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Reading Difficulties and the Twofold Character of Language

How to Understand Dyslexia

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ABSTRACT

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The present longitudinal study, which comprised 125 children from Grade 2 (typal age: 8) to Grade 6 (typal age: 13), examines and interprets the results of several decoding and reading comprehension tests. A point of departure is the proposition that there may be a lack of concepts about central questions that help interpret the results of an expanding test practice in the educational system. To construct the central questions the typologies and hypothetical causes of reading problems ought to be constrained in relation to explanatory constructs combining reading acquisition and reading difficulties.

First, the field of research on reading acquisition and reading difficulties was surveyed as a background to the presentation of the model, which is heavily indebted to and basically molded on the balance model but which also takes advantage of the proposition of combining the double-route and connectionist approaches.

Second, the following themes were investigated empirically:

– The predictive power of the tests: Generally, there seem to be almost as accurate predictions from Grade 2 as from Grade 3. A combined decoding-comprehension prediction was not shown to be more powerful as a product than as a linear combination.

– The possibility of an image/symbol transition in early reading acquisition: A weak image/letter decoding correlation distinguished boys weak in reading comprehension from all others in Grade 3; a weak letter/word decoding correlation distinguished those weak from those strong in reading comprehension regardless of gender in Grades 2 and 3; and a weak image/word decoding correlation distinguished boys from girls in Grade 2.

– Indications of stages in the development of reading: The conclusion is that orthographic decoding is more strongly related to reading comprehension than is phonologic decoding but there appears to be a parallel development of phonologic and orthographic decoding between Grades 3 and 6. This pattern seems to be the same for boys and girls and for those with low and high reading comprehension.

– Comparing subtypes: The surface/phonologic dyslexia distinctions were tentatively related to the linguistic/perceptual dyslexia distinctions and the letter/word-decoding screening instrument. The compensatory concept is questioned.

– Dimensions in reading acquisition and reading difficulties: A conclusive proposition of the study is that the hypothetical twofold metaphor/metonym character of language may be instrumental in analysing the complex interaction between the characteristic traits of the learning brain and the construction of meaning through script.

Key words: Reading acquisition, dyslexia, logographic, pictographic, phonographic, orthographic reading, image/symbol transition, metaphor and metonym.

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In fact they were often found to be talented although strangely weak at reading, and haunted by intense feelings of guilt and shame not seldom hidden behind self destructive strategies. Meeting with these children supposed to be lazy or just unintelligent was a significant experience when working as a school psychologist in the nineties.

I happened to come across the book *Neuropsychological treatment of dyslexia* and visited its author, Dirk Bakker of the Free University and Paedological Institute in Amsterdam. Checking out my insights, he asked me what I knew of the work of Samuel Orton. Realising that this was unknown to me, he patiently started to explain the basic ideas of Orton, and in what respects they had become obsolete.

Although he has no responsibility whatsoever for the design and shortcomings of the present work, the supportive attitude of Professor Bakker "from afar" has meant a lot to encourage the pursuit of my exploratory undertaking. Combining research, educational work, and, together with the late Dr. Jaan Kappers, an interesting remedial practice, Professor Bakker represents a multifaceted effort of importance in the field of reading research. I am honoured that he has agreed to become the opponent at my public examination.

As a supervisor in the final preparation of the thesis, Professor Bo Ekehammar of the Department of Psychology at Uppsala University, in an excellent demonstration of "the art of supervision", has made a very ambitious contribution of decisive importance. Professor Mats Fredrikson of the same department has with great care scrutinised the methodological aspects of the draft. Professor Samuelsson of the Stavanger Center for Reading Research and Professor Hjelmqvist of the Department of Psychology at Gothenburg University have also contributed valuable comments. At the University of Karlstad discussions with Dr. Anders Arnqvist and Mona Edwertz of the Department of Educational Sciences have been very helpful. Jeanne Sturmhoefel is to be thanked for correcting and polishing the language of my thesis.

Without the teachings of T'ai Chi Ch'üan of Professor William S. Dockens the hardships of this enterprise might not have been endured.

Many warm thanks for their continuous support to Eva Broman, Anton Lundström, and Emma Lundström.

In the tongue of the islanders of my native part of Sweden, who are also the subjects of the present investigation, a child having a hard time learning what the school demands is said to be ´einsöilt´, that is, turned contraclockwise, originally as the trunk of a tree turning contrary to the movement of the sun. To these children I dedicate this work, and to the memory of my eldest brother Hans who generously supported my initial research efforts. Finally suffering from left-temporal strokes, he proved that language is merely a superficial reflection of the true personality of an individual.

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Lars Lundström

Preface

The present study is the result of a journey into the cloudy terrain of dyslexia, visiting the more or less forsaken battlefields of the so-called reading wars (Share & Stanovich, 1995; Snow, Burns, & Griffin, 1998).

The structure of the thesis certainly reflects its genesis as an exploratory attempt, from a practitioner's standpoint, to understand or come to grips with the complex field of reading difficulties. Further, focusing on problems conceived in professional practice as a school psychologist and teacher trainer, it ultimately aims at giving feedback to the practitioner. It is a dilemma that there is a psychological practice going on in urgent need of feeding from research, but at the same time unable to await more definite results, if such are ever achievable in a scientific process always prone to questioning itself.

The main questions addressed in this study are related to the field of reading acquisition and reading difficulties, obviously of vital importance both for school psychology and for teacher training, but also an important field of psychological research.

Concerning reading difficulties, the author's experience is an extensive and expanding test practice in the educational system, and a proposition behind the present study is that this practice could profit from closer links to theories and ongoing research in the field. Otherwise, for lack of concepts to handle and interpret the results, relevant information is perhaps not extracted from the data available. This is not to say that there does not exist a rationale underlying the use of tests, but this rationale is more rarely consciously expressed. In fact, according to the author's personal experience, tests are often dutifully performed in schools but the results are just piled up without much analysis or any firm conclusions being drawn. There is no end to remedial suggestions regarding reading difficulties, maybe helpful in the individual case but often without any serious evaluation, and possibly just effective as placebos.

Based on a longitudinal approach, the aim of the present study then is to examine and interpret some empirical data from fairly common tests in the light of an introductory survey of some aspects of the field of reading research; that is, in a way it is an attempt to screen the field for basic questions. Against this background, a model is proposed (Chapter 1) and some theoretical concepts are tested in relation to data (Chapters 2 – 6), hopefully contributing somewhat to the discussion on the meaning of tests and the use of models in guiding the learning-to-read process and the treatment of reading difficulties. In this process, not shying from but rather trying to reconstruct and raise some basic questions, and even discussing some positions held in the field might be permissible. For example, when it comes to drawing conclusions concerning the neuropsychological characteristics of dyslectics, one is faced with the challenge of distinguishing the causes from the effects of not reading (Ljungberg, 2001) and indicators of dyslexia from indicators of illiteracy (Petersson, Reis, Askelöf, Castro-Caldas, & Ingvar, 2000).

The empirical data in this study were not initially collected to answer very precisely and openly stated hypotheses but were originally more a result of the general intention to, over time, examine and interpret some basic reading tests used in assessing early reading acquisition. Empirically based reflections might be the best way to describe the undertaking. Probability not being the same as possibility (Sandqvist; in Hansson & Sandin, 2000, p.153), and as we perhaps know too little of the inconsistencies of the empirical data, the use of statistics is rather to be seen in the context of theory generation than as instruments for verification (Schmidt, 1996). It must also be noted that it is a study of a total population without random sampling.

Just collecting some tests, covering the process from not reading to understanding what one reads, can be seen as a rather simple undertaking, but is of course the consequence of certain conceptions concerning what reading is about and what skills are central in reading acquisition. The study is influenced from its start, as noted initially in Chapter 1, by a proposition that letters, in early reading acquisition, can be perceived in qualitatively different ways: as pictograms or as phonograms. This notion is cross-examined with the help of concepts chosen on the basis of the suggestion that there might be potentially interesting similarities or analogies, to the extent that a common model is motivated, between:

- concepts of neuropsychology; analysing brain hemisphere activity in terms of handling sequences or wholes (Ornstein, 1997),
- concepts of reading research; analysing orthographic and phonologic elements of reading skills (Lundberg, 1995, Castles, Datta, Gayan, & Olson, 1999) or in terms of perceptual and linguistic qualities in reading difficulties (Bakker, 1990), and
- concepts of linguistics; analysing the meaning of the elements of language in context or in similarity (Jakobson, 1974).

The intention of the present study is eventually to help develop practicable measures to acknowledge and support all those individuals struggling with their reading difficulties, in danger of giving up and hiding behind self-destructive strategies.

Vocabulary

Acquired dyslexia: Caused by brain damage of some kind.

Balance model: A neuropsychological model for learning to read and dyslexia, focusing on the necessity of establishing appropriately balanced hemispheric activity.

Connectionist model: Refutes the dual-route model and proposes a single route. Phonological activation is present at all levels of word identification and is not seen as a separate process.

Developmental dyslexia: "Normal dyslexia". Not caused by any known damage to the brain.

Dual-route model: Proposes two independent processes that govern access to lexical representation. A **direct** dictionary look-up procedure that can read words but cannot read nonwords and an **indirect** letter-to-sound procedure that can read nonwords and regular words but misreads exception words by regularising them.

Dyslexia: A hypothesised state in some individuals when reading is strangely hard to establish. Whether and how it can be distinguished from reading difficulties in general is a matter of dispute.

Logographic reading: Reading words from superficial signs. Reading *camel* as "*m* has two humps".

L-type dyslexia: Linguistic dyslexia according to the balance model. This is a hasty and guessing type of reading because of ineffective phonologic imprinting of letters.

Metaphor: Conferring meaning as an image (**similarity**).

Metonym: Conferring meaning from context (**nearness).**

Orthographic reading: Advanced reading of whole words and sentences without sounding out letters or words.

Phonologic awareness: Refers to a general appreciation of the sounds of speech as distinct from their meaning, for example, demonstrated in playing with sounds, appreciating rhymes and alliteration. **Phonemic awareness** when that insight includes an understanding that words can be divided into a sequence of phonemes. Neither term refers to any connection between spoken and written language.

Phonologic deficit: Perhaps the most influential and generally accepted hypothesis concerning the background to dyslexia. The phonological deficit hypothesis contends that dyslexics have difficulties storing and retrieving fully specified phonological representations.

Phonologic dyslexia: The phonological dyslectic, weak in letter-to-sound conversion rules, tries to read orthographically but falls short confronted with nonwords.

Phonologic script: Based on linkage between as such meaningless letters and different sounds.

Pictographic script: Originally based on **images,** i.e. similarity between word and denoted object, regardless of phonology.

P-type dyslexia: Perceptual dyslexia according to the balance model. Slow reading by sounding out each letter. Difficulty in engaging advanced language centres in the left cerebral hemisphere.

Reading: A kind of animism when marks on a surface could become messengers from worlds of love and hatred.

Second-order symbolism: Something stands for something else, as in playful activities when a stick becomes a horse, or writing when you draw oral speech.

Surface dyslexia: The surface dyslectic, weak at word specific information, tries to read phonologically and consequently falls short at irregular words.

CHAPTER 1

Introductory Survey. How to Understand Reading Acquisition and Reading Difficulties

1.1 Reading as Deciphering: The Jersild Dilemma

The initial process of literalisation can be conceived as a process of looking and searching for meaning, that is, a deciphering of visual stimuli in relation to spoken language. Is meaning supposed to be concealed in the grapheme as a pattern or a picture, in its auditive structure when pronounced or perhaps in its potential of combining into larger entities? Where can we find the meaning of written signs? Is it to be found somewhere in the audiovisual configuration or is it perhaps to be ascribed to the word in an active process? In a way this process is similar to the deciphering of script from ancient cultures. For example, how to read the Phaistos disc (Figure 1.1) and what does one need to know in order to be able to read it? Is it a calendar? Is it some sort of message? Where to start reading and in what direction? Are there pictographs or phonographs for sentences, words, syllables, letters or figures? And what is the language? These questions are still unanswered.

Incorrect hypotheses may lead one far astray and effectively block any decoding and understanding. For example, what kind of experience do you have in seeing people read or hearing people read and how do you conceive their activity?[1] What really are your hypotheses concerning reading when beginning to read? Is the individual prepared to change these hypotheses when proved wrong? "In each situation they (children) encounter, their understanding is both increased and constrained by their existing models of written language" (Snow et al., 1998, p. 44).

A central theme of the present study is the observation that letter writing (phonographic) in Western alphabetical script, perhaps as distinguished from Eastern picture writing (pictographic), demands a transformation in the perception of letters when hitherto meaningless graphic configurations are ascribed meanings in terms of sounds and words. When one is familiar with the

[1] I remember myself at about eight years of age asking my mother whether if I just learned another sound to the letters, would I then be able to speak English?

Figure 1.1. The Phaistos disc. This 3500 year-old Minoan disc has been subject to a multitude of interpretations. The script is still unread.

proceedings one tends to forget the bewildered beginnings. Tales of this confusion are told by, for example, the Swedish author P. C. Jersild:

> Then what was it messing things up? I now believe that it had to do with shape and sound. Letters to me in the first place were signs that reminded me of things, i.e. a kind of pictorial language. The letter *A* looked like a roof, *C* like a sickle, and *G* like a fishing hook. I was so busy finding similar associations for all the signs of the alphabet that I did not simply grasp that the Western alphabet was ordered according to a different basic principle. For instance, take the word DOG (*HUND* in Swedish) – in what way does it resemble a real dog? Not in any way. *H* looks like a stand for beating carpets, *U* like a horseshoe, *N* like the frame of a wooden gate, and *D* like an orange segment. (Karnstedt, 1991, p. 51, my translation from Swedish)

The Swiss psychoanalyst C.G. Jung (1999) tells of a similar experience in school when he found out that no one could understand his difficulties with symbols. The dyslectic around-the-world sailor Sven Lundin put it this way: "I could not learn what I could not understand". A seemingly natural proposition, but unfortunately the capacity of doing without understanding is a strategy not seldom forced in hectic schools. For example, in a study (Kronlund, 1996) of the relation between knowledge and marks in chemistry, a reversed relation was found, that is, those with weak knowledge had the best marks. Perhaps they had given up the time-consuming and "complicating" work of understanding. Marton, Dahlgren, Svensson, and Säljö, (1987) have pointed to the fact that many texts used in schools are of a kind that is impossible to understand in any deeper sense. The kind of acquired learning difficulty this may foster is seldom recognised and diagnosed.

There might be a parallel in modern physics, where models are not really understandable as describing reality but primarily judged as to their efficiency in "making things happen". The despair of a pedagogically motivated father when trying to explain maths, hearing his children argue, "but Father, we don't have time to understand this, we just have to do it", is perhaps explainable in this context, separating understanding from doing. One could also refer to the "black box" of Skinnerian psychology, overlooking mental processes.

Kullberg (1991) notes an "initial collision" crisis (p. 275) at the beginning of Grade 1 at the time of the initial development of the learning of letters and the initial sounding together of consecutive graphemes and phonemes. The difficulty seems to be for the eight children in the study to apply this principle in reading, "in using this knowledge and to 'carry' it along as a general principle in all reading" (p. 278).

> During this period of change, the eight children start to leave the group level of operation to become individuals in relation to their development in the written language. With this comes the concomitant change that the eight children put aside their belief that learning is coming from the outside and will in some magical way "plop into their heads"… As the outcome of the "initial collision" crisis, the eight children approach their learning in different ways, which also seem to include their own thoughts (theories) about their learning (Kullberg, 1991, pp. 276–277).

To exemplify the complexity met when trying to understand the function of letters, I present some possibilities in approaching the letter G:

G – just a silent and meaningless configuration
G – a riddle, meaning something
G – a fishing hook
G – a sign for a sound
G – part of the alphabet
G – part of a word
G – logo for a shipping company
G – a numeral

The point of departure of the present work is an acknowledgement (and in a way sharing) of this initial confusion of the potential reader. How can one make these strange marks on a sheet of paper come alive? Should they come alive as images/pictographs or as signs/phonographs, as sights or as sounds? Without arguing against the communicative aspect of written language, which is rather obvious, it might be possible to separate a decoding aspect. It is possible to read aloud a language you do not understand (e.g., Finnish) in a way that enables a Finnish-speaking person to understand what you say.[2]

An experienced student is even quite able to read without understanding. We all know that. And it is even possible to read aloud without actually listening to yourself, such as when reading stories for children. This "reading with-

[2] In a transparent orthography the grapheme-phoneme correpondences are reliable. In an 'opaque' orthography, characterising for example the English language, they are not (Goulandris 2003).

out listening" might be one crucial characteristic of deficient reading that the educational system does not give necessary attention to.

The Russian psychologist of the early 20th century, Lev Vygotsky, asked (1987, p. 202), "Why is written speech so difficult for the schoolchild?" He answered his question by referring to the following:

- The high degree of abstraction in written speech lacks all sound characteristics. "Written speech is speech in thought, in representations" (p. 202).
- The lack of an interlocutor. "It is conversation with a white sheet of paper, with an imaginary or conceptualized interlocutor" (p. 202).
- Inaccessible motives. "When he begins to write, the schoolchild does not sense the need for this new speech function" (p. 203).
- The need for volitional and conscious acts. "In saying a word, the child is not conscious of how he pronounces the sound. He does not intentionally pronounce each separate sound. With written speech however, he must become consciously aware of the word's structure. He must partition it and voluntarily recreate it in written signs" (p. 203).

> In summarizing this brief discussion of our study of the psychology of written speech, mental functions, which form written speech, are fundamentally different from those which form oral speech. Written speech is the algebra of speech. It is a more difficult and a more complex form of intentional and conscious speech activity. Two conclusions follow: (1) this explains the radical difference between the child's oral and written speech (this difference is a function of differences in the level of development required by activities that are spontaneous, involuntary, and without conscious awareness and those that are abstract, voluntary, and characterized by conscious awareness); and (2) when instruction in written speech begins, the basic mental functions that underlie it are not fully developed; indeed, their development has not yet begun. Instruction depends on processes that have not yet matured, processes that have just entered the first phase of their development" (Vygotsky, 1987, pp. 204–205).

When writing, the child translates some aspect of reality into spoken words (primary symbols), after which speech is translated into writing (secondary symbols). In advanced writing, spoken words vanish as mediators and the relation between written signs in the mind and written signs on paper becomes direct. According to Vygotsky (1987), to understand the development of literalisation, it is necessary to examine its sociogenesis, i.e. its relation to mental and physical reality. The "prehistory" of writing is outlined as follows: Through gestures and visual signs the child learns to substitute real objects for symbols. "Gestures, it has been correctly said, are writing in air, and written signs frequently are simply gestures that have been fixed" (Vygotsky, 1987, p. 107). "In general, we are inclined to view children's first drawings and scribbles rather as gestures than as drawings" (Vygotsky, 1987, p. 207).

> When asked to draw good weather, a child will indicate the bottom of the page by making a horizontal motion of the hand, explaining, "This is the earth," and then,

> after a number of confused upward hatchwise motions, "And this is good weather." We have had the occasion to verify more precisely, in experiments, the kinship between gestural depiction and depiction by drawing, and have obtained symbolic and graphic depiction through gestures in five-year-olds (Vygotsky, 1987, p.108).

Likewise, from playing the child learns how something can represent something else (e.g., a stick could exemplify a horse). Through play, the symbolic world of oral language is developed, an experience that could be transferred to writing. The symbols of play and writing are analogous. Vygotsky tried to experimentally establish this stage of object writing in children by letting objects become parts of play stories and found that most three-year-olds could easily read this kind of symbolic notation (Vygotsky, 1987).

The objects do not have to look like the thing they symbolise as long as they can be used to make the adequate gestures with. "The object itself performs a substitution function: a pencil substitutes for a nursemaid or a watch for a drugstore, but only the relevant gesture endows them with this meaning. However, under the influence of this gesture, older children begin to make one exceptionally important discovery – that objects can indicate things they denote as well as substitute for them" (Vygotsky, 1987, p. 109). A book can be a forest because it is dark, a bottle being the wolf has an opening, which is the mouth, and so on. The meaning of the objects can also be changed in new games.

Vygotsky, relating to Western alphabetic/phonographic writing, points to the necessity of a transition from drawing things to drawing speech as a transition to second-order symbolism, when something stands for something else, as in play activities. Consequently, he sees play as a major contributor to the development of written language, and in a way foreshadows the playing with language recommended according to the Bornholm method (Lundberg, Frost, & Petersen, 1988) in order to facilitate reading acquisition.

1.1.1 Reading trees or letters: Is a different type of attention necessary?

Decoding simply implicates the capacity to transform signs into language. You can decode without understanding but can you understand without decoding? Obviously not, it seems. But then decoding could be of a different quality and it is possible to guess on the basis of a very feeble decoding.[3] And even this "guessing capacity" could be of a very different quality depending on presumptions. The tendency to guess on the basis of a weak "guessing capacity" might characterise another way of reading not given necessary attention to in reading acquisition.

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[3] "I took a course in speed reading, learning to read straight down the middle of the page, and was able to read "War and Peace" in twenty minutes. It's about Russia." (Woody Allen).

That it is possible to understand despite weak decoding is demonstrated by clinical case stories of deep dyslexia due to brain damage (Ellis & Young, 1998). The emotional content or general character of words could be grasped even if they could not be read out loud.

Gough and co-workers (Gough & Tunmer, 1986; Hoover & Gough, 1990) have demonstrated that “empirically, we can progress surprisingly far by considering reading to be a product of decoding and listening comprehension” (p. 3). And further:

> In short, word recognition is the foundational process of early reading acquisition. Obviously, to emphasize the centrality of word recognition is not to deny that the ultimate purpose of reading is comprehension. Adequate word recognition ability clearly does not guarantee good comprehension. Nevertheless, while it is possible for adequate word recognition skill to be accompanied by poor comprehension abilities, the converse virtually never occurs. There is no known teaching method that has resulted in good reading comprehension without simultaneously leading to the development of at least adequate word recognition ability. Furthermore, an overwhelming amount of evidence indicates that the proximal impediment to reading in at-risk and reading-disabled children is difficulty recognizing words (Share & Stanovich, 1995, p. 3).

The centrality of the decoding aspect of reading is also emphasised by Witting (lecture, 1994). She tells about her astonishment when pupils with reading difficulties, when free to make their own choice, choose to work with pseudowords (meaningless but word-like). The form-emphasised step, the mastering of form, noted by Kullberg (1991) could be considered in this context.

> There is found to be a step in between the steps doing and knowing in which the children seem to have their total attention directed toward the form. This step is, for everyone, found in the initial learning of the letters of the alphabet. The children all seem to strongly emphasize the form aspect. For a short period of time they seem to be ‘blind’ to everything else. In this form-emphasized step, content and meaning in stories and texts do not seem to be important. What is important to the children in this in-between step is the mastering of the form (Kullberg, 1991, p. 301).

Separating form from content may be, at least to some, a facilitating step toward integrating these two aspects of written language in reading.

The decoding of letters represents a special problem for the beginning reader. Are the letters to be seen as separate entities or as parts, as pictographs or phonographs? And in which direction are you supposed to read? Ornstein (1997) points to the strange fact that almost all pictographic systems favour a vertical layout though most phonographic systems are horizontal.

> And out of several hundred phonographic scripts that have vowels, almost all are written toward the right, while out of fifty languages that do not have signs for vowels, all are written to the left” (Ornstein, 1997, p.37).

On the introduction of vowels, the Greek alphabet, originally being written from right to left, changed into being written from left to right over a period of

150 years when it was written in *boustrophedon* (like plowing, alternately right to left and left to right). Without vowels, the written language depends to a higher degree on previous knowledge as a text could have many different "solutions". There is evidence that reading historically was exclusively performed aloud and was perceived as something to defend oneself against, a sort of insult, a burglary into one's brain. And no knowledge was thought to come out of this activity as no dialogue could be held with script as with living individuals. Rather, there was a loss of the intimate qualities of oral communication (Svenbro, 1999)[4]. The very significant differences between orality and literacy have been analysed by Ong (1990) in his work on the technologising of the word. In this context one can recall the resistance against note reading on the part of the early jazz-musicians, as reading was supposed to affect their playing negatively. Even today many musicians try to avoid reading (and thinking) in order to really get into improvisation and the soul of music.

It is perhaps no coincidence that the concept of spelling could be used in magical contexts, such as in casting a spell and thereby causing someone to be bewitched, bothered, and bewildered.

> For to read is to enter into a profound participation, or chiasm, with the inked marks upon the pages. In learning to read we must break the spontaneous participation of our eyes and our ears in the surrounding terrain (where they had ceaselessly converged in the synaestetic encounter with animals, plants, and streams) in order to recouple those senses upon the flat surface of the page. As a Zuni elder focuses her eyes upon a cactus and hears the cactus begin to speak, so we focus our eyes upon these printed marks and immediately hear voices. We hear spoken words, witness strange scenes or visions, even experience other lives. As nonhuman animals, plants and even "inanimate" rivers once spoke to our tribal ancestors, so the "inert" letters on the page now speak to us! *This is a form of animism that we take for granted, but it is animism nonetheless – as mysterious as a talking stone*. And indeed, it is only when a culture shifts its participation to these printed letters that the stones fall silent. Only as our senses transfer their animating magic to the written word do the trees become mute, the other animals dumb. (Abram, 1996, p. 131)

The Swedish author Sara Lidman in *Before the word* (1988) makes a similar point describing how she abandoned her childhood conversations with a spruce tree when she started school. "...to read in a book would demand a different attention than I gave the tree – and how could I keep them apart? I had to choose between the consciousness (*sam-vett*) of the spruce – becoming like a tree (*förträdas*) – and learning the alphabet and becoming like people" (Lidman, p.10, my translation from Swedish).

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[4] White people, according to a Tohono o'odham (Papago, Native American) myth, were revived by an Indian hero. Because they had been dead for so long they had forgotten all they once knew and had to be endowed with reading and writing skills as means of assistance. Thus reading and writing were signs of the confused and ignorant character of the Europeans, secluded from self-knowledge (Wilson, 2001).

1.2 Reading Difficulties and the Question of Definition

The vast topic of reading difficulties is characterised by a series of interrelated questions and longstanding debates more or less clearly related to shifts in the general ideas about human nature and learning in society reflected in the debate on preferred methods in literacy acquisition. Lately, there are some signs of rapprochement between hitherto competing views. On a scientific level, in the words of Oliver Sacks: "It won't take long before you can identify the results of a successful psychoanalysis by PETscan" (PETscan: measurement of cerebral blood flow through Positron Emission Tomography; TV interview, 1998), and on a behavioural/educational level exemplified in the U. S. National Research Council report *Preventing reading difficulties in young children* (Snow et al., 1998) intended to overcome obsolete disputes and present a common view. There is a Swedish parallel in Myrberg, (2003).[5]

Central questions in the debate on reading difficulties include the following: Is it possible to differentiate between reading difficulties in general and specific reading difficulties (dyslexia)? If this is possible – on what grounds, and consequently, what are the causes?

Can reading difficulties be remediated? And if they can, how? And generally, what method should be used when learning to read in order to avoid the emergence of reading difficulties?

To begin with, the general question of how to learn to read has been highly controversial for decades. The "reading wars" (Share & Stanovich, 1995, p. 30) concern the meaning-oriented whole-word approach versus the phonics-oriented approach controversy of the 1970s modernised as the whole-language versus code-emphasis controversy of the 1990s. In short, learning to read synthetically, from parts to wholes – letters to words and sentences, or analytically, from wholes to parts – words and sentences to letters. In its crude form, this controversy implies that the advocates of each side portray the advocates of the other side in caricature and accuse them of being responsible for all the failures in reading acquisition. The Swedish variant of this controversy has been analysed by Hjälme (1999).

Are there special reading difficulties that can be differentiated from reading difficulties in general? The term dyslexia is sometimes used concerning these potential special reading difficulties and the somewhat pseudomedical connotations of this label have been questioned as has the validity of the distinction in itself. (For an overview of the multitude of dyslexia definitions, see, e.g., Hooper & Willis, 1989.) In 1968, the World Federation of Neurology defined dyslexia as "… a disorder manifested by difficulty in learning to read despite conventional instruction, adequate intelligence, and socio-cultural opportu-

[5] The report: "To establish consensus concerning actions of schools to counteract reading and writing difficulties". Twenty-four scientists participated in this project. Twenty-two researchers signed a common declaration of consensus whereas two did not agree.
One could comment that a rift in opinions in Sweden has appeared between researchers and practitioners rather than among researchers.

nity. It is dependent upon fundamental cognitive disabilities which are frequently of constitutional origin" (Tönnessen, 1995, p. 149). Annett (1985), exemplifying one kind of reasoning, based on the findings of Rutter, Tizard, and Whitmore (1970) and Rutter and Yule (1975), finds that the longstanding controversy concerning the existence of a "dyslexia category" has been solved in the affirmative.

> The children who were poor readers in relation to age and IQ, termed "specific reading retardates", were compared with children who were poor readers in relation to age but not in relation to IQ, termed "backward readers". They differed on several counts. The sex ratio differed such that there were 3.3 boys to 1 girl among the specific reading retardates and only 1.3 boys to 1 girl in the backward reading group. Signs of neurological disorder were more common in the backward readers, together with clumsiness and poorer performance on constructional tests (such as making shapes from matches). The groups also differed in educational progress as assessed at a follow-up examination 4 to 5 years after the initial assessment. The specific reading retardates had made less progress than the backward readers in reading and spelling, but they had made better progress than backward readers in an arithmetic-maths test (Annett, 1985, pp. 84–85).

Annett states her position as being that "there can be no further reasonable doubt that there are children with specific difficulties in learning to read among the many backward readers" (1985, p. 85).

This kind of discrepancy and IQ-related definitions have been questioned by, for example, Gustafson and Samuelsson (1999), who point out the problem of defining one fuzzy term (dyslexia) in terms of another fuzzy term (IQ). According to numerous studies, the correlation between reading ability and intelligence is in the range 0.30–0.40, which means that only about 10–15% of the variation in reading ability could be explained by the variation in intelligence (Höien & Lundberg, 1999). Further consequences of these definitions are that they leave out those with low IQ and those who are successful at compensating for their difficulties. Moreover, they tend to lead to an overestimation of dyslexia among adults whose social and educational conditions have been poor (Gustafson & Samuelsson, 1999). This last notion is central to the research on dyslexia diagnosis. Referring to studies of dyslexia among prison inmates and juvenile delinquents, Gustafson and Samuelsson conclude:

> However, in none of these studies have the phonological decoding skills of the subjects been compared to the skills of a relevant control group (i.e., a group matched on reading level). Thus, these studies cannot really conclude whether the reading difficulties found in their "dyslexic" subjects are caused by phonological deficits, which are assumed to be at the core of dyslexia, or if those reading difficulties are merely a consequence of the subjects' lack of experience with written language (1999, p. 129).

Höien and Lundberg (1999) compare the distinction between reading difficulties in general and special reading difficulties with the distinction between fat and thin people; there is no qualitative difference, the dividing-line depends on a more or less arbitrary decision. Their definition is the following:

> Dyslexia is a disturbance in certain linguistic functions of critical importance for a productive use of the principles of script when written language is coded. The disturbance is primarily expressed as difficulties in achieving an automatized word recognition during reading. It is also clearly manifested in poor spelling. The dyslexia disturbance often runs in families, and there are reasons to assume that a genetic disposition is involved. A characteristic feature of dyslexia is that it tends to persist. Even if reading eventually may be acceptable, spelling difficulties often remain. In a thorough mapping of the phonological skills these are often found to persist into adulthood (pp. 20–21).

And in a short form: "Dyslexia is a persistent disturbance of the decoding of writing caused by a weakness in the phonological system" (Höien & Lundberg, 1999, p. 21).

Höien and Lundberg's definition causes the present author to become somewhat confused as it talks about a weakness in the phonological system as a definite cause of dyslexia, but in the fat-thin argument, Höien and Lundberg (1999, p. 14) discuss a continuum with a haphazard dividing line between reading difficulties and special reading difficulties. Is not Figure 1.2 to be seen as questioning a definition in terms of a singular, more precisely defined cause of dyslexia? Is it at a certain level that the phonological weakness becomes fatal? But then is this not also a cause of reading difficulties in general and perhaps not just of dyslexia?

In an earlier definition Lundberg (1995) advocates a definition also involving orthographic processes: "Certainly phonological processes, not least as a mechanism of self-instruction, play a decisive role in the initial reading acquisition, but later orthographic processes containing inner representations of the spelling or the orthographic construction of words are also added. It is not impossible that dyslectics can be characterised by weaknesses of this system without the phonological system failing. Thus, there might exist distinct subgroups of dyslexia. But so far the efforts to delimit such groups have not been particularly successful" (Lundberg, 1995, pp. 39–40, my translation from Swedish).

The Orton Dyslexia Society Research Committee proposes the following working definition: "Dyslexia is one of several distinct learning disabilities. It is a specific language-based disorder of constitutional origin characterized by difficulties in single word decoding, usually reflecting insufficient phonological processing" (Elbro, Borstroem, & Petersen, 1998, p. 39).

It is the present author's opinion that the need to allocate resources to individuals with special educational needs in schools has given impetus to the development of a somewhat premature diagnostic "culture" in urgent need of, looking for and accepting simplified diagnostic criteria, not acknowledging the hypothetical character that is scientifically motivated (Tönnessen, 1995):

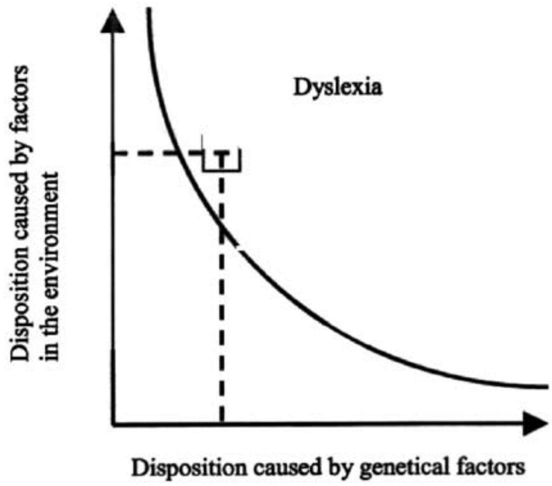

Figure 1.2. Environmental and genetic factors in relation to dyslexia (after Höien & Lundberg, 1999, p. 194).

> Determination of the extent of the discrepancy that serves as a marker for reading disability is not a psychological decision but a fiscal one, based on the amount of monies allocated to a school district in any given year. Because of this, the number of children identified as having reading disability can vary from year to year (Aaron, 1997, p. 41).

As to the related question concerning what grounds and causes there are for special reading difficulties, theories have been put forward ranging from biological/genetic to socio-emotional. In Sweden, one proponent of the former is von Euler (1992), asserting a frequency of 5–8% of the population having severe reading difficulties with a neurological/genetic background, and proponents of the latter view are Allard and Sundblad (1982), estimating this proportion to be some per thousand and asserting that most reading difficulties are of a psychological/pedagogical origin.

As to prevalence, OECD (1995) estimated that about 7.5% of adults in Sweden had functional and writing disabilities, i.e. they could at the most read well-structured and familiar texts, interpret simple documents, and perform easy calculations. Vellutino, Scanlon, Sipay, Small, Pratt, Chen, and Denckla (1996), using difficult-to-remediate as a criterion, found that only about one third of the 9% of the children identified as disabled learners could not be normalised with one semester of daily one-to-one special training; only one sixth of these children could be diagnosed as severely impaired (1.5 % of the total number of children in the population). Commenting on the Vellutino et al. study, Höien and Lundberg (1999) asked if these children had been advantaged by a reading method not particularly hard on phonetic skills.

Gough and Tunmer (1986), Hoover and Gough (1990) and Aaron (1997) propose a model (the simple view of reading) that classifies poor readers ac-

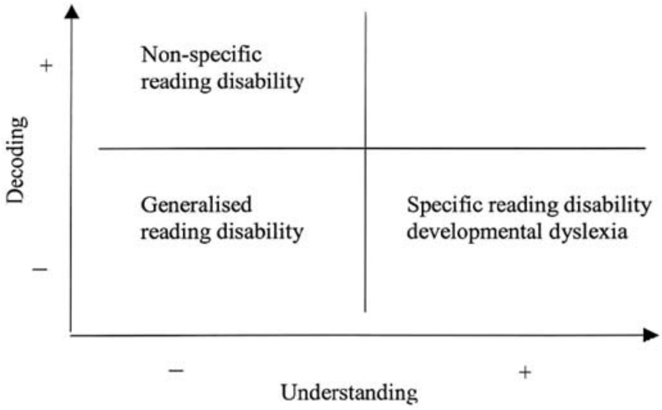

Figure 1.3. Subgroups of reading difficulties according to Aaron (1997). Decoding is defined as word decoding and understanding as listening comprehension.

cording to two components: comprehension and word decoding skills. Aaron proposes three subgroups of reading difficulties which should be treated differently (Figure 1.3).

Aaron (1997) finds support for the conclusion that listening and reading comprehension are very closely related skills. As reading comprehension must be influenced by decoding capacity, it is perhaps listening comprehension that is the most valid indicator in this categorisation system. It could be argued though that listening comprehension is passive and that reading comprehension is even more valid, as this skill, as a variable, might differentiate between those who can and those who cannot comprehend, despite weak decoding capacity. Valuable information might be found in the difference between listening and reading comprehension because this indicates poor word decoding. Otherwise, a potentially interesting aspect of the information-retrieving capacity of the individual in relation to script might be overlooked. If in Figure 1.3 understanding is defined as reading comprehension, the combination of adequate decoding and weak understanding in its strong form is labelled hyperlexia.

The generalised reading disability marked by deficits in both word recognition and comprehension skills is perhaps the most prevalent category of reading problems according to Aaron (1997). “A good deal of confusion exists in the dyslexia research literature because of failing to identify children belonging to this group and separating them from children with dyslexia” (p. 43). This specific reading disability/developmental dyslexia category is defined as deficient reading comprehension where there is adequate listening comprehension. Is there a problem with this categorising system that it does not show differences in reading comprehension within the deficient decoding category? Another question is why restrict the dyslexia label to specific reading difficulties? Those weak at understanding in spite of adequate decoding might constitute an important category in danger of being neglected.

Generally it seems constructive not to speak in reductionist terms but in terms of interweaving environmental and genetic influences resulting in dyslexia according to Figure 1.2., even if this simplified figure does not cover the environmental/genetic developmental dialectics over time. A small diversion in early development can give rise to a huge diversion later, seemingly of a very non-accidental, "genetic" character.

> … to render a diagnosis of specific reading disability in the absence of early and labor-intensive remedial reading that has been tailored to the child's individual needs is, at best, a hazardous and dubious enterprise, given all of the stereotypes attached to this diagnosis (Vellutino et al., 1996, p. 662).

The search for the ultimate cause of the problem, as well as treating special reading difficulties as a single category and talking about dyslexia in general terms, is perhaps misleading. Recognition of the existence of different kinds of difficulty could even help resolve some disputes, as different methods of reading acquisition and of remediation might apply to different individual needs. Gustafson and Samuelsson (1999) concluded the following:

> … it might be important to examine which word decoding strategy a particular child is normally using when he or she is reading, before planning and implementing a training program. The way a child is actually reading is much more directly related to the reading difficulties of that particular child than the problematic concept of "intelligence". Also, it should be much easier to find out the extent to which a child is using the two main reading strategies (the phonological and the orthographic) than to administer a complete standard test of intelligence with its numerous sub-tests (p. 132).

It also follows that decoding and comprehension difficulties might demand remediation with rather different foci.

In Sections 1.5.1 and 1.5.2 the definitions according to the dual-route and balance models are presented, and in the following chapters the themes of this introductory presentation will be dealt with in greater detail.

1.2.1 Phonological awareness and the phonological deficit hypothesis

As hypotheses concerning the background to dyslexia, many possible flaws have been suggested, including visual deficit, auditive deficit, and automaticity deficit. Perhaps the firmest, most empirically underpinned deficit is the phonological deficit hypothesis which points to the importance of grapheme/phoneme connections in order to be able to read successfully (Share & Stanovich, 1995. For a critical account see, e.g., Coles, 2000.)

The phonological deficit hypothesis has different expressions and is often linked to the concept of phonological awareness in slightly different ways. According to the National Research Council report (Snow et al., 1998), the term *phonological awareness* refers to a general appreciation of the sounds of speech as distinct from their meaning (e.g., demonstrated in playing with sounds, appreciating rhymes, and alliteration). When that insight includes an understanding that words can be divided into a sequence of phonemes, this fine-grained sensitivity is termed *phonemic awareness*, which corresponds to the insight that every word can be conceived of as a sequence of phonemes.

> Because of the physical and psychological nature of phonemes as well as the nature of human attention, few children acquire phonemic awareness spontaneously. Rather, attaining phonemic awareness is difficult for most children and far more difficult for some than others. Still, because phonemes are the units of sound that are represented by the letters of an alphabet, an awareness of phonemes is the key to understanding the logic of the alphabetic principle (Snow et al., 1998).

Lundberg, Frost, and Petersen (1988) order linguistic awareness into three categories: (1) the awareness of words, (2) the awareness of syllables and rhymes, and (3) the awareness of separate phonemes, that is, phonological or phonemic awareness. According to Gustafsson, Samuelsson, and Rönnberg (2000), phonological (or phoneme) awareness tasks measure the ability to explicitly focus and reflect on the sound structure of words.

There is evidence of a causal relationship between phonological skills and reading ability in that early training of phonological skills affects later reading skills positively (e.g. Lundberg et al., 1988). Under the heading "Good phonic instruction should develop phonological awareness", Stahl, Duffy-Hester, and Dougherty-Stahl (1998) made the following point:

> The key to the development of the alphabetic principle, word recognition, and invented spelling is phonological awareness. Phonological awareness is one of the most important concepts to arise out of the past 20 years of research in reading (Stanovich, 1991). Phoneme awareness is the awareness of sounds in *spoken* words (p. 340).

Muter and Snowling (1998) showed that rhyme and phoneme awareness are independent skills. Tests of rhyme discrimination proved to be poor long-term predictors of reading accuracy, whereas phoneme awareness was found to be a very powerful predictor of reading accuracy. A puzzling finding was that nonword replication at the ages of 5 and 6 functioned as a good predictor in the long run at the age of 9 but not early in the development of reading in the first two years at school. Muter and Snowling speculated the following:

> … in the early stages of learning to read, access to critical phonemic segments in spoken words (e.g., initial and final phonemes), combined with letter knowledge, suffices to establish primitive mappings between printed and spoken words. At a later stage, access to more precise phonological representations is required to create complex mappings between orthography and phonology. It is at this stage that nonword repetition appears to be a predictor of the ease with which such fine mappings are established (1998, p.333).

Gustafson, Samuelsson, and Rönnberg (2000), in a longitudinal intervention study of poor readers in Grade 4 receiving phonological awareness instruction during one year, found no improvement in reading skills compared with controls, although phonological awareness was enhanced. The phonological tasks in the study of Gustafson et al. were rhymes, position analysis, subtraction and addition of sounds, segmentation, blending, and accentuation. Speculating on reasons why kindergarten children according to other studies benefit from phonological awareness training in contrast to these 10- to 11-year-olds, they discuss, among other things, the possibility that an integrated, relied-upon orthographic strategy could have become an obstacle for some. In re-analysing the results they found that phonological training for some children indeed helped to improve their reading considerably, whereas others were resistant to this training in terms of effects on reading. They found a remarkable difference between these two groups. For those improving from phonological training, both orthographic and phonological word decoding skills contributed to text reading ability, whereas those who did not improve continued to rely on orthographic decoding although their phonological awareness had increased.[6]

Neither the phonological awareness nor the phonemic awareness, by definition, include phoneme/grapheme connections or any contact with script whatsoever. What is concerned is metalinguistic skills and the capacity to relate to the sounds of oral language. The crucial capacity to connect oral and visual language is not involved. It is presumed that, for example, the ability to differentiate between the sounds of speech will make it easier to learn to read. But if the problem (for some at least) is not metalinguistic skills or the partitioning of oral language but their main difficulty lies in the transition from oral to visual language, then this kind of training might be less effective. "Just measuring how many letters a kindergartner is able to name when shown letters in random order appears to be nearly as successful at predicting future reading, as is an entire readiness test" (Snow et al., 1998, p. 113).

According to Höien and Lundberg (1999), the definition of dyslexia explicitly states that a weakness of the phonological system is the cause of the problem. The Gustafson et al. findings indicate that phonological training might not be useful in certain cases that make limited use of the phonological strategy. Alternatively, is this orthographic strategy to be seen as a compensation strategy because of weak phonological skills? Muter and Snowling (1998) note that many studies have demonstrated "a close and probably causal link between early phonological awareness and beginning literacy. However, an unresolved issue concerns the mechanism that accounts for the relationship of phonological skills to learning to read."(p. 320).

Concerning growth rate in word decoding for both dyslectic and normal readers, Jacobson and Lundberg (2000), found surprisingly weak predictive

[6] These results seem relevant when comparing results deduced from the balance model (Bakker, 1979; see Section 1.5.2) according to which P-dyslectics (perceptual dyslectics) might improve from training of this kind but L-dyslectics (linguistic dyslectics) do not.

power in phonological skills estimated in Grade 2. They comment: “It might also be the case that phonological skills in children who already know the basics of reading have less predictive power for further reading development than an early assessment of phonological skills prior to reading instruction and before the alphabetic code is broken” (p. 293).

Also commenting on the predictive power of phonological awareness, Snow et al. (1998) expressed the following view:

> When classificatory analyses are conducted, phonological awareness in kindergarten appears to have a tendency to be a more successful predictor of future *superior* reading than of future reading *problems*. That is, among children who have recently begun or will soon begin kindergarten, few of those with strong phonological awareness skills will stumble in learning to read, but many of those with weak phonological sensitivity will go on to become adequate readers (p. 112).

In a critical review of the experimental methodology in phonological awareness research, Troia (1999) concluded that metaphonological training could improve phonological awareness skills and literacy acquisition, although he found serious methodological flaws in all the 39 studies he examined. He also drew the conclusion that the durability of treatment effects must be more convincingly demonstrated and notes that phonological awareness training does not advantage all children.

Lundberg and Höien (1990) compared dyslexic 15-year-old students with an age-matched group of normal readers and a reading-level matched group of young, normal readers (about 9 years old) and found that most dyslexics read nonwords much more slowly and with far more errors than the reading-level-matched much younger students. Relating this study, Lundberg and Höien (1997) make a significant conclusion relative to the present study: “(t)he fact that the two groups read real words equally well indicates that dyslexic children may use an alternative strategy for identifying words, perhaps relying more on orthographic patterns in a compensatory way” (p. 23).

If there are different possible reading strategies, are these compensatory or is there a common underlying causal factor? (This question is further discussed in Chapter 5). Could this common factor be conceived of as a metaphor competence, a second-order symbolistic capacity, according to Vygotsky (see Section 1.1), or a linguistic awareness? It must be kept in mind that phonological awareness training has nothing to do with real reading in the sense that the language processing is still auditive and not script-based or visual. It represents a pre-stage of reading in making language an object of analysis, separating form and content and objectifying it. Some people benefit from this. But again, which people resist, and do some even react negatively? If growing literacy is seen as a change in the perception of language from hearing (but at the same time looking at the speaker to see what he/she means) to just seeing, then this visual language must initially depend on auditive cues becoming visual cues. Deaf persons demonstrate that it is possible to bypass this “auditive stage”. Why some do resist is really a very appropriate question. Do they try to solve the alphabetic cipher in unproductive ways? Or, are they weak in certain respects, such as in phonological awareness?

The not unequivocal results regarding the phonological deficit hypothesis (e.g., some gain from training whereas others do not) give rise to speculations. If one supposes that children have different inclinations already from an early age to use a leftward or a rightward oriented hemispheric strategy, one can suggest different possible hypotheses. The leftward oriented might be advantaged by an orthographic training initially but when their phonological strategy is developed, they do not react to this kind of training anymore. The rightward oriented, on the other hand, might be advantaged by phonological training initially but not later. In line with the balance model (Bakker, 1979; Kappers, 1997; see Section 1.5.2) perhaps the positive effects of a hemisphere shifting technique in remediation could be explained in this way.

Larsen, Höien, Lundberg, and Ödegaard (1990) demonstrated in an MRI (Magnetic Resonance Imaging) study a relation between phonological problems (in nonword reading, phoneme segmentation, and phonemic synthesis) and symmetry of the planum temporale. In their study of 19 dyslectic children, 13 were symmetric and 6 asymmetric, whereas in the control group of 18 matched normal readers, 4 were symmetric and 14 asymmetric. The eight with the most serious phonological difficulties all had symmetric planum temporale, an in-between group with both serious phonologic and orthographic problems had mostly symmetric plana and the few dyslectics without serious phonological problems had a tendency toward asymmetrical plana. Two children in the control group with symmetric plana demonstrated notable problems in nonword reading and phonemic segmentation.

What could be the rationale for the phonological problems of the symmetrical brain? As the symmetry of planum temporale is a result not of a constricted left area but of a more extensive right area, one could speculate about a possible conflict between an extended language area in the right hemisphere and the necessity of eventually establishing written language in the left “language” hemisphere, where motorics of speech are localised (Donald 1993).

Do the phonological problems of children with symmetrical brains implicate that language will be developed also in the “language areas “ of the right hemisphere (see Section 1.3) but in a pictographic way, as that is the main functioning of that hemisphere – wholeness, here and now, weak memory and weak articulatory rehearsal loop – as phonology is strongly lateralised to the left hemisphere (Donald, 1993). Consequently, these children need phonological training. But do they resist or not? Or is it a reasonable conclusion that this kind of training is not suitable even in kindergarten for certain children. Could phonological awareness training restrain them from the necessary stage of visual imprinting of letters and foster a guessing strategy?

This emphasis on phonological processing skills as a constitutional factor underlying dyslexic problems does not, however, rule out the possibility that there exist other factors that can account for reading disabilities. One such factor is the ability to form, store, and access visual/orthographic representations, that is, print-specific information, when recognizing words (Samuelsson, Gustavsson, Herkner, & Lundberg, in press).

1.3 The Neuropsychology of Reading

Historically, the interpretations of brain functioning in special reading difficulties (dyslexia) have been marked by the general ideas concerning the functioning of the brain – from very specialised theories about the localisation of different capacities to very broad theories of a brain functioning as a whole with almost unlimited capacities to compensate for damaged areas.

Phineas Gage, who in an accident in 1848 got an iron bar through the frontal areas of the brain, was known to have completely recovered at the beginning of 1849. This case was seen as a living example of how unnecessary were the frontal lobes or at least of how easily these functions could be compensated for by other parts of the brain. In relating this event, Oliver Sacks (1995) noted that it was 20 years before the important personality changes really characterising Gage were acknowledged. New ideas on higher layers of the brain managing or inhibiting lower ones had been put forward, permitting another view on the effects of the accident.

At the time of this accident, the brain was considered as undifferentiated as the liver. This, in turn, was a reaction against the phrenology of the first half of the century, which ascertained that specific intellectual and moral capacities had very precise localisation in the brain. These hypotheses of either a specialised or a general brain functioning have prevailed until now, taking more or less antagonistic forms[7].

During the latter half of the 19th century, Broca in 1861, in the search for specific neuroanatomical structures for language, described expressive aphasia linked to a specific area where he supposed language to be independently located, as damage here only affected language. It soon became clear that reading and writing could be damaged independently of spoken language and consequently ought to have separate localisation, i.e. there had to be brain areas for coding of graphemes independent from their phonetic expressions. Wernicke in 1874 described another type of aphasia (fluent aphasia) caused by damage in another area of the brain than Broca's. In Wernicke's area, the sound impressions of language were assumed to be stored and transferred to

[7] Answering a question concerning the connection between word blindness and the inability to recognise faces, Peter Gärdenfors, specialising in research on cognition, stated: "No, there is no such connection, as the inability to recognise faces is localised in the right side of the brain while language functions mainly are situated in the left side of the brain" (TV program Nova, January 14, 2002, my translation).

Broca's area where they could be transformed into speech. He also alleged contacts with other receiving areas for language in a rather complex model consisting of several systems in which damage to different pathways could result in different types of aphasia. This model is still referred to (Donald, 1993). Yet, it must be noted that the areas are not very precisely defined: "it is well known that there is controversy over exactly where these regions are" (Ellis & Young, 1998, p. 357)

Gestalt psychology in the 1930s and 1940s marked the return of the holistic view. Thought and language, which were seen as functions of the brain as a whole, were reflected in hypotheses concerning a general intellectual ability that could be affected by damage to the perceptual and motor systems of the brain. The standpoint of Wernicke was reborn with Geschwind (Geschwind & Levitsky 1968), who found neurological proofs of localisation of different kinds of disturbance.

"The causes behind this conflict lie deep, as deep as the philosophical basis of neurology" (Sacks, 1995, p. 37). The human perception of the world was seen as the reception of integrated pictures versus integrating different aspects of the world that are perceived as separate qualities (e.g., supposing modules for the visual monitoring of bodily movements, identification of faces and melodies, or for more specified aims such as colour or degree of leaning; Donald, 1993).

Donald (1993), interested in understanding the evolutionary perspective of language, proposed that language might have its origin in some rather simple evolutionary innovation. One could hardly conceive, though, the reading and writing brain as an evolutionary product, rather that the brain confronted with these challenges draws on capacities developed serving other functions. If the semiotic capacity (the capacity to use signs to communicate thoughts) is older than spoken language, is it possible when it comes to developing and interpreting written signs to talk of a return to this older system in pictorial writing? Difficulties then may develop when confronted with the alphabetical/phonetical systems utilising a completely different code. Jensen (2000) proposes that "the causes of dyslexia must have existed before man was even trying to read or write. In this aspect, what we call dyslexia might just be one part or one effect of something else and should not be described as difficulties with lexical tasks solely, i.e. specific reading and writing impairments" (p. 3).

Recently, Dick, Bates, Wulfeck, Utman, Dronkers, and Gernsbacher (2001) have shown that conditions often found in aphasia can also be observed in neurologically healthy individuals under stress. In contrast to the view of the brain as a highly differentiated organ with considerable division of labour between regions, Dick et al. offered the following alternative:

> Just as the giraffe has achieved its ability for high leaf eating through quantitative adjustments in a neck that continues to carry out the basic sensorimotor functions (e.g., swallowing, breathing, holding, and moving the head), the human brain may

> achieve its specialization for functions, such as language through quantitative adjustments to cortical and subcortical regions that continue to carry out the basic sensorimotor functions for which they originally evolved. If this vision of evolution is correct, then we should not expect to find complex functions such as grammar within any single, bounded, and compact region of the brain. We should instead expect to find that many different regions of the brain participate in this function, even though each region may participate in a different way, making a different kind of contribution (2001, p.784).

The authors note that even if a flat tire makes steering almost impossible, it is a bit hasty to think of air pressure in the tires as the steering mechanism.

Öhman (2000) points at the circular definitions of linguists looking for structures (e.g., innate grammars) that they themselves have superimposed on the language under study. Dahlin (2001) notes a similar tendency in psychology of, for example, reifying the schema concept and consequently looking for physiological correlates of analytic categories: "…the hypothetical character of the concept has been forgotten, or at least neglected. It is now more or less taken for granted, at least in educational circles, that schemata exist " (p. 1).

Acknowledging this risk of circular reasoning, could there be certain characteristics of written language related to the more general functioning of the central nervous system? In a study employing diffusion-tensor magnetic-resonance imaging (DTI), Klingberg, Hedehus, Temple, Saltz, Gabrieli, Moseley, and Poldrack (2000) investigated the microstructural integrity of white matter in adults with poor or normal reading ability. The DTI technique, unlike the standard magnetic resonance imaging technique (MRI), allows measurement of the microstructural features of white matter.

> In white matter of the brain, diffusion of water perpendicular to the direction of the axons is restricted by the myelin sheath and cell membrane such that diffusion will be greater along the length of the axon than perpendicular to the axon. Anisotropy is a measure that quantifies the degree to which diffusion differs in the three dimensions (Klingberg et al., 2000, p. 494).

Increased myelination, (i.e., increased fat layers around axons) is associated with greater anisotropy. To test the hypothesis that reading deficit in dyslexia is related to a structural disturbance of the white matter tracts connecting anterior and posterior cortical regions, Klingberg et al. (2000) studied six adults with poor reading skills and a history of developmental reading disorders and eleven control adults with no history of reading problems.

The results were as follows: (1) Subjects with reading difficulty exhibited decreased diffusion anisotropy bilaterally in temporo-parietal white matter. Axons in these regions were predominantly anterior-posterior in direction. (2) White matter diffusion anisotropy in the temporal-parietal region of the left hemisphere was significantly correlated with reading scores within the reading-impaired adults and within the control group. From these results, Klingberg et al. (2000) reached the conclusion that the group differences were bilateral but that the reading scores correlated only with the left hemisphere anisotropy reflected the critical role of that hemisphere in language. "The significance of the right hemisphere difference, if any, is presently unknown" (p. 497).

As in the present study a possible right shift of hemispherical activation in reading acquisition and the coordination between the hemispheres in reading will be discussed, it is interesting to note the bilaterally decreased anisotropy in reading difficulty.

The Klingberg et al. (2000) study further supports the conceptualisation of dyslexia, emphasising the continuity across normal and dyslexic readers rather than the differences:

> By this view, reading difficulty becomes apparent when white matter integrity falls below some threshold. The finding of a correlation of white matter microstructure and reading in both poor and normal readers does not exclude the possibility of a discrete neurological insult affecting white or grey matter in dyslectic subjects. However, the present findings show that it is not necessary to presuppose such an insult in order to explain the deficits in reading (p. 498).

A crucial condition sometimes neglected in neuropsychological studies of reading difficulties is the features of the non-reading, non-alphabetical brain as a necessary control. The difference between illiterate (not including dyslectically or functionally illiterate) and literate persons was studied by Castro-Caldas, Petersson, Reis, Stone-Elander, and Ingvar (1998) and Petersson, Reis, Askelöf, Castro-Caldas, and Ingvar (2000). The participants were all inhabitants of a small town in Southern Portugal, where in the past it was seldom possible for parents to send all their children to school. The eldest girl had to take care of younger siblings and was engaged in household activities with no possibility to learn how to read and write.

At the behavioural level, the results of these studies demonstrate that illiterate subjects had more difficulty repeating pseudo-words correctly as compared with literate subjects. Measuring the regional cerebral blood flow (by PET), the two groups were found not to activate the same neural structures. During repetition of real words, they performed more comparably and activated similar areas of the brain. In the pseudo-words versus word PET comparison, literate participants activated several regions, including the left anterior cingulate, right frontal operculum/anterior insula, left lentiform nucleus, and anterior thalamus. This pattern of activation was not seen in the illiterate group. In contrast, the illiterate participants activated the right middle frontal/frontopolar region, an activation not seen in the literate group (Castro-Caldas et al., 1998): "The results of this study are consistent with the hypothesis that absence of knowledge of orthography limits the ability of illiterate subjects to repeat pseudo-words correctly, and that this inability is related to failure to activate an adequately configured neural network" (p. 1060).

The above results give an intriguing perspective to the notion that dyslexic problems often manifest themselves in difficulties in reading pseudo-words

(Elbro, Borstroem, & Petersen, 1998) and actually can be caused by phonetic deficits or “weakness of the phonological system” (Höien & Lundberg, 1999, p. 21). Selective impairment in nonword reading relative to reading words is central in phonological dyslexia (e.g., Coltheart, Curtis, Atkins, & Haller, 1993). The question must be asked, then, if this impairment is a problem of illiterates as much as of dyslexics. ‘Why do some remain partly illiterate?’ perhaps ought to be a question as relevant as ‘why do some become dyslectic?’

Ljungberg (2001) points to the huge mass of documentation concerning the possibility of causal relations working in opposite ways. “Even if it is possible in certain functional deficiencies to show changes in functions in certain regions of the brain, this does not make it possible to a priori decide whether these changes are caused by or are causes of the functional deficiencies of the individual” (p. 7, my translation from Swedish).

When it comes to drawing conclusions concerning the neuropsychological characteristics of dyslectics, one is faced with the necessity of deciding which are the causes and which are the effects of not reading. Which characteristics just coexist with dyslexia? For instance, instead of being an indication of phonological problems leading to dyslexia, the pseudo-word problem could be a result of the illiterate individuals’ lack of experience in mentally seeing the words, relating sounds to graphs (decoding) and thus also remembering the pseudo-words more easily. This is a hypothesis supported by De Graaff’s (1996) findings, which suggest “that the mode of processing in reading unfamiliar words is different to that engaged when reading familiar words in the first stage of learning to read, whereas in later stages both familiar and unfamiliar words appear to evoke a similar mode of processing” (p. 145).

In this context it is notable that kindergarten interventions aimed at problems with phoneme analysis have given substantial results regarding phonological decoding of pseudo-words, but less pronounced ones for decoding of real words (Elbro et al., 1998) and that there is a difference in prognostic power of nonword repetition as mentioned earlier.

Analogously, a demonstrated difference in cerebral blood flow between normal readers and dyslectics could be an effect of differences in reading experience and thus might have nothing to do with dyslexia or causes of dyslexia. Likewise, it is of course not sufficient to demonstrate the existence of specific brain structures in dyslectics without accounting for the frequency of these anomalies in the general population. For example, hemispherical symmetry may be a characteristic of about 30% of the general population (Annett, 1985, p. 48; Van Strien, 1997, p. 99) and could then hardly do as a sufficient diagnostic criterion of dyslexia among some 1.5% of the population.[8]

[8] When treating the topic of hemispherical symmetry/asymmetry, one must also consider the often overlooked prevalence of “reversed brains”, which refers to individuals having their language centres localised in the right hemisphere and those with bilaterally localised language (Blakeslee 1986).

1.3.1 Gender differences

Shaywitz, Shaywitz, Pugh, Constable, Skudlarski, Fulbright, Bronen, Fletcher, Shankweller, Katz, and Gore, (1995), in a functional MRI study, found that during phonological tasks (rhyme judgements) male brain activity was lateralised to the left inferior frontal gyrus region, whereas female brain activity was very different, involving both the left and right inferior frontal gyrus. "Our data provide clear evidence of a sex difference in the functional organization of the brain for language and indicate that these variations exist at the level of phonological processing" (p. 607). These results can be related to the often noted (but more and more challenged) ratio of boys to girls diagnosed as dyslectics, ranging from 2:1 to 5:1 or higher (Annett, 1985; Snow et al., 1998) and also the fact that girls are ahead of boys in reading acquisition (e.g., Jacobson 1998; see also Chapter 2 and Appendix B of the present study).

Another significant and notable finding in many studies in different cultures is that women outscore men on the Digit Symbol subtest in the Wechsler Intelligence Scale (WAIS-R) (Alm, 2004). This is true both for "children and adults, and for typical and clinical samples" (Alm, 2004, p. 329). While waiting for further clarification of the relations between these neuropsychological and behavioural findings in trying to understand reading difficulties, it seems to be motivated to pay special attention to gender differences.

1.3.2 The language of the hemispheres

Bogen (1985) tested the ability of split-brain patients to draw with either hand. In split-brain patients the Corpus Callosum (the bridge between the hemispheres) is sectioned to avoid, for example, the spread of epileptic seizures. The right hand, corresponding to the left hemisphere, can reproduce individually (i.e. one-by-one) most of the characteristics of the model to copy, possibly in a time sequence that becomes totally unintelligible when viewed as a picture. But the right hand can write down a word. The left hand, corresponding to the right hemisphere, can reproduce pictures as wholes. And it can do some writing but obviously with more "pictographic qualities" (see Figure 1.4).

The outcome of two decades of split-brain research suggests that the left hemisphere is better at solving problems in a time sequence while the right hemisphere is best at solving problems here and now in a holistic way (Ornstein, 1997). This result also could be discussed in philosophical terms: the left hemisphere being "Western" in a cause-and-effect analysis of time sequences and the right hemisphere being "Eastern", seeing things happening at the same time but at different places. Split-brain research is in a way similar to the Zen Buddhist *koan* ("impossible task") of listening for the sound of applause from just one hand. Possible effects of interhemispheric support and/or inhibition may be disregarded (Ellis & Young, 1998). This problem has, for example, been discussed by Coltheart (2000), who defends the idea of deep dyslexia

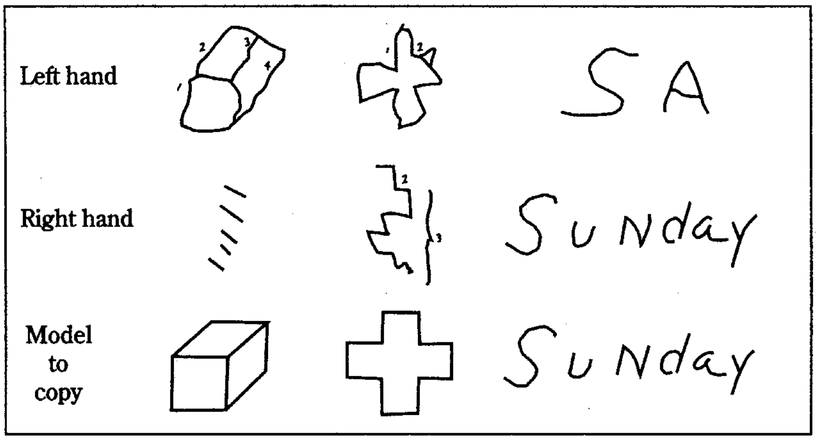

Figure 1.4. Right and left hemisphere copying (from Ornstein, 1997, p. 69).

being right-hemisphere reading against a hypothesis proposing that this kind of dyslexia results in reading aloud with the damaged left hemisphere.

Regarding the balance model of Bakker (1979) (see Section 1.5.2), there is also a similar question whether an L- or P-type dyslectic is characterised by a weak left or right hemispheric capacity or by weak support/inhibition from the contralateral hemisphere. In the present study this reasoning about the functioning of the hemispheres in Chapter 6 will be related to the analysis of disturbances found either in the similarity or the context construction of the meaning of language (Jakobson, 1974).

Identifying the meaning of words must include decisions concerning their emotional significance. In the present context the question is raised whether this capacity is hemisphere-specific, as the use of anxiety-laden words in dyslexia remediation has been shown to stimulate the right hemisphere (Van Strien, Stolk, & Zuiker, 1995). According to Jaynes (1976), the identification of emotions in visual images (e.g., faces) also depends on right-hemispherical processing (see Figure 1.5).

When focusing on the centre of the face, the half fields of the face are projected on the contralateral hemispheres (see Figure 1.6). In most cases the emotional expression of the face is identified by only one of the hemispheres. Mirror-changing the faces below (Figure 1.5) changes the perceived emotional expressions: the one looking sad now seems happy and vice versa.

The limited focus field of each eye connects to both hemispheres but the fields on both sides of focus connect only to the contralateral hemisphere.

Most subjects report the emotional characteristic of the left half of the face, whereas a smaller number report the right half emotion; finally, some people report both faces as the same, and often as being sad or confused. It is remarkable that these characterisations are stable over time, indicating that the left hemisphere does not "learn from the right hemisphere" but remains unable to

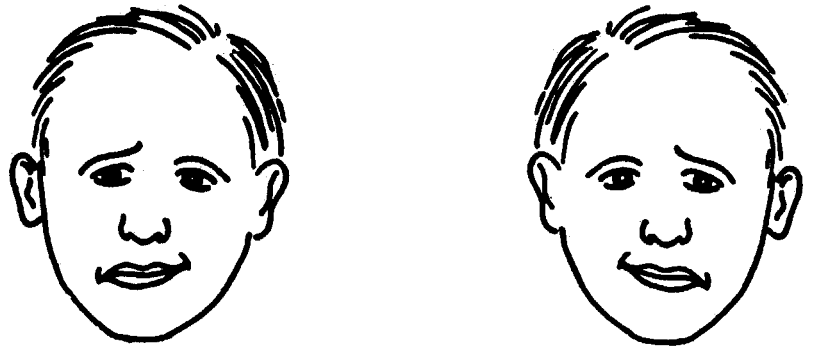

Figure 1.5. Sad or happy? (After Jaynes, 1976).

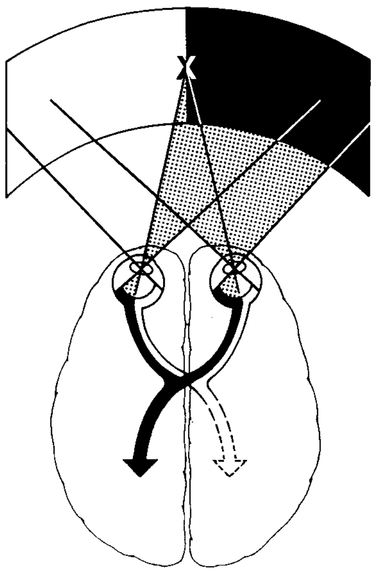

Figure 1.6 . Crossed relationship between left visual field and right hemisphere (the “white” tract) and right visual field and left hemisphere (the “black” tract) (after Levine in Bakker, 1990).

identify emotions even though it has to report them verbally (vocomotor behaviour being managed by the left hemisphere [Donald, 1993]). Very speculatively, the silence of the written language, could in a certain sense be compared to the silence of faces characteristic of autistic disorders or the loss of meaning in certain contexts that are connected to traumatic experiences. Is it the right “emotional” hemisphere that is silenced? [9]

Sacks (1987) tells about his aphatic patients (left cerebral damage) laughing at a speech of President Reagan, reacting to the false gestures and tones, while the agnostic patients (right cerebral damage), lacking capacity to decide on the

[9] There is a second visual system transmitting information to the cortex through the brainstem and the thalamus: the tecto-pulvinar system. This system handles rapid recognition and localisation of new and movable stimuli such as lightning (Donald, 1993).

emotional character of the speech, came to the logical conclusion that the president had something to hide.

Blakeslee (1986), referring to Pirozzolo (1977) and Kershner (1972), reports that when faces and words are rapidly shown in the half-fields, faces are more exactly identified when presented in the left half-field and words when presented in the right half-field. The incorrect answers in the left field are characterised by words looking alike – the right hemisphere perhaps remembering words visually. Incorrect answers in the right field sound alike – the left hemisphere tending to remember words auditorily.

Jakobson (1990), quoting Balonov and Deglin (1976, only available in Russian) says:

> During the inactivation of the right hemisphere, the noise of an applause was actually taken for the winnowing of grain, laughter for crying, a thunderstorm for an engine, the squeal of a pig for the noise of a Caterpillar tractor, the honking of geese for the croaking of frogs, a dog barking for the cackling of hens, the noise of a motorcycle for that of an animal. (pp. 503–504)

Exclamations of an emotional character and emotional characterisation in general are also mediated through the right hemisphere. When inactivated, the capacity to deduce from pictorial symbols vanishes, as does the ability to construct a wholeness from a part, for example, a person from just hearing the voice (Osolsobé, 1967; Balonov, Barkan, & Deglin 1979, only available in Czech or Russian, referred to by Jakobson, 1990). Inactivation of the left hemisphere especially affects the verbs with the exception of exclamations, while nouns in the nominative out of context seem to be controlled by the right hemisphere.

One could argue that the differences between the hemispheres as exposed in the half-field studies are rather limited. Ornstein (1997), however, questions this proposition:

> If you had two stations that could receive the same television program, where Channel 1 receives it perfectly 100 percent of the time and Channel 2, 83 percent of the time, you'd *always* tune in to Channel 1. We use the best of what we have. But if Channel 1's system went down, you'd just switch to Channel 2 with the remote. Similarly for the body: The left and right hands aren't completely different, of course, in writing ability, but a right-hander would never use the left if she didn't have to...There exists a bodily "winner take all". So if one hemisphere is "only" 20 percent better than the other at spatial locating, face perception, movement perception, or noun identification, this small difference will give rise to a big difference in how it's used in normal practice. *This* is the difference between biology and physiology. An accountant who makes 20 percent fewer mistakes or a chef who prepares meals 20 percent more to our taste will be selected much more than their strict mathematical advantage would predict. (p. 15)

1.4 Phonographic and Pictographic Script

1.4.1 The example of kana and kanji

It has been suggested by Frith (1985) that the low frequency of dyslexic problems in Japan was due to the pictographic Japanese script. Snow et al., (1998) state:

> (i)nstruction in alphabetic literacy, particularly regarding the correspondences between letters and phonemes, in turn appears to facilitate further growth in phonological (especially phonemic) awareness. That is why adults from nonliterate societies and students who learn to read nonalphabetic languages exhibit much weaker levels of phonological awareness than do readers of alphabetic languages. (p. 56)

Other researchers have reported otherwise and found dyslexia prevalence in accordance with the Western figures among Chinese and Japanese children (Hirose, & Hatta, 1988).

There are two types of non-alphabetic symbols in Japanese orthography. *Kanji* are essentially non-phonetic pictographic symbols and *kana* are phonetic symbols for consonant-vowel type syllables that are similar to letters (Hatta, 1977b; Sasanuma et al., 1977). There are two different sets of *kana* symbols, *hirakana* and *katakana*. *Kana* letters are recognised more correctly in the right visual field (corresponding to the left cerebral hemisphere) than in the left visual field (corresponding to the right cerebral hemisphere); *kanji* letters are recalled (non-significantly) better from the left visual field than from the right (Hatta, 1977b).

Studies (Sasanuma, 1977) of aphasic patients have shown that there are a sizeable number of patients who exhibit selective impairment of *kana* processing in which the ability to process *kanji* is relatively well preserved or almost intact in contrast to the severe impairment in *kana*, whereas there are some rare patients who show selective impairment of *kanji* but remarkable preservation of *kana* processing. It has also been observed that even in patients with global aphasia (with severe impairment of all language modalities including reading and writing) the ability to match some high-frequency *kanji* words to corresponding pictures is sometimes retained. Furthermore, analyses of errors of *kana* and *kanji* processing in these and other types of patient have often disclosed that the strategies used for decoding the two types of symbol are different, i.e., there is a visual (or a direct graph-meaning) processing for *kanji* in contrast to a phonological (or an indirect graph-phoneme-meaning) processing for *kana* (Sasanuma, 1977). Sasanuma also reported that there are many adult readers who introspectively claim to be "visual" readers of *kanji* characters in the sense that they extract semantic properties of lexical items written in *kanji* directly from the graphic symbols without any phonological mediation.

A methodological consideration concerning these early half-field investigations is that the method used to assure fixation "in the middle" when presenting stimuli in the right or left visual fields is rather tricky. In Sasanuma (1977), Arabic numerals from 0 to 9 were randomised and printed (1 cm high) at the fixation point of each card preceding the stimulus. The numerals had to be correctly reported together with the actual stimulus. This procedure might have induced a set in the sense that the numerals evoke a heightened responsivity in the left cerebral hemisphere. Today, there are more refined methods of handling this problem.

As Sasanuma commented, "since the response mode required of the subjects was verbal (i.e., oral reports of what was presented) rather than nonverbal (such as pointing to the display presentations), it is conceivable that this had the effect of engaging more of the left hemisphere function than would have been the case otherwise, or of causing some loss of information processed in the right hemisphere due to interhemispheric transmission" (1977, pp. 551–552).[10]

Hatta (1977a) reported an experiment to confirm the superiority of the left visual field in the recognition of *kanji* and to "evaluate the relative ability of the two hemispheres to recognize *kanji* classified into two categories in their meaning: highly abstract ones and highly concrete ones" (p. 731). The superiority of the left visual field for recognition of *kanji* and consequently of a right hemispheric processing was confirmed with both concrete and abstract *kanji*. Both are pictographic and non-phonetic, but as Hatta noted, concrete verbal materials are high on a scale of imagery whereas abstract ones are low in imagery.

Apparently, the abstract-concrete dimension does not make a big difference as long as the symbols are non-phonetic and pictographic. The conclusion is that the right hemisphere can handle abstract words as long as they are non-phonetic. Put differently, it is the non-phonetic and visually complex character that concerns the right hemisphere and not the concrete depicting in the first place, even if concrete imagery also concerns the right rather than the left hemisphere. Phonetics take place "in time" and thus may concern the left hemisphere whereas visualising takes place momentarily "in space" and consequently may concern the right hemisphere.

In an early study Gazzaniga (1970) described the words that could be recognised by the right hemisphere of split-brain patients as noun-object words. Adjectives could be recognised but never verbs. Ellis and Shepherd (1974) pointed out that it is likely that the stimulus words employed by Gazzaniga differed not only in syntactic category but also in concreteness. "Noun-object words are highly concrete, whereas verbs usually are not" (Ellis & Shepherd, 1974, p. 1035).

[10] The question of handedness could be a further complicating factor even if the subjects are classified as right-handed. But are they "true" right-handers? Left-handers, who represent 10% of the population, only to some small extent (about 15%) have language centres in the right hemisphere; 15% of left-handers have language centres in both hemispheres and 70% in the left hemispheres like ordinary right-handers (Blakeslee, 1984). How many right-handers have their language centres localised in the right hemisphere?

In a dichotic-listening pilot study, Scott, Hynd, Hunt, and Weed (1979) found a left ear advantage (right hemisphere advantage) in Native American Navajo subjects consistent with findings regarding Native American Hopi children. The literal and concrete character of these languages might favour processing in the right cerebral hemisphere although this conclusion is "highly speculative and questionable" (p. 91).

When nonsense words are presented with phonetic symbols, the left hemisphere does the work best, and when non-phonetic pictographic symbols are presented, the right hemisphere is preferred. Hatta (1977b) remarked that most concrete *kanji* were derived from the shape of concrete objects corresponding to them and have been historically simplified to present forms.

In these *kana* and *kanji* experiments the stimulus presentations were made in the one or the other half-field separately. What happens when you are in a position to make a choice by yourself? Ellis and Shepard (1974) presented one abstract and one concrete word in each half-field at the same time. They came to the conclusion that while abstract and concrete words falling in the right visual field do not differ significantly in probability of recognition and were both better recognised compared with presentation in the left visual field, concrete words are better recognised than abstract words when they occur in the left field.

1.4.2 Comments on alphabetic/phonographic and pictographic symbols

The phonological deficit hypothesis (see Section 1.2.1) in Chinese developmental dyslexia in Hong Kong has been studied by Ho, Law, and Ng (2000). Referring to a multitude of convergent research findings, the study focused on phonological problems as the root cause of most dyslexic reading difficulties in alphabetic script. The question then is if this is also the case with non-alphabetic readers or if dyslexia is only a Western phenomenon. Ho et al. (2000) conclude that their study suggests that "Chinese children with dyslexia have deficits in processing phonological information like their alphabetic counterparts" (p. 57).[11]

[11] 56 children (46 boys and 10 girls) aged 7 to 10 (i.e. Grades 2 to 5) were chosen for the study because their reading achievement was at least one year behind in Chinese word reading. They had an IQ of 90 or above and no suspected brain damage, uncorrected sensory impairment, or serious emotional or behavioural problems. 33 had reading difficulties only (R-dyslectics) and 23 had reading and writing difficulties (R+W-dyslectics). Another 112 normally achieving children served as CA controls matched on chronological ages and RL controls matched on reading levels for the two dyslectic groups. The tests were an intelligence test (Raven), three Chinese reading tests (two-character word reading, regular/irregular character reading and pseudo-character reading), and four phonological tests (onset detection, rhyme detection, word repetition, and non-word repetition). The results were that the R+W-dyslectics, both in comparison to their age group and to those about one year younger at the same reading level, performed significantly less well on the phonological tasks (one exception: onset detection and those at the same reading level). Concerning the R-dyslectics, they too performed significantly less well in relation to their age group on all the phonological tasks but, in relation to the children about one year younger at the same reading level, they performed less well only on one phonological task (non-word repetition) (Ho et al., 2000).

In the educational system in Hong Kong visual problems are seen as the main cause of reading difficulties in Chinese. But according to Ho et al., there is a reason why phonological skills should have something to do with learning to read Chinese. In about 90% of Chinese characters there is a phonological component indicating the tone level, and first- and second-graders in Hong Kong spontaneously use the phonetic component of a Chinese character for sound cues in reading (Ho & Bryant, 1997). The usefulness of the phonetic component in Chinese character reading has been questioned however (Hoosain, 1991). The children start learning to read Chinese characters from the age of 3 without any system for phonetic aid (which is used in mainland China and Taiwan). "Teachers in Hong Kong adopt a whole-word approach in teaching reading, without much emphasis on the orthographic components within a Chinese character" (Ho et al., 2000, p. 62).

In Chinese script, the script-meaning relationship is close, whereas the script-sound relationship is arbitrary, except for the phonetic cues in the characters, which was what motivated the Ho et al. study regarding the relevance of the phonetic deficit hypothesis in Chinese. This information about the phonetic cues in Chinese characters seems contradictory or at least confusing in that people speaking different Chinese dialects cannot understand each other when speaking, but can, however, read and understand the same script. According to Henrikson and Hwang (1967, p. 417), how its phonetic component is pronounced is irrelevant to the understanding of the character.

As to the characters, how far has the process of simplifying been taken? As can be seen in both Japanese and Chinese pictographic characters, they have been transformed from icons (i.e., pictures) to more simplified graphic patterns. According to Henrikson and Hwang (1967), almost 2000 years ago Shen, as the author of the oldest known Chinese dictionary, distinguished six groups of characters:

1. Pictographs (i.e. graphs) more or less simplified, depicting, for example, *sun, moon, mountain, tree, head,* and things that could be depicted.
3. Simple ideographs (i.e. signs similar to our traffic signs) as well as figures below ten, concepts like *under* and *over* which are written with a horizontal line plus a dot on the relevant side, and *right* and *left* originally depicting the right and left hand.
4. Complex ideographs. Sun and moon together means *light*; two trees means *forest*; tree together with man means *rest*; two men means *follow*; and a roof and a man and the sign for food means *stay for the night*.
5. Phonetical identities, i.e. characters depicting something that read aloud sounds like the thing one wants to write.
6. A minor group, the opposite to 4 above, including deduced characters sounding different but looking alike.
7. Phonetical compounds consisting of two signs, one marking the sound group and the other the meaning. Most characters (over 80%) belong to this

group. The phonetic part, however, could sound different without influencing the meaning.

The study thus raises some questions concerning the phonological deficit hypothesis in relation to Chinese script. First, if there are important phonetic components in Chinese script, it seems natural that weak phonetic awareness could be part of the reading difficulty syndrome in China. Rather it would then be strange if it were not. Does this mean that the processes when learning Chinese script essentially are the same as in alphabetical script?

Second, on the other hand, if there are not really important phonetic cues in Chinese script, why should phonetic deficit be part of the reading difficulty syndrome in China?

Why should Chinese weak readers exhibit phonologic problems at all, given that the characters are mainly non-phonologic. What are the implications for the phonological deficit hypothesis concerning Western dyslexia if phonologic deficit is also the main cause of dyslexia in non-phonetic script? Could this then indicate that there is an underlying factor behind the phonologic deficit?

The process of learning to read Chinese is perhaps (at least as described above) similar to the whole-word approach in Western learning-to-read methods where you are supposed to read the word as a meaningful entity and pay secondary attention to the decoding of the separate sounds. "From primary school to university, the learning of signs was carried on in a totally mechanistic way without any explanatory support" (Lindqvist, 1989, p. 7). In terms of the dual-route model (see Section 1.5.1), Chinese reading of this "mechanistic" kind could thus be described as direct. The characters in Chinese script are not easily seen as images; rather, they can be seen as complex graphical patterns. Although there are some phonetic cues, their special quality still lies in their close script-meaning relation in comparison to the script-sound relation in alphabetic reading. The script/sound relation must be different for the different Chinese groups of dialects using the same script.

In both phonographic and pictographic writing, when concentrating on the pictographic properties of the signs, activating the right hemisphere, it might be hard to establish and memorise the phonetic representations of these signs. There are indications that not only is image processing right hemispheric in beginning reading, but also the initial transfer from image/grapheme to phoneme (De Graaff, 1996). The capacity to understand metaphors seems to depend heavily on an undamaged right brain. With a damaged right brain, the language becomes very literal, matter-of-fact, and non-metaphoric (Donald, 1993; Sacks, 1987).[12]

[12] It could be argued that most abstract words have a past as metaphors but have lost their metaphorical content (e.g., the word abstract, which means to literally draw something out of something; Latin: abstrahere. The word context originally concerned weaving; Latin: textere = weave). Concerning metaphors that have lost their meaning and "metaphor blindness", see Asplund, 2002).

The labelling of things seems to rely heavily on the left hemisphere while the direct visual experience and identification depends on rightward processing. Jakobson (1990) notes that when the left hemisphere is inactivated, the capacity of the right to identify musical phrases is enhanced in a similar way as the talkativeness of the left hemisphere is enhanced when the right is inactivated.

In a longitudinal study of the learning-to-read process of eight children, Kullberg (1991) noted the following when using mixed text and pictures in training:

> There seems to be a specific change in the eight children's reading of the picture-texts over the three years. In the first grade the children easily read the pictures in the stories. No hesitations are noticed prior to the reading of the pictures, but pauses are noticed in front of words to be read. In grade three, hesitations are noted in front of pictures but not in front of words. Furthermore, the children are now showing a need for distinguishing what kind of dog a picture of a dog refers to. The way in which the children develop in relation to the pictorial symbols seems to be an effect of the learning to read. The pictorial symbols open up possibilities for the beginning reader and the written words include possibilities for the reader (p. 263)…The children in third grade sometimes seem to guess about what the pictures refer to. This they never do in the first grade. To the children in the third grade, the pictures of a dog or a tree no longer refer to just a dog or a tree, which is the case when first reading picture-texts in first grade, but to a specific kind of dog or tree. The children are not satisfied with not being able to tell the kinds. On the surface, this suggests that although the pictorial signs are thought of as closed symbols to the children in beginning reading and can be considered as valuable tools in the first stages of the learning-to-read process, the pictorial logographic symbols do not open up such possibilities to children who read automatically (p. 295).

It seems as if these children have some problems with the pictographic/phonographic dimension in script (regarding the transformation from image to symbol, see Chapter 3).[13] These observations actualise the possibility of important changes in modes of perception accompanying the reading acquisition process.

[13] In the words of Albert Einstein the complex process behind concepts is expressed as follows:
The words or language as spoken or written do not seem to play any role in my thought mechanism. The mental units that seem to serve as elements in thinking are certain signs or more or less clear images that can be reproduced voluntarily and be combined.
There are of course certain connections between these elements and relevant logical concepts. It is also evident that an urge ultimately to reach these logically connected concepts is the emotional motivation behind this rather obscure playing with the elements mentioned. From a psychological standpoint though, this combinatory game seems to be the most important characteristic in productive thinking – before there are any connections to verbal logical construction or any other signs that can be communicated to others.
These elements mentioned are in my case of a visual and sometimes muscular kind. Not until the second stage when this associative game is sufficiently established and can be reproduced voluntarily, can conventional words or other signs with great effort be searched for. (Albert Einstein on his creative thinking; Blakeslee, 1986, pp. 47–48, my translation from Swedish.)

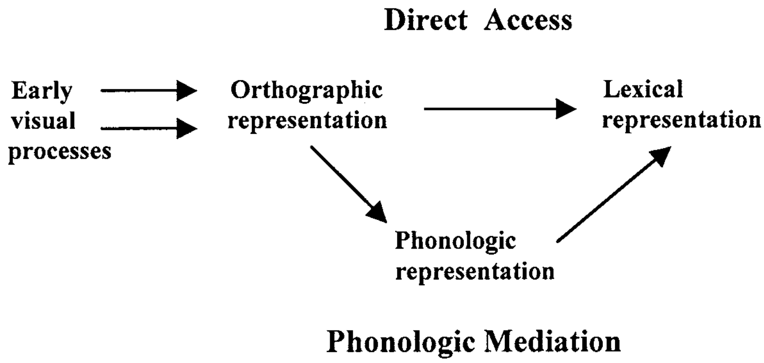

Figure 1.7. Dual-route or dual-process model (after Van Orden, Stone & Pennington, 1990, p. 489).

1.5 Toward a Combined Model of Reading

1.5.1 The dual-route model

The dual-route or dual-process model (see, e.g., Coltheart, Curtis, Atkins & Haller, 1993) presupposes two independent processes that govern access to lexical representation when it comes to converting print to speech. The main features of the models are displayed in Figure 1.7. The internal lexicon (i.e. the long-term memory for words) is available through two pathways. “A dictionary look-up procedure and a letter-to-sound procedure” (Coltheart et al., p. 589; definition of routes also according to Share & Stanovich, 1995; Höien & Lundberg, 1999). “What we mean by the term dual-route model is a model that has a route that can read words but cannot read nonwords and another route that can read nonwords and regular words but misreads exception words by regularizing them” (Coltheart et al., 1993, p. 590):

1. *Orthographical*. A direct visual access or lexical route concerning well-known words. By learning, these words and their pronunciation are stored in the postulated lexicon. This route does not involve phonological mediation. There are sounds linked to the visual impressions.
2. *Phonological*. An indirect, non-lexical, phonologically mediated route when confronted by unknown words. There are no sounds linked to the visual impression. These words can be pronounced through a stored system of spelling-to-sound correspondences or rules specifying the usual relationships between letters and sounds unique to the language in question. The route is ineffective when the pronunciation of words does not obey these rules.

The Höien and Lundberg (1999, p. 57) decoding model (see Figure 1.8), partially based on the dual-route theory, consists of the following processes: vis-

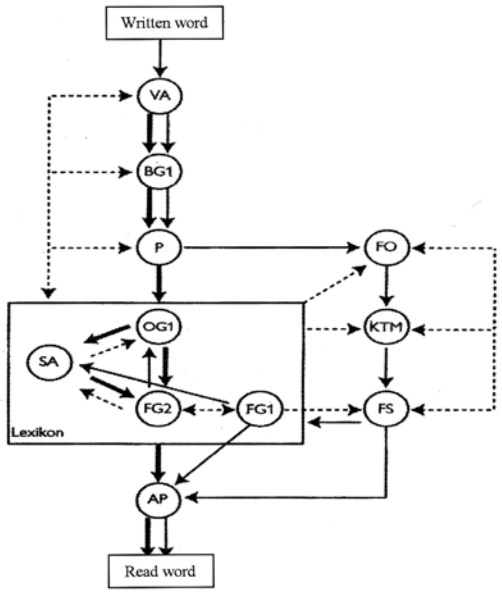

Figure 1.8. The Höien and Lundberg decoding model (1999, p. 57). The orthographical strategy is marked by thick arrows and the phonological by thin arrows. Dotted lines show feedback from lexical processes and interactivity between the singular processes.

ual analysis (VA), letter recognition (BG1), and the parsing (analysis of the sentence) process (P) contained as part processes in both decoding strategies. The same holds for semantic activation or semantic identity (SA) and the articulatory process or articulation (AP). Word detection (OG1) and phonological word memory (FG2) are critical in using the orthographical strategy. There are four other processes linked specially to the phonological strategy: phonological recoding (FO), verbal short-term memory (V-KTM), phonological synthesis (FS), and phonological (word) recognition (FG1)(Höien & Lundberg, 1999, p. 58). Höien and Lundberg express the difference between the paths as follows:

> When the word has been recognised, this leads to a parallel activation of the *phonological* (FG2) and *semantic identity* (SA) of the word. The phonological knowledge is the basis for the *articulation* (AP) of the word. If the reader has not learned the spelling of the word, the processing of the word proceeds differently. In that case information concerning the word cannot get into the lexicon through the described *direct route* as, when the reader has not learned the way of spelling it, there is no orthographic knowledge about this word in the orthographical long-term memory. Instead the information about the word must pass to the lexicon through the *indirect route*. That is, the letter string must be transformed into inner speech sounds – to a sound resonance image of the word. The phonological recoding process (FO) transforms letters and syllables into corresponding phonological segments that are stored for a short time in the verbal short-term memory

> (V-KTM). The phonological process of synthesis (FS) links the segments into a unity of sound that is the basis for phonological recognition (FG1) (Höien & Lundberg, 1999, p. 59, my translation from Swedish).

The fallacy of the dual-route model, according to Van Orden, Stone and Pennington (1990), is the assumption that rule-like behaviour must be governed by discrete, explicit rules. On empirical grounds, Van Orden et al. (1990) refute the alleged independence of the double routes and the three basic assumptions of this theory:

a) The *GPC hypothesis* presumes that phonologic coding is strictly governed by grapheme-phoneme correspondence (GPC). Criticism: There is a correspondence between orthography and phonology, not according to the dichotomous GPC rules but "as a function of the relative consistency and frequency with which spelling and phonology covary" (p. 490).
c) The *delayed-phonology hypothesis* presumes that the processing of the phonologic characteristics of words is delayed in comparison with the direct access to lexicon and consequently has little or no influence upon skilled word identification. Criticism: "The delayed-phonology hypothesis is countered by experiments in which stimulus phonology was shown to affect word identification within its normal time course" (p. 491).
c) The *bypass hypothesis* presumes that skilled readers can bypass phonologic mediation as compared with beginning readers relying exclusively on phonologic mediation. Criticism: "phonologic coding operates in every instance of word identification, irrespective of a reader's familiarity with the word being read" (p. 493).

I do not understand how one knows if a word is well known or unknown without consulting the lexicon as "the word cannot get into the lexicon" (see quotation above). The not-yet-unknown word cannot go directly to the phonological store of spelling-to-sound correspondences either. First, one has to look into the lexicon to find out if the word is there or not. Are there two types of dual-route theory: one assigning the sorting function known/unknown to the lexical level and another assigning the sorting function to the message in itself? This is an identical problem to the one concerning the delegating of words with different characteristics to the adequate hemisphere. How does one decide what goes where? Perhaps "everything goes everywhere" but is only received in some places. More complications arise when considering what happens when reading silently: Are there movements in the speech motor muscles? There could be wrong ways of spelling words in the lexicon, and so on.

The lexicon concept as a metaphor for a cognitive "place" in which the meaning of words is somehow stored could be questioned like the concept of routes. The present study, for example, might ponder the eventuality that the lexicon could be divided into an icon and a symbol, with the latter perhaps being further divided into a metaphor and a non-metaphor "department". The all-or-nothing character of the recognition of words according to the dual-route model does not fit in very well with subjective experiences of just not remembering, almost remembering, and so on, which are more compatible with a continuum concept of recognition.

What is a word in the mind? It is not primarily a lexical translation out of context but a crossroads of potential images, sounds, connotations, denotations, impulses, flavours, smells, denials and confirmations. As in poetry:

> I forgot the word that I wanted to say,
> And thought, unembodied, returns to the hall of shadows.
>
> (O. E. Mandelshtam: The Swallow. Quoted by Vygotsky, 1987, p.243).

Seidenberg and McClelland (in Coltheart et al., 1993) have argued that a connectionist model with a single route will do quite well in explaining the facts that the dual-route model tries to handle. For example, phonological activation is present at all levels of word identification and is not seen as a separate process (for a critical review, see Coltheart et al., 1993). The general idea of the covariant learning hypothesis (Van Orden et al., 1990) is that the "quality of being closer to or farther from a correct code is the essential quality of subsymbolic performance" (p. 505).

> One never fully learns a language, not even one's own. It can always be stretched further, be refined, be nuanced, become more expressive; it can hold even more subtle shifts and construct even more striking metaphors and thoughts never thought before (Liedman, 2001, p. 56, my translation from Swedish).

1.5.2 The balance model

In the 1920s, Samuel T. Orton proposed that dyslexia was caused by absent hemispherical dominance (Orton, 1937). For example, the letter *d* in one hemisphere was accompanied by the mirror image *b* in the other hemisphere. In the event that these pictures were equally strong, the reader did not know which one to read. Consequently, according to Orton, dyslectics were characterised by many mirror-errors and also by weak lateral preferences (e.g., concerning hand, foot, and eye), as this indicated a weakly established cerebral dominance. It has been shown that dyslectics are not characterised much by mirror-errors and thus it can be questioned if there exists any connection between lateral preference and dyslexia. Nevertheless, Orton's basic contention on hemispheric functioning has not been completely abandoned even if research is now focused on hemispherical functional specialisation rather than on hemispherical dominance (see Section 1.3). For instance, analysing the visual characteristics of written text supposedly activates the right hemisphere. This could also be the case when grown-up readers are exposed to perceptually demanding texts (Hynd, 1989). Goldberg and Costa (1981) propose that new information is best mediated by the right hemisphere, which also holds for intermodal information.

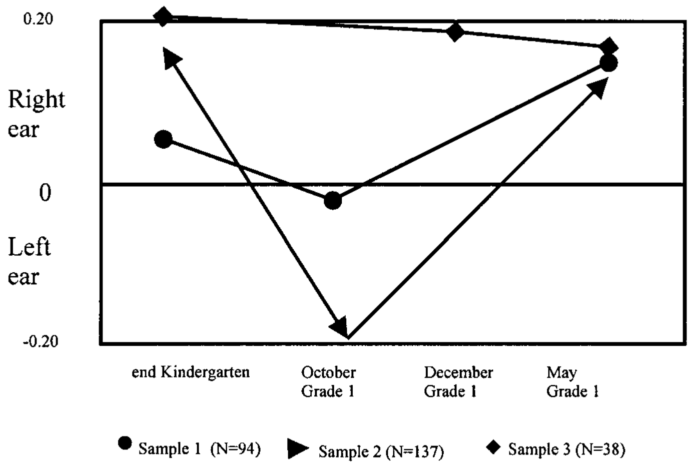

Figure 1.9. Development of ear preference based on data from three samples of children 5–7 years old. Samples 1 and 2 started to learn reading approximately 10 weeks before the first test. The third sample received no formal training to read until a couple of months after the last test (Kappers, 1990).

> Letters may be better processed by the right hemisphere in cases in which they are perceptually demanding, and, accordingly elicit a visual-perceptual strategy. This may happen in young primary school children. A LFA (left visual field advantage) for script may shift to an RFA (right visual field advantage) when, during development, perceptual analysis recedes below the level of consciousness and the utilisation of semantic strategies becomes more prominent (Rourke, Bakker, & Fiske, 1983, p. 53).

The original research results that are the basis of the development of the balance model for reading concern the unexpected left (or none) instead of right ear advantage that tends to occur in early reading as manifested in dichotic listening tasks. Bakker (1979) demonstrated that a left ear/right hemisphere advantage in second grade was transformed into a right ear/left hemisphere advantage in third grade. Kappers (1990) has demonstrated the relation of this left ear/right hemisphere shift to the onset of the learning-to-read process (Figure 1.9).

There is a different timing in the studies, where Kappers (1990) places the shift in the first grade and Bakker (1979) in the second and third grade. Kappers also notes that some children could shift preference twice.

This shift might be related to an early occupation with the visual characteristics of letters that precedes more advanced reading. In terms of the balance model, remaining in this phase has been characterised as P-dyslexia (Perceptual dyslexia) and a too early abandonment of this phase as L-dyslexia (Linguistic dyslexia). The validity of this typology (dimensionality) has been amply demonstrated (Licht & Spyer, 1994). Lorusso (1994) defined the balance model as follows:

> According to the model, in the early stages of normal reading acquisition the first approach to written language would be characterized by a predominance of visuo-perceptual analysis, allowing for new, unfamiliar, perceptually demanding material to be recognized for subsequent processing. Therefore, the first stage would mainly involve processes subsided by the right hemisphere. As written material becomes more familiar and the processes for its recognition and identification become more automatic, progressively less perceptual analysis will be needed. The core of cognitive processing will now be directed to more subtle linguistic analyses, mainly involving the left hemisphere, aimed at the extraction of meaning on the basis of semantic and syntactic cues (p. 2).

In a longitudinal event-related potential (ERP) study (event-related-potential changes recorded from the scalp) of children aged between kindergarten and the third grade of primary school, Licht (1988) interpreted his results in terms of (1) stronger engagement of the right hemisphere in the early reading process during the processing of visuospatial features of script, and (2) age-related changes in hemispheric asymmetry as a change in hemispheric mediation of word reading from the right to the left hemisphere. The author also found differences between inferior and superior readers that were highly similar to differences between younger and older children, probably reflecting the more difficult processing of visuospatial features of words by the inferior readers.

Lorusso (1994) noted that the balance model characterises the "right-hemispheric" P-dyslectics as having problems with phonology while phoneme/grapheme connections in most models of dyslexia are referred to the left hemisphere. De Graaff (1996) presented two tasks in an ERP study that required the beginning readers to decide whether arrays of four letters were physically identical (PI-tasks), for example, *jjjj* (an example of a non-target is *pplp*) or name identical (NI-tasks), for example, the combination of letters *aaAa* (examples of non-targets are *Accc* or *dDdm*). One obtains the right answer only if the letters are sounded out internally. A phoneme has to be coupled with the grapheme. Surprisingly, this task appeared to be more a matter for the right than for the left hemisphere. This indicates that not only icon processing is right hemispheric at this age but also the transfer from image/grapheme to phoneme.

> The present findings of right hemispheric task differentiation and asymmetry are in support of neuropsychological reading models that assume right hemispheric mediation in identifying graphemic information in early stages of learning to read. The observed changes across age may indicate that greater right hemispheric involvement in processing letter names, as reflected in parietal activity, decreases as children gain proficiency with the task, or with letter names and configurations" (De Graaff, 1996, p. 46).

An important indication of the left cerebral lateralisation of speech is that right-hemispheric damage influences left-side motor behaviour but with the exception of speech motor control, which is obviously then managed by the left hemisphere (Donald, 1993). When the left hemisphere is damaged in deep dyslexia, there are two views concerning reading aloud accomplished via a sequence of three processing stages: orthographic processing, then semantic processing, then phonological processing (Coltheart, 2000):

a) reading aloud by a multiply damaged left hemisphere reading system.
c) reading aloud relies extensively on right-hemisphere orthographic and semantic processing while the phonological output lexicon is a left hemisphere process.

Supported by extensive brain imaging and behavioural data, Coltheart (2000) advocates alternative b. The author describes the reading of deep dyslexics as often semantically but not orthographically or phonologically related to the word they are trying to read. For example, *error* might be read as "wrong" and *saxophone* as "violin". When reading aloud, visual errors (*sleeve* = "sleep"), morphological errors (*paint* = "painting"), and problems with function words and words with abstract meanings can also occur. Nonwords cannot be read aloud at all. It seems as if the right hemisphere reads the meaning of the word but not the word itself. In this context it is worth noting the weak right-cerebral hemispheric capacity for memorising and also for establishing an articulatory rehearsal loop as phonology is mainly lateralised to the left hemisphere (Donald, 1993).

The balance model points out that it is ineffective to use an unbalanced way of reading. For example, the P-type might struggle to read with the right hemisphere and might therefore have problems with phonology that demands left-hemispheric activation. On the basis of the model, an extensive repertoire of remedial measures has been developed (Bakker, 1990; Kappers, 1997; Van Strien, 1997) aiming at restoring or establishing a balanced "hemisphere-driven reading" by hemisphere-alluding and/or hemisphere-specific stimulation. Even if remediation is not primarily in focus in the present study, it could be noted that the hemisphere-alluding program for P-dyslectics is very similar to the phonologic awareness training of the Bornholm model (Lundberg et al., 1988) and the hemisphere-specific training for P-dyslectics contains a strategy challenge in much the same way as Johansson (2001) is developing in her computer-based programs. The remediation program of "slowing down" L-dyslectics is unparalleled, though, in the Swedish context.

1.5.3 A proposed model of reading, reading acquisition, and reading difficulties

Bjaalid, Höien, and Lundberg (1997) proposed a framework combining elements of the dual-route (dual-process) model and a connectionist model (see Section 1.5.1). This latter model proposes a single complex system rather than separate routes. Bjaalid et al.(1997) remarked: "Dual-route models have been criticised for being based on empirical observations of adult patients due to

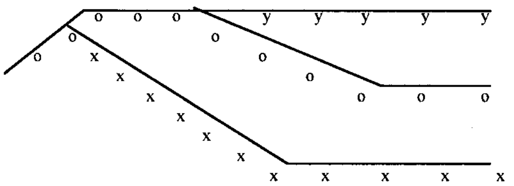

Figure 1.10. A proposed model for normal and deficient reading based on Bakker (1994) and Bjaalid, Höien, and Lundberg (1997). For an explanation, see text.

brain injuries (acquired dyslexias), connectionist models are criticized for having been built on empirical evidence from skillful readers" (p. 74).

Perhaps it is possible to think of the dual-route, connectionist and balance models in terms of an integrative model that can also handle a pictographic/phonographic, image/symbol transition. The direct access of the dual-route can be thought of as an L (linguistic)-tendency, the phonologic mediation of the dual-route as a P (perceptual)-tendency and the connectionist model as a theory for the mainstream reading acquisition. An attempt to construct such a model is made in Figure 1.10. As depicted in the figure, the model proposes a normal reading development (*o*), one development disturbed by a cancelled or a too early abandoned phonologic phase (*x*), and another characterised by remaining phonologic reading (*y*). According to the balance model, *y* denotes perceptual dyslexia (P-type) and *x* linguistic dyslexia (L-type). According to Lundberg (1995), *y* refers to phonologic reading due to weakness of the orthographic system and *x* refers orthographic reading due to weakness of the phonologic system. Tentatively simplifying: y = trying to read with the right hemisphere without much support from the left, x = trying to read with the left hemisphere without much support from the right, and o = whole brain reading. There are possibly large differences in the timing of the individual learning-to-read process and the process for girls is about one year ahead of the process of boys.

The model has the advantage of trying to handle the impasse that Share and Stanovich (1995) noted: "However, one curious aspect of our literature is that what is known about individual differences in reading is not always well integrated with models of the acquisition process. This has allowed speculations about the causes of individual differences in reading acquisition to be unconstrained by a specified model of the reading acquisition itself" (p. 2).

In this context, they refer to Byrne (1992):

> One thing that could be said about this rather long list of possible causes of reading problems is that it is needed, because reading is multifaceted and because there are many kinds of problems. This is a standard line of reasoning...(but) given the uncertainty about a typology of reading difficulties and given that fewer explanatory constructs than reading problems may be needed, there may well be too much explanatory power for the job at hand, A way is needed to constrain the

> power. Economy of explanation characterises the scientific endeavour and should be invoked in this branch of science. It is possible that the explanatory power available could be constrained if it were required that each of the many hypothetical causes of reading problems fits a well-worked out account of the acquisition procedure (p. 3).

And summing up the point: “Most investigators have either focused on developing generic developmental models of stages that all children traverse or they have concentrated on looking for patterns of correlations in studies of individual differences” (Share & Stanovich, 1995, p. 2).

The present study is to be seen in this context of trying to reduce the explanatory constructs and constrain the explanatory power. The empirical data and the models – can the twain ever meet?

1.6 Outline of the Empirical Studies

The present longitudinal study of 125 children from Grades 2 to 6 examines results of decoding and reading comprehension tests in relation to a combined model of reading acquisition and reading difficulties. It is a study of a total population without randomisation.

The model proposed is heavily indebted to the balance model of Bakker (1990). However, it also takes advantage of the Bjaalid, Höien, and Lundberg (1997) proposition of combining the dual-route and connectionist approaches. A revised version of the simple view of reading (Gough & Tunmer, 1986; Hoover & Gough, 1990; Aaron, 1997) and the phonologic versus surface dyslexia distinction (Castles et al., 1999) is considered. The different parts of the present work all draw on the same set of data but examine different aspects in order to discuss some hypotheses concerning mainly three themes: prediction possibilities, phases of reading acquisition, including possible image/symbol transitions, and subtypes or dimensions in reading difficulties. The proposed model presented in Figure 1.10 (see Section 1.5.3) is the central theme of the thesis. Most of the tests used (see Section 1.6.2) are constructed in the context of the dual-route model and are widely used in schools today.

Chapter 2 concerns the problem of prediction and examines the hypothesis that reading comprehension in children in Grade 6 can be predicted from decoding and comprehension tests in Grades 2 and 3. The letter decoding test, the word decoding test, and the word reading comprehension test are applied as predictor variables. Target variables are the sentence reading comprehension test and the silent reading comprehension assessment.

Chapter 3 is concerned with the transition from oral to written language as a process of image/symbol confusion in reading acquisition, focusing on empirical indications of a potential transformation in letter perception. To study this problem the relations between the image decoding, letter decoding, word decoding, and sentence reading comprehension tests are studied over time.

Chapter 4 is concerned with the concept of a phonologic followed by an orthographic stage in the learning-to-read process. Along with the sentence reading comprehension test, the phonologic word decoding and orthographic word decoding tests are studied and related to a recent account of dyslexia in the Swedish language (Goulandris, 2003).

Chapter 5 turns to the question of subtyping in relation to the proposed model. Ways of delimiting inadequate reading abilities and some subtyping or dimensional hypotheses are presented and discussed. The image, letter, word, phonologic and orthographic decoding tests, the sentence reading comprehension test and the assessed reading pace are all used to study the relations between dyslexia models and to examine the plausibility of a compensatory or a non-compensatory outlook.

Chapter 6 further develops the findings of the study related to the hypothetical twofold image/symbol and similarity/nearness character of language (Jakobson, 1990). In this chapter all the tests of the study are subjected to a factor analytical treatment.

A characteristic feature of the following chapters is the interest in the analysis of subgroups based on gender and/or scores in tests on the grounds that in such an analysis what initially seem to be rather insignificant results on a general level, might reveal some surprises (e.g., Gustafson et al., 2000; see Section 1.2.1). As it is often observed (e.g., Annett, 1985), there is a gender difference in the prevalence of special reading difficulties, which are noted as about three to four times as common with boys as with girls. This notion, also challenged (Snow et. al., 1998), has perhaps not been given appropriate consideration. The signs of gender-specific neuropsychological processing of script (Shaywitz et al., 1995) also motivate the attention directed toward gender-specific differences in the present study (see Section 1.3.1).

1.6.1 Participants

In a longitudinal study lasting from Grade 2 to Grade 6 participants in the different parts of this investigation were the total number of children (124: 62 boys and 62 girls) of the same age in a school district (9 schools) in a rural area of Sweden. The children's ordinary teachers administered the tests which were performed as group tests in the classroom situation. These teachers had been carefully instructed on how to administer the tests. They were also interviewed and asked to make ratings of their pupils, which they did with a great deal of confidence and subjective exactness.

1.6.2 Tests

The tests (see Table 1.1) are presented at the points where they are applied in the investigation.

Table 1.1 *Sequence of Tests Administered*

Grade 2 May	Grade 3 Oct/Nov	Grade 3 May	Grade 6 Nov/Dec	Grade 6 May
Decoding tests				
Letter decoding		Letter decoding		Letter decoding
Word decoding		Word decoding		Word decoding
	Image decoding			Image decoding
	Phonologic decoding			Phonologic decoding
	Orthographic decoding			Orthographic decoding
Comprehension tests				
Word reading comprehension		Word reading comprehension		
	Sentence reading comprehension			Sentence reading comprehension
Teacher ratings				
			Reading pace	
			Silent reading comprehension	

CHAPTER 2

Predicting Reading

2.1 Introduction

In the report *Preventing Reading Difficulties in Young Children* from the US National Research Council (Snow et al., 1998), the authors commented that "it is critical to distinguish predictors from causes or explanations of reading difficulties – predictors are simply correlates" (p. 100).

Snow et al. (1998), mainly concerned with predictions from pre-school to the first years of reading instruction, summarised their findings in Table 2.1 (condensed).

Only studies with a sample size of 30 or more were considered. At least one of the risk factors of interest had to be assessed initially when the children were within about one year of beginning formal schooling in reading, and at least one assessment of reading skills had to be obtained after one, two, or occasionally three years of instruction. If a word recognition measure was used in a prediction study, its correlation(s) with predictors was used; otherwise, a composite reading score or, rarely, a reading comprehension measure was instead accepted as the criterion variable. When more than one correlation coefficient per risk factor was available in a given sample of children (because multiple reading assessments were conducted and/or because multiple measures of the predictor were used), the average correlation for the sample was used for aggregation. Therefore, to obtain the average correlation across samples each sample contributed only one independent observation (Scarborough; in Snow et al., 1998, p. 110).

The relationships displayed in Table 2.1, while substantial, are perhaps not very impressive. Letter identification (i.e. how many letters a pre-schooler is able to name when shown letters in a random order) appears to be the strongest single predictor. Regarding the possibility of an early diagnosis of potential reading problems in children, this is often part of treatment programs (which the present investigation is not). Lundberg, Frost, and Petersen (1988) studied a large group of Danish pre-school children. Phonological awareness training was given before any formal reading instruction. In Grade 2, the trained chil-

Table 2.1. *Prediction of Reading Difficulties at School Entry (from Snow et al., 1998)*

Factors identified in the child	Number of samples	Strength of relationship (median r)
Language		
Verbal memory for stories/sentences	11	.49
Lexical skills		
1. Receptive vocabulary	20	.33
2. Confrontation naming	5	.49
3. Rapid serial naming	14	.40
Receptive language, syntax/morphology	9	.38
Expressive language	11	.37
Overall language	4	.47
Phonological awareness	27	.42
Early Literacy-related Skills		
Reading "readiness"	21	.56
Letter identification	24	.53
Concept of print	7	.49

dren were significantly better at reading than a control group. The results indicated that the effect of the training on reading skill was modest. In a longitudinal intervention project, Gustavsson et al., (2000) studied the effects of one year of phonological awareness instruction. The results of the study led them to conclude that the phonological training group made the most progress in phonological awareness but they did *not* improve their reading skills any more than the controls. However, the authors found that some participants in the phonological training group did improve their reading whereas others did not. A remarkable difference between these subgroups was that those resistant went on relying only on orthographic decoding despite their increase in phonologic awareness, whereas for improving readers, both orthographic and phonologic word decoding contributed to text reading performance. The Vellutino et al. (1996) study showed that with intensive one-to-one training, two thirds of the 9% "reading disabled" could reach a normal level and only 1.5% of the total population remained in a severely impaired range.

Other reports on the perspectives in reading development paint a darker picture. For instance, in a longitudinal study of 74 boys with reading disabilities in Grade 2, Jacobson and Lundberg (2000) found that only a few of these reached a normal level in Grade 9. Most authors have reported persisting reading and writing disorders through elementary school and very limited or no improvements with special training (Jaklewicz, 1997). Many studies have shown that dyslexia diagnosed in the early school years persists into adulthood in almost every case (Elbro et al., 1998, p. 52). In general, longitudinal studies on reading and writing are difficult to compare because of different sampling methods (Jaklewicz, 1997).

Table 2.2. *Correlations of Wordchains Test Scores between Different Test Occasions (Grades 2, 5, and 9) for all the Children, all the Boys, and the Reading Disability (RD) Boys (Jacobson, 1998, p. 13)*

Test occasions	All children	All boys	RD boys
Between Grades 2 and 5	.84 (N = 172)	.87 (N = 136)	.57 (N = 82)
Between Grades 5 and 9	.86 (N = 172)	.85 (N = 136)	.71 (N = 74)
Between Grades 2 and 9	.77 (N = 180)	.78 (N = 136)	.54 (N = 76)

The screening test *Wordchains* (also used in the present study and presented in more detail later) was administered in 1989 to more than 2,000 Grade 2 children in the county of Kronoberg in Sweden (Jacobson, 1993). Together with the *Letterchains* test, it has since then often been used as a screening test in the Swedish school system at different ages. The results (see Table 2.2) indicate considerable test-retest reliability over time. Because the *Wordchains* test correlates strongly with different tests of reading ability, it could be used as a potential valid predictor of reading.

Why do we find these weaker correlations of Reading Disability (RD) Boys between Grade 2 and both Grades 5 and 9? Is it possible that RD boys in Grade 2 have not yet stabilised their reading patterns?

A general problem when predicting reading difficulties might be the wish of every teacher to make a change – to counteract predictability by pedagogical measures, i.e. making development of reading possible regardless of initial difficulties. Predictability then must be fundamentally connected to the reading acquisition process as it is conceived and performed in the actual educational system. One could argue that ideally one should not be able to predict reading from the Grade 2 results as everyone at this stage should have equal possibilities regarding reading acquisition.

Reading according to the simple view of reading model (Gough & Tunmer, 1986; Hoover & Gough, 1990; Aaron, 1997, see Section 1.2) could be seen as consisting of a decoding and a listening comprehension component. In the present study, a semantic-categorisation (word comprehension) and a sentence-reading-completion (sentence comprehension) test were used as comprehension tests. This revision of the simple view of reading model (i.e., to substitute reading comprehension for listening comprehension) is motivated by the proposition that both decoding and reading comprehension are important variables in beginning reading and that they might uphold a certain independence. Given a certain (even low) level of word decoding, there might be a varying capacity on an individual basis to extract meaning from script. A prediction to be drawn from the simple view is that "the product of skill in the two components will significantly improve the estimate of reading comprehension over that obtained from the linear combination of the two components" (Hoover & Gough, 1990, p.132).

Before discussing the studies that are more closely related to the main model proposed in Chapter 1, in this chapter I examine the general prognostic power of the decoding and comprehension components of reading. Expressed differently, I analyse the degree to which the "reading future" of the child is built into the learning-to-read process at an early stage. This destiny, often referred to in terms of the gospel of St. Matthew (to those who have, shall be given) might, with an individualised approach to reading acquisition, be possible to challenge. In that case the prediction should be rather weak because some learning has hopefully been going on, especially concerning those to whom not much has been given.

2.2 Hypotheses

Hypothesis 1: Reading comprehension in children in Grade 6 can be predicted from their performance on both decoding and comprehension tests in Grades 2 and 3. More specifically, *Hypothesis 1a:* Letter and word decoding as well as word reading comprehension in Grades 2 and 3 predict (are positively correlated with) sentence reading comprehension and teacher assessment of silent reading capacity in Grade 6; and *Hypothesis 1b:* To explain the relation between the decoding and comprehension aspects of reading the formula Reading = Decoding x Comprehension (e.g., Hoover & Gough, 1990) is often used. Thus, it was expected that a multiplicative Decoding x Comprehension predictor would be more efficient than an additive Decoding + Comprehension predictor.

Hypothesis 2a: Girls are already more advanced than boys in reading skills in Grade 2, and *Hypothesis 2b:* Having stabilised their reading patterns at this age, they are more predictable than boys.

2.3 Method

2.3.1 Predictor variables and instruments

2.3.1.1 The Letterchains: A test of letter decoding

The *Letterchains* test was developed, and is usually employed, together with the *Wordchains* test (see below). "The main purpose of this test is to control for the visuo-motor components and speed factor involved in the Wordchains test" (Jacobson, 1995, p. 261). The task is to mark with a pencil the two places in each chain that separate identical letters.

Examples of test items: *IPNNLDDZXQ FVHHYJTTS WAACBXXOE*, and with indicated correct markings: *IPN/NLD/DZXQ FVH/HYJT/TS WA/ACBX/XOE*.

Totally, there are 80 chains with a time limit of 90 seconds. Performance is expressed as the number of correctly marked chains.

In the *Letterchains* test girls commonly perform better than boys in Grades 1–9. Girls are about one year ahead in Grades 4–5. This gender difference disappears among adults (Jacobson, 1993). In the present study this difference was not found in Grade 2, where boys and girls scored at about the same level (Appendix B). The test-retest reliability, according to Jacobson (1993), is .81 in Grades 1–3 and .57 in Grades 4–6. The lower reliability as compared with *Wordchains* is due to the very short testing time (90 seconds). But why is the reliability as high as it is in Grades 1–3? The validity of the *Letterchains* is more difficult to estimate. Some preliminary data indicate that the correlation with a similar method of simple figures instead of letters varies between .80 and .85 in various groups (Jacobson, 1998).

2.3.1.2 The Wordchains: A test of word decoding

The *Wordchains* test is chiefly designed to measure word decoding. Jacobsson (1998) suggests that the test focuses on an alphabetic-phonemic strategy in word recognition for younger readers and on an orthographic-morphemic strategy for more advanced readers. Jacobsson (1998) also notes that perhaps young children who are mostly at a logographic-visual stage of word recognition can use this strategy when performing some of the word chains. "Most of the children in Sweden make very few errors in the test. Thus, the Swedish Wordchains measurement primary reflects the rate of processing rather than accuracy" (Jacobsson & Lundberg, 2000, p. 276).

The task is to mark the two places in each chain that separate the words. Examples of test items include *seeroofblue dolltwopig stoplakehole boygomeet*, and with indicated correct markings: *see/roof/blue doll/two/pig stop/lake/hole boy/go/meet*.

The time limit is 180 seconds, and there are totally 120 chains. Performance is expressed as the number of correctly marked chains.

As to the characteristics of the test, Jacobson (1998) notes that girls perform better than boys in each grade and continue to perform better in adulthood. The average girl in Grade 4 processes words at the same speed as the average boy in Grade 5. Girls in Grade 6 have the same mean results as boys in Grade 8. Reliability is noted as acceptable with regard to the short testing time. Test-retest correlations with about 12 months between the two measurement occasions ranged from .80 to .90 in different groups (school classes) from Grades 1–6 (Jacobsson, 1993).

The validity of the test has been examined by comparisons with a test of silent word reading in Grade 2 (r = .72; N = 2,159), oral word reading, individually tested in Grade 2 (r = .78; N = 579) and in Grade 3–4 ($r \cong .60$), standard word reading with emphasis on reading comprehension in Grade 9 (r = .69, N = 136; for RD and control boys together) and r = .43 just for the 74 RD boys (Jacobson, 1993). The *Wordchains* test also had significant correlations (r = .56 – .67) with tests of reading comprehension in Grades 2–6. Data from Grade 2 (N = 2,162 children) showed an expected low correlation between the

Wordchains test and a group version of Raven's Progressive Matrices, r = .28 (Jacobsson & Lundberg, 2000). The manual of the test (Jacobson, 1993) also notes weak correlations with both verbal (ITPA) and nonverbal (Raven's Matrices) intelligence tests and correlations between *Letterchains* and *Wordchains* varying from ≈ .40 in Grades 1–5 to ≈ .60 in Grades 6–9.

According to Jacobson, "Many young children must sound out or pronounce each letter before they can identify the words, whereas older children and adults seem to have immediate lexical access based on rapid recognition of the orthographic patterns" (1995, p. 261). Commenting on this remark, one can notice the similarity between these word chains and script without interpunctuation and interword spaces from those early days when writing was mainly intended for reading aloud (Svenbro, 1999). When listening to a known language, words are perceived as separated in time, even if they in reality are not. Could a phonological reading strategy be useful when decoding word chains? For a radical questioning of the validity of the *Wordchains* test, see Alm (2004)

The initial rationale for combining a letter and a word decoding test was the supposition that letter decoding would assess the perceptual/motor ability necessary for reading and writing but without the reading/writing aspect involved, whereas word decoding would assess a decoding aspect that is central for reading. A discrepancy between the results on these tests in favour of letter decoding might indicate a special word decoding difficulty. It has been shown that special reading difficulties could also go with weak letter decoding (Jacobsson, 1993). In Chapter 5 this issue will be dealt with in greater detail.

2.3.1.3 The Semantic: A test of word reading comprehension

The *Semantic* test was developed for the present investigation to assess word reading comprehension. The test consists of 20 lines with 9 words, three of which in each line are animals. The child is supposed to "catch" these animals by making marks around them. The task is to identify a concrete semantic category easy to visualise; the test is intended to supplement the *Wordchains* test, which only demands decoding. In the Catch Animals test it is also necessary to understand the meaning of the word. Performance is expressed as the number of correctly marked words. The time limit is 180 seconds. Examples of items are listed below (the correct answers are given in boldface):

Penna kung ***lamm*** *ner* ***torsk*** *vid gröt peta* ***katt***
sol tumme ***häst*** ***mås*** *glas bror* ***kråka*** *äpple mage.*

The test-retest reliability of this test in the present study was .79, with about 12 months between the two measurement occasions in Grades 2 and 3.

2.3.2 Target variables and instruments

2.3.2.1 The Read: A test of sentence reading comprehension

The Read was constructed by Olofsson at the University of Umeå in Sweden to measure sentence reading comprehension. The task involves choosing words that fit into gaps in a story. The time limit is 180 seconds. Performance is defined as the number of correctly marked words. Example (correct answers in boldface):

Maria and her brother Jan had been out walking. He had just learned to walk. (The swim, **the walk**, the ride) had lasted for quite a while and been winding. Behind the neighbouring house, Jan had almost stepped on a snake and had been very afraid. Not until it was too late had Marie discovered (**the snake**, the crocodile). Frightened, Maria had seen Jan bending to pick up the snake. His small (ears, **fingers**) tried to grip it but the snake got away.

Nine stories were presented, each story being progressively more advanced. The test-retest reliability of this test in the present study was .78, with 3½ years between the two measurements in Grades 3 and 6.

2.3.2.2 Teacher assessments: Ratings of silent reading comprehension

In Grade 6 the teachers of the classes under examination in the nine schools were interviewed and asked to make ratings of their pupils on 21 5-point scales, ranging from 1 (very weak) to 5 (very strong). At the interview, all the teachers gave the impression of having excellent knowledge of their pupils. Further, the teachers seemed to experience the task as interesting and very realistic to perform. They even tried to refine the 5-point scale with + and –. In this chapter only one of the scales has been used, namely, teacher ratings of silent reading comprehension.

2.3.3 Design

The general design is presented in Section 1.6.2. The predictor variables concerning letter and word decoding [scores on *Letterchains* (Letter) and *Wordchains* (Word)] and word reading comprehension (scores on Semantic) were assessed in Grades 2 and 3. The target variables were sentence reading comprehension (scores on Read) and silent reading comprehension in Grade 6.

2.4 Results

2.4.1 Frequency distributions

All the frequency distributions of predictor and target variables were roughly normally distributed (Appendix A), with one obvious exception (Appendix C) regarding the teacher ratings of silent reading comprehension of girls in Grade 6. For the combined data of boys and girls, the distribution is negatively

Table 2.3. *Means and Standard Deviations of the Predictor Variables in Grades 2 and 3 for Boys and Girls and t-tests of Gender Differences*

	Girls			Boys			
	N	*M*	*SD*	*N*	*M*	*SD*	*t*
Grade 2							
Letter	62	23.08	8.11	62	23.15	7.00	–0.05
Word	62	25.31	13.70	62	18.60	8.10	3.32**
Semantic	62	30.90	13.68	62	22.87	12.03	3.47**
Grade 3							
Letter	54	31.19	6.65	57	29.70	6.00	1.24
Word	59	40.19	18.57	61	30.77	11.36	3.36**
Semantic	58	39.72	11.55	61	32.11	11.92	3.53**

Note. Letter = letter decoding; Word = word decoding; Semantic = word reading comprehension.
$^{**}p < .01$.

skewed. However, when the distributions for boys and girls are separated, only the distribution for girls is negatively skewed while the distribution for boys is more normal. This difference in skewedness is not found when comparing the distributions of test results on sentence reading comprehension in Grade 6. This gender difference in teacher ratings was not expected but is too obvious not to be noted and hence must be kept in mind in the statistical analyses.

2.4.1.1 Predictor variable statistics

Relevant to Hypothesis 2a, Table 2.3 shows the means and standard deviations of the predictor variables in Grades 2 and 3 for boys and girls, and *t*-tests of gender differences (Girls–Boys).

Table 2.3 clearly indicates the advantage of girls already in Grade 2 on word decoding (Word) and word reading comprehension (Semantic). On the other hand, girls have no advantage in letter decoding (Letter). This pattern remains about the same in Grade 3.

2.4.2 Correlations among predictor variables

To examine the degree of relationships among the predictor variables in Grades 2–3 pairwise product-moment correlations were computed (Table 2.4). This examination can be seen as a pre-analysis to the multiple regression analyses that follow.

As shown in Table 2.4, the letter decoding (Letter) and word reading comprehension (Semantic) test scores are the least related predictors in Grade 2 ($r = .19$). Letter and word decoding in both Grades 2 ($r = .36$) and 3 ($r = .52$) show significant relations. Word reading comprehension is quite strongly correlated with word decoding in both Grades 2 and 3.

Table 2.4. *Correlations among Predictor Variables in Grades 2 and 3 for All Participants* ($N \approx 120$)

	Grade 2			Grade 3		
	Letter	Word	Semantic	Letter	Word	Semantic
Grade 2						
Letter		.36**	.19*	.52**	.30**	.23*
Word			.75**	.36**	.89**	.66**
Semantic				.23*	.74**	.79**
Grade 3						
Letter					.52**	.44**
Word						.68**
Semantic						

Note. Letter = letter decoding; Word = word decoding; Semantic = word reading comprehension. *p < .05, **p < .01.

Table 2.5. *Correlations among Predictor Variables in Grades 2 and 3 Split by Gender. Boys* ($N \approx 60$) *above and Girls* ($N \approx 60$) *below the Main Diagonal*

	Grade 2	Grade 3				
	Letter	Word	Semantic	Letter	Word	Semantic
Grade 2						
Letter		.38**	.15	.53**	.38**	.13
Word	.38**		.71**	.46**	.72**	.65**
Semantic	.24	.75**		.21	.73**	.75**
Grade 3						
Letter	.51**	.27	.21		.55**	.43**
Word	.27*	.93**	.72**	.48**		.71**
Semantic	.32*	.65**	.79**	.41**	.65**	

Note. Letter = letter decoding; Word = word decoding; Semantic = word reading comprehension. *p < .05, **p < .01.

Concerning gender differences in correlations among predictors (Table 2.5), they were significant just in one case; between word decoding in Grade 2 and word decoding in Grade 3 (boys = .72; girls = .93, $p < .01$).

2.4.3 Correlation among target variables

The correlation between sentence reading comprehension and teachers' assessment of silent reading comprehension in Grade 6 was .59 for the total sample (boys, $r = .53$; girls, $r = .58$). This rather modest figure could perhaps be related to the different shapes of the frequency distributions of boys and girls in the teacher assessments, which are not in accordance with the shapes

Table 2.6. *Correlations of Predictor Variables in Grades 2 and 3 with Target Variables in Grade 6. Split for Gender and Median Split for Sentence Reading Comprehension in Grade 3*

	Grade 6									
	Sentence reading comprehension					Silent reading comprehension				
	Total	Boys	Girls	Strong	Weak	Total	Boys	Girls	Strong	Weak
Grade 2										
Letter	.19	.19	.22	.21	−.06	.08	−.03	.23	.16	−.13
Word	.71**	.65**	.72**	.56**	.69**	.59**	.56**	.60**	.44**	.41**
Semantic	.64**	.53**	.67**	.39**	.50**	.72**	.68**	.73**	.61**	.51**
Grade 3										
Letter	.41**	.43**	.35**	.32*	−.02	.20**	.15	.18	.31*	.01
Word	.73**	.69**	.73**	.61**	.67**	.56**	.58**	.50**	.44**	.35*
Semantic	.70**	.63**	.70**	.43**	.56**	.65**	.57**	.66**	.40*	.41**

Note. Letter = letter decoding; Word = word decoding; Semantic = word reading comprehension. *$p < .05$, **$p < .01$.

of the frequency distributions of sentence reading comprehension (see Section 2.4.1 and Appendix C).

2.4.4 Correlations between predictor and target variables

The relationships (product-moment coefficients) between predictor and target variables are shown in Table 2.6.

Concerning Table 2.6, there is a tendency that word decoding in both Grades 2 and 3 in the total sample is more powerful in predicting sentence reading comprehension in Grade 6 than silent reading comprehension in Grade 6 (differences significant at $p < .05$). Letter decoding is apparently irrelevant for prognostic purposes, with the unexpected and notable exception of the Grade 3 results in relation to sentence reading comprehension in Grade 6. This applies to boys, girls, and those strong at sentence reading comprehension in Grade 3 but not to those weak at sentence reading comprehension in Grade 3. Letter decoding in Grade 3 also predicts silent reading comprehension as assessed by teachers in Grade 6 at $p < .05$.

The formula Reading = Decoding x Comprehension is often used to explain the relation between the decoding and comprehension components of reading (e.g., Hoover & Gough, 1990). Creating the new multiplicative and additive variables Word decoding x/+ Word comprehension, and Letter decoding x/+ Word comprehension and relating them to the target variables showed no advantage of the product over the linear combination of the components, a finding that does not support Hypothesis 1 b (Table 2.7).

Table 2.7. *Correlations of Multiplicative versus Additive Decoding/Comprehension Predictive Variables in Grade 2 with Target Variables in Grade 6. Split for Gender and Median Split for Sentence Reading Comprehension in Grade 3*

	Target									
	Sentence reading comprehension					Silent reading comprehension				
	Total	Boys	Girls	Strong	Weak	Total	Boys	Girls	Strong	Weak
Predictor (raw scores)										
Word decoding × word comprehension	.66	.59	.69	.54	.64	.62	.70	.60	.47	.47
Word decoding + word comprehension	.72	.63	.75	.54	.65	.71	.69	.70	.58	.50
Letter decoding × word comprehension	.58	.54	.57	.39	.25	.58	.57	.57	.42	.30
Letter decoding + word comprehension	.61	.53	.64	.40	.34	.63	.54	.68	.53	.31

2.4.5 Multiple regression analysis

A multiple regression analysis (Table 2.8) of the predictors from Grades 2 and 3 in relation to the target variable sentence reading comprehension confirms the above pattern, showing that in Grade 2, word decoding (Word) gives the most significant contribution to the prediction in Grade 6 for both boys and girls. For girls, word reading comprehension (Semantic) also provides a significant contribution to the prediction already in Grade 2. From Grade 3, word decoding still gives the strongest (and only) significant contribution to the prediction equation for boys, but now word reading comprehension gives the only significant contribution for girls. In relation to the target variable silent reading comprehension, the analysis indicates that word reading comprehension in Grade 2 yields the only significant contribution to the prediction. From Grade 3 this is still true for girls but for boys word decoding has now become the strongest predictor.

2.5 Discussion and Conclusions

The first hypothesis (Hypothesis1a), that sentence reading comprehension and teacher assessment of silent reading comprehension in children in Grade 6 can be predicted from their decoding (letter and word decoding) and word reading

Table 2.8 *Multiple Regression Analysis (Standardised Regression Coefficients and R) of the Predictors in Grades 2 and 3, and the Target Variable Sentence Reading Comprehension in Grade 6 and Teacher Assessment of Silent Reading Comprehension in Grade 6*

	Sentence reading comprehension			Silent reading comprehension		
	Boys	Girls	Total	Boys	Girls	Total
Predictor						
Grade 2						
Letter	–.05	–.01	–.02	–.20	.06	.06
Word	.57**	.49**	.52**	.26	.08	.15
Semantic	.14	.31*	.26*	.52**	.65**	.63**
R	.66	.75	.73	.72	.73	.73
R–adj.	.40	.53	.52	.49	.51	.52
Grade 3						
Letter	.07	.08	.07	–.27*	–.16	–.20*
Word	.45*	.24	.36**	.61**	.23	.43**
Semantic	.25	.53**	.39**	.19	.52**	.37**
R	.72	.48	.75	.67	.68	.69
R–adj.	.77	.56	.55	.42	.42	.47

Note. Letter = letter decoding; Word = word decoding; Semantic = word reading comprehension
*p < .05, **p < .01.

comprehension capacities in Grades 2 and 3, was confirmed for both boys and girls, with the exception of letter decoding, where the hypothesis was confirmed only from Grade 3. The multiple regression analysis specifies this pattern of results and provides through *R* an index of the accuracy of the prediction. Generally, there seem to be almost as accurate predictions from Grade 2 as from Grade 3, which underpins the argument for assessments in Grade 2 and early actions to avoid self-fulfilling prophesies of reading acquisition.

The second proposition of the first hypothesis (Hypothesis1b), that a combined decoding-comprehension prediction would be more powerful as a product than as a linear combination, was not confirmed. These findings do not contradict the prediction from the simple view of reading model (see Sections 1.2 and 2.1) as a revision of this model (substituting reading comprehension for listening comprehension) was introduced in the present study. Nonetheless, the findings motivate some restraints in the widespread use of the simple formula: Reading = Decoding x Comprehension.

Concerning Hypothesis 2a, girls tend to be more advanced in every predictor variable, in both Grades 2 and 3. The only exception was letter decoding, where boys and girls did not differ significantly. Concerning Hypothesis 2b, girls also tended to be (non-significantly) more predictable than boys according to every predictor/target correlation, with the exception of word decoding in Grade 3 predicting silent reading comprehension in Grade 6.

Word decoding might be approached in different ways, stressing either decoding or comprehension components. The covariation of word decoding and letter decoding results might imply a decoding strategy, whereas the covariation of word decoding and word comprehension results might imply a comprehension strategy when reading. The correlations (.75 in Grade 2 and .68 in Grade 3) between word decoding and word reading comprehension indicate that, despite substantial common variance, differences useful in diagnosing reading difficulties might be obtained by singling out children who have difficulties in comprehension, although they decode quite well, from children who get the gist out of script despite feeble decoding and spelling problems.

It is notable how differently the teachers evaluate the silent reading comprehension of boys and girls. The achievements of boys are apparently judged as distributed according to the bell curve, whereas this is not so for the girls. The frequency distributions of reading comprehension test scores did not show these characteristics. Does this difference support the widely used notion that men tend to be seen as the norm and women, by definition, as exceptions?

According to Snow et al. (1998), letter identification (i.e., how many letters a pre-schooler is able to name when shown letters in a random order) appears to be the strongest predictor ($r = .53$). Therefore, recognising and naming letters in pre-school then seems to assess different and more reading-related skills than drawing lines between identical letters in Grade 2, as in the present letter decoding test. This did not predict much of the variance in reading comprehension, with the notable exception that letter decoding in Grade 3 significantly predicted reading comprehension in Grade 6. This latter finding could be interpreted as indicating a developing "loading of reading" in letter decoding.

CHAPTER 3

From Image to Symbol

3.1 Introduction

The model (see Section 1.5.3.) proposes three paths of reading acquisition and reading comprehension, two of which induce inadequate reading. Can the different modes of reading be conceived of in terms other than reading speed, reading accuracy, and with reference to right and left hemispherical activation when reading? How to handle the "Jersild problem" (see Section 1.1); the choice between a pictographic and a phonographic code when trying to read.[1]

The suggestion that, accompanying the reading acquisition process, there are important changes in modes of perception of the pictographic/phonographic qualities in script, is supported by the Kullberg (1991, see Section 1.4.2) notion of an "initial collision" crisis (p. 275). This concerns the question of how learning will come about and is supposed to take place at the initial development of the learning of letters and the initial sounding together of consecutive graphemes and phonemes. The children stop thinking that learning comes from the outside and in some magical way will "plop into their heads" (p. 276). As the outcome of this crisis, the children approach their learning in different ways and think about it differently. Kullberg also observes a form-emphasised step in the initial learning of the letters of the alphabet when content and meaning in stories and texts do not seem to be important. "What is important to the children in this in-between step is the mastering of the form" (p. 301).

Using stories with both pictures and words, Kullberg (1991) notes changes in the reactions to these. In the first grade the children easily and without hesitations read the pictures, but pauses are noticed in front of words to be read. In grade three it is the other way around; hesitations are noted in front of pictures but not in front of words. In beginning reading they seem to be satisfied with pictures showing for example a dog or a tree, but when confronted with pictures in more advanced reading the children express a need to specify

[1] Davis (1999) considers the difficulty in reading words that do not give rise to images as the key problem of dyslectics.

the kind of dog or tree. It thus must be classified. Something seems to have been lost in the direct perception of images. "The pictorial symbols open up for possibilities to the beginning reader and the written words include possibilities for the reader "(p. 295).[2]

Peirce (1932) analyses signs as *icons, indices,* and *symbols*:

Icons have qualities resembling those of the objects they represent and could be further divided into *images*, alike in simple qualities, *diagrams* representing analogous relations and *metaphors* representing a parallelism.

Indices are anything that focuses the attention, such as the simple pronouns "this" and "that".

Symbols are words, sentences, books, and other conventional signs. "Any ordinary word as 'give,' 'bird,' 'marriage,' is an example of a symbol. *It is applicable to whatever may be found to realize the idea connected with the word*; it does not, in itself, identify those things. It does not show us a bird, nor enact before our eyes a giving or a marriage, but supposes that we are able to imagine those things, and have associated the word with them" (Peirce, 1932, p. 168). "A symbol, as we have seen, cannot indicate any particular thing; it denotes a kind of thing" (Peirce, 1932, p. 169).

It is notable that Peirce refers metaphors and symbols to different categories. To return to the pictogram and phonogram distinction, a pictogram means something in terms of its resemblance to a visual reference. In the terms of Peirce, this would be classified in the category of icons. In beginning reading it seems reasonable to look for the visual meaning of letters. Confronted with a letter, there is a possibility that the child attempts to understand what he or she sees as an icon, perhaps in the first place as an image or a pictogram looking like something, meaning something in terms of its visual form. When letters are then explained as something other than images, the ability to see them as images might vanish ("it's not a snake, it's an S"). If rotated 90 degrees, the letter S could again be seen as a snake. Its "letterishness" then vanishes.

If letters are not to be understood in their visual form, then how should we understand them? Are they to be understood as sounds without meaning? Or, are they to be understood as potential bearers of meaning because of their capacity to combine into words? As symbols for what? The images of the alphabet books do not make things easier, at least for some children. Even if letters have a prehistory as ancient pictograms, they do not now transfer meaning in this capacity, but rather in a symbolic capacity in linking to the sounds of language as phonograms. But they could of course still be perceived as either symbols or as images that, in a neuropsychological perspective, might allude to left and right hemispheric processing, respectively. [And with the possibility recognised of right hemispherical symbol reading as long as symbols are non-

[2] In refound copies of Aristoteles manuscripts the drawings on their own are as important as the written text. Later the written text became more important and drawings just complementary to the text (The world of science, TV 2, 030721).

phonetic and pictographic (Hatta, 1977a; see Section 1.4.1)]. With advanced reading, automated letter perception actualises the possibility of reading words as "images without visual meaning". This hypothetical stage could be referred to as "whole brain reading". That is to say, letters in beginning reading are transformed from signs without obvious meaning into images, then into symbols for sounds and eventually into parts of words (identifiable as word gestalts). Even the sound denotation of the letter is dependent on the word it is a part of; for example, *Lundberg* is pronounced as *Lumberg* in Swedish (Lundberg 1991). It may be possible that in beginning reading one tries to decode the message of a letter by looking at it as an image, which would mean using rightward cerebral processing. This is what the balance model (see Section 1.5.2) implies. But then one must have problems with phonology because of the weakness of the articulatory rehearsal loop in the right cerebral hemisphere (Donald, 1993). Still, the grapheme–phoneme linkage, at least at young ages, appears to be more a matter for the right than for the left hemisphere (De Graaf, 1996). Is this the paradox of right hemispheric reading?

At this juncture, one might question the practice of teaching reading from "words to letters". Would words at the outset of beginning reading (as gestalts, as images of words) induce a right cerebral bias? Starting with words, even these must be identified mainly by a rightward cerebral processing as images. One can identify, for example, the word camel by "the *m* has two humps". Could an early logographic reading in some cases even result in later reading problems of a certain kind?

Parallel to this shift in letter perception, what happens to the perception of images? Seen as images of something, they are seen as wholes, as gestalts in a direct process. They are easily identified, in which they are different from letters which lack this meaningful visual identity.

> We have seen as well that iconic writing systems – those that employ pictographic, ideographic, and/or rebuslike characters – necessarily rely, to some extent, upon our original sensory participation with the enveloping natural field. Only with the emergence of the phonetic alphabet, and its appropriation by the ancient Greeks, did the written images lose all evident ties to the larger field of expressive beings. Each image now came to have a strictly *human* referent: each letter was now associated purely with a gesture or sound of the human mouth. Such images could no longer function as windows opening on to a more-than-human field of powers, but solely as mirrors reflecting the human form back upon itself. The senses that engaged or participated with this new writing found themselves locked within a discourse that had become exclusively human. Only thus, with the advent and spread of phonetic writing, did the rest of nature begin to lose its voice (Abram, 1996, p. 138).

The general idea, then, is that in the beginning reading, images and letters are not identical and are thus perceived in different ways. The perception of letters is in an unstable phase of image–symbol transformation: from hard-to-identify images to signs for sounds to potential parts of words.

In Chapter 2, an indication of a “loading of reading” in letter decoding was observed in Grade 3 when letter decoding significantly predicted reading comprehension in Grade 6. The aim of this third chapter is to relate a possible transformation in letter reading to the main model (see Section 1.5.3). Are there indications of a critical period in reading acquisition in Grade 2/3 when the image–symbol interpretation dilemma becomes acute and serves as a starting point for the different paths of reading acquisition?

Letters in beginning reading are decoded as images (pictograms; one tries to see what they mean) and as symbols in more advanced reading (phonograms; one hears what they mean in the context of other letters, as symbols for words). This transformation might be indicated by changing qualities of image decoding, letter decoding, and word decoding as the activation of the brain is adapting to the demands of reading acquisition.

3.2 Hypotheses

According to the model in Section 1.5.3, the relation between image, letter and word decoding in early reading acquisition is supposed to change over time as the initial right hemispheric activation of the brain gives way to a balanced or a left hemispherical activation when reading. How, then, does one foresee the shapes of the possible patterns of correlations in these relations? Initially, trying to read letters as images will create difficulties. This difficulty is indicated by weak correlations between scores on image chains and letter chains tests which, however, gradually become stronger with reading proficiency. This change comes about because one gives up the reading of letters as images. Advanced mainstream readers manage to disregard or reinterpret the differences in item characteristics between letters and images, which is indicated by normally stronger correlations between test scores on image and letter decoding, whereas initial and problem readers are still under the influence of these differences, which would show weak correlations.

Hypothesis 1a: In general, the relation between image and letter decoding is in a process of strengthening from Grade 2 to Grade 6 (i. e., the correlation between scores on image and letter chains will increase from Grades 2 to 6). *Hypothesis 1b:* The strengthening does not apply to children weak in reading comprehension (i. e., the correlation between image and letter chains will not increase. The image/letter confusion prevails).

The rationale underlying the choice of letter chains in combination with word chains as indicators of potential dyslexia implies that scores on letter chains assess “non-reading” perceptual and motor skills. In Chapter 2, it was suggested that there is no simple relation between letter decoding and word decoding, but that such a relation could vary over time because letter reading changes from image to symbol reading. The reading of letters will become more comparable with the reading of words.

Hypothesis 2a: In general, the relation between letter and word decoding strengthens from Grade 2 to Grade 6 (i. e. the correlation between scores on letter and word chains increases from Grade 2 to Grade 6). *Hypothesis 2b:* The increased correlation does not apply to children weak in reading comprehension (i. e., the correlation between letter and word chains will not increase here as the image/letter confusion stills prevails).

How will the relation between image and word decoding turn out? Because advanced reading is "visual" or orthographic, it is suggested that the relation will become stronger as reading proficiency improves.

Hypothesis 3a: In general, the relation between image and word decoding strengthens from Grade 2 to Grade 6 (i. e., the correlation between scores on image and word chains will increase from Grade 2 to Grade 6). *Hypothesis 3b:* The stronger correlation, however, does not apply to children weak in reading comprehension (i. e., the correlation between letter and word chains will not increase as they cannot perceive words orthographically).

The results will be analysed as a function of gender and reading comprehension. This analysis will be performed because it is presumed that the analysis of the total sample "hides" important information that could be revealed by a subgroup analysis. Reading comprehension is obviously important when examining a process of transformation in letter decoding; gender differences are of interest because of research suggesting gender differences in hemispherical processing when reading (see Section 1.3.1), as well as notable differences in early reading abilities (see Section 2.4.1.1). These differences in early reading ability might especially concern the relations between image and letter decoding in that girls are assumed to involve the right image-processing hemisphere in reading to a greater extent than boys (Shaywitz et al., 1995).

3.3 Method

3.3.1 Tests

3.3.1.1 Tests of letter, word decoding, and reading comprehension

To examine the image–symbol transformation the tests presented in Chapter 2 were used in addition to an image-decoding test (the *Imagechains* test). Furthermore, in order to split for reading comprehension, the sentence completion test (*Read*) was employed. [See Section 2.3.1 regarding tests of letter decoding (*Letterchains*), word decoding (*Wordchains*), and reading comprehension (*Read*).]

3.3.1.2 The Imagechains: A test of image decoding

The *Imagechains* test has been used earlier to validate the *Letterchains* test (see Section 2.3.1.1) and is presumed to correlate from .80 to .85 with the *Letterchains* test (Jacobsson, 1993). The rationale for incorporating it in the

Figure 3.1. Examples of test items of the image decoding test (*Imagechains*). (The signs were indistinct when presented.)

present test battery was because of its “nonreading qualities”, that is, its “image character”. It demands perceptual/motor abilities similar to those necessary for writing, but not reading capacity. However, there might be different strategies applied in working through the items of the *Imagechains* test (e.g., going for gestalt or content). Examples of items are given in Figure 3.1.

The task is to put a mark between identical figures. There are 80 chains and the time limit is 90 seconds. Performance is expressed as the number of correctly marked items. In the present investigation the test–retest reliability for the scores on the *Imagechains* test from Grade 3 to Grade 6 was $r = .57$, $p < .000$.

3.3.2 Design

For the full design, see Section 1.6.2. As can be seen in Table 1.1, the letter and word decoding tests were administered late in Grades 2, 3, and 6 and the image decoding test in the middle of Grade 3 and late in Grade 6.

In the absence of image test results late in Grades 2 and 3, the expected correlations between letter and image decoding tests in Grades 2 and 3 and between word and image decoding tests in Grades 2 and 3 are tentatively assessed by relating the scores on letter and word decoding tests late in Grades 2 and 3 to the image decoding test scores in the middle of Grade 3.

3.3.3 Analysis

Relations between test scores on the image, letter, and word decoding tests in different grades were calculated using Pearson’s correlation coefficient. The results are split on gender (boys = B, girls = G) and reading proficiency in terms of results of the sentence reading comprehension test *(Read)* in Grade 3. Using a median split, participants were divided into weak reading comprehension (W > 9 points on *Read*) and strong reading comprehension (S > 8 points on *Read*).

3.4 Results

The results are presented in Figures 3.2–3.5 in the form of correlations between test scores on three separate occasions (i.e., Grades 2, 3, and 6). Figure 3.2 depicts the total sample; Figures 3.3.A (girls) and 3.3.B (boys) display correlations based on splitting only for gender; and Figures 3.4–3.6 depict correlations based on splitting for both gender and reading comprehension.

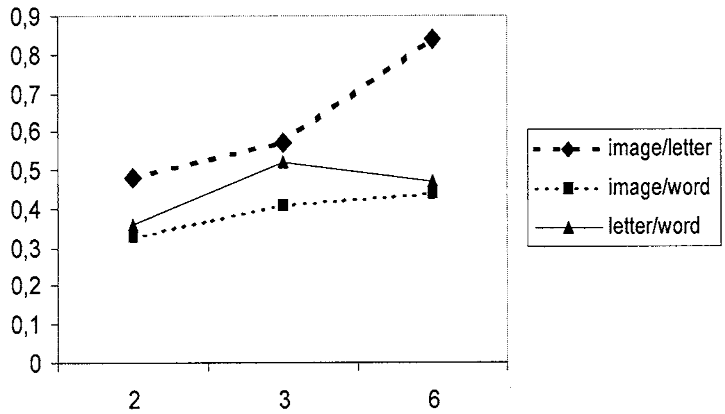

Figure 3.2. Correlation coefficients between image, letter, and word decoding scores in Grades 2, 3, and 6 for the total sample (image/letter, N = 109, 97, 110; image/word, N = 109, 106, 110; letter/word, N = 124, 111, 110; in Grades 2, 3, and 6, respectively).

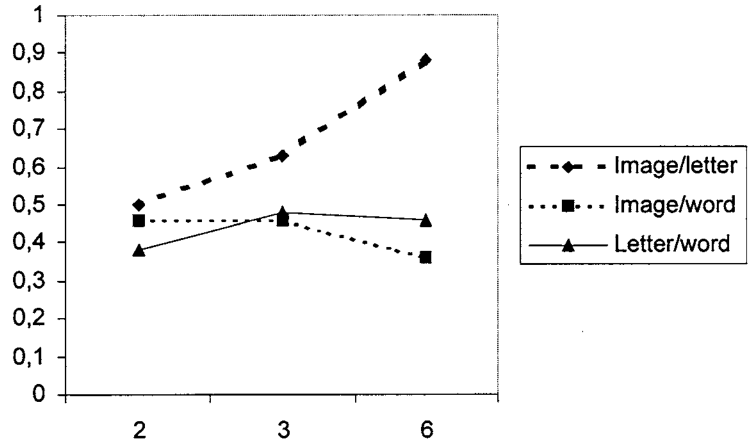

Figure 3.3.A. Correlation coefficients between image, letter, and word decoding scores in Grades 2, 3, and 6 for girls (Image/letter, n = 50, 43, 46; Image/word, n = 50, 48, 46; Letter/word, n = 56, 49, 45; in Grades 2, 3, and 6, respectively).

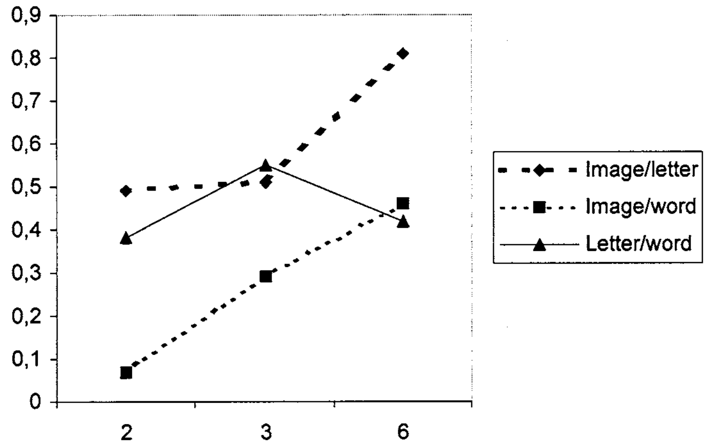

Figure 3.3 B. Correlation coefficients between image, letter, and word decoding scores in Grades 2, 3, and 6 for boys (Image/letter, $n = 44, 40, 50$; Image/word, $n = 44, 44, 50$; Letter/word, $n = 51, 47, 50$; in Grades 2, 3, and 6, respectively).

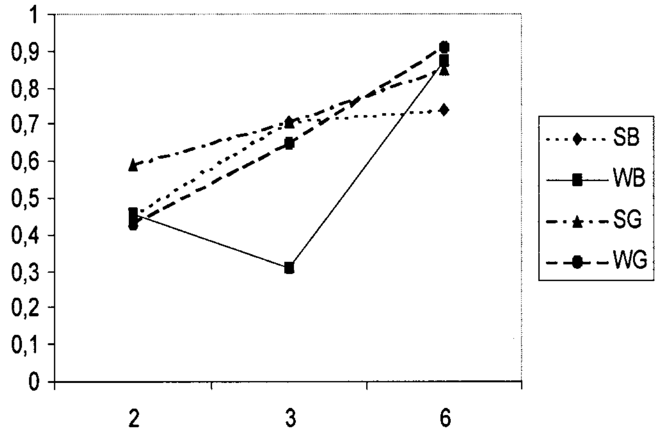

Figure 3.4. Correlation coefficients between image decoding and letter decoding in Grades 2, 3, and 6 split for gender (B = Boys, G = Girls) and reading comprehension in Grade 3 (W = Weak reading comprehension; S = Strong reading comprehension; SB, $n = 16, 13, 18$; WB, $n = 28, 27, 32$; SG, $n = 31, 26, 27$; WG, $n = 19, 17, 19$ in Grades 2, 3, and 6, respectively).

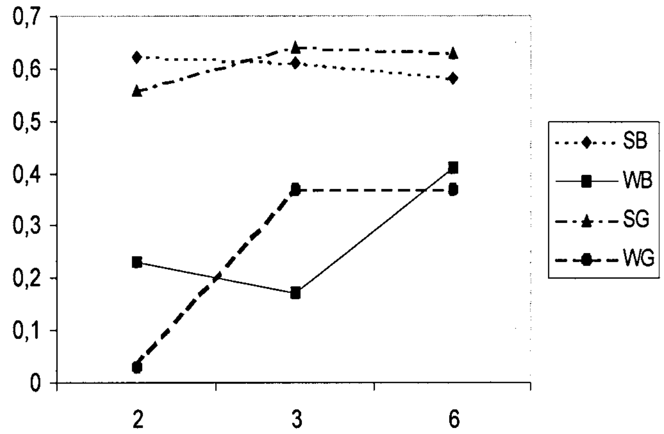

Figure 3.5. Correlation coefficients between letter decoding and word decoding in Grades 2, 3, and 6 split for gender (B = Boys, G = Girls) and reading comprehension in Grade 3 (W = Weak reading comprehension; S = Strong reading comprehension; SB, *n* = 19, 16, 18; WB, *n* = 32, 31, 32; SG, *n* = 35, 30, 27; WG, *n* = 21, 19, 19 in Grades 2, 3 and 6, respectively).

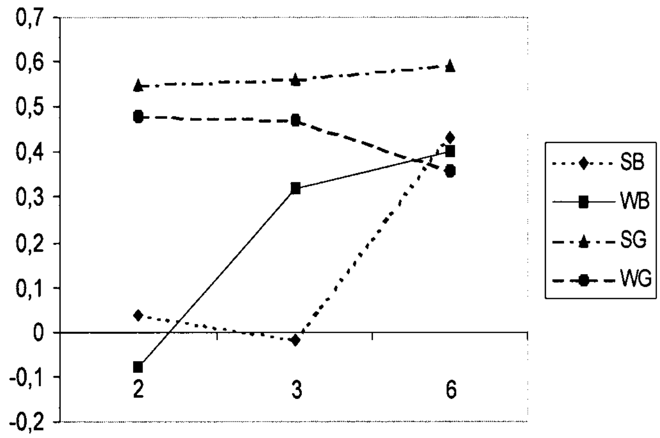

Figure 3.6. Correlation coefficients between image decoding and word decoding in Grades 2, 3, and 6 split for gender (B = Boys, G = Girls) and reading comprehension in grade 3 (W = Weak reading comprehension; S = Strong reading comprehension; SB, *n* = 16, 14, 18; WB, *n* = 28, 30, 32; SG, *n* = 31, 30, 27; WG, *n* = 19, 18, 19 in Grades 2, 3, and 6, respectively).

3.5 Summary of Results

3.5.1 Relationship between image and letter decoding

3.5.1.1 Total sample

The correlation over time (Grades 2 to 6) between image and letter decoding (Figure 3.2) exhibited a monotonic increase in accordance with Hypothesis 1a, and reached the same level in Grade 6 as noted in the manual of the *Word-chains* test (Jacobsson, 1993). Differences between correlation coefficients in Grade 2 and Grade 6 and between correlation coefficients in Grade 3 and Grade 6 were significant ($p < .01$).

3.5.1.2 Sample split for gender

No significant difference between boys and girls was found (Figures 3.3.A and 3.3.B). Hypothesis 1a is still supported by the data.

3.5.1.3 Sample split for gender and reading comprehension

The correlation over time (Grades 2 to 6) between image and letter decoding (Figure 3.4) evidenced a monotonic increase for the strong subgroups in accordance with Hypothesis 1a. However, girls weak in reading comprehension also showed this increase, a finding that contradicts Hypothesis 1b, which states a non-strengthening relation for the weak subgroups. An unexpected finding was the low correlation between image and letter decoding just for boys weak in reading comprehension and only in Grade 3. This finding clearly sets these boys apart from the general pattern. The difference between the correlation coefficient for weak boys and the correlation coefficient for the rest was marginally significant at $p = .07$. Thus, Hypothesis 1b only receives partial support concerning boys weak in reading comprehension in Grade 3. This subgroup showed a decrease in the strength of the correlation between image and letter decoding from Grade 2 to Grade 3, whereas the results in Grade 6 coincided with the results of the other subgroups.

3.5.2 Relationship between letter and word decoding

3.5.2.1 Total sample

The correlation between letter and word decoding (Figure 3.2) in Grades 2, 3, and 6 indicates some, though very limited, increase between Grades 2 and 3, with a waning off of this tendency between Grades 3 and 6. Such findings do not support Hypothesis 2a. Differences between correlation coefficients were not significant.

3.5.2.2 Sample split for gender

The correlation between letter and word decoding in Grades 2, 3, and 6 is around .40 to .50 with no significant difference between boys and girls (Figures 3.3.A and 3.3.B).

3.5.2.3 Sample split for gender and reading comprehension

Again, an unexpected difference was observed (Figure 3.5) between children weak and strong in reading comprehension regardless of gender. Those strong in reading comprehension displayed a stronger correlation between letter and word decoding. Regardless of gender, they did not show any increase in accordance with Hypothesis 1a in that the correlation between letter and word decoding starts at a rather high level and remains at this level. The opposite is true of those weak in reading comprehension. These children exhibit an initially low level of correlation between letter and word decoding in Grade 2. The difference between weak and strong subgroups was obvious in Grade 2 (significant at $p = .02$). It was marginally significant ($p = .06$) in Grade 3 and Grade 6 ($p = .12$). The findings for those children weak in reading fail to support Hypothesis 2b as there was an increase in the correlation between letter and word decoding.

3.5.3 Relationship between image and word decoding

3.5.3.1 Total sample

The correlation between image and word decoding was rather weak in Grades 2, 3, and 6 ($r = .33, .41, .44$, respectively; see Figure 3.2). Consequently, Hypothesis 3a concerning an increasing correlation was not confirmed.

3.5.3.2 Sample split for gender

Here, the findings indicate that Hypothesis 3a was valid for boys but not for girls (Figures 3.3.A and 3.3.B).

3.5.3.3 Sample split for gender and reading comprehension

In Grade 2, a gender specific difference was confirmed (significant at $p = .03$) regardless of reading comprehension (Figure 3.6). Higher correlations between image and word decoding were noted in girls as compared to boys, regardless of the strength of the boys' and girls' reading comprehension. Boys starting at about level zero in Grade 2 ended up at about the same level as did weak girls in Grade 6, but showed a difference between those strong and weak in reading comprehension in Grade 3. Thus Hypothesis 3a was partly confirmed for boys and Hypothesis 3b was not confirmed.

3.6 Discussion and Conclusions

Hypothesis 1a was confirmed regarding the increasing image/letter correlation from Grade 2 to Grade 6 as differences between correlations in Grade 2 and Grade 6 and between correlations in Grade 3 and Grade 6 were significant ($p < .01$). However, Hypothesis 1b was only partly supported for boys weak in reading comprehension in Grade 3. Hypothesis 2a, concerning the strengthening of the letter/word correlation from Grade 2 to Grade 6, was not confirmed. Those weak in reading comprehension showed a non-monotonic increase indicating non-confirmation of Hypothesis 2b. Hypothesis 3a, concerning the strengthening of the image/word correlation from Grade 2 to Grade 6, was partly supported for boys. Hypothesis 3b was not confirmed as those weak in reading comprehension, regardless of gender, showed a strengthening relationship.

Summing up the findings:

- weak boys stood out in Grade 3 showing weak correlation between images and letters
- reading comprehension level was critical for the letter versus word decoding correlations regardless of gender in Grades 2 and 3, those weak in reading comprehension showing weak correlations between letters and words
- gender was found to be decisive for the correlation between image and word decoding in Grade 2, boys showing weak correlations between images and words.

A general problem in the analysis when splitting for both gender and reading comprehension is the small sample sizes which could lead to misleading results. Thus, the results should be interpreted with great caution.

A speculative interpretation of the results, trying to relate to the neuropsychology of reading (see Section 1.3): Regarding gender differences, girls were equally good at image (right hemisphere) and word (left hemisphere) decoding tests whereas the results of these tests were initially more unrelated regarding boys (Figure 3.6). This might be the case because girls are supposed to activate both hemispheres in a balanced way when reading. Boys, on the other hand, as more extremely lateralised have difficulties in reading words and images in the same way and boys weak in reading comprehension also have difficulties in reading images and letters in the same way (Figure 3.4). It is worth noting that girls, who are generally more advanced than boys in the reading acquisition process, were not more advanced in letter decoding in Grade 2 as they were in image decoding. Correlations between results in letter and word decoding (Figure 3.5), both tests demanding left cerebral processing in advanced reading , will not evoke gender differences; however, they will evoke differences between strong and weak readers of both sexes because weak readers may still be uncertain in the decoding of letters as images or symbols. The lack of discriminatory power of the letter/word correlations regarding gender differences may be relevant for the interpretation of the much used wordchain/letterchain test.

A further question concerns the concept of the symbol in relation to sound, word, word in context, or semantic category. Are grapheme/phoneme connections to be considered as symbols in the common sense of the word? They do not, and they should not, mean anything besides a sign/sound relation, and are perhaps more to be seen as indices in the terms of Peirce (1932). Is it this meaninglessness that is hard to understand? One could refer to the subjective need of the dyslectic pupils of Witting (1995) to work with meaningless words, separating form from content (see Section 1.1.1), and to Kullberg (1991) on the change in the perception of letters and script at the time of the form-emphasised step in learning to read when content and meaning do not seem important (see Section 1.1.1). The studies of Castro-Caldas et al. (1998) and Petersson et al. (2000) also seem relevant in this context as they note the greater capacity of literate compared to illiterate subjects to repeat pseudowords, that is remembering meaningless information (see Section 1.3).

A related question concerns the supposed "concreteness" of the right hemisphere as metaphors rather may be referred to the symbol category together with concepts without any obvious connection to images. A problem with the Peirce (1932) categorisation system is that he refers metaphors to the icon category and only allows nonmetaphorical words in the symbol category. In this context, one could again consider the notion that the right hemisphere can handle abstract words as long as they are non-phonetic (Hatta, 1977a). Is it this non-phonetic trait of the right hemisphere that has led to the understanding that it is not capable of symbol reading?

In conclusion, there are indications that the hypothesis concerning an image/symbol transition may be useful in analysing the rather complex nature of the subgroup differences and the intricate relations between the development of image, letter, and word decoding abilities in reading acquisition. The information-retrieving possibilities of subgroup analysis are clearly indicated. Splitting for gender revealed differences in the image and word decoding relation and splitting also for reading comprehension, added information on image/letter and letter/word decoding differences. Disregarding gender differences may be the main reason for non-confirmation or partial confirmation of Hypotheses 1 and 2 while perhaps the timing of the process concerned in Hypothesis 3 is inappropriate. The results could be contained within the general model but certainly motivate attention to gender differences. Are boys especially prone to complicate a possible image/symbol transition?

CHAPTER 4

Stages in Reading Acquisition

4.1 Introduction

The ambition of this chapter is to discuss a stage concept applied to reading acquisition according to the proposed model (see Section 1.5.3), and examine whether such a concept is useful in interpreting the results of some tests of phonological and orthographic decoding. The model contains two modes of inadequate reading; a delayed phonologic/indirect route and a premature orthographic/direct route. In Chapter 3, gender specific signs were found indicating a low correlation between image and word decoding in Grade 2 for boys in general and between image and letter decoding concerning boys weak in reading comprehension in Grade 3. Are these signs possible indications of a critical stage transition for boys? A related question is whether it is possible to be left behind in early stages of reading acquisition when retarded in the development of reading.[1]

A key question is whether – and in what way – there are general stages in reading acquisition or if there are only processes related to each new written item that the individual is not earlier acquainted with (Share & Stanovich, 1995; for a critical review, see also Coltheart et al., 1993). To what extent does the learning-to-read process reflect the pedagogical method of learning? This procedure in itself often contains elements of initial whole-word presentations, followed by grapheme/phoneme pairing and eventually more advanced reading demands. Stages found in reading acquisition could then be just artefacts, reflecting the educational method. Could there be a "natural way" of learning to read? Even though there are children who seemingly learn to read by themselves, this seems to be the exception: for the majority, the process has to be guided.

> This issue is of great importance if we consider the possibility that different habits or experiences and different educational methods could result in different func-

[1]Some comments on the consequences of month of birth in relation to reading comprehension are given in Appendix D.

> tional structures, so that it would be useless to describe reading failure in terms of a defect in a theoretical structure (corresponding to the model) that has never actually developed. Moreover, the units in the model might be different, or differently linked, at different stages of reading acquisition (Lorusso, in Licht & Spyer, 1994, p. 4).

In the following sections, some indications of a general stage development in reading acquisition are examined. In the next part, Chapter 5, the question of inadequate subgroup developments is discussed.

4.2 Stages

Lorusso (1994) maintains that there is some general agreement on "an initial shift from whole-word, visual recognition strategies to a more analytical, phonologically based strategy of decoding grapheme-by-grapheme, and a subsequent further shift to an exclusively linguistic, so-called 'orthographic' strategy" (p. 3). Examples of these kinds of stage models are proposed by, for example, Frith (1985) in terms of a logographic strategy when words are recognised as wholes, followed by an alphabetic strategy when graphemes are conversed into phonemes, and finally, an orthographic strategy when words are analysed into abstract orthographic units (morphemes) without phonological conversion. These three stages may first parallel and then substitute for one another. Further, Höien and Lundberg (1999) identify four similar stages in word recognition when learning to read:

1. Pseudo-reading (the child pretends to read).
2. Logographic–visual reading (the child starts to attend to a global visual configuration of words).
3. Alphabetic–phonemic reading (the child succeeds in breaking the alphabetic code or cipher).[2]
4. Orthographic–morphemic reading (the child discovers the structures of higher order, recurring spelling patterns, prefixes, word stems, etc., word recognition is increasingly automated).

Possible parallels to the Höien-Lundberg scheme in the early perception/decoding of letters include the following:

(1) Letters are overlooked as not meaningful.
(2) S is a snake. The Jersild dilemma (see Section 1.1). Letters are seen as images or as pictograms (logographic reading – you try to see what they mean).

[2]One must note that the alphabetic–phonemic reading of stage 3 represents something other than the pre-school phonologic awareness training proposed (according to the Bornholm model, see Lundberg et al., 1988) to counteract later development of reading difficulties and which is not presumed to link grapheme and phoneme (see also Gustafsson et al., 2000).

(2/3) S is not a snake but something you can do reading with.
(3) S becomes a sound. Letters are seen as representing sounds (phonologic reading – you may try to hear what they are intended to mean but they do not really mean anything).
(3/4) Letters are seen as potential parts of different morphemes and words. (They can be parts of different meaningful auditory patterns.)
(4) It is possible finally to bypass the auditory phase and again receive the message mainly by vision (orthographic reading).

With a whole-word approach to reading acquisition, a word reading period might be identified before stage 3. However, to be able to read unfamiliar words, there must be a return to the scheme proposed above. And there is also the phenomenon of deaf reading, indicating the possibility of a solely orthographic path to reading. Stages 2 and 3 are characterised by a transition in letter reading from image to symbol reading – grasping the code. Is this “deciphering” a gradual process or is it the result of a more sudden insight (*Aha-Erlebnis*)? Does it mark a change in the general perception of the world in an analytical direction, that is, a Piagetian schema transformation?

The postulated phonological stage initially coincides with the weak correlation between image and symbol decoding examined in Chapter 3 (letters may be seen as images or symbols for sounds) and finally with the transition to the orthographic stage with advanced symbol reading ability (clusters of letters as symbols for morphemes or words). A possible scheme might consider as critical the transitions from image reading (logographic) to letters-as-sounds (phonological) to words-as-symbols (orthographic) and eventually to advanced reading comprehension. Instead of stages, it is perhaps more appropriate to refer to critical periods or tasks that demand solutions to very different aspects of the deciphering of written language.

The meaning of letters is just their meaninglessness but the meaning of words is their potential for being meaningful. This is a qualitative difference that makes the either/or character of the grapheme/phoneme connection less adequate regarding words. The lexicon look-up metaphor is not very adequate when it comes to understanding words, the meaning of which has to be built in a long process of associations in different contexts. If the words are very concrete nouns, perhaps an image will do as reference. But images also have their associations and their interpretations are the results of lifelong learning (Sacks, 1995).

There might also be a certain problem concerning the concepts of orthography and orthographic strategy being confused with the concepts of logography and logographic strategy. What does orthography really represent? It is associated with a visual whole-word process and concerns especially the meaningfulness of the language unit, that is, its semantic and syntactic status. “The distinction between logographic whole-word recognition, based on purely visual cues, and an orthographic strategy is not always taken into consideration in other models of reading acquisition" (Lorusso, 1994, p. 4, referring to the model of Frith, 1985).

Still, a problem is the fact that the stage concept is not clear. It could be applied in different ways by supposing harmonious or conflict-ridden transitions between the potential stages. In the latter case one should expect breakdowns in reading between stages. Are stages to be seen as succeeding each other, existing parallel to each other or as later ones incorporating earlier ones? Does the concept of stages imply a certain time spent in the stage or just a passing through process? Then passing through what? Are we talking about a staircase or a hill slope? Are there successive tasks to be solved in order to reach advanced reading skills: a logographic stage solving the problem of image/symbol confusion, then a stage primarily depending on an auditory, phonological reading strategy, solving the phoneme/grapheme linkage tasks, and finally a stage primarily depending on an orthographic, nonauditory strategy, solving the tasks of advanced reading? Alternatively, is it more adequate to look at the process as if interrelated problems have to be solved in order to enter a new stage characterised by the newly acquired skills? Then, for example, the image/symbol confusion has to be solved before entering a phonologic stage, the grapheme/phoneme linkage tasks have to be solved before entering an orthographic stage, and the whole-word decoding skills need to be mastered before advanced reading. Or are stages, as hang-ups in reading acquisition, rather to be avoided? The question arises again as to whether there are gradual processes, parallel processes, or sudden insights induced by educational methods.

Olofsson (2003) presents data from a study on the development of word recognition in terms of phonologic and orthographic skills. When examined in Grades 2 to 9, the orthographic decoding ability increases dramatically by Grade 4, whereas the phonologic decoding ability scarcely increases after this year. Thus, orthographic word decoding is getting under way from Grade 3 to 4, making for a rapid and correct decoding of common words (Figure 4.1). Olofsson concludes: "The normal path of reading acquisition in Swedish commences with an initial phonological word-decoding stage. However, very soon, perhaps during the first year of instruction, orthographically based coding processes become increasingly more important for the development of word-recognition speed" (2003, p. 153)

Share and Stanovich (1995) question the sound-to-visual-based stage theories and propose instead that phonological decoding might be item based, that is, it is a process in connection with each new word and not a stage in the development of reading in general. In any case, it seems that there must be a certain time when knowledge develops that letters are not images but signs for sounds. This insight, however, could hardly be item based.

There might exist a certain difficulty demonstrating general stages and subgroups in a common context. The balance model of Bakker (1994, see Section 1.5.2), the main constituent of the proposed model (see Section 1.5.3), in a sense resolves this problem by allowing for the possibility of a mainstream

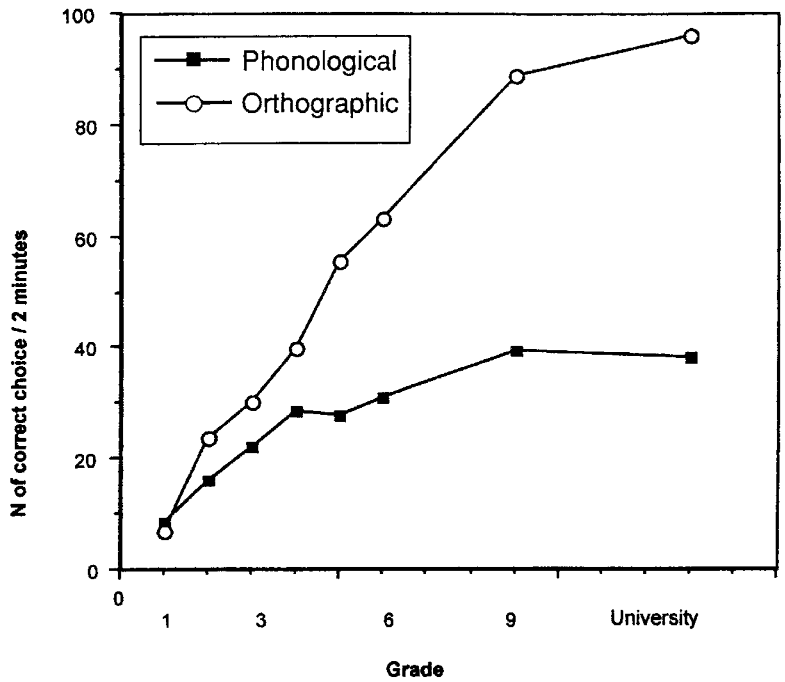

Figure 4.1. General development of orthographic and phonologic word decoding ability. Twenty-nine psychology students in university sample, 59 children in Grade 9 and 16, 34, 37, 39, 59, and 22 in Grades 1 to 6, respectively, and approximately equal numbers of boys and girls (after Olofsson, 2003).

development and inadequate subgroup developments in the same theoretical framework.

In this chapter, the stage concept is applied in the sense that one is presumed to read in qualitatively different ways during reading acquisition, orthographically-based coding processes becoming increasingly more important for the development of word-recognition speed. A phonologic (reading mainly by hearing) process is supposed to be replaced by an orthographic (reading mainly by seeing) process. The Olofsson (2003) study is partly replicated in a longitudinal setting and with special attention directed to sub-group and individual differences.

4.3 Hypotheses

In the present empirical data, are there indications of a phonologic stage of importance for reading comprehension that precedes an orthographic stage? A straightforward indication of an initial phonologic phase followed by an orthographic phase would be a high frequency of cases where, in early reading acquisition, phonological word decoding is stronger than orthographic word decoding while the opposite is true in more advanced reading. However, because phonologic and orthographic decoding, in the present study, are measured on different scales that are probably not comparable, such a procedure would not be meaningful. However, it would be possible to test if there are non-parallel developments in phonologic and orthographic mean scores between Grades 3 and 6 for sub-groups differing in reading comprehension strength. According to Olofsson's (2003) study, between Grade 3 and Grade 6, orthographic decoding scores in general increase more than phonologic decoding scores.

Hypothesis 1. The increase in orthographic decoding between Grade 3 and 6 is more pronounced than the increase in phonologic decoding, especially for those strong in reading comprehension.

Another way of examining this general problem is to hypothesise that in early stages of reading acquisition, phonologic decoding would be more strongly related to reading comprehension than would orthographic decoding, the opposite being true in later stages.

Hypothesis 2. In Grade 6, the correlation between orthographic decoding and reading comprehension is stronger than in Grade 3, the opposite being true regarding phonologic decoding.

A growing dependency on orthographic decoding should not strengthen the correlation between phonologic and orthographic decoding from Grade 3 to Grade 6 – rather the reverse.

Hypothesis 3. The correlation between orthographic and phonologic decoding is stronger in Grade 3 than in Grade 6.

Because of the gender differences found in the previous chapters, the results of boys and girls are studied separately. Subgroup analyses of those strong and weak in reading comprehension might also reveal patterns not found when analysing the total sample.

4.4 Method

4.4.1 Tests

4.4.1.1 Phonologic word decoding test

This test and the following one were developed by Åke Olofsson (see Olofsson, 1994b, 2003, and Figure 4.1) at the University of Umeå in Sweden. The task of phonological word decoding requires "reading" or phonologically decoding a number of pseudo-words, some of which are pseudo-homophones, that is, they sound like ordinary Swedish words if one pronounces them. To solve this task (time limit = 120 seconds, number of items = 80, total score = number of right answers), the participant has to recode the pseudo-words to a "sound form" which he or she then tries to identify as possible real words that sound like those when pronounced. The test used in the present study is similar to that used in the study of Olofsson (1994b, 2003) referred to above (see Section 4.2). In later versions there are, instead of two words per row, three to four. Orthographic knowledge is of limited use as none of these pseudo-words are to be found in the Swedish dictionary. In the present study, the test–retest reliability from Grade 3 to Grade 6 for the phonologic word decoding test was *r* (95) = .43, with no significant (*p* = .16) gender difference [boys, *r* (49) = .53; girls, *r* (44) = .29].

Example of test items
Which words sound like ordinary words?

kjur	sorf
vöt	*såmm*
schön	ongi
slejk	*vämm*
tjilling	gjorv

(The words italicised above – not in the test – sound right in Swedish although they are not spelled correctly.)

4.4.1.2 Orthographic word decoding test

Here the task is to compare two words, one of which is correctly spelled although not in a phonological way, and the other is the same word spelled in a phonological way (but wrongly according to the dictionary). The time limit is 120 seconds and the number of items is 140 (total score = number of correct answers). The test used in the present study is similar to that used in the study of Olofsson (1994b, 2003) referred to above (see Section 4.2). In the present study, the test–retest reliability from Grade 3 to Grade 6 for the orthographic word decoding test was *r* (95) = .76, with no obvious gender difference [boys, *r* (49) = .67; girls, *r* (44) = .79].

Example of test items
Which word in each pair is correct?

sand	sannd
syckel	*cykel*
hökt	*högt*
genom	jenom

(The words italicised above – not in the test – are correctly spelled in Swedish.)

In Olofsson's (1994a) study, the correlation between orthographic decoding and wordchains (based on a somewhat modified version of the Wordchains test) was .84, the correlation between orthographic decoding and phonological decoding was .67, and the correlation between phonological decoding and wordchains was .67. Olofsson suggests that these correlations are as expected considering that the Wordchains test consists of fairly frequent words that can best be processed rapidly using an orthographic strategy. This argument helps explain the high correlation between the orthographic and Wordchains test.

It is plausible to argue that the Wordchains test is suited for a phonologic strategy because the absent space between the words is visible but not heard when pronounced.

As to relations with other tests, Olofsson (1994b) reports that in Grade 3 the orthographic word-decoding test correlated 0.81, and the phonologic word-decoding test 0.48, with the Wordchains test. In Grade 5, these correlations were 0.71 and 0.52 respectively.

Olofsson (1994a) remarks that, despite huge decoding problems, some people can read a simple text by using a guessing strategy based on identified morphemes and contextual information. There are also a limited number of adults with reading problems (even self-admitted) who do not show a defective word-decoding ability.

4.4.1.3 Sentence reading comprehension test

Sentence reading comprehension was assessed using the same tests as described in Section 2.3.2.1.

4.4.2 Analysis

The analysis of the phonologic and orthographic decoding tests and the sentence reading comprehension test is based on the raw scores. (For descriptive statistics, see Table 4.1 and Appendix A.) Relations between test scores were calculated using Pearson's correlation coefficient.

Weak or strong reading comprehension was defined by (A) a median split in sentence reading comprehension in Grade 3 which resulted in weak (< 9 in Grade 3) and strong (> 8 in Grade 3) sentence reading comprehension groups or (B) a median split in sentence reading comprehension in Grade 6, which resulted in weak (< 16 in Grade 6) and strong (> 15 in Grade 6) sentence reading comprehension groups. These two ways of defining strong and weak subgroups yielded very similar results.

4.5 Results with Comments

4.5.1 General characteristics of the phonologic and orthographic decoding tests, and the sentence reading comprehension test in Grade 3 and Grade 6

Descriptive statistics of the phonologic and orthographic decoding tests, and the sentence reading comprehension test in Grade 3 and 6 are given in Table 4.1. (Graphical representations of the distributions are shown in Appendix A.)

Table 4.1 *Descriptive Statistics of the Phonologic (Phono), Orthographic (Ortho) Decoding Tests, and the Sentence Reading (Read) Comprehension Test in Grades 3 and 6*

Test	*N*	Minimum	Maximum	*M*	*SD*
Phono Grade 3	112	2	63	20.49	10.18
Phono Grade 6	110	3	55	30.61	11.56
Ortho Grade 3	112	1	65	23.00	15.06
Ortho Grade 6	110	3	98	34.45	18.54
Read Grade 3	110	0	21	8.17	4.99
Read Grade 6	110	2	32	17.05	6.62

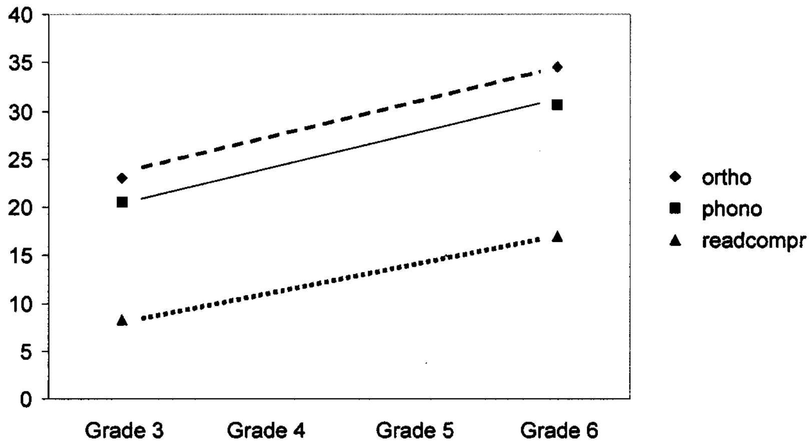

Figure 4.2 Mean results for total group in Grade 3 and Grade 6 in phonologic decoding (phono), orthographic decoding (ortho), and sentence reading comprehension (readcompr) (phono: Grade 3, $N = 112$, Grade 6, $N = 110$; ortho: Grade 3, $N = 112$, Grade 6, $N = 110$; readcompr: Grade 3, $N = 110$, Grade 6, $N = 110$)

4.5.2 Phonologic decoding, orthographic decoding, and sentence reading comprehension from Grade 3 to Grade 6 for total group

Regarding these three tests the development in general between Grade 3 and Grade 6 as indicated by mean raw scores appears to be parallel (Figure 4.2).

4.5.3 Phonologic and orthographic decoding tests from Grade 3 to Grade 6 split for gender and reading comprehension

When splitting for gender and splitting in halves for sentence reading comprehension in Grade 3, the development between Grade 3 and Grade 6 appears to be roughly parallel (Figure 4.3). Boys and girls strong in reading comprehension did better on orthographic as well as phonologic decoding compared to

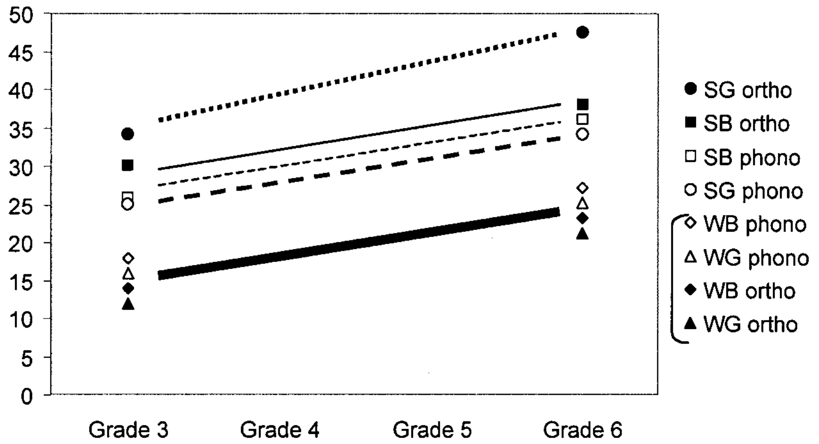

Figure 4.3 Phonologic (phono) and orthographic (ortho) decoding tests in Grades 3 and 6, split for gender (B = boys, G = girls) and sentence reading comprehension in Grade 3 (W = weak, S = strong).

boys and girls weak in reading comprehension. The results of the weak subgroups were found to be very close to each other and are connected by a broad line in Figure 4.3.

A statistical test of Hypothesis 1, that the gap between orthographic and phonologic decoding scores is wider in Grade 6 than in Grade 3, means that the Orthographic (Grade 3, Grade 6) × Phonologic (Grade 3, Grade 6) interaction should be significant. Further, to test possible interactions with Gender and Reading comprehension, an Orthographic (Grade 3, Grade 6) × Phonologic (Grade 3, Grade 6) × Gender (boy, girl) × Reading comprehension (weak, strong) ANOVA was carried out where the first two factors are within-subjects factors and the last two between-subjects factors. The analysis revealed that the Orthographic × Phonologic interaction was non-significant, $F(1, 92) = 1.08$, $p = .30$, and so was the three- and four-way interactions, $F(1, 92)$ varying between 0.01 and 2.32, and p varying between .13 and .94. Thus, there appears to be a parallel development between Grades 3 and 6 in phonologic and orthographic ability, and this pattern seems to be the same for boys and girls and for those with low and high reading comprehension. Figure 4.3 nicely illustrates this outcome. Thus, Hypothesis 1 was not confirmed.

Ignoring for the moment the commensurability problem of the scales, a closer look at the results reveals considerable individual differences. Nineteen cases (12 girls and 7 boys) out of 127 scored higher on phonologic than orthographic decoding in Grade 3 and the other way around in Grade 6. The reversal, scoring higher on orthographic than phonologic decoding in Grade 3 and the other way around in Grade 6, was valid in 15 cases (11 boys and 4 girls). Phonologic word decoding scores were higher than the orthographic word decoding results in both Grade 3 and Grade 6 for 26 individuals (14 boys and 12 girls). This may indicate different individual or sub-group scoring patterns rather than stages.

4.5.4 Correlations in Grade 3 and Grade 6 of phonologic and orthographic decoding with sentence reading comprehension

The correlation between orthographic decoding and sentence reading comprehension for the total group was r (108) = .83 in Grade 3 and r (108) = .75 in Grade 6. These figures are significantly ($p < .01$) higher than corresponding correlations between phonologic decoding and sentence reading comprehension [r (110) = .54 in Grade 3, and r (108) = .56 in Grade 6]. All correlations are significant from 0 at $p < .01$ but there were no significant differences between the Grade 3 and 6 results, neither for phonologic nor for orthographic decoding (ps > .10).

Thus, Hypothesis 2 does not find support as the correlation of orthographic and phonologic decoding with reading comprehension was about the same in Grades 3 and 6. Further, orthographic decoding showed a stronger relation to reading comprehension in both grades.

4.5.5 Correlations in Grade 3 and Grade 6 between phonologic and orthographic decoding

The correlation between phonologic and orthographic decoding in Grade 3 for the total group was r (110) = .48 and in Grade 6 it was r (108) = .62, both coefficients significant from 0 at the 0.01 level. Splits were made on gender and sentence reading comprehension in Grade 6. These subgroup analyses showed mostly significant correlations at least at $p < .05$ varying between .01 and .05. Non-significant exceptions were found in Grade 3 regarding both boys and girls strong in sentence reading comprehension [boys, r (18) = .09; girls r (25) = .32] and for strong boys also in Grade 6 [r (25) = .34]. In all four subgroups, the correlations were stronger in Grade 6 as compared to Grade 3. Thus, Hypothesis 3 does not find support.

4.6 Discussion and Conclusions

The gap between phonologic decoding results and orthographic decoding results in general did not widen between Grades 3 and 6. This was also the case for all subgroups, split for gender and reading comprehension. Hypothesis 1 was thus not confirmed. The difference between orthographic and phonologic decoding scores was related mainly to girls strong in reading comprehension (see Figure 4.3). Is their special gift a capacity to "go beyond" phonology? When interpreting results of phonologic and orthographic tests it is highly

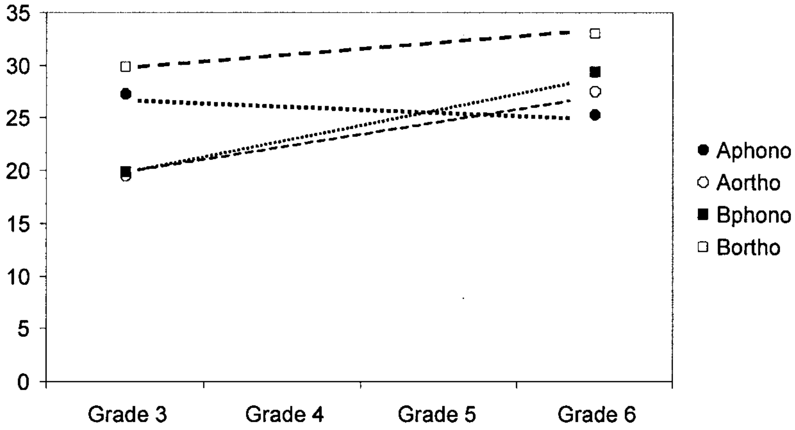

Figure 4.4 Mean results for School A (9 boys and 14 girls) and School B (8 boys and 13 girls) in Grade 3 and Grade 6 in phonologic (phono) and orthographic (ortho) decoding.

recommendable to consider the actual frequency of boys and girls in the study.

Hypothesis 2 did not find support as the correlation of orthographic and phonologic decoding with reading comprehension was of the same magnitude in Grades 3 and 6. In all four subgroups, the correlation between phonologic and orthographic decoding was stronger in Grade 6 as compared to Grade 3. Thus, Hypothesis 3 did not find support either.

Judging from Olofsson's studies (see Figure 4.1, Section 4.2), phonologic and orthographic decoding skills are concomitant until Grade 4, and then phonologic decoding ability remains about the same while orthographic decoding ability increases. Why is this not the case in the present study? A difference between the studies is that the present one is longitudinal whereas Olofsson's was cross-sectional. There might be rather significant differences between schools and classes in a cross-sectional study due to different teaching traditions and specific circumstances, such as cut-downs in special education, or differences in teaching staff and/or educational policies.

Differences between schools can also be exemplified in the present study (see Figure 4.4). The children in School A showed a decrease in phonologic decoding mean scores from Grade 3 to Grade 6 (from 27.22 to 25.30) whereas the children in School B showed an increase (from 19.86 to 29.33).

As none of the hypotheses find support, there were, in the present study, no obvious indications of a general phonologic stage in reading acquisition where phonologic and orthographic processes are parallel, followed by a stage when they diverge. The general trend seems to be that phonologic and orthographic decoding skills are moderately concomitant (r = .48 and .62 in Grades 3 and 6, respectively). What are indicated are not stages but rather different individual or subgroup characteristics. Perhaps a successful reader, by definition, is able to change strategies according to the type of task? The orthographic and phonologic decoding skills, rather than being put in a sequential setting of stages, may be seen as dialectically interrelated.[3] Consequently the proposed model (Section 1.5.3) ought to be interpreted accordingly.

[3] According to the neuropsychology of reading (see Section 1.3) the present tests of phonologic and orthographic decoding may both rely heavily on left-hemispherical processing.

CHAPTER 5

Comparing Sub-types

5.1 Introduction

Discussions concerning questions related to dyslexia have been intense in Sweden from time to time (von Euler, Hjelmqvist, Lundberg, Myrberg, & af Trampe, 1998; Hjälme, 1999). Generally speaking, the problem of reading difficulties was largely underrated during the 1970s and 1980s. In the 1990s, however, we have witnessed a renewed interest in the topic. The discourse has centred on fairly specific aspects:

- How many people are to be diagnosed as dyslectics, if any at all? Where to draw the dividing line and why (Tönnessen, 1995)?
- Is not the real problem that of being labelled as dyslectic and thus stigmatised (rather than not being able to read and labelled as lazy or stupid; Riddick, 2000)?

At one extreme, there has been a one-category dyslexia diagnosis and at the other, a multifaceted analysis of the reading of the single individual. In between these positions very few suggestions related to different dyslexia dimensions or sub-types have been put forward in reading research in Sweden, although numerous typologies have been suggested internationally (see, e.g., Hooper & Willis, 1989, for an overview). That the dyslexia sub-typing discussion is not merely of academic interest is evident if, for example, it can be demonstrated that remediating ought to be tailor-made according to the particular difficulty of the individual. The reading of some individuals should perhaps be hastened while that of others should be slowed down. Consequently, by reversing the treatments, direct harm might result with respect to reading acquisition.

Internationally, there is currently widespread support for the notion that sub-types of dyslexics can be identified (Höien & Lundberg, 1999; Castles et al., 1999). There are a great variety of ways to diagnose dyslexia (Hooper & Willis, 1989).

When referring to sub-types of dyslexia, it is important to bear in mind that we are talking about two hypotheses: first, that there is something that could be defined as dyslexia, distinguishable from reading difficulties in general and also from illiteracy, and secondly, that this possible category could be split into sub-types. Another way of thinking, which perhaps is more in line with the findings reported in earlier chapters, envisages different styles of reading among readers in general, and suggests that you could be "left behind" at various critical moments in the reading acquisition process.

This chapter deals with the distinctions according to the dual-route model (see Section 1.5.1) and the balance model (see Section 1.5.2), two diagnostic systems combined in the proposed model of reading, reading acquisition, and reading difficulties (see Section 1.5.3). The letter/word-decoding instrument for screening of potential dyslexia (see Section 2.3.1) is also considered in the same context. In the Swedish educational system this instrument is much used as a screening instrument for reading difficulties. The manual of this test (Jacobson, 1996) holds that:

> "High scores at the word decoding test in combination with clearly lower scores at the letter decoding test can be seen as signs of specific decoding problems when reading. It might be a sign of dyslectic problems. Observe though that dyslectics might as well show low scoring at Letter chains" (1996, p. 23).

A dyslexia index is proposed based on the first alternative (see Appendix F). The notion of a second, different response pattern is not further enlarged upon in the manual. Do these patterns reflect different dimensions of dyslexia?

A question of principal interest is how the different diagnostic systems relate to each other and to the proposed model (see Section 1.5.3) and whether and how they could be used to understand the results of the present study. Empirical data concerning low-achieving individuals are analysed in search of consistent scoring patterns or potential sub-types.

5.1.1 The dual-route model (phonological and surface dyslexia) in relation to the balance model [P-(perceptual) and L-(linguistic) dyslexia]

A commonly made distinction is the one between *developmental phonological dyslexia,* characterised by poor non-word reading, and *developmental surface dyslexia,* characterised by poor reading of irregular words (Castles et al., 1999). The dual-route models (e.g., Coltheart et al., 1993), proposing an indirect, non-lexical, grapheme–phoneme based way of reading and a direct, lexical, whole-word based way of reading, imply two patterns of possible reading disorders (Castles et al., 1999). A weakness in the indirect route relates to the poor non-word reading in phonological dyslexia "since reading such items is presumed to require the use of conversion rules", whereas a weak direct route relates to the poor irregular, exception-word reading of surface dyslexia "since success with these items is thought to require access to word-specific information" (Castles et al., 1999, p. 74; see also McAnally, Castles, & Stuart, 2000).

> We wish to emphasize that we do not see the poor readers in the surface and phonologic dyslexic subgroups as representing distinct "subtypes", who are qualitatively different from other dyslexics, but rather simply as those subjects who fall at the extreme ends of the distributions of performance on orthographic and phonological processing (Olson et al., 1985). Based on an assumption that these processes can develop independently, at least to some degree, we interpret the surface dyslectic pattern in terms of relatively better development of phonological than orthographic skills and the phonologic dyslectic pattern as the reverse (Castles et al., 1999, p. 89).

These two dyslectic patterns are thus characterised by both a weakness and a relative strength or compensatory strategy. The surface dyslectic, weak at word specific information, tries to read phonologically and, consequently, falls short at irregular words. The phonological dyslectic, weak in conversion rules, tries to read orthographically but falls short when confronted with non-words.

A condition must be that there is an alternative strategy fairly strong, but not too strong either, as otherwise the individual would not have been classified as dyslectic. In that case the dyslexia could have been compensated for. Another necessary condition is that the alternative strategies are present at the same time and do not develop in succession, as you cannot of course prefer a strategy not yet developed. Because an orthographic strategy in terms of advanced morphemic/linguistic ability is hardly developed in early reading, perhaps Castles et al. refer to an orthographic strategy more in the sense of a logographic reading of letters and whole words as images. However, one is then left with the problem of logographic decoding preceding phonologic decoding. The assumption of independence of the phonological and orthographic processes could also be questioned (see Chapter 4). In a longitudinal perspective, the independence might vanish as reading skill becomes integrated and intertwined. In dyslexia, perhaps, a problem may be precisely the independence of these processes. Are the concept of two routes and the concept of a dimension in dyslexia "at the extreme ends of the distributions of performance on orthographic and phonological processing" compatible? Is not a dimension between two routes a bit hard to conceive?

What about these categories in relation to the P-type (perceptual) and L-type (linguistic) dyslexia proposed by the balance model? Licht (1994) comments:

> In conclusion the present findings suggest that L-type children have problems in the visual analysis of letter arrays and may also have difficulties with graphemic analysis or grapheme–phoneme translation. Their slower responses in lexical and semantic decision tasks relative to normal readers may be attributed to the aforementioned problems, and probably not to problems in lexical search processes. In contrast, when it concerns lexical processing, the poorer performance of P-type children may be largely attributed to problems in accessing and searching the

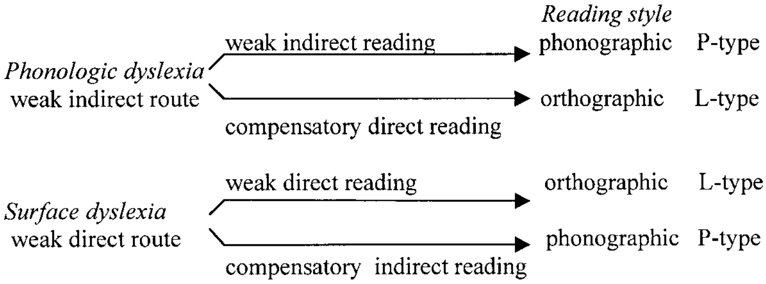

Figure 5.1 Two ways of interpreting dyslectic reading.

> lexicon, problems that cannot be ascribed to deficits in visual scanning or letter identification. If the latter interpretations are valid, then L-type children may (have to) adopt a direct 'logographic' reading strategy to compensate for their problems in analysing letter features, whereas the lexical problems P-type children have may force them to rely on a slow, indirect reading strategy (Licht, 1994, p. 53).

According to the terms of P- and L-dyslexia, Ps are ineffective direct readers taking time to decode and using an indirect strategy (like surface dyslectics); in contrast, Ls are ineffective indirect decoders with a more rapid process and using a direct strategy (like phonologic dyslectics). Licht here adapts to the concept of compensatory strategies.

An alternative view (Figure 5.1) is that when reading deficiently, one is not using an alternative strategy but is in fact reading with the weak strategy labelling the dyslexia, incapable of developing a more effective strategy.[1] The dyslectic who uses a weak phonologic strategy when reading should not be seen as a surface dyslectic trying to compensate. Rather, he or she could be defined as a phonologic dyslectic with a phonologic reading strategy. For the same reason, the dyslectic using a weak orthographic strategy might not be seen as a phonologic dyslectic trying to compensate but as a surface dyslectic reading with a weak orthographic strategy. In this alternative view, P-dyslectics according to the balance model, persistently trying to do phonologic grapheme–phoneme indirect reading with the right hemispheric non-meaningful letter images, are comparable to phonologic dyslectics reading with a weak phonologic strategy. Further, L-dyslectics according to the balance model, persistently trying to do orthographic/logographic whole-word direct reading with the left hemispheric sound/grapheme conversions, are comparable to surface (orthographic) dyslectics reading with a weak orthographic strategy.

A further question is how the postulated phonologic and orthographic strategies in individuals are related to the successive mastering of the logographic/

[1] These questions can be seen as parallel to the discussion concerning acquired deep dyslexia, whether the individual is reading with the damaged left hemisphere or using the undamaged right hemisphere (Coltheart, 2000).

phonological transition (decoding written script as sounds, not as images) and the phonological/orthographic transition (getting meaning from whole words and sentences). You could remain using a logographic strategy in an attempt to solve both phonological and orthographic demands with this strategy, or you could remain using a phonologic strategy in an effort to solve orthographic demands. In this context can be observed that Höien and Lundberg (1999) discuss the plausible and interesting notion that orthographic dyslexia can be caused by limited phonological difficulties in combination with inadequate experience of reading, whereas phonologic dyslexia represents more serious phonological difficulties in combination with extensive reading experience.

At least two types of framework for interpreting reading difficulties are identifiable:

(A) *Compensatory*. Reading in a certain way because the reader is comparatively good at it and perhaps has also been trained in it. The theoretical framework of Castles et al. (1999) proposes such an alternative as a compensatory manoeuvre of the reader confronted with difficulties. Having problems with phonology, the reader uses orthography and vice versa.

(B) *Non-compensatory*. Because readers are having difficulties preventing them from advancing their reading development, they remain in a stage or are in the process of regressing to it. The reader reads phonologically, although he/she is weak at it and orthographically despite orthographic difficulties. Concerning the balance model, the reader is reading deficiently with an unbalanced hemispherical activation, which might be due to the lack of bilateral hemispherical support. "Possible causes may be a functional over-development of one hemisphere and/or an under-development of the other hemisphere, or brain dysfunction and even brain lesion" (Kappers, 1997, p. 4).

As phonologic or orthographic reading strategy is not decided in a free-choice situation, the problem of compensatory or non-compensatory reading in dyslexia can, in the present study, just be touched upon.

The aim of this chapter is mainly to explore, very tentatively and descriptively, whether it is possible in the same context to treat the surface/phonologic distinction (Castles et al., 1999), the perceptual/linguistic sub-typing (Bakker, 1990) and weak word decoding combined with weak or notably stronger letter decoding (Jacobson, 1993, 1996). Is it possible, in a compensatory set-up, to identify:

- phonologic dyslectics (L-type dyslectics in terms of the balance model), having problems with the indirect grapheme/phoneme conversion route, better at orthographic than phonologic decoding and weak at word and letter decoding
- surface (orthographic) dyslectics (P-type dyslectics in terms of the balance model), having problems with the direct route, better at phonologic than orthographic decoding and notably better at letter decoding than word decoding?

According to a non-compensatory interpretation of surface and phonologic dyslexia (see Figure 5.1), phonologic dyslexia will equal P-type dyslexia and surface dyslexia will equal L-type dyslexia. In order to approach this question the kind of errors made in the phonologic and orthographic decoding tests and the teacher assessments of reading pace are analysed.

5.2 Method

5.2.1 Test instruments

The tests (the sentence reading comprehension test, and the image, letter, word, phonologic, and orthographic decoding tests) were described in Chapters 2, 3 and 4. Reading pace was rated by teachers on 5-point scales, ranging from 1 (very slow) to 5 (very fast).

5.3 Results and Comments

5.3.1 Inadequate readers in Grade 6 according to sentence reading ability

In the present study, how to define normal in relation to dyslectic (inadequate) development of reading? In Figure 5.2 the scores on the word decoding test and sentence reading comprehension test are plotted against each other and a way of delimiting the inadequate subgroup is indicated.

To assess reading it seems most appropriate to use the sentence reading comprehension test, as skills expressed in this test seem to be the most adequate expression of what is generally considered as reading. (Also of interest is the decoding aspect of reading as it is shown in the results of the word-decoding test. The high and low achievers in word decoding in Grade 6 are described and analysed in Appendix E.)

The definition of inadequate readers at this stage is very exploratory and tentative, just cutting off some 10% from the low end of the distribution. If there are subgroups of inadequate readers, they ought to be found here.

A proposed cut-off point for Sentence Reading Comprehension is indicated in Figure 5.2 [reading comprehension scores < 10 (n = 10, that is 9,1% of total N); 9 boys and 1 girl]. In what follows this distinction to delimit inadequate readers is applied. To further define the inadequate readers of Grade 6, Figure 5.3 shows the positions of the inadequate readers in scatter plots (comprised of total N) of phonologic decoding against orthographic decoding test scores and, in Figure 5.4, letter decoding against word decoding test scores.

In Section 5.3.3, the candidates are examined for surface and phonologic dyslexia in relation to L-type (linguistic) and P-type (perceptual) dyslexia and the letter/word decoding instrument. The compensatory or non-compensatory concepts regarding dyslexia are considered.

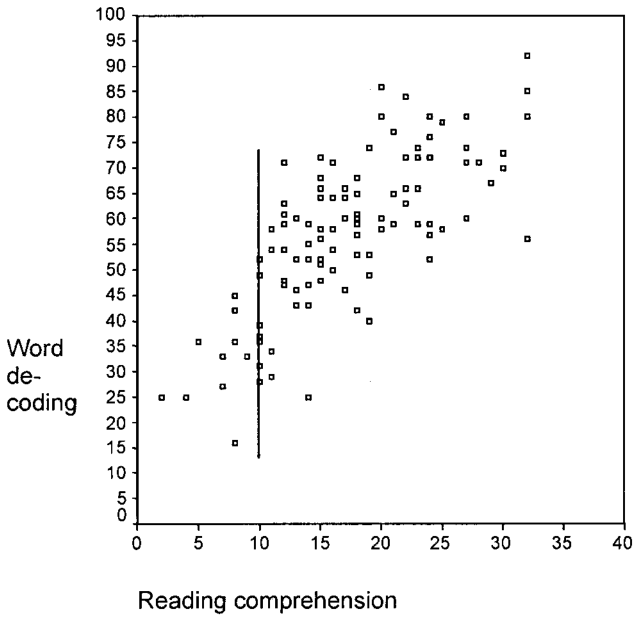

Figure 5.2 Scatter plot of Sentence reading comprehension scores (x-axis) and Word decoding scores (y-axis) for total sample in Grade 6. Inadequate readers (Sentence reading comprehension score < 10 in Grade 6) are indicated.

5.3.2 Graphic analysis of inadequate readers (candidates for dyslexia sub-types) in Grade 6 according to sentence reading ability

5.3.2.1 Phonologic versus orthographic decoding

According to the compensatory set-up, those supposed to be found above the diagonal in Figure 5.3 are the surface (orthographic, P-type) dyslectics, doing better in phonologic decoding, and below the diagonal, the phonologic (L-type) dyslectics, doing better in orthographic decoding. The inadequate readers in Grade 6 are indicated with black dots.

Figure 5.3 shows that those weak in reading comprehension in Grade 6 are also weak in orthographic decoding, but vary in phonologic decoding from weak to normal.

5.3.2.2 Letter decoding versus word decoding

Are phonologic dyslectics (L-type), who have problems with the indirect grapheme–phoneme conversion route, better at word than letter decoding? Similarly, are surface dyslectics (P-type), who have problems with the direct route, better at letter decoding than word decoding?

As shown in Figure 5.4, those weak in reading comprehension in Grade 6 all do better in letter decoding compared to word decoding. In word decoding they are all weak but in letter decoding the scores range from very weak to strong.

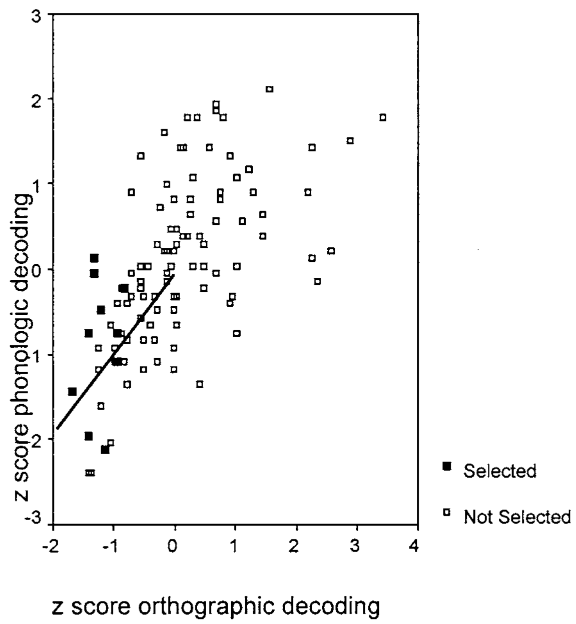

Figure 5.3 Scatter plot (total *N*) of phonologic decoding results in relation to orthographic decoding results (expressed as *z* scores) in Grade 6. Weak reading comprehenders in Grade 6 (reading comprehension score < 10 in Grade 6) are selected and marked.

5.3.3 Candidates for surface and phonologic dyslexia in relation to L-type (linguistic) and P-type (perceptual) dyslexia. Compensatory or non-compensatory interpretations

What are the characteristics of the most typical candidates for the surface (*z* phonologic decoding > *z* orthographic decoding) and phonologic (*z* orthographic decoding > *z* phonologic decoding) patterns? Do they fit into a compensatory or non-compensatory interpretation of the patterns? Table 5.1 shows (in *z* values) the scores of the candidates on Image, Letter, Phonologic, Word, and Orthographic decoding tests. Also shown are the differences between Orthographic and Phonologic decoding results, the results on the Sentence reading comprehension test, and Teacher assessments of Reading pace.

As seen in Table 5.1, there is a weak (though not extremely weak) spectra of scores concerning image, letter, and phonologic decoding ability among those categorised as inadequate readers of both patterns, whereas word and orthographic decoding are generally very weak. The candidates that stand out are No 27, who does very well in letter decoding, and No 46, who is extremely weak in image, letter, phonologic and word decoding. Weak candidates for surface dyslexia due to a small difference between phonologic and orthographic decoding are Nos 19 and 10. For the same reason No 121 is uncertain as a phonologic candidate.

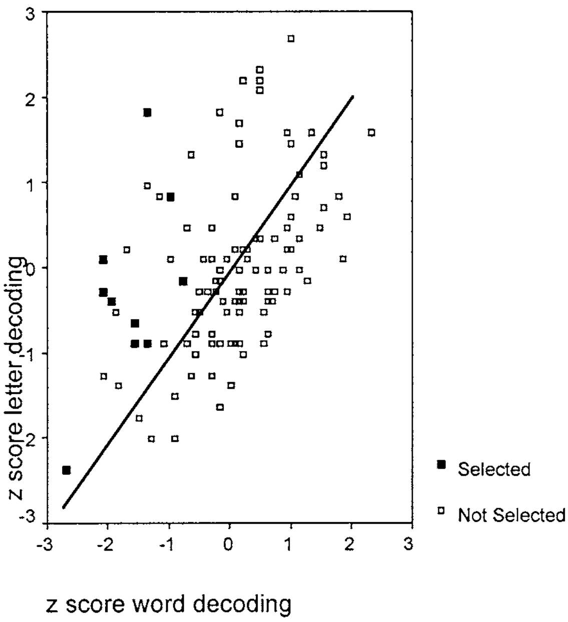

Figure 5.4 Scatter plot (total *N*) of letter decoding results in relation to word decoding results (expressed as *z* scores) in Grade 6. Weak reading comprehenders in Grade 6 (reading comprehension score < 10 in Grade 6) are selected and marked.

There are no other obvious signs of differentiating test score characteristics regarding the potential surface and phonologic dyslexia candidates apart from the phonologic–orthographic decoding difference, which is, by definition, clearly positive for surface and slightly negative for phonologic dyslexia candidates.

In Section 5.1.1 the correspondence between the P-type/L-type and the surface/phonologic distinctions in reading difficulties and the possible relations to letter, word, phonologic, and orthographic decoding scores were questioned. To check the consistency of the pattern of strong letter combined with weak word decoding (labelled as uneven: Stanine difference > 3) and the pattern of weak letter combined with weak word decoding (labelled as even: Stanine difference ≤ 3), Table 5.2 shows the scores of the dyslexia candidates on these tests in Grades 2, 3, and 6.

Comments

Concerning the relation between letter and word decoding results comparing the Grade 2 and Grade 6 results we find that all four with even results in Grade 6 were already even in Grade 2. Of the 6 with uneven results in Grade 6 two were uneven and three were even in Grade 2 (one is missing in Grade 2).

Concerning phonologic decoding one phonologic dyslexia candidate (No 40) deteriorated in phonologic decoding between Grades 3 and 6, another (No

Table 5.1 *Test Scores*

Dyslexia candidates	*Test* Image decod	Letter decod	Phono decod	Word decod	Ortho decod	Ortho–Phono	Read compr	Read pace
Surface dyslexia P(L)								
No 6 (boy)	0.1	–0.9	0.1	–1.4	–1.3	1.4	–1.8	3
No 27 (boy)	*0.1*	*1.8*	*–0.1*	*–1.4*	*–1.3*	*1.2*	*–1.4*	*2*
No 7 (boy)	0.4	–0.3	–0.7	–2.1	–1.4	0.7	–2.0	2
No 19 (boy)	–0.8	0.1	–1.4	–2.1	–1.7	0.3	–2.3	1
No 37 (boy)	–0.6	0.8	–0.5	–1.0	–1.2	0.7	–1.4	2
No 110 (boy)	–0.4	–0.2	–0.2	–0.8	–0.8	0.6	–1.4	4
No 10 (boy)	–0.5	–0.9	–0.7	–1.6	–0.9	0.2	–1.2	2
Phonologic dyslexia L(P)								
No 40 (girl)	–0.3	–0.4	–2.1	–2.0	–1.2	–0.9	–1.5	1
No 121 (boy)	–0.7	–0.7	–1.1	–1.6	–0.9	–0.2	–1.5	1
No 46 (boy)	*–2.5*	*–2.4*	*–2.0*	*–2.7*	*–1.4*	*–0.6*	*–1.4*	*1*

Test Scores (z-transformed) on Image, Letter, Phonologic (Phono), Word, and Orthographic (Ortho) Decoding, Reading Comprehension (Read compr), and Reading Pace (Read pace) According to Teacher Assessments (on a 5-point Scale) in Grade 6 of Candidates for Surface and Phonologic Dyslexia Diagnosis (most Typical in Italics). Difference between Orthographic and Phonologic Decoding Indicated (Ortho–Phono). Perceptual Dyslectic and Linguistic Dyslectic Categories According to a Compensatory Model Indicated by P and L. (P) and (L) in Brackets Indicate Definitions According to a Non-compensatory Analysis. The Numbers Identifying the Dyslexia Candidates are Taken from the Original Data Sheet.

46) showed the smallest increase, and the third (no 121) made progress. The surface candidates all make progress in phonologic decoding between Grade 3 and Grade 6, especially Nos 6, 27, 7, and 10 (Nos 7 and 10 starting from a low level, Nos 37 and 110 from a higher level). No 19 does not fit into the pattern. Nos 121 and 19 are also indicated in Table 5.1 as weak candidates.

The most typical candidates in Table 5.2 (Nos 27 and 46) stand out; No 27 extremely uneven in Grade 2, 3, and 6 and really making progress at phonologic decoding between Grades 3 and 6, no 46 extremely even in Grades 2, 3, and 6, and hardly making progress at phonologic decoding between Grade 3 and 6.

5.3.3.1 Arguments for a non-compensatory interpretation of the phonologic and surface dyslexia distinction

The high proportion of cases in the surface dyslexia category is remarkable (see Table 5.1) as this is not usually the predominating dyslectic category (Lorusso, 1994).

Teacher assessments of the actual reading style of the individuals (see Figure 5.1, variable Read pace) characterise the phonologic dyslexia candidates (supposed to be relatively better at orthographic than phonologic skills) as

Table 5.2 *Dyslexia Candidates*

	Grade 2		3		6			3	6	
	word	letter	word	letter	word	letter	evenness	phono	phono	diff
Candidate no										
6	1	3	1	6	3	5	even	12	32	20
27	2	9	4	9	2	9	uneven	12	30	18
7	–	–	2	8	1	6	uneven	2	22	20
19	1	3	2	8	1	7	uneven	8	14	6
37	1	9	7	–	4	9	uneven	18	25	8
110	4	3	3	5	3	7	uneven	17	28	8
10	4	3	–	–	2	5	even	8	22	14
40	1	1	–	–	1	5	uneven	13	6	–7
121	1	2	2	3	2	5	even	8	18	10
46	1	1	1	1	1	1	even	6	8	2

Even or Uneven Type According to Letter/Word Decoding in Grades 2, 3, and 6 (Stanine). See Text for Even/Uneven Criteria in Grade 6. Phonologic Decoding in Grades 3 and 6 (Raw Scores) and the Difference between these scores (diff).

extremely slow readers. Only one of the surface dyslexia candidates (supposed to be relatively better at phonologic than orthographic skills) is characterised as extremely slow, four as slow, one as normal, and one even as fast. In a compensatory context, phonologic dyslexia is identified with L-type dyslexia and surface dyslexia with P-type dyslexia (see Section 5.1.1) These assessments are paradoxical, as P-type dyslexia and L-type dyslexia by definition are characterised by different paces in reading in quite the opposite way, P-types being slower and L-types faster (Bakker, 1990). More exactly, both accuracy (number of real errors) and speed of reading count. It is the ratio of the two that decides whether dyslexia is more likely a P-type or an L-type. This ratio cannot be decided in the present study but in Table 5.3 the number of errors on word, phonologic, orthographic decoding and word comprehension tests are shown. With one exception, all surface dyslexia candidates demonstrate a higher rate of orthographic faults in Grade 6 than in Grade 3. (One of the phonologic dyslexia candidates does that). This fact may indicate a guessing strategy in line with L-type dyslexia. All three phonologic dyslexia candidates demonstrate a higher rate of phonologic errors in Grade 6 compared to Grade 3. This may indicate persistent phonologic problems in line with P-type dyslexia. Most of the surface candidates do not show this pattern.

These facts may question the compensatory in favour of a non-compensatory set-up regarding dyslectic reading.

Table 5.3 *Number of Errors*

	Word errors			Phonologic errors		Orthographic errors		Comprehension errors	
	Grade 2	Grade 3	Grade 6	Grade 3	Grade 6	Grade 3	Grade 6	Grade 2	Grade 3
Surface									
6	1	6	2	2	2	14	3	0	0
27	0	7	0	1	1	6	9	0	0
7	–	2	6	3	2	8	11	–	0
19	1	1	4	1	3	3	6	0	0
37	5	–	6	2	2	9	12	0	0
110	1	0	1	0	1	6	9	0	0
10	1	0	1	0	0	4	6	2	0
Phonologic									
40	3	–	6	1	6	4	4	0	–
121	5	0	0	2	4	3	7	0	0
46	15	0	1	0	5	5	4	0	0

Number of Errors on Word, Phonologic, Orthographic Decoding, and Word Comprehension Tests in Grade 2, 3, and 6 of Candidates for Surface and Phonologic Dyslexia Diagnosis (most Typical in Brackets).

5.4 Discussion and Conclusions

According to the difficult-to-remediate criterion of Vellutino et al. (1996) (see Section 1.2) one would expect about two severely impaired dyslectics among the children of the present study. Let us say that these are the most typical candidates of Table 5.1. Trying to apply the three models at the same time No 27 stand out as an example of one “prototype”, weak in word decoding and very strong in letter decoding (Jacobson’s main type), doing better in phonologic than orthographic decoding (Castles’s surface type), improving in phonologic decoding between Grade 3 and Grade 6 and reading by guessing (more orthographic than phonologic errors) and not very slow (Bakker’s L-type). The other “prototype” No 46, is weak in letter and word decoding (Jacobson’s second type), very weak in image decoding (logographic), doing better in orthograpic than phonologic decoding (Castles’s phonologic type), hardly improving in phonologic decoding between Grade 3 and Grade 6 and reading by demonstrating this weakness, slowly and with more phonologic than orthographic errors in Grade 6 (Bakker’s P-type). These individuals were both pinpointed in an initial Grade 2 screening of potential dyslectics (See Appendix G) as having serious problems.[2] At least one could argue that these

[2] Comparing the screening in Grade 2 with the inadequate readers of Grade 6, we find seven out of eleven from this group-at-risk turning up in the group of ten inadequate readers in Grade 6. (One girl from the group-at-risk had left and there was one newcomer in the group of dyslexia candidates.)

are examples of very different "dyslexias", hardly gaining by being classified in the same dyslectic category.

According to Castles et al. (1999), those reading phonologically (these readers are presumed to have problems of the orthographic, direct route) should be referred to as surface or orthographic dyslectics and those reading orthographically (these readers are presumed to have problems of the phonological, indirect route) should be named phonological dyslectics. This compensatory set-up could be open for discussion as the present results indicate that the children are perhaps reading with a weak strategy without access to a relatively stronger strategy. Those better at phonologic than orthographic decoding read relatively fast and by guess, like L-types and those better at orthographic than phonologic decoding, read very slowly and with more phonologic errors, like P-types. Accordingly, in Table 5.1, surface and L-type dyslexia should be coupled, as should phonologic and P-type dyslexia.

Gustafson et al. (2000, see Section 1.2.1), in their longitudinal intervention study of poor readers in Grade 4 receiving phonological awareness instructions, discuss the possibility that an integrated, relied-upon orthographic strategy could have become an obstacle for some. They found that phonological training for some children indeed helped to improve their reading, whereas others were resistant to this training. They found a remarkable difference between these two groups. For those improving from phonological training, both orthographic and phonological word decoding skills contributed to text reading ability, whereas those who did not improve continued to rely on orthographic decoding although their phonological awareness had increased. These results seem to agree with results deduced from the balance model (Bakker, 1979; see Section 1.5.2), according to which P-dyslectics (perceptual dyslectics) might improve from training of this kind but L-dyslectics (linguistic dyslectics) do not. The Gustafson et al. study can be seen as a strong argument for the necessity of analysing subgroups of dyslectics.

The main rationale underlying the combined letter/word decoding test used as a screening instrument for dyslexia concerns relatively strong letter decoding in combination with weak word decoding as a warning sign indicating potential dyslexia. Because this screening instrument relates to a definition of dyslexia as mainly a phonologic deficiency, a certain contradiction exists between this concept and the compensatory surface/phonologic dyslexia concept of Castles et al. (1999). The three individuals among the dyslexia candidates with letter decoding results above a z-score of 0 are all to be found in the category that is labelled surface dyslexia according to Castles et al., and basically seen as an orthographic weakness.

It is noteworthy that the letter/word decoding concept also acknowledges the existence of a combined weak letter and weak word decoding dyslexia (Jacobson, 1993), which can also be identified in the present study and contains the most typical phonologic dyslexia candidate (no 46) according to Castles et al. (1999).

The results indicate that those weak in reading comprehension vary in letter and phonologic word decoding almost to the same degree as normal readers. Thus, these tests in isolation are not promising indicators of dyslexia. However, in combination with a reading comprehension test they have the potential to discriminate between qualitatively different reading difficulties. It appears that inadequate readers can be better at phonologic than at orthographic skills just as the opposite. Inadequate readers are not found to be extremely low scoring in phonologic decoding, which means that the phonologic deficit hypothesis does not find unequivocal support in the present data.

Hopefully it has been demonstrated that it is possible to treat the different models applied in this chapter in a common context. If this is the case it might support the proposal of a common model of reading, reading acquisition, and reading difficulties (see Section 1.5.3).

CHAPTER 6

Reading Difficulties and the Twofold Character of Language

6.1 Introduction

The proposed model (see Section 1.5.3) suggests a normal route for reading acquisition and reading difficulties within a twofold scheme. This twofold kind of reasoning characterises, for example, the categories of decoding and understanding in the simple view of reading (see Section 1.2), the dual route model of reading (see Section 1.5.1), the distinction of phonologic and orthographic patterns regarding reading difficulties (see Chapters 4 and 5), and the linguistic and perceptual dyslexia of the balance model (see Section 1.5.2). Do they all refer to some common underlying dichotomy? For instance, the two dyslexias of the balance model refer to an unbalanced hemispherical activity when reading, either being late in reading with a right hemispherical activation or too rapidly moving to a left hemispherical activation.

Language can be understood as consisting of words and sentences denoting concrete and abstract content. When language is heard, the concrete words give rise to images and the abstract words are given meaning in the context or as metaphors. The process of metaphors becoming or being used as non-metaphors has been discussed by Asplund (2002), who points to the problematic cognitive effects of these pseudo-literal words.

Initially, when learning to read you must hear the written language, listen to your reading and get the meaning of the message (deaf reading is an important exception). Thus, abstract words can come to life in context. The meaning of separate concrete words can be seen as images in isolation from context. The lexicon look-up metaphor often associated with the direct route of the dual-route model for reading seems problematic and somewhat obsolete as a lexicon mainly treats words out of context. This is not how language is normally learned.

Analysing the signs of language, Roman Jakobson (1974) recognises two types of arrangement of signs: (1) in combination or nearness (metonymical), when signs (a) function as a context for more simple units and/or (b) find their context in more complex units of language: (2) in selection or similarity (metaphorical), substituting one alternative for another, equivalent in one aspect and differing in another. In combination two or more signs are present in a row while in selection signs are linked "in absentia".

Regarding the dependence on context, Share and Stanovich (1995) suggest that there has been a longstanding claim of advocates of top-down models of reading that skilled readers, in comparison with less skilled readers, rely less on graphic cues and more on context cues. As noted by Share and Stanovich (1995, p. 4), "…good readers develop hypotheses about upcoming words and are then able to confirm the identity of a word by sampling only a few features in the visual array". Yet, according to Share and Stanovich, this is a misconception because of an inappropriate generalisation from the comprehension level to the word recognition level. Children do not recognise words slowly because they are not using context. Instead, it is the reverse – they are not using context because they are decoding inefficiently.

The analysis in terms of nearness and similarity, as well as Peirce's (1932) analysis of images and symbols (see Section 3.1), could be seen in the light of modern neuropsychological research on the functioning of the hemispheres of the brain (Ornstein, 1997), which are summarised in Figure 1.4 (Section 1.3.2). The left hemisphere solves problems in time sequence as sign symbols in a context and the right hemisphere analyses wholeness in the present moment as images in substitutions (metaphors). It is suggested that the left hemisphere analyses in terms of nearness in context and the right in terms of similarity in absence. Memorising language and speech motor behaviour is mostly the business of the left hemisphere while identification of emotional content is the task of the right hemisphere.[1]

The difficulty of constructing an articulatory rehearsal loop in the right hemisphere (Donald, 1993) is a memento, as there is evidence (De Graaf, 1995) suggesting that the initial grapheme/phoneme linking does activate the right hemisphere. The phonology in reading is usually associated with the left hemisphere in that it is the most important obvious localisation of language and the centre for speech motor behaviour (Donald, 1993). One of the key paradoxes of reading would thus be to be forced to initiate the grapheme/phoneme connection process, activating the right hemisphere in studying script as visual patterns. Lorusso (1994) writes:

> The first characteristic that distinguishes Bakker's model from other models of reading development seems to be the role of phonologic skills: in the balance model, they are associated with visual strategies; in the other models, they explicitly are not. More specifically, in Bakker's description, phonological conversion, although only sporadically addressed, is apparently assumed to be linked to right-hemisphere processing as the result of visual analysis of single graphemes (Bakker, 1990). We may question the idea of considering phonological coding as

[1] When referring to right and left hemisphere characteristics, one must keep in mind that there is a substantial proportion of individuals, both left- and right-handed, with "reversed brains", and that there also exist different degrees of bilateral specialisation in different individuals.

> a part of a visuo-perceptual process: in fact, phonological awareness is so closely related to specific linguistic skills and so poorly correlated with visuo-perceptual measures that it should probably be considered as a separate process. There is evidence that phonological processes plays a fundamental role in dyslexia: a lack of phonological awareness (Bradley & Bryant, 1983) and difficulties in grapheme–phoneme conversion (Snowling, 1980) are very often found in dyslexic children and have been proposed as the general cause of reading difficulties. The issue is therefore of the greatest importance (Lorusso; in Licht & Spyer, 1994, p. 5).

Considering the task involved, the idea of localising the initial grapheme–phoneme conversion in a right hemisphere context may not seem that far-fetched from a neuropsychological viewpoint (Goldberg & Costa, 1981; Hynd, 1989; Ornstein, 1997). Furthermore, there are substantial findings to support this notion (Licht, 1988; De Graaf, 1996; see also the Jersild experience, Section 1.1). The training of phonologic awareness without connecting script to spoken language is also found not to be advantageous to all beginning readers in developing their reading skills (Gustafson et al., 2000).

To study the brain by isolating the hemispheres seems about as wise as studying walking by combining a person with no left leg with a person with no right leg. Advanced reading is certainly a product of complex bilateral hemispheric engagement. There is also the complicating factor of shifting hemispherical activation over time[2]. The capacity to manage this shift through conscious choice based on the character demands of the task might be a decisive factor. Despite these reservations, something about fundamental dimensions of human language might be learned from clinical cases of language disturbances.

Jakobson (1974) observes that aphasic symptoms always appear as more or less severe damage to either the capacity of selecting and substituting or the capacity of combining and shaping of context: the relations of similarity being suppressed in the former case and the relations of nearness in the latter. Neuropsychologically, the "similarity aphasia" might refer to damage in the right hemisphere and the "nearness aphasia" to damage in the left hemisphere.

It might also be possible to refer to the Piagetian notion of concrete versus abstract thinking as a critical accommodation at about the time of reading acquisition. A symbol like "house" might be used to refer to a very special house and not to houses as a kind. This concrete reading is also exemplified in Davis (1999) and considered a main cause of dyslexia. Words that do not give rise to images cannot be read very easily. This difficulty in the reading of words not denoting concrete objects might be an interesting option to discuss as a kind of logographic dyslexia.

The importance of these bipolar patterns of nearness (metonymical) versus similarity (metaphorical) are stressed by Jakobson (1974) referring to the Freudian analyses of the symbols and time sequences of dreams in terms of similarity and nearness. The principles underlying magical rites were also an-

[2] For example, as in the 80-minutes cycle noticed in Swara yoga training.

alysed by Frazer (1992) in terms of two categories: homeopathic based on similarity, and contagious based on relations in time. "The dichotomy discussed here turns out to be of basic importance and to have consequences for all verbal behaviour and for human behaviour in general" (Jakobson, 1974, p. 135, my translation). Jakobson's analysis fits in well with Ornstein's (1997; see Section 1.3.2) balance sheet on the research on hemispherical activation. According to this the right hemisphere specialises in getting the gist of situations in their totality in the present moment (in similarities) while the left hemisphere specialises in understanding situations in time sequences (in nearness), as images in the first cases and as sentences in the second. The fundamentals of the human language, as well as the fundamentals of the human brain, both call for these two capacities in full action in order to establish an advanced reading skill, when the experience of reading becomes as vivid as looking at a movie. The obvious sequential nature of reading and writing in comparison to the "now" of oral language may endanger this positive outcome and foster a leftward hemispherical unbalance.

Consequently, reading demands both analysis of sequences in time and perception of wholes here and now. If the analysis of sequences is disturbed, the context words will be without meaning; if the analysis of wholes is disturbed, image words and metaphors will be without meaning. The former indicates an inadequate left hemispherical function and the latter an inadequate right hemispherical function, which means reading with an unbalanced hemispherical activation. In other words;

- either trying sequential and phoneme/grapheme connections with the right hemisphere lacking a developed articulatory rehearsal loop and specialising in instant recognition of wholes and emotional/metaphorical content
- or trying perception of wholes/orthographic identifications with the left hemisphere specialising in matter-of-fact sequential analysis, speech motor activity and weak in capacity for identifying faces, emotional meaning and metaphorical statements.

Relating to the dual route model (see Section 5.1.1) there may be no need to postulate the combination of a weakness and a compensatory strategy. It may just be impossible to do advanced reading mainly relying on one strategy/ hemisphere. Or in other words: the weakness is the relative isolation of the activated hemisphere and the lack of "support" of contralateral hemispherical activity.

At this junction the question of test validity of reading tests could be raised. A test may be supposed to measure a particular skill, but how it is really perceived could be completely different from what is intended, and different for different individuals. In the letter decoding test, items could be seen as images or symbols for sounds. The word decoding test could be seen as a decoding test, a comprehension test or an image evoking test, and so on. This test contains concrete and abstract words, nouns, verbs, and adjectives that could be differently perceived by individuals with different reading strategies. If there is a dyslectic syndrome characterised by the necessity of a text that gives rise to images in order to be possible to translate into reading, individuals with this syndrome will react to the word decoding test in a different way from dyslectics who might have grapheme/phoneme conversion difficulties. In performing the test it might be rewarding to rely on an auditory strategy in that one can hear space between words pronounced even if there is no space on the paper. The task in the word-decoding test is just to make a mark between words written without space in between. Low scores on the test could imply different types of reading difficulty and could have varying meanings at different junctions of the reading acquisition process. The concomitant strong or weak letter decoding scores could be used as indicators of these differences in reading strategies (see Chapter 5). How these results relate to scores on other tests will become a decisive question. It is also important to look for which kinds of errors that occur.

A battery of tests might reveal the attitude and strategy of the person doing the test, but a single test will hardly accomplish that. It is necessary to distinguish the intention of the inventor of the test from the attitude of the person being tested. Factor analyses of test results might give some clues to these potential differences in the meaning of tests. For example, the test image decoding obviously should be expected to load strongly on a metaphor (similarity) factor and the test sentence reading comprehension on a metonym (nearness) factor. The rest of the tests should vary between these "extremes" in relation to changes in reading acquisition development. For example, the letter decoding test, initially loading on a metaphor factor, may later load on a metonym factor. The word, phonologic, and orthographic decoding tests could load differently depending on the concreteness of word items and the "attitude" of the subject.

Therefore, the chief aim of this chapter is to focus on the question of whether the tests used throughout the study can be found to load on different factors, hopefully on a metaphor (similarity) and a metonym (nearness) factor. Moreover, it would be of interest to determine if the tests load differently on these factors in different grades and also in changing relation to each other. It is suggested that the secrets of reading difficulties might be strongly connected with the basic characteristics of the brain and language outlined above.

6.2 Method

6.2.1 Tests

The tests (image, letter, word, phonologic, and orthographic decoding as well as word and sentence reading comprehension) used here were presented previously in Chapters 2, 3, and 4.

6.2.2 Analysis

The tests that were analysed included image, letter, word, phonologic, and orthographic decoding, as well as sentence reading comprehension in Grade 2/3 and in Grade 6. Splits were performed on gender and word reading comprehension (median split). The factor analyses were run as exploratory, principal components analyses. The factors were rotated to simple structure according to Varimax. The number of factors to be rotated was (with one exception) extracted according to the criterion of an Eigenvalue greater than 1.

6.3 Results

6.3.1 Factor analysis of the total sample and of samples split for gender and word-reading comprehension

The results of the factor analysis of test variables image, letter, word, phonologic, and orthographic decoding, as well as sentence reading comprehension in Grade 2/3 and in Grade 6 are given in Table 6.1. Results based on a gender split are given in Table 6.2 and results based on a word reading comprehension median split in Table 6.3 (weak: word reading comprehension score in Grade 2 < 26; strong: score > 25). In Table 6.4, the median split is based on word reading comprehension in Grade 3 (weak: word reading comprehension score in Grade 3 < 38; strong: score > 37) and the letter and word decoding tests of Grade 3 are substituted for the letter and word decoding tests of Grade 2.

Table 6.1. *Factor analysis of test variables in the total sample in Grade 2/3 and in Grade 6*

	Grade 2/3		Grade 6	
	I	II	I	II
Decoding tests				
Image	.11	**.87**	.20	**.94**
Letter	.21	**.80**	.20	**.93**
Word	**.80**	.29	**.84**	.32
Phonologic	**.66**	.21	**.76**	.26
Orthographic	**.89**	.11	**.88**	.19
Comprehension test				
Sentence reading	**.93**	.07	**.90**	.03
Eigenvalue	3.19	1.14	3.61	1.31
% variance explained	53	19	60	22

Note. Salient factor loadings (> .40) in boldface.

Table 6.2. *Factor analysis of test variables in the total sample in Grade 2/3 and in Grade 6, split for gender*

	Grade 2/3				Grade 6			
	I		II		I		II	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Decoding tests								
Image	.04	.09	**.90**	**.90**	.25	.12	**.92**	**.97**
Letter	.25	.24	**.77**	**.79**	.14	.12	**.94**	**.94**
Word	**.88**	**.74**	.11	**.44**	**.86**	**.84**	.31	.29
Phonologic	**.66**	**.69**	.30	.17	**.77**	**.80**	.28	.27
Orthographic	**.82**	**.91**	.05	.17	**.87**	**.88**	.21	.15
Comprehension test								
Sentence reading	**.93**	**.93**	.08	.07	**.90**	**.90**	.05	.07
Eigenvalue	3.05	3.34	1.27	1.15	3.62	3.55	1.31	1.43
% variance explained	51	56	21	19	60	59	22	24

Note. Salient factor loadings (> .40) in boldface.

Table 6.3 *Factor analysis of test variables in the total sample in Grade 2/3 and in Grade 6, split for word reading comprehension in Grade 2*

	Grade 2/3				Grade 6			
	I		II		I		II	
	Weak	Strong	Weak	Strong	Weak	Strong	Weak	Strong
Decoding tests								
Image	.19	.20	**.82**	**.83**	.30	**.94**	**.91**	.13
Letter	.07	**.55**	**.90**	.37	.23	**.92**	**.93**	.19
Word	**.76**	**.51**	.29	**.57**	**.79**	**.69**	**.43**	**.49**
Phonologic	**.74**	.02	.17	**.73**	**.72**	**.42**	.31	**.49**
Orthographic	**.85**	**.91**	.06	.06	**.84**	.23	.30	**.85**
Comprehension test								
Sentence reading	**.82**	**.88**	.04	.11	**.90**	.10	.08	**.88**
Eigenvalue	2.90	2.80	1.26	1.08	3.85	3.37	1.01	1.10
% variance explained	48	47	21	18	64	56	17	18

Note. Salient factor loadings (> .40) in boldface.

Table 6.4 *Factor analysis of test variables in the total sample in Grade 3 and in Grade 6, split for word reading comprehension in Grade 3*

	Grade 3				Grade 6			
	I		II		I		II	
	Weak	Strong	Weak	Strong	Weak	Strong	Weak	Strong
Decoding tests								
Image	–.07	–.18	**.84**	**.69**	.20	.08	**.94**	**.95**
Letter	–.02	.23	**.88**	**.91**	.18	.20	**.93**	**.93**
Word	**.82**	**.74**	.28	**.45**	**.86**	**.66**	.29	**.43**
Phonologic	**.70**	–.02	–.14	–.01	**.67**	**.61**	.29	.27
Orthographic	**.89**	**.93**	–.13	.08	**.89**	**.84**	.23	.11
Comprehension test								
Sentence reading	**.78**	**.90**	–.08	–.06	**.90**	**.86**	–.08	–.05
Eigenvalue	2.59	2.51	1.59	1.68	3.51	2.94	1.31	1.40
% variance explained	43	42	26	28	58	49	22	23

Note. Salient factor loadings (> .40) in boldface.

6.4 Discussion and Conclusions

In the first analysis (Table 6.1, total sample), Factor I in Grade 2/3 and in Grade 6 is tentatively interpreted as a metonym (nearness) factor, with strong loadings for the comprehension test and the orthographic and word decoding tests. Factor II in Grade 2/3 and in Grade 6 is tentatively interpreted as a metaphor (similarity) factor, with strong loadings for the image and letter decoding tests.

Splitting for gender in Table 6.2 gave almost identical patterns for boys and girls and the result was highly similar to that of the total sample. However, there was a tendency towards a small gender difference in Factor II concerning word decoding in Grade 2/3, boys showing weaker loadings in the metaphor factor.

A median split on word reading comprehension in Grade 2 (Table 6.3) showed a complex pattern of differences between those weak and those strong in word reading comprehension, particularly for image and letter decoding. As can be seen in Table 6.3, there has been a reversal in factor order (Factor I is now the metaphor and Factor II is the metonym factor for those in Grade 6 already strong in word reading comprehension in Grade 2). Phonologic decoding loads rather strongly in the "metonym factor" for those weak in word reading comprehension in Grade 2, whereas it loads on the "metaphor factor" for those strong in word reading comprehension.

When splitting on word reading comprehension in Grade 3 (analysing the same variables as above but using letter and word decoding of Grade 3 instead of letter and word decoding of Grade 2), the result of this analysis turns out as shown in Table 6.4 with no factor reversal. Concerning strong word reading comprehenders in Grade 3, the analysis produced three factors (the third factor is not shown in Table 6.4; Eigenvalue 1.01; 17% of variance explained). Word decoding here, as in Table 6.3, also tends to load on the "metaphor factor" for those strong in word reading comprehension.

One plausible interpretation of the factors is that the nearness (metonym) and similarity (metaphor) dimensions are relevant. The factor loadings of the different tests over time for the total population are all quite stable. In the analyses of subgroups though, there are indications of a gender difference regarding the word decoding test, loading stronger on the metaphor factor for girls in comparison to boys in Grade 3. There is also a difference over time regarding the subgroups weak and strong in reading comprehension as a function of the letter and word decoding tests being made in Grade 2 or Grade 3. As noted previously in this study, the results may indicate that the perception of images and letters as well as words could be changing qualitatively over time in early reading acquisition. Some reservations are however to be made because of limited sample sizes ($n \approx 50$).

CHAPTER 7

Epilogue

7.1 Summary of findings in relation to the proposed model

The present study represents an effort to think about reading acquisition and reading difficulties in rather speculative terms. It attempts to understand some empirical data from mostly common screening tests concerning reading acquisition and reading difficulties. All these tests (with the exception of a word comprehension test designed for the present study) derive their origin from reading research carried out in Sweden and are often used for screening purposes in schools. Concepts from this research but also from the fields of neuropsychology and linguistics are used as tools and inspiration in order to interpret the significance of empirical data.

With reference to the predictive power of the tests (see Chapter 2), there are almost as accurate predictions from Grade 2 as from Grade 3, which underpins the argument for early assessments and actions to avoid self-fulfilling prophesies of reading acquisition. The hypothesis that a combined decoding-comprehension prediction would be more powerful as a product (*Reading = Decoding x Comprehension*) than as a linear combination (*Reading = Decoding + Comprehension*) was not confirmed.

A weak image/letter decoding correlation distinguishes boys weak in reading comprehension from all others in Grade 3; a weak letter/word decoding correlation distinguishes those weak from those strong in reading comprehension regardless of gender; and a weak image/word decoding correlation in Grade 2 distinguishes boys from girls. Thus, there are indications that the hypothesis concerning a critical image/symbol transition may be useful in analysing the rather complex nature of the subgroup differences and the intricate relations between the development of image, letter, and word decoding abilities in reading acquisition. In Chapter 3, these results were (very speculatively) interpreted in terms of cerebral hemispherical activation. Girls showed an early strong relation between the results for image (right hemisphere) and word (left hemisphere) decoding tasks whereas the results for these two tasks were more unrelated for boys (see Figure 3.6). This might be the consequence of a proposition that girls activate both hemispheres in a balanced way when reading (Shaywitz et al., 1995). Boys, on the other hand, being more extremely lateralised, have difficulty in reading words and images in the same way and boys weak in reading comprehension even have difficulty in reading images and letters in the same way (see Figure 3.4).

Concerning the question of stages in the development of reading treated in Chapter 4, what are indicated are not so much stages but rather different individual or sub-group strategies. The conclusion is that orthographic decoding was more strongly related to reading comprehension than was phonologic decoding but there appears to be a parallel development of phonologic and orthographic decoding between Grades 3 and 6. This pattern seems to be the same for boys and girls and for those with low and high reading comprehension. Further, there are very substantial individual differences and certainly a gender difference, indicating that successful girls are more inclined to (or perhaps able to) abandon a phonological in favour of an orthographic reading strategy. Individuals with strong reading comprehension can also be found among those scoring better at phonologic than orthographic decoding. Perhaps a successful reader, by definition, is able to change strategies according to the type of task?

There are indications of a combined phonologic and orthographic weakness regarding both boys and girls who are weak in reading comprehension.

In Chapter 5, the elements of the proposed combined model were further studied in relation to each other. The linguistic/perceptual dyslexia distinctions (Bakker 1990) were related to the surface/phonologic dyslexia distinctions (Castles et al.,1999) and to the strong/weak letter decoding in relation to weak word decoding (Jacobson 1996). The compensatory set-up of Castles et al. (1999) was questioned as independent alternative strategies may not be accessible and the dyslectics thus forced to read with a weak strategy, unable to choose a more favourable alternative.

The surface dyslexia category seems to have a lot in common with the L-type categorisation and the main type of the word/letter decoding instrument, as have the phonologic dyslexia category, the P-type dyslectics and the second type of the letter/word decoding instrument. It was shown that the three different dyslexia distinctions could be treated in the same context and applied to the same empirical data.

A further speculation is that a logographic dyslectic dimension in early reading acquisition is sometimes perhaps mistaken for an orthographic dyslectic dimension. The phonologic deficit hypothesis (see Section 1.2.1) as a general cause of dyslexia did not find unequivocal support as most of the dyslexia candidates performed within a normal range regarding phonologic decoding (z scores above –1 in six cases, between –1 and –2 in three cases, and below –2 in one case) (see Figure 5.3).

A conclusion of the factor analyses in Chapter 6 was that the nearness (metonymical) and similarity (metaphorical) dimensions might be relevant. In the analyses of subgroups there were indications of a gender difference regarding the word decoding test, which loaded stronger on the metaphor factor for girls in comparison to boys in Grade 3. There was also a difference over time regarding the subgroups weak and strong in reading comprehension as a function of the letter and word decoding tests being made in Grade 2 or Grade 3. The results may support the notion of Chapter 3 that the perception of images and letters as well as of words in early reading acquisition changes qualitatively over time.

A conclusive proposition of this study is that the hypothetical twofold metaphor/metonym (image/symbol or similarity/nearness) character of language, analysed as conferring meaning in similarities or in context, correspond with the proposed model and may be instrumental in analysing and understanding the complex interaction between the characteristic traits of the learning brain and the construction of meaning through written language. Instead of an either-or analysis in terms of weak and compensatory, direct and indirect strategies, a dialectical explanation of reading difficulties as a function of lacking hemispherical co-ordination is proposed. A weakness is not assumed to be inherent in one or the other hemisphere or strategy but is presumed to be due to the lack of support from the contralateral hemisphere. (One cannot walk with one leg even if it is very strong.) Again, in relation to this conceptualisation of dyslexia, the bilaterally decreased anisotropy in reading difficulty found by Klingberg et al. (2000) is notable (see Section 1.3) and also its concept of dyslexia, emphasising the continuity across normal and dyslexic readers rather than the differences.

There are many reservations to be made. The limited scope of the investigation in terms of endurance and tests used clearly limits the validity of the conclusions. The construct validity of the tests may be limited (i.e., not assessing the preferred strategy in a free choice situation when actually reading).

It is crucial to admit the complexity of reading and the many tasks there are to be solved and understood in order to decipher script and ultimately reach an advanced reading capacity. Consequently, the search for the ultimate cause of reading difficulties may be unprofitable, as there are numerous mutually dependent constitutional predispositions and tendencies as well as psychosocial factors influencing reading acquisition, the method used in teaching and the conditions of stress introduced certainly not being the least decisive. It is also essential to analyse differences between literate and illiterate individuals to avoid conceiving illiterate traits as causes and/or effects of dyslexia.[1]

[1] The Portuguese example (Castro-Caldas et al., 1998) regarding the poor pseudo-word memory of illiterates continues to represent a challenge about the relation between dyslexia and illiteracy. How come that a person learns to remember meaningless words by ear as a consequence of learning to read? Does the process involve mentally seeing them? A capacity to differentiate form from content? Image from symbol? Compare the form-emphasised step in reading acquisition noted by Kullberg (1991; see Section 1.1.1).

To analyse the development of advanced reading, several factors have to be observed:

A. The meta-cognitive awareness of language as an object that could be manipulated and played with independently from its meaning, both as heard in oral language and as seen in script.
B. The capacity to go beyond logographic image reading, not transforming this reading into a habit.
C. The capacity to transgress the focusing on grapheme/phoneme linkage in an expanding process of reading in context.
D. The conception of B and C as dependent rather than as compensatory, independent or successive processes, as each one profits from the development of the other.
E. The admittance of the possibility of this fruitful relationship between B and C not being established, which could result in different backward reading patterns.

Substantial information concerning the individual way of reading can be obtained from fairly simple and easily administered tests, covering the range from image reading to advanced reading comprehension, given that the single test score is related to scores on other tests of the battery and that these relations are interpreted in the context of a combined model of reading and reading acquisition.

Trying to condense the different diagnostic systems of Chapter 5, and to incorporate the concepts of similarity and nearness, the proposed combined Bakker, Bjaalid, Höien, and Lundberg model (see Section 1.5.3) could be somewhat revised (see Figure 7.1). A logographic/phonologic turning point in the initial reading acquisition process may be recognised (the concept of logography is preferred to that of orthography, which is better suited for more advanced phases). Not passing this turning point may have two effects. Which one of these will in fact dominate the reading acquisition of the unique individual is influenced by, for example, disposition, degree of hemispherical lateralisation, and pedagogical method used in teaching.

A. Some readers will remain in the phase of logographic reading of letters, equalling P-type (perceptual) dyslexia/phonological dyslexia, and a slow indirect grapheme/phoneme type of reading (incomplete indirect) strategy – trying to establish sequential and phoneme/grapheme connections with right hemispheric subservience (lacking a developed articulatory rehearsal loop and specialising in instant recognition of wholes and emotional/metaphorical content). This will result in weak phoneme/grapheme conversions and phonological problems. If they eventually reach the word-reading level, these readers can read and understand words that give rise to images. In short: These readers try to read on similarities without contextual cues. [2]

[2] Perhaps creative "metaphorical thinkers" like Jersild and Jung (see Section 1.1) will have special difficulties in this phase.

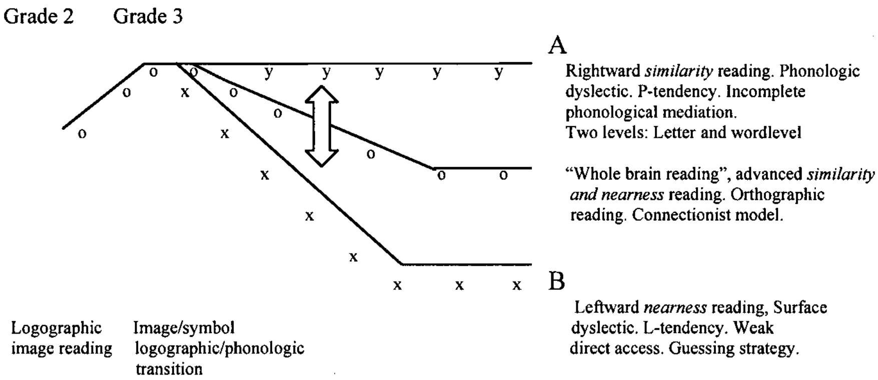

Figure 7.1 The proposed model revised. For an explanation, see text.

B. To overcome the same difficulties, other readers will try to develop a rapid word-guessing (incomplete direct) strategy, equalling L-type (linguistic) dyslexia/surface dyslexia. These readers try perceptual/orthographic identifications, while mainly relying on the left hemisphere (which specialises in sequential analysis and speech motor activity and, which lacks the capacity to identify faces, emotional meaning and metaphorical statements). This strategy of trying to read in context will not be very successful as the grapheme/phoneme conversions are feeble. In short: These readers try to read on context without metaphorical involvement.

The model, according to Figure 7.1, supposes that As (perceptual dyslectics) have a problem with the nearness/context dimension, whereas Bs (linguistic dyslectics) have a problem with the similarity/metaphor dimension. Both types of dyslectics have problems because they are trying to perform with unilateral subservience, without being able to a sufficient degree to integrate the capabilities of both hemispheres. The arrow in Figure 7.1 indicates the interactive aspect of the two main types of reading difficulties.

7.2 Future research

The present study may raise questions rather than give answers. Yet, it is supposed that good questions and a model constraining explanatory power are needed in the field of research on reading acquisition and reading difficulties, because there exist too many and unrelated answers.[3] If it is possible to combine neuropsychological and linguistic findings and concepts into a common model, this may hold promises for future research.

When facing an individual with difficulties in reading, there is no great

[3] A textbook on learning disability subtyping (Hooper & Willis, 1989), for example, enumerates different alternatives over eight pages.

comfort in merely knowing a lot of diagnostic categories and the probabilities of different syndromes. One is in urgent need of concepts that empower one's thinking about, and examining of, the unique individual process. What comprises the difficulty in this particular case? Where did it go wrong? And most importantly, not denying or under-estimating the reading difficulties, how does one get this person to believe in his or her opportunities and to participate as the main actor in his or her own learning process? The motivational aspect not in focus in the present study must not be overlooked. A scientific way of thinking about reading difficulties though, may help to liberate the individual in trouble from a heavy burden of guilt and shame. In the experience of the author this is the important and necessary first step of remediation.

The fact that overall analyses might be misleading and conceal very important information has been demonstrated. The fruitfulness of sub-group analyses, taking into consideration, for example, reading level and gender, is very obvious.

Also discussed in the present study and demanding further investigations are:

– the differences and similarities in the brain functions of illiterate and dyslectic subjects in order to distinguish causes of dyslexia from effects of not reading
– a possible image/symbol transition in early reading acquisition and the consequent possibility of logographic dyslectic patterns
– the dimensions of similarity (metaphor) and nearness (metonym) in analysing reading and reading difficulties as these dimensions are characteristic features of the human brain and language.

It is notable throughout the study that substantial gender differences are found both in different paces in reading acquisition and in qualities in reading. Why are girls so much ahead of boys in reading skills already in Grade 3? Why are they not ahead in letter decoding in Grade 3 and phonologic decoding in Grade 6? Teacher assessments of reading abilities seem to produce a distribution of scores with boys as the norm and girls as exceptions (Appendix C). Is the reading of girls assessed adequately? Maybe the model must be revised to really encompass the reading acquisition of girls considering the findings of Shaywitz et al. (1995), indicating a sex difference in the functional organisation of the brain for language located at the level of phonological processing. Perhaps an inquiry into these gender differences also can help explain why there are so many more boys who are assumed to have serious reading difficulties. Is it a question of learned helplessness or of a disposition to be caught in the dead ends of reading acquisition?

The development of different ways of challenging backward reading patterns is another interesting option for research, having recognised that there is probably not just one dyslectic pattern. For example, exploring treatment in different combinations and time sequences, focusing on comprehension in nearness or in similarities, and on different kinds of decoding, and slowing down or speeding up of reading pace.

The controversy of the "reading wars" (Share & Stanovich, 1995, p. 30) was about how you best learn how to read, whether analytically from a whole-word approach, from words and sentences to letters, or synthetically from a grapheme/phoneme decoding approach, from letters to words and sentences.

Paradoxically, the question might be answered by the possibility that, in isolation, both approaches may be capable of causing or reinforcing reading difficulties of different kinds. But in combination, and adjusted to the changing needs of the individual reading acquisition process, both approaches seem to constitute necessary prerequisites for advanced reading. This interpretation would provide support for the notion that the reading wars really are over.

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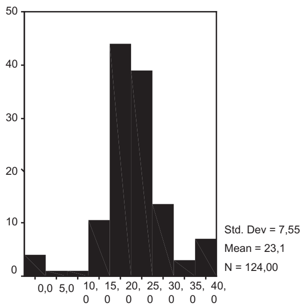
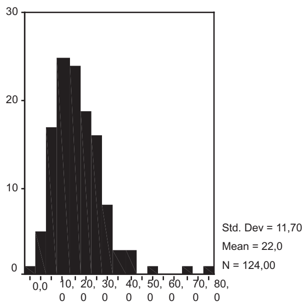
APPENDIX A

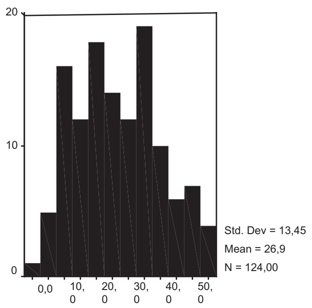
Descriptive statistics showing all the tests for the total sample



Letter decoding



Word decoding



Word comprehension

Figure A. 1. Frequency distributions of tests in Grade 2

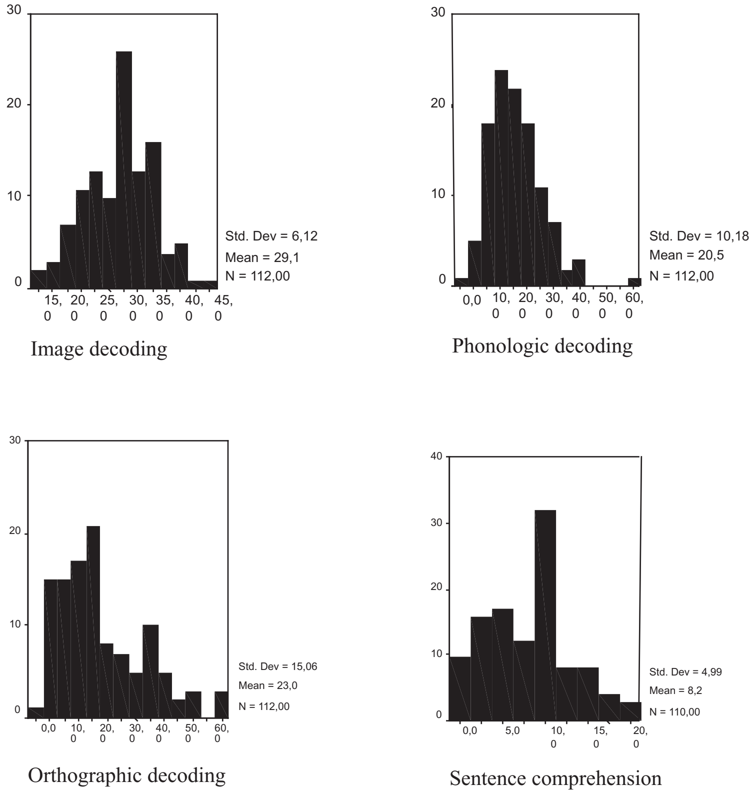


Figure A.2. Frequency distributions of tests in Grade 3

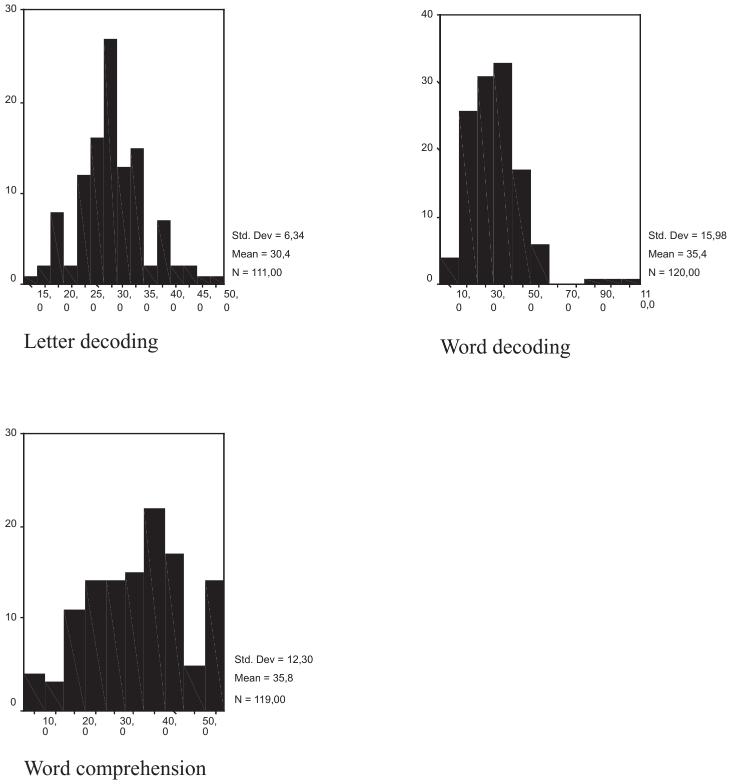


Figure A.2. Frequency distributions of tests in Grade 3 (cont.)

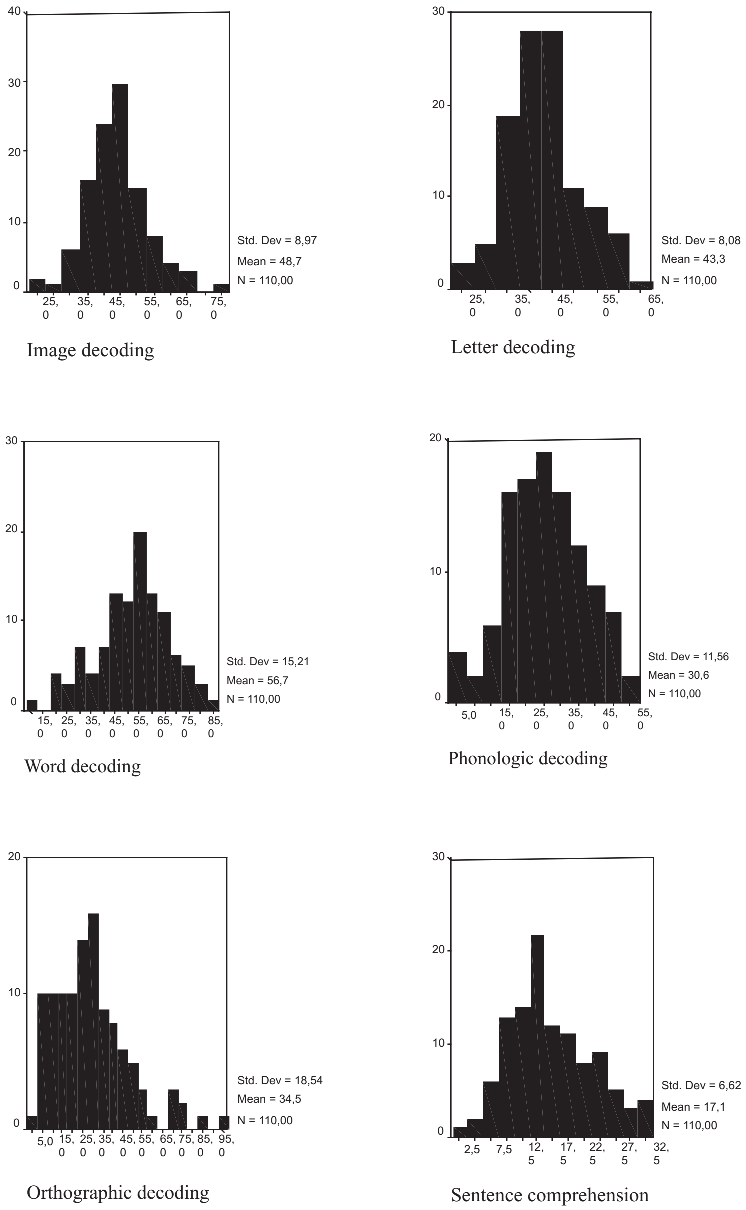


Figure A. 3. Frequency distributions of tests in Grade 6

APPENDIX B

Descriptive statistics showing all the tests used in the study for the total sample split for gender

Table B.1 *Descriptive statistics showing all the tests used in the study for the total sample split for gender*

	Boys					
	Test	*N*	*Minimum*	*Maximum*	*M*	*SD*
Grade 2	Letter decoding	62	2	42	23.15	7.00
	Word decoding	62	1	41	18.60	8.10
	Word comprehension	62	3	56	22.87	12.03
Grade 3	Image decoding	56	14	43	28.04	6.19
	Phonologic decoding	56	2	63	19.50	10.65
	Orthographic decoding	56	1	48	19.64	12.57
	Sentence comprehension	54	0	17	6.80	4.42
	Letter decoding	57	16	45	29.70	6.00
	Word decoding	61	7	61	30.77	11.36
	Word comprehension	61	9	57	32.11	11.92
Grade 6	Image decoding	59	26	69	47.24	8.81
	Letter decoding	59	24	62	41.92	8.20
	Word decoding	59	16	80	51.73	14.70
	Phonologic decoding	59	3	55	30.59	12.34
	Orthographic decoding	59	3	75	30.63	15.43
	Sentence comprehension	59	2	30	15.34	6.01
	Girls					
	Test	*N*	*Minimum*	*Maximum*	*M*	*SD*
Grade 2	Letter decoding	62	0	42	23.08	8.11
	Word decoding	62	3	78	25.31	13.70
	Word comprehension	62	0	57	30.90	13.68
Grade 3	Image decoding	56	17	45	30.23	5.90
	Phonologic decoding	56	4	46	21.48	9.69
	Orthographic decoding	56	3	65	26.36	16.63
	Sentence comprehension	56	0	21	9.50	5.18
	Letter decoding	54	18	49	31.19	6.65
	Word decoding	59	10	113	40.19	18.57
	Word comprehension	58	8	57	39.72	11.55
Grade 6	Image decoding	51	36	80	50.41	8.94
	Letter decoding	51	31	65	44.82	7.73
	Word decoding	51	27	92	62.49	13.81
	Phonologic decoding	51	6	51	30.63	10.72
	Orthographic decoding	51	11	98	38.88	20.89
	Sentence comprehension	51	7	32	19.04	6.80

APPENDIX C

Teacher assessments of boys and girls in silent reading comprehension

All the frequency distributions of predictor and target variables are roughly normally distributed, with one obvious exception regarding the teacher ratings of silent Reading comprehension of boys and girls in Grade 6. For the data of boys and girls combined, the distribution is negatively skewed (Figure B.1, N = 113, M = 3.5, SD = 1.18). However, when the distributions for boys and girls are separated, this feature is only characteristic of girls (Figure B.3, N = 52, M = 3.9, SD = 1.11) while the distribution for boys is close to being normal (Figure B.2, N = 61, M = 3.3, SD = 1.17). This gender difference is not found when comparing the distributions of test results for sentence comprehension in Grade 6 (Figures B.4 and B.5). This gender difference in teacher ratings was not expected, but is so obvious that it has to be recognised as remarkable.

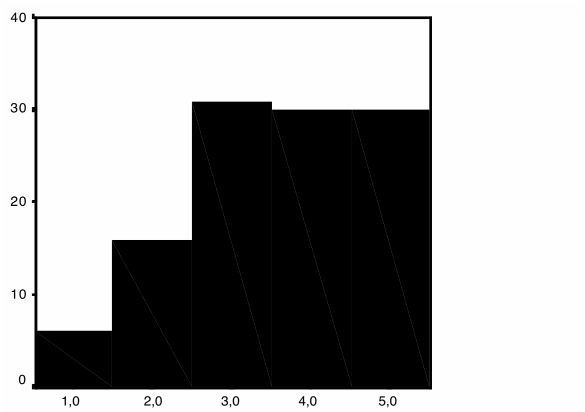


Figure C.1. Silent reading comprehension (teacher ratings) in Grade 6 for boys and girls combined.

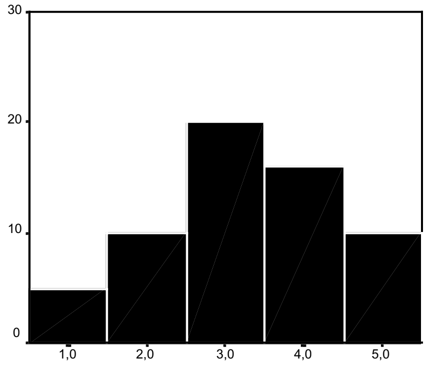


Figure C.2. Silent reading comprehension for boys in Grade 6 according to teacher reports.

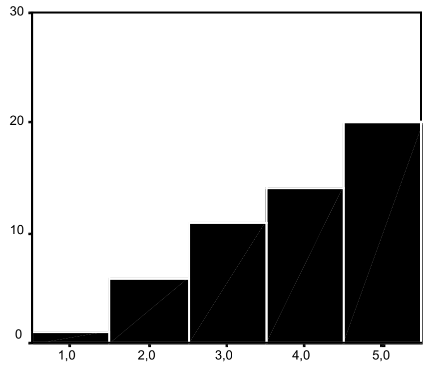


Figure C.3. Silent reading comprehension for girls in Grade 6 according to teacher reports.

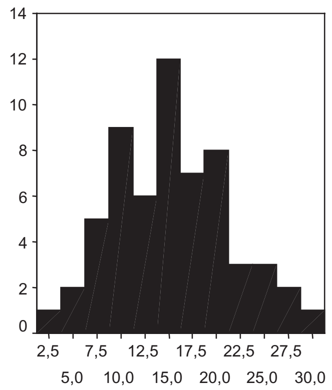


Figure C.4. The scores for boys on the reading comprehension test in Grade 6.

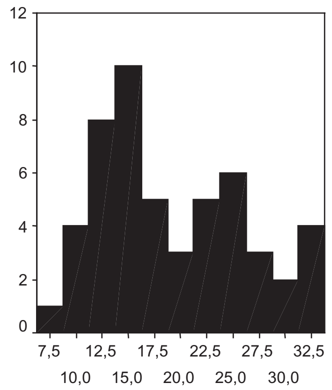


Figure C.5. The scores for girls on the reading comprehension test in Grade 6.

APPENDIX D

Effects of age

In relation to the question of possible stages in reading acquisition, it might be worthwhile relating to the “somewhat out-dated but still lively discussion on the ´developmental lag versus deficit´ nature of dyslexia” (Lorusso, 1994, p. 8). How does age in terms of the month of birth of subjects influence backward and advanced reading comprehension according to reading comprehension results in Grade 6. Inadequate readers: Reading comprehension score < 10 (n = 10; 9 boys and 1 girl); Advanced readers: Reading comprehension score > 25 (n = 12; 9 girls and 3 boys).

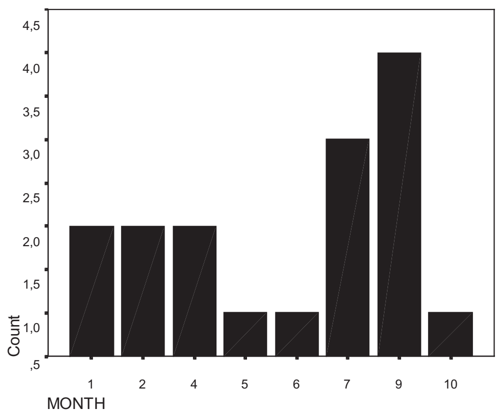


Figure D.1 Month of birth for advanced readers.

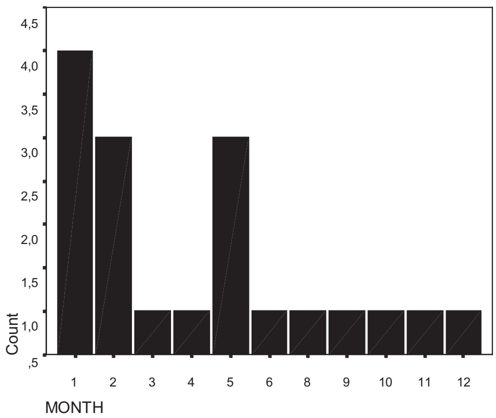


Figure D.2 Month of birth for backward readers.

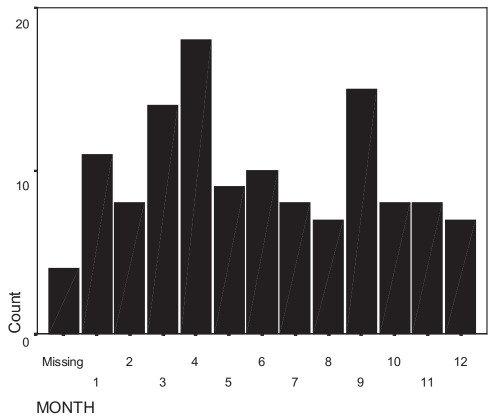
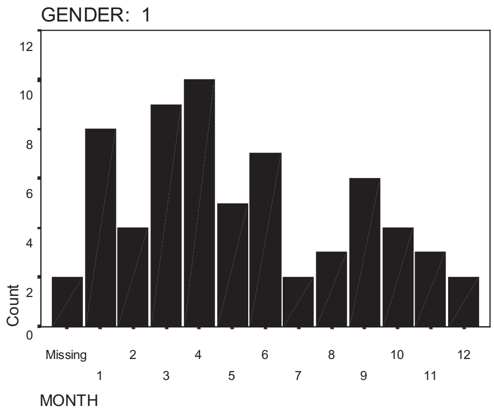


Figure D.3 Month of birth for all subjects.



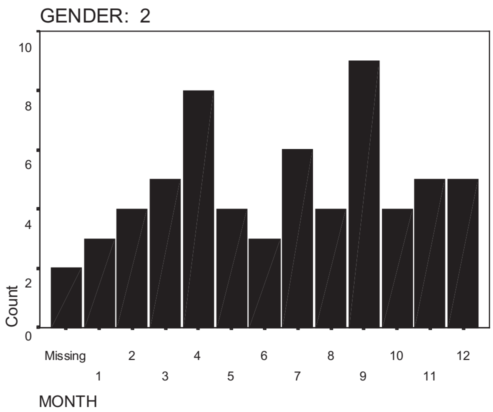


Figure D.4 Month of birth for all subjects split for gender (Gender 1 = boys, Gender 2 = girls).

Comments

To become an advanced reading comprehender, date of birth does not seem to be influential. Paradoxically, to become a backward reader an early date of birth seems more risky. The skewedness of the frequency distribution for boys helps to explain why most backward readers are born early in the year? Around 68% of the boys were born in the first half of the year and 45% of the girls. At least to be comparatively young does not seem to predispose for inadequate reading comprehension.

APPENDIX E

High and low achievement in word decoding in Grade 6

Low achievement in word decoding

There are twelve boys and two girls assigned to the low-achieving subgroup in word decoding in Grade 6 [Word Decoding Score < 37, n = 14 (12,7% of Total N)]. Seven individuals are distinctly better at letter decoding than at word decoding (Stanine difference > 3). None are stronger at word decoding than at letter decoding but seven are fairly even in word and letter decoding. Seven individuals are better at phonologic decoding than orthographic decoding, two are better at orthographic than phonologic decoding, five are fairly even (difference < 4). T-scores do not change the general tendency of phonologic preference but somewhat weaken the effect. (Preference just indicates a relatively better performance.) Regarding low achievers, comparing phonologic and orthographic test scores from Grade 3 and Grade 6 transformed to z values (Table 5.3) does not reveal any consistent patterns.

In Grade 3, four are better at phonologic decoding (two even and two uneven in letter/word decoding), two are better at orthographic decoding (one even and one uneven in letter/word decoding) and eight are fairly equal (four even and four uneven in letter/word decoding).

In Grade 6, six are better at phonologic decoding (three even and three uneven in letter/word decoding), five (three even and two uneven in letter/word decoding) are better at orthographic decoding, and three are fairly equal (one even and two uneven in letter/word decoding).

Between Grade 3 and Grade 6:

– Six participants stay in or move towards phonologic preference. One stays in phonologic preference, four move from equal to phonologic preference, one moves from orthographic to phonologic preference and none from orthographic to equal.

– Six participants stay in or move towards orthographic preference. One stays in orthographic preference, two move from equal to orthographic preference, two move from phonologic to orthographic preference and one from phonologic to equal. Two are equal in phonologic and orthographic preference in both Grade 3 and Grade 6.

High achievement in word decoding
There are twelve girls and two boys assigned to the high-achieving subgroup [Word Decoding Score > 73, *n* = 14 (12,7% of total *N*)]. Word and letter decoding are even and on a very high level. Nine individuals have orthographic preference, two have phonologic preference, three are even (difference ≤ 5). In T-scores, seven have orthographic preference, three have phonologic preference and four are even.

In sum:
Most of the low-achieving word decoders of Grade 6 already demonstrated a better phonologic than orthographic decoding ability in Grade 3 or they did about equal in these two tests. There are also advanced readers who are relatively better at phonologic than orthographic decoding in Grade 6 but those with phonologic or equal preferences generally demonstrate the lowest scores in reading comprehension in the high-achieving subgroup. The high-achievers generally also do much better in the phonologic decoding test, compared to the weak word decoders.

The weak word decoders of Grade 6 are all to be found in the lower half of the distribution of phonetic decoding scores in Grade 3. Strong phonetic decoding thus is no indication of later problems. On the contrary, it seems to be a prerequisite for successful reading comprehension four years later.

The proportions of weak readers showing phonologic as well as orthographic preferences grow from Grade 3 to Grade 6 and the proportion of equal results diminish.

APPENDIX F

The Word Reading Index (WRI)

To combine the results on the wordchains and letterchains tests, Jacobsson (1995, 1996) proposes a word recognition index (WRI) defined as follows:

WRI = 100 x (number of wordchains – number of letterchains)/number of letterchains.

The rationale for this index is the notion that as the time for word decoding is twice that of letter decoding, advanced reading should result in the index 100. WRI < 10 – 20 for teenagers and adults indicates specific reading difficulties. In Grade 2 it is close to 0 which means that the children have similar scores on the two tests (Jacobsson, 1996). If the result in letterchains is very weak the index could turn out as strongly positive even though wordchains results are very weak. The index presupposes strong letterchains results with dyslectics and this notion thus seems to have been a point of departure when constructing these tests, the difference between the perceptual/motor capacity and an unexplained low score in word decoding being an indicator of dyslectic problems. The index does not recognise the dyslectic pattern of weak word decoding and weak letter decoding although it is observed in the manual. Because of the questions concerning the informative value of the WRI it was not used in the present investigation.

APPENDIX G

A Grade 3 screening for potential dyslexia

The first screening for potential dyslectic problems at the end of Grade 2 resulted at the time in the following report to school authorities (see Table G 1).

This report was never conveyed to the teachers and thus could not have influenced the actual learning-to-read process of the children. The report was made on the basis of either weak results on the three tests concerning letter decoding, word decoding and word reading comprehension or uneven results, with letter decoding notably stronger than word decoding.

In comparison with the results of reading comprehension tests in Grade 6, seven individuals from the group at risk are found among the nine (8.2% ot total *N*) with the lowest results, one (a boy) at about percentile 15, one (a girl) at percentile 30 and one (a boy) at about percentile 50. One (a girl) is missing in Grade 6.

Table. G 1 *May Grade 2, Early Warning Report*

School	*n*	Still having problems decoding and understanding words	Serious problems	Possibly serious problems
1	6	2 (33%)		1
2	14	7 (50%)	1	
3	13	1 (1%)	1	
4	10	2 (20%)	1	1
5	13	9 (69%)	1	1
6	23	12 (52%)	2	
7	15	4 (27%)		
8	20	8 (40%)		
9	10	5 (50%)	2	
Total	124	50 (40%)	8 (6%)	3 (9%)