of text structure and recall of ideas. Research in both L1 and L2 reading seems to warrant the conclusion that awareness and recall are not always separate phenomena, and that there are complex interrelationships between readers ability to recall top-level ideas and their awareness of text structure. For the present study, the main finding of relevance is that awareness of text structure has been shown to facilitate recall of more idea units in addition to better recall of main ideas from text. This finding is consistent for both L1 and L2.

## **SUMMARY OF FINDINGS AND RATIONALE FOR THE PRESENT STUDY**

Meyer's (1975, 1985) work has proved quite influential as a model of text analysis showing the relations between superordinate and subordinate ideas. In the present study, the same framework of analysis is used to identify the content structure of four passages, two organised as problem/solution and two as

comparison/contrast. In addition, the tasks selected to measure awareness of text structure and comprehension of main ideas was a written recall task, used widely in both L1 and L2 studies on text comprehension.

The research reviewed above has produced two major findings. First, differences in discourse type affect memory and learning. Certain rhetorical structures, notably comparison/contrast, cause/effect and problem/solution appear to be more effective as organisational types than other types of rhetorical structure such as collection of descriptions because they produce more main ideas in texts recalled after reading. Another interesting finding is that subjects who recall more main ideas tend to use the structure of the original passage to organise their recalls.

### **LIMITATIONS OF PREVIOUS RESEARCH**

The studies reviewed in Chapter 2 indicate that there is a relationship between text structure awareness and recall of ideas from text. The empirical studies carried out by Meyer & Freedle (1984) and Meyer's original work (1975) rely heavily on textual analysis displaying hierarchical organisational patterns in texts. Little data is provided to show how subjects reconstructed the texts in their recalls.

The work of Carrell (1984a, 1992) lacks process data to support the claims that students from different cultural backgrounds recall texts differently, and that different organisational features and text structures have an impact on recall of information from texts. In addition, Carrell (1984a, 1992) does not directly address the question of language proficiency and provides only a general and broad description of the language level of the subjects. Both studies fail to address the critical interaction of language proficiency with reading ability and rely entirely on schema theory to explain differences in text recall

among subjects. It is also assumed by Carrell (1984b) and by Connor (1984) that textual patterns are different in different languages and that L2 readers are unfamiliar with patterns in L2 texts.

The overgeneralisations and limitations of previous studies provide the rationale for the present investigation. In the present study the contributions of schema theory and language competence thresholds are considered in recall of scientific texts among tertiary level students.

To extend the existing research it is important to test the generalisability of the effects of text structure awareness with expository prose with subjects in a different context and within a specific content domain. The intention was to build on previous studies in L1 and L2 research by focusing on the interaction of text structure awareness and recall of ideas from expository prose. The present study was designed on the assumption that recall of text is facilitated by awareness of text structure and by the language proficiency and reading skills of the readers. The subjects were assumed to be proficient readers and while they had different language backgrounds, were expected to have a degree of mastery over the organisational components of the text types presented. In addition, several important dimensions were added to the present study of recall and awareness of text structure which distinguishes it from previous studies.

1. Most previous studies used short, specially constructed texts, where content was controlled and rhetorical structure manipulated to correspond to some idealised form of Meyer's top-level organisational patterns. The present study used authentic texts selected from *The New Scientist*.
2. Previous studies employed only one or two passages which subjects were asked to recall. The present study used two examples of each text type in order to ensure that the results were reliable.

3. Little research has been carried out with L1 tertiary level students including subjects from different language and cultural backgrounds for whom English is a second language.

Having reviewed the research in L1 and L2 relating to text structure awareness and recall of ideas in text, the next chapter will look more closely at the theoretical aspects of reading and schema theory.



## **Chapter 3**

# **Interactive Reading Processes and Schema Theory**

In this chapter, research on first and second language reading comprehension is reviewed to support the claim that *reading is an interactive process*, involving the interrelationship of formal schemata, defined as knowledge of discourse structure, and cultural schemata, which is seen as background knowledge of the cultural content of the text. The content structure approach of Meyer (1975; Meyer (1985) is interpreted as an active processing model of reading, whereby the reader builds up a mental representation of the text by accessing the textual patterns the writer employs. Both the interactive approach to reading and Meyer's content structure analysis are supported by empirical research within a schema-theoretic framework.

Having established in Chapter 2 that readers' knowledge of the formal organisational features of the text can influence their construction of meaning from texts, this chapter presents the theoretical foundations for these findings by linking the interactive processes of reading to schema theory research. An overview of the interactive approach to reading is first presented as the theoretical basis of the present study. Next, the role of schema theory will be

discussed, highlighting the central role of the reader in constructing meaning from texts.

This chapter will draw together diverse strands of enquiry from L1 and L2 reading research and cognitive psychology which have direct relevance to the research questions presented. The studies chosen for inclusion in this chapter are those that demonstrate the interdependency of cultural and discourse knowledge factors with comprehension. Following an overview of relevant literature, the limitations of schema theory will be discussed. The final section deals with L1 and L2 reading and demonstrates how the interactive approach and schema theory combine to provide theoretical insights into the differences between L1 and L2 text comprehension.

### **SUMMARISING THE INTERACTIVE APPROACH TO READING**

The term interactive is widely used to describe the process of reading. The term can refer to two different conceptions which may cause confusion. As stated in Chapter 1, the present research is based on an interactive approach to reading which recognises the significant contributions to reading of the reader, the text characteristics and the context. This view also includes the notion of interactive in the sense that many component skills come together in the process. (See page 8.) Reading is an interpretative activity or dialogue which takes place between the reader and the text. In this dialogue, there are contributions from the reader's background knowledge, the context in which the reading occurs and the textual information itself. (See Figure 1.1, page 10.) It is appropriate in the present context to cite the views of Lipson & Wixson (1991, p. 22) who provide a summary.

There is ample reason to conclude that reading is accomplished as an interplay among three factors: the reader, the text, and the context. Reader

factors that influence process and performance include the reader's prior knowledge, his or her knowledge about reading, and his or her attitude and motivation for reading. In addition, there are text factors that affect the reading process. These include the type and organisation of the text, the linguistic properties of the text, the structural features including headings, maps and so on.

In addition, the context, purpose and task affect the reading process, as do the reading instruction, its content and methodology.

Other interpretations of the term interactive are found in the literature. According to Grabe (1988) the term interactive refers to the interaction of many component skills in operation while reading is taking place. Reading involves both lower level rapid recognition skills together with higher level comprehension and interpretation skills. This view is more limited than the one adopted for the present study. Grabe (1988, p. 60) expresses the view that

"There is no single interactive model. Rather, interactive models include that any model that minimally tries to account for more than serial processing and that does so assuming that any parallel or array processing will interact".

The second use of the term interactive is best reserved for Interactive Parallel Processing Models (Grabe, 1988) which incorporate both top-down and bottom-up strategies. These models emphasise that accurate decoding and word recognition skills together with conceptual interpretative and predictive skills are important in the reading context. In such models, the term interactive is used in the limited sense of meaning the relations between the various component skills and does not recognise the contributions of the reader, text characteristics and context to the construction of meaning by the reader. This view or 'model' of reading should not be considered as an alternative version of the approach adopted in this study, that *reading as an interactive process*.

(See Figure 1.1 on page 10.)

More recently, the term interactive has come to be associated with the socio-cultural model of reading proposed in the work of Freebody (1992), who describes reading as the interaction of four activities on the part of the reader: code-breaker, text-participant, text-user and text analyst. (See Chapter 1.) As code breaker, the reader must come to be aware of sound-symbol relationships and alphabet. This is equivalent to the decoding process described in schema theory as 'bottom-up'. The next role is that of text-participant, which implies that the reader must have the resources to understand how texts are connected and how to infer meaning. Freebody (1992, p. 49) acknowledges the role of schema theory in highlighting the central importance of the reader's role in constructing meaning.

Researchers working within the framework of, for example, schema theory, have drawn attention to the centrality of the reader's role in bringing to bear appropriate knowledge sources-knowledge not only of the topic of the text but also of the generic structures commonly found in written texts, whether they be narrative or expository.

In this he draws attention to the role of formal schemata, or explicit knowledge of text structure which is part of the reader-text interaction. Equally, content schemata, or background knowledge, must be integrated into the reading process, as Freebody (1992, p. 50) states:

The significance of the reader's access to and use of knowledge resources in reading a text successfully has been well established in recent research, particularly within the context of schema-theoretic accounts of reading.

In brief, Freebody's view of reading endorses the interactive approach insofar as it calls on the reader to employ a set of resources, graphic, semantic, structural, pragmatic and ideological. To be a successful reader entails having

these resources at ones' disposal. While there are some overlaps and areas of agreement between schema-theoretic accounts of reading and the socio-cultural approach of Freebody, there are also major differences. (See section: Limitations of Schema Theory, page 79.)

At this point it is appropriate to expand on the observation made above and to consider how schema theory can contribute to an understanding of the interaction between reader and text factors that influence text comprehension. Research on first and second language comprehension will be reviewed to support the claim that reading is an interactive process, involving the interrelationship of formal and cultural schemata and discourse structure.

### **SCHEMA THEORY AND READING**

The role of background knowledge in reading is known as schema theory. According to Rumelhart (1980), schema theory shows that the manner in which language users process textual material is dependent not only on the information present in the text but also on the mental structures or schemata that readers may bring with them to the processing of this material. Previously acquired knowledge structures are called schemata. A schema is an abstract knowledge structure which summarises what is known about a variety of cases, events, concepts that may differ in many particulars.

There is now a good deal of evidence, based on research, that schemata incorporating knowledge of the world play an important part in text comprehension. While reading, the reader's prior knowledge interacts with the text type and structural features to construct a meaning from the text. The schema theory model (Rumelhart, 1980) maintains that any text, either spoken or written does not by itself carry meaning. A text only provides directions to listeners or readers on how they should construct meaning from their previously

acquired knowledge. A schema approach focuses on one aspect of comprehension which is of central importance to reading comprehension: how the readers' prior knowledge, or schemata function in the interpretation of new information.

Readers carry background knowledge of various kinds including knowledge of content area and knowledge of how text is organised. According to schema theory, efficient comprehension involves relating the textual material to one's own knowledge. In other words, comprehending words, sentences and entire texts involves reliance on more than linguistic knowledge. Every input must be mapped against some existing schema. Both bottom-up and top-down processing are involved. When presented with a novel text, readers activate an appropriate schema against which they try to make consistent interpretations. This implies that much of the meaning understood from a text resides in the reader, in her/his schematic knowledge. What the reader understands is largely a function of whatever schemata are activated at the time of reading the text. In short, schema theory has explanatory power which can be linked to the interactive approach to reading to help us understand reading processes.

In the literature, research on schemata is divided into two main categories. Formal schemata refer to knowledge about text, text conventions and rhetorical structure while content schemata are knowledge structures relating to information and concepts derived from the content domain (Rumelhart, 1980). These schemata provide interpretive frameworks which readers utilise when reading. It is not intended to review all these studies, but to select the findings of the cross-cultural and cross-linguistic studies which are relevant to the present research and which give further insight into the comprehension processes of readers from different cultures and backgrounds.

Formal schemata include, as stated above, background knowledge of the formal rhetorical organisational structures of the text. In other words readers

are expected to have knowledge and expectations about differences in genre, differences in the structure of stories, poetry and so on. A number of studies reveal that even younger readers possess expectations regarding the type of events that are likely to occur in narrative (e.g., Whaley, 1981). Mandler (1978) also found evidence that readers have schemata that distinguish between causally and temporally connected stories. For expository texts, the research of Meyer (1975, 1985) recognises that there are five different patterns of textual organisation in expository prose: collection (list), causation (cause and effect) response (problem and solution), comparison (comparison and contrast) and attribution (description). Each of these types represents a different abstract way that texts are organised, reflecting the writer's intentions and, it is proposed, the way readers understand written texts. This study is intended to explore whether readers in fact, do possess the formal schemata to recognise and use these text structures in their written recall of expository passages they have read.

The second type of schemata that readers are expected to have are content schemata, that is, is background knowledge of the content domain of a text. For example, it would be difficult to construct meaning from an abstract article purely on research dealing with calculus, without some background in the subject. Content schemata may also be referred to as *cultural content schemata* when the text contains knowledge, events, values or attitudes which may be culturally specific. Texts from a reader's own background and cultural heritage are expected to be consistent with the reader's own expectations and therefore easy to understand (Kintsch & Greene, 1978). On the contrary, texts which are culturally alien are likely to be incomprehensible. Thus, culturally based and culturally-biased reading passages may cause problems for ESL readers unless they have attained bi-cultural understanding. Indeed, the view taken here is that the very existence of 'general' or 'culture-free' texts can

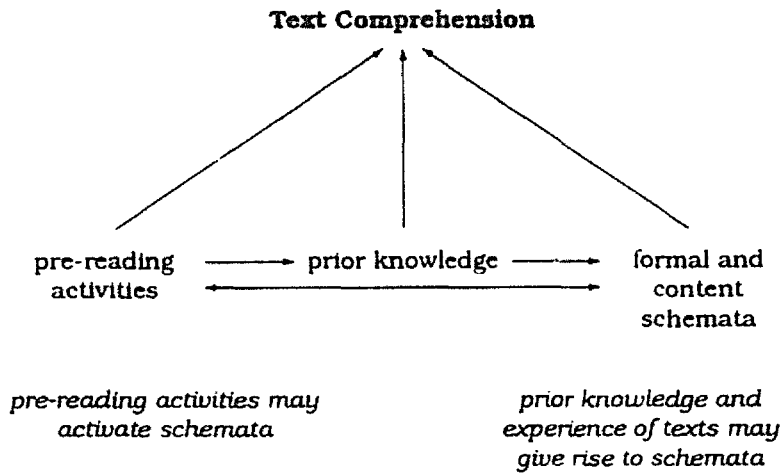


Figure 3.1. Relationship between Schemata and Text Comprehension.

be doubted.

In support of this claim Alderson & Urquhart (1988, p. 169) comment on the absence of cultural homogeneity in texts.

In general, the increased recognition of the importance of background knowledge may lead us to doubt the existence of any text which is 'neutral' across a wide range of readers. Certainly, we may suspect the 'generality' of themes popular with recent textbook writers-pollution, the women's movement etc.

The research available on cultural content schemata suggests that comprehension is radically affected by the reader's cultural background. This will be reviewed in the next section.

The schema-theoretic approach to the study of language comprehension has, over the past two decades, provided a powerful stimulus to the analysis of the process of comprehension in first and second language learners (Anderson & Pearson, 1984; Carrell, Devine & Eskey, 1988; Irwin, 1991). In Figure 3.1 the relationship of schemata to text comprehension is depicted



diagrammatically. Both formal and content schemata contribute to text comprehension and may be activated by pre-reading activities. Prior knowledge and experience lead to the development of formal and content schemata, and pre-reading activities and elaborations may evoke, or activate prior knowledge (Irwin, 1991). Since learning and reading in a second language require the integration of new knowledge into some schematic structure, readers need to have developed appropriate schema to accommodate new, incoming concepts and information. First and second language comprehension research has produced a considerable body of literature, which has been divided into categories comprising language and cultural studies, linguistic and psycholinguistic studies. As Figure 3.2 illustrates, there is a considerable range of studies which can be subsumed under the heading 'schema-theoretic research'. These studies show that empirical research on content and formal schemata is multi-dimensional and provide insight into the complexity of textual analysis and comprehension. These studies also show the interrelationship of linguistic, cultural, and psycholinguistic approaches to text comprehension and contribute to an understanding of the many levels of interaction involved. While many of the studies depicted in Figure 3.2 are discussed in the present study, this is not intended to represent an exhaustive list of all research in the field; instead, relevant selections have been made to support the underlying thesis that reading is an interactive process.

Studies relating to cultural and formal schemata will now be reviewed to demonstrate that reading comprehension involves the interaction of the readers' background knowledge, or schemata, with the text (Mandler, 1978; Carrell, 1984a; Barnett, 1984; Carrell, 1985a; Davis, Lange & Samuels, 1988; Raymond, 1993).

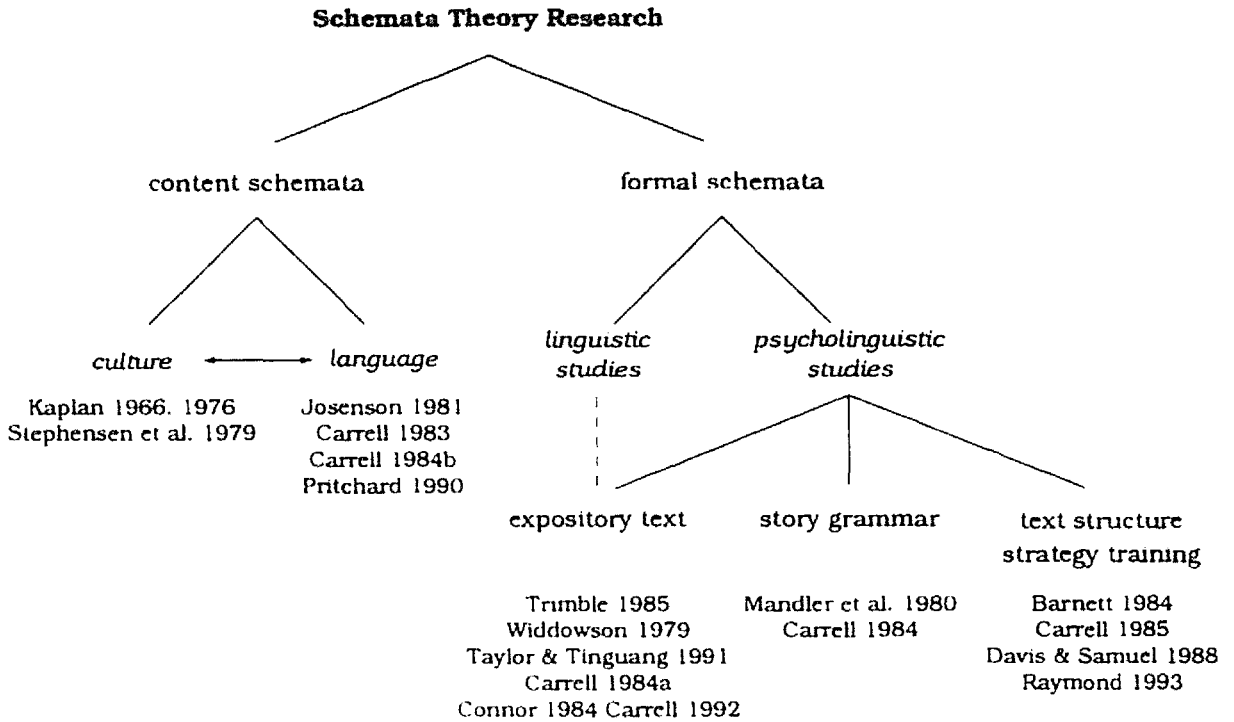


Figure 3.2. Research on Text Analysis and Comprehension.

### CULTURAL CONTENT SCHEMATA

A number of research studies in second language reading (Carrell, 1983; Carrell, 1984a) have shown that prior knowledge of the cultural background of a text, known as cultural content schemata, affects text comprehension and recall of ideas. Cultural knowledge must be considered in any model of reading, as empirical studies show that it may affect comprehension and recall. Other studies described below add weight to this claim. These studies have followed the research paradigm of earlier studies by (Meyer, 1975; Meyer & Freedle, 1984) and are based on data analysed from the written recall protocols of subjects.

The absence of schemata from the reader's cultural background may result in a failure to comprehend. This has been illustrated by (Steffensen, Joag-Dev

& Anderson, 1979) in a study in which subjects of Indian and American nationality read letters about an Indian and an American wedding. Their interpretations and observations were the subject of investigation. As most adults have well-developed marriage schemata (i.e., expectations about what happens at a wedding), large differences in comprehension, learning and memory of the letters were found. The study by Steffensen et al. (1979) is often cited in support of the interaction of cultural and linguistic variables in models of reading (Reynolds, Taylor, Steffensen, Shirley & Anderson, 1982; Barnitz, 1986). Two other studies support the notion that schemata which embody the readers' background knowledge about the content of culturally familiar text enable readers to construct an interpretation of the text.

Johnson (1982) conducted an experiment with university level ESL students in order to determine the role of background knowledge on reading comprehension. Iranian and American students were asked to read stories from American and Iranian folklore. Two versions of the story were administered: one half of each cultural group read simplified versions of the two texts from both cultures. The other half read the more complex texts. Results showed that the syntactically complex texts were no more difficult to recall than simplified ones. Subjects made more cultural references/elaborations in the recall of the text from their own culture. It seems that the explicit cultural content of a text interacts with the reader's own cultural background knowledge. If it is congruent with the reader's background knowledge and expectations comprehension is facilitated. Similar studies such as Pritchard's (1990) show that prior background knowledge of culture specific information presupposed by a text affects reading comprehension of that text and the level of comprehension achieved. In Pritchard's study, sixty proficient readers, thirty from the U.S. and thirty from the Pacific island nation of Palau, read culturally familiar and unfamiliar texts. Recall protocols showed that

culturally familiar material resulted in a greater number of idea units and elaborations than culturally unfamiliar material. On the basis of these findings Pritchard (1990, p. 291) concludes:

Reading is an active process in which readers use their background knowledge, the situational context and the cues provided by the author to construct an interpretation of the meaning of a text.

Floyd & Carrell (1987) explored the related question of whether students' reading could be improved by helping them build culture specific background knowledge on a topic prior to reading. The subjects in the study were all intermediate level ESL students and were separated into an experimental group and a control group. Subjects were expected to read and answer questions on a letter describing the Fourth of July celebrations in Boston. It was anticipated that while all students would have a general holiday schema, few would have had a specific schema for that particular community and locality. The control group received no instruction prior to the test but the experimental group were exposed to two training sessions. These sessions did not focus explicitly on the text, but on the customs, festivities and music associated with the Fourth of July celebrations. In the test, one half of each group received a syntactically more complex version than the other half. Both specific questioning and recall tasks were used to test comprehension of the article read. Results showed superior performance by the training-experimental group over the control group, but syntactic complexity showed no significant effect on subjects' performance. It was concluded that cultural background knowledge is more of a determining influence on reading comprehension than is syntactic complexity.

In addition, these studies have revealed that cultural background relevant to reading comprehension can be taught. Various studies are reported by Carrell (1987) to show the separate effects of cross-cultural content schemata on

ESL reading. These studies support a view of reading which is interactive and where cultural and linguistic variables are part of a model of reading. They also demonstrate that what is understood from the text does not reside only in the text but in the reader, and in the background or schematic knowledge brought to the reading task. This implies that when readers encounter culturally unfamiliar material they may lack the relevant schemata and therefore the text remains ambiguous. The next section will present further evidence that reading is influenced by readers' background knowledge of the formal structures of the text and the cues presented by the writer.

### **FORMAL SCHEMATA**

In order to demonstrate further the existence and operation of schemata in reading comprehension, an overview of the literature on *formal* schemata and the potential effects on comprehension will now be discussed. Recent studies have investigated the effects on reading in L1 and L2 of both culture-specific content schemata and formal schemata. Carrell (1987, p. 461), refers to formal schemata as "... knowledge relative to the formal, rhetorical organisational structures of the text". This is explained by Carrell (1983) as background knowledge of, and expectations about differences in rhetorical structure, and of genres. According to these authors (p. 559)

One type of schema which readers are said to possess is background knowledge about, and expectations of, differences in rhetorical structures, such as differences in genre, differences in the structure of fables, simple stories, scientific texts, newspaper articles, poetry and so forth.

Evidence for formal schemata can be found in research on narrative text structure in L1. Stories have been collected from many different cultures which attest to a commonly occurring template for the narrative (Mandler &

Johnson, 1977). The template may have the following components: time, place and character identification, a problem and a resolution. Using such a model, researchers have been able to predict that well formed stories will contain these constituents in a canonical order, also known as a story grammar (Rumelhart, 1977b; Mandler & Johnson, 1977). It has also been predicted that the sequences are stored in memory, as schemata, and that they operate as aids to memory in the comprehension of specific stories (Hatch, 1992).

In L2 research, the work of Carrell (1984a), has provided evidence for story schemata. In investigating the effects of formal schemata, second language readers of English read stories written in English, some in canonical order, some not. Subjects who read the stories in canonical order recalled more than those who had received an irregularly structured story. Furthermore, subjects who had read the non-canonical story tended to recall the text in its canonical order rather than its presentation order. These studies show that formal schema operate as powerful organising devices in the comprehension of narrative text.

In the context of schema theory, reading comprehension is the process of choosing and verifying both content and formal schemata against a reader's background knowledge structures. According to Meyer's (1985) version, a reader may possess a finite number of schemata related to text organisation. These function as knowledge of the conventional organisation of texts. To comprehend a text, the reader selects the formal schema which best accounts for that text and uses it as an organising principle. Similarly, when retrieving text from memory, a reader activates a formal schema and then uses it to retrieve information stored in memory (Britton, Meyer, Simpson, Holdredge & Curry, 1979; Kintsch & Greene, 1978).

According to Meyer (1975), texts are hierarchically organised, and those ideas which are at the top of the hierarchy are encoded, stored and retrieved more readily than those at lower levels. Main ideas are assumed to be cognitively more salient than minor ideas, and therefore correspond to the top-level information, while details and supporting points occupy the lower levels. (See Chapter 5 for a full description of the content structure analysis of texts.) Carrell (1984b, p. 447) explains the reason quite succinctly:

the reason why top-level information is more memorable, that is, more cognitively salient, is that the superordinate structure gets rehearsed with each new piece of information that the reader processes and attempts to integrate with the main ideas of the text. Peripherally related information gets less rehearsal in memory: each piece of subordinate information gets stored in the proper place in the hierarchy, but does not get rehearsed again as each new piece is taken in. It is thus more quickly forgotten than the top-level information, which gets rehearsed frequently.

Several studies have been carried out in L1 and L2 reading showing the effects of formal schemata. The studies reviewed in Chapter 2 show the effect of readers' recognition of text structure on comprehension and recall and demonstrate that when readers recognise the structure of texts, they are more likely to recall them and, at the same time, identify main ideas (Meyer, Brandt & Bluth, 1980; Taylor & Samuels, 1983). Taken as a whole, these studies illustrate how formal schemata are related to text structure and how they affect comprehension and recall.

A number of cross-cultural studies conducted with L1 and ESL readers of English from different cultural backgrounds are relevant to the present study, which is a cross-cultural comparison of reading recall and structure awareness. Research by Carrell (1983) illustrates how three components of background knowledge interact in second language reading comprehension in

a cross-cultural context. In this study, Carrell investigated the effects of three aspects of background knowledge (content, familiarity and transparency) on the reading comprehension of three groups of readers: L1 English speakers, advanced ESL readers and high intermediate ESL learners. In general, Carrell found that the non-native readers were less efficient at using contextual and textual clues in reading. This was attributed to lack of proficiency in English.

Carrell (1984b) also investigated the effects of the various rhetorical patterns on the reading recall of adult ESL readers. The students came from distinct language backgrounds: Spanish, Arabic, Oriental and Arabic. An English text was constructed to adhere to the discourse types identified by Meyer & Freedle (1984). The findings revealed that discourse type influences the amount of information recalled. Comparison, causation and problem solution texts were better recalled than collection of descriptions. Moreover, the recall of ideas by specific language groups was related to specific textual patterns. For example, the Arabic speakers found that collection of descriptions was more facilitative for recall of ideas whereas the same pattern was least facilitative for the Spanish readers. This research shows that students from different language backgrounds may carry different formal schemata which affect their ability to recall important information from text.

Further evidence illustrates the role of discourse patterns on recall. Research by Connor (1984) and Connor & McCagg (1987) studied the effects of expository text structure on the recall of text by first and second language speakers of English. In this study, Spanish and Japanese students at advanced level read an expository prose passage in which the ideas were structured hierarchically, but without a linear sequence of events. All subjects had to write an immediate recall of the passage read. Results indicated that there were no significant differences in recall of superordinate ideas, but subjects recall of subordinate ideas differed. First language speakers showed



better recall of subordinate ideas and a greater tendency to reorganise the story events according to real life schemata. Second language speakers of English recalled fewer main ideas but used the structure of the original passage in their write recalls.

Carrell's (1987) study investigated the effect of both content and formal schemata. Carrell manipulated the reading task by presenting texts with unfamiliar content and unfamiliar form to one group, familiar content and familiar form to another and to a third group a mixed condition. This consisted of familiar content combined with unfamiliar rhetorical form and, unfamiliar content combined with familiar rhetorical form. The findings are summarised by Carrell (1987, p. 476):

When both content and form are unfamiliar, the reading is relatively easy: when both content and form are unfamiliar the reading is relatively difficult. When either form or content is unfamiliar, unfamiliar content poses more difficulties for the reader than unfamiliar form. However, not surprisingly, rhetorical form is a significant factor, more important than content, in the comprehension of the top-level episodic structure of a text and in the comprehension of event sequences and temporal relationships among events. In other words, each component, content and form, play a significant, but different, role in the comprehension of text.

In a more recent study by Carrell (1992) advanced level students from ESL backgrounds were found to recall a greater number of ideas from passages if they used the structure of the original passage in their own recall protocols. Use of a structure strategy indicates that the reader/writer has awareness of appropriate schemata to interpret and recall the text.

To conclude this section, the weight of evidence reviewed from empirical research on L1 and L2 reading supports an interactive model of reading, where

the reader's background knowledge of the formal discourse structure influences recall and comprehension of ideas. The definition of comprehension as "building bridges between the new and the known" cited by Irwin (1991, p. 129) is relevant in the context of the present study as it emphasises both the active nature of the process and the importance of prior knowledge. While reading, readers link incoming knowledge with what they already know.

### **SCHEMA AVAILABILITY AND ACTIVATION**

In text comprehension, schema theory emphasises the role of pre-existing knowledge structures in interpreting information in text. These were described above as formal and content schemata. Reading comprehension is characterised as involving the interaction of text-based and knowledge-based processes. The former are bottom-up skills such as decoding the text while the latter are related to the reader's existing background or schemata. Research on schema theory has shown that the most effective way to process text is interactive, combining top-down and bottom-up skills. This involves using perceptual and decoding skills together with higher level skills such as prediction of meaning and use of formal and content schemata (Eskey, 1988). Skilled readers constantly shift their mode of processing information, accommodating to the demands of the particular reading situation. Less skilled readers tend to rely on processes in one direction, and may fail to activate the correct schemata (Carrell, Devine & Eskey, 1988).

The research reviewed has shown how content and formal schemata operate in the process of text interpretation. The examples provided by Stephensen, Joag-Dev & Anderson (1979) and Pritchard (1990) with L1 readers have shown that the cultural knowledge presupposed by a text interacts with the reader's own cultural background knowledge of content and that texts

which are familiar culturally are also easier to comprehend. Further research with first and second language readers has shown that variation in discourse type influences the number of idea units recalled (Carrell, 1984b; Carrell, 1992; Connor, 1984). The findings cited above have indicated that L2 readers' prior knowledge of cultural content and rhetorical structure of text can have a significant effect on their ability to comprehend and assimilate this material.

The research on formal and schemata has generated empirical research in two other related areas. One is in viewing comprehension, that is the comprehension of film or video material combining visual and verbal input (Tudor & Tuffs, 1991). In this study attempts were made to activate text-relevant schemata in a group of advanced level ESL learners under experimental conditions. The treatment involved provision of information on cultural element and problem/solution models together with practice activities before the viewings. The results showed that prior activation of text relevant schemata can enhance comprehension and retention of the content and message of video materials.

Other studies which lend support to the schema-theoretic approach are those involving instruction about text structure in order to activate appropriate formal schemata. Such studies are motivated by the need to improve retention of ideas and comprehension of text. Instruction in relevant contextual information can help readers activate appropriate schemata. Barnett (1984) demonstrated the effectiveness of instruction in the use of text structure with a group of university students studying psychology. The instruction was given prior to reading expository prose and it showed significant effects on recall of information. Another study, involving teaching of organisational patterns of discourse was conducted by Raymond (1993) with university students reading French as a foreign language. Subjects who had received instruction text structure about recalled more ideas. In English as a second language

studies, (Carrell, 1985a) showed that explicit teaching of the top-level rhetorical organisation of texts can facilitate students' reading comprehension as measured in quantity of information recalled. Training in text organisation also facilitates recall of ideas presented scientific articles according to Davis, Lange & Samuels (1988).

In summary, the research reviewed attests to a growing body of evidence that knowledge of the discourse patterns and cultural content can guide the expectations of readers as they process texts. If content and rhetorical structure match the readers' expectation, more efficient comprehension takes place. Several types of schemata or frameworks may interact to facilitate comprehension. Background knowledge, in the form of cultural schemata and formal or knowledge-based schemata may contribute to comprehension. This point is made quite emphatically by Barnitz (1986, p. 106).

The knowledge of linguistically and culturally specific discourse patterns guide the expectation of readers as they process native and nonnative texts. If the content and discourse patterns match the readers' expectations, more efficient comprehension and recall is likely to occur.

Thus, text and text schemata are interdependent variables in L1 and L2 speakers' reading processes. Furthermore, reading is a skill which demands that readers use their background knowledge, the situational context and the text to construct meaning. The empirical studies reveal that two of the most important factors in comprehension are the cultural background of the reader and the cultural loading, or perspective of the text.

A reader's failure to activate an appropriate schema can result in misunderstanding. The failure to activate may be due to a range of factors and can result in partial or complete reading failure. The studies reviewed in this section have signalled that one of the obvious reasons why a schemata may not exist is that it may be culturally specific, or outside the readers's framework

of formal discourse knowledge. The relevance of these findings for second language readers is the subject of the next section.

### **DIFFERENCES BETWEEN L1 AND L2 READING**

The extent to which L1 and L2 reading differ is an issue important in the context of the present study. The Australian students spoke English as their first language and English was the language through which they had always communicated. The Singaporean subjects in the study come from backgrounds where English may not have been the first language learnt, but was the primary language of instruction since early childhood. Therefore all the Singaporean students would have been exposed to English at a very early age, and as it is the medium of instruction in Singaporean schools subjects would have studied through English. Thus, Singaporean students would not classify themselves as ESI, speakers, and many would certainly use English for day-to-day interactions. The Malaysian students would have studied through English at high school while speaking languages other than English at home. English was for them, a secondary language of interaction until their arrival in Australia. Despite these differences in language background, all three groups were considered proficient readers as they had successfully satisfied university requirements for tertiary entry, both in English language and academic subjects. However, as the three groups differed substantially in their exposure to and use of English as a primary language on interaction, it was predicted that differences in the quantity and quality of ideas recalled would be found among the different groups. This prediction may be explained and subsequently the results accounted for by a brief description of the differences between L1 and L2 reading framed within the schema-theoretic model.

In L1 reading research, schema theory can be seen as a theoretical metaphor

for readers' prior knowledge. Accordingly, information stored in memory is organised in efficient and integrated ways, so that it may be drawn upon in reading new information. In L2 reading schema theory has proved quite fruitful in explaining why certain activities, such as prereading, improve recall. These activities do so because they activate schemata, or expectations about content and structure and enable the reader to draw inferences about the text being read.

Much of the research on L2 reading processes cited through out this study are based on the findings of schema theory (Carrell, 1983; Carrell, 1984a; Carrell, 1992; Wolff, 1987; Eskey, 1988). According to schema theory, comprehension is an interactive process between the reader's background knowledge and the text.

Reading therefore involves relating the information in the text to one's own knowledge. In this process various cognitive processes are engaged. As cognitive psychology defines comprehension as information processing, this leads to the assumption that comprehension is a cognitive process (Wolff, 1987). Theories of comprehension have to account firstly, for decoding perceptual stimuli (words, letters, figures) and secondly, for conceptual and propositional processing (ascribing meaning and interpretation). Top-down processing is the making of predictions about the text based on prior experience or background knowledge and then checking the text for confirmation or refutation of these predictions. Bottom-up processing is decoding individual linguistic units such as phrases and words and then building meaning from the smallest units to the largest. Text comprehension is schema guided in both processing directions. A reader's pre-existing background knowledge is modified on the basis of information encountered in the text. The comprehender's expectations about the text will determine how the text is constructed in memory. If the correct schemata do not exist or cannot be activated, the text will not be

understood. Skilled readers constantly shift their mode of processing information, adjusting to the demands of the text. Eskey (1988, p. 94) provides a concise overview of L2 comprehension:

This... interactive model does not presuppose the primacy of top-down processing skills- the gradual replacing of painful word-by word decoding with educated guessing based on minimal visual cues- but rather posits a constant interaction between bottom-up and top-down processing in reading, each source of information contributing to a comprehensive reconstruction of the meaning of a text. In this view, good readers are both good decoders and good interpreters of text, their decoding skills becoming more automatic but no less important as their reading skill develops.

While the role of schemata or background knowledge is generally agreed upon in the literature, there are various interpretations of how it applies to L2 reading. According to Davis & Bistodeau (1993), there are two views of the L2 reading process which may account for performance. The first is Clarke's (1980) short circuit hypothesis. (A short circuit is any reading activity which does not produce meaning for the reader.) This states that low proficiency in the target language causes readers to change from top-down, conceptual strategies to bottom-up strategies when reading. When readers encounter a culturally unfamiliar or difficult text, they may abandon the effort to construct a global understanding and instead rely on text-based connections. This means that while they can understand and decode the words, the overall meaning may not be grasped. As readers improve in proficiency they gain mastery of global processing strategies.

A competing theory to the short-circuit hypothesis is that readers are bi-oriented (Davis & Bistodeau, 1993). Accordingly, even readers who are novices are able to combine top-down with bottom up strategies. As a result there is little difference in the psychological processing of L1 and L2 texts. Davis &

Bistodeau (1993) also support the view that both top-down and bottom-up processing are components in comprehension, and are adequately described by the schema theoretic model. In second language reading, both the short-circuit and the bi-directional model carry some explanatory power and support the view that reading is an interactive process.

Research has shown and clarified the demands of reading in a second language. For example, Alderson & Urquhart (1988) have found that an extensive vocabulary is required for reading. In L1 studies, evidence has emerged that good readers are not good simply because they predict better or make better use of context. The differences are stated quite succinctly by van Dijk & Kintsch (1983, pp. 23–24):

Evidence from first language research indicates that good readers are not good simply because they are better predictors or make better use of context – it is consistently found that good readers are able to recognise lexical forms at a speed faster than the time required to activate context effects and conscious predicting.

A number of studies have focussed on the difficulties experienced by second language readers of English. Research by Carrell (1983) indicates that reading may be inhibited by linguistic problems. In particular, it was found that among ESL readers there was an over-reliance on bottom-up processing without utilising contextual information to facilitate comprehension.

In contrast, other studies have found an over-reliance on top-down or knowledge-based processes. Studies by Steffensen, Joag-Dev & Anderson (1979), and by Carrell (1983) show that readers are sometimes limited by culturally-based content schemata. In other words, readers interpret texts and reach an understanding of them according to their own cultural schemata, or knowledge framework. Texts which are unfamiliar culturally will either not be understood, or they may be misinterpreted. Carrell, Devine & Eskey (1988,



pp. 107–109) have discussed the reasons behind such unidirectional bias in second language reading, with consequent reliance on inappropriate strategies. The reasons for this may be:

- linguistic deficiencies;
- failure to activate schema;
- reading skill deficiencies;
- misconceptions about reading in a second language; *or*
- individual differences in cognitive styles.

Each of these causes of unidirectional bias will be discussed, and the circumstances under which readers display different types of deficiencies will be described. In addition, the relation of these biases to cultural schemata will be analysed.

### **Linguistic Deficiencies**

Studies by Cziko (1978, 1980) and Cooper (1984) indicate that greater language competence allows readers to overcome textual constraints. With readers of advanced levels of proficiency, (as is the case in the present study) Cziko found that L2 readers displayed similar sensitivities to syntactic, semantic and discourse constraints, while lower level students were unable to do so.

Further research by Cooper (1984) highlights the role of attitudinal factors in L2 reading. Cooper compared the performance of 2 groups of non-native readers enrolled at the University of Malaya. One group of readers had studied in English and had developed skills with university level texts.

The other group, while they had studied in English had been educated in their first language, and displayed difficulties dealing with English language texts. Nevertheless, both groups were equally capable of reading academic texts in their own language.

This study provides interesting points of comparison with the present research. The Malaysian students who participated in the present study had studied English and had satisfied the university requirement in English language for admission. No evidence was found of any linguistic deficiency, and none was assumed for the purposes of the study. The Singaporean students had been educated through English and therefore had more experience than the Malaysian group in dealing with academic texts. This would lead to the expectation that the greater skills of the Singaporean students would manifest themselves in better recall of ideas and awareness of text structure.

### **Failure to activate Schemata**

The processes involved in reading require both top-down and bottom up approaches. Bottom-up processing involves decoding linguistic units and building textual meaning from the smallest unit to the largest by utilising and modifying background knowledge. Top-down processes involve making predictions and inferences about the text based on prior experience, and then checking the text to see if these predictions are confirmed.

Efficient reading requires both kinds of processing and skilled readers constantly shift from one mode of processing to the other, depending on the demands of the text. Carrell, Devine & Eskey (1988, pp. 101–102) called this “bi-directional text processing”. If readers are uni-directional in their processing they may show overreliance on the text and confine themselves to bottom-up processing. On the other hand, readers may overrely on knowledge-based, top-down processes. This is called schema interference. The circumstances

in which readers display different types of biases or reading skills deficiencies can be explained in the context of schema theory.

To understand a text, appropriate knowledge based structures must be available to the reader. Both formal and content schemata provide the reader with the ideational scaffolding to understand the text. The research studies described in Chapter 3 indicate that culture specific schemata interact to make texts whose content is familiar easier to understand than texts whose content is based on an unfamiliar culture. The research studies of Carrell (1992) and Pritchard (1990) have shown that the absence of content and formal schemata appropriate to a particular text can result in readers experiencing processing difficulties. What happens then if a reader encounters a text for which he/she lacks an appropriate schemata? They may either rely on text-based processes and try to construct the meaning totally from the text, or they may substitute a schema that they already possess and try to accommodate the new information to that schemata.

The result, in either case, that comprehension and recall of ideas will be impaired.

### **Reading Skill Deficiencies**

Two related skill deficiencies may lead to insufficient interaction of text-based and knowledge-based processing in L2 reading. The first of these is linguistic deficiency, which is discussed separately in the section on reading ability and language proficiency (see page 77).

In the component skills approach to reading (pp. 10–12) a reader may be more or less skilled in any of these areas. For example a reader who relies on textual clues and tries to build meaning by simply decoding will be unable to construct any higher order relationships among ideas. On the

other hand, readers who rely on pragmatic inferencing may neglect to process words and idea units, and instead hypothesize about the content or message of the text. The result is that reading comprehension is impaired and while meaning is constructed by the reader, it is likely to be partial or distorted. Skill deficiencies may interact with lack of proficiency resulting in a 'short-circuit', whereby processing becomes unidirectional.

### **Misconceptions about Reading in a Second**

#### **Language**

Readers from different cultural and language backgrounds, as is the case in the present study, may have different attitudes and concepts about reading, how it is done and what purposes it serves in an Australian academic institution. Many assumptions are made about readers at tertiary level and it is often assumed that they have highly sophisticated skills. The work of Ballard & Clanchy (1984, 1991) has served to highlight the critical differences in cultural attitudes to knowledge, learning and teaching. For example, readers in first year at university may be unfamiliar with the notion of "critical reading" in which a reader is asked to compare and evaluate conflicting details and to make judgement about the relative validity of texts.

In addition, reading is not an isolated skill, but is directed and controlled by the needs and purposes of the individual (Dubin, Eskey & Grabe, 1986). Operating in a new culture means that acculturation processes require time and effort, and the additional demands of reading in a second language require readers to adjust their reading strategies. For example, texts which are culturally "alien" will require the reader to accommodate incoming ideas with existing knowledge structures.

## **Individual Differences in Cognitive Style**

A final cause of reading problems may be related to a maladaptive learning style. According to Brown (1987) a reader's style may be part of a general cognitive style. The interactive approach to reading (Figure 1.1) requires that readers employ relevant knowledge and skills in the construction of meaning. Readers may be overly reliant on text-based or knowledge based skills. Empirical research supporting differences in cognitive style have been found in the work of Kimmel & MacGinitie (1984) who have identified a reading strategy in L1 readers called "perseverative text processing". Such readers make an interpretation solely on the basis of an initial sampling of the text and do not revise it in line with further information. Readers therefore often miss the main idea, particularly if it is last. Whether such a reading style would characterise advanced readers at tertiary level is unlikely, and the literature has produced no evidence to support the findings. Nevertheless, reading is a complex skill, and many variables interact to shape the styles, approaches and skills of individual readers.

In summary, these five different causes for over-reliance on text-based or knowledge based processing in L2 reading have not all been empirically tested. In presenting this overview of inappropriate reading strategies, an effort has been made to relate the findings of available research to the present study.

Having considered the vital importance of the cultural and formal schemata that readers bring to text, yet another factor influencing text comprehension will be considered. Since the present study involved readers of English as a second language, the question of how language proficiency interacts with comprehension must be addressed.

## **READING ABILITY AND LANGUAGE**

### **PROFICIENCY**

Second language learners do operate with a set of constraints which may impinge on their ability to read in their L2 (Dubin, Eskey & Grabe, 1986; Cziko, 1978). For example, students of varying language levels and orthographic conventions may be limited in their reading comprehension. More importantly, it cannot be assumed that a large vocabulary and basic syntactic structures already exist unless language proficiency is first established. This is important in many respects. Firstly, a number of studies have identified linguistic deficiency as an inhibiting factor in reading (Cohen, Glasman, Rosenbaum-Cohen, Ferrera & Fine, 1979; Carrell, Devine & Eskey, 1988). Secondly, readers need an extensive vocabulary as part of the comprehension process (Alderson & Urquhart, 1988).

According to Clarke (1980) poor language proficiency in a second language limits reading performance. This is called the short circuit hypothesis. However Hudson (1982) indicates that existing prior knowledge structures or induced schemata such as pre-reading activities can compensate for the short-circuiting effect of limited language proficiency. If appropriate schemata are activated prior to a reading task, this may compensate for problems caused by lack of language proficiency.

Lee & Ballman (1987) studied the ability of four levels learners of Spanish to read and recall an expository text. The recalls were scored for the total number of ideas they contained and for the number of most and least important information units they recalled. It was found that the level of the learners, corresponding to proficiency in the language, was a significant factor affecting the quantity of ideas recalled.

On the other hand, L2 learners may have advantages such as a broader

cultural and conceptual sense of the world and the ability to make logical inferences from the text. Students who are highly literate in their first language and who have mastered English as a second language may be better able to employ metacognitive strategies in their learning as well. In addition, ESL students may be very highly motivated (Wenden & Rubin, 1987; O'Malley & Uhl Chamot, 1990).

Overall, the results of research provide sufficient indication that L2 readers may experience some problems with text comprehension (Eskey, 1988). What is not agreed upon is how L2 readers cope with such difficulties, or what may cause them, although the critical interaction of language proficiency and reading ability is now well documented. Devine (1988) presents a comprehensive summary of research, a discussion of which is outside the scope of the present investigation. According to the interactive approach to reading it may be concluded that proficient L2 reading depends on the interaction of various kinds of knowledge, including linguistic, background, and schematic, which must come together to form a 'critical mass' (Dubin, Eskey & Grabe, 1986). In the context of the present study, with second language readers studying at university in a different culture, the problem may simply be the gap between what they know and what a relatively educated first language reader knows about the language and content of written texts. Eskey (1988, p. 17) called this 'the comprehension gap'.

Every second language learner who has not yet achieved full, or at least native-like comprehension will suffer from particular deficiencies of knowledge in one or more of the major categories of knowledge- linguistic, pragmatic and cultural, required for full, or at least native-like comprehension of written texts in that language.

The present research does not adopt a deficit view of the L2 reader, but acknowledges the contributions that research on the interaction of language

proficiency and reading comprehension may make to the present investigation. The final section of this chapter considers the limitations of schema theory and its application to reading processes.

### **LIMITATIONS OF SCHEMA THEORY**

Apart from the fact that there are some areas of agreement between schema theory and the interactive approach to reading, there are some limitations which need to be detailed. In L1 reading research, prediction activities, prior knowledge and text type are variables associated with schema theory (Anderson & Pearson, 1984; Taylor, 1979). These variables are also considered important in L2 text comprehension (Figure 3.1 on page 55).

In reviewing the status and explanatory power of schema theory, Grabe (1991, p. 385) offers the following critical comments:

Aside from the fact that we know we can call up prior knowledge from long-term memory, and that information seems to be integrated in efficient ways, it is difficult to know exactly how this prior knowledge is called up and used. The notion that our long term memory is organised by stable schema structures does not appear to be strongly supported by current research. While no one doubts the need to account for the role of prior knowledge and inference in reading comprehension, many researchers question theories which cannot be explicitly defined.

It is certainly the case that in second language reading research schema theory has proved to be very powerful explanation for many studies on the role of cultural schemata in L2 reading. In addition, it has provided a stimulus to the continuing research on the influence of content and formal schemata in reading and viewing. Some of the recent studies reviewed here (Carrell,



1992; Raymond, 1993; Tudor & Tuffs, 1991) give support to the schematheoretic research paradigm, just as the present study is following a line of enquiry which has emerged from schema theory. Nevertheless, it is essential to consider the limitations of this approach to comprehension and to address the questions raised by critics of schema theory.

Grabe's (1991) general criticisms of schema theory focus on the stability of schema structures, possibly in the light of the dynamic nature of cognitive processes, which are constantly being challenged by new incoming data. As this is fundamentally a question of memory organisation and cognition, further discussion of this dimension is beyond the scope of the present study which is concerned with reading and understanding text.

Other criticisms have come from competing theories in first language reading research. Carver (1992) has challenged the assumptions of schema theory and has shown evidence for the existence of five basic reading processes. These are: skimming, scanning reading, learning and memorising. Reading refers to the normal, ordinary process of reading that individuals operate as they read, as opposed to studying or learning from text. The goals, outcomes and reading rates associated with each of these reading processes differ and there is no one universal type of reading. Moreover, the reading process is flexible and a reader may shift from reading to any other process, depending on the purpose or goal. Reading may not be expedient or efficient for many reading tasks such as studying or recalling information. This view appears to have some support in the literature on first language (English) reading and comprehension processes. For example Irwin (1991) describes reading processes that can be selected and varied to meet task demands.

Building on evidence for the existence of a range of reading processes, Carver (1992) has applied the findings to illustrate the limitations of schema theory. According to Carver (1992, pp. 170-171) schema theory is limited

in its application because it was developed to explain reading and recalling information from texts, and it does not therefore apply to 'typical reading', the main aim of which is not recall. Carver cites the original work of Anderson & Pearson (1984) in support of the claim that schema theory is only partial and unlikely to be applicable to all reading processes. The predictions of schema theory are relevant when reading or studying with the intention of learning, but less relevant for simple reading. According to Anderson & Pearson (1984, p. 277):

The demand characteristics of laboratory experiments on discourse processes put subjects more in the mode of studying than simply reading.

There is agreement therefore that while schema theory may be relevant to learning and memorising, it is less likely to contribute to, or explain reading processes. And so Carver (1992, p. 170) concludes: "Just because schema theory has direct relevance to reading and recalling does not mean that the theory and its predictions will be relevant to typical or normal reading where individuals are reading the complete thoughts in sentences as they are being read with no re-reading or studying".

In the present study, these observations are of direct relevance and relate to the methodological basis of the research questions. The reading situations and tasks presented to the subjects in the present study would have demanded both learning and memorising strategies. In addition, subjects were given a limited amount of time, controlled for all tasks, which would encourage them to seek strategies for recall of text. All subjects were oriented to the task by specific instructions on what would be expected following reading of the passages so that cognitive processes would have been activated. The task could not therefore be described as a normal or natural reading process or as reading. Carver (1992, p. 172) agrees that the predictions from schema theory are more likely to be substantiated if subjects are given a relatively fixed

time and are forced to switch from a rauding process to a learning process. The texts and tasks selected in the present study were designed to ensure that normal reading conditions which induce rauding processes were not operable (see Chapter 6 for discussion of texts and tasks).

Apart from the limited applications of schema theory to specific instances of reading and learning processes, another criticism has come from Luke (1992, p. 5) who has drawn attention to the fact that schema theory has tended to marginalise cultural and social dimensions, and to prioritise cognitive skills. The acceptance of such a static view of reading runs counter to the socially critical model of reading. He states:

Research in the psychology and pedagogy of reading has a long history of shunting normative social and cultural issues to the sidelines of instruction, as subordinate to the acquisition of cognate skills, whether described as 'basic', 'functional', or 'higher order' text processing strategies. These key theoretical and practical omissions are continuing characteristics of cognitive and psycholinguistic approaches to reading. Schema theories of reading, for example, recognise the relationship between structured, culture-specific background knowledge that readers bring to texts and the knowledge demands of text. However, such models stop short of recognising how knowledge and texts can be ideological, that is, how particular knowledge structures operate in the interests of social configuration of power. In this way, psychological versions of reading tend to privatise and individuate social and cultural knowledge.

The model of reading as an interactive process adopted in this study and supported by schema theory is quite distinct from the socially critical model of reading defined by Freebody & Luke (1990). It has been acknowledged above that there are limitations in the adoption of a schema-theoretic approach to reading and that it may not describe all reading contexts, except those which involve study reading or remembering information from text. In an empirical

study of this kind, there are limits to the research paradigm adopted, which does not admit of socio-cultural analysis of the qualitative kind required by a socially critical model of reading. The researcher is aware of such limitations and draws attention to these in the discussion section in Chapter 8.

Nevertheless, there are methodological and theoretical strengths in the approach adopted. Without models of text analysis reading researchers would be unable to specify how the reader interacts with the text. Specifying the textual patterns and interrelationships in text enable the researcher to collect valuable data and gain insights into the way readers process and understand text. Moreover, knowledge about how texts are organised has made it possible to predict which ideas will be recalled from text, and which features (e.g., signalling devices) can facilitate comprehension. Adoption of this approach, which has been a major influence and generative force on research on text comprehension for at least two decades, has also enabled the investigator to integrate tasks, texts and reader characteristics. The next chapter in the literature review analyses the various approaches used in analysis of text and discusses the goals and methods of these approaches.

## **Chapter 4**

# **Approaches to Analysis and Interpretation of Texts**

Reading always involves text, and there is now a rich and complex domain of enquiry which has investigated text structure and discourse. Two distinct approaches to the organisation of discourse which have received a great deal of critical enquiry will be discussed. These are genre analysis and text structure theory, the latter approach characterising the approach to text analysis on which the present study is based. The intention is to briefly outline the conceptual frameworks used for analysis, to describe the contributions of each to the understanding of how discourse is organised and, where possible, to highlight areas of similarity. This is important as it clarifies the strengths and limitations of the approach to text analysis adopted in the present study.

A related area of enquiry is research on contrastive rhetoric and L2 writing which has given some attention to types of expository prose texts. The work of Kaplan (1966, 1987) and (Purves, 1988) have combined to highlight the importance of contrastive patterns in expository prose and the practical and pedagogical concerns in reading and writing among students from different language backgrounds. This chapter considers the relevant research on

contrastive rhetoric insofar as it relates to the research questions on cross-cultural awareness and understanding of text.

Various systems and approaches have been devised to describe how text structure is analysed in expository prose. These approaches focus on the identification and analysis of textual elements which influence how people read, comprehend and remember text. These features of text include signalling devices, (Mayer, 1983; Loman & Mayer, 1983) textual patterns, (Meyer, 1985) cohesion and register (Steffensen, 1986). Text structure analysis combined with reading research in L1 has made some progress towards specifying discourse types according to structure for example, simple stories, scientific and technological text and expository prose.

Despite the proliferation of research there is no agreement on a universally accepted method of analysis. It is important to emphasise that there are a number of reasons for this. Firstly, interest in text structure has come from a wide and diverse range of disciplines including education, psychology, linguistics and artificial intelligence. These disciplines have different goals and methods of analysis. A further reason for the diversity of text analysis is that the purposes of analysis differ. In literary theory, for example, an appreciation of genre and text is fundamental to an appreciation of literature. It is necessary because the text analysis provides an interpretive and evaluative framework for a work of art or piece of literature. In linguistics however, the emphasis may be sociolinguistic, to discover perhaps, which communications are typical, what elements of verbal behaviour are linguistically salient and what the community considers to be acceptable or unacceptable as in Labov's (1972) study of speech patterns in New York city (Labov, 1972). It may be best to consider the study of text structure as interdisciplinary as insights from a number of areas can enrich our understanding.

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presented information and can be represented as an outline or tree structure diagram. (Meyer, 1975; Richgels, McGee, Lomax & Sheard, 1987). The text structures used in narratives are generally more accessible to readers and differ greatly from text structures used in exposition (Mandler, 1978). It may sometimes be the case that otherwise skilled readers are unaware of the common types of structures found in science texts (Cook & Mayer, 1988), and this is another reason why such texts are the focus of the present study. Furthermore, the importance of awareness of text structure has been made evident from empirical studies on the effects of instruction on scientific text structure (Davis, Lange & Samuels, 1988) (page 37).

To provide an overview of the area, Figure 4.1 depicts two broad based approaches which characterise the way people comprehend and remember the type of discourse they come in contact with. The approaches below can broadly be described as the cognitive psychological, as exemplified by Freedle (1979) and Meyer (1975), based on schema theory in which prior world knowledge, reader interpretation and formal and content schemata interact in the act of interpretation.

The socio-cultural approach to discourse analysis includes many dimensions in its interpretation of discourse. Meaning is mediated by the topic, participants in the reading event, setting, conventions, formal and functional aspects of language. Associated with this is the Hallidayan model of language as social action (Halliday, 1978) which is a functional approach to language and is an example of a socio-cultural model of text analysis. This approach looks at the types of meaning in discourse and how they relate to the linguistic features of text that reflect the social context in which it was produced and will be described as genre analysis. This approach differs from schema theoretic approaches to analysis and interpretation as it draws on linguistic and socio-linguistic theory to explain how discourse is formed and understood.

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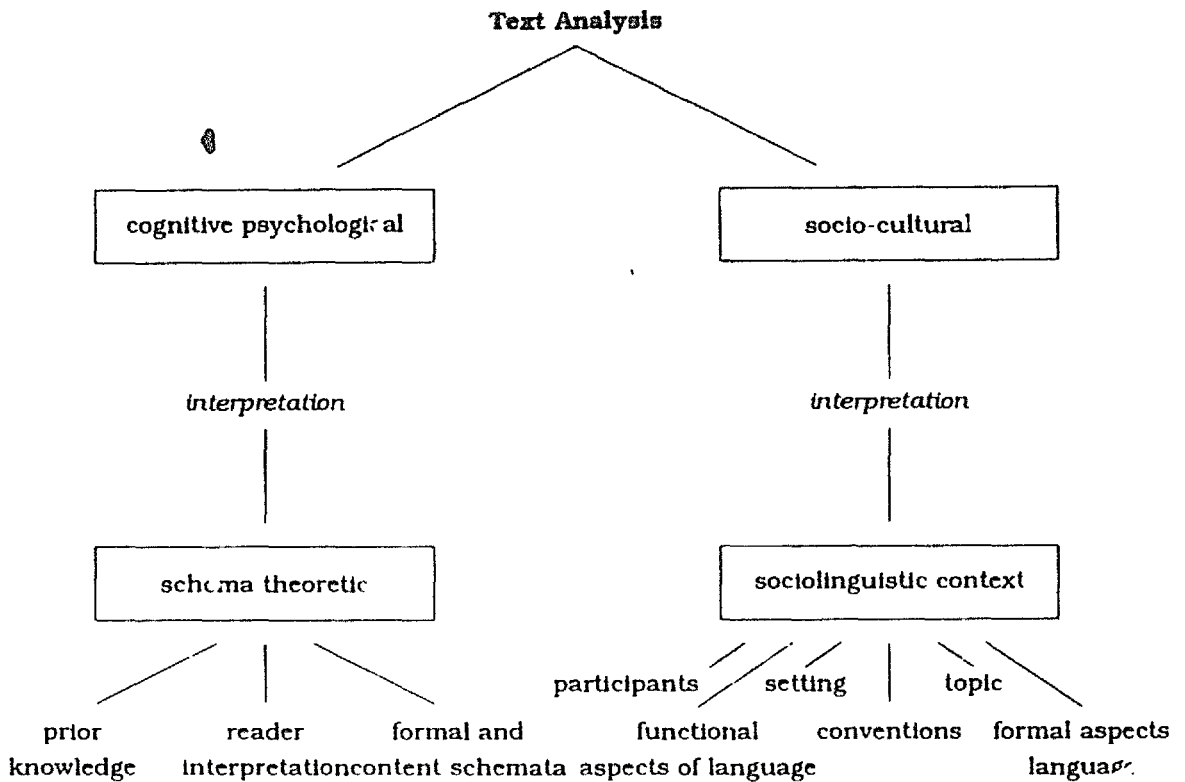


Figure 4.1. Theoretical Orientations to Text Analysis and Interpretation.

Both the schema-theoretic and the socio-linguistic approaches give considerable attention to the rhetorical organisation of texts, and there are overlaps between the two approaches to text analysis which the present chapter will describe.

### GENRE APPROACHES TO TEXT ANALYSIS

Swales (1990, p. 58) defines genre as

A genre comprises a class of communicative events, the members of which share some set of communicative purposes. These purposes are recognised by the expert members of the parent discourse community, and thereby constitute the rationale for the genre. This rationale shapes the schematic structure of the discourse and influences and constrains the

choice of content and style. Communicative purpose is both a privileged criterion and one that operates to keep the scope of the genre as here conceived narrowly focused on comparable rhetorical action.

What is the relationship between genre and schemata? Figure 4.2, adapted from Swales (1990, p. 84), shows how schemata contribute to genre formation. As explained earlier (Chapter 2) schemata are guiding structures in the comprehension process. They are formed as a result of prior knowledge and experience in the world. Content schemata are derived from world experiences, facts and concepts. Formal schemata are derived from linguistic experience of prior texts, including rhetorical structure, style and syntax. Prior knowledge contributes to the formation of schemata, which are concept driven, which in turn call up or evoke routines or procedures. (Going shopping or ordering a meal at a restaurant might for instance, be considered procedures.) Such procedures guide expectations and influence behaviour in social contexts and in reading and writing texts.

Swales (1990, p. 86) suggests that procedures stemming from prior texts and world experience may lead to the formation of formal schemata, described earlier as background knowledge of the rhetorical organisation of texts. With sufficient exposure to texts, a reader may develop familiarity with a range of informational and rhetorical structures so that a formal schema is activated while reading. Formal schemata are organised knowledge structures about the rhetorical structures of texts. Meyer (1975) has identified expository prose structures as collection, description, causation, problem/solution and comparison. Situational and linguistic clues, together with the expectations a reader has as a result of schemata formation, may lead to a recognition of genres. According to the genre approach, for scientific prose these have been identified by Martin (1990) as reports, explanations, experiments, biography and exposition. Thus, the categories of text analysis identified by

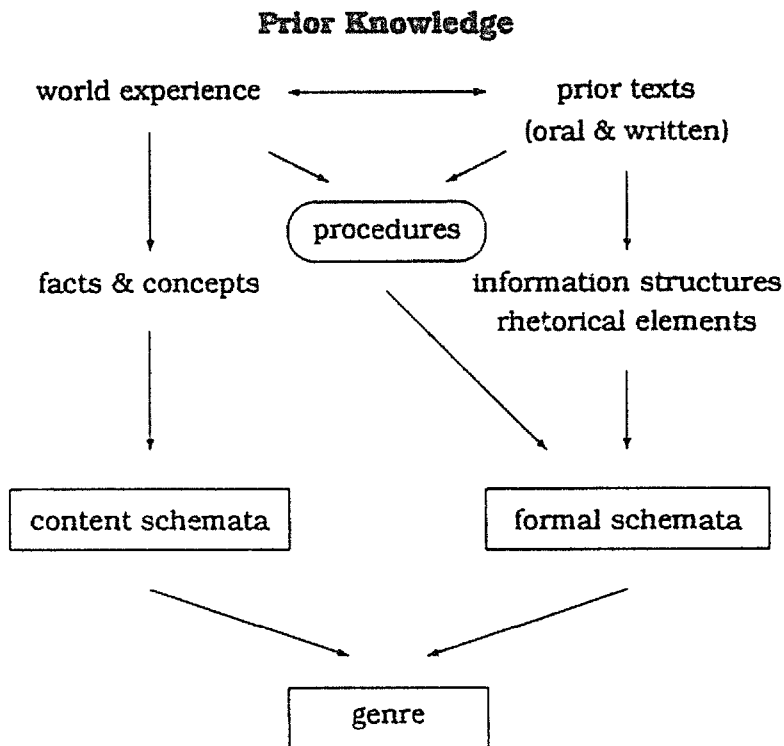


Figure 4.2. Relationship between genre and schemata (adapted from Swales (1990, p. 84)).

genre-theorists and the schema-theoretic research tradition vary.

A theoretical divide exists between genre theory and text structure approaches. The former emphasises the purpose and form of the communication while the latter characterises text in terms of the relations between parts of the text rather than starting with an overall template. The approaches differ because the goals of the analysis differ. Text structure theory (e.g., Meyer's 1975) explores the text in ways which show how it is possible to analyse the writer's intentions in ways that capture some aspects of text's structure which the reader in turn can access as a means of constructing a coherent representation of the text.

Swales' (1990) work, which criticises the cognitive approach, follows the British tradition in discourse analysis, and is greatly influenced by Halliday's

(1978) functional approach to language. Within this tradition, most of the research follows linguistic-structural criteria, and has been productive in the area of isolating sets of rules defining sequences of well-formed discourse. In genre analysis, it is not possible to isolate the text from its context as form and content are tied together. Genre, within the theoretical framework of systemic functional linguistics (Halliday, 1993) is oriented to the description of language as a resource for constructing meaning within a social context. The result is an overall template for understanding discourse.

In contrast, Meyer's (1975) analysis is intended to include the reader and the writer. It describes the relationships that exist between elements of a text, and captures these elements in a tree structure diagram (see Chapter 5). The writer produces this form with the reader in mind. While the structure is created by the author, the reader can build up a hierarchical structure of propositions and identify top-level ideas, and thereby construct a meaning. Unlike genre analysis which looks at the overall form of the text and its purpose, Meyer's approach describes relations between ideas within a text. In short, Meyer's content structure approach to text analysis contributes a great deal to an understanding of the connections between the clauses of a text. In addition, it can show how such connections are signalled through a text and how a reader can access these structures to build up a representation of the text. (This will be demonstrated in Chapter 5.)

Swales(1990) is critical of the schema-theoretic approach to text analysis, which he argues has tended to rely on "decontextualised textual samples that fit broad textual categories" (p. 87). This particular reference is presumably directed towards Meyer's (1975) five types of expository organisation, (see Figure 2.1 on page 32).

Swales' (1990) critique of schema theoretic approaches can be summarised in three points as follows:

- Schema theory approaches do not consider communicative purpose.
- Schema theory emphasises the role of cognition (comprehension is a cognitive act) and therefore isolates the text from its purpose and environment.
- Schema theory sees text structure in supra-generic terms, as opposed to seeing text type as being genre-specific.

Swales' conclusion is that Meyer's top-level structural organisations (problem/solution, causation, description, comparison/contrast and cause/effect) which highlight text relations, do not account for the communicative purpose of the text. Indeed, there is no explicit recognition of this dimension in schema-theoretic approaches. The fact that the text may be either a research article or an abstract is fundamental to a genre approach, as each would represent a distinct form of social action. In the context of reading, the social and pragmatic context enables the reader to identify the purpose and activate expectations which lead to identification and understanding of the text. Genre analysis would therefore start with the rationale for the text and its communicative intent. Such an approach is both plausible and realistic as it takes into account language as social action. Swales (1990, p. 91) concludes, "Schemata alone reflect a microcosmic cognitive world dangerously adrift from the rest of the world". This may refer, in part, to the use of short decontextualised text samples, experimentally created, which have been used in many empirical studies of text structure awareness (Meyer & Freedle, 1984; Carrell, 1984b). In support of Swales it may be said that one of the weaknesses of previous studies in the schema theory tradition, which the present study has sought to avoid, is the use of such contrived samples of text. Authentic articles were chosen for the present investigation, and subjects were informed as to the source, author and details of publication.



There are, nevertheless some points of similarity and overlap between genre analysis and text structure theory, as Hatch (1992) points out. Firstly, both approaches set out to discover structure, but do so in a different manner. According to Swales (1990, p. 88): "... the nature of genres is that they coalesce *what* is sayable with *when* and *how* it is said".

Secondly, there is a theoretical overlap between genre and schemata. Both genre and text structure approaches recognise the power of prior knowledge. Through exposure to prior texts (Figure 4.1 on page 87) content and formal schemata guide the reader's expectations and comprehension of text genres. According to Swales (1990, p. 90) the same content and formal schemata may guide the production of written genres, depending on the communicative purpose of the writer.

Furthermore, there are some weaknesses in Swales' criticisms of schema theory approaches. It is important to clarify the criticisms as a means of understanding the limitations and strengths of schema theory. One such criticism surrounds the communicative purpose of the text, which schema theory is purported to neglect.

For example, Meyer & Freedle (1984) found that different text structures may be more or less effective for different communication goals, thereby refuting Swales' claim that schema theory approaches neglect communicative purpose. When trying to recall information and remember text, readers found the description type was the least successful, and comparison/contrast the most effective. In second language reading studies Carrell (1985a) found a similar result. Both delayed and immediate recalls showed that description was the least effective for number of ideas recalled, and problem/solution, causation and comparison/contrast more facilitative. These findings are strengthened by Carrell's (1992) finding that quality and quantity of ideas recalled was influenced by text type. Texts written in comparison/contrast structures produced

better results. According to Carrell (1987), Meyer's research shows that textual structures may produce different effects on readers. This suggests that research on content structure and rhetorical organisation may be closely related to the communicative purpose of the text. By learning how to access the writer's intentions a reader can recall the main ideas from a text and develop skills transferable to writing tasks. It would be reasonable to conclude therefore, that genre approaches and text structure theory complement each other.

In conclusion, this section has served to clarify how two approaches to the interpretation of discourse, cognitive psychological and genre based, share features in common, yet lead to different models for the analysis of text. The work of Meyer (1975; Meyer (1985) is more closely linked to the schematheoretic view, as it implies that readers approach texts with formal schemata which correspond to the content structure of the texts they read. Both approaches may provide insight into the communicative purposes of texts. The starting point for Meyer (1975) is to understand the reading process by examining what information the reader can recall from the text. To do this, it is necessary to know exactly what information is presented in the text. For Meyer, a text is a cognitive product, as the logic and message intended by the author are embedded in the text. The prose analysis procedure will involve a construction of the underlying logic and message of the text from the perspective of the author. This is called the content structure analysis. (See examples on pages 124 and 125). A skilled reader will form a representation of the text in memory parallel to that of the content structure. This is not an exact replica of the original text, but a structured and coherent recollection of the superordinate ideas and relationships in the passage. The implication of content-structure analysis is that it provides a framework for readers to

access the meaning of the text through its organisational structure and signalling devices. This in turn implies that a reader's awareness of the rhetorical organisation of texts enables them to accomplish specific communicative goals, such as finding important information, or learning and remembering the content of texts.

### **EXPOSITORY AND SCIENTIFIC TEXT**

This section clarifies the nature of expository text and indicates why scientific text is a distinctive type of text genre. Much early work on text understanding concerned story grammar, and many of the ideas now being applied to expository text were developed first with stories (Glenn, 1978). This was probably due to the essential first step in any science of investigating the simplest materials possible. Folktales and children's stories fulfilled this requirement.

Narratives usually begin with an orientation which includes time and setting. In addition the characters must be set up and given substance. The narrative template for traditional folktales includes syntactic features which establish time, characters and setting. For example, folktales usually begin with the phrase "Once upon a time..." Research in both first language reading (Mandler & Johnson, 1977) and second language reading has provided evidence for a story schema. Carrell (1984a) found that non-native readers of stories written in English who read the text in canonical order recalled more than those who did not. Even subjects who read the texts in the non-canonical order tended to recall the text in its canonical order rather than the order in which it was read. This is evidence that readers have a well defined story schema which is activated when reading and which prevails despite experimental conditions which might distort the temporal order of events. In other studies, the explicit teaching of story grammars has been shown to improve

comprehension of narratives (Singer & Donlan, 1982).

Other research investigating text structure analysis have attempted to apply a story grammar model to the structure of science reports (Davis, Lange & Samuels, 1988). The model has a number of top-level, or main components. These represent the problem to be investigated, the description of the investigation, the results and the conclusion. These components correspond to the units of the story grammar. The problem can be equated to the initial event of the story, the description corresponds to the reaction to the situation, while the conclusion corresponds to the moral of the story. The model was constructed like the hierarchical tree structure diagrams in Meyer's (1975) work (pages 24 and 125) and was found to be successful in predicting which statements would be recalled in relation to their position in the hierarchy.

Grabe (1987) investigated whether expository prose is a major text genre and what sub-types could be found within expository prose. Grabe set out to establish whether text-types existed and what differentiated them from other sub-text types. Grabe used two sociolinguistic parameters, topical context and audience to interpret variation in text type. Texts were compared by means of twenty seven syntactic and six cohesion measures. The results showed that expository prose can be defined as a major expository text genre, and that a number of sub-text type distinctions can be drawn. In the context of Grabe's (1987, p. 117) analysis, the texts selected for this study, extracted from *The New Scientist* would be classified as popular natural science, as the intended audience for the journal is broad rather than narrowly academic or specialist.

In describing the distinctive nature of scientific texts, the term 'scientific English' will be used in the Hallidayan sense, as "a useful label for a generalised functional variety or register, of the modern English language" (Halliday, 1993, p. 54). Apart from sharing this useful definition, the approach

to text analysis adopted in this study has nothing in common with the systemic functional model of language which distinguishes Halliday and Martin's (1993) work on scientific discourse.

### **SCIENTIFIC TEXT STRUCTURE**

A number of linguists can be cited for their descriptive and analytical comments on the distinctive nature of scientific writing. Widdowson (1979) describes scientific text as having its own independent secondary linguistic system. He adds (p. 61) "Scientific organisation is structured according to certain patterns of rhetorical organisation, which, with some tolerance for individual stylistic variation, imposes a conformity on members of the scientific community no matter what language they happen to use". Widdowson's view represents a belief that there is a universal pattern of scientific language, with its own independent discourse conventions. The distinctive nature of scientific discourse, though not the universalist position, is endorsed by Halliday & Martin (1993, p. 172) who state:

The fact is that no scientist could do his or her job without technical discourse. Not only is it compact and therefore efficient, but most importantly it codes an alternative perspective on reality to common sense, a perspective accumulated over centuries of scientific inquiry. It constructs the world in a different way.

It is outside the scope of this study to provide further detail on the genre approach to the analysis of scientific text structure. Instead, the focus will be on the framework used by Meyer (1985), linking text structure to cognition and the reading process. The links between this approach and schema theory have already been elaborated in Chapter 2. The next section will first discuss evidence for the textual patterns in expository and scientific discourse and

show how the text structures identified in the present study are confirmed by other research on text structure.

## **EVIDENCE FOR ORGANISATIONAL PATTERNS IN SCIENTIFIC TEXT**

An important feature of texts is that they cohere or “hang together” and make sense. Coherence is something created by the reader in the act of reading the text: most readers and listeners are motivated to find meaning in discourse. In addition to coherence, well-written texts also display cohesion, which is the surface marking of grammatical links between clauses and sentences in written texts Halliday & Hasan (1976).

While cohesive devices are micro-structures, texts also display macro-structures, or patterns in longer stretches of discourse. (Meyer, 1975) has proposed that there are five basic ways of organising expository prose. (See Figure 2.1.) This is not intended as an exhaustive or definitive list, but represents the most commonly occurring patterns in texts. (See Figure 2.1 on page 32.)

Carrell (1984b, p. 443) comments:

These five basic expository types are common in various contexts. News articles are typically of the description type, telling us who, what, where, when and how. Scientific texts are often of the problem/solution type, first raising a problem and then presenting a solution.

Most expository prose consists of combinations of these rhetorical patterns. For example, fictional narratives may contain description, causation, and time sequenced events (i.e., collection) within the overall macrostructure of problem-solution. Research employing this macrostructure approach has led to confirmation of Meyer’s scheme of five organisational patterns common in

expository text (Meyer, 1975; Meyer & Freedle, 1984; Englert & Hiebert, 1984; Horowitz, 1986). Individual sentences of a text therefore combine to form certain characteristic patterns, such as cause, consequence, temporal sequence and contrast (Hatch, 1992).

Text structure has been identified as one of the factors influencing creative-problem solving from scientific or technical passages. Mayer (1983) investigated the impact of certain text features on learning. It was found that advance organisers, in the form of labelled diagrams depicting the structure of the text, and techniques for highlighting explanative text improved readers' understanding of science prose.

Cook & Mayer (1988) found that undergraduate students had difficulty sorting passages into categories on the basis of text patterns such as organisation, enumeration, sequence and classification. Consequently, it was decided to investigate whether teaching text structure explicitly would improve comprehension. Students were then divided into a training group and a control group. The latter were given no specific activity relating to text structure. The training group received eight hours of training in how to discriminate and use text structures found in their textbooks. This was called text structure strategy training and involved students in identifying ideas in written texts and connecting them to text structures. Results showed that training was successful in helping students to focus on the top-level structure of scientific texts. This empirical research is important because it reinforces the importance of one level of interpretation that we engage in while reading, that of recognising textual patterns. There is consistent evidence in L1 and L2 reading research that training in awareness and use of text structure can enhance reading proficiency (Barnett, 1984; Taylor & Beach, 1984; Carrell, 1985a; Cook & Mayer, 1988; Davis, Lange & Samuels, 1988; Kern, 1993; Raymond, 1993).

As structure strategy training has such a high profile in reading instruction, the implication is that the structures found in text are identifiable and may be common across a range of contexts. According to McCarthy (1992, p. 28):

Certain patterns in text reoccur time and time again and become deeply ingrained as part of our cultural knowledge. These patterns are manifested in regularly occurring functional relationships between bits of the text. These bits may be clauses, phrases sentences or groups of sentences.

While reading, the reader engages in the cognitive activity of interpreting relations between the propositions, and constructing a representation of the whole text. Texts may contain signalling and content words to orientate the reader as to how relations should be interpreted. These assist the reader in deducing relations between text segments and, according to Meyer (1985, p. 29) "help readers to make educated guesses about which relational patterns or schemata to assign to the text".

There is a some support in the literature for Meyer's five organisational patterns. McCarthy (1992) claims that the problem/solution organisation pattern is very common in texts. Trimble (1985) who has carried out considerable research and analysis of English for science and technology (EST), uses a discourse approach to structural organisation. (Trimble, 1985) examines rhetorical elements in texts in a similar way to Meyer, and emphasises the overall pattern of discourse.

For instance both use the term rhetoric to mean "...the process a writer uses to produce a desired piece of text. This process is basically one of choosing and organising information for a specific set of purposes and a specific set of readers". (Trimble, 1985, p. 10). This mode of analysis involves looking at how text is organised and which patterns are used to organise and



## Rhetorical Process Chart for Scientific Texts

Level 1:	Objectives of the whole text.			
Example:	<ol style="list-style-type: none"> <li>1. Detailing the experiment</li> <li>2. Making a recommendation</li> <li>3. Presenting a new hypothesis or theory</li> <li>4. Presenting other type of scientific information</li> </ol>			
Level 2:	General rhetorical functions to develop the objectives of Level 1			
Example:	<ol style="list-style-type: none"> <li>1. State purpose</li> <li>2. State past research</li> <li>3. State problem</li> <li>4. Describe apparatus and experimental procedure</li> </ol>			
Level 3:	Specific rhetorical functions that develop Level 2			
Example:	<ol style="list-style-type: none"> <li>1. Description: physical, function and process</li> <li>2. Definition</li> <li>3. Classification</li> <li>4. Instruction</li> <li>5. Visual verbal relation</li> </ol>			
Level 4:	Rhetorical techniques that provide relationships within and between the rhetorical units of Level 3			
	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <ol style="list-style-type: none"> <li>1. Time order</li> <li>2. Space order</li> <li>3. Causality and result</li> <li>4. Order of importance</li> <li>5. Analogy</li> <li>6. Exemplification</li> <li>7. Illustration</li> </ol> </td> <td style="width: 5%; vertical-align: middle; text-align: center;">}</td> <td style="width: 45%; vertical-align: top;"> <p><i>Meyer's Top-Level Structures</i></p> <p>Time order</p> <p>Comparison/contrast</p> <p>Cause/effect</p> <p>Problem/solution</p> <p>Collection of descriptions</p> </td> </tr> </table>	<ol style="list-style-type: none"> <li>1. Time order</li> <li>2. Space order</li> <li>3. Causality and result</li> <li>4. Order of importance</li> <li>5. Analogy</li> <li>6. Exemplification</li> <li>7. Illustration</li> </ol>	}	<p><i>Meyer's Top-Level Structures</i></p> <p>Time order</p> <p>Comparison/contrast</p> <p>Cause/effect</p> <p>Problem/solution</p> <p>Collection of descriptions</p>
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Figure 4.3. Rhetorical elements in scientific and technical English (adapted from Trimble 1985, p. 11).

structure the ideas. This involves firstly, the sequencing of items of information, and secondly, establishing the relationships that exist between them. Trimble (1985) divides the whole text or discourse into four rhetorical levels, each displaying distinctive purposes. Level one gives the purpose and level two the major parts or sections in a scientific passage. Level three shows the rhetorical functions that are found most commonly on scientific discourse e.g., classification, definition, or instruction. Level four describes the rhetorical techniques a writer employs as a framework in which to present information. Rhetorical techniques also show the relationships between the different items of information.

As Figure 4.3 shows there are points of similarity between the approaches of Trimble and Meyer. The former provides an overview of the macro structure of the text at levels 1, 2 and 3. Level 4 deals with the micro-level, the level at which the relationships between the individual sentences are important. Meyer's (1975) top-level structures are parallel to Trimble's (1985) rhetorical techniques, but the latter describes more categories than Meyer's five types.

In this way it is possible to draw parallels between the work of Meyer (1975, 1985) and applied linguists working on analysis of scientific prose. The literature reviewed indicates that there is a measure of agreement among linguists and cognitive psychologists that scientific text displays characteristic forms of organisation. The next section will present evidence that there are preferred patterns in scientific discourse, though these may not be invariant across cultures.

## **CROSS-CULTURAL STUDIES ON TEXT**

### **ORGANISATION**

The area of cross-cultural rhetoric has generated a large body of research which demonstrates the effects of formal schemata on the comprehension

and production of written text: 1 a second language. Basically, contrastive rhetoric, according to Purves (1988) embodies the notion that cultures express unique concepts and develop distinctive perceptions of the world that have an impact on written expression. The area of contrastive rhetoric emerged from the work of Robert Kaplan (1966), who in 1966 produced an article entitled 'Cultural Thought Patterns in Intercultural Education'. This article was based on observation that students of English as a second language wrote texts that were distinctly different from those of native speakers, despite the fact that their proficiency levels were adequate to the task of writing. In a later article, Kaplan (1987, p. 9) explained his position as follows:

The interesting distinctions occur, it seems to me, at what I have decided to call the rhetorical level; i.e., at the level of organisation of the whole text. There are, it seems to me, important differences between languages in the way in which discourse topic is identified in a text and in the way in which discourse topic is developed in terms of exemplification, definition and so on.

Kaplan (1966) claimed that there are marked differences in rhetorical structure of languages. English was described as linear, with a clearly defined topic, introduction and conclusion, with no digressions which would violate the essential unity of the text. This pattern was contrasted with the parallel structures of Arabic prose, the circular and indirect patterns of Semitic languages and the digressive nature of Romance languages. Kaplan's later (1987) article qualifies these generalisations with the admission that all of the various rhetorical modes, linear, digressive, circular and parallel may be possible in any language. Kaplan's (1987) views have modified his earlier notion of ethnolinguistic thought patterns distinctive of English, Semitic, Oriental and Romance languages. He maintains that while all forms are possible in each language, there are clear preferences within languages and all patterns do not

occur with equal frequency. Moreover, he expressed the view any speaker in any language can avail of a vast repertoire of different stylistic mechanisms to express the same meaning. These variations may be limited by sociolinguistic constraints. The crucial point that Kaplan (1987, p. 11) makes is that there are differences in the ways L1 and L2 speakers can avail themselves of these choices in writing.

The native speaker can choose between them, presumably recognising the various pertinent constraints. . . . The non-native speaker does not possess as complete an inventory of possible alternatives, and does not recognise what sorts of constraints a choice imposes on the text which follows.

These limitations influence the discourse processing strategies of non-native English readers. It may mean less fluency in reading and writing in L2 texts.

From the study of contrastive rhetoric, two issues which are of relevance to the present study emerge. The first issue concerns whether texts of the same genre, in this case scientific texts, exhibit universal or language specific tendencies. This is important because if the textual patterns of scientific discourse are found to vary from one culture to another, it would be likely that readers of scientific texts in a second language might lack the formal schemata to deal with such texts. In the present study, second language readers of English, i.e., students from Malaysia were asked to read and summarise scientific passages. The second question is related to the first. Is there any evidence that transfer of culture specific genres might interfere with their interpretation of science texts? The findings of research may have implications for the interpretation of the results of the present study, which investigates awareness of text structure among various students of different cultural and language backgrounds.

While Kaplan's work has shown some evidence for preferred cultural patterns of exposition in the writing of second language speakers of English,

this only occurred in writing free compositions. In the context of the present study, transfer of culturally specific patterns is unlikely to have taken place, as later studies such as Connor & McCagg (1987) have shown. Connor & McCagg's findings show a lack of transfer of culturally preferred patterns in an elicited recall task. Their study investigated the differences in sequencing of information in paraphrases of texts written in English. Results showed that in recall protocols, the non-native speakers were more likely to maintain the order and sequence and structure of the original than native speakers, who often experimented with structure.

The first question posed concerns the comparison of texts of the same genre in different languages, and whether there are 'transnational discourse communities' (Swales, 1990, p. 65), or culture-specific patterns of writing. This is important in the present study as it bears on whether L2 speakers of English would have the formal schemata to deal with scientific texts. Here the evidence is conflicting. Widdowson (1979, p. 61) argues for the strong universalist position that language specific differences do not obtain in scientific prose.

Scientific exposition is structured according to certain patterns of rhetorical organisation which, with some tolerance for individual and stylistic variation, imposes a conformity on members of the scientific community no matter which language they happen to use.

There are therefore two quite different views on the subject. The universalist position such as Widdowson's maintains that scientific text structures are relatively invariant across cultures, while Kaplan's view is that different languages display preferences for different kinds of textual patterns, showing a dominance of either linear, circular, parallel, or digressive patterns of organisation. In view of these opposing positions, further evidence will be considered.

Mohan & Lo (1985) are cautious about Kaplan's claim that English displays a linear pattern in contrast to which Chinese displays circularity. These authors assembled evidence of linear patterns from both classical and modern Chinese sources that indicates very little difference between the structures available to writers of English and Chinese. This refutes Kaplan's (1966) claim that such imputed differences exist between languages.

In another study, Taylor & Tinguang (1991) look at sources of variability in scientific discourse by comparing the introduction to scientific papers written in a variety of related disciplines by three groups of physical scientists: Anglo-Americans writing in English, Chinese writing in English and Chinese writing in Chinese. Taylor and Tinguang's study was highly specific and controlled the authorship and content of the data to ensure that the written products were comparable on as many dimensions as possible. The results showed that all writers used a similar pattern of stages in writing the text. These they called 'moves'. In conclusion, Taylor & Tinguang (1991, p. 332) state:

There is an internationalisation of scientific discourse that is nevertheless heavily qualified by significant variations in both regional and disciplinary cultures. It is the study of these interactions, rather than in broad generalisations, about national rhetorical styles or about universals, that we can best approach how to help students of a second or foreign language to deal with the requirements of writing for English for 'academic purposes'.

This study was very explicit and concentrated on one specific text-type, the introduction to the scientific paper written by members of a relatively homogeneous cultural group. The results showed that despite variations in style, all writers used a similar pattern of moves in writing an introduction to a scientific paper. They add that such findings are heavily qualified by variations in regional and disciplinary cultures. Taylor & Tinguang's (1991) study does not, however, support the universalist position of Widdowson. Instead it

acknowledges that while scientific discourse is recognised internationally as distinctive, there are strong cultural and regional differences that influence the style of written communication.

Other studies, such as Clyne's (1987) describes cultural differences in the organisation of linguistic and sociological texts written by English and German speakers. Clyne found differences in linearity and digression as well as text processing differences and attitudes to textual organisation. This study indicates that the English and German languages differ in textual organisation. These differences may operate as a barrier to the exchange of ideas between the two related cultures.

Overall, there is lack of agreement between studies on account of the variability in methodologies and approaches adopted. Taylor & Tinguang (1991) identified potential sources of bias in studies on contrastive rhetoric. These include authorship, genre and content of the data together with the reliability of the research methodology undertaken. The earlier evidence provided by Clyne (1987) and by Mohan & Lo (1985) indicate that all studies varied in methodology, genre, authorship of the texts, tasks used to elicit written texts and type of analysis used. It would be unwise to conclude on the basis of present evidence that there are definite invariant patterns in scientific prose which are universally accepted. Instead the evidence suggests that there are many powerful influences that impinge on the production and interpretation of written texts. Swales (1990) mentions national, cultural, social, technical and religious influences. Ballard & Clanchy (1984) suggest learning styles and traditions of learning.

To conclude this chapter, a relativist position will be adopted with respect to the existence of particular organisational features in scientific texts. The weight of evidence suggests that this is both sustainable and reasonable.

The implication is that while Kaplan's (1966) view of intrinsic cultural differences is not supported, there is a measure of support for the view that there may be, in different languages, preferred patterns in written texts. The evidence is taken to suggest that there are a range of linguistic choices for the construction of meaning in any language, and that languages may vary in the salience of one or other form of rhetorical organisation, whether it is the result of social, educational or communicative factors. For example, Eggington (1987), in research on contemporary Korean, has shown the existence of two quite distinctive rhetorical styles, one traditional, the other similar to English. Other languages may display a similar range of styles.

In focusing on the five rhetorical patterns exemplified by Meyer (1975) and scientific texts which exemplified these patterns, the aim of the present researcher is not to suggest that such patterns are invariant across cultures, but to isolate some typical exemplars of how English scientific texts are organised and to observe whether students in Australia from different language backgrounds are aware of such patterns and whether they can use them to organise their recalls. In this way the subjects' own schemata for texts are activated. If the texts read are congruent with their pre-existing cultural and formal schemata, it is likely that all subjects would display similar patterns of awareness and recall.

Neither is it assumed in this study that the texts are culturally neutral (Alderson & Urquhart, 1988). Subjects were expected to interpret the texts according to their own cultural knowledge, assumptions and reading skills. Within the framework of schema theory adopted, awareness of text structures could be interpreted as evidence that readers have the appropriate cultural and formal schemata to interpret the text, whether these schemata were acquired in the first or second language. These issues will be taken up again in the discussion section.



## **Part III**

# **Methodology**

## Chapter 5

# Content Structure Analysis of Texts

As discussed in Chapter 4, in texts there is usually a larger pattern or organisational plan used by the writer that can be interpreted by the reader. Often this is signalled by grammatical and lexical devices. This chapter, the first of two dealing with the methodology of the study, presents an overview of Meyer's (1975) text structure analysis procedure.

Meyer's research and that of others (Trimble, 1985; Hatch, 1992; McCarthy, 1992) in the related field of discourse analysis has shown strong support for the claim that there are significant types of rhetorical devices or organisational patterns used in prose. These organisational features are also known as rhetorical techniques (Trimble, 1985) and are described in Figure 4.3 on page 100 as *comparison/contrast*, *problem/solution*, *description* and *cause/effecttime order*. Meyer's research (1975, 1985) as well as that of Kintsch & Greene (1978) and Mandler & Johnson (1977) has shown that the hierarchical content structure of a text, and the relationship between the superordinate and subordinate ideas plays an important role in comprehension and recall of ideas. The purpose of this chapter is to explain and illustrate

this approach and show how it has been applied to the expository passages selected for the present study.

In Chapter 2 empirical studies showing the effects of awareness of text structure on comprehension were reviewed. There is compelling evidence from the literature reviewed that readers who use a structure strategy recall more main ideas from texts. In studies with proficient first language readers of English, Meyer & Freedle (1984) found that those who did not use the structure of the original to organise their recalls tended to produce disorganised lists of ideas, so that they recovered neither the main ideas nor the details very well. In studies with speakers of English as a second language, Carrell (1984b, 1992) found results similar to Meyer's. Using expository texts structured according to Meyer's (1975) types, it was found that ESL readers who organised their recalls according to the structure of the original text recalled significantly more ideas than those who did not. This section will demonstrate and explain the content structure analysis and apply it to the four passages chosen for the present study. In this way, the methodology for analysis and scoring of the subjects recall protocols will be clarified, as they are compared to the hierarchical structures of the original passages.

## **MEYER'S HIERARCHICAL STRUCTURE**

### **APPROACH**

In the present study, Meyer's approach to content structure analysis as outlined in *The Organisation of Prose and its Effects on Memory* (1975) has been adopted and applied to the scientific passages selected for the investigation. Meyer's (1975) content structure analysis combines sentence level connections and macro-level organisation. Basically, Meyer's analysis views the text as a set of inter-related micro-propositions that form complex arguments. The

analysis results in hierarchically arranged tree structures with nodes showing how content is organised. Relationships between ideas are specified and organised and subordination of ideas is made explicit.

According to Meyer (1985) passages usually vary in their content structure: most have multiple 'levels' from a top-level, specifying main ideas, down to lower levels which describe or give more information about the ideas in the structure. The top-level ideas have many levels of subordination beneath them, to which they are related. The ideas at various levels in the structure are the actual content words and phrases from the text.

Meyer's system enables relations between content words to be classified and labelled as either role relations or rhetorical relations. Role relations specify the relationship between content words (lexical predicates) and their arguments. These role relations are essentially those outlined by Fillmore (1968) as case relations, and are dominated by lexical predicates. Meyer's is a complex system of text analysis which results in a hierarchical content structure diagram, displaying ideas at varying levels. This general overview of Meyer's system prefaces a more detailed description, together with a step-by-step analysis of each of the scientific texts used in the present study, and a description of the rules for building the hierarchical structure of a text. Four scientific passages were used for the present study: two passages were organised as comparison/contrast and two were organised as problem/solution. All passages will be analysed in detail, and two examples of the hierarchical content structures will be presented. (See Figures 5.2 and 5.3, pages 124 and 125)

## TEXT ANALYSIS PROCEDURE

To understand and apply Meyer's content structure analysis, it is important to proceed in stages. Three primary levels of analysis are identified and described in this approach to prose analysis. The first is the sentence level, which is concerned with the way ideas are organised within sentences and how sentences are organised within texts. The second level relates to issues of logical organisation and argumentation, at which the five rhetorical structures identified by Meyer operate. (See Figure 2.1 on page 32.) The third level is that of top-level structure or overall organisation.

Beginning at the first level, a text may be viewed as a series of simple propositions which go together to make up a complex proposition. A *proposition* is a meaning unit which consists of a predicate or relation and one or more arguments connected to each other. Case grammar provides a finite list of relations that exist between arguments within a single proposition. Case grammar is a sentence and clause level semantic model. A list of sentence level role relationships can be seen in Table 5.1, from Meyer (1975, p. 28).

A proposition consists of (i) a predicate (relater) which may be a lexical item like a verb, adjective or sentence connective, for example 'but' which combines the propositions into arguments, and (ii) the arguments that are required by the meaning of the verb. The arguments fulfil different semantic operations and each is labelled with the name of a particular case role that identifies its relation to the predicate. In a simple or complex sentence, the list of case roles is limited and may be specified. Case grammar enables one to see the relations between sentences. Texts, however, differ structurally from sentences. It is more difficult to list a set of all relations for a text and to show how sentences fulfil text level roles.

Table 5.1. Role Relationships (from Meyer, 1975, p. 28).

1. Agent	Instigator of an action
2. Instrument	Something <u>used</u> inanimately by an agent to perform an action
3. Force	A casual relation devoid of responsibility — previously called noninstigative cause
4. Vehicle	Something that conveys a patient or moves along with it — previously called noninstigative cause
5. Patient	Who or what is directly affected by an action or what is in a particular state — includes previous patient, experienced and essive roles
6. Benefactive	Someone or something on whom an action has a secondary effect, good or bad — previously also called benefactive
7. Latter	Where the patient begins a motion — previously called source and material
8. Range	Path or area traversed, a static location, or the limitation of a process to a specified field or object — previously called range

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Halliday & Hasan (1976, p. 10) stated the problem of explaining the progression of whole texts. "We have to show how sentences which are structurally independent of one another may be linked together through particular features of their interpretation". The grammar of English offers a limited set of options for creating surface links between the clauses and sentences of a text. Halliday & Hasan (1976) use the term cohesion to describe the grammatical links from sentence to sentence. The resources available for grammatical cohesion in English are features such as pronominalisation (use of pronouns) ellipsis (omission of items which are retrievable from the text) and conjunction of various kinds. Cohesive items are only signals as to how the text should be read. They are not absolutes. The other feature of well formed texts is coherence, the sense a reader has that the whole text makes sense. If a reader is presented with a text on a complex and totally unfamiliar topic, the cohesive ties might be evident and clear, but the text might remain incoherent if the reader cannot understand it (Steffensen, 1986). Coherence is therefore independent of, but signalled by cohesive markers and the interaction between the two depend as much on what the reader brings to the text as what the author puts into it. Making sense of a text is an act of interpretation, and Meyer's approach acknowledges the role of the reader in comprehension.

At the second level of analysis, the relationships among ideas in larger stretches of discourse are essential. According to Meyer (1975), the independent sentences of a text are linked by what are called *rhetorical predicates* which are organising relations in prose. Rhetorical predicates may or may not be lexicalised. An example of a rhetorical predicate is a *response* which may relate equal important pairs of arguments, such as *question and answer*. In addition, Meyer (1975, p. 25) adds:

Rhetorical relations often relate together the information in a number of sentences or paragraphs and chapters. Their arguments are the top-level



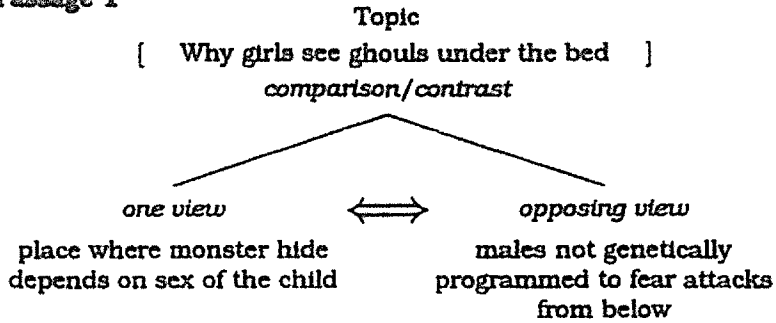
of subordinate propositions. Thus, an entire passage can be thought of as one very complex proposition which is composed of subordinate propositions which are also composed of subordinate propositions. This chaining of propositions continues to the depth necessary for a particular passage.

Rhetorical predicates are listed in Table B.1 on page 179.

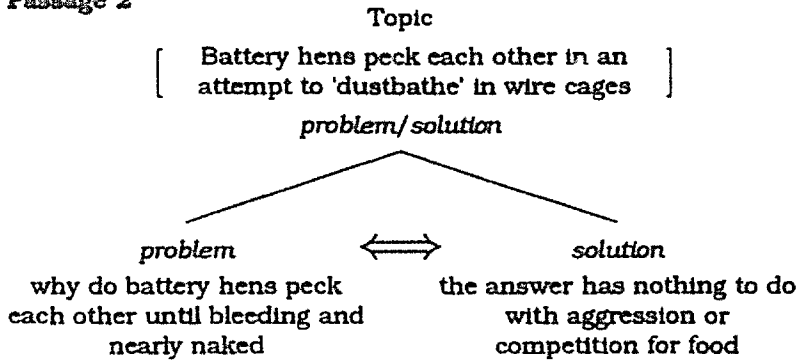
The five basic types of relationships identified by Meyer are as follows; *description*, *comparison*, *problem/solution*, *causation* and *collection*. While one or more of these patterns of organisation may be found in a text, and link together sentences they can also serve to organise the text as a whole. This is Meyer's third level of analysis, referred to as the top-level structure or organisation of the whole text. Figure 5.1 displays the top-level structures of the four texts used in the study. As the diagram depicts, there are two of each type of organisation, problem/solution and comparison/contrast. Meyer explains that rhetorical predicates are often found at the top levels of content structure where they show how subordinate ideas are linked together. They are primarily responsible for giving prose its overall organisation.

In summary, Meyer's (1975) content structure approach provides a system of classification at both micro- and macro- levels of analysis. At the micro-propositional level it uses case grammar to link clauses together. At the macro-level of the paragraph or passage it describes how sentences are related to each other. As texts are longer structured pieces of discourse, a method for identifying text structure is a necessary procedure for examining the reading comprehension process. To investigate what information the reader has processed from the text, the researcher needs to know just what information was presented in the text. For (Meyer, 1975), the procedures used to analyse the text are also used as scoring templates to access the reader's recall of text. Variations between text structure and a reader's recall protocol

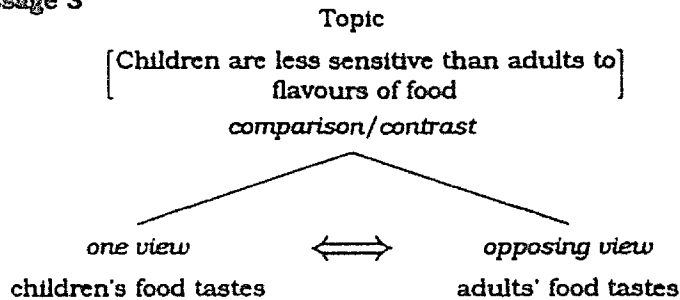
**Passage 1**



**Passage 2**



**Passage 3**



**Passage 4**

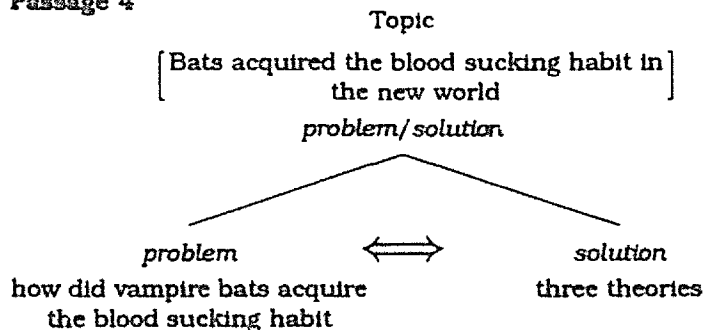


Figure 5.1. Top Level Structures of the Four Texts Used in the Study.

are analysed to establish the degree of recall and memorability of ideas. The following section presents the set of procedures for construction of a content structure analysis of texts.

### **DEMONSTRATION OF MEYER'S SYSTEM OF CONTENT STRUCTURE ANALYSIS**

Meyer has indicated two procedures for analysing the organisation of information in prose. One is a bottom-to-top parsing which starts with the simple sentences in a text and progressively builds up the inter-relationships between sentences to show the hierarchical structure. The other approach is top-to-bottom level analysis. This begins with identifying the main propositions in a text and classifying their interrelationships. Further analysis may be undertaken if required. Meyer (1975, p. 44) has remarked that this latter procedure is valuable if the top levels of organisation of a passage are needed. For the present study, since the bottom-up procedure is very detailed and the information not essential to the analysis, the four passages will be analysed using the top-to-bottom procedure. The sequence of steps is as follows:

1. Identify the topics discussed in each paragraph. The chunking of information usually corresponds to the organisation of content at the top levels of content structure. See Tables 5.2, 5.3, 5.4 and 5.5.
2. Establish whether signals are used to present information. Signalling often provides useful information for identifying the top-level organisation of content. The top-level organisational structure of the text can now be identified. This may be illustrated as an overall structural pattern. (See Figure 5.1 on page 116.)
3. Having identified the main ideas, the next step is to further analyse the complex propositions by identifying their interrelationships, predicates

Table 5.2. Analysis of Passage 1: Why Girls See Ghouls.

Paragraph Number	Topic	Content Structure	Signalling
1	differences between sexes on beliefs about location of monsters	Comparison /Contrast	but .. different places depending on more girls than boys
2	children asked about fears: differences between sexes revealed	Top level	more girls than boys
3	physical features of female, lighter frame, smaller feet	High level	female more than males
4	behavioural remnants have survived	Mid level	lighter, more flexible
5	other behavioural differences have been found	Mid level	girls spend more time than boys
6	another experiment planned	Low level	

and arguments.

4. A tree-structure diagram is then constructed to show the top-level structures and subordinate ideas. (See Figure 5.3 on page 125.)

The first step, a paragraph by paragraph analysis is illustrated in Tables 5.2, 5.3, 5.4 and 5.5. For each paragraph, the topic and level of ideas in relation to the main idea is displayed.

The second step which is identification of the top-level of the content structure of each of the four passages is displayed in Table 5.1. For the third step the texts are further analysed into hierarchical tree-structure diagrams showing the top-level structures according to Meyer's content-structure approach. (See Figures 5.2 and 5.3.)

Table 5.3. Analysis of Passage 2: A Handful of Dust Makes a Happy Hen.

Paragraph Number	Topic	Content Structure	Signalling
1	battery hens peck each other until bleeding and naked	problem stated	why... scientists have found
2	scientists have set out to discover the reason for hens savage behaviour	High level	to find reason for
3	describes experiment; two groups of fowl kept in different conditions	High level	one group
4	Describes behaviour of free birds-rarely peck each other	Mid level	
5	compares behaviour of birds in wire cages	compare/contrast	however, nevertheless, but, some, others
6	authors conclude that battery hens peck each other in attempting to behave like free birds	High level; solution	conclude that

Table 5.4. Analysis of Passage 3: Only Big Boys Like Broccoli.

Paragraph Number	Topic	Content Structure	Signalling
1	children less sensitive than adults to the flavour of food	Top level Comparison /Contrast	less popular... less sensitive than
2	children ages 5 to 15 asked to rank vegetables in order of preference	High level	to rank according to
3	cauliflower and brussels sprouts less popular, corn most popular	Mid level	rankings, bottom
4	high sugar content of corn & peas, low sugar content of cauliflower determine popularity	Mid level	comparatively high... low sugar... less appetising...
5	boys 2-5 times less sensitive than adults; girls as sensitive as adults to sweet bitter, salty tastes	High level	as sensitive as adults... less sensitive than adults...
6	children taste less than adults therefore they prefer salty or sugary foods	High level	much less intense than...
7	further projects to explore children's food preferences; goal of this research	Mid level	further projects

Table 5.5. Analysis of Passage 4: Vampire Bats.

Paragraph Number	Topic	Content Structure	Signalling
1	how have vampire bats acquired a taste for blood?	Top level Problem /Solution	how...?
2	Theory 1: fruit eating bat with large incisors: theory not correct	High level	according to one theory
3	Theory 2: bats that lived on parasites that fed on blood were ancestors of vampire bats	High level	a second theory
4	theory 2 refuted why bats living on blood is a problem	High level	this idea is also flawed
5	Theory 3: Ancestors of bats began by eating insects attracted to wounds on large animals	High level	now a biologist has proposed a third theory
6	advantages of this theory	Mid level	theory has a lot going for it
7	South America home to several large birds on which vampires could feed. Many species died; reduction in numbers of large animals; introduction of domestic animals	Low level	Fenton believes that; Brock believes that...

A separate and additional analysis carried out for the present study was the identification of the idea units for each paragraph. This was done in order to compare idea units recalled by the subjects in the study with those in the original texts. In addition, this analysis enabled the researcher to identify which ideas were at varying levels of the content structure. The idea units are listed in Appendix A.

### **SUMMARY: A PROCEDURAL APPROACH TO TEXT ANALYSIS**

For (Meyer, 1975), the content structure represents the underlying logic and communicative intent of the author. A reader approaches the text with certain expectations regarding form and content and a desire to interpret the writer's message. A reader therefore creates a representation of the text in memory. This enables the reader to interpret the text. Meyer's technique for analysing expository texts results in a hierarchically arranged tree structure diagram called the content structure. Examples of the content structures of two of passages used are displayed on pages 124 and 125. The former shows a comparison/contrast structure while the latter displays a problem/solution structure.

In order to comprehend a text, the reader has to activate prior knowledge, make inferences and construct a coherent representation of what is read in the light of reading goals and the structure of the text. Schema theory proposes that structures embodying background knowledge about the text structure provide the ideational scaffolding for understanding the setting, argument, characters and chain of events. Meyer's (1975, p. 85) approach is therefore compatible with the interactive approach to reading, engaging the reader in constructing relationships between the elements of a text. The empirical research reviewed in Chapters 2 and 3 demonstrate that efficient readers use



a 'structure strategy' (see page 34) to recall the text, which involves recognising the textual patterns that occur and link together the ideas. What makes content structure approach to text analysis both robust and enduring is that it underlines the complexity of comprehending a text, and at the same time provides a coherent framework which can be applied to any text to show the relation of superordinate and subordinate ideas. Meyer (1985) emphasises the mental activities involved in interpretation, and how the reader might construct a representation of the text in memory parallel to the content structure. Thus, Meyer's approach could be described as procedural, emphasising the role of the reader in building the world of the text, based on his/her experience of the world. Making sense of a text is an act of interpretation and it depends on what the reader brings to a text. Content and formal schemata therefore interact in the process of interpretation, and the reader has to activate such knowledge and inferences to enable her/him to create a coherent representation of the text. The content structure analysis demonstrated in this chapter illustrates the structure of the text. In order to recall details from text, the reader is expected to form a representation in memory of the text parallel to that of the content structure.

The next section deals with the methodology and procedures for collection of data.

**Top Level Structure of Sub-topics in Passage 1 "Why girls fear things under the bed"**  
*comparison/contrast*

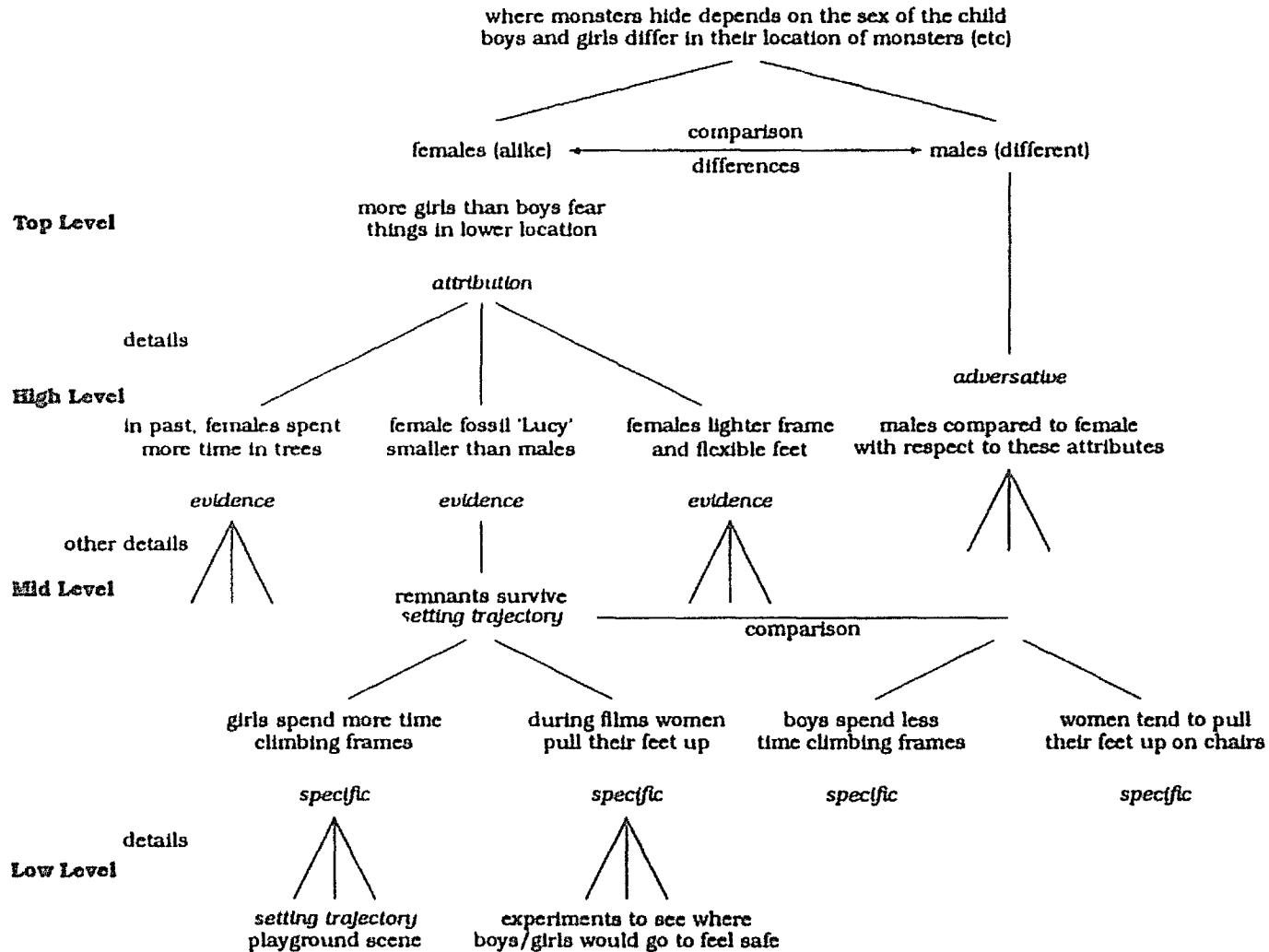


Figure 5.2. Top Level Structure of Comparison/Contrast Passage 1 "Why Girls Fear Ghouls Under the Bed".

**Top Level Structure of Sub-topics in Passage 4**  
**"How did vampire bats acquire a taste for blood?"**  
*problem/solution*

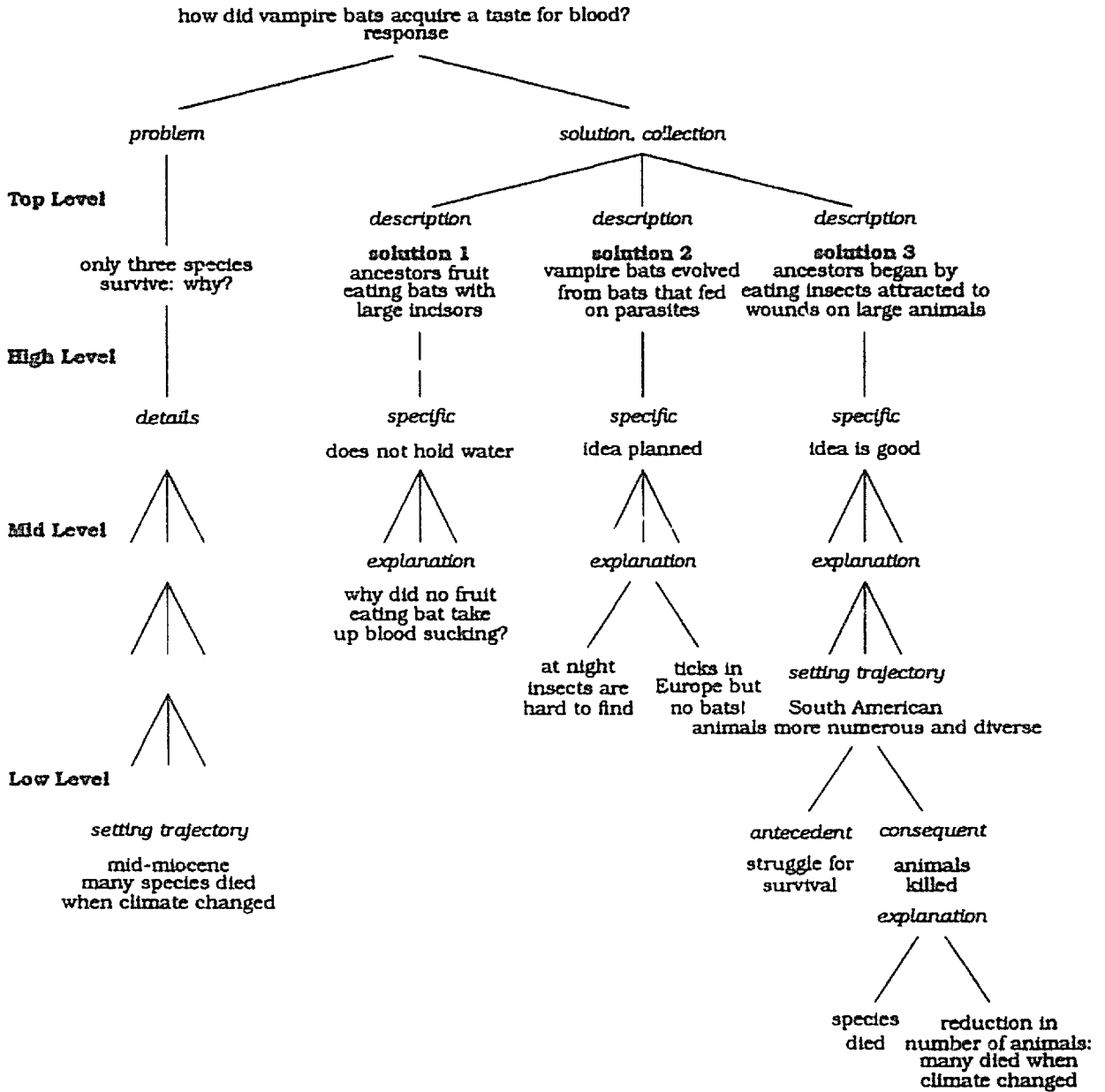


Figure 5.3. Content Structure Analysis of Problem/Solution Passage 4 "Vampire Bats".

# Chapter 6

## Methodology

### STUDY DESIGN

The study was designed to identify differences between three groups of subjects from different language and cultural backgrounds in their recall and awareness of expository text. (See Chapter 1.) The research questions were centred around two major themes, identified as idea units and main ideas recalled, and awareness of text structure. It was intended to investigate whether subjects from different language backgrounds displayed differences in quantity of idea units and main ideas recalled. For these questions, two dependent variables between groups were measured. The first was subjects' recall of idea units from a scientific passage following a reading. The second was their recall of main ideas as opposed to supporting details (referred to as level of ideas recalled). In addition, two questions investigated the effects of the different text structure types to establish which of the two text structures, comparison/contrast or problem/solution was more facilitative of recall of idea units and main ideas.

The second set of questions investigated differences in awareness between the groups of subjects from different language backgrounds. Awareness of

text structure was measured according to responses to three different tasks. The first was use of top-level structure in written recalls. The second was a recognition task, and the third involved naming the specific organisational pattern.

The last two questions concerned the possible interaction of text structure awareness and recall, specifically, whether there was an interaction between subjects awareness and recognition of text structure and their recall of main ideas. In the study the independent variables were language background and text structure type. The dependent variables were recall of idea units, level of ideas recalled, and awareness of text structure in response to three different tasks, involving *use*, *recognition* and *naming* of text structure. (See also page 133.)

It was expected that the study would show findings similar to previous studies, (see Chapter 2) and reveal a significant relationship between awareness of text structure and recall of main ideas.

For the set of questions relating to between group variables, several three by one way analyses (ANOVA) were carried out. Three by one way ANOVAs were used to test for differences in number of ideas recalled between groups. For level of ideas, the study used Meyer's top-level structure analysis and identified ideas at each of four levels: top, high, mid and low. Top and high level ideas represented the main ideas, mid and low the supporting ideas. Four three by one way ANOVAs were run, one for each level to test for differences between groups in recall of main versus supporting ideas.

Paired *t* tests were used to test for differences between the two text structures in terms quantity and level of ideas recalled by subjects in their written responses. The second set of questions related to awareness of text structure and the interactions between these measures and recall of ideas. To measure difference between groups in awareness as measured in use of structure

in written recall a 3 (groups) by one (use of structure) way ANOVA was run. Interaction between the measures of awareness was established by using a cross-tabs procedure. The results section reports on the statistical procedures in more detail, responding to each research question individually.

## **SUBJECTS**

Subjects for the study were chosen from first year university students enrolled in science foundation courses and in the first semester of their study at university. Three groups of subjects were chosen, consisting of fifteen students from each of the following language backgrounds: Singaporean, Malaysian and native English speaking Australian. Both the Singaporean students Malaysian groups were from overseas, having recently arrived in Australia. All the Australian subjects were first language speakers of English. The Malaysian identified themselves as speakers of English as a second language (ESL) having learnt English at school as a second language. The Singaporean students did not identify themselves as ESL, and reported that English was as much their first language as Chinese as they studied all subjects through English at school and considered themselves bilingual.

All overseas students entering the university at which the study was undertaken had to satisfy the university requirements for English language, and in addition, had to sit a diagnostic test in English language. The subjects selected for the study had all completed and passed this diagnostic test, and those selected had achieved scores in the top 25%. Selection of high achievers in the diagnostic test was carried out in order to match the groups as closely as possible in terms of language proficiency. All groups shared the following characteristics:

- All students were in their first year of study

- All were undertaking a science foundation course
- All had indicated that science would be their major area of study (Science includes three majors: computer science, environmental science and physical science).

All subjects were approached through their tutor groups and asked to volunteer in the study. They were each paid \$4 to take part.

### **MATERIALS**

The texts chosen for the study consisted of four short passages taken from *The New Scientist*. These articles were chosen for a number of reasons. Firstly, the essential course material was observed to include several extracts from similar journals, required reading for the students as part of their studies and it was therefore a suitable and relevant source of materials. Also, as the *The New Scientist* contains articles for a wide range of audiences and interests, articles were selected which would not reflect any bias towards any particular content area. This would not have been possible if texts had been selected from reading lists; as subjects came from three different branches of science (computing, environmental and physical sciences) it was important to select content which was not biased in any one direction.

Another reason for choosing authentic texts from journals is that the texts are less contrived than those from content area textbooks. Previous research investigating text effects on reading (Hare, Rabinowitz & Schieble, 1989) have observed that it may be more difficult for readers to identify main idea in naturally occurring texts on account of the more complex structure of the texts. In a constructed or specially prepared text, the main idea is usually explicit, and often located at the beginning of the text. Naturally occurring texts

present more difficulty. The main idea may not be in initial sentence position, thus demanding greater skill from the reader. Moreover, naturally occurring texts are structurally more complex and may contain a greater variety of text structures.

The texts were selected by searching through issues of the *The New Scientist* for passages that did not require specialist vocabulary or background knowledge, and that were of similar length and complexity. Two of the passages were organised as comparison/contrast, while the other two were problem/solution. (See Appendix A for idea units.) There were no tables, figures or graphs accompanying the texts used.

The passages and tasks were piloted with a group of four adult native English speakers and three postgraduate students in non-science subjects who were second language speakers of English. All subjects in the pilot agreed that the texts were more general than specialised, and did not require a specialised vocabulary. A computerised version of the Flesch Reading Ease Formula was applied to the texts. The length and readability of the texts is compared in Table 6.1. Readability is computed using two criteria: number of syllables per hundred words and average number of words per sentence in a 100-word sample. According to the formula the difficulty of a word is related to the number of syllables: longer words are more complex. Another index of complexity is words per sentence: longer sentences are more complex syntactically and therefore more difficult (Singer & Donlan, 1989).

Table 6.1 shows the difficulty level and the grade level of the passages. Passages 1 and 3 are comparison/contrast and calculated to be 8.4 and 11.8 on the Flesch Grade levels, corresponding to standard level and fairly difficult texts at high school level. Passages 2 and 4, of the problem/solution type, were calculated as being at 10.1 and 8.7 on the Flesch grade level, corresponding to the same levels of difficulty as the comparison/contrast texts.



Table 6.1. Length and Readability of Four Texts Used in Study.

<b>Texts:</b>	1 cc	2 ps	3 cc	4 ps
Characters	1283	1832	2629	2151
Words	221	309	427	376
Sentences	18	16	21	23
Paragraphs	6	6	7	7
Sentences per Paragraph	3	2	3	3
Words per Sentence	22	19	20	16

<b>Readability</b>				
Passive Sentences	20%	6%	14%	4%
Flesh Reading Ease	65.7	59.3	53.9	60.24
Flesh Grade Level	8.4	10.1	11.8	8.7
Flesh Kincaid	9.5	9.7	10.5	8.6

This comparison of the passages in terms of readability is carried out only to provide some basis for comparison and to ensure that the texts were approximately the same length and level of difficulty. There are a number of readability formulae in use to-day which measure the characteristics of text and assign grade levels to obtain a comprehension measure in a given population (Meyer, 1993). There has been widespread criticism of such formulae as they are all based on the same underlying model of the reading process. This model sees reading as a passive process in which the reader decodes the text to obtain the meaning. It is therefore a bottom-up model and readability formulae based on it are the subject of criticism (Baker, Attwood & Duffy, 1988). Texts are analysed only in terms of word and sentence characteristics and do not take into account the context in which the reading is done, the reader's background knowledge and the comprehension task. The application

of a readability formula to the analysis of the texts used in the present study does not mean that such a view of reading is endorsed or supported as a theoretical model. Instead the readability analysis provided by the Flesch Reading Ease and Grade level together with the Flesch-Kincaid score is used to provide some general index of length and grade level to ensure that the passages were comparable and of a suitable reading level for university students. It was decided to use two passages of each type in order to ensure that the results were more reliable. In the comparison/contrast passages, each of the texts presented details which were compared and contrasted. The problem/solution passages were structured as question and answer, first presenting a problem (question) then describing a solution.

### **TASKS**

To measure subjects' recall of main ideas from the passages, they were asked to write down as much of the passage as they could remember following a reading of each passage. The recall task has been widely and effectively used to measure comprehension of text and is therefore a reliable measure, as discussed in Chapter 2 (Irwin, 1991; Carrell, 1992).

Before the actual test was administered to the subjects in the study, a pilot study with adult monolingual English speakers indicated that the passages were too long to remember verbatim so it may be concluded that this task required readers to process the information in each passage. Subjects were directed to read the passages carefully so that they would recall as much as possible. Giving subjects instructions before reading the passages ensured that they were oriented to the task. The recall protocols were scored for number of idea units recalled and for the levels of ideas written down. The recall protocols were analysed to establish whether they were organised in

the same way as the test passages, and content structures compared of the student protocols were compared to the original texts.

Three measures were taken of subjects awareness of text structure. The first was a measure of awareness used to organise the recall protocol. This measure has been widely used in studies of text structure awareness among first and second language speakers of English (Richgels, McGee, Lomax & Sheard, 1987; Carrell, 1992). Subjects written recalls were compared to the original with respect to use of rhetorical organisation. The second task used to measure awareness consisted of six item multiple choice test identification task where readers had to choose which texts were similar in organisation. This task required subjects to look at the texts holistically and to compare them. To simplify the task, subjects were required only to tick the correct responses to the numbered pairs of texts. The following multiple choice question was presented to subjects:

1 (a) Which passages are similar in organisation and structure? Tick your answers.

1 and 2

2 and 3

2 and 4

1 and 3

1 and 4

3 and 4

The third task was a six item question which served as the recognition, or naming task. Subjects were asked to write down the text number opposite the text organisation descriptors. A list including problem/solution, cause/effect, comparison contrast, description, classification and time order was presented

to subjects and opposite these descriptors they wrote the text numbers 1–4 as appropriate.

The following question was the recognition or naming task, asked directly after 1 (a) above.

1 (b) Using the information you have given above, decide which type of organisational pattern best describes how the ideas are organised in the passages. Write the text number beside your choice.

1. Comparison and contrast
2. Description
3. Problem and Solution (Question/Answer)
4. Cause and Effect
5. Classification
6. Chronological Order

The students in the study were expected to have some degree of familiarity with the organisational features of problem/solution and comparison/contrast passages, as these are widely used in expository prose and are also required in writing essays and reports in the sciences (Cook & Mayer, 1988).

### **PROCEDURE AND INSTRUCTIONS**

Subjects attended the reading sessions in groups of four or five. All the materials were in packages placed before each subject. To begin with, subjects read a statement which explained that they would be participating in an experiment on reading and memory and that the task would take about an hour. Subjects were told that there were four passages to be read, and that they would have to remember as much as possible in order to write a paraphrase

following the reading of each passage. Each of the tasks was explained and students were asked to glance at the materials to ensure that they understood. For the final task, which required naming the text structures, the researcher briefly explained the terms referring to text types as follows:

- Cause/effect: This structure identifies a cause or reason and then describes the results or effects. For example there are many causes of road accidents and these accidents lead to or result in death or injury.
- Comparison/contrast: This structure looks at similarities and differences between objects, events or people. classification: this is used to classify objects such as rocks, blood types etc on the basis of criteria and to sort them into categories
- Problem/solution: this structure identifies a question or problem and then presents an answer or solution.
- Description: This structure simply describes the features or characteristics of places, objects, people or events.

Subjects were invited to ask for further clarification if needed, but this proved unnecessary. Subjects were directed to read passage number one (1) entitled *Why Girls See Ghouls Under the Bed*. They were told: "When you have finished reading you will be asked to write a paraphrase of the passage. Try to remember as much as you can. While you are writing, you will not be allowed to look back at the passage." Subjects were given six minutes to read the passage, followed by a further eight minutes to write the recall. All subjects finished writing within this time. The same procedure was followed for each passage, and the subjects were monitored to ensure that they did not look back at the passage while reading. The next task required subjects to identify similar passages, and to tick appropriate responses on their answer

sheets. They were given the following instructions: "You may now look back at passages 1, 2, 3 and 4 to compare how they are organised and structured. Before you answer, spend at last five minutes re-reading the passages". For the naming task subjects were asked to write their responses on the answer booklet. Subjects were asked to complete this as accurately as possible and to avoid guessing, if possible. All subjects completed the tasks within one hour and ten minutes.

### SCORING

Before the protocols were scored a list was made of all the idea units contained in each passage. (See Appendix A.) Each idea unit consisted of a single main or subordinate clause. Two separate raters were used to arrive at the idea unit analyses, and compared the results to ensure inter-rater reliability. There was agreement for 95% of ideas. The recall protocols were scored according to the presence or absence of each idea unit as compared to the original text. In the scoring, the protocols was judged by the researcher and one other assistant. Any disagreements were resolved by negotiation. The scorers were blind to the students' country of origin.

To determine whether there were differences in the kinds of idea units recalled, each of the idea unit analyses was organised into a hierarchy (Meyer & Freedle, 1984; Connor, 1984; Carrell, 1992). Each idea unit was determined to be a top-, high-, mid- or low-level idea unit, depending on its position in the hierarchy. On this basis, ideas were assigned to a 'level', with top-level corresponding to main ideas in the passage and low levels corresponding to minor details. (See Figures 5.2 and 5.3.) The criteria adopted for deciding on levels of ideas were the same as those of Carrell (1992, p. 7):

1. Top-Level: represents the main ideas being compared/contrasted or the

main ideas framed as a problem and solution.

2. High-level: represents major ideas or main topics in the passage
3. Mid-level: represents minor ideas or subtopics in the passage.
4. Low-level: represents minor detail

These criteria enabled the recall protocols to be analysed into levels of ideas recalled. The passages were analysed into idea units and levels by the researcher and one other assistant. There was agreement for 95% of the idea units at top, high, mid and low and discrepancies were settled by negotiation and re-examination of the protocols. Organising the idea units of each original passage into a hierarchy enabled the researcher to analyse the recall protocols in terms of the levels of ideas recalled and to determine whether the student had recalled ideas corresponding to the levels in the content structure of the original. The number of idea units recalled at each level was recorded as a percentage of the total. These scores for similar type of passages were then added to obtain an overall score for each passage. Then the mean scores for each group at each level was recorded.

### **MEASURING AWARENESS**

The investigation involved three measures of awareness of text structure. The first of these was a measure of the use of structure in written recalls. As discussed in Chapter 2, the most widely used awareness measure has been the written recall protocol, which is analysed for the degree to which the reader has used the same structure as the author. While the same task is also used to count the number of idea units recalled after reading, its reliability and effectiveness as a measure of awareness has also been demonstrated (Meyer & Freedle, 1984; Richgels, McGee, Lomax & Sheard, 1987; Carrell, 1992). In

the present study, each recall protocol was analysed to determine whether or not it employed the rhetorical type of the original (i.e., comparison/contrast or problem/solution). To be classified as comparison, the overall structure had to compare and contrast opposing aspects or details; to be classified as problem/solution the overall structure had to be organised as question and answer or present a problem and then a solution as described in the passage. The order in which the ideas were presented did not have to match the original passage exactly, but the overall organisation had to be clear. The pair of raters agreed 80% of the time in their scoring of use of structure in written recall. Where disagreement arose, this was resolved by a re-examination of the protocol and the negotiation of a score.

The second measure of awareness involved a recognition task in which subjects were asked to identify similar passages. The correct responses were passages 1 and 3 (comparison/contrast) and 2 and 4 (problem/solution). Responses were scored as either incorrect with a score of 0, or correct, with a score of 1 and the answers recorded.

The third measure of awareness was explicit naming of text structure. Responses were scored from 0 to 4 with zero corresponding to incorrect naming of all passages and four corresponding to correct naming of all.

Having presented the details of the tasks, texts and procedures for scoring of protocols, the results of the investigation will now be presented.



## **Part IV**

# **Results and Discussion**

# Chapter 7

## Results

In this chapter, a summary of the results will be presented which highlights the main findings for each of the research questions. (Additional and supporting data will be found in Appendix C.) Analysis of variance (ANOVA) was used to test hypotheses about differences in mean number of idea units recalled for each cultural group and to test for differences in levels of recall between the different groups. Paired *t* tests were used to measure differences between the two text types in number and levels of ideas recalled. A significance level of  $p < 0.05$  was chosen except where otherwise stated. Data were analysed using the SPSS package of statistical procedures (Statistical Package for the Social Sciences, 1975).

### Research Question 1.

Are there differences in number of idea units recalled by each of the three groups from different language backgrounds?

Overall scores for quantity of ideas recalled on similar texts were combined, that is results for both passages on comparison/contrast were combined to give each subject an overall score. Similarly, scores for idea units

recalled from and problem/solution passages were added to give each subject an overall score. Next, scores for each of the different groups were calculated by adding individual scores. In order to determine whether there were differences between groups in the number of ideas recalled, separate three by one-way ANOVAs (3 groups  $\times$  recall of ideas) were run for each text type. Table 7.1 shows means and standard deviations for each of the groups for comparison/contrast passages.

Table 7.1. Means and standard deviations of Idea Units Recalled for Comparison/Contrast passages.

Group	Count	mean	SD	Error
Australian	15	116.57	34.96	9.03
Malaysian	15	80.93	31.51	8.14
Singaporean	15	102.83	29.78	7.69

$$F = 4.686, df = 2, p = 0.015.$$

Table 7.2. Scheffé Stepdown Tests on Comparison/Contrast Passages.

Group	Australian	Malaysian
Australian	—	
Malaysian	* 4.605	—
Singaporean	0.684	1.739

\* denotes  $F$  values of Scheffé test significant at 0.05 level

For comparison and contrast texts, the ANOVA results show that there is a significant difference between groups ( $F = 4.686, df = 2, p = 0.015$ ). Using Scheffé stepdown tests, the difference was identified as being between Australians and Malaysians in the total number of ideas recalled. The Australian students recalled a significantly greater number of ideas than the Malaysian students from the two comparison/contrast passages. See Table 7.2.

For problem/solution, the ANOVA results show that there is a significant difference in number of ideas recalled between groups ( $F = 7.581$ ,  $df = 2$ ,  $p = 0.002$ ). Using Scheffé stepdown tests, a significant difference was found between Malaysian and Australian and between Malaysian and Singaporean subjects in recall scores. There was no significant difference between Australian and Singaporean results for either comparison/contrast or problem/solution. Both Australian and Singaporean students recalled a significantly greater number of ideas than the Malaysian students on both comparison/contrast and problem/solution text types. The results are reported in Tables 7.3 and 7.4.

Table 7.3. Means and Standard Deviations of Idea Units Recalled for Problem/Solution Passages.

Nationality	Count	mean	SD	Error
Australian	15	102.33	38.87	10.04
Malaysian	15	60.30	27.89	7.20
Singaporean	15	104.10	35.48	9.16

$F = 7.581$ ,  $df = 2$ ,  $p = 0.002$ .

Table 7.4. Scheffé Stepdown Tests for Problem/Solution Passages.

Group	Australian	Malaysian
Australian	—	
Malaysian	* 5.444	—
Singaporean	0.010	* 5.918

\* denotes  $F$  values of Scheffé test significant at 0.05 level

**Research Question 2.**

Are there differences in levels of ideas recalled by each of the three different groups?

Following Meyer & Freedle (1984) and Carrell (1992) each idea was determined to be at one of four levels: top, high, mid or low. Ideas at the top and high levels represent the main ideas of the passage, as they occupy the top level of the tree-structure diagram (see Chapter 5). Results for both comparison/contrast passages were combined into a total score, as were the results for problem/solution passages. Table 7.5 shows the means and standard deviations of idea units recalled at the different levels of text structure.

Table 7.5. Means and Standard Deviations of Idea Units Recalled at Different Levels According to Text Type.

Group	Text Type	Top		High		Medium		Low	
		mean	SD	mean	SD	mean	SD	mean	SD
Australlian	CC	140.00	52.44	140.87	21.29	119.20	42.83	51.93	55.58
	PS	116.67	49.70	130.27	42.42	116.53	37.97	39.40	33.37
Malaysian	CC	80.00	59.16	114.60	34.46	81.87	39.51	47.00	51.20
	PS	50.00	46.29	82.13	39.43	76.10	31.85	31.73	28.72
Singaporean	CC	136.67	63.29	117.47	24.14	113.80	38.27	57.60	51.30
	PS	110.00	73.68	114.67	22.71	119.87	40.91	61.93	51.75

CC denotes comparison/contrast

PS denotes problem/solution

Four 3 × 1 way ANOVAs (3 groups × level) were run for each text type to determine whether there were any differences between groups at each of the four different levels of recall. Results are reported in Table 7.6. Significant differences were indicated ( $p = 0.5$ ) at top, high and mid levels for both text types.

Table 7.6. Summary of ANOVA Results Showing Differences Between Text Types at Different Levels of Recall.

Level	Comparison/Contrast			Problem/Solution		
	<i>F</i>	<i>df</i>	<i>p</i>	<i>F</i>	<i>df</i>	<i>p</i>
Top	4.9890	2	0.0114	6.0415	2	0.0049
High	4.2024	2	0.0217	7.0120	2	0.0024
Medium	3.7693	2	0.0312	6.4674	2	0.0036
Low	0.1518	2	0.8597	2.4019	2	0.1029

Table 7.7. Differences Between Groups in Levels of Ideas Recalled: Scheffé Procedure Ranges for 0.05 Level.

Level of Ideas	Nationality	Australia		Malaysia	
		CC	PS	CC	PS
Top	Australia	—	—		
	Malaysia	* 3.949	* 4.979	—	—
	Singapore	0.012	0.050	* 3.552	* 4.033
High	Australia	—	—		
	Malaysia	* 3.491	* 6.734	—	—
	Singapore	2.711	0.707	0.042	3.076
Medium	Australia	—	—		
	Malaysia	* 3.226	* 4.453	—	—
	Singapore	0.067	0.030	2.360	* 5.218
Low	Australia	—	—		
	Malaysia	0.033	0.143	—	—
	Singapore	0.043	1.237	0.152	2.222

\* denotes *F* values of Scheffé test significant at 0.05 level

Using Scheffé step down tests, a difference was identified between Australian and Malaysian, and between Singaporean and Malaysian subjects in number of top-level ideas recalled for comparison/contrast and problem/solution passages. Table 7.7 shows differences between Australian and Malaysian and between Singaporean and Malaysian subjects in levels of ideas recalled for comparison/contrast and problem/solution passages. Results show that differences emerged between groups at top and high levels. Australian and Singaporean subjects showed no significant differences at any level in quantity of ideas recalled. Overall, Malaysian subjects were found to have recalled fewer ideas at top levels than other groups. There was no difference found between any groups at the lowest level, corresponding to minor details of the passage.

### **Research Question 3.**

Do differences in rhetorical organisation of science texts result in variations in number of ideas recalled?

In order to ascertain whether the text types comparison/contrast and problem/solution yielded differences in quantity of ideas recalled, the scores for ideas recalled from the passages were combined according to text type. Table 7.8 presents the means and standard deviations of the number of idea units recalled for results on comparison/contrast and problem/solution text types. Paired  $t$  tests for the two mean scores revealed that there was a significant difference between the overall scores for the comparison/contrast passages compared to the problem/solution passages ( $t = 3.15$ ,  $df = 44$ ,  $p < 0.003$ ). Overall, subjects recalled a greater number of ideas from the comparison/contrast passages.

**Table 7.8. Means, Standard Deviations and *t* test Results for Idea Units Recalled According to Text Type.**

Text Type	mean	SD
Comparison/Contrast	100.11	34.75
Problem/Solution	89.11	39.20

$t = 3.15, df = 44, p = 0.003.$

**Research Question 4.**

Do differences in rhetorical organisation of science texts result in variations in levels of ideas recalled?

In contrast to question three which measured the overall differences in numbers of ideas recalled between text types, this question explored differences in level of ideas recalled, that is recall of main ideas compared to details. Main ideas are those at the top level of the structure, while low level ideas are minor details at the bottom of the hierarchy. (See Figures 5.2 and 5.3, pages 124 and 125.)

**Table 7.9. Levels of Ideas Recalled for Text Types: *t* test (paired).**

Level	CC		PS		<i>t</i> Value	Two-Tail Prob.
	mean	SD	mean	SD		
Top	118.89	63.55	92.22	64.14	3.55	0.001
High	124.31	29.14	109.02	40.53	2.91	0.006
Medium	104.96	42.71	104.17	41.46	0.15	0.881
Low	52.18	51.71	44.36	40.46	1.25	0.220

A paired *t* test was used to compare top, high, mid and low level ideas recalled according to text type. Results show that mean scores for ideas recalled at top ( $t = 3.55, df = 44, p < 0.001$ ) and high ( $t = 2.91, df = 44, p < 0.006$ ) levels *only* are significantly different according to text type. Comparison/contrast



passages are associated with recall of a greater number of main ideas at top and high levels than problem/solution. See Table 7.9.

### **Research Question 5.**

Are there differences among the three groups in awareness of text structure?

The measure of awareness used in this question was whether subjects used the structure of the original passage to organise their recalls. The written recall protocols were analysed and compared to the structure of original passages. To qualify for use of structure, subjects had to organise their written recalls quite explicitly as comparison/contrast or problem solution. Comparison/contrast passages had to be organised around details which were compared or contrasted. Problem/solution had to state a problem or question and then present an answer, or describe a solution. Recall protocols for each text type were scored separately as follows:

- 0 = no awareness
- 1 = awareness of one passage
- 2 = awareness of both passages

Scores were added according to text type and results were analysed by means of a 3 (groups) by 1 (use of structure) way ANOVA for each text type. Means and standard deviations for combined scores on awareness measures are presented in Table 7.10. No significant differences were found between groups at the 0.05 level for comparison/contrast ( $F = 3.423$ ,  $df = 2$ ,  $p = 0.0419$ ), or for problem/solution ( $F = 4.872$ ,  $df = 2$ ,  $p = 0.0125$ ).

Using the Scheffé procedure, differences in awareness between groups were explored at different levels, as some of the results were approaching significance at the 0.05 level. For the text type comparison and contrast, there was found to be a difference between Australian and Malaysian at the 0.06

Table 7.10. Awareness of Text Structure: Means and Standard Deviations for Use of Structure in Written Recall of Text Types.

Group	Comparison/Contrast				Problem/Solution			
	mean	SD	F	p	mean	SD	F	p
Australian	1.73	0.46			1.53	0.64		
Malaysian	1.13	0.83	3.423	0.0419	0.80	0.56	4.872	0.0125
Singaporean	1.60	0.63			1.40	0.83		

level. Table 7.11 shows that for problem/solution, there is a significant difference between the Australian and Malaysian at the 0.05 level, while Malaysian and Singaporean students revealed some differences at the 0.07 level.

Table 7.11. Differences in Awareness of Text Structure Between Groups.

Group Nationality	Australian		Malaysian	
	CC	PS	CC	PS
Australian	—	—		
Malaysian	o 3.104	* 4.292	—	—
Singaporean	0.153	0.142	1.878	† 2.873

\* denotes *F* values of Scheffé test significant at 0.05 level

o denotes *F* values of Scheffé test significance level at 0.06

† denotes *F* values of Scheffé test significance level at 0.07

Overall, for problem/solution passages, Malaysian subjects showed lower levels of awareness as measured in use of structure of the original passage in their written recalls.

### Research Question 6.

- a) Are there differences among the three groups in awareness of text structure, manifest in a recognition task?

b) Can subjects who recognise text structure also name it?

The second measure of awareness in Question 6(a) was whether subjects could recognise passages with a similar structure. Subjects were asked to respond to a multiple choice question. (See page 135.) In the naming task in Question 6(b) subjects were asked to name the type of text structures they had identified as similar in the recognition task. As the subjects were studying at university it was expected that they would have some knowledge of different patterns of organisation in writing. It was of interest to find out whether subjects who recognised the structure of the passage could also name it.

The results were analysed by means of a 3 (groups) by 1 (recognition) way ANOVA. It was found that there was no significant difference between groups in the recognition task for the comparison/contrast passage ( $F = 0.8077$ ,  $df = 2$ ,  $p = 0.4527$ ) or the problem solution passages ( $F = 1.1519$ ,  $df = 2$ ,  $p = 0.3258$ ) (see Tables 7.12 and 7.13).

Table 7.12. Recognition of Structure in Comparison/Contrast Passage. Summary of Analysis of Variance.

Group	mean	SD
Australian	0.73	0.46
Malaysian	0.53	0.42
Singaporean	0.53	0.52

$$F = 0.8077, df = 2, p = 0.4527.$$

For question 6 (b) relating to whether subjects who recognised text structure could also name it, Table 7.14 shows the descriptive statistics for subjects who recognised and named text structure. Chi-square tests for inferences about the paired observations showed no significant results. Out of a total of 20 subjects who recognised comparison and contrast text structure, 16 subjects recognised and named it. The results for problem/solution show that

Table 7.13. Recognition of Structure Problem/Solution Passage. Summary of Analysis of Variance.

Group	mean	SD
Australian	0.60	0.51
Malaysian	0.33	0.49
Singaporean	0.44	0.51

$F = 1.1519, df = 2, p = 0.3258.$

Table 7.14. Subjects Recognising and Naming Text Structure: Crosstabs.

Recognition Comparison/Contrast				
		No	Yes	Total
Awareness Naming	No	11	4	15
	Yes	14	16	30
	Total	25	20	45

Recognition Problem/Solution				
		No	Yes	Total
Awareness Naming	No	18	5	23
	Yes	18	4	22
	Total	36	9	45

**Recognition:** recognition of text structure by identifying similar text types

**Awareness:** awareness of text structure manifest in naming of structure in written recall

only 4 out of 9 subjects who recognised text structure also named it.

**Research Question 7.**

Is there a relationship between quantity and level of ideas recalled and structure awareness? i.e.,

- a) Do subjects who recognise text structure recall more than those who do not?
- b) Do subjects who use the structure of the original passage recall more than those who do not?

Subjects were grouped into those who recognised text structure and those who did not recognise text structure. This new grouping did not correspond to the original grouping by nationality: instead all subjects who recognised the structure of the comparison/contrast passages formed one group, while those who recognised problem/solution formed the other. In order to identify the effects of recognition of text structure on recall of ideas, a paired *t* test was used. The results showed no significant effects for recognition of text structure. See Tables 7.15 and 7.16.

Table 7.15. Recognition & Recall for Comparison/Contrast *t* test Results.

Recognition	Count	mean	SD
No	18	97.36	39.64
Yes	27	101.94	31.73

$t = -0.43, df = 43, p = 0.670.$

Separate 3 (groups) by 1 (recall score) way ANOVAs were conducted for each type of text structure to test whether there were any significant differences between those who used the structure of the original passage to organise their

Table 7.16. Recognition & Recall for Problem/Solution *t* test Results.

Recognition	Count	mean	SD
No	25	88.12	39.49
Yes	20	90.35	39.81

$$t = -0.19, df = 43, p = 0.852.$$

Table 7.17. Idea Units Recalled as a Function of Use of Text Structure in Comparison/Contrast Passage.

Group by Use	Count	mean	SD
No+No	5	43.70	6.24
No+Yes	13	80.38	15.35
Yes+Yes	27	120.06	26.62

$$F = 31.1070, df = 2, p = 0.0000.$$

recalls and those who did not. The groups were identified by performance on the use of structure in written recall: group one used a structure strategy for neither passage; group two used a structure strategy for one passage, and group three used a structure strategy strategy for both passages. The results showed that those who used the structure of the original passage in their recalls for both passages recalled quantitatively more ideas than those who did not. See Tables 7.17 and 7.19. This finding was consistent for both text types but more marked for comparison/contrast than for problem/solution. The results are significant at the 0.05 level. See Tables 7.18 and 7.20.

Table 7.18. Idea Units Recalled as a Function of Use of Text Structure in Comparison/Contrast Passage: Scheffé Stepdown Tests.

Group by Use	No+No	No+Yes
No+No	—	
No+Yes	* 4.767	—
Yes+Yes	* 24.128	* 13.547

\* denotes  $F$  values of Scheffé test significant at 0.05 level

Table 7.19. Idea Units Recalled as a Function of Use of Text Structure in Problem/Solution Passage: Scheffé Stepdown Tests.

Group by Use	Count	mean	SD
No+No	8	48.50	19.65
No+Yes	18	69.86	23.53
Yes+Yes	19	124.45	25.70

$F = 38.1252$ .  $df = 2$ ,  $p = 0.0000$ .

Table 7.20. Idea Units Recalled as a Function of Use of Text Structure in Problem/Solution Passage.

Group by Use	No+No	No+Yes
No+No	—	
No+Yes	2.21	—
Yes+Yes	* 28.40	* 24.09

\* denotes  $F$  values of Scheffé test significant at 0.05 level

### Research Question 8.

Is there a relationship between the three measures of structure awareness, use and recognition, i.e., do subjects who use a structural strategy also recognise and name structural differences? Using a cross-tab procedure, the number of subjects using and recognising structural differences was identified. For comparison/contrast, only nineteen out of the total population of 45 both used and recognised text structure. For problem/solution, the number was smaller, with only nine students using and recognising text structure. A Chi-square analysis of these results showed no significant differences according to text type, between groups who used and recognised text structure. See Table 7.21.

Table 7.21. Use and Recognition of Text Structure: Crosstabs.

		Use of Structure Comparison Contrast			
		No+No	No+Yes	Yes+Yes	Total
Awareness Recognition	No	2	5	11	18
	Yes	3	8	16	27
	Total	5	13	27	45

Pearson's  $\chi^2 = 0.019$ ,  $df = 2$ ,  $p = 0.991$

		Use of Structure Problem Solution			
		No+No	No+Yes	Yes+Yes	Total
Awareness Recognition	No	2	12	11	25
	Yes	6	6	8	20
	Total	8	18	19	45

Pearson's  $\chi^2 = 3.967$ ,  $df = 2$ ,  $p = 0.138$

For Question 8, it is also relevant to display the descriptive statistics for percentages of ideas recalled at different levels as a function of use, naming



and recognition of text structure. Subjects' scores on each of the comparison/contrast passages were initially calculated as percentages of the total number of ideas in the passages. Scores for both passages were added and then a mean percentage was obtained. The same procedure was followed for problem/solution passages. The overall results are relevant insofar as they display at a glance the relationship between the measures of awareness used in the passage.

A cursory glance at Table 7.22 and Table 7.23 shows that overall, subjects who used the structure of the original passage recalled a greater percentage of main ideas (i.e., ideas at top and high levels) than those who did not. For comparison/contrast passages, subjects who used the structure of the original passage for both recall tasks accounted for (27) out of the (45) subjects in the study. Out of this group, (5) subjects who used the structure of the original passage for their recall but could not either recognise or name text structure recalled 80% of main ideas and 65.71% of high level ideas. A larger group of (7) subjects who used, recognised and named text type scored similarly in recall of top-level ideas, with a score of 80.36%. This indicates that recognition and naming of text structure were not discriminatory variables. For comparison/contrast only (5) subjects overall did not use a structure strategy in their written recalls and for these subjects recall of top-level ideas was recorded as only 5% ( $2 \times 12.5\%/5$ ).

For problem/solution, a similar pattern was found, i.e., subjects who used the structure strategy for both recalled more top-level ideas than those who did not. For example, (8) subjects using a structure strategy for both problem/solution passages *but who could not recognise or name text type* recalled 75% of ideas at top level. By comparison (2) subjects who used the structure strategy and also named and recognised text type recalled 68.75% of ideas at top level. These results show that there were no significant differences

Table 7.22. Comparison/Contrast: Mean Percentage of Ideas Recalled at Different Levels as a Function of Use, Recognition and Naming of Text Structure.

Use <sup>a</sup>	Rec. <sup>b</sup>	Name <sup>c</sup>	Count	Top	High	Medium	Low
No+No	No	No	1	0.00	50.00	14.50	0.00
		Yes	1	0.00	44.00	26.50	6.00
	Yes	No	2	12.50	40.25	34.00	14.50
		Yes	1	0.00	44.00	19.50	6.00
No+Yes	No	No	3	33.33	59.50	32.00	4.16
		Yes	2	37.50	56.25	24.25	0.00
	Yes	No	5	45.00	56.30	50.20	37.70
		Yes	3	45.84	65.00	46.34	7.16
Yes+Yes	No	No	5	80.00	65.70	66.10	42.60
		Yes	6	75.00	66.91	57.33	29.66
	Yes	No	9	77.78	67.61	59.39	30.00
		Yes	7	80.36	67.50	69.93	39.21
Total			45	59.44	62.16	52.48	26.09

<sup>a</sup>refers to use (Yes) or not (No) of structure in written recall for each passage

<sup>b</sup>refers to recognition of text structure in identification task

<sup>c</sup>refers to explicit naming of text structure in response to multiple choice question

Table 7.23. Problem/Solution: Mean Percentage of Ideas Recalled at Different Levels as a Function of Use, Recognition and Naming of Text Structure.

Use <sup>a</sup>	Rec. <sup>b</sup>	Name <sup>c</sup>	Count	Top	High	Medium	Low
No+No	No	No	2	0	30.50	40.25	20.00
		Yes	0				
	Yes	No	5	10.00	39.40	36.90	3.30
		Yes	1	25.00	7.00	42.00	31.00
No+Yes	No	No	10	20.00	41.40	35.98	10.45
		Yes	2	50.00	55.25	42.75	8.25
	Yes	No	5	30.00	55.30	51.80	28.80
		Yes	1	25.00	75.50	73.00	0.00
Yes+Yes	No	No	8	75.50	64.75	57.50	29.56
		Yes	3	87.50	77.66	76.83	38.33
	Yes	No	6	79.16	67.66	71.91	39.82
		Yes	2	68.75	77.25	68.75	27.50
Total			45	46.11	54.51	52.08	22.18

<sup>a</sup>refers to use (Yes) or not (No) of structure in written recall for each passage

<sup>b</sup>refers to recognition of text structure in identification task

<sup>c</sup>refers to explicit naming of text structure in response to multiple choice question

between use, recognition and naming of text structure.

For both passages, subjects who did not use a structure strategy recalled a very low number of ideas. Some differences, however, emerged in the recall scores for the text types. Overall, more subjects (27), demonstrated awareness of the comparison/contrast structure in their recalls than they did for problem/solution (19). The summary of results displayed in Tables 7.22 and 7.23 demonstrates that there were no significant differences between the three levels of awareness, *use, recognition and naming of text structure*, in terms of recall of top-level and main ideas.

## Chapter 8

### Discussion

This chapter will be divided into a discussion of differences between groups in awareness and recall measures, followed by an analysis of the influence of text type on the same variables. The major findings of the study were:

- Significant differences were found between the three groups of students from different language backgrounds in terms of idea units recalled. This supports the findings of Carrell (1984a) and Connor (1984);
- There were significant differences between groups in recall of main ideas.
- There were significant differences between the text types comparison/contrast and problem/solution in terms of the quantity and levels of ideas recalled by subjects. Comparison/contrast passages produced greater numbers of idea units and more main ideas in the written recall protocols of subjects. This supports the findings of Meyer & Freedle (1984), Richgels, McGee, Lomax & Sheard (1987) and Carrell (1992)
- The first measure of awareness, use of structure in written recall, was statistically more frequent than either of the other measures of awareness, i.e., the recognition of text structure by identifying similar passages and explicitly naming the text types.

- Subjects who used the structure of the original passage in their written paraphrases recalled significantly more main ideas than subjects who did not. This supports the findings of Carrell (1985a), Carrell (1992) and Davis, Lange & Samuels (1988).

These findings will be discussed from the perspective of schema theory and evaluated in the light of similar empirical studies.

## **RECALL AND AWARENESS OF TEXT**

### **STRUCTURE**

The study set out to explore awareness and recall of scientific text structure in three groups of students from different language backgrounds studying science in the first year at university.

The Australian and Singaporean students showed similar levels of recall, while Malaysian subjects were found to have significantly lower scores for total number of ideas recalled. In addition, the Malaysian group were found to have recalled fewer top-level (main) ideas for both passage types. This finding can be explained by the fact that both Australian and Singaporean subjects used English as the major language of interaction while Malaysian subjects had studied English as a second language, and continued to use another language for everyday communication. Although the Singaporean and Malaysian students had been matched for subject background and age, it is possible that language proficiency may have varied among the groups. All thirty overseas subjects were regarded as proficient speakers of English, having satisfied the entrance requirements for English language and all had scored in the top 25% of the University English Language Placement Test. This would still have allowed a range of proficiency levels among the groups.

As discussed in Chapter 2, the critical interaction of reading ability with language proficiency is now well established and documented in the literature

Cziko (1978), Devine (1988) and Dubin, Eskey & Grabe (1986). Therefore readers who are dealing with texts in a second language may experience certain disadvantages relating to comprehension. Clarke's (1980) short circuit hypothesis also adds weight to this view. Limited control over the language 'short circuits' the good reader's system when confronted with a difficult or demanding task. Syntactic, semantic and discourse constraints serve as important sources of information for readers. Language proficiency level may affect the ability of L2 readers to access this information. This factor, in the context of the interactive model of reading adopted for this investigation (Chapter 3) suggests that students reading in a second language may have certain disadvantages. An interactive model suggests that reading requires a high degree of grammatical control over the structures presented and rapid identification of syntactic features at various levels in the text (Eskey, 1988). Successful reading therefore demands possession of a high level of linguistic knowledge and automatic processing of syntactic patterns. This knowledge must interact with background knowledge assumptions and relevant formal and content schemata. (See Chapter 3.) Second language speakers of English, although fluent and literate and of proven academic calibre, may have difficulty meeting the demands of texts written in what is for them, a second language.

Another explanation may be found within the framework of schema theory and cognitive psychology. Empirical studies on the effects of schemata, or knowledge structures on comprehension have provided insight into the problems that may be encountered by L2 readers (Anderson & Pearson, 1984). Firstly the research provides insights into the effects of extratextual background knowledge on comprehension. The knowledge, beliefs and values that a reader brings to the text are crucial in building meaning and interpretation, and these schemata vary according to age, background, culture, language,

education and life experience. Hudson (1982, p. 185), therefore concludes: "From the perspective of schema theory, the principal determinant of the knowledge a person can acquire from reading is the knowledge she or he already possesses". In short, L2 readers may not have the schemata to comprehend texts written in a different language, or they may have the schemata but are unable to activate them. The second implication of schema theory for L2 reading is that when trying to process text and apply some meaning, a reader may resort to strategies which contribute to a short-circuit. When reading a passage which presents unfamiliar syntax, vocabulary or discourse features, L2 readers may abandon text based processing and simply rely on content schemata to ascribe meanings which accommodate their own cultural understanding. The research on cultural schemata conducted by Floyd & Carrell (1987) and by Pritchard (1990) (see Chapter 2) is particularly relevant here. Differences in comprehension between Australian and Malaysian subjects may therefore be attributed to any one, or combination of the above circumstances.

The finding that native speakers of English recall significantly greater numbers of ideas, and more superordinate structures is in accord with other studies comparing L1 and L2 comprehension, such as Connor (1984). Other studies, such as Carrell's (1983) are based on the assumption that there are processing differences between L1 and L2, but that these are differences in degree. She concludes, (p. 199):

Non-native speakers of English reading in English, don't read like native speakers: they do not process text as native speakers do. Neither advanced nor high-intermediate ESL readers appear to utilise context or contextual clues. They are not efficient top-down processors, making appropriate predictions based on context, nor are they efficient bottom-up processors, building up a mental representation of the text based on the lexical information in the text.

Carrell's statement presents a deficit view of the L2 reader which may not be applicable to the present study, which focussed on highly literate and fluent readers. Nevertheless her view is relevant in the context of the interactive approach to reading adopted here, which indicates that successful reading is a complex interplay of top-down and bottom-up processes.

### **RECALL AND AWARENESS BY TEXT TYPE**

Two research questions investigated whether the text type influenced recall of a greater number of main ideas, and produced recalls of better quality, in terms of ideas at top levels of the content structure. The analysis of recall protocols showed that the passages organised as comparison/contrast produced significantly greater numbers of idea units, and that these were at a higher level, with more main ideas, than problem/solution. This finding supports earlier studies (Carrell, 1984b; Meyer & Freedle, 1984; Richgels, McGee, Lomax & Sheard, 1987; Carrell, 1992) reported in Chapter 3, that comparison/contrast facilitates recall when compared to other text types. Meyer & Freedle (1984) compared problem/solution and comparison/contrast top-level structures to more loosely organised collection of description types and found that both problem/solution and comparison/contrast produced superior recalls.

The present study may be the first which compares comparison/contrast, a highly structured rhetorical type, with another highly structured type, problem/solution, using authentic scientific texts. The facilitative effects of comparison/contrast may be task dependent, according to a study carried out by Hiebert, Englert & Brennan (1983). Among high school students, comparison/contrast was found to be most recognisable in reading, but more



difficult to produce in writing tasks. Other findings cited in the literature review (Carrell, 1992) suggest that comparison/contrast facilitates recall among advanced level readers. It is believed that comparison/contrast structures are based on associative networks and contrasts thereby creating better mnemonic effects. In a writing task, this pattern is also highly structured because it requires the writer to define and delineate parallel features and attributes being compared Englert, Stewart & Hiebert (1988) Richgels, McGee, Lomax & Sheard (1987). In the present study, with adult readers of authentic scientific texts the comparison/contrast passages produced significantly more idea units, and more ideas at the top levels of the content structure hierarchy in the recall tasks than the problem/solution passages. (See Tables 7.8 and 7.9.) This finding indicates that for this study, comparison/contrast passages facilitate recall more readily than problem/solution passages, though it would be unwise to generalise unless the effect of longer passages was also investigated.

#### **AWARENESS, RECOGNITION AND NAMING OF TEXT STRUCTURE**

Of central importance in this study was an investigation of differences between Australian, Malaysian and Singaporean students in awareness of text structure. Three different measures of awareness were used:

- (i) use of structure in written recall,
- (ii) recognition of structure by identifying similar passages and
- (iii) naming of text structure.

The results showed no differences at the 0.05 level between groups for use of comparison/contrast structure. This indicates that all subjects were able to use a structural strategy when recalling ideas from the comparison/contrast passages. (See Table 7.11 on page 148). With respect to problem/solution,

a significant difference emerged between the Australian and Malaysian group at the 0.05 level. Overall, these results indicate that the Malaysian students did not organise their recall protocols according to the structure of the original passages, and therefore they scored lower than the both Australians and Singaporeans on the first awareness measure. This result is consistent with the findings on quantity and level of ideas recalled; the Malaysian group recalled fewer idea units and fewer top-level propositions than the other groups and so it could be predicted that their written recalls would not reflect the organisation of the original passage. The top-level ideas are usually those which state the main idea of the passage and also indicate how the ideas in the passage are organised. (See Figure 5.1 on page 116.) Further explanation of the relationship between awareness and recall can be found in the results of research question seven, whether subjects who used the structure of the original passage recalled more than those who did not. It was found that subjects using the structure of the original passage recalled more top-level ideas and more idea units than those who did not. Therefore, use of a structure strategy in recalling information from text appears to be quite efficient.

This finding is supported by other studies examining the effects of readers' recognition of text structure on comprehension and recall. Studies by Taylor & Samuels (1983) (1983) and by Kletzien (1992) indicate that when readers recognise and use the structure of the text, they are better able to identify important ideas and recall them. Based on these studies, it is possible to conclude that awareness and recall are not completely separable. The present study was designed on the assumption that awareness of text structure facilitates recall of text. It was therefore expected that students who had the appropriate background knowledge, in this case an awareness of the different rhetorical patterns used to organise the science passages, would be more likely to use a structure strategy when they study texts. They would

demonstrate understanding of well-structured texts. The results of this study confirm that awareness of text structure as displayed in the written recall protocols would be related to the relative number of ideas recalled. In addition, subjects who used a structural strategy also recalled more main ideas, that is, propositions at the top-level of the tree structure hierarchy. (See Figures 5.2 and 5.3, pages 124 and 125.)

### **CROSS-CULTURAL COMPARISONS**

The Malaysian group achieved lower scores on the awareness measures, and as the explanation above predicts, showed a corresponding lower level of recall for idea units and main ideas. There were, however, no significant differences found between the Singaporean and Australian groups. In studies investigating the differences between L1 and L2 readers of English, Connor (1984) and Carrell (1992) suggests that different groups perceive rhetorical patterns in quite distinctive ways. Carrell (1984b) suggested that interference from preferred first language rhetorical patterns might provide explanatory power, and cites the research by Kaplan (1966) in support. However, the later research of Connor & McCagg (1987) provide no evidence for transfer of culture specific language patterns in a controlled recall task. Kaplan's (1966) research relied on patterns found in free compositions and is not therefore relevant to the present findings. Within the schema theoretic framework adopted for this study, the findings can be adequately explained. The Malaysian students, although highly literate and fluent in English language, may not have had the formal or cultural schemata appropriate for interpreting the texts.

With respect to the second measure of awareness, whether subjects could recognise and name text type, a different conclusion emerges. The task of identifying similar structures would have demanded that subjects scan

the texts and form some mental representation of how ideas were organised and presented. No significant differences were found between groups for the recognition task involving identifying the passages which were both organised as comparison/contrast or problem/solution. The fact that no differences were found between groups is an indication of top-down processing, requiring extra-textual knowledge based processes to make predictions about organisational patterns. All groups achieved the same results on this measure of awareness indicating that Malaysian subjects employed top-down strategies quite effectively.

The interaction between the levels of awareness was an aspect of some importance to this study. A measure of the interaction between the levels of awareness was therefore included. Question eight investigated whether subjects who used a structural strategy in their recalls also recognised text structure similarities. A Chi-square analysis of the results showed no significant interaction. A possible limitation here was the fact that the exercise was timed and that subjects may have felt pressured into guessing because of time constraints. The final Tables 7.22 and 7.23 in the results section display the means and standard deviations for ideas recalled as a function of use recognition, and naming of text structure. Among subjects who used the structure of the original passage for both texts, only a minority could also explicitly name and recognise the text types. There were no significant interactions for use, recognition and naming of text structure. This indicates that students could write and organise their recall protocols displaying knowledge of text structure without explicit awareness or ability to identify such structures by name.

Overall, it can be concluded that subjects who used a structural strategy to organise their written recalls produced significantly more main ideas.

## LIMITATIONS

While the present study has attempted to examine and compare L1 and L2 reading processes and text comprehension in a cross-cultural perspective, its conclusions are limited in certain respects. The present study used only two text types, comparison/contrast and problem/solution and found that comparison/contrast facilitated recall of more main ideas than problem/solution. A more complete and expanded study would include other types of rhetorical organisation known to be common in scientific discourse, such as cause/effect, classification, and definition (Trimble, 1985). Although two examples of each text type were used, it would be unwise to generalise the findings too broadly. Other studies reviewed throughout this research have found that comparison/contrast is more salient, and therefore more accessible than other forms of organisation. The passages chosen were matched carefully for word length, reading ease and grade level but it is nevertheless possible that subjects found that the passages differed in complexity, thus producing different results. Another potential explanation lies in the topics of the passages and subjects familiarity with them. There is no straightforward way to determine whether a topic is predisposed to, or more accessible to one readership, or cultural background than to another. In the present study, the readings were tested for comprehensibility with both L1 speakers and L2 speakers of English before the main study and were found to be suitable in terms of length, comprehensibility and content. A further limitation of the present study was the tasks used to measure awareness of text structure. The first measure, use of structure in written recall was chosen because it is a well established method of exploring readers' understanding of ideas encountered, and to assess their ability to use a particular strategy to enhance recall. Protocols were scored as either zero or one, with no exceptions allowed for 'degrees' in the use of structure strategy (see methodology). A different research design,

using a qualitative approach could have shown whether subjects used a similar structural organisation to the passage or decided to use a different one to the original. For the present study, only top-level structures which matched the original were taken into account when rating protocols for awareness of text structure. However, the results indicate that most students used the structural strategy in their recalls. In addition, the results provide evidence of an empirical relationship between text structure awareness and recall. The task of identifying and naming of text structure may have been too demanding for students especially in view of the time limit which would have forced them to speed read the passages. An alternative way of investigating explicit structure awareness would be to present subjects with a map (visual representation) of the text and to ask them to identify similar structural diagrams. This would save having students read the texts again.

A further limitation of the study is that it did not control for relevant content knowledge or prior knowledge of the texts which may have advantaged one group rather than another. However, four texts with different content and subject matter were used to spread that effect. Like previous research studies of text structure awareness, the present study does not include process data, for example, an in-depth analysis of the strategies students use to recall ideas from text. Further experimental studies could use process data to determine whether students use a structure strategy to facilitate recall of ideas.

While the research paradigm of schema-theory research has been used to investigate reading contexts, Meyer's (1975, 1992) work, as explained in the review of literature, does not acknowledge the social and ideological dimensions of texts.

## CONCLUSIONS AND IMPLICATIONS

This study was intended to extend the findings of empirical research on text comprehension and recall in three important ways. Firstly, authentic passages were used, selected from a scientific journal. In addition, two exemplars of each text type were selected in order to ensure that the findings were more reliable. Secondly, a specific content domain, science, was chosen and subjects were selected according to specified criteria to ensure that they were matched on aspects which would influence their interpretation of science texts. Thirdly, the study compared both L1 and L2 and speakers of English at advanced level who were also assumed to be proficient readers, and used three different measures of awareness of scientific text structure. The study demonstrates that knowledge of text structure can enhance comprehension and recall of main ideas for advanced level readers of scientific English.

This study illustrates and emphasises the interactive nature of reading comprehension and how structural patterns are manifest in written texts. Its pedagogical implications are that assumptions regarding the comprehensibility of texts may be ill-founded and that texts vary in their level of salience to students from different language backgrounds. Although this study did not include any specific investigation of strategy training, explicit instruction in text organisation patterns, or how ideas are structured in expository prose, may facilitate recall of more superordinate ideas in passages, particularly for students from non-English speaking backgrounds.

From a cross-cultural perspective the study suggests that Australian and Singaporean speakers of English display similar patterns of awareness and recall. For the Malaysian group, the 'comprehension gap' is obvious, and what contributes to this may be a complexity of factors, including language proficiency and lack of appropriate schemata.

Finally, this study demonstrates that the findings of a number of disciplinary areas contribute to an understanding of the complexity of the reading process. The findings suggest that reading is an active process demanding skill and interpretation. When the reader's strategies for recall displays awareness of text structure, there is better recall of main ideas.



## **Part V**

# **Appendices and References**

## Appendix A

# Idea Units of Passages Used in Study

### IDEA UNITS IN PASSAGE ONE: "WHY GIRLS SEE GHOULS UNDER THE BED" (Mestel, 1993)

1. A child's bedroom is filled with nooks and crannies where monsters hide at night.
2. Monsters hide in different places according to the sex of the child.
3. Differences could be linked to the way our ancestors lived millions of years ago.
4. Cross asked children about their night time fears.
5. where were the ghouls and monsters in their bedrooms?
6. More girls than boys said they came from under the bed.
7. Cross believes differences hark back to our past.
8. Females may have spent more time in the trees than males.

9. Lucy the 3 million year old fossil was much smaller than other fossils widely believed to be males of the same species.
10. Some scientists have proposed that the female's more flexible feet were better suited to life in the trees.
11. If females slept in the trees it would make more sense if they, not males were genetically programmed to fear attacks from below.
12. Cross suggests that behavioural remnant of this ancient time live on in our genes.
13. Others doubt that such a useless behaviour would persist for so long.
14. Cross believes that natural selection can act fast.
15. Cross has also found other behavioural differences to fit his theory.
16. In playgrounds, girls spend more time than boys climbing frames and monkey bars.
17. They are more at home up high.
18. During scary films, women will pull their feet up to protect their dangling limbs from danger.
19. Cross is planning another scene with caves which he will show to children.

**IDEA UNITS IN PASSAGE TWO: "A HANDFUL OF  
DUST MAKES A HAPPY HEN" (Bradley, 1993)**

1. Why do battery hens peck each other until they are bleeding and nearly naked?
2. This behaviour has nothing to do with competition for food.

3. Zoologists have found that birds peck each other in order to dustbathe in wire cages.
4. Two scientists have set out to find the reason for hens' strange behaviour.
5. This behaviour might result in death.
6. They suspected that it might have something to do with dustbathing.
7. Dustbathing had been observed earlier in free hens.
8. Birds peck the ground
9. Birds squat in dirt and shimmy.
10. They work the dust particles into their feathers.
11. In a laboratory, scientists kept two groups of jungle fowl.
12. The birds in one group were reared in large cages with sand and earth on the floor.
13. The birds in the other group were reared in cages with wire mesh floors.
14. Birds reared on sand and earth prepared to dustbathe by pecking the ground vigorously.
15. They raked their bills as if to discover if it was suitable for dustbathing.
16. They rarely pecked each other, particularly when they had started dustbathing.
17. Birds on the bare floors were unable to dustbathe.
18. Nevertheless they went through the motions of dustbathing
19. They warmed up by pecking the ground.
20. But they often pecked at each other as well.

21. Some birds would peck frantically.
22. Some birds seemed stuck in this warm-up phase.
23. Others would mime dustbathing on the wire mesh floor.
24. Scientists conclude that the savage behaviour of battery hens is a result of their attempt to behave like free birds.

**IDEA UNITS IN PASSAGE THREE: "ONLY BIG  
BOYS LIKE BROCCOLI" (Dayton, 1993)**

1. Children turn up their noses at brussels sprouts for good reason.
2. These vegetables are less popular than corn and peas.
3. They have less sugar, according to Australian sensory researchers.
4. Children appear to be less sensitive than adults to the flavours of food.
5. Children aged 5–18 were asked to rank 8 common vegetables according to preference.
6. Researchers set out rows of food plates.
7. The plates were labelled 'like very much' or 'dislike'.
8. Youngsters placed containers of each vegetable on the plate that matched their opinion of the food.
9. In the analysis corn was rated number one 80–90% of the time.
10. Peas and carrots scored well.
11. Tomatoes, mushrooms and broccoli received middle rankings.
12. Cauliflower and brussels were bottom of the list.
13. High content of corn, peas and carrots make them winners with children.

14. the low sugar and odour of cauliflower make them appetising to young eaters.
15. These findings agree with results of other studies on children's sensitivity to taste.
16. Eight-year-old boys are 2–5 times less sensitive than adults to all four tastes.
17. Girls are as sensitive as adults to sweet, bitter and salty.
18. Girls are 2–3 times less sensitive to sour tastes.
19. Eight year olds were chosen for the study because their taste system is not fully developed.
20. Tastes that children perceive are less intense than what adults experience.
21. Children compensate for their bland perception of flavours by heading for salty and sweet food.
22. This is because their sensory mechanism is immature.
23. Laing wants to explore factors that influence children's tastes.
24. He also wants to find out how children's taste apparatus matures.

**IDEA UNITS FOR PASSAGE FOUR: "HOW  
VAMPIRE BATS ACQUIRED A TASTE FOR  
BLOOD" (Timson, 1993)**

1. How did vampire bats (vb's) acquire the blood sucking habit?
2. Only three species survive.
3. One theory states that the ancestors of vb's were fruit-eating bats with large incisors to cut through tough rinds of fruit.

4. This idea does not hold water.
5. No European fruit-bat with the correct teeth took up the habit.
6. Other biologists believe that vb's evolved from bats that fed on parasites e.g., ticks, feeding on large animals.
7. They simply developed a taste for blood.
8. This idea is flawed.
9. Vb's feed at night when such parasites are hard to find.
10. Another problem is that ticks are spread widely throughout Europe and Asia.
11. Why did vb's not develop in these areas?
12. Vb's need about 20 grams of blood per day.
13. The blood of birds and mammals is only between 6 and 10 percent of their body mass.
14. Bats must be able to rely on the presence of large animals in their habitat.
15. Now a biologist from Canada has proposed a third theory.
16. He believes that vb's began by eating insects attracted to wounds on large animals.
17. Later, they began to live on the animals blood alone.
18. This theory has a lot going for it.
19. When vb's evolved, the mammals of SA were more numerous and diverse than in any other part of the world.
20. There would be an intense struggle for survival.

21. Many animals were wounded.
22. When v's evolved in the mid miocene, the mammals of SA were more numerous and diverse than elsewhere.
23. Many species died when the climate changed.
24. Introduction of domesticated animals by humans saved the surviving species.



## **Appendix B**

# **Rhetorical Predicates**

Table B.1. Rhetorical Predicates (Meyer, 1975, p. 33).

Alternative	Equal weighted alternative options
Response	Equal weighted Question(s) and Answer(s), Remark or Reply, or Problem(s) and Solution(s)
Attribution	Describes qualities of a proposition
Equivalent	Restates same information in a different way
Specific	Gives more specific information about something that was stated in a general manner
Explanation	Previously stated information is explained in a more abstract manner (for example: relating the information to a general principle) or more concrete manner
Evidence	Evidence through perception of a situation to support some idea
Analogy	Analogy given to support an idea
Manner	Way an event or event complex is performed (examples: slowly, carefully)
Adversative	Relates what did not happen to what did happen
Setting time	Gives time of setting in which information being related occurs (often in narratives)
Setting Location	Gives location of setting in which information being related occurs (used particularly in narratives)
Setting Trajectory	Gives changing background of location and time that occurs in a narrative when characters travel through various places
Representative Identification	Singles out one element of a group and makes it stand for the group as a whole
Replacement Identification	One thing standing for something else
Constituency Identification	Identifies a part in relation to some whole
Collection	List of elements related in some unspecified manner
Covariance	Relation often referred to as condition, result, or purpose with one argument serving as the Antecedent and the other as the Consequent or result of the antecedent

## Appendix C

# Detailed Results of Analysis of Variance

### QUESTION 1.

The following results correspond to Table 7.1 on page 141.

Variable CC13                      Quantity of ideas recalled: Comparison/Contrast  
By Variable GR                      Nationality

#### ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	9689.7444	4844.8722	4.6856	.0146
WITHIN GROUPS	42	43427.2000	1033.9810		
TOTAL	44	53116.9444			

The following results correspond to Table 7.3 on page 142.

Variable PS24                      Quantity of ideas recalled: Problem/Solution  
By Variable GR                      Nationality

#### ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	17930.4111	8965.2056	7.5812	.0015
WITHIN GROUPS	42	49667.5333	1182.5603		
TOTAL	44	67597.9444			

## QUESTION 2.

The following results correspond to Tables 7.5 and 7.6 on page 143.

Dependent Variable By levels of Value Label	CCQ13TOP GR	Top Level Scores for Comparison/Contrast Nationality			
		Mean	Std Dev	Sum of Sq	Cases
1.00 Australia		140.0000	52.4404	38500.0000	15
2.00 Malaysia		80.0000	59.1608	49000.0000	15
3.00 Singapore		136.6667	63.2926	56083.3333	15
Within Groups Total		118.8889	58.4692	143583.333	45

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	34111.1111	2	17055.5556	4.9890	.0114
Within Groups	143583.3333	42	3418.6508		
Eta = .4381		Eta Squared = .1920			

Dependent Variable By levels of Value Label	PSQ24TOP GR	Top Level Scores for Problem/Solution Nationality			
		Mean	Std Dev	Sum of Sq	Cases
1.00 Australia		116.6667	49.7015	34583.3333	15
2.00 Malaysia		50.0000	46.2910	30000.0000	15
3.00 Singapore		110.0000	73.6788	76000.0000	15
Within Groups Total		92.2222	57.8552	140583.333	45

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	40444.4444	2	20222.2222	6.0415	.0049
Within Groups	140583.3333	42	3347.2222		
Eta = .4727		Eta Squared = .2234			

Dependent Variable	CCQ13HIG	High Level Scores for Comparison/Contrast				
By levels of	GR	Nationality	Mean	Std Dev	Sum of Sq	Cases
Value	Label					
1.00	Australia		140.8667	21.2867	6343.7333	15
2.00	Malaysia		114.6000	34.4587	16623.6000	15
3.00	Singapore		117.4667	24.1391	8157.7333	15
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Within Groups Total			124.3111	27.2227	31125.0667	45

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	6228.5778	2	3114.2889	4.2024	.0217
Within Groups	31125.0667	42	741.0730		
Eta = .4083		Eta Squared = .1667			

Dependent Variable	PSQ24HIG	High Level Scores for Problem/Solution				
By levels of	GR	Nationality	Mean	Std Dev	Sum of Sq	Cases
Value	Label					
1.00	Australia		130.2667	42.4221	25194.9333	15
2.00	Malaysia		82.1333	39.4332	21769.7333	15
3.00	Singapore		114.6667	22.7114	7221.3333	15
-----						
Within Groups Total			109.0222	35.9186	54186.0000	45

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	18092.9778	2	9046.4889	7.0120	.0024
Within Groups	54186.0000	42	1290.1429		
Eta = .5003		Eta Squared = .2503			

Dependent Variable		CCQ13MED	Medium Level Scores for Comparison/Contrast			
By levels of		GR	Nationality			
Value	Label		Mean	Std Dev	Sum of Sq	Cases
1.00	Australia		119.2000	42.8339	25686.4000	15
2.00	Malaysia		81.8667	39.5129	21857.7333	15
3.00	Singapore		113.8000	38.2664	20500.4000	15
Within Groups Total			104.9556	40.2506	68044.5333	45

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	12213.3778	2	6106.6889	3.7693	.0312
Within Groups	68044.5333	42	1620.1079		
Eta = .3901		Eta Squared = .1522			

Dependent Variable		PSQ24MED	Medium Level Scores for Problem/Solution			
By levels of		GR	Nationality			
Value	Label		Mean	Std Dev	Sum of Sq	Cases
1.00	Australia		116.5333	37.9697	20183.7333	15
2.00	Malaysia		76.1000	31.8525	14204.1000	15
3.00	Singapore		119.8667	40.9126	23433.7333	15
Within Groups Total			104.1667	37.1040	57821.5667	45

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	17807.4333	2	8903.7167	6.4674	.0036
Within Groups	57821.5667	42	1376.7040		
Eta = .4852		Eta Squared = .2355			

Dependent Variable		CCQ13LOW	Low Level Scores for Comparison/Contrast			
By levels of		GR	Nationality			
Value	Label		Mean	Std Dev	Sum of Sq	Cases
1.00	Australia		51.9333	55.5819	43250.9333	15
2.00	Malaysia		47.0000	51.1971	36696.0000	15
3.00	Singapore		57.6000	51.3027	36847.6000	15
Within Groups Total			52.1778	52.7335	116794.533	45

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	844.0444	2	422.0222	.1518	.8597
Within Groups	116794.5333	42	2780.8222		
Eta = .0847		Eta Squared = .0072			

Dependent Variable	PSQ24LOW	Low Level Scores for Problem/Solution			
By levels of	GR	Nationality			
Value	Label	Mean	Std Dev	Sum of Sq	Cases
1.00	Australia	39.4000	33.3719	15591.6000	15
2.00	Malaysia	31.7333	28.7215	11548.9333	15
3.00	Singapore	61.9333	51.7528	37496.9333	15
Within Groups Total		44.3556	39.2299	64637.4667	45

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	7392.8444	2	3696.4222	2.4019	.1029
Within Groups	64637.4667	42	1538.9873		
Eta = .3204		Eta Squared = .1026			

### QUESTION 5.

The following results correspond to Table 7.10 on page 148.

Variable CCUSE Awareness/Use of Text Structure for Comparison/Contrast  
By Variable GR Nationality

#### ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	2.9778	1.4889	3.4234	.0419
WITHIN GROUPS	42	18.2667	.4349		
TOTAL	44	21.2444			

Variable PSUSE Awareness/Use of Text Structure for Problem/Solution  
 By Variable GR Nationality

ANALYSIS OF VARIANCE

SOURCE	D. F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	4.5778	2.2889	4.8716	.0125
WITHIN GROUPS	42	19.7333	.4698		
TOTAL	44	24.3111			

**QUESTION 6A.**

The following results correspond to Table 7.12 on page 149.

Variable TEMPCC Awareness/Recognition of Text Structure  
 By Variable GR for Comparison/Contrast  
 Nationality

ANALYSIS OF VARIANCE

SOURCE	D. F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	.4000	.2000	.8077	.4527
WITHIN GROUPS	42	10.4000	.2476		
TOTAL	44	10.8000			

The following results correspond to Table 7.13 on page 150.

Variable TEMPPS Awareness/Recognition of Text Structure  
 By Variable GR for Problem/Solution  
 Nationality

ANALYSIS OF VARIANCE

SOURCE	D. F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	.5778	.2889	1.1519	.3258
WITHIN GROUPS	42	10.5333	.2508		
TOTAL	44	11.1111			



### QUESTION 7B.

The following results correspond to Table 7.17 on page 152.

Variable CC13                    Quantity of ideas recalled: Comparison/Contrast  
 By Variable CCUSE                Awareness/Use of Text Structure for Comparison/Contrast

#### ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	31709.9009	15854.9504	31.1070	.0000
WITHIN GROUPS	42	21407.0436	509.6915		
TOTAL	44	53116.9444			

The following results correspond to Table 7.19 on page 153.

Variable PS24                    Quantity of ideas recalled: Problem/Solution  
 By Variable PSUSE                Awareness/Use of Text Structure for Problem/Solution

#### ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	43588.5943	21794.2971	38.1252	.0000
WITHIN GROUPS	42	24009.3501	571.6512		
TOTAL	44	67597.9444			

## **Appendix D**

### **Texts Used in the Study**

## Why girls see ghouls under the bed

A CHILD'S bedroom is filled with nooks and crannies where monsters and ghouls lurk at night. But the monsters hide in different places depending on the sex of the child, says Richard Coss, a psychologist at the University of California, Davis. Those differences, he says, could be linked to the way our ancestors lived their lives millions of years ago.

In an experiment, Coss had interviewers ask children aged three to four about their night-time fears. Where were the ghouls and monsters in their bedrooms? Significantly more girls than boys said that their monsters came from lower locations such as that old classic, "under the bed".

Coss thinks the difference harks back to a time in our evolutionary past when females may have spent more time in trees than males. Lucy, the famous 3-million-year-old fossil australopithecine was much smaller than other fossils widely believed to be males of the same species. Some scientists have proposed that the female's lighter frame and more flexible feet were better suited to life in the trees. If females slept in trees, it would make sense if they—and not males—were genetically programmed to fear attacks from predators from below.

Coss suggests that behavioural remnants of this ancient time live on in our genes. But others doubt that a now useless behaviour would persist for so long. "We've had at least two million years on the ground, and we know that natural selection can act pretty fast," says Richard Wrangham, a behavioural biologist at Harvard University.

Still, Coss says that he has unearthed other behavioural differences that fit his theory. In playgrounds, girls spend more time than boys playing on climbing frames and monkey bars, as if they are more at home up high, he says. During scary films, Coss's surveys show that women will pull their feet up onto their chair more often than men—as if to protect dangling limbs from danger. Now he is planning another experiment—a miniature "scene", complete with trees and caves, which he will show to children. "I'd ask them where would they go in this structure to feel safe, and see whether the girls would choose the trees and the boys choose structures on the ground," he says.

Rosie Mestel

## A handful of dust makes a happy hen

WHY do battery hens often peck each other until they are bleeding and nearly naked? The behaviour has nothing to do with aggression or competition for food. Now zoologists have found that the birds peck each other in a vain attempt to "dustbathe" on the bare wire floors of their cages.

Klaus Vestergaard of the Royal Veterinary and Agricultural University in Frederiksberg in Denmark, Jaap Kruijt of the University of Groningen in the Netherlands and Jerry Hogan of University of Toronto set out

to find the reason for the hens' savage behaviour, which may result in death. Vestergaard suspected it might have something to do with dustbathing, which he had observed earlier in free hens. To stop their plumage becoming too greasy, the birds peck at the ground, then squat in the dirt to shimmy and shake, working the dust particles into their feathers.

In a laboratory, Vestergaard and his colleagues kept two groups of jungle fowl, the wild relative of the domestic hen. The birds in one group were reared in large cages with sand and earth on the floor, while the birds in the other group were reared in similar cages with bare wire mesh floors (*Animal Behaviour*, vol 45, p 1127).

The birds reared on sand and earth prepared to dustbathe by pecking the ground vigorously and raking their bills through it, as if to discover if it was suitable for bathing. They rarely pecked each other, particularly once they had started dustbathing.

However, the birds on the bare floors were unable to dustbathe. Nevertheless, they went through the motions of dustbathing. They warmed up by pecking the ground. But they often pecked at each other as well. Some birds would peck frantically, as if somehow stuck in this warm-up phase, while others would go on to mime dustbathing on the wire mesh floor.

Vestergaard and his colleagues conclude that the savagery of battery hens is a by-product of their attempts to behave like free birds.

Georgia Mason

## Only big boys like broccoli

**Leigh Dayton**

CHILDREN turn up their noses at cauliflower and Brussels sprouts for good reason. These vegetables are less popular than corn and peas because they have less sugar, according to Australian sensory researchers. Children appear to be less sensitive than adults to the flavours of food, they add.

Psychobiologist David Laing and his colleagues at the University of Western Sydney asked 600 children, aged 5 to 18, to rank eight common vegetables according to preference. The researchers set out a row of plates labelled with a range of preferences, from "like very much" to "dislike very much". The youngsters then placed containers of each vegetable on the plate that matched their opinion of the food.

"Corn seems to stand out by a mile," says Laing. "In the preliminary analysis it was rated number one, two or three 80 to 90 per cent of the time." Peas and carrots also scored well. Tomatoes, mushrooms and broccoli received middling rankings, while cauliflower and Brussels sprouts were at the bottom of the list.

Although the data are not yet fully analysed, and still not published, Laing believes that the comparatively high sugar content of corn, peas and carrots made them winners with the children. Conversely, he suspects that the low sugar and strong odour of cauliflower and sprouts made them less appetising, especially to the youngest participants.

The findings dovetail with those from a study the team recently completed of children's sensitivity to the four basic tastes: sweet, sour, bitter and salty. On

average, 8-year-old boys are two to five times less sensitive than adults to all four tastes. Girls at age 8, by contrast, are as sensitive as adults to sweet, bitter and salty tastes, but are two to three times less sensitive to sour tastes. The group chose 8-year-olds because it seemed likely that their taste system is not fully developed, yet they are old enough to understand experimental tasks.

According to Laing, the sensations children perceive may be much less intense than those adults experience. So when children head for salty snacks or sugary sweets

they may be compensating for the relatively bland perception of flavours triggered by their immature sensory mechanism.

Laing has further projects under way. He hopes to pinpoint the factors that influence children's food preferences, to determine how the taste-sensing apparatus matures in the mouth and brain, and to discover when children become fully adult in their ability to assess the characteristics of food. The goal is to help nutritionists, parents and food manufacturers to produce food that will appeal to young taste buds. □

# How vampire bats acquired a taste for blood

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John Timson

HOW did vampire bats evolve the habit of sucking blood? Curiously, it evolved only in the New World, and only three species survive, the most common of which is *Desmodus rotundus*.

According to one theory, the ancestors of vampire bats were fruit-eating bats with incisors that could cut through the tough rinds of fruit. But this idea does not hold water. If blood made a better meal than fruit, why did no European fruit bat with the right teeth take up the blood-sucking habit?

Other biologists believe vampire bats evolved from bats which fed on parasites such as ticks on the skin of large mammals. They simply developed a taste for blood. But this idea is also flawed. Vampire bats feed at night when such parasites are hard to find. An even more serious problem is that ticks are spread widely throughout Europe and Asia. Why did vampire bats not evolve in these places as well?

Living entirely on blood is a precarious way of life. A vampire bat needs about 20 grams of blood each day. Because the blood of mammals and birds is only between 6 and 10 per cent of their body mass, bats must be able to rely on the presence of large animals in their habitat.

Now a biologist in Canada has proposed a third theory. Brock Fenton of York University, Ontario, Canada, believes that the ancestors of the vampires began by eating insects attracted to wounds on large animals. Later, they began to live on the animals' blood alone (*Biological Journal of the Linnean Society*, vol 47, p 161).

The theory has a lot going for it. In the mid-Miocene, when vampire bats evolved, the mammals of South America were more numerous and diverse than in any other part of the world. Fenton believes there would have been an intense struggle for survival, which led to many animals being wounded frequently.

In the mid-Miocene, South America was also home to several large birds on which vampires could feed as well. Brock believes many species of vampire may have died when the climate changed and there was a reduction in the number of large animals. Only the introduction by humans of domesticated animals saved the surviving species from the same fate.

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