1 Introduction

The practice of developing and testing second language (L2) reading must follow as clear an understanding of this skill as possible, and such an understanding must be a result of rigorous research, both theoretical and empirical. Comparisons have been made between applied linguistic research on L2 reading and cognitive psychological research on L1 reading, both of which directly or indirectly contribute to our understanding of the nature and development of reading. Compared to cognitive psychology's extensive and cumulative research base resulting from successions of empirical data collection and theory and model generation, not only for description but for explanation and prediction of reading behaviour, L2 reading research effort within the applied linguistics community has been said to suffer from lack of a solid empirical research base (Bernhardt 1991a) and a resultant relative weakness in generalizability and predictability of L2 reading behaviour. It is therefore imperative that more principled effort be made to accumulate empirical evidence on the nature of L2 reading. While L2 reading research has at times drawn insights from the L1 reading literature, the issues it has addressed and emphasised have tended to be distinct from the ones researched through typical cognitive psychological approaches.

Two questions which characterise L2 reading research have been whether L2 reading difficulty arises from incomplete L2 knowledge or insufficient L1 literacy (Alderson 1984) and whether there is a linguistic threshold level which the L2 reader must achieve in order for his or her L1 literacy skills to be positively transferred to the task of L2 reading comprehension (Clarke 1978). These questions obviously relate to the facts that most individuals learning to read in L2 do not have the kind of sophistication in linguistic competence shared by the majority of the native speakers of the target language and that these L2 readers already have varying levels of literacy skills in their own L1.

While these features specific to L2 reading must be sufficiently highlighted and reflected in L2 reading research designs (Alderson 1984, Koda 1994), effort also seems to be justified which examines the factors considered to be significant for L1 reading comprehension. The advantages of such an effort would be the availability of methodology established in L1 research and its extensive body of research evidence, which enables us to compare L2 reading

data with their L1 counterparts and to determine whether those factors considered to influence reading comprehension skills among L1 readers are also importantly related to those among L2 readers. This type of research has the potential of bringing closer the two fields of cognitive psychology and applied linguistics, since findings resulting from a common ground in terms of research design, variables, and instruments could be more easily compared or built into a common research base.

A review of L1 and L2 reading literature for methodological compatibility identifies one line of L1 reading research which has aimed to identify components of reading skills and possible sources of individual differences in reading abilities. It emerges from the overview of the L1 component skills literature that such variables as vocabulary knowledge, word recognition efficiency, phonological awareness, and working memory span account for a relatively larger amount of the variance in reading comprehension than do the others (Cunningham, Stanovich and Wilson 1990, Daneman 1991, Just and Carpenter 1992, Stanovich, Cunningham and Cramer 1984). It would seem most meaningful to subject such variables in L2 readers to theoretical and empirical scrutiny along with the L2-specific variable of grammar knowledge, whose relationship with L2 reading seems to deserve more attention than has been given so far (Urquhart and Weir 1998).

The present study initially surveys in Chapter 2 how reading has been researched and understood and details some of the knowledge areas and processing subskills which the researchers suggest as important for reading abilities. Discussions of these knowledge and skill areas will lead to the initial attempt to form a set of research questions for the present study.

Chapter 3 considers the research methodology that, if adequately employed, would answer the research questions initially posed. The emphasis in Chapter 3 will be on the practicality and feasibility of the research variables and their instrumentation. Taking account of the theoretical significance and the practicality constraints, revised research questions will be stated in this chapter.

Chapters 4 and 5 will describe a total of six preliminary studies to simultaneously evaluate the potential values of the initially selected variables for the subsequent main study and to evaluate the instruments and their content to make necessary refinements. The two chapters represent separate phases of the research programme each covering three studies.

Reports on the actual main study will begin in Chapter 6, which will present detailed background and basic descriptive data.

Chapters 7 and 8 will report on the main findings based on two different methods of analysis. The results of a series of multiple regression analyses to answer the research questions will be presented in Chapter 7, but an additional analysis which explores latent variables and helps consider the data from a slightly different perspective will be reported in Chapter 8.

What the data have indicated in Chapters 7 and 8 will be examined in Chapter 9, in which the research questions will be answered, the findings discussed in reference to the related research, the implications of the findings evaluated, and recommendations for future research proposed.

2 Literature review

Chapter overview

Research on reading in L2 requires an overview of how reading has been understood in the reading literature. This section will begin by briefly discussing how reading may be defined, followed by a developmental overview of the interactive process models of reading to capture some significant elements of reading which emerged from systematic L1 reading research. The focus will then shift to the difficulties of the process model approach in general and to the alternative approach to reading research, the component skills approach. This will lead to the discussion of the components and issues addressed in the L2 reading literature and the identification of some research variables that have been suggested as worthy of further investigation. The section will conclude by specifying the research questions emerging as a result of the literature review and theoretical and practical considerations.

Definitions of reading

In a well-quoted synthesis of previous reading research, Grabe (1991) avoided simple definitions of reading on the grounds that they 'typically misrepresent complex cognitive processes such as reading' (1991:378), underscoring the difficulty in defining reading. However, it is notable that, by way of rationalising his reluctance to provide a simple definition, Grabe actually states his view of reading as a 'complex cognitive process'. While this seems to be the position accepted by both the L1 and L2 reading researchers, Alderson and Urquhart's (1984) caution against equating reading with general cognitive activity is also commonsensical. What differentiates reading from other cognitive activities such as reasoning or mathematical calculation is the involvement of written language, or the text, faced by the reader. We may thus attempt to formulate our initial definition of reading as 'a complex cognitive process the individual is involved in while engaged with a written text'. This is still a very broad definition, but it seems rather premature to narrow our focus to which to commit ourselves when dealing with something as multi-faceted as reading. The divergence of views on reading even within a single academic discipline of cognitive psychology requires at least a brief survey of how reading has been understood. The following section reviews

some previous work on reading which seems to be relevant for our attempt to formulate a balanced yet more focused and research-specific definition of reading.

Theories and models of reading

Processes of reading

Current efforts among reading researchers to theorise and model reading date back to at least the late 1960s, when Goodman (1967) proposed the notion of reading as a 'psycholinguistic guessing game'. He argued against the then prevalent view within the teaching profession which saw reading as a precise process involving exact, detailed, sequential perception and identification of letters, words, etc. and proposed an alternative view in which the reader is conceptualised as constantly making predictions or hypotheses on the linguistic or propositional contents of the text, relying heavily on the prior linguistic and non-linguistic knowledge available and cyclically confirming, disconfirming, or reforming the predictions made as the textual information is sampled rather than thoroughly processed. This significant role assigned to the reader's knowledge and guessing (or 'higher-level' processes) as the guiding force in reading, in contrast with the relative lack of emphasis on the role of the text (at the 'bottom'), has come to make his and a similar view (Smith 1971) the top-down model of reading. The model has earned popularity in the reading literature and pedagogy and exerted influence on the L2 reading material and curriculum (see Paran 1996), although its general credibility, and particularly its assertion that the more skilled readers guess more, have been significantly weakened as a result of a vast volume of empirical counter-evidence (cf. Stanovich 1991) based on data on readers' eye movements and vision (e.g., Just and Carpenter 1980, Rayner and Pollatsek 1989) and on the effects of context on word recognition (e.g., West and Stanovich 1978). Grabe and Stoller also state that 'few reading researchers actually support strong top-down views' (2002:32). Reading is certainly an active process; however, it does not appear to be entirely a psycholinguistic guessing game.

Conceptualisations at the other end of the top-down bottom-up continuum were also being developed at about the same time in the history of reading theory evolution. Gough (1972), among others, worked out a strictly sequential, bottom-up model, very much the type Goodman was trying to refute. Not only was Gough's model overshadowed by the popularity of the top-down approach to reading, its strictly serial stage-by-stage concept also suffered inconsistencies with experimental findings (Reicher 1969, Rumelhart 1977). However, Gough's model is also considered to have contributed more to the field of reading research than did its top-down competitor. In fact,

Rayner and Pollatsek (1989) evaluate Goodman's and Smith's top-down model as 'so vague as to be untestable' but Gough's as 'very clear in what he thought was happening during reading' (1989:467) and gave the latter credit for making explicit testable predictions and stimulating a great deal of reading research. What the discussion on Gough's model made clear is that reading is not simply an act of serial bottom-up decoding, although one cannot initiate the act of reading without some sort of decoding of print.

One of the important results of the subsequent research effort was the emergence of the interactive models of reading, which took into account the claims of the two opposite approaches mentioned so far (although much less of the top-down models). Rumelhart introduced an interactive parallel processing model (1977) based on the idea and previous research which suggested that our perception of input at one level, be it letter, word, or syntax, is facilitated by the context in which we encounter it (e.g., the surrounding letters or the syntactic or semantic constraints). This interaction among various levels of knowledge has become a standard feature of subsequent models of the reading process that are still widely cited (Just and Carpenter 1980, Rayner and Pollatsek 1989, Stanovich 1980), though these models also maintained emphasis on the extraction of information through perceptual processes. Reading has thus been viewed as an interactive process in which various types of knowledge and textual information contribute to successful identification of letters, words, syntactic functions of words, and larger units of meaning.

The concept of interaction was also an integral part of the popularised schema-theoretic view of reading (Anderson and Pearson 1984, Carrell and Eisterhold 1983), which argued that the reader's schemata, or structured world/background knowledge, play a significant role when trying to make sense of the information presented in the text. In this framework, the phenomenon of interest seems to be general language comprehension, which was considered a function of the interaction between old knowledge stored in the comprehender's memory and new information presented via a linguistic message. Grabe (1991) distinguished between this type of reader-text interaction approach and the interaction-of-component-knowledge/skills approach previously described. He expressed scepticism on the former as it is difficult to demonstrate experimentally how prior knowledge is called up and used. Clapham (1996) emphasised the difficulty in assessing such knowledge as well. The role of prior knowledge must surely remain in our wider conceptualisation of reading, and the ultimate goal of reading is usually more than simply decoding the written symbols; however, the current interactive process approaches to reading stress the efficiency of bottom-up processes and integration of information within and between the memory structures (Just and Carpenter 1980, Rayner and Pollatsek 1989) and assign no central role to schemata.

The discussions so far have presented a view of reading as an interactive cognitive process involving various levels and types of reader knowledge for efficient processing of visually presented text. The models that represent such an understanding of reading have been identified as process models or stage models, since they typically identify distinctive stages of information processing which are interrelated with other stages to attain a certain goal, which is usually comprehension of the text. While such process models derive from careful synthesis of empirical evidence on L1 reading behaviour, no one is exhaustive. Each model mirrors the researchers' orientation towards their interests and research focus with its possible consequence being an emergence of a range of essentially interactive process models differing only in emphasis (Urquhart and Weir 1998). Rayner and Pollatsek (1989) warn when introducing their own model that it reflects their 'theoretical biases' and how they 'interpret the . . . evidence on the reading process' (1989:471). Such a cautionary note adds to our doubt with regard to the general usefulness of process models and discourages researchers from working out another variant of an interactive process model, at least until significant research findings have necessitated a major revision to the available models. Another difficulty seems to be with the lack of consideration of individual differences (see, however, Stanovich 1980) and differential purposes of reading within the same individuals. Modelling the cognitive processes of even a certain type of reading by a certain type of reader requires a synthesis of an enormous volume of empirical evidence. These difficulties, coupled with the extremely diverse background of L2 readers, may explain the scarcity of process models of general L2 reading (see Segalowitz 1986 and Paran 1994 for exceptions). Although these difficulties with process models are not easily surmountable, L2 reading research does need a framework in which to structure more empirical research for the purpose of characterising L2 reading. Thus, an alternative method of describing, explaining, and predicting reading comprehension ability will be discussed below, after a consideration of the different purposes of reading as they are related to different types of reading.

Purposes and types of reading

The previous section has alluded to the failure of the process models of reading to take account of the various types of reading associated with different purposes. Urquhart and Weir (1998) differentiate among five types of reading: Scanning, Search Reading, Skimming, Careful Reading, and Browsing. Although one might attempt to organise them in terms of the complexity of the cognitive operations required, one can more clearly distinguish them in terms of the reader's purposes. Browsing is contrasted with the rest by its lack of clear purpose. In that sense, it may be considered 'quasi-reading'. The first three of Scanning, Search Reading, and Skimming are expeditious

reading, which means that priority is given to the speed of fulfilling a specific purpose at the expense of thorough text processing. The purpose of Scanning is to simply locate a set of textual strings which satisfy a certain search condition. Search Reading is for locating the answers to a pre-determined question without having to arrive at anything like a superordinate main idea of an extended discourse such as paragraphs or passages. Skimming is for gaining such a main idea, and contrary to Search Reading, without any prior clues as to the topic of the text. Careful Reading is different from any expeditious reading since it aims to deal with both the details and the general ideas, which must be constructed through comprehension and synthesis of the details, while the processing speed is secondary to digesting the majority of the text.

The tentative definition of reading stated earlier (see the section 'Definitions of reading') should now incorporate this purposefulness in reading: reading is a cognitive process the individual is engaged in with a written text for one or more specific goals such as quickly identifying particular facts stated in it or constructing a thorough semantic representation of most of it.

Clearly, no type of reading is superior to the others in any absolute sense. Nevertheless, any research which claims to deal with reading will have to specify what type or types it means by reading (cf. Taillefer 1996, Weir, Yang and Jin 2000). The primary interest of the present study is in Careful Reading at the passage level, which seems to be required in many academic, professional, and personal functions.

Components of reading

A somewhat different line of reading research, which perhaps complements the process model approach rather than competes with it, is what is known as the component skills approach or componential approach. Research in this category tries to identify the components of reading or to model the ability of reading through such components. Another goal of this approach is to account for the individual and developmental differences in reading performance in terms of the differences in specific component processes or knowledge sources. Carr and Levy (1990a) state:

> Many investigators believe that the kind of full characterization that results from component skills analysis is the only way to get an accurate picture of reading ability, how it changes developmentally, and what creates individual differences among readers who are otherwise roughly the same in developmental level (1990a:xi).

According to Hoover and Tunmer (1993), 'components' refer to some 'theoretically distinct and empirically isolable constituents' of reading (1993:4).

L1 componential research has argued, for instance, for separate word

recognition and linguistic comprehension components (Hoover and Tunmer 1993). Their 'Simple View' of reading finds support in the L1 developmental or dyslexic situations, in which the reader has the linguistic competence to achieve listening comprehension but lacks the skill for visual word identification, or in hyperlexic situations, in which the reader can successfully decode the printed words but has deficiency in making sense of the results of this decoding. Urquhart and Weir's (1998) reaction to Hoover and Tunmer's Simple View points to the difficulty in identifying mutually exclusive components (word recognition subsumes access to mental lexicon, which is a part of linguistic comprehension), but the Simple View serves as a useful point of reference for the L2 componential approach and a reminder of the necessity to minimise the number of component distinctions to only the most meaningful ones.

Earlier L1 componential work with adult readers is found in such published studies as Jackson and McClelland (1979), Palmer, MacLeod, Hunt and Davidson (1985), Baddeley, Logie, Nimmo-Smith and Brereton (1985), Dixon, LeFevre and Twilley (1988) and Cunningham et al (1990).

Jackson and McClelland's (1979) research examined the correlates of the L1 reading speed of a group of university undergraduates and indicated that the largest proportion of the variance in their reading speed was accounted for by listening comprehension performance and the second and third largest proportions by their performance on letter-name matching and homonym matching reaction time measures respectively. The results have led the researchers to conclude that reading speed is dependent on the two main factors of general language comprehension ability and 'speed of accessing overlearned memory codes for visually presented letters' (Jackson and McClelland 1979:151).

A group of university undergraduates participating in the study by Palmer et al (1985) responded to a set of tasks yielding a total of 28 measures, which included reading comprehension, reading speed, listening comprehension, and various speeded measures of letter-, word-, and sentence-processing. Their correlational results indicated that reading comprehension was predicted very well by listening comprehension and in fact much better than by reading speed, which in turn correlated less well with listening comprehension. Their measures of visual stimulus-matching speed and speeded sentence-verification measures correlated well among each other but less well and differentially with the reading and listening comprehension and reading speed measures. They concluded from these and other results from a series of factor analyses that there is a modality-independent verbal comprehension component that can be dissociated from the reading speed component.

Baddeley et al's (1985) componential analysis with a group of adult L1 readers showed their lexical decision speed measure and sentence-span working memory measure to be accounting for the largest and roughly

equivalent proportions of the variance in reading comprehension performance and their vocabulary measure to be explaining a smaller but significant proportion as well. Their second experiment, which did not include the lexical decision speed measure, also showed their working memory and vocabulary measures to be uniquely accounting for a significant portion of the reading variance. From these results, Baddeley et al claimed that vocabulary, lexical access speed, and some form of working memory are separable and important components of fluent reading.

Not only reading comprehension and reading rate but also the ability to make plausible inferences based on world knowledge were measured in Dixon et al's (1988) study with a group of university undergraduates reading in L1. Variance in their reading comprehension measure was best accounted for by the vocabulary score while sentence-span working memory and the knowledge of multiple meanings of specific words also uniquely explained additional variance. Reading rate and the inferencing ability measure showed a somewhat different pattern though vocabulary was again the strongest predictor for each criterion. These data allowed Dixon et al to claim multidimensionality of reading proficiency and importance of word knowledge even with skilled, mature readers.

Cunningham et al (1990) were interested in whether visual word decoding is a separate skill which contributes to explaining the individual differences in reading comprehension among their university undergraduates. Vocabulary size, listening comprehension, word and pseudoword reaction times, and working memory span were among the variables correlated most strongly with reading comprehension and on which good and poor readers differed significantly. A series of their multiple regression analyses, with reading comprehension as criterion, consistently revealed a significant effect of word decoding, measured through pseudoword reaction time, and their confirmatory factor analysis supported a 3-factor model yielding what they named the global verbal comprehension, word recognition, and reading comprehension factors.

L1 componential analyses referred to so far suggest several variables as potentially important for reading abilities among adults. Most of the studies (Baddeley et al 1985, Cunningham et al 1990, Jackson and McClelland 1979) showed the significant effects of some form of efficiency in accessing the lexical and sublexical information stored in long-term memory, which may be loosely termed 'word recognition efficiency'. Fast and accurate word recognition, which was once relegated as secondary to contextual prediction skill, is now considered to be a major determinant of reading success (Stanovich 1991), and the individual differences in the efficiency of this skill should be examined as a potentially important factor in L2 reading as well.

Other variables which predicted reading comprehension across different studies were vocabulary and working memory (Baddeley et al 1985,