Mental Imagery, Learning Styles, and Text Comprehension

Studies in Educational and Cognitive Psychology

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op het gebied van de Sociale Wetenschappen

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door

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A scientific essay in Social Sciences

Doctoral thesis

to obtain the degree of doctor
from Radboud University Nijmegen
on the authority of the Rector, Prof. dr. C.W.P.M. Blom,
according to the decision of the Council of Deans
to be defended in public on Monday, 20 December 2004
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by

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Contents

CHAPTER 1
INTRODUCTION

There is almost universal agreement among educators that one main goal of education is to develop the ability of students to acquire skills of deep understanding. Schools, however, seem to fall far short of this goal, as is widely acknowledged, not only by educators (e.g., Gardner, 1991; Perkins & Blythe 1994), but also by the public. To mention only one internationally-recognized example: The widely publicized results of the PISA study (Programme for International Student Assessment conducted by the OECD, the Organization for Economic Co-operation and Development in Paris; OECD, 2001) were shocking to many nations. The study assessed how well 15-year old students around the world are learning skills needed for success in life. It found that many students have serious problems understanding basic texts and using acquired knowledge.

Other studies also report that, even at college level, students' basic misunderstandings of core concepts remain untouched by coursework: Views and thinking about many phenomena do not change by the end of a semester or even by the end of college (e.g., Gardner, 1991; Ramsden, 1988). The upsetting finding is that this is true not only for bad students or only for students of some countries, but for successful ones as well, all over the world (Gardner, 1991).

Why is it important for education to emphasize understanding main concepts and principles on a deep level at all? Howard Gardner, one of the most prominent educational theorists of the late twentieth century offers several reasons. One is that understanding serves as a basis of learning and using knowledge: "The person who understands deeply has the capacity to explore the world in a number of ways, using complementary methods. She arrives at concepts and principles in part on her own explorations and reflections, but she must ultimately reconcile these with the concepts and principles that have evolved in various disciplines" (Gardner, 1991, p.117). The amount of available information is constantly increasing, so our knowledge has to be updated frequently (at least in our professional or skill areas). This can hardly happen without understanding the topics we have to master. From a broader view, with the capacity to understand certain phenomena, one "can think appropriately about phenomena of consequence in her society, particularly ones that she has not previously encountered" (Gardner, 1991, p.117). In other words, deep understanding makes it possible to lead a thoughtful life and serves as a basis for lifelong learning.

Why do schools fail to teach understanding? The answer is not easy to determine. There seem to be many factors influencing the process of understanding, and the relationships among them are not fully investigated and may be quite complicated. Also, changes in practice do not automatically follow research. For example, studies of the seventies and eighties (e.g., Ramsden, 1988) already showed that a large workload leads students towards surface learning, but this knowledge, has led to little change in curricula.

Teachers themselves cannot fix the problem. In several countries (e.g., Hungary), the curriculum and testing are centralized. In other countries (e.g., the U.S.), local school boards and standardized tests drive curriculum and goals. Also, as Ramsden, Martin, and Bowden (1989) found, competitive selection for higher education on the basis of school grades drives students towards strong achievement motivation, instead of a deep approach to learning and good study habits.

Part of the answer to why schools fail to teach understanding has to do not with politics and institutions, but with still incomplete knowledge of the determinants of understanding. There are bodies of work in cognitive psychology on reading and in educational psychology on text comprehension that have not been brought fully together. Yet, their main concerns, many concepts, and some research conducted in the fields actually overlap. Integrating work in the two fields would give a more complete picture of the process of text comprehension and suggest ways to design more useful studies.

One goal of the present dissertation is to further this integration by examining work in the orientation to learning tradition in educational psychology and in the reading literature in cognitive psychology. By bringing together ideas from both fields, I hope to achieve a second goal of drawing attention to an important factor that influences the choice of a deep approach to learning (e.g., Sadoski & Paivio, 2001). This factor is the text itself, specifically, the comprehensibility of the text.

The second chapter examines the orientation to studying tradition (within the learning styles literature) in educational psychology. This tradition is based on Craik and Lockhart's (1972) theory of levels of processing. Researchers in this tradition make a distinction between surface and deep approaches to learning and seek ways to lead learners to deep approaches. By organizing research in the field, a picture of the internal and external factors (e.g., motivation, interest, and assessment system) that influence the choice of approaches to learning emerges. I argue that many factors have to come together to make it possible for students to get deeply engaged with a text or course material. While none of the factors is enough by itself to ensure deep understanding, problems with almost any of them can interfere with a deep approach and leave students on a surface level.

The second chapter also argues that if a text is hard to comprehend, students will have difficulty reaching a deep understanding of it. The less comprehensible a text is, the more energy, time and persistence students must devote to understanding it. The role of the text in understanding is not fully articulated in the orientation to studying tradition. It is a very important practical point that improving texts does not require changes in school system and so may be able to bring results fairly quickly for large numbers of students.

The third chapter examines contributions from cognitive psychology and reading literature to understanding how aspects of texts affect comprehension. It introduces two theories of cognition in reading, Kintsch's Propositional Theory (Kintsch, 1998) and Paivio's Dual Coding Theory (Sadoski, & Paivio, 2001) that offer guidance on how to develop more comprehensible texts. Kintsch emphasizes the importance of good organization and wording and matching the text with students' prior knowledge. In Sadoski and Paivio's (2001) view, mental imagery is the most powerful factor in text comprehension.

The fourth chapter offers an integration of aspects of the orientation to studying and text comprehension literature.

The fifth chapter presents the first of two original studies on the role of text comprehensibility in learning: an interview study of Hungarian 5-8th graders on study habits, obstacles to deep understanding, and the role of mental imagery in reading and understanding.

The sixth chapter describes the process of developing text passages that vary only in their imagery evokingness.

The seventh chapter describes an experiment with a group of Hungarian 6^{th} graders that used these text passages to explore casual relationships between the imagery evokingness of a text and understanding of the text. The experiment also examined relationships among learning styles as measured by Approaches to Studying Inventory (Entwistle & Kozéki, 1985) and grades and understanding.

The eighth chapter discusses the results of the interview study and the experiment in light of earlier research and describes implications of the studies for future research.

PART I

THEORETICAL BACKGROUND

CHAPTER 2
LEARNING STYLES IN THE ORIENTATION TO STUDYING TRADITION

2. 1. Introduction

The term "style" is widely used in different contexts to refer to features of persons that are more or less stable over time. We find the concept in various areas of psychology, "such as personality, cognition, communication, motivation, perception, learning and behavior" (Riding & Rayner, 1998, p.6). A learning style is, roughly, a generalized approach to learning: We lack a general definition or theory of learning styles. Researchers have given different meanings to the concept and developed different models of it and of its role in learning depending on which tradition they belonged to or which aspect of learning they think is most important. On the basis of similarities in the "conceptualization of learning, psychometric design, and a relationship to formation of learning strategy" (p. 6), Riding and Rayner (1998) identified four models of learning style implicit in the existing research. 1) Process of learning models based on learning defined as "the process whereby knowledge is created through the transformation of experience" (Kolb, 1984, as cited in Riding & Rayner, 1998, p. 54). Learning styles in this model are made up of perceiving and processing characteristics (e.g., Honey & Mumford, 1992, as cited in Riding & Rayner, 1998; Kolb, Boyatzis, & Mainemelis, 2001). 2) Cognitive skills development models based on the idea that successful learning involves development in intellectual skills. Learning style is "perceived as a multi-modal construct which is understood to describe a range of intellectual functioning relating to the learning activity" (Riding & Rayner, 1998, p.72). Researchers belonging to this group include Keefe (Keefe & Ferell, 1990), Letteri (1980, 1985), and Reinert (1976). 3) Instructional preference models that propose optimal matches between type of student and type of teaching (e.g., Dunn, 1984; Hruska and Grasha 1982; Stevenson & Dunn, 2001). 4) Orientation to studying models, such as those of Entwistle (1988, 2001), Schmeck (1988), Biggs (Biggs, 1988; Biggs, Kember & Leung, 2001), Ramsden (1988), and Vermunt (1998), which are based on Craik and Lockhart's (1972) theory of levels of processing in learning.

I am interested in learning styles because I am concerned with helping students learn with greater understanding, waste as little time as possible memorizing texts that are not related to their interests and prior knowledge, and study with greater pleasure. The orientation to studying tradition provides a very useful framework for approaching the problem. Craik and Lockhart's (1972) pioneering work posited a value that is accepted by many researchers in this tradition: Deep processing is better than surface because it enables the learner to memorize better. But in the orientation to studying tradition and in the beliefs of most educators, deep approaches to learning are better than surface approaches, not just or even mostly because they lead to better memorization, but because the intellectual activities used in deep processing are valuable in their own right. Raising questions, reading critically, seeking to understand the author's intentions, elaborating on the given information, making connections with previous learning, reaching personal conclusions, and other aspects of a deep approach are widely valued intellectual skills. The belief in the value of deep learning is supported by a number of studies that found strong positive associations between certain learning styles and achievement: deep learning is related to superior learning outcome (Dahlgren, 1984; Van Rossum & Schenk, 1984) and is often connected to academic progress (e.g., Gadzella, Ginther, & Williamson, 1986; Ramsden & Entwistle, 1981; Watkins, 1984, 1998; Zhang, 2000).

Many researchers in this tradition seem to hope that we can find *the* factor, or *the* method, or *the* type of training that leads to consistent and appropriate use of deep approaches. Entwistle (1988) says motivation is the factor; Marton (1988) talks about learning concepts; while De Jong (1990) thinks metacognition is the most important. The truth is that no one has been able to identify one factor that is entirely responsible for deep learning.

Not only is the learning process difficult to conceptualize, measure and influence, schooling itself is also a complicated phenomenon that is not easy to see clearly. There is a difference in many cases between the intentions and the actions, not just of teachers but of entire departments and institutions. A good example is the problem of the hidden curriculum (Snyder, 1971). The stated goal of most schools is to enhance students' thinking skills and their ability to apply knowledge (Kaplan, 1990). But, as Snyder (1971) states, in many cases there is a hidden curriculum wherein the declared goal of the school or the department is different from the goals perceived by students and actually enacted by the teachers. For example, a school wants students to learn to think critically, but assesses memorization of factual knowledge. As a result, students' goal of performing well conflicts with the goal of deep understanding (Crooks, 1988). This problem can be solved only by thinking through what we want to teach children and creating harmony between learning goals and assessment.

In the following sections, I review some of the literature in the orientation to studying tradition, paying attention to unresolved issues and findings that relate directly to the research reported in this dissertation. First, I give a picture of the development of the learning style concept within this tradition, and then I discuss the identified factors that influence or make up learning styles: characteristics of the student—personality, motivation, metacognition, and learning conceptions; and characteristics of the environment—teaching styles and assessment.

2. 2. Learning Styles and Approaches

One of the first researchers in this tradition was Pask (1988). He approached the study of text learning using methodology and concepts drawn from systems theory and cognitive psychology. In an important experiment, Pask and Scott (1972) gave subjects unfamiliar material to learn (descriptions of "Martian" animals). They identified two learning strategies based on the subjects' selection of information from the text. Subjects who preferred to understand the text as a whole and the relationships among its parts exhibited a holist strategy. Subjects who preferred learning step by step and acquiring specific data exhibited a serialist strategy. The term strategy refers to a set of procedures (activities, tactics) for accomplishing a task. In Pask's point of view, both serialists and holists can be successful. Neither has an advantage, and they both have strengths and weaknesses in achieving understanding.

In the mid-seventies, Svensson (1976, as cited in Entwistle, 1988) introduced the concepts of holistic and atomistic approaches to learning. A holistic approach to learning is characterized by the learner's intention to understand the text as a whole, an atomistic approach, by the learner's focusing on the sequence of the parts of text without trying to understand the text as a whole. These appear similar to Pask's concepts of holistic and serialist strategies, but have an important difference. On Svenssons's view, only holistic learning leads to understanding. An atomistic approach cannot lead to grasping the meaning of a text. Svensson's claim that not all approaches lead to equally valuable outcomes is accepted by most researchers in the field.

Marton and Saljö's (1976) deep and surface levels of processing distinction corresponds to Svensson's distinction between holistic and atomistic approaches to learning. Later called, respectively, deep and surface approaches to learning (Marton, 1988), these concepts are recognized by many in the field as key contributions to understanding how students learn (Biggs, 1988; Biggs, Kember & Leung, 2001; Entwistle, 1988, 2001; Ramsden, 1988). Marton and Saljö use "approach" instead of "strategy" to indicate that level of processing of information is not just a matter of something in a student's head, but of a relationship between a student and a learning environment. An approach consists of motivations and strategies enacted in a particular context (Schmeck, 1988).

A student with a deep approach to learning aims to discern the main point of a text and to extract personal meaning from the text, sees interrelationships among parts of the text, and asks questions of the text. A student using this approach is actively and thoughtfully engaged with the material. A student using a surface approach focuses on the text itself, the sequences of words, the sentences, unaware that these are vehicles of the author's intentions. The result is at best recall or reproduction of the text with little or no personal engagement with the author. Researchers from around the world have confirmed the validity of this distinction (Biggs, 1988; Biggs et al. 2001; Entwistle, 1988, 2001; Entwistle & Kozéki, 1985; Ramsden, 1988; Schmeck, 1988).

2. 3. Learning Styles and Learning Orientations

As mentioned above, the term "style" roughly refers to a set of qualities, activities or behaviors sustained over a period of time, but has no generally accepted precise usage (Riding & Rayner, 1998). Even within the area of orientation to studying, the concept of style changes over time and across theories. It is instructive to chart the development of the term learning style. In Pask's initial formulation, learning style simply indicated a consistent use of a group of learning strategies. Now it is seen as a multi-dimensional phenomenon that includes other student characteristics and aspects of learning environments. The increased complexity of the term parallels a growing appreciation of the complexity of the process of learning. Learning has more and more come to be seen as a system of complexly interrelated parts. We can distinguish three "eras" in the use of the concept of learning style.

I. Pask (1988) argued that individuals' learning strategies are consistent across different learning situations. The disposition to use a learning strategy indicated to him that strategy choice was a matter of learning style. He identified three styles, operational (using mainly serial strategies), comprehension (using mainly holist strategies), and versatile (using both strategies). Schmeck's (1988) definition is similar to Pask's. He defined a learning styles as a predisposition to adopt a particular learning strategy regardless of the specific demands of the learning task (Schmeck, 1988). He believed learning style was related to personality characteristics and attitudes, but he did not include these in his descriptions of styles.

II. Entwistle introduced the concept of a learning or studying "orientation." He used "style" only to refer to stable, trait-like consistencies in cognition, but the four orientations he identified are also fairly consistent in individuals across situations. These four orientations are derived from factor analyses of inventories that draw on Pask's concept of learning styles and Marton and Saljö's (1976) concept of approaches to learning. According to Entwistle (1988), an orientation to studying is characterized by a particular motivation to learn and a particular approach to learning. The Meaning Orientation is characterized by a deep approach, comprehension learning, and intrinsic motivation; the Reproducing Orientation, by a surface approach, operation learning, improvidence, fear of failure, and extrinsic motivation; an Achieving Orientation by a strategic approach, and extrinsic and achievement motivations; and a Nonacademic Orientation by disorganized study methods and negative attitudes. Biggs (1979), independent of Entwistle, described a similar link between strategies and motivation.

III. Vermunt (1998), though he speaks of learning styles instead of learning orientations, essentially adds complexity to Entwistle's conception of orientation to studying. He posited four components of a learning style: 1) cognitive processing activities, such as memorization, analysis, concrete processing and deep processing; 2) metacognitive regulation of the cognitive activities, which include planning, monitoring and diagnosing difficulties in learning; 3) mental models of learning, which refer to a host of learning related conceptions, such as self-concept as a learner and conceptions of learning objectives; and 4) learning orientations, the learner's goals, intentions, motives, expectations, and attitudes.

Factor analysis of these four components yielded four learning styles that are relatively consistent across situations: meaning-directed (relating and structuring, critical processing, self-regulation, construction of knowledge and personal orientation); reproduction-directed (memorizing and rehearsing, analyzing, external regulation, intake of knowledge, and certificate and self-test-directed learning); undirected (lack of regulation, ambivalent orientation, cooperation and simulating education); and, application-directed (concrete processing, use of knowledge, vocational and certificate oriented).

With Vermunt, Pask's relatively one-dimensional and straightforward concept of a learning style as a consistent use of certain strategies "inside" the learner, becomes a complex multi-dimensional concept that addresses motivation, goals, metacognitive activities, and conceptions of learning.

2. 4. Student Characteristics and Situational Influences

The notion of cross-situational consistency is intrinsic to the notions of learning style. Whether the styles are understood as relatively simple (Pask) or very complicated (Vermunt), they are assumed to be *relatively* consistent, but not immutable. However, even though a style is by definition relatively consistent, and even though assessment inventories are based on this idea, the question remains, are styles really consistent? Or, more accurately, do styles exist? This question arises from the fact that there is considerable research that showing both consistency and inconsistency (e.g., Biggs, 1988; Entwistle, 1988; Entwistle & Ramsden, 1983, Vermetten, Lodewijks, & Vermunt, 1999).

A number of researchers have addressed this problem. Boekaerts (1996) argues that we know almost nothing about consistency in styles. Ramsden (1988) suggests that the environment might have long-term effects on students, so that "individual students develop habitual ways of approaching study tasks" (p. 175). Entwistle (1988) concluded that "looking at a [broad] range of students' activities. . . [shows] considerable consistency in approach. . . Although few students were wholly consistent, most of them could be classified as adopting either a deep or surface approach" (p. 25). Entwistle's resolution of the problem, to insist on a sort of broad picture of the phenomenon, does not seem satisfactory. The research findings, both those he examined and those since, point more to students choosing different styles in different conditions. We can more accurately speak of a preferred style, but this leaves us with an oxymoron.

Most researchers simply consider learning styles to be both context-dependent and student-dependent and leave the matter at that. They tend to refer to "orientation" or "approach" to avoid the implication of consistency implicit in "style." For example, Ramsden (1988) argues that learning represents relations between a learner and the world and uses "approach" to denote this relationship. In Biggs (1988) terminology, "approach" refers to the learning processes that emerge from students' perceptions of the academic task, as influenced by their personal characteristics, and so has both contextual and personological elements.

If we emphasize person variables, we will tend to see styles as hard to change. If we emphasize the environment, we will tend to see styles as easier to change. Most researchers, as stated earlier, seem to agree that the goal for all students is the acquisition of the ability to employ a deep approach or deep strategies to most of the learning tasks in school. The very fact of this goal, indeed, we can say the very existence of schools, indicates a general belief, if not the fact, that styles can be changed. While I use "style" throughout this chapter, the literature reviewed here shows that there are many influences on when and how and whether students' use particular learning styles.

Research using learning style inventories, such as those devised by Entwistle and Ramsden (1983), Schmeck (1988), Biggs (1988), Vermunt (1998), have yielded important ideas about the effects of a number of situational variables on style of learning and level of processing. The effect of workload, assessment system, teaching style and other variables on learning styles are discussed below. The use of these inventories may, however, obscure important questions about *how* and *when* students typically arrive at a stable style and *the extent to which* styles vary across different school subjects and learning situations. Learning research that uses these inventories give a general picture of the student or indicate general ways the environment influences learning.

A general picture of the student, however, might not be enough when we want to investigate the early choices of learning strategies in the child's life and how a child achieves a mature style. A general picture hides details and does not let us answer a question such as: How does a child cope with a variety of subjects, teaching styles, and assessment approaches? Almost all of the early research on school learning was conducted on college students. Although in the last two decades, researchers have turned their attention to younger students, we have nothing like a clear picture of how students come to adopt consistent learning styles.

In the following sections, I give an overview of what we know about the factors that influence *choice of learning strategies* and development of a learning style. The picture that emerges from the research is that the acquisition of the ability to use deep approaches and the actual use of a deep approach in a given situation is the outcome of a complicated and fragile process. There seem to be many factors that are needed to acquire a deep approach and many ways in which the use of a deep approach in a given learning situation can be hindered or completely scuttled. As the following review shows, it is much easier to create conditions that lead students to use surface approaches and far more difficult to create conditions that lead to the use of deep approaches (e.g., Marton & Saljö, 1976). Furthermore, for many of the variables studied, the direction of causality is as yet unknown.

2. 5. Characteristics of the Student

Research in this area has addressed characteristics of students associated with particular learning styles. The most examined characteristics are personality, motivation, metacognition, and conception of learning. The following briefly reviews the literature, focusing on research that is relevant to effecting change in learning styles

2. 5. 1. Learning Strategies and Personality

Personality is a unique and enduring cluster of characteristics that influences our behavior in many situations. Learning is a complex endeavor associated with a wide variety of behaviors. Neither is independent of other aspects of life. Culture, family, and personal experiences all shape behavior in learning tasks and situations involving achievement and evaluation. Though there is an obvious connection between personality characteristics and learning styles, we don't know much about the details of this relationship. Most of the research on connections between personality and learning strategy examined only the roles of self-concept and self-esteem in learning. Very few studies have explored connections between learning styles and the big five personality factors or the effect of the family (such as parents' values and coping behavior).

Being able to specify personality/learning styles relationships does not necessarily lead to a simple solution to improving learning. Personality is difficult to change, and teachers have no influence on students pre-school experiences. Understanding these influences, however, can be important in developing programs that help us to develop training tailored to specific personality types.

What we know about the topic mostly comes from Busato, Prince, Elshout, and Hamaker (1999), Vermetten, Lodewijks, & Vermunt (2001), and Zhang (2003). Busato et al. (1999) used Vermunt's questionnaire to measure learning styles and found correlation with the Big Five traits in the range of .09 to .33. Vermetten, et al. (2001) using the same questionnaire had similar results. Their findings support the idea that personality traits influence approach to learning situations and so are connected to learning behavior. For example, an undirected learning style predicts low achievement and is related to neuroticism. Reproduction and application-directed learning styles are connected to agreeableness, extraversion, and conscientiousness (Busato et al., 1999). Zhang (2003), using Biggs (1993) Study Process Questionnaire, found that e.g. conscientiousness was related to deep and achieving approaches, openness to deep approach, and neuroticism to surface approach.

What we think and feel about ourselves, self concept and self-esteem (which have academic and non-academic components), are also very important in interpreting situations and shaping behavior and attitudes (McCarthy & Schmeck, 1988). Academic achievement and academic self concept are in strong relationship; they seem to have a reciprocal effect on each other (Marsh & Yeung, 1997).

How do self-esteem and achievement relate? One possible answer may be that learning strategies mediate between them. The use of deep strategies involves playing around with ideas to understand them better, critically questioning ideas and claims, and giving new and personal interpretations to concepts. Students with low self-esteem who are afraid of not being clever enough or not having good ideas are not likely to try new methods or look for new solutions. They will stick with the book and try to learn it as it is written without elaborating upon it or questioning it. Research supports this idea. For example, in Dean's (1977) study, self concept was related to learning, independent of intelligence. Children with low self-esteem maintained an output order similar to the input. They seemed to be more rigid. They relied on simple rehearsal methods when a more complex strategy would be more efficient. Children with higher self-esteem used more sophisticated strategies. In other words, students with low self-esteem were more likely to chose surface learning strategies. Later several studies found a relationship between academic self-esteem and learning approaches: high self-esteem was connected to deep and achieving approaches to learning (Drew & Watkins, 1998; Watkins, 1984, Watkins & Hattie, 1990; Watkins, Reghi, & Astilla, 1991) and also to a versatile approach (Watkins & Reghi, 1996). In a meta-analytic study based on data from 8710 respondents, Watkins (2001) found an average correlation of -.05 for surface, .30 for deep, and .28 for achieving approach and self-esteem.

2. 5. 2. Learning Strategies and Motivation

The relationship between motivation and choice of leaning strategies is so close that many researchers find it impossible to separate them. Entwistle (1988, 2001) and Vermunt (1998), for example, include motivation in their conceptions of learning styles/orientations. Entwistle (1988) identified three types of successful students, one is motivated by hope for success (reinforcement of high academic self-esteem), a second, by academic interest, and a third by fear of failure. Unsuccessful students may have entered university for external reasons, such as parental pressure or to get a better job (Wankowski, 1973, cited in Entwistle, 1988). In Entwistle's Approaches to Studying Inventory, the three main orientations are connected to different types of motivation. The connections are so strong that the same factor structure was found in several countries: Meaning Orientation was strongly connected to intrinsic motivation, Reproducing Orientation to external motivation, and Achieving Orientation to competitive achievement motivation. (Diaz, 1984, cited in Entwistle, 1988; Kozéki & Entwistle, 1986).

Interest

Students who are interested in a topic are more likely to spend time trying to understand it than those who are not interested in it at all. Those who are interested in the subject usually show a higher level of achievement. This relationship was found not only between interest and grades, but also between interest and actual learning and interest and quality of understanding (Krapp, 1999). These results suggest that interest motivates the learner to go beyond the surface level of the text (Krapp, 1999). In other words, those who find an article interesting are more likely to adopt a deep approach to studying it (Entwistle & Ramsden, 1983) and to apply elaboration strategies (Krapp, 1999). On the other hand, students who use a deep approach to studying a text are more likely to say that it is pleasant to read, while students who use a surface approach often complain about the multitude of data in the text (Van Rossum & Schenk, 1984). This suggests that those who are not interested in a topic itself can easily find themselves in a vicious circle in which low interest leads to use of surface strategies, which leads to finding the text uninteresting.

Students differ in the extent to which they find a text interesting, but a text can be manipulated so that more people will like it by adding anecdotes, attractive pictures, and so forth. Increasing "interestingness" can help students learn better (Wade & Adams, 1990). Interestingness can be so powerful that sometimes increasing the interestingness of not important details can lead to neglecting the main message. This phenomenon is referred to as "seductive details" (Garner, Brown, Sanders, & Menke, 1992).

Belief in the Usefulness of Learning

If students think that the material they have to learn is useless, there is little chance they will study it hard. The personal value of a subject predicts reported effort, persistence, and willingness to try a variety of strategies (Pokay & Blumenfeld, 1990). Studying the effects of training at work places, Clark, Dobbins, and Ladd (1993) found that participants are unlikely to be motivated to learn unless they believe that training will result in improved job performance or career advancement. Voluntary participation in training is connected to stronger beliefs that training is appropriate than is required participation (Hicks & Klimoski, 1987). If the same is true for school children, compulsory education and a strict curriculum that doesn't let children make any important decisions about their learning may well be a significant factor in why many students choose surface learning strategies.

Fear of Failure

Researchers agree that anxiety has a debilitating effect on learning and performance (e.g., Cassady & Johnson, 2002; Pekrun, Goetz, Titz, & Perry, 2002). High test-anxious students have lower grade point averages, show poorer performance on every question type, and do relatively better on multiple choice tests than on short answer questions (Benjamin, McKeachie, Lin, & Holinger, 1981). One explanation is that anxious students produce irrelevant answers in test situations because they don't concentrate well (Kuhl, 1992; Pekrun et al., 2002). They also report a higher rate of problems in learning than do low test-anxious students. They have problems in retrieving information in the test situation itself and report more problems in learning (encoding) the information. They do more memorizing without understanding, and it is more difficult for them to find important points in a text (Benjamin, et al., 1981; Pekrun et al., 2002). This corresponds with findings that anxious students are more likely to use a surface approach (Entwistle, 1988). Concerns about ability and evaluation can increase the students' "effort-minimizing" strategies, such as frequent seeking for help, copying answers, or guessing at solutions (Ames & Archer, 1988). Also, students who use a surface approach are reported to be significantly more nervous in test and exam situations and more often disturbed during studying (Van Rossum & Schenk, 1984). The questions remains: Does anxiety lead to surface learning or does surface approach cause anxiety, or does causality work in both directions?

Goal Orientation

Students learn in order to accomplish goals. The main difference in how they conceive of goals is whether they see learning as "an end in itself" (Meece, Blumenfeld, & Hoyle, 1988, p. 514) or as a tool for reaching something else—social approval, superiority, or positive evaluations. Ames and Archer (1988) collapse various schemes for organizing learning goals (e.g., Ames & Ames, 1984; Dweck, 1986; Nicholls, 1984) into mastery goals and performance goals. Performance goal orientation involves concern with being judged able. Students with a performance goal orientation use evidence of success or superior performance to please teachers and show they are smart. Mastery goal orientation involves believing that the main importance of learning is developing new skills. Students with a mastery goal orientation value learning and the effort that leads to acquiring skills.

A mastery orientation is generally held to be better for learning (Ames & Archer, 1988; Meece et al., 1988). Students who use a mastery orientation make more adaptive attributions and use more effective learning strategies and deeper processing (Ames & Archer, 1988; Elliot, McGregor, & Gable, 1999). Students with mastery goals report more active cognitive engagement in learning, greater preference for tasks that offer challenge, believe that efforts and success covary, and are more likely to have intrinsic motivation and continuing interest (Ames, 1992; Meece et al., 1988).

2. 5. 3. Learning Strategies and Metacognition

In the 1970s, researchers refined their thinking on motivation and developed a conception of learners as active seekers of knowledge who direct, wholly or in part, their own instruction, regulate themselves during the learning process, and reinforce their own learning (Zimmerman & Martinez-Pons, 1986). One aspect of the picture of the self-directed learner is metacognition, self-monitoring of memory, comprehension, and other aspects of cognition (Flavell, 1979). This monitoring of cognitive processes is key to the self-regulation of learning.

The concept of metacognition comes from Flavell (1971), who claimed that young students very rarely used memory strategies, even though they knew how to use them. His explanation was that students lacked metamemory, that is, awareness of one's own memory processes. Many studies have confirmed the idea that metacognition is connected to higher achievement in learning and problem solving: Novice and expert learners differ not only in the amount of knowledge they have, but in metacognitive skills as well (Beishuizen & Stoutjesdijk, 1999; De Jong & Simons, 1988; Ertmer & Newby, 1996; Veenman, Elshout, & Bushato, 1994; Young & Vrongistinos, 2002; Zimmerman & Martinez-Pons, 1986). Ertmer and Newby (1996) argue that metacognitive knowledge and metacognitive control (management, regulation) interact in a dynamic way and so are more than the sum of the individual components.

Metacognitive Knowledge

To succeed in a learning task, two kinds of basic knowledge are needed: knowledge about task requirements and knowledge about personal resources (Ertmer & Newby, 1996). Knowledge about task requirements refers to knowledge about the nature of the task and awareness of the learning strategies that can accomplish the task. We have to know not only the cognitive demands of the task, such as the strategies needed to organize and comprehend the material (cognitive component), but also the effort we need (motivational component), and the circumstances and conditions under which we must operate, e.g., the library or laboratory (environmental component). In addition, it is important to be familiar with our personal resources, such as our prior knowledge, and the strategies we are able to use. These also have cognitive, motivational and environmental components (Ertmer & Newby, 1996).

Metacognitive Control (Self-Regulation)

Students can use metacognitive knowledge to regulate their learning. Self-regulated learners are "metacognitively, motivationally, and behaviorally active participants in their own learning process" (Zimmerman & Martinez-Pons, 1988, p.284). From a metacognitive process aspect, "self regulated learners plan, organize, self instruct, and self evaluate various stages during the acquisition process" (Zimmerman & Martinez-Pons, 1988, p.284). From a motivational aspect, "self-regulated learners perceive themselves as self-efficacious, autonomous, and intrinsically motivated." (Zimmerman & Martinez-Pons, 1988, p.284) And from a behavioral aspect, self-regulated learners "select, and even create social and physical environments that optimize acquisition" (Zimmerman & Martinez-Pons, 1988, p.284). Others accept this conception of a self-regulated learner (e.g., Simons & De Jong, 1992).

Zimmerman (1990) describes four metacognitive strategies: planning, organizing, monitoring, and evaluating. When learners plan, they first try to see the goal clearly, then they decide which strategies (metacognitive, motivational, and environmental) are required to achieve the goal and consider potential obstacles to achieving the goal. Monitoring is the process whereby learners check what they are doing and the effect they are having. For this they have to be able not only to see what is going on in the moment, but to look back to the plan and forward to the steps yet to be completed. After completing the task comes evaluation, where learners make decisions about the effectiveness of the strategies they used and the mistakes they made (Ertmer & Newby, 1996). According to Zimmerman (2000), these self-regulated learning activities occur in a three-phase cycle of forethought, performance/volitional control, and self-reflection.

There is much research on the differences between good and poor learners in terms of self-regulation. Successful students use more learning orientations and have more directing and testing abilities (De Jong & Simons, 1988; Veenman, et. al., 1994). Good students check their knowledge during recall, pay more attention to the results of their learning process (De Jong, 1987), and use more monitoring (De Jong, 1987, 1990, 1995). Simons and Lodewijks (1987) found that successful students checked their understanding of a text more, while less successful students checked their acquisition of knowledge more often. This supported the claim that it is not the amount of checking by itself was different, but what was checked.

De Jong (1990) argues that "self-regulation is probably what causes a successful student to be successful" (p.159). Whether or not the use of these strategies is both necessary and sufficient for successful learning, the strategies are without a doubt very useful. Self-regulated learners are able to flexibly shift between different learning activities, depending on the goals and task constraints. They are able to execute learning activities that lead to knowledge, comprehension, integration, and problem solving (De Jong & Simons, 1990). They perceive themselves as self-efficacious, autonomous and intrinsically motivated. They are aware of functional relations between strategies and outcomes (Zimmerman & Marztinez-Pons, 1988, 1990). They tend to report deep levels of learning (Vermetten et al., 2001).

Every student should be able to use metacognitive strategies. But how can we increase students' use of these strategies? How can we effectively teach these skills? Metacognitive strategies probably rarely develop spontaneously. Students have to be taught how to be aware of what they are doing and how to monitor and regulate their cognitive activities in order to achieve better understanding. (De Jong, & Van Hout-Wolters, 1994).

Regulation activities don't always work with the same effectiveness. They are highly dependent on the text and the goal. In an experiment, De Jong (1994) found that successful students used more strategies than unsuccessful ones, especially in the case of vocabulary, but when studying more complex texts, the variety of their strategies decreased. De Jong's explanation is that schools require memorization, so students are not trained in how to study complex texts.

Training must do more than simply advise students on how to develop metacognitive skills. This is not enough, even for college students (Simons & De Jong, 1992). Students have to practice using different strategies with explicit feedback and learn when to use specific strategies (Simons & De Jong, 1992). In De Jong's experiments, training usually had a positive effect on students' metacognitive knowledge (De Jong, 1991). The training had a negative effect on the regulation of learning of students who had lower levels of intelligence and students with learning disabilities. De Jong (1991) suggests that one possible explanation for this is that these two groups of students might have problems with the comprehension of the text itself. The instruction in metacognitive strategies distracts them, and they try to follow the instructions instead of paying full attention to trying to understand. This suggests that in order for learning strategies to be most effective, students must first comprehend a text at a basic level.

2. 5. 4. Learning Strategies and Learning Conception

Learners have different ideas of the learning situation and the tasks they have to accomplish. Do their learning conceptions influence their learning process? If they do, can students change their conceptions? Saljö (1976 as cited in Marton, 1988) in an interview study asking the simple question "What do you mean by learning?" identified five different conceptions of learning. Three of them can be categorized as surface (quantitative increase in knowledge, memorization, and acquisition of facts and procedures), and two as deep (abstraction of meaning and interpretative process aimed at understanding reality). Marton, Dall'Alba, & Beaty (1993) introduced a sixth conception, learning as self-transformation. Learning conceptions are one of the four components of a learning style in Vermunt's (1998) theory of learning. He identified three conceptions that are similar to Saljö's: learning as memorizing, learning as acquisition of facts to utilize in practice, and learning as an interpretative process aimed at understanding of reality.

There is a relationship between students' conceptions of learning and their approach to learning (Marton, 1988; Van Rossum & Schenk, 1984). Those who have a surface conception of learning usually adopt a surface approach; while those who have a deep conception of learning don't necessarily use a deep approach (Marton, 1988). This suggests that a surface conception of learning is sufficient to drive the learning process in the direction of a surface approach, but that a deep approach requires more than a deep conception of learning.

Klatter, Lodewijks, and Aarnoutse (2001) were interested in knowing more about the development of learning conceptions. The six graders they studied seemed to have already developed coherent conceptions of learning. One group showed an emphasis on learning as personal growth and qualitative change in knowledge (developmental learning conception); another group reflected a primary interest in success and good grades and dependence on external help (functional learning conception); a third group had no clear goals and were not much aware of the learning process (restricted learning conceptions).

2. 5. 5. Strategy Development in Young Children

How do learning strategies develop? When do children first start to use strategies and why? These are two basic questions in the study of learning styles. At this time, our answers to the questions are at an equally basic level.

It seems that early elementary school children are actually able to use certain strategies, such as organizing, rehearsal, and vivid imagination, but only when they are told to do so or are trained to use them. (Cox, 1994; Melot & Corroyer, 1992). According to one explanation (Miller, Woody-Ramsey, & Aloise, 1991), young students don't use strategies because it's too much work, much more than it is for older students. With practice, strategy use is easier, but young students still do not use strategies as effectively as older students (Miller et al., 1991). Preschool children use recall strategies that they have been taught when they are motivated to perform well and when they are given instructions and information about why the strategy is effective and about how, where, and when to use it (Lange and Pierce, 1992). This suggests that children have more problems with knowing when to use a strategy and seeing the value of a strategy than with actually using strategies (Cox, 1994) or that the use of a certain strategy depends on metacognitive knowledge that children have not yet developed (Flavell, 1971).

Even if young students are able to use strategies when they are instructed, they fail to transfer the strategy to other learning situations, unless they get proper feedback on its effectiveness (Cox, 1994), which includes demonstrating a relationship between using a strategy and achievement (Melot & Corroyer, 1992). The most effective way of training students to transfer strategies is involve them in the process of evaluation by using self-testing and other self-reflection techniques (Cox, 1994). Butler (1998) suggests it is important that students feel that they own their strategies. This means that strategies "are personalized, grounded in their prior understanding, responsive to their unique needs, and expressed in their own words" (p. 694).

2. 6. Characteristics of the Environment

Research on characteristics of the environment addresses variables believed to influence the acquisition and use of learning styles. These include, characteristics of texts, teaching styles, and assessment methods.

2. 6. 1. Learning Strategies and the Task or the To-be-learned Material

In a study of science students' approaches to problem solving, Laurillard (1984) found that learning approach was related to the nature of the learning task. In other words, as we know from everyday life, what we are trying to learn affects how we try to learn it. Tasks can influence learning in many ways. The first important influence is the amount of the to-be-learned material. Light workloads are associated with the use of a deep approach; formal teaching and a heavy workload are associated with a surface approach (Entwistle, Kozéki & Tait, 1989; Entwistle & Ramsden, 1983; Ramsden & Entwistle, 1981). One explanation for this is that higher levels of learning strategy take time and effort. If students have too much to study, they don't have enough time to make connections, raise critical questions, or carry out other time-intensive and demanding intellectual tasks that are necessary for deep understanding.

The other important factor is the difficulty or complexity of the text. Qualitative differences in understanding seem to play a crucial role, not only in remembering the text itself but also the choice of strategies. Those who don't understand an author's message are more likely to pay attention to the words of the text and miss the main point of the text (Saljö, 1984). This leads to surface learning. Ramsden (1988) mentions that if a text lacks structure, it is not possible to use deep learning, only memorization.

In Vermetten et al.'s (1999) study, university students in courses that had a more vivid and concrete learning material used a wider range of learning strategies and more self-regulation strategies. Beishuizen, Stoutjesdik, Spuijbroek, Bouwmeester, and van der Geest (2002) found direct connections between the concrete elaboration scale of Vermunt and Van Rijswijk's (1988) Inventory of Learning Styles. Students scoring high on concrete elaboration (tending to think about concrete examples while studying a text) benefited more from a text explaining two statistical laws without illustrations or examples, while those who scored low on concrete elaboration benefited more from a text that introduced a law through examples.

2. 6. 2. Learning Strategies and Teaching Style

How material is taught is as important as the material itself. Research on the role of the teacher in learning has focused on two matters: effective teaching and teaching style and its relationship to learning style. Stringer and Irwing (1998) define teaching as effective "to the extent student performance improves after a certain period of instruction in a manner consistent with the goals of the instruction" (p. 410). If we agree that the main goal of education is to enhance students' understanding of to-be-learned material, we can agree with Ramsden (1988) that "effective teaching places students in situations where they are encouraged to develop more complex conceptions of learning and practice the use of deep, holistic approaches" (p.167).

The literature on the important characteristics of good teaching shows that good teachers lecture well, explain well, give useful feedback, use assessment methods that pull for deep understanding, relate information to students' prior knowledge, help students organize the to-be-learned material, perceive relationships between content and real world matters, set mastery goals, set clear goals and directions that enable students to participate in their own learning, and care about and have empathy for their students (Blumenfeld & Meece, 1988; Entwistle et al., 1989; Ramsden, 1988; Ramsden & Entwistle, 1981; Stringer & Irwing, 1998).

Ramsden (1988) notes that there is no direct connection between teaching styles and behaviors and student behavior. Students' perceptions of the requirements of the learning environment are as or more important than teachers' actual behaviors. These perceptions partly depend on previous learning experiences and partly on the characteristics of the context. Also, sometimes students simply can't or don't want to do what they are asked (Blumenfeld & Meece, 1988).

Research suggests that active monitoring of students' work, asking questions frequently, and collecting and returning assignments quickly can enhance students' achievement and help them become self-regulating learners (Blumenfeld & Meece, 1988). Vermunt and Verloop (1999) define three types of teacher control: strong, weak, and shared control. A strongly controlling teacher takes over the cognitive, metacognitive and affective activities from students, minimizing the need for students to be active involved in learning. This kind of controlling behavior can undermine students' motivation (Blumenfeld & Meece, 1988). A loose teacher assumes that students will direct their own learning. A teacher who uses shared control stimulates students to use more metacognitive activities.

Vermunt and Verloop (1999) argue that teaching and learning activities are mirror images of each other and may be described in similar terms. They use the same categories for teaching activities as for learning activities: cognitive—presenting and clarifying the subject matter; affective—creating and maintaining a positive motivational and emotional climate; regulative—steering student's learning processes. Teaching styles consist of fairly consistent use of specific teaching strategies (Vermunt & Verloop, 1999). The important issue, according to them, is not teachers' teaching styles, but the compatibility of teacher styles with the student styles. Vermunt and Verloop (1999) call compatible styles congruent. When styles are not compatible, there is friction between styles. Friction can be positive (when the teaching strategy has a positive effect on the learning activities) and negative (when the result is the opposite). Vermunt (1995) offers process-oriented teaching as a means of minimizing destructive friction and maximizing positive friction. The instructional tasks in process-oriented teaching are initiating, guiding and influencing students' thinking. In this model, the teacher is a collaborator, rather than an evaluator, and control is transferred from the teacher to the learner (Vermunt, 1995). Entwistle, McCune, and Walker (2001) also claim that conceptions of teaching and styles of teaching can be described with the same concepts as learning conceptions and styles.

2. 6. 3. Learning Strategies and Assessment

Ramsden (1988) declares that assessment is the most critical environmental influence on learning approaches. The assessment system provides a "signal" about the type of learning to attempt and knowledge to acquire. Assessment refers both to in-class assessment directed by teachers and institutional assessment related to entrance and graduation. The way students approach a text is influenced by the content of the questions they anticipate (Van Rossum & Schenk, 1984). Written assignments and essay tests are associated with deep approaches to learning, while multiple choice and short answer examinations are more likely to lead to surface approaches (Beishuizen & Stoutjesdijk, 1999; Thomas & Bain, 1984). If students feel threatened or intimidated by an assessment, they are more likely to use surface approaches (Ramsden, 1988).

If we want to encourage deep processing, the solution appears simple: Test for it—assess learning in ways that pull for deep understanding. Unfortunately, the effects of the assessment system are not so straightforward. The first problem, as discussed earlier, is that the assessment system may be inconsistent with the declared goals and ideals of the institution or class, and teachers and administrators may not be aware this. They may want students to understand at a deep level, and say this is a goal, but mostly test in ways that promote surface learning. This means that often students are not led to try to understand at a deep level and that their misunderstandings are never brought to light and corrected (Ramsden, 1988).

The second problem is that despite teachers' use of assessments that pull for deep understanding, students may still not use deep approaches. Ramsden (1988) reports a study that modified a final-year assessment in ways that would promote deep learning. The modifications actually achieved the opposite result. He explains these results in terms of a "disjunction between the faculty's goals and the goals perceived by the students" (p.166), although the explanation may as likely be that the change was poorly conceived.

Questions that pull for surface learning usually succeed in eliciting surface approaches to learning (Marton & Saljö, 1984). Students who use deep approaches can easily adopt surface approaches if they think this will lead to a better grade. But, students who use surface approaches have difficulty adopting deep approaches

(Crooks, 1988). This supports the idea advanced earlier that teaching students to apply deep approach is more complicated then teaching them to use surface approaches.

The third problem that makes it hard to promote deep understanding by changing the assessment system is that not all students react in the same way to changes. How students perceive a task is influenced by previous experience, so it is extremely difficult to give assignments that lead everybody towards deep learning. As Miller and Partlett (1974, as cited in Crooks, 1988) argue, some students seek out clues that help determine the best strategies for a good grade, some recognize clues when they come their way but don't look for them, and some are clue deaf and can't hear the call of a clue even when it barks at them.

There are some partly successful ways to address these problems. Teachers can give feedback to students about their answers. This helps if the feedback is not given too soon (e.g., as in programmed textbooks) and if the material is not too difficult for the student (Bangert-Drowns, Kulik, & Kulik, 1991). The form of the feedback is also important: In the case of factual knowledge, it is enough to give the correct answer, but when the question is higher level and involves comprehension, more detailed feedback is required (Crooks, 1988).

Allowing students opportunities to ask questions also helps teachers assess student understanding. The level of the question reveals the level of understanding. Research has shown that higher levels of questions are associated with higher achievement (Mevarech & Susak, 1993). Active learners seek help more often, ask more questions, and increase their effort when necessary (Karabenick & Knapp, 1991; Zimmerman & Martinez-Pons, 1988). Many students, especially those with lower self-esteem never seek help (Karabenick & Knapp, 1991; Mevarec & Susak, 1993). Teachers not only teach but also evaluate, and students may not ask questions out of fear that this will reflect badly on them.

2. 6. 4. Learning Strategies and Programs, Departments, and Institutions

Because schools, programs, and departments differ in the assessments they use, it is likely that students differ in the learning styles they employ. Entwistle and Ramsden (1983) used the Approaches to Studying Inventory (ASI) to show general differences among academic units. Students in departments in which surface approaches were adaptive used more reproductive approaches. Students in schools and departments with a problem-based curriculum scored higher on meaning orientation, than did students in more traditional schools (Ramsden, 1988).

One of the best known comparison studies of secondary school students is Kozéki and Entwistle's (1985) study of Scottish and Hungarian students. The researchers found Hungarian school children scored higher on deep approach, while Scottish students scored higher on use of surface approaches. The reason for the difference, they suggest, was that Hungary made some effort to inspire imaginative ways of teaching and to discourage rote learning, while in England, the external examination system directed students to rote memorization. Hungarian students perceived their teachers making more connections between the study material and real life than Scottish students (Entwistle et al., 1989).

2. 7. Conclusions

This chapter reviewed the development of the concept of learning style within the tradition of orientation to studying and the literature on relationships between learning styles and characteristics of students and environment. Most of the research described here is not experimental. Consequently, we cannot at this point in our knowledge draw confident conclusions about the causes of and conditions for developing and using deep learning approaches. It is, nevertheless, instructive to build a picture of the deep learner that emerges from the research.

Deep learners are extroverted, open to experience, and have positive self-concepts and high self-esteem. They are not neurotic. They are intrinsically motivated; they are interested in what they are learning; they see the value of their learning for themselves; they enter the learning situation voluntarily; and they have a mastery orientation to learning. They have metacognitive knowledge: knowledge about task requirements, required or relevant type of strategies and resources, and their own learning resources. On the basis of this knowledge, they are able to plan, monitor, and evaluate their own work. They have a deep conception of learning. Plus, it is good if they comprehend the material they are trying to learn. Deep learners are easy to work with, and they can learn and think independently.

We find deep learners in the classes of teachers who lecture and explain well, help students to see the relevance of the subject to life and other knowledge, set clear goals, have great empathy, and give students freedom to chose content and method. They use process-oriented instruction to teach content and thinking strategies. They focus on students' thinking skills rather than on the amount of memorized knowledge, and they act more as a collaborators than as directors. We find deep learners in schools with non-threatening assessment systems, curricula (nothing hidden) that encourage comprehension (e.g., a problem-based curriculum), and appropriate assessment systems. The school gives moderate amounts of work.

Because of gaps in our knowledge and inter-correlation among the factors contributing to deep learning, the picture above is exaggerated. Still, it emphasizes a point made earlier that becoming a deep learner is a complicated multi-dimensional and fragile process. There is not one factor that insures deep learning. Many factors can forestall the development of deep approaches, and many others can lead deep learners to use surface approaches. We know that it is much easier to make surface learners out of deep learners than it is to do the opposite (Crooks, 1988; Marton & Saljö, 1984). We can picture the deep learner in training as walking down a long road to the destination of deep learning. If everything works out, if all the factors are there—parenting, training, school, teachers, and so on—the student achieves the goal of developing a deep approach and uses it consistently. If a few factors are missing and even if one factor is wrong (e.g., the assessment system pulls for surface learning), the student can easily fall off the road to deep understanding into the ditch of a surface approach to learning.

If we are interested in creating more deep learners and if we have identified pretty much all of the factors leading to a deep approach to learning, then one way to develop deep learners is to alter the school environment and create intensive, individualized, multi-dimensional training programs that address everything from personality factors to metacognitive strategies. While this demands great resources, it surely could be effective. Unfortunately, hoping for such drastic changes of the school system in the near future is not realistic. Another approach is to focus on factors such as texts and the assessment system that are relatively easy to change and can impact the development of a deep approach for many students. The next chapter focuses on one of the relatively easy to change factors, the text itself.

CHAPTER 3
TEXT COMPREHENSION AND MENTAL IMAGERY

3. 1. Introduction

To get a full picture of the factors that influence the choice of approaches to learning, we have to examine further the role of a factor mentioned in the previous chapter, the text itself. Students who don't understand an author's message are more likely to pay attention to the words of the text and miss the main point (Saljö, 1984). In the orientation to studying tradition, understanding is a goal of the learning process, a result, not a starting point. This is certainly valid. Everything discussed in the previous chapter can affect the sort of understanding a learner achieves. But the understanding a learner achieves will also be significantly determined by the text itself. An extreme and obvious example makes this point clear. Students with high intrinsic motivation, interest, high self-esteem, a deep learning conception, and all the other features of a deep learning approach will understand nothing of a text in an unfamiliar language unless they are so extremely motivated, interested in the topic, and persistent in learning that they learn the language. If the text is written in a language students can easily comprehend they won't have much trouble dealing with it and they will have more of a chance to use a deep approach. In short, the more comprehensible a text is (or the better the material is explained), the more chance students have to reach a deep level of understanding and the less of an ideal deep learner they have to be and the less variables of circumstances will disturb them (e.g., lack of time and tiredness).

If and how students use a deep approach to learning is partly a function of the comprehensibility of the texts they study. Ramsden (1988) and others in the orientation to studying tradition recognize this point as well. If students can comprehend a text on a certain level, then they can play around with it, ask questions of it, and relate it to previous knowledge. In short, they can use a deep approach and accomplish even a deeper understanding of the text. If the material is not clear but they have time, motivation, and good strategies to understand it and good teachers to help, they might be able to reach deep understanding. But in this case, disturbing factors might have a much bigger role. Texts that are dense or unclear or confused or otherwise difficult to comprehend place greater demands on the resources of students and teachers than do clear, appropriate, well-written texts. Anyone who has ever taught with a bad textbook knows how much the book affects students' motivation, interest, and understanding and how much harder one must work to help students understand. Because study materials build on each other or come in series that span grade levels, students who face bad texts at an early age and who are not lucky enough to have a string of good teachers, may never have an experience of deep understanding and may develop a fixity to a surface approach to learning. It follows that increasing the comprehensibility of a text will increase the likelihood that readers will employ a deep approach to learning and actually accomplish deep understanding. On the other hand, this idea might work only within limits. It is also common sense that in some cases texts that are "too easy" do not offer enough challenge for students, which can lead to boredom, loss of motivation, and a surface approach.

The factor of text comprehensibility doesn't reduce or replace the role of the other factors that affect learning outcome. It exists in addition to them. But because of its powerful impact on the learning process, it may be a particularly important situational variable that schools can control. Bad texts drain resources and energy from students and teachers in a way that, say, bad assessment systems and insufficient time do not. To better understand the notion of text comprehensibility and its relationship to learning approaches, we turn to the cognitive psychological literature, particularly Kintsch's Propositional Theory (Kintsch, 1988; Van Dijk & Kintsch, 1983) and Paivio's Dual Coding Theory (Paivio, 1986, 1991; Sadoski & Paivio, 2001). These theories give a very important role to the text itself in comprehension that is crucial from the point of view of the present dissertation. Both address many aspects of text comprehension, drawing detailed pictures of the phenomenon supported by experiments. And both place their findings in the context of broad theories of cognition.

3. 2. Text Comprehension

In the 1970's cognitive psychologists turned from studying word and sentence recall to studying text comprehension (Brozová, 1995). There are several ways of investigating comprehension. Researchers interested in the process of text comprehension examine the mental operations and the brain areas participating in the process of comprehension (e.g., Britton, Stimson, Stennett, & Gülgöz, 1998). Other researchers, mostly from the field of reading, investigate the skills and strategies students need to comprehend a text, such as summarizing, drawing inferences, and using metacognitive strategies (e.g., Palincsar & Brown, 1984; Taraban, Kimberly, & Statsky, 2000). A third line of research examines the characteristics of texts, their readability, that lead to better comprehension (Horning, 1987, 1991). Kintsch's Propositional Theory of text comprehension draws on all three lines of research and is one the major theories in its field (Sadoski, 1999a).

3. 2. 1. Kintsch's Propositional Theory

Kintsch's theory is an ambitious attempt to model and explain text processing and, indeed, cognition in general (Kintsch 1998). This brief review primarily addresses aspects of his theory that relate to the experiment at the heart of this dissertation—the role of aspects of texts (e.g., organization, presence of cues) in comprehension—and relationships between texts and readers.

Kintsch argues that the structure of a text is connected to different levels of understanding. The first level of understanding is the level of verbatim information; the second is the propositional text base that involves the "semantic and rhetorical structure of the text" (Kintsch, 1994, p. 294)—converting words and sentences into overlapping and nested propositions; the third is the broadest level, the "situation model"—mental representations of situations in the text. On this level, one connects text ideas with prior knowledge. Although Kintsch (1998) acknowledges that mental representations can be coded in a variety of forms (e.g., in images and feelings), he stresses that propositional representations are most important and that all others can be reduced to them (Sadoski, 1999a). For this reason, Sadoski (1999a) argues that Kintsch's theory is a single code theory: Propositions are abstract; they have no sensory modality.

Kintsch (1994) makes a distinction between remembering a text and learning from a text. Remembering a text "means that one can reproduce it in some form, more or less verbatim and more or less completely, at least its gist" (p. 294). "Learning from a text implies that one is able to use the information provided by the text in other ways not just for reproduction" (p. 294). Learning, he states, "requires deep understanding" (p. 294). In terms of the three levels of understanding, remembering and learning are distinguished by "how complete and elaborate a situation model is constructed" (Kintsch, 1994, p. 295). Usually (but not always) remembering and learning a text are correlated. Kintsch's distinction between remembering and learning from a text is very similar to the distinction between surface and deep approaches to learning (Marton & Saljö, 1976).

According to Kintsch (1994), how well and whether one learns a text is affected by the language of the text and language skills and prior knowledge. In Communis, Kintsch, Reusser, and Weimer's (1988) experiment with mathematical word problems, poor linguistic knowledge led to poor performance, but the nature of the errors could be connected to certain text characteristics. Most texts have cues (extralinguistic, syntactic, semantic, and rhetorical) that the reader uses to comprehend the text (Kintsch & Yarborough, 1982). Some examples of cues are: a more or less explicit mention that a word in the text is defined, section headings, and transitional sentences. If we delete cues from a text, the text will be less organized, but if it is not too difficult the reader can still understand it. Texts with clear organization are easier to comprehend, as they "facilitate macrostructure formation" (p. 829). A well-organized text makes it easier to answer main idea or situation model level questions, but makes no difference to answering questions that address text base processes, questions with answers that can be read in the text (Kintsch, & Yarborough, 1982; Moravcsik & Kintsch, 1993).

As creating a situation model involves integrating text and prior knowledge, it is logical that prior knowledge influences text comprehension. In an experiment reported in Kintsch (1994), readers with low and high background knowledge were compared. They didn't differ on the text base level, but students with low background knowledge showed lower achievement on the situation model level compared to students with high background knowledge.

The relationship between a text and prior relevant knowledge has an important role in Kintsch's theory. Too little overlap between them makes a text difficult to understand, while too much overlap makes the text boring (Kintsch, 1994). Even good writing can't compensate for poor background knowledge. Good writing helps the reader create a coherent text base but can't help in the creation of a good situation model (Moravcsik & Kintsch, 1993). Texts that spell out everything believed to be relevant for students with low background knowledge make students with high background knowledge bored or lull them into thinking they understand without having to read carefully (Kintsch, 1994). If students with high background knowledge are encouraged to read the text more actively (e.g., by having to answer questions while reading) this effect disappears (Kintsch & Kintsch, 1995). Kintsch and his colleagues note this as an example of a more general phenomenon—that teachers can intervene to compensate for a poor text—and argue that it is better to start with appropriate texts. It is true that even with texts that have characteristics that facilitate or pull for deep understanding, individual differences among students remain. Deep understanding is effortful, and many students don't do it if they don't have to. But we always have to keep it in mind that it is difficult to change students. Kintsch and Kintsch (1995) say that we have to work more on the situational variables to help students engage texts with deep processing. One solution is "to carefully coordinate student characteristics and learning tasks to assure the best results" (p. 150). McNamara, Kintsch, Songer, and Kintsch (1996) suggest that texts need to have just the right amount of difficulty. They have to be "challenging enough to stimulate active processing but not so difficult as to break down comprehension" (p. 36).

3. 2. 2. Paivio's Dual Coding Theory

The Dual Coding Theory (DCT) developed by Paivio (1971, 1986, 1991) and modified by Sadoski & Paivio (2001) is a rival to Kintsch's theory. Like Kintsch's Propositional Theory, DCT offers an explanation of text comprehension in the context of a general theory of cognition. For the purposes of this dissertation, its main virtues are its accounts of the role of mental imagery in understanding and of the relationship between text features and the formation of mental images.

Sadoski (1999a) criticizes Kintsch for missing the role of mental imagery in text comprehension. Indeed, there is much evidence that mental imagery is a useful aid for memory and comprehension of words, phrases, and texts. A partial list of phenomena that cannot be understood without considering the role of mental imagery:

1) Mnemonic imagery techniques have been used since ancient times. Many experiments have shown their effectiveness, although the techniques have limitations and are not recommended by everyone (Krinsky & Krinsky, 1994, 1996; McDaniel & Pressley, 1984; McDaniel, Pressley, & Dunay, 1987; Peters & Levin, 1986; Wieziczynski & Blick, 1996). 2) Pictures have long been used in teaching and have been shown to be helpful in facilitating memory and comprehension (Gibson, Glynn, Takahasi, & Britton, 1995; Glenberg & Langston, 1992; Hodes, 1992; Sadoski, Paivio, 2001). 3) Instructions to generate mental pictures have similar effects (Hodes, 1992; Konopak, Williams, & Granier, 1991). A combination of picture presentations and imagery instructions seems to be the most effective in memory and comprehension (Gambrell & Jawitz, 1993). 4) Most important from the point of view of this dissertation: Concrete words and texts are more likely to evoke mental images and be remembered and understood than abstract ones. This is called the "concreteness effect" (Sadoski, 1999a; Sadoski, Goetz, & Fritz, 1993; Sadoski, Goetz, Stricker, & Burdenski, 2003; Sadoski & Paivio, 2001).

There are several explanations of why mental images and pictures facilitate memory and comprehension—e.g., images reduce the load of working memory by assimilating details and allow more information to be stored and recalled (Gagne, 1985); mental images help to connect information to prior knowledge (Linden & Wittrock, 1981)—but DCT provides the fullest account of the role of mental imagery in comprehension.

The theory holds that there are two separate mental coding systems, the verbal (speech, writing, abstract ideas) that encodes "logogens" and the nonverbal (sights, sounds, feels, tastes, and smells) that encodes "imagens." The systems can function independently, in parallel, or in a connected manner. Words can be represented by other words, images by images, words by images, and images by words. Sadoski and Paivio (2001) distinguish three types of processing. Representational processing is the direct activation of verbal or non-verbal representations (e.g., seeing a cow; reading a sentence); referential processing is the activation of the verbal system by the nonverbal system or the other way around (e.g., picturing a cow while reading a description); associative processing is the activation of representations within the same verbal or nonverbal system (e.g., defining a "cow" with other words).

The verbal and nonverbal code systems are both independent and additive. Information encoded both verbally and nonverbally can be remembered better than information encoded in only one form (Clark & Paivio, 1991; Sadoski & Paivio, 2001). According to Paivio (1971), individuals have a preference for processing information in a verbal or an imaginal mode. This idea fostered a research on verbalizer and visualizer cognitive styles (for an overview, see Riding & Rayner, 1998). "Visualizers are those individuals who rely primarily on imagery processes when attempting to perform cognitive tasks; verbalizers prefer to process information by verbal-logical means" (Kozhevnikov, Hegarty, & Mayer, 2002, p. 47) According to some research (e.g., Riding & Ashmore, 1980; Riding & Douglas, 1993) visualizers are better in dealing with pictorial information while verbalizers are superior in dealing with verbal information. Other studies found no relationship between visual information processing preference and performance on imagery tasks (Kozhevnikov et al., 2002). Kozhevnikov et al. suggest that there are two different types of visualizers: iconic type who create vivid and detailed images of objects and spatial type who create images of spatial relations between objects.

The Dual Coding Theory's explanation for the concreteness effect is that concrete words evoke mental images easier than abstract ones and can be encoded both in verbal and nonverbal forms. The effectiveness of mnemonic imagery strategies receive a similar explanation: Images work as mental "pegs" on which related information is mentally "hung." Images also facilitate organization of information by allowing multiple elements to be combined in a single image so that a partial cue can evoke the whole image (Clark & Paivio, 1991).

The three types of processing correspond to three levels of meaning (Sadoski & Paivio, 2001). The representational level is the most basic. It "refers to relatively direct activation of logogens by linguistic stimuli and imagens by nonlinguistic stimuli" (p. 71). Familiarity and knowledge play an important role here. The referential level of meaning is based on connections between language and mental images. Referential connections to words and sentences evoke imagery that "gives form, shape and substance to meaning" (p.74), that is, that elaborates the verbal information. The associative level of meaning is based on within system connections. The reader associates letters to letters ("a 'u' probably follows the 'q'"), words to words (rabies to mad dog), complex images to more simple ones (an image of a city to an image of buildings) and so on. Generally, images are processed simultaneously and verbal information is processed sequentially.

While Sadoski and Paivio (2001) refer to *levels* of meaning, the levels do not stand in a clear hierarchy, e.g., associative meanings are not necessarily deeper than representational ones. Their point is rather to emphasize the importance of connections within and between the two systems in the generation of meaning. They define the meaning of a text as "the set of reactions evoked by indirectly or brought to bear on it by the vehicles of reference and association from our linguistic and nonlinguistic knowledge" and argue that "the richer the elaboration of activated mental representations and their defining interconnections, the richer the meaning" (p. 69). Sadoski and Paivio (2001) portray Kintsch's highest level of understanding, the situation model in terms of a web of connections between words and images: "any activated set of logogens and/or imagens and the referential and/or associative connections between them" (p. 79).

The more associations a text is able to evoke and the greater a reader's background knowledge, the greater the richness of meanings the reader can generate from a text. Thus, individual differences and differences in texts are both important in comprehension. Concrete familiar texts (e.g., a description of an animal the reader knows) are the easiest to comprehend as they have many referential and associative connections. Familiar but abstract texts (e.g., a high school student reading about the sociology of friendship) are a bit harder to understand because the reader has fewer associations to experiences to draw on and has to pay more "attention on the verbal code and the cues provided by orthography and grammar" (p. 84). Abstract unfamiliar texts are the most difficult to comprehend.

As we have seen, in DCT, verbal and nonverbal codes are strongly related to each other. Sadoski and Paivio (2001) state that "the ongoing activation within and between codes elaborates and specifies meaning" (p. 83). This gives mental imagery an extremely important role in text comprehension. Indeed, not only are mental images important in that they convey information and add richness to verbal codes, but they are considered to be the ultimate basis of all meaning, even of abstractions. "All meaning may ultimately lie on a foundation of direct, nonverbal experience"

(Sadoski and Paivio, 2001, p. 85). It is quite easy to agree with this point in the case of concrete material. But is this really true of abstract material? Sadoski and Paivio argue that "abstract language may be understood more in terms of verbal associates, but somewhere the verbal/associative links of abstract language must find outside reference to something that is not language" (p. 85). Abstract words can evoke memories of concrete situations. Even if an original image is not available for the person, it can still serve as a basis of understanding: "Our understanding of abstractions may be no more than the sum total of the actual life experiences we have had where such language was used or to which such language might apply in our memories or imaginations" (p. 85). This view of the relationship between language and experience is echoed in Hode's (1994) view that children develop an ability to form images before they learn a language and use images to help make sense of words.

Sadoski's Contribution to DCT

The main concern of Sadoski and his colleagues is the text: How can Paivio's (1986) findings with words or paragraphs be applied to longer texts? Do longer texts evoke mental images just as do words and sentences? If yes, are the texts that evoke more mental images easier to recall and understand than those that evoke fewer mental images (as is the case with words)? Under what circumstances and through what processes are concrete words more likely to evoke mental images and be understood and remembered than abstract words—i.e., exactly how does the concreteness effect work?

To answer these questions, we must first determine if mental imagery occurs spontaneously while reading a text. Everyday experience suggests that this is a common occurrence. Sadoski (1983, 1985) verified this by simply asking subjects to report the mental images that occurred while reading a text. Subjects as young as ten years old reported a variety of spontaneous images, mostly consistent with the meaning of the text (Sadoski; 1983, 1985; Sadoski, Goetz, & Kangiser, 1988). Images are frequently unrelated to story illustrations (in case of illustrated stories), but have the same vividness as images related to these illustrations. Sadoski et al. (1988) found that subjects reported similar degrees of mental imagery and affect at certain paragraphs of the story, with considerable agreement on the kind of pictures and feelings the story evoked. This result suggests that—while allowing for individual and group differences (e.g., in education and profession)—it is possible to predict the occurrence of images in a text, to measure the imagery evokingness of texts, and even to design texts with imagery cues specific to an audience.

In his early studies, Paivio (1986) found that words with higher imagery value were remembered better than ones with lower imagery value. Sadoski showed that this is true for entire texts (Sadoski & Quast, 1990). According to Sadoski and Quast (1990), the best-recalled parts of a text two weeks later were not connected to the importance of the parts, as many researchers had hypothesized, but rather to imagery and affect ratings and paragraph length. They note that the "importance ratings may tend to reflect the reader's reconstruction of the author's idea hierarchy," while imagery and affect ratings "may tend to reflect the construction of personal meanings" (p. 271). This finding is similar to those of Garner, et al. (1992) who referred to this phenomenon as "seductive details" (see Chapter 2).

Studies in which concreteness (ease of imaging) and comprehensibility of sentences and paragraphs were rated by subjects found that concreteness and comprehensibility were strongly correlated and highly predicted recall, better than even familiarity ratings (Sadoski, Goetz & Avila, 1995; Sadoski, et al. 1993). Although the concreteness effect was not equally strong in every text type (Sadoski, Goetz & Rodrigez, 2000), it never disappeared. Researchers not affiliated with Sadoski have, however, failed to find a concreteness effect (e.g., Marschark, 1985; Randsell & Fischler, 1989). While these studies suggest that concreteness effect may not always be present, there is still good reason to believe that it is a powerful and common effect: If we want the important parts of a text to be recalled, we should increase the imagery evokingness of those parts.

Indeed, there is some reason to believe in an even stronger claim—that the concreteness effect extends to comprehensibility. Subjects who reported a climax image for a story were more likely to understand the theme of the story and to score higher on comprehension (Sadoski, 1983, 1985). Sadoski (Sadoski, et al., 1993; Sadoski et al., 2000) found high correlation ($r = .91$, $r = .94$, $r = .96$) between concreteness and comprehensibility. Unfortunately, in all of these experiments, concreteness and comprehension were rated by the subjects, and only their common effect on recall was investigated. So, we don't know anything about the nature of the relationship between concreteness and comprehensibility. Are they simply correlated or is there a causal relationship? If increasing of the imagery evokingness of a text increases the comprehensibility of the text itself, we could aim to write more comprehensible texts by making them more imagery evoking. One of the few studies on the causal relationship between concreteness and comprehensibility was carried out by Wharton (1980, 1987). He found that revising abstract history texts to be more imagery evoking had a considerable effect on comprehension, suggesting that imagery evoking texts improve comprehension.

The role of mental imagery as described in DCT and Sadoski's work has significant pedagogical implications. It gives guidance for the development of more comprehensible texts and for determining the sequence of presentation of ideas and information in a text. With more studies on group differences and similarities in concreteness ratings of certain texts, it might also be possible to design highly comprehensible texts for specific target populations. The main points relating mental imagery and comprehension are: 1) The more concrete a text is, the easier it evokes mental imagery and the easier it is to understand. 2) Mental images function as nodes of associations and allow learners to construct rich meanings of texts. This serves deep understanding. 3) Abstractions must be connected to concrete experiences, at least when the abstraction is first introduced. After one abstraction is understood with reference to experience, additional abstractions can be built on them. If the first step is ignored, students may construct vague, confusing links between abstract ideas that have no relationship to their experience.

3. 3. Conclusions

As we have seen, Propositional Theory and Dual Coding Theory both offer explanations of text comprehension. It is interesting to note that while the theories address the same phenomena and acknowledge many of the same variables, the research programs of each pass the other by. DCT gives a role to key elements of Kintsch's theory—the importance of well-organized texts, and prior knowledge—and

Kintsch acknowledges that mental imagery has a role in comprehension. But, neither empirically investigates the phenomena held most important by the other. Further research aimed at integrating the theories might show the proper weight to give to key variables, such as concreteness and text organization.

CHAPTER 4
ORIENTATION TO STUDYING
AND TEXT COMPREHENSION:

TOWARD AN INTEGRATION OF TWO FIELDS

The literature on text comprehension and the literature on orientation to studying rarely meet. Even though the bodies of literature are quite independent, they show similar pedagogical interests and complement each other very well. As this dissertation straddles both fields, it is useful to explore some of their points of intersection. As we will see, both fields acknowledge the importance of deep learning, have similar conceptions of deep understanding, and see similarities in how deep understanding happens. Especially important to this dissertation, both fields more or less agree that imagery, concreteness, interestingness, comprehensibility, and deep understanding are linked in important ways.

Craik and Lockhart's (1972) distinction between surface and deep processing that inspired the orientation to studying tradition provides one obvious link between the two fields. Both fields have the practical goal of helping students learn at a deep level. Text comprehension theorists concentrate on the process of understanding and model the interaction between the learner and the text. As researchers have learned more about comprehension, they have broadened their views. For example, Dole (2000) discusses social psychological aspects of comprehension. Orientation to studying researchers investigate relationships between deep and surface approaches to learning and a host of variables relating to the circumstances in which learning occurs (including the text) and the characteristics of the learner. They may turn to cognitive psychology for ideas useful to the development of style and strategy measures (e.g., Entwistle & Waterson, 1988).

The two fields have similar conceptions of deep understanding. The goal in the learning styles literature is to identify the factors that determine the choice of learning approach in order to be able to help more students use a deep approach. Applying a deep approach involves the use of certain learning strategies, higher level strategies that lead to understanding (Alao & Guthrie, 1999; Entwistle & Ramsden, 1983). A deep approach involves "the intention to extract personal meaning from the text" (Entwistle, 1988, p. 24), and "this leads to an active process of learning in which the student challenges ideas, evidence, and arguments presented by the author, tries to see interrelationships among the ideas presented and seeks links with personal experience and the outside world" (Entwistle, 1988, p. 24). Understanding in the field of text comprehension is "an active process through which meaning is constructed" (Taraban, et al., 2000, p. 12) and includes "the set of reactions evoked by indirectly or brought to bear on [a text] by the vehicles of reference and association from our linguistic and nonlinguistic knowledge (Sadoski & Paivio, 2001, p. 69). The "richer the elaboration of activated mental representations and their defining interconnections, the richer the meaning" (Sadoski & Paivio, 2001, p. 69). Thus, both fields see understanding as an active process that involves combining ideas from a text with prior knowledge (Britton, et al, 1998; VanDijk & Kintsch, 1983).

As noted earlier, Kintsch describes learning as requiring deep understanding. He links this type of understanding to his third level of understanding, the situation model. Lonka, Lindblom-Ylaenne, and Maury (1994) make an explicit connection between Kintsch's levels of understanding and learning styles. They relate surface representation to surface level processing (Craik & Lockhart, 1972) and to surface approach (Marton & Saljö, 1976) and text base and situation model level understanding to deep processing and a deep approach to understanding. (Note that they disagree with Kintsch about whether text base understanding is deep or surface.)

The two fields also have significant similarities in how they see the variables that affect deep understanding. Both address prior knowledge and long term memory (LTM), comprehension strategies, metacognitive strategies, motivation, and text variables. Some parallels have already been indicated, but it will be useful to summarize key points of overlap.

According to Kintsch and other cognitive psychologists, comprehension involves connecting new information to old information stored in LTM (Britton et al., 1998; Chi, De Leeuw, Chiu, & Lavancher, 1994; VanDijk & Kintsch, 1983). This makes prior knowledge extremely important. The more knowledge one has in LTM, the more connections one can make to new information, so the easier understanding is. People with brain damage that impairs storing or retrieving information have problems with comprehension (Marcus, Cooper, & Sweller, 1996). In the orientation to studying literature, prior knowledge has an important role in determining choice of learning approach (Entwistle & Ramsden, 1983; Ramsden, 1988). Comprehension strategies identified by text comprehension researchers—e.g., summarizing, drawing on prior knowledge, and relating points to one another (e.g., Palincsar & Brown, 1984; Taraban, Kimberly, & Kerr, 2000)—are found among deep learning strategies identified in the orientation to studying tradition (Entwistle, 1988; Entwistle & Ramsden, 1983).

The second chapter discussed the role of metacognition in the orientation to learning literature (e.g., Beishuizen & Stoutjesdijk, 1999; De Jong, 1990; De Jong & Simons, 1988). Cognitive psychologists who study reading and comprehension also emphasize the importance of metacognition. Skilled readers are better not only in monitoring their understanding, but they are also more aware of their goals and processes. In other words, compared to poor readers, they have more metacognitive knowledge and they are more likely to apply their knowledge (Britton et al., 1998; Cain, 1999; Jitendra, Hoppes, & Xin, 2000; Taraban et al., 2000).

The second chapter also described the important role motivation plays in the learning styles literature. Findings in text comprehension literature corroborate the learning orientation findings and give additional ideas for motivating students (e.g., Guthrie, Wigfield, Metsala, & Cox, 1999). Cognitive psychologists have found individual differences in students' motivation to process new information—e.g., students are more likely to pay attention to information that has personal meaning; a role for social context in information processing—e.g., students are motivated to understand something if members of their group understand it; and a role for the perceived attractiveness and trustworthiness of a source (Dole, 2000).

Researchers in the learning styles tradition have addressed text difficulty, the complexity and organization of the text (Bluemenfeld & Meece, 1988; Ramsden, 1988). Ramsden (1988) suggested that texts with poor structure cannot be understood at a deep level. Cognitive psychologists—especially researchers in the field of readability (Irwin, 1988; Mosenthal & Tierney, 1984)—have examined many aspects of text complexity and organization. Kintsch and his colleagues (Kintsch & Yarbrough, 1982; Moravcsik & Kintsch, 1993) found a strong relationship between the organization and comprehension of texts. Indeed, the study of the relationship between text features and understanding is a major line of research in the field of text comprehension.

Mental imagery, as we have seen, is a central focus of the DCT theory of text comprehension, but researchers in the orientation to studying tradition say very little about it. One of the few mentions of imagery in this tradition is in a study by Vermetten, et al. (1999). They found that university courses with more vivid and concrete learning material were associated with a wider range of learning strategies and more self-regulation strategies. Another is Beishuizen et al's (2002) study, which offers direct links between the use of concrete examples and learning styles. According to their results, students who scored high on concrete elaboration (tending to think about concrete examples while studying a text) benefited more from a text without illustrations or examples, while those who scored low on concrete elaboration benefited more from a text that introduced a law through examples.

The orientation to studying tradition does, however, address a phenomenon closely related to imagery evokingness—the interestingness of a text. In fact, both traditions have found that interestingness is an important determinant of how well students understand a text (e.g., Entwistle & Ramsden, 1983; Sadoski, et al., 1993). As described in the second chapter, students differ widely in what they find interesting, but it is possible to change texts in ways that make them more interesting to most readers, regardless of their learning approach or style. By adding anecdotes and pictures and making the content more appealing, a text becomes more interesting and students learn it better (Wade & Adams, 1990). Research on DCT has found that texts that evoke mental imagery are also found to be interesting by students (Sadoski & Paivio, 2001). Indeed, Sadoski (1999b) found that imagery, interest, and comprehension are consistently related, and often load on a common factor.

In short, the main concern of the text comprehension and learning orientation fields is helping students to better understand the material they read. The two fields have different starting points. Text comprehension theorists approach the problem from the side of the text, while researchers in the orientation to studying tradition approach from the side of the student. But as each takes more and more variables influencing text comprehension into account, their work converges. The research of this dissertation described in the following chapters takes another step: It examines connections between learning approach, the imagery evokingness of texts, and understanding.

PART II

RESEARCH

INTRODUCTION

As the second chapter showed, although there is a great deal of research on factors affecting choice of learning styles, important questions remain unanswered. One of the conclusions of the chapter was that none of the factors alone seem to be sufficient to ensure deep learning, while problems with any of them are likely to lead students to surface learning. Our understanding of interactions among these factors is incomplete, and we know little about the role of what may be one key factor, the difficulty of the material.

The present research is an attempt to begin filling in gaps in our knowledge about factors influencing deep understanding. It focuses on one factor that has been little investigated, the comprehensibility of texts. At the beginning of the third chapter, I argued that the more comprehensible a text is, the greater chance students have to apply a deep approach to it and the less circumstances such as tiredness and lack of time will disturb them. Research in cognitive psychology suggests that the imageability and comprehensibility of texts are strongly connected: The more imagery evoking a text is, the easier it is to understand (Sadoski, et al., 1993; Sadoski, et al., 2000; Wharton, 1980, 1987). I argued that the easier a text is to image, the more likely that students will take a deep approach to it and the greater will be their understanding of it. Implicit in this is the notion that the choice of learning approach varies within students depending on the topic or text.

The next three chapters describe research that focuses on the relationships among text imageability, learning approach, and comprehension. Chapter 5 describes an exploratory interview study of the circumstances under which students use a surface approach. It specifically examines whether the difficulty of texts has a relationship to the choice of using a surface approach and whether students see a relationship between understanding and picturing a text. It also investigates the relationship between scores on the Hungarian version of the Approaches to Studying Inventory (ASI) and reported approaches to studying school subjects and texts.

The experiment described in the seventh chapter examines the effect of text concreteness on understanding and explores relationships among grades, learning approaches, text concreteness, and understanding as shown in answers to essay type questions. Chapter 6 describes the process of designing and testing the concrete and abstract paragraphs used for building the experimental texts.

The Hungarian Educational System

In order to better appreciate and understand the studies described here, it will help to know about the Hungarian education system. It should be noted that I see the Hungarian school system as tending to promote surface understanding, while Kozéki & Entwistle (1986) suggest the opposite. Their study was conducted during a very different era of politics and education. While teachers now may support deep learning in words, in deed, in many cases, they encourage surface learning. Hungarian children start school at the age of six or seven. For the first four years, they are considered to be young pupils. Classes have one or two teachers who teach every subject. Young children get more and more homework as they advance in grades, but the school atmosphere is looser and more fun than in the higher grades.

Fifth grade brings a great change. Students have more subjects than before (usually seven, plus art, music, and gym), and more teachers (five or so). Students must study "seriously." Almost every teacher gives daily homework or a reading assignment (e.g., a poem, text on Romanian industry, five to six math problems). Many students get bad grades for the first time.

After eight years (now, sometimes after four or six years) of elementary school, students go to academic high school, vocational high school, or a vocational school. Students are selected on the basis of school grades and high school entrance exam scores (and connections). To graduate high school, students must pass a comprehensive exam covering many subjects. To enter college or university, they must pass an entrance exam. There are more applicants than places. Students are selected on the basis of school grades and entrance exam scores. High exam scores can compensate for low grades, but high grades make admission easier.

Elementary school students are graded on their written and oral presentations of their knowledge. Written questions are mostly short answer or essay. Multiple choice tests are not very common. A typical Hungarian class begins with an oral exam period. The teacher picks one or two students from the class list to "answer." Students stand up or walk to the front of the class and tell everything they know about a topic covered in the previous class (e.g., vegetation of the savannas or the development of English Absolutism in the 13th century). The teacher usually asks questions. The teacher gives a critique and announces the grade to the entire class. Students rarely know when they will be called on. This is very stressful for many of them.

Students do oral presentation only two to three times a semester, so every grade is important. There are also several major and several shorter written tests scheduled each semester. Teachers are often perceived as powerful authorities or even enemies. Students often try to hide their "weaknesses" rather than ask for help.

The oral exams and essay tests are ideal for assessing understanding, but teachers vary greatly in the types of questions they ask and in the aspects of the answers they value. In general, they value memorization. It is not always sufficient for students to show they understand the material, they have to be able to recall it, sometimes in detail. University and college entrance exams reward memorization of material, and teachers try to prepare students for these exams.

CHAPTER 5
INTERVIEW STUDY

5. 1. Introduction

As the second chapter showed, an important problem in the literature of learning styles has to do with the consistency of styles. Research shows that styles are both consistent within students and inconsistent across situations (e.g., Biggs, 1988; Entwistle, 1988; Entwistle & Ramsden, 1983; Vermetten, et al., 1999). Most researchers consider learning styles to be both context-dependent and student-dependent and leave the matter at that. The problem, however, is not in claiming that style use is multi-determined, but in using questionnaires that ask about learning in general. Many researchers in the learning orientation tradition (e.g., Biggs, 1988; Entwistle & Ramsdem 1983; Schmeck, 1988; Vermunt, 1998) use questionnaires that ask about learning in general (e.g., "When I study, I always . . .") not about learning in relationship to specific subjects, texts, or tasks.

Studies using these questionnaires have yielded important results, especially when their goal is to see the general effects of the environment on learning styles (e.g., how does changing an assessment system influence learning orientation?). But, by using only questionnaires we do not get information about the changes in students' learning approach to specific subjects, texts, and tasks. The general picture of the students that questionnaires give hide details and the extent to which styles vary across different learning situations. Thus, a score on these questionnaires does not necessarily say much about how a student behaves in a specific learning situation. Students in elementary school and in high school usually have at least six or seven subjects taught by different teachers. They not only must study different material and different textbooks, but the assessment procedures and course requirements also vary.

A reason to expect wide divergence between elementary students' style scores on a questionnaire and actual behavior comes from a point Ramsden (1988) makes. He argued that "individual students develop habitual ways of approaching study tasks" (p.175), and that this stability does not mean fixity, even in case of university students. It is likely that the habits of elementary students are far less developed than those of university students. Consequently, we can reasonably expect large differences between elementary students' report on their learning in general (scores on deep and surface approach on a questionnaire) and their reports of their learning in concrete learning situations.

As one of my goals was to study the influence of one situational factor, the comprehensibility of the text, on learning approach, using only a general questionnaire would clearly not be adequate. Another approach is required. The study described in this chapter used a semi-structured interview in addition to the Approaches to Studying Inventory (ASI).

An interview is a good method for getting specific information about a wide range of phenomena related to school learning, e.g., how students approach specific school subjects, the difficulties they encounter in their studies, how they deal with the difficulties, and the role of text comprehensibility in the choice of learning approach. Comparing interview results with the scores on deep and surface approach on the ASI can show whether students who score high on deep approach deal with difficult texts differently than those who score high on surface approach.

Following Ramsden's (1988) suggestion that students can approach badly structured texts only at the surface level of learning, we would expect that students are more likely to use a surface approach with difficult to understand subjects. Certainly the amount of homework and the assessment system play important roles here, too. We have also seen in the second chapter that heavy workload by itself is associated with surface approach (e.g., Entwistle, et al., 1989; Entwistle & Ramsden, 1983). If schedules are tight, students have less time and energy to research a topic or try alternative approaches to understanding, especially if they can get good grades with rote memorization.

An argument could be made that students who do not understand something go to the teacher and ask for help instead of studying by heart (simply memorizing). But we have also seen that if students feel threatened or intimidated by an assessment system, they are more likely to apply surface approach (Ramsden, 1988). Ramsden (1988) also assumed that students in higher education "strive to adapt to the context" (p. 161). This adaptation probably starts in elementary school. Because good grades are very important in Hungarian schools, it is quite likely that if students cannot understand something they try to hide this and study the material by heart rather than give a teacher a bad impression of them. Thus surface learning can be already an adaptive behavior, consciously chosen in order to get better grades. We can also approach this problem by asking if students are aware of their own choices. If students make a conscious decision to study by heart in order to get better grades or to avoid punishment, they might know about the disadvantages of rote learning and the reasons why they choose it.

The third chapter gave a detailed account of the role of text features in text comprehension. Sadoski and his associates (Sadoski, et al., 1993; Sadoski, et al., 2000) found strong correlations between images evoked by texts and text comprehension. Wharton (1980, 1987) found a causal relationship between comprehension and imagery. Sadoski (1985) argues that students form mental images spontaneously while reading a text. Novelists give vivid descriptions of characters and scenery, which may evoke mental images in many readers. What about textbooks? Do they give vivid descriptions of the material? Though some studies suggest that the imageability of a text depends on the concreteness of the text, and students have similar images connected to certain parts of the story they read (Sadoski, 1983, 1985; Sadoski, et al., 1988), it is quite likely that students vary in picturing different subjects or topics (Paivio, 1971).

If forming mental images of a text is strongly connected to understanding the text, we can expect that students will report more images of subjects they understand than of subjects they do not understand. Thus I expected that students who say they understand a subject are more likely to report mental images of the subject than are students who report not understand the subject. I also assumed that many students will report that picturing and understanding are connected.

In summary, the interview has three main foci. First, examining under what circumstances students study by heart, that is, without trying to understand the material deeply. Second, examining whether students picture the content of all kinds of texts or of only some kinds. Third, exploring relationships between understanding a text and forming mental images of the text. The following research questions address these issues:

I. Does learning approach vary across situations?

1. Are there relationships between student reports of studying by heart and scores on the Deep Approach Scale and the Surface Approach Scale?

2. Can we find among the important reasons for using a surface approach that students do not understand the material?

3. Is it an important reason for using a surface approach that students want to get better grades or are afraid of getting bad grades if they don't know something?

4. Do students who study by heart know the disadvantages of studying by heart?

II. Do students form mental images while reading certain texts (such as novels, which provide many visual cues)

5. Do students report forming mental images while reading a novel they like?

6. Do students who report creating images while reading novels not report creating images while reading school books?

III. Do students report seeing a relationship between picturing a text and understanding it?

7. Do students report forming more visual images of subjects they understand than of subjects they do not understand?

8. Do students see relationships between understanding and picturing a text?

5. 2. Method

5. 2. 1. Subjects

Seventy-eight students, 35 girls and 43 boys, from a middle-sized public school in Hungary participated in the study. Twenty of the students were fifth graders, 20, sixth graders, 20, seventh graders, and 18, eighth graders. Their ages ranged from 11 to 14 years old. This age group was chosen because from fifth grade on students have to study at home, and they are old enough to reflect on their studying. The school director chose classes that had "easy" periods (music and art classes) at the scheduled time, and the headmaster for each group of students selected students within each class to participate in the study, usually the first ones from the class list.

5. 2. 2. Materials

Interview Guide

The first key task in creating the interview guide was to adequately operationalize the concepts I was interested in so that young Hungarian students would understand them. The two key concepts were "surface approach" and "forming mental images." Surface approach is defined by Entwistle (1988) as having the focus of attention on the text while reading, being concerned with verbatim recall of the text or the facts in it, having little or no personal engagement in learning. It is a "mechanical process of rote memorization. . . [and leads to]. . . a more or less complete reproduction of the text, which is unlikely to contain the central core of the authors message" (p. 25). To communicate to young students, I used the expression "studying by heart" ("magolás"), which is an everyday expression that captures the essence of a surface approach to learning. A very similar expression, "studying word by word" ("szóról szóra tanulás") can be used as a synonym of studying by heart in everyday language. To avoid possible confusion, I asked every student to describe what the two concepts meant. For the few who were not clear about the meaning of the terms, I used the term "studying without understanding" ("tanulás megértés nélkül").

Finding an appropriate Hungarian expression for "forming mental images" was more difficult. The verb "to imagine" ("elképzel") is close, but for many children it has the meaning of actively forming an image of something unknown (e.g., a dragon) and does not refer to forming a mental image of something previously experienced (e.g., a lion seen on TV). The expression "to see in front of one's eyes" or "to see in front of oneself" ("a szeme elõtt látja" or "maga előtt látja") refers to any kind of mental visual image. I asked each student to clarify this concept. All of them understood it as I did.

The second key task in the study was to develop interview questions that clearly and accurately addressed the research questions. The interview was part of a larger study, and here I describe only the questions that are the focus of the present dissertation (see Appendix A for the complete interview guide). Following are the interview questions along with the research questions:

I. Does the choice of learning approach vary across situations?

Research question 1. Are there relationships between student reports of studying by heart and scores on the Deep Approach Scale and the Surface Approach Scale?

Question 10: What do you do when you don't understand something?

Question 11: If nobody is at home or you don't happen to find the answer for your questions, do you study what you don't understand?

Later in the interview I asked:

Question 19: Do you study by heart? (if yes) When?

Research question 2. Can we find among the important reasons for using a surface approach that students do not understand the material?

Question 11: If nobody is at home or you don't happen to find the answer for your questions, do you study what you don't understand?

Question 19: Do you study by heart? (if yes) When?

Research question 3. Is it an important reason for using a surface approach that students want to get better grades or are afraid of getting bad grades if they don't know something?

Question 12: Why do you study what you don't understand?

Question 13: What would happen if you showed up in class and said to the teacher that you could not study because you could not understand the material?

Research question 4. Do students who study by heart know the disadvantages of studying by heart?

Question 35: What do you think of studying by heart? Is it good or bad?

II. Do students form mental images while reading certain texts (such as novels, which provide many visual cues)?

Research question 5. Do students report forming mental images while reading a novel they like?

I asked students to think of a novel they had read as an example, then asked:

Question 21: Do you think about what you are reading while reading?

Question 22: If yes, how do you think about what you are reading?

I approached the problem this way because I wanted to see how many students report picturing novels by themselves. This was the first question I asked that could have to do with forming mental images. Once they answered freely, I asked directly:

Question 23: Do you picture what you read?

Research question 6. Do students who report creating images while reading novels not report creating images while reading school books?

Question 25: How about History? Do you picture what you read when you are reading a History book? I asked the same about Literature, History, Geography, Biology, Physics, Chemistry, Math, and Foreign Language.

III. Do students report seeing a relationship between picturing a text and understanding it?

Research question 7. Do students report forming more visual images of subjects they understand than of subjects they do not understand?

Question 25/a: What makes it difficult to picture texts in Literature, History, Geography, Biology, Physics, Chemistry, Math, and Foreign Language.

Question 9: Do you understand Literature? I asked the same about the other subjects

Research question 8. Do students see relationships between understanding and picturing a text?

Question 31: Can you picture what you understand?

Question 32: Can you picture what you do not understand?

And from the other way around:

Question 29: Is it possible to teach all subjects in a way that every student could picture them?

Question 30: What would happen if all subjects were taught in a way that everyone could picture them?

Interview Procedure

The interviews were conducted using a semi-structured format. The atmosphere of the interviews was conversational. I asked every participant the same specific questions, but I tailored follow-up questions to each student in order to get more complete answers. I did not inject my own opinions or ideas in order to stimulate a responses, rather I adjusted my questions according to how students were responding in order to clarify vague statements or get elaboration of brief comments. When students wandered to unrelated topics, I directed their attention back to the issues at hand. At the beginning of the interview I asked a warm up question ("Do you think it is hard to study?") in order to build rapport and to help students get relaxed and used to being recorded. The next two questions asked about subjects found most easy and most difficult and why. Most students were relaxed by the time they had answered these questions.

Inventory of Study Approaches

There are a number of questionnaires for measuring learning approach including, the Study Process Questionnaire (Biggs, 1985, 1993), Inventory of Learning Styles (Vermunt, 1998), and the Approaches to Studying Inventory (Entwistle & Ramsden, 1983). Each has different strengths and weaknesses. The only one of them translated and used in Hungary is the Approaches to Studying Inventory (Entwistle & Kozéki, 1985; Kozéki & Entwistle 1986). The Hungarian version of the Approaches to Studying Inventory (ASI) was developed from the 64 item Approaches to Studying Inventory (Entwistle & Ramsden, 1983). Entwistle and Ramsden's ASI was designed for use by researchers and teachers with students in higher education. Factor analyses of the Approaches to Studying Inventory yielded four main factors of learning orientation: meaning, reproducing, achieving, and nonacademic. The same factor structure was found in different countries in the world both at item and scale level, although the first two factors are more stable than the other two (Entwistle, 1988).

Entwistle and Kozéki altered the ASI to make it suitable for use with elementary/middle school students with the intention "to retain, as far as possible, the main features of the meaning, reproducing, and strategic orientations" (Entwistle, 1988, p. 39). The wording of the questions was altered, scales were omitted or renamed, and an approach was redefined (e.g., learning styles pathologies such as globetrotting and improvidence were omitted and Strategic approach was defined as a "highly organized way of tackling school work with an eye to good attainment"

(Entwistle & Kozéki, 1985, pp. 127). The final inventory (Entwistle & Kozéki, 1985) contains 60 items. Ten scales, each made of six items with five point Lickert scales (for the Inventory scales see Table 5.1., and for the whole Inventory see Appendix. B).

The questionnaire was translated into Hungarian (Balogh, 1995; Entwistle & Kozéki, 1985; Kozéki & Entwistle, 1986). In one study (Entwistle & Kozéki, 1985; Kozéki & Entwistle, 1986) using both the Hungarian and English version, Hungarian elementary/middle school students and Scottish elementary/middle school students were compared (579 Hungarian, and 614 Scottish students, age between 13-17). The same factor structure was found in the answers given by the two samples.

The test-retest reliability for the scales were between .63 and .77. The internal reliability of some of the scales was rather low (between .45 and .79 for the Scottish and between .32 and .76 for the Hungarian sample). A recent study on Hungarian children using the same inventory had similar results (Páskuné, 2002). The reliability of the scales was from low to moderate (Cronbach's alpha: .25 - .59).

Table 5.1.
Scales of the Approaches to Studying Inventory for elementary/middle school students

Scales	Items belonging to the scales
Deep Orientation	
Deep Approach	01, 11, 21, 31, 41, 51
Holist Style	02, 12, 22, 32, 42, 52
Intrinsic Motivation	03, 13, 23, 33, 43, 53
Surface Orientation	
Surface Approach	04, 14, 24, 34, 44, 54
Serialist Style	05, 15, 25, 35, 45, 55
Fear of failure	07, 17, 27, 37, 47, 57
Instrumental Motivation	06, 16, 26, 36, 46, 56
Strategic Orientation	
Strategic Approach	08, 18, 28, 38, 48, 58
Conscientiousness	09, 19, 29, 39, 49, 59
Hope for Success	10, 20, 30, 40, 50, 60

As the study was concerned only with deep and surface learning, the strategic approach and the motivation scales were left out of all analyses. Four of the ten ASI scales were chosen, Deep Approach, Surface Approach, Holist Style, and Serialist Style. In Entwistle and Kozéki's (1985) study, the Cronbach's alphas for the Hungarian sample were: Deep Approach Scale, .64; Surface Approach Scale .61; Holist Style Scale, .51; Serialist Style Scale, .32.

5. 2. 3. Procedure

Before beginning the interviews, I visited each class to introduce myself and explain the study in order to address student questions, build good rapport for the interviews, and administer the ASI. I told students that the goal of the study was to collect information about how students learn and the difficulties they encounter in learning in order to help create better teaching methods and textbooks. On the basis of earlier experiences, I paid careful attention to this part of the process. In a preliminary interview (not reported here) some students were reluctant to talk about their problems because they perceived me as a teacher figure. Aware of this problem, I started a casual conversation to reduce fear and nervousness. I made it clear that I was not a teacher and that I intended to help students and teachers with my study. I told them that they could help me the most if they honestly talked about their experiences and problems. I emphasized that the participation was voluntary and that students could simply decline to participate. I also emphasized that the answers to the questions would remain anonymous: I would remove their names from the questionnaires and no one, especially not their teachers, would know what they said. I also emphasized that the interview was not a test and I would make no conclusions about their intelligence or other abilities. It worked. Students seemed to trust me. In the interviews, they criticized their teachers and the school in many ways and seemed to honestly describe their problems.

Students took 20-30 minutes to complete the ASI. Then the individual interviews were conducted in a small classroom. The interviews took approximately 30-35 minutes each. They began with a brief chat and a discussion of the procedure and a demonstration of the tape recorder. I stated again that identities and answers would be anonymous. All agreed to have the interview recorded. Many students expressed pleasure that they could participate in a "real study" and that their opinions were important. Two students did not show up for the interviews.

Each interview was recorded and later transcribed. On the basis of a preliminary study, I developed a coding sheet with some preliminary answer categories. During the interviews, I scored some answers. I later checked these against the recordings.

5. 2. 4. Creating Answer Categories

Creating answer categories was fairly straightforward. Answers were frequently short, sometimes only one word (e.g., "yes," "no," "sometimes"). In many cases I did not even have to use the categories of "other," or "fuzzy answer." In most cases, categories clearly follow answers and answers were easy to fit into one of the categories. After the categories were developed, an independent judge put answers into the already existing categories for the questions in which answers required interpretation. The interrater agreement (kappa) of my and the other judge's answers was between .77 and 1.00.

5. 2. 5. Missing Data

In Hungary fifth and sixth graders do not study physics, and seventh graders do not study chemistry. They were not asked about these subjects. The tape recorder lost about half of one student's answers. Rarely (not more than 1% of all the questions), students did not answer or the answer could not be understood.

5. 3. Structure and Reliability of the Approaches to Studying Inventory

ASIs with missing responses and ones that suggested that students did not pay attention or did not take the task seriously (had too many of one type of responses, e.g., all 60 responses were 1s) were deleted from the analysis. This left 70 sets of data for analysis. Considering the small number of respondents relative to the number of analyzed items of the questionnaire, the study must be considered exploratory.

The means and standard deviations of the deep and surface approaches can be seen in Table 5.2. The structure of the Deep Approach, Surface Approach, Holist

Style, and Serialist Style Scales were examined by means of principal component analysis. If the scales worked as designed, four factors would have emerged. The Varimax rotated four factor solution, however, did not reveal a clear pattern and was difficult to interpret. A rotated two factor solution showed a clearer picture. The two components explained 27.04% of the total variance. The first component had from moderate to high loadings from all six items of the Deep Approach Scale (01, 11, 21, 31, 41, and 51), two items of the Holist Style Scale (12 and 32), and one item of the Surface Approach Scale (34). The second component had from moderate to high loadings from four items of the Surface Approach Scale (04, 14, 24, and 54), two items of Serialist Style Scale (item 5, 15), and one item from the Holist Style scale (42). In other words, the items of the Deep Approach Scale loaded together on one factor and the items of the Surface Approach Scale more or less loaded together on the other factor. The items of the Holist and Serialist Styles Scales did not show any clear pattern of loadings. The Holist and Serialist Styles Scales were dropped, and only the original six-item Deep and Surface Approach Scales were used in the next step of the analysis.

A principal component analysis was then completed using only the Deep and Surface Approach Scales. Two components emerged rather clearly, one with moderate to high loadings from all six items of the Deep Approach Scale (01, 11, 21, 31, 41, and 51) and a second with moderate to high loadings from five items of the Surface Approach Scale (04, 14, 24, 44, and 54). Item 34 of the Surface Approach Scale had very low loadings on any of the components, and it was dropped from the analysis. In the next two component analysis, two more items of the Surface Approach scale were dropped for the same reason (44, 54). The final analysis yielded a two factor solution that explained 47.9% of the total variance of the original Deep and Surface items. Table 5.3. shows the rotated component matrix.

Table 5. 2.
Descriptive Statistics of Deep Approach and Surface Approach

	N	Mean	Std. Deviation
factor 1 Deep	70	3.8091	.70152
factor 2 Surface	70	2.6236	.92342
Valid N (listvise)	70		

Table 5. 3.
Varimax Rotated Component Loadings of the Items of the Deep and Surface Approach Scales

Items		Components 1	2
01	I always try to connect what I study to topics we have studied in other subjects	.53	-.38
11	I always try to understand things, even if it seems difficult at the beginning	.70	-.16
21	I often ask questions of myself about what I have read or heard in class	.57	.11
31	I try to connect what I read to my personal experience	.68	-.07
41	I like to take my own notes whenever I can	.58	-.07
51	To understand what I am learning about I try to connect it to my everyday experience	.73	-.09
04	To be well-prepared, I have to study lots of things word by word (by heart)	-.03	.75
14	If I read a book I can't spend time thinking about what it is about	-.22	.68
24	I understand the concepts best if I remember definitions in the textbook word by word	.05	.77

A reliability analysis yielded a Cronbach's alpha of .70 for the Deep Approach Scale. Dropping items 34 and 44, and 54 yielded a Cronbach's alpha of .62 for the Surface Approach Scale. Both alphas indicate a moderate reliability. That the Cronbach's alphas of the scales in this study are only moderate is confirmed by the experiment study (Chapter 7) and is consistent with the findings of Páskuné (2002). The reliability of the ASI will be further discussed in Chapters 7 and 8.

All the items of the Deep Approach Scale were used in the present study. The scale describes students who try to understand what they read. They ask questions about a text and try to connect information in a text to previously learned information and to their personal, everyday experiences. They have a personal engagement with the material they read. This description corresponds to Entwistle's (1988) definition of deep approach.

The items of the Surface Approach Scale used in the present study are:

04. To be well-prepared, I have to study lots of things word by word (by heart).

14. If I read a book I can't spend time thinking about what it is about.

24. I understand the concepts best if I remember definitions in the textbook word by word.

Students described by these items do not have much personal engagement with the material they are learning. These students try to remember a text word by word and they do not think about what they are reading. This description is very similar to Entwistle's (1988) description of a surface approach.

The items dropped from the analysis are conceptually poor fits to the concept of a surface learner:

34. I like having precise explanations of what I have to do in written assignments.
44. I only write down something in class when the teacher tells us to.
54. I usually read only what I have to.

Items 44 and 54 describe students who do not do any work beyond what they absolutely have to. This might be an aspect of surface learning, but the concept does not require it. Item 34 does not fit with Entwistle's (1988) description of a surface approach. It refers to a need for knowing exactly what an assignment is, not to how one learns.

5. 4. Results and Discussion

The interview study described here is an exploratory study designed to investigate circumstances under which students use a surface approach to learning, specifically whether the difficulty of a text has a relationship to the choice of a surface approach and whether students see a relationship between understanding and picturing a text. It also investigated the relationship between scores on the Hungarian version of the Approaches to Studying Inventory (ASI) and reported approaches to studying school subjects and texts.

Generalizability was not a concern. Relatively simple methods, such as descriptive statistics and cross tabulations are used to analyze the data. Correlational analyses were used to examine relationships between interview data and scores on the ASI. As interrater agreement on the scoring of the interview data was very high, my coding was used in the data analyses.

The following sections address the results. For each main research question, I present a general summary of the results and then address specific research questions in detail.

5. 4. 1. Does the Choice of Learning Approach Vary Across Situations?

Results of the interview suggest that students use different learning approaches in different situations. This result is consistent with other studies showing the context-dependent nature of learning approaches (e.g., Ramsden, 1988; Vermetten et al., 1999).

There was no association between students' reported use of a surface approach in certain situations and their scores on the ASI. Those who scored higher on deep approach were not less likely to study by heart than those who scored lower on deep approach. Similarly those who scored higher on surface approach were not more likely to study by heart than those who scored lower on surface approach.

One important reason for studying by heart was difficulty in understanding the material. Students reported choosing a surface learning because they were afraid of getting bad grades: If they didn't understand the text, at least they could memorize it. This is consistent with other findings on the effect of an intimidating assessment system on learning (e.g., Entwistle, 1988). Interestingly, while students reported studying by heart in certain situations, the disadvantages of surface learning ("I can't use what I learn"; "I forget it quickly") was absolutely clear to most of them. This suggests that students even at this age do not react passively to learning situations but assess them and make conscious choices about how to learn.

Research question 1. Are there relationships between student reports of studying by heart and scores on the Deep Approach Scale and the Surface Approach Scale?

Three questions (Question 10, 11, and 19) elicited information about studying by heart. The answers to these questions were then compared to answers on the ASI.

When asked Question 10, "What do you do when you don't understand something?" most students said they asked their parents or a friend or made some other responsible attempt to understand (Table 5.4.). When I asked further, "If nobody is at home or you don't happen to find the answer for your questions, do you study what you don't understand?" (Question 11), 59% of the students said that they did (Table 5.5.). Many answered with the confidence of "of course" or "we have to." Twenty-two percent said that they sometimes studied what they didn't understand, depending on the subject. For example, one student explained that "in literature there is no point to memorizing things like rhyme forms because the main point is to be able to find them in poems. But in geography, yes, we have to rote learn."

Table 5. 4.
Frequency and Percentage of categories for Question 10: What do you do if you do not understand something?

Answers	Frequency	Percent %
Ask my parents	53	67.9
Ask my sibling/friend	25	32.1
Try to understand	21	26.9
Look up in a book	23	29.5
Ask my teacher	13	16.7
Give up	10	12.8

N of students = 78 (students could give answers in more than one category)

Nineteen percent reported that they persist in trying to understand. Later in the interview I simply asked students if they studied by heart, and if yes, when (Question 19). Twelve percent said that they never studied by heart (Table 5. 6.).

The mean score on the ASI Deep Approach Scale was 3.8, and the mean score on the ASI Surface Approach Scale was 2.62, both on a 5-point Lickert scale. This means that students agreed more with statements about connecting new information to old, connecting study material to personal, experience, trying to understand, and taking their own notes, and they agreed less with statements that emphasized the necessity of studying word by word or being able to understand something only by remembering a definition word by word. The mean scores in this study were higher for deep approach than for surface approach. Entwistle and Kozéki's (1985) study of Hungarian students found the same: The mean deep score was 2.8 for boys and 2.95 for girls; mean surface score, 1.7 for boys and 1.57 for girls.

Table 5. 5.
Frequency and Percentage of categories for Question 11: Do you study what you do not understand?

Answers	Frequency	Percent %
Yes/I try to study it	46	59.0
Sometimes/ depends on subject	17	21.8
No/try to understand	15	19.2
Total (N)	78	100.0

N of students = 78

Table 5. 6.
Frequency and Percentage of Categories for Question 19: Do you study by heart (if yes, when)?

Answers	Frequency	Percent %
If teacher requires it	13	16.7
If I don't understand	48	61.5
If I don't feel like	9	11.5
If no time to understand	14	17.9
Certain rules/ subjects	10	12.8
No	9	11.5

N of students = 78 (students could give answers in more than one category)

None of the responses to questions 11 or 19 relate to deep or surface scores at anything near significance. For Question 19, the correlations between the answer categories and the Deep and Surface Approach Scales ranged from -.08 to .17; for Question 11 the result of the analysis of variance was F= .56, p= .947 for deep and F=.48, p=.619 for surface approach. (A correlational analysis is appropriate for each of the answer categories of Question 19 because respondents could give multiple answers; ANOVA is appropriate for Question 11 because respondents could give only one answer.) This means that whether or not students affirm items on the ASI indicating a deep or surface approach, it says nothing about their reported actual deep and surface learning in certain situations. In the case of the present study one explanation for these results may be that the internal consistency of the scales was only moderate. This by itself immediately raises questions about the validity of the questionnaire: What does the ASI measure?

The word "try" is often present in the ASI Deep Approach Scales items (e.g., "I try to connect. . ."), suggesting that the deep approach scales more or less measure intentions. The interview questions addressed actual behavior. Part of the reason for the absence of association may be, then, that the interview and the ASI measure two different phenomena: intention and self-perceived behavior. In a discussion of one of his studies, Entwistle (1988) makes a similar distinction—between intention and actual behavior: "Many students who intended to understand, failed to carry through the full process necessary to achieve a deep level of understanding" (p. 45). Marton (1988) makes distinctions between intention, behavior, and self-perceived behavior: "what one is actually doing in learning situation, what one is trying to do in learning situations, and what one thinks one is doing in learning situations" (p. 76). While these distinctions serve to preserve the value of the ASI as a measure of intended learning approach, it is still surprising that intention has no relationship to self-perceived behavior. More research is needed to reveal the exact nature of the relationships among intention, behavior, and perception of one's behavior.

A second explanation for the absence of a relationship between ASI scores and reported learning behaviors is that the wording of the ASI may be confusing to students. This may lead students to interpret questions in many different ways and answer according to different interpretations. This would lower the validity and reliability of the inventory. For example, item 21 ("I often ask questions of myself about what I have read or heard in class") asks students to judge the strength of their agreement with a statement that requires them to estimate the frequency of a behavior, without asking about the frequency precisely. This is a confusing task and may result in a wide variance in ways of figuring an answer.

A third possible explanation for why ASI scores differ from the interview results is that the ASI evoked socially desirable answers from students, but the interview did not. Watkins' (1996) concern about the effect of social desirability on the validity of Biggs' Learning Styles Questionnaire (Biggs, 1985) is relevant here. In Hungary, studying by heart is often seen as a shame. The word "magoló" refers to a rote learner and is very pejorative and in some cases implies stupidity. Students, then, might have shied away from endorsing ASI items that suggested they were rote learners. In the interview, however, where their criticisms and complaints of school were accepted and where they spoke more about subjects and situations than about themselves, they may have been more honest about their study practices.

Research question 2. Can we find among the important reasons for using a surface approach that students do not understand the material?

We saw that many students reported studying by heart what they do not understand. The results showed that not understanding was the most common reason for studying by heart. If a student said yes to Question 19, Do you study by heart?, I asked in what situations they studied by heart. As shown in Table 5.6, the most frequently mentioned reason was, "I don't understand the material" (61.5%).

It is worth noting that Question 19 came after Question 10, What do you do when you do not understand something? and Question 11, If nobody is at home or you do not happen to find the answer to your question, do you study what you do not understand? Both questions deal with not understanding and may have primed students to mention this in their answers to Question 19. On the other hand, many answers to Question 19 contained elaborations that have the ring of truth (e.g., "when the teacher does not explain it, or explains it but it might be my stupidity that I don't understand it" or "I did not understand something and I did not have any hope to be able to grasp it, so I thought it would be much better just to simply memorize it"). If the earlier questions did affect answers to Question 19, the effect probably was not great, and we can still conclude that difficulty with understanding the material is a significant factor in choosing a surface approach and that this phenomenon merits the attention of educators.

Research question 3. Is it an important reason for using a surface approach that students want to get better grades or are afraid of getting bad grades if they don't know something?

If students said that they studied by heart what they did not understand, I asked why they did so (Question 12). Table 5.7. shows that 75.6% of the students stated that they did so in order to get better grades or to avoid getting bad grades (e.g., "I absolutely don't understand it, but I try to study it by heart so it looks as if I knew it" or "I don't want to get a bad grade" or "Have to, teachers ask it.").

Table 5. 7.

Frequency and Percentage of Categories for Question 12: Why do you study what you don't understand?

Answers	Frequency	Percent
Good grades	59	75.6
Save time	1	1.3
Understand later	4	5.1
Don't study	15	19.2
Don't know	1	1.3

N of students = 78 (students could give answers in more than one category)

Table 5. 8.
Frequency and Percentage of Categories for Question 13: What would the teacher say if you said that you couldn't study the text because you didn't understand it?

Answers	Frequency	Percent
Bad mark/punishment	29	37.2
Depends on the teacher	34	43.6
Teacher would help	19	24.4
Never happened/ would never tell	13	16.7

N of students = 78 (students could give answers in more than one category)

I further probed students' motives for studying by heart by asking them to respond to a hypothetical situation: What they thought would happen if they showed up in class and said to their teachers that they could not study the day's text because they could not understand it (Question 13). Table 5.8. shows the results. Thirty-seven percent thought they would get a bad mark or be punished somehow; 43.6% thought that the consequence would depend on the teacher; 16.7% said that it never happened or they would never tell the teacher that they did not understand something.

Punishment in this context meant verbal abuse. Students frequently said that the teacher would say that they should have figured out or done something to understand the reading. Some students thought that they would be accused of stupidity or lying. Many students gave examples, playing the role of the teacher, with the teacher's tone. For example, "How is that possible that you don't understand it. I have already explained it!" or "This story belongs to the category of fairy tales." or "How come that a six grader does not understand it?" Some students said that the teacher would give them a bad grade and say, "Then study it without understanding!"

Table 5. 9.
Frequency and Percentage of Categories for Question 35: What do you think of studying by heart? Is it good or bad?

Answers	Frequency	Percent
Good/good grade/time	22	28.2
Bad, you forget	62	79.5
Bad, you cant use	21	26.9
Bad, other	10	12.8

N of students = 78 (students could answer in more than one category)

Table 5. 10.
Cross tabulation of Question 11 (Do you study what you do not understand?) by Question 35 (Is it good to study by heart?)

Answers 11 35	Yes/I try to (46)		Sometimes/depends (17)		No/try to understand (15)	
	Count	Percent %	Count	Percent%	Count	Percent %
Yes, good mark/time	13	28.3	5	29.4	4	26.7
No you forget	37	80.4	13	76.5	12	80.0
No, can't use	14	30.4	4	23.5	3	20.0

N of students = 78 (in Q 35 students could answer in more than one category)

The cross tabulations of Question 25 (Can you picture the subjects?) with Question 9 (Do you understand the subjects? shown in Table 5.17.) shows that students who report that they do not understand a subject with few exceptions also report that they cannot picture it. Students more often report understanding a subject and not picturing it. This suggests that it is difficult to picture something without understanding it, but that there are ways of understanding subjects without picturing them. Very few students, however, said they did not understand a subject at all. Many almost automatically said they understood. This again shows the importance of asking very specific questions at the level of topics and texts.

Table 5. 11.
Cross tabulation of Question 35 (Is it good to study by heart?) by Question 12 (Why do you study what you don't understand?)

Answers 35 12	Good grades/save time		Do not study	
	Count	Percent %	Count	Percent%
Yes, good mark/time	17	28.3	4	28.6
No you forget	48	80.0	11	78.6
No, can't use	17	28.3	3	21.4

N of students = 78 (in both questions students could answer in more than one category)

Research question 4. Do students who study by heart know the disadvantages of studying by heart?

Question 35 aimed to see if students consciously choose to study by heart in order to survive school: "What do you think of studying by heart? Is it good or bad?" Table 5.9. shows that about a quarter of the answers pointed out advantages of studying by heart: to get good grades and to save time (e.g., "You remember a few sentences and you can answer the teacher's questions"). The great majority of the answers indicated the disadvantages of studying by heart (e.g., "You forget it anyhow; it is a waste of time" "We will not know it later and cannot apply it"). The cross tabulation of answers to Question 11 and Question 35 (Table 5.10.) shows that most students who reported studying what they did not understand said that this was not good because they will forget what they studied (80.4%) or because they can't use the knowledge (30.4%).

Cross tabulations of answers to Questions 12 and 35 and Questions 19 and 35 gave very similar results. As table 5.11. shows, 92.3% of those who study by heart when teachers require them to do so think they will forget it anyhow. Table 5.12. shows that 100.0% of those who study by heart when they don't feel like learning think they will forget the material.

Answers to Questions 11, 12, and 35 and suggest that even though students know the disadvantages of rote learning they still chose it in a very conscious way in order to get better grades or avoid punishment. This result supports Entwistle's (1988) findings that surface approach is related to external motivation and fear of failure.

Table 5. 12.
Cross tabulation of Question 35 (Is it good to study by heart?) by Question 19 (Do you study by heart?)

Answers 19 35	If teacher requires		If I don't understand		If I don't feel like it		No time to underst.		Certain Rules, subj.		No	
	N	%	N	%	N	%	N	%	N	%	N	%
Yes, good mark/time	7	53.8	10	20.8	1	11.1	4	28.6	2	20.0	4	44.4
No you forget	12	92.3	39	81.3	9	100.0	10	71.4	9	90.0	5	55.6
No, can't use	4	30.8	13	27.4	1	11.1	2	14.3	4	40.0	3	33.3

N of students = 78 (in both questions students could answer in more than one category)

It also supports the idea that at least as early as 6th grade, students intentionally adapt to the learning context (Ramsden, 1988). Students seem to choose an approach in a specific situation on the basis of a variety of considerations. Even if they think rote learning does not make any sense, they use it to avoid bad grades. Because they do not have always time and do not always feel like consulting other books, they simply memorize.

5. 4. 2. Do students form mental images while reading certain texts (such as novels, which provide many visual cues)?

Most students reported spontaneously forming mental images while reading a novel they liked. Sadoski (1983, 1985) found much the same. Most students in the interview study did not report always creating images while reading text books. Creating images of text books seems to vary across subjects and students: Certain subjects seem to be easier to picture than others, and students differ in the subjects or topics they can picture.

Research question 5. Do students report forming mental images while reading a novel they like?

So as to not cue answers, I approached the question indirectly by first asking students if they think about what they read (Question 21) and then asking how they think (Question 22). Many students said they did think about novels while reading them (65.4%). Some said they had to be interested in the novel (23.1%) or understand it (5.1%) in order to think about it (Table 5.13.).

Table 5. 13.
Frequency and Percentage of Categories for Question 21: Do you think about what you read while reading?

Answers	Frequency	Percent %
Yes	51	65.4
No	1	1.3
If I am interested	18	23.1
If I understand it	4	5.1
Sometimes	4	5.1

N of students = 78

Table 5.14. shows that nearly 70% of the students spontaneously reported picturing novels—seeing the story in their heads. Others live the story through as if they were the main character, or think about its meaning, or try to figure out the end.
I then directly asked students if they pictured a story while reading (Table 5.15.).
Nearly 95% said that they did. They usually gave examples of how they pictured what they read (e.g., "as if I was a camera" or "as if I was standing there") and could easily describe the content of the pictures and if they moved or had sounds. This suggests that the greater percentage of students reporting images when asked directly is not due to a desire to please but to the question jarring their memories. In any case, if the lower figure alone is trusted, at least two-thirds of the students form mental images while reading stories.

Research question 6. Do students who report creating images while reading novels not report creating images while reading school books?

Novels are usually written in a highly vivid way with detailed descriptions of characters and actions. This might make them easier to picture. Text books often lack vivid detail. And indeed, students' reports of picturing school material varied greatly across subject areas and within students (Question 25, see figure 5.1). Literature, History, and Biology are relatively easy to picture: Approximately 50% of the students said they could picture these subjects; approximately 10% said they could not. Geography and Chemistry are more difficult (approximately 27% said they could picture these subjects; 8% that they could not). Physics, Math and Foreign languages are very difficult to picture (approximately 20% said they could picture these subjects; 50% that they could not).

These results certainly have something to do with both the nature of the subjects and with how text books are written (as we will see later in Question 25a). For example, history is in many cases "similar to a tale" as some students pointed it out, while Mathematics (Geometry was not taken into account) is more difficult to image because it is "about numbers." From Figure 5.1., we can also see that there are many students who said sometimes yes, sometimes no—it depends on the topic or text. This suggests that imagery evokingness is not so much a matter of subject areas as of texts and topics.

Table 5. 14.
Frequency and Percentage of Categories for Question 22: How do you think about the text when you read it?

Answers	Frequency	Percent %
Picture it	54	69.2
Live through	15	19.2
Think about meaning	7	9.0
Figure out end	3	3.8
Fuzzy answer	6	7.7

N of students = 78 (students could give answers in more than one category)

In general, most students who can picture novels are not able to picture all subjects, or all topics within the subjects. Thus, differences among students in reports of imagery formation cannot be due simply to differences among students in skills—e.g., that some are visualizers and some verbalizers. The idea discussed in Chapter 3 that text features affect imageability receives support from students' reports.

5. 4. 3. Do students report seeing a relationship between picturing a text and understanding it?

The results support the answer that students see a relationship between picturing and understanding topics and texts (Sadoski et al. 1993, 2000; Wharton, 1980, 1987). Students usually did not report picturing subjects they did not understand. Most students also thought that a relationship exists between understanding and picturing texts. They experienced this relationship working in both directions.

Table 5. 15.
Frequency and Percentage of categories for Question 23: Do you picture the story while reading?

Answers	Frequency	Percent
Yes	74	94.9
No	1	1.3
Sometimes	3	3.8

N of students = 78

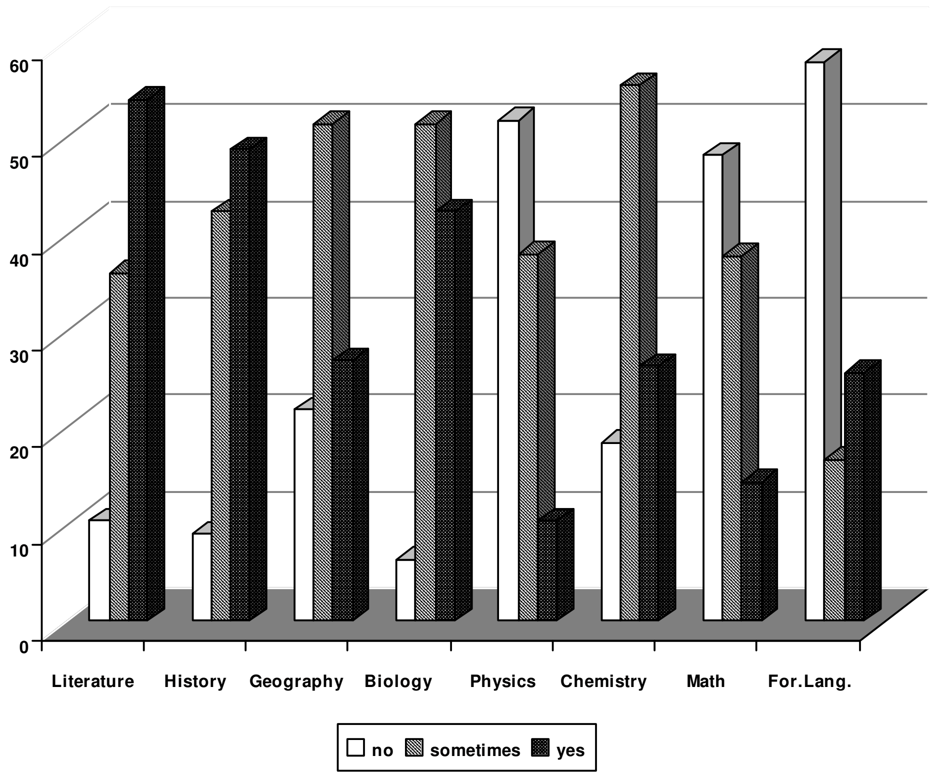

Figure 5.1.
Percent of categories for Question 25: Can you picture the subject?

Research question 7. Do students report forming more visual images of subjects they understand than of subjects they don't understand?

I asked students what makes it difficult to picture texts in six subject areas (Question 25a; see Table 5.16). Except for answers having to do with not liking a subject or with the subject area not being amenable to picturing (e.g., Mathematics), the answers can be connected to the text lacking vividness or to problems with understanding the text: e.g., "the text is not good"; "cannot understand the text"; "have never seen such a thing" (e.g., a strange animal); the phenomena described by the text extends over many years (e.g., the formation of mountains) and cannot be pictured.

The cross tabulations of Question 25 (Can you picture the subjects?) with Question 9 (Do you understand the subjects? shown in Table 5.17.) shows that students who report that they do not understand a subject with few exceptions also report that they cannot picture it. Students more often report understanding a subject and not picturing it. This suggests that it is difficult to picture something without understanding it, but that there are ways of understanding subjects without picturing them. Very few students, however, said they did not understand a subject at all. Many almost automatically said they understood. This again shows the importance of asking very specific questions at the level of topics and texts.

Table 5. 16. Question 25/a: What makes it difficult to picture each subject?

	Literature		History		Geography		Biology	
	N	%	N	%	N	%	N	%
Emotional(like/will)	10	33.3	18	34.0	11	18.3	12	23.5
Nothingtopicture	4	13.3	4	7.5	5	8.3	4	7.8
Textnotgood	6	20.0	11	20.8	6	10.0	5	9.8
Don'tunderstand	7	23.3	5	9.4	5	8.3	3	5.9
Haveneverseen	2	6.7	3	5.7	26	43.3	23	45.1
Longprocess/toosmall	0	0.0	8	15.7	4	6.7	3	5.9
Other	1	1.3	4	7.5	3	5.0	1	2.0
Total	30	100.0	53	100.0	60	100.0	5	100.0

	Physics		Chemistry		Math		Foreign language	
	N	%	N	%	N	%	N	%
Emotional (like/will)	6	12.0	3	14.3	0	0.0	1	4.3
Nothing to picture	9	18.0	2	10.0	20	80.0	17	74.0
Text not good	4	8.0	0	0.0	0	0.0	0	0.0
Don't understand	5	10.0	3	14.3	1	4.0	3	13.0
Have never seen	19	38.0	9	42.9	1	4.0	1	4.3
Long process/too small	2	4.0	3	14.3	1	4.0	0	0.0
Other	5	10.0	1	4.8	2	8.0	1	4.3
Total	52	100.0	21	100.0	25	100.0	23	100.0

N of students = 78

Table 5. 17.
Cross tabulation of Question 9 (Do you understand the subject?) by Question 25 (Can you picture the subject?)

Can you picture the subject	Do you understand the subject?											
	Literature						History					
	No		Sometimes		Yes		No		Sometimes		Yes	
	N	%	N	%	N	%	N	%	N	%	N	%
No	1	50.0	1	10.0	6	9.4	1	50.0	1	9.1	5	8.2
Sometimes	1	50.0	3	30.0	22	34.4	1	50.0	7	63.6	23	37.7
Yes	0	0.0	6	60.0	36	56.3	0	0.0	3	27.3	33	54.1
Total	2	100.0	10	100.0	64	100.0	2	100.0	11	100.0	61	100.0
	Geography						Biology					
	No		Sometimes		Yes		No		Sometimes		Yes	
	N	%	N	%	N	%	N	%	N	%	N	%
No	5	55.6	2	12.5	9	18.0	1	50.0	1	6.3	3	5.2
Sometimes	4	44.4	11	68.8	24	48.0	5	0.0	11	68.8	28	48.3
Yes	0	0.0	3	18.8	17	34.0	0	0.0	4	25.0	27	46.6
Total	9	100.0	16	100.0	50	100.0	2	100.0	16	100.0	58	100.0
	Physics						Chemistry					
	No		Sometimes		Yes		No		Sometimes		Yes	
	N	%	N	%	N	%	N	%	N	%	N	%
No	9	81.8	12	50.0	7	41.2	6	54.5	1	12.5	0	0.0
Sometimes	2	18.2	10	41.7	7	41.2	4	36.4	5	62.5	11	61.1
Yes	0	0.0	2	8.3	3	17.6	1	9.1	2	25.0	7	38.9
Total	11	100.0	24	100.0	17	100.0	11	100.0	8	100.0	18	100.0
	Math						ForeignLanguage					
	No		Sometimes		Yes		No		Sometimes		Yes	
	N	%	N	%	N	%	N	%	N	%	N	%
No	2	66.7	9	50.0	23	43.4	1	33.3	7	87.5	30	50.0
Sometimes	1	33.3	6	33.3	22	41.5	1	33.3	1	12.5	11	18.3
Yes	0	0.0	3	16.7	8	15.1	1	33.3	0	0.0	9	31.7
Total	3	100.0	18	100.0	53	100.0	3	100.0	8100.060100.0			

N of students = 78

Table 5. 18.
Frequency and Percentage of categories for Question 31: Can you picture what you understand?

Answers	Frequency	Percent
Yes	72	92.3
If I want to	1	1.3
Maybe/not sure	4	5.1
I usually don't	1	1.3

N of students = 78

Research question 8. Do students see relationships between understanding and picturing a text?

Over 92% of the students said that they are able to picture what they understand (Table 5.18.). Seventy percent stated they could not picture what they did not understand. Less than 3.0% said they could picture what they did not understand (Table 5.19.). Since the goal of education is not to put pictures into students' heads, but to help them understand, I asked questions to see if students thought picturing texts helped them to understand them better. I asked if it would be possible to teach all subjects in a way that everybody could picture them. Nearly 70% said yes. Much smaller percentages excluded one or more subjects or were not sure.

Asked what would happen in if all subjects (except any the student excluded) were taught in such a way that everyone could picture them, three quarters of the students thought that subjects would be easier to study (see Table 5.18.). A slightly smaller percentage thought that then they would not have to study by heart so much or at all. Approximately one third mentioned that it would be easier to understand material.

Table 5. 19.
Frequency and Percentage of categories for Question 32: Can you picture what you do not understand?

Answers	Frequency	Percent
Yes	2	2.6
Not so well	12	15.4
No	55	70.5
Parts of it	10	12.8
It gets dark	4	5.1
It is fainted/fuzzy	9	11.5

N of students = 78 (students could give answers in more than one category)

Table 5. 20.
Frequency and Percentage of Categories for Question 30: What would happen if all subjects were taught in a way that everyone could picture them?

Answers	Frequency	Percent
Would be easier to study	59	75.6
Would be easier to picture	9	11.5
Would be easier to understand	29	37.2
Wouldn't have to study by heart	50	64.1
Would be more interesting	7	9.0
No/worse	3	3.8
Don't know	4	5.1

N of students = 78 (students could give answers in more than one category)

Putting together the data from Questions 30, 31, and 32 (Tables, 5.18., 5.19., and 5.20.), it is clear that students see picturing and understanding as facilitating each other. This is an important result that supports the need for experimental explorations of causal relationships between imagery evokingness and understanding. It also suggests that students may be able to demonstrate their understanding of certain texts by describing or drawing the images they form while reading the text.

5. 4. Conclusions

Results suggest that students' learning approaches vary across topics and situations. Among other factors, such as lack of time or fatigue, an important reason for choosing a surface approach is not understanding the material. Students generally report using a surface approach, not because they like doing so, but because they do not have time, energy, or motivation to understand or they are afraid of bad grades. Students seem to judge the situation they are in (e.g., the material they must study, their tiredness, the teacher's expectations) and consciously chose the learning approach that seems to have the best chance of getting good grades and avoiding punishment.

Students' reports of using a surface approach did not show any relationship with answers on the ASI. On the basis of the ASI, it is impossible to predict what students reported doing in specific learning situations. This lack of correlation raises questions about the validity of the questionnaire for use with middle school students.

Students reported forming spontaneous mental images while reading novels, but very rarely reported them while reading school texts. The incidence of images seems to vary across subjects (e.g., more students can picture History texts than Math). Most students do not report mental images of subjects they do not understand. Students are more likely to report understanding a subject without forming mental images of it. Students themselves see a relationship between images and understanding in both directions: Picturing facilitates understanding and understanding facilitates picturing.

Asking about certain subjects seems to be too broad a way to assess learning approaches. Many students understand some topics, and do not understand others or can form images of certain parts of a subject, but not of everything within the subject. Further studies on learning approaches should narrow their scope of investigation to the level of topics and texts or even passages.

CHAPTER 6
PRELIMINARY STUDY FOR THE EXPERIMENT

6. 1. Introduction

The main experiment described in the next chapter investigates the causal relationship between imagery evokingness and understanding of texts. The experiment required texts that differ in their imagery evokingness. As suitable texts are not available in Hungarian, they had to be developed. The goal of the preliminary study was the creation of passage pairs—the building blocks of the texts used in the experiment. In order to remove possible confounding variables, the passage pairs needed to be identical except in their concreteness, the ease with which their content can be visualized, as judged by a group of students similar to those in the experiment. The passage pairs needed to have the same main point and contain almost identical information, have the same readability level (ease of understanding of written material due to writing style), and be on an unfamiliar topic. This chapter describes the process of creating passage pairs that differed only in their imagery evokingness.

6.2. Developing the Passage Pairs

The topic of the experimental texts was a writer's interview of a scientist about life on Mars (see chapter 7). I picked Mars, because in Hungarian schools Mars is not covered until eighth grade and the subjects in this preliminary study and the experiment are sixth graders. I drew on a variety of eighth grade science texts and my own knowledge to create the passage pairs. This way, the texts were roughly one to two grade levels above the grade levels of the students in the experiment.

In most of the studies in which concrete and abstract passages were used (e.g., Sadoski, et al., 1993; Sadoski, et al., 2000), the general topic of the passages were the same, but the passages did not contain the same information. My passage pairs expressed the same main point and contained nearly identical information. This is a crucial difference between the text passages used by Sadoski et al. (1993, 2000) and those used in the research described here. This difference is important. In the case of

Sadoski's experiments, it is possible that the main idea of the more concrete sentences or paragraphs were easier to understand than the main idea of the abstract sentences or paragraphs. In this regard my method is more similar to that of Wharton (1980, 1987), who picked passages from history textbooks criticized for their abstract style and revised them by injecting more concrete and more imagery evoking words without distorting their meaning. He then tested the passages on subjects.

Determining readability is easy for English texts. There are several formulas, such as the Flesh (1974) readability formula, available in the spelling and grammar check of MS Word. In Hungarian, however, neither a program for measuring readability nor a readability formula exists. I also could not find statistical data on the average number of words per sentence or syllabi per words. The Flesh readability formula determines readability on the basis of the number of words in sentences and the number of syllabi in every 100 words. On the basis of this information, it is possible to generate a Flesh score for a Hungarian text, but the number is meaningless. For good readability, Flesh recommends words with 1.5 syllabi and sentences with 20 words in average (Flesh, 1974). Even without statistical data on the Hungarian language, it is easy to see that Hungarian sentences are shorter than English sentences, but Hungarian words have more syllabi. Hungarian uses word endings instead of prepositions, and this decreases the number of words per sentence and increases the number of syllabi per words compared to English. My solution was to simply keep the number of sentences, words, and syllabi about the same in each passage pair. Appendix C shows the readability data of the passages.

The most difficult part of developing the passages was creating abstract and concrete versions of passages with almost identical meanings. The literature offers two examples of how to do this. Wharton revised abstract passages by replacing abstract words with words that "seemed to the writer more picture forming" (p.132), while keeping information, readability level, and style the same. Another method for determining the concreteness of a text can be to control the "ratio of concrete words to abstract words" (Sadoski & Paivio, 2001, p. 178) in passage pairs. This idea comes from Kolker and Terwilliger (1986) who determined the concreteness values of passages selected from school texts by comparing the concreteness of the words they contained. Paivio, Yuille, and Madigan (1968), for example, list many English words and their imagery value rating as determined by tests on hundreds of subjects.

I could not use Wharton's or Kolker and Terwilliger's method. First, there are no standardized word lists (word norms) for concreteness (imagery value) in Hungarian. I had to draw on my opinion while developing the passage pairs: I composed sentences that seemed more abstract or concrete to me, or found sentences in textbooks that seemed to use abstract style and, if necessary, modified them for the purpose of my experiment. Second, finding concrete and abstract synonyms of certain Hungarian words was a problem. Most of the abstract words in Hungarian come from Latin or Greek, and most all of them have synonyms with Hungarian origins that are much more concrete. Students start to learn Latin and Greek words in high school at the earliest. So for elementary school children, I had to use words with Hungarian origin, otherwise I would have ended up with measuring foreign language knowledge that students have not yet acquired.

I solved these problems by finding other methods to make texts more concrete or abstract than by simply substituting some words. In the high imagery versions, I used more verbs, especially more active forms, that, I conjectured, would evoke images easier than passive forms. In the low imagery versions, I used more passive forms, and fewer verbs. I especially tried to avoid verbs that express movement or action. The result of this work process was 22 pairs of abstract and concrete passages.

6. 3. Testing the Passages

It is not enough to use one's judgment that passage pairs really differ in imagery evokingness, especially when the target population is children. I had to verify the difference of my passage pairs in their imagery evokingness by giving them to students who were similar to the subjects of the experiment and asking them to judge the imagery evokingness of the passages. In the first round of testing, only eight pairs of paragraphs differed significantly in their imagery evokingness. Eight passages were not enough for me to build a text for the experiment, so I developed 18 more pairs of passages and tested them again on a different group of students who were also similar to the subjects of the experiment. The procedure of testing the paragraphs was the same in both cases.

Every subject received one version of each of the 22 or 18 passage pairs (abstract or concrete) in a random order. It would have been possible to give the pairs of passages to the students, but in this case they could be able to figure out that one is more imagery evoking than the other and they would probably rate each unit relative to the other, instead of absolutely. I made sure that none of the students received two versions of any of the units. Many students are used to questionnaires that repeat some questions, and they might have guessed that passages that were on the list twice are "checking questions" and might have given the same response for the pair units if they recognized that the meaning was the same.

To make list pairs that are the mirrors of each other in their imagery evokingness, so that half of the students would get the concrete, the other half the abstract version of each paragraphs, I flipped a coin to determine which version of the passages would be in the first and second lists (heads, concrete; tails, abstract). I flipped a coin 22 times in the case of the first 22 text passages. This way I had two lists that were mirrors of each other, each containing the obverse of its mate.

In order to control for order effects, I used a list of random numbers to make two randomly ordered versions of both lists. This yielded four final lists of passages. Every list contained the concrete or the abstract version of every passages in a random order. I repeated the process in case of the 18 passages version.

6. 4. Method

6. 4. 1. Subjects

The subjects in the preliminary study were 90 sixth graders from two middle-sized public schools in Hungary. School directors selected two classes from each of the two schools on the basis of which students had an easy class (e.g., singing) on the day of the study so that the participants did not have to miss an important class. Students were informed that they did not have to participate. All of them did. These students were similar to the goal population in age and type of school attended—middle-sized public schools. Forty-nine students (22 boys and 27 girls) judged the first 22 text passages, and forty-one (21 boys and 20 girls), the second 18 text passages.

6. 4. 2. Materials

The materials were photocopied items of 22 and 18 passage pairs (abstract and concrete versions of each). As described above, the passage pairs had the same main point and contained almost identical information and were virtually identical in readability and length. There were four to five passages per page. Each passage was followed by a five-point Lickert scale that ranged from 1, "I can't picture it at all," to 5, "I can picture it very easily." Students were also asked to indicate their gender and age and the date.

6. 4. 3. Procedure

The study took place in a regular classroom during class time. After students rated the passages, the entire class, as promised, received cookies they could share among themselves. After introducing myself and the goal of the study, I made sure that students understood their task. I gave examples of what it means to picture something, and asked if they could picture the examples. If they could, I asked them what they could see in their heads. When there were no more questions or comments, I described the research task. I asked the subjects to rate how easily they could picture each paragraph. Students understood the instructions quite well and had no problem with the task. Then students were randomly given one of the four lists of either the 22 or 18 passages lists. The whole process from giving instructions to collecting the questionnaires took approximately 35 minutes each time. Following are rough translations of the instructions I gave to each group:

You will get some paragraphs on paper. I will ask you to read each paragraph one after the other and decide for each one how easily you can picture in your head what the paragraph is about. You know there are things that are easier to picture and there are things that are more difficult to picture. I would like to ask you to decide how easy it is to picture each paragraph.

Do you understand what it means to picture? Can you picture, for example a pencil? Can you see anything in your head? [Here, children usually described what *kind of pencil they picture]. OK. Now I will mention something else. Just pay attention and judge how easy it is to picture what I say: peace [Kids usually had some problem with this, although some children reported very vivid pictures] Now, let's try a sentence: A girl is swimming. OK. Does anybody have questions?*

This is what you have to do with these paragraphs. Read each paragraph and decide how easy it is to picture each one. You might picture some paragraphs very easily. In this case, please circle number 5 after the paragraph. Or you might picture the paragraph, but not as easily as in the first case—the picture comes into your mind kind of easily but not very easily. In this case, please circle 4. If the paragraph is not easy, and not difficult to picture, circle 3. If it is a little difficult to picture, please circle 2. And if the paragraph is very difficult to picture or you can't picture it at all, please circle 1. OK?

6. 5. Results

Means and standard deviations of the concrete and abstract passages, and the t-test results of the 15 passages that showed significant differences in their ratings are shown in Table 6.1. (For means and standard deviations of all concrete and abstract passages, and the t-test results for all the passages, see Appendix D). For the first 22 passages, the mean ratings of abstract passages fell between 2.17 and 4.20 (overall mean, 3.27), and concrete passages, between 2.88 and 4.48 (overall mean, 3.78).

In many cases (e.g., passages I/4 and I/6), abstract passages were rated as relatively abstract compared to their concrete counterparts, but their mean score was above the mid-point of 3. This phenomenon also occurred in studies by Sadoski et al. (Sadoski et al., 1993; Sadoski et al., 2000). Their abstract sentences and texts had average ratings above the mid-point of 4 on an 7-point scale (between 4.37 and 4.87 points), but were still rated lower than their concrete counterparts. In some, but very few cases (e.g., passage I/19), just the opposite happened: the average ratings for the concrete version was below the mid-point of 3 (e.g., 2.88).

Table 6. 1.
Means (SD), t-tests (t-values, significance), and Effect sizes (d, R) of Passage Ratings by Text Type of the 15 passages showing significant differences

	Mean (SD)					
Var.	abstract	concrete	t	p	d	R
I/2	3.00 (1.22)	3.88 (1.05)	-2.71	.009	-0.78	.135
I/4	3.52 (1.33)	4.38 (.82)	-2.72*	.010	-0.78	.134
I/6	3.38 (1.21)	4.12 (78)	-2.55*	.015	-0.74	.123
I/8	4.09 (1.04)	2.96 (1.22)	3.46	.001	0.99	.203
I/9	3.96 (1.36)	3.08 (1.32)	2.29	.027	0.66	.100
I/10	2.17 (1.03)	3.42 (1.33)	-3.64	.001	-1.04	.220
I/12	2.33 (1.09)	3.24 (1.01)	-3.02	.004	-0.89	.162
I/14	3.68 (1.03)	4.33 (.82)	-2.46	.018	-0.70	.114
II/1	3.81 (1.29)	4.65 (.75)	-2.57*	.015	-0.79	.142
II/2	3.24 (1.37)	4.05 (1.10)	-2.08	.044	-0.65	.100
II/5	2.18 (1.14)	4.05 (1.08)	-5.37	.000	-1.68	.425
II/6	2.50 (1.19)	3.42 (1.39)	-2.29	.027	-1.09	.119
II/10	2.95 (1.28)	3.86 (1.24)	-2.31	.026	-0.73	.121
II/15	3.42 (1.07)	4.59 (.59)	-4.24*	.000	-1.38	.333
II/16	2.00 (1.11)	3.41 (1.40)	-3.53	.001	-1.11	.242

$NI_{abstract}$=21 $NI_{concrete}$=20
$NII_{abstract}$=24 $NII_{concrete}$=25
* = equal variances not assumed

Eight passages of the 22 showed significant differences in their concreteness ratings. Interestingly, in two cases (passages I/8 and I/9), the differences among ratings of the abstract and concrete versions of the passages were significant but in the opposite direction than expected.

For the second 18 passages, mean ratings of abstract passages fell between 2.00 and 3.81 (overall mean, 3.09); ratings of concrete passages fell between 2.88 and 4.48 (overall mean, 3.65). In some cases, the abstract passage had an average rating above the mid-point (e.g., passage pairs II/1 and II/17), and a concrete passage had rating below the mid-point (passage II/18). In a few cases, the abstract version of some passage pairs were rated higher than their concrete counterparts (passages II/4, II/13, II/18), but the degree of the difference (opposite than expected) was not significant. Seven passages of the 18 showed significant differences in their concreteness ratings. This is a higher percent of significantly different pairs than was obtained the first time.

Eight of the first 22 passage pairs and seven of the second 18, a total of 15 passages of 40, showed significant differences in their concreteness ratings (Table 6.1.). Mean ratings of the 15 abstract passages was 2.95; mean ratings of the concrete passages was 3.96. Fifteen passages was enough to create experimental texts, and the goal of the preliminary study was accomplished. In the case of the two passages that were rated in the opposite of the expected direction, it made sense to simply accept the student ratings and switch the identity of the passages. As we will see from the discussion in Chapter 7, we are far from fully understanding what makes a passage concrete or abstract for Hungarian six graders.

6. 6. Discussion: Imageability and Text Features

Despite a concerted effort to construct passage pairs different in their imageability, only 15 passage pairs of 40 showed significant differences in their student concreteness ratings, and two of these were in direction opposite of predicted. This underlines the need for more research in order to better predict which texts are more imagery evoking for specific groups of students.

As the introduction of this chapter indicated, there are several sources of difficulty in creating concrete and abstract passage pairs in Hungarian. Changing abstract words to more concrete synonyms according to a standardized word list was not possible. There are no lists of Hungarian words according to their concreteness. Using words that seemed to be abstract for the abstract versions and words that seemed to be more concrete for the concrete versions of the passages as Wharton (1980, 1987) did was also difficult. Concrete words tend to have Hungarian origins and be familiar to young students, and words that are abstract tend to have Latin or Greek roots and be unfamiliar. The innovation of using fewer verbs and more passive voice for abstract passages and more verbs and active voice for concrete passages was not wholly successful. It may be instructive, then, to see what can be learned about the characteristics of low and high imageability Hungarian texts by examining the 15 passage pairs that were rated as significantly different in concreteness. (See Appendix E for the 15 passage pairs.)

There seem to be no characteristics that distinguishes all the abstract passages from all the concrete ones. Some passages rated as abstract relative to their concrete counterparts contained a reference to relationships involving constants and ratios while the concrete counterpart did not (e.g., "On Mars, if the animal's muscle mass compared to its body mass is the same as it is for humans. . ." versus "If the animal on Mars has the same size and the same amount of muscles as humans do. . ."). Other abstract passages used a more scientific language, while the concrete versions used a more everyday language (e.g., "a necessary condition for the existence of air is that the mass of the planet has to be between certain limits" versus "to have an atmosphere similar to Earth's, the planet has to be a certain size"). Sometimes the grammar of the abstract passage was more complicated or less clear than the grammar of the concrete passage (e.g., "By this time, the heliocentric worldview became widespread, that is placing the planets around the Sun as the central celestial body" versus "At that time, many people thought that the Sun was the middle of the universe and the planets orbited around it—this is the heliocentric worldview").

In two cases, the concrete passage was not only written in everyday language but also contained a very vivid image illustrating a concept (e.g., "The stimulus for the receptors of the lungs is the stretching of the lungs" versus "When the lung is full of air it stretches out like a balloon, and that is sensed by the receptors of the lung"). The two passage pairs that were modified by adding a vivid illustration showed the first and third biggest effect sizes among the 15 passage pairs rated as significantly different ($d=1.68$ and $d=1.11$). Sadoski's DCT would have predicted this. According to the theory, concrete, and vivid examples make texts more imageable. How can differences in imageability due to differences in use of scientific language, statements of complicated relationships, grammatical structure, and prior knowledge be explained? One answer suggests that Kintsch's Propositional Theory and Sadoski's DCT "meet" at the idea that syntactic, semantic, and rhetorical features of texts and prior knowledge influence both imageability and comprehensibility of texts.

The above analysis of passages rated as more abstract than their concrete counterparts showed that features such as difficult grammar and scientific language and prior knowledge probably affect imageability. Kintsch (1994) argues that certain text features are related to text comprehension. Texts can be well- or ill- structured and have syntactic, semantic, and rhetorical cues that readers use to facilitate comprehension (Kintsch & Yarborough, 1982). If a text is ill-structured and has none of these cues, it will be difficult to comprehend. From this it follows that sentences or passages that have a complicated or unclear grammatical structure will be difficult to comprehend. Language skills and prior knowledge also influence comprehension (Kintsch, 1994). If a sentence is grammatically correct and clear but uses terms that students are not familiar with, students will have problems with comprehension: They cannot use the syntactic and semantic cues of the text, because they don't have schemas for them. Students with more prior knowledge might be able to comprehend texts that are not so well-organized or don't have so many cues in them; while students with no prior knowledge cannot comprehend them.

Chapter 3 described Sadoski's (Sadoski et al., 1993; Sadoski et al., 2000) and Wharton's (1980, 1987) studies showing that imageability and comprehension of texts are strongly related. Putting together the findings of Sadoski and Kintsch suggests that clear organization, semantic, syntactic, and rhetorical cues, and prior knowledge increase the imageability and comprehensibility of texts. This raises questions about the nature of the relationship between imageability, the text features Kintsch identifies, prior knowledge, and comprehension: Do text features identified by Kintsch, such as grammatical structure and organization, influence the imageability of texts? Does prior knowledge influence the imageability of texts? Is there a causal relationship between imageability of texts and comprehension of these texts? Does one cause the other or is imageability of texts just a byproduct of comprehensibility? The answers to these questions wait on further research.

CHAPTER 7

EXPERIMENTAL STUDY:

TEXT CONCRETENESS, APPROACHES TO LEARNING, AND GRADES

7. 1. Introduction

The goal of the present study is to examine the effect of text concreteness and approaches to learning on text understanding in a group of Hungarian school children. As discussed in the third chapter, studies show a strong connection between text concreteness and comprehension, although only a few examine the causal relationship between the two. In general, the more concrete a text, the easier it is to understand (Sadoski, et. al., 1993; Wharton, 1980, 1987). Sadoski and his colleagues (Sadoski, et. al. 1993, 2000) asked subjects to rate concreteness (ease of picturing) and comprehensibility of paragraphs, but they did not examine the causal relationship between text concreteness and text comprehension. They found very strong relationship between concreteness and comprehensibility: The easier a text was to picture, the more comprehensible it was. In an experiment investigating the effect of concreteness on comprehension, Wharton (1980, 1987) found that increasing the imagery evokingness of a text while leaving other text factors (e.g., readability and rhythm) the same led to better understanding.

From the studies in the orientation to learning tradition (see Chapter 2), we know that students with a deep approach to learning have "the intention to extract personal meaning from the text they read, and this leads to an active process of learning" (Entwistle, 1988, p.24). Deep learners search for relationships among text ideas and among text ideas and prior knowledge which "in turn, implies that. . . [they are] reconstructing knowledge within a personal framework" (p. 24). Students with a surface approach to learning are more concerned with recall. They focus on the text itself without much personal engagement, "and the outcome [of their reading] is a more or less complete reproduction of the text, which is unlikely to contain the central core of the author's message" (Entwistle, 1988, p.25). Only students with a deep approach have chance to understand a text. Students with surface approach can only memorize and repeat what they read.

The study described here was designed to investigate the effects of learning approach and text concreteness on understanding and to gain a picture of the relative importance of concreteness, learning approach, and general ability/academic self-concept on text comprehension. A group of Hungarian school children read an abstract (hard to picture), a concrete (easy to picture), or a mixed (half easy, half hard) version of a text. The texts and the process of creating them are described below. Students answered open-ended questions and factual knowledge questions (not part of this study) about the text and completed the Hungarian version of the Approaches to Studying Inventory (Entwistle & Kozéki, 1985, Kozéki & Entwistle, 1986).

This study is closer to Wharton's (1980, 1987) than to Sadoski's (Sadoski, et al., 1993, 2000) in that it tests a hypothesis about a causal relationship between text concreteness and comprehension and does not simply seek to establish a relationship between concreteness and comprehension. The study differs from Wharton's in two important respects that make it more useful and a more realistic simulation of school learning: It uses concrete, mixed, and abstract text conditions, not just concrete and abstract conditions, and it uses only open-ended and not multiple choice questions to assess understanding. The intermediate or mixed condition's inclusion in the study may give a more accurate picture of how much change in concreteness is needed to produce a significant change in understanding. Open-ended questions are better than multiple choice questions for revealing students' real understanding of text. Although multiple choice questions are easier to score (Simons, 1984) and less affected by lack of motivation and attention, they can often be answered just by relying on memory (e.g., Gardner, 1991) and test-taking skills. Open-ended questions elicit more complex responses and are more likely to show students' real understanding of a text. The problem of measuring understanding is discussed in detail below.

7. 2. Hypotheses

The hypotheses stated here, with the exception of those involving school grades, have their rationales in the arguments and literature reviews of Chapters 2 and 3. The main contention there is that text concreteness has a powerful effect on understanding. The results of the investigation of these hypotheses will provide a picture of the relative power of concreteness, learning approach, and grades in predicting level of understanding. The importance of grades in achievement in school-related tasks is well-known. Including grades in the study provides a familiar context for judging the importance of text concreteness in understanding.

1. Students in the concrete text condition will understand a text better than students in the abstract or mixed conditions, regardless of learning approach (surface or deep) and grades.

As Chapter 3 shows, there is much reason to think that text concreteness has a powerful effect on comprehension and that this effect holds regardless of approach to learning. The investigation of this hypothesis seeks to confirm and extend previous research. The SOLO (Structure of the Observed Learning Outcome) taxonomy used to measure understanding is described below.

2. The higher students score on deep approach the higher level of understanding of the text they will show, regardless of text condition, surface approach, and grades. The higher students score on surface approach, the lower understanding of the text they will show regardless of text condition, deep approach, and grades.

The investigation of this hypotheses also seeks to confirm and extend previous research. Research shows that deep learners give much better answers to text comprehension questions than do surface learners (e.g., Martin & Ramsden, 1987). As the ASI yields both surface and deep scores for every respondent, the hypothesis is stated in terms of an association between both surface and deep scores and understanding.

3. The better school grades students have, the higher level of understanding of the text they will show regardless of text condition or learning approach.

The learning task in the study—extracting meaning from a text—is a paradigmatic school task. It is reasonable to expect then, that better students as measured by school grades will understand a text better than poorer students.

Research shows a strong relationship between school grades and scores on intelligence tests. Students with higher IQ scores have better grades than students with lower IQ scores (e.g., Taub, Hayes, Cunningham, & Sivo, 2001). IQ-test type scores often account for about 40% of the variance in academic achievement (Nash, 2001). Academic achievement is also strongly related to academic self concept. The two are probably reciprocally related (Marsh & Yeung, 1997). Thus, school grades serve as a rough indicator of intelligence and academic self-concept.

7. 3. The Problem of Measuring Understanding

The first question in measuring understanding (or any other social science phenomenon) is conceptual. In this case, the question is: What do we mean by understanding? Entwistle and Entwistle (1992) argue that the concept is not clearly defined, even in cognitive psychology. They write that, surprisingly enough, "understanding itself has. . . been rather taken for granted" (p. 2). One source of the problem of defining understanding is that understanding encompasses all sorts of understandings, from knowing how galaxies are formed, to grasping Shakespeare, to knowing how to repair a car. Thus, any definition of the phenomenon is necessarily very abstract (Gardner, 1991), just as with "love," and not very helpful in research. Even Gardner (1991), who examines students' misunderstandings in several domains, admits that "understanding is a complex process that is itself not well understood" (p. 179) and does not give a definition either.

The text comprehension and the learning styles literatures talk mostly about the processes that lead to understanding. As we have seen in Chapter 4, they view understanding as an active process that leads to the creation of personal meaning (e.g., Entwistle, 1988; Taraban, et al., 2000). During the process, the individual "tries to see interrelationships among the ideas presented and seeks links with personal experience and the outside world" (Entwistle, 1988, p. 24). But these fields do not say what a personal meaning is, nor do they specify what people who understand a topic know (compared to those who do not understand it), except to say that those who understand something are able to apply their knowledge to new situations (e.g., Pask, 1976). But again, simply saying "connecting ideas" or "using knowledge in a new situation" are not very useful either. They themselves are too vague. They don't help us distinguish good uses from bad, rational from irrational connections, or even understanding from creativity, which also involves personal meanings, connections, and use of knowledge.

Definitions of understanding are really only meaningful and useful once they are operationalized for a particular task or subject, or in the context of certain body of literature. As we know little about what exactly happens inside a person who understands a text, we can measure only performance. Whatever is in a person's head, the person has to show signs of understanding. As Gardner (1991) puts it, "If you answer questions on a multiple choice test in a certain way, or carry out a problem set in a specified manner, you will be credited with understanding" (p. 6). Crediting somebody with understanding always happens based on the decision of a person in authority (e.g., a teacher or researcher). Since ideas of competence change over time, determinations of what counts as understanding also change (Gardner, 1991).

There are two crucial aspects to measuring understanding: 1) determining the relevant data; 2) analyzing or scoring the data. What methods are available to gather information about students' understanding? Multiple choice questions are easy to score and are often used in school settings and in research (e.g., Anderson, 1972; Simons, 1984). The main problem with multiple choice questions is that in many cases students can answer them by relying on memory without understanding the material (e.g., Gardner, 1991). Open-ended questions, and related methods, such as retelling and summarizing the text, are better in this regard. Although, as Kintsch (1994) notes they might also not touch the deepest level of understanding (in his terms, the *situation model*), wherein one actually connects text ideas with prior knowledge. Texts can be recalled and summarized on the basis of only a lower level understanding (*text base*, which involves understanding the semantic structure of the text). The same is echoed by Gardner (1991) who states if we want to see if students understand the material we "have to look more deeply" (p. 145). He recommends confronting students with "new and unfamiliar problems, followed by open-ended clinical interviews or careful observations" (p. 145). Kintsch (1994) argues that measuring deep understanding requires methods that require elaboration and reconstruction, such as answering inference questions about the text, or sorting key words (a task where students decide which words are most relevant to the meaning of a text). With these methods, we can gather information about the situation model students form about a text.

After gathering students' responses to questions about a text, we must analyze or score their answers to determine their understanding. Here we must employ the notion of *levels* of understanding. During the process of understanding, a student makes connections between information in the text and personal experience. A person who understands a text is able to connect ideas within the presented topic and to connect ideas to prior knowledge and everyday experience. The connection of the idea—whatever types of connections we think matter—have different degrees in every case. A person might be able to see more connections between one topic or question and everyday experience than between another topic and everyday experience, or might be able to see connections only among text ideas. This means that there are necessarily levels of understanding.

This idea is found in Kintsch's (Kintsch, 1998) Propositional Theory, described in Chapter 3. In his model, the first level of understanding is simply understanding the words and phrases of the text; the second is understanding of the ideas presented in the text itself (text base); and the highest level is the connection of text ideas to prior knowledge (situation model). Kintsch's model can be used to measure levels of understanding. The number of and accuracy of statements in answers that are not in the experimental text is a measure of the highest level of understanding (Moravcsik & Kintsch, 1993).

A more complex scoring system is the SOLO (Structure of the Observed Learning Outcome) taxonomy. The taxonomy is based on ideas similar to those of Kintsch. In the SOLO system, seeing no connections is a lower level of understanding than seeing connections among ideas in the text, and seeing connections among text ideas and ideas not given in the text (extended abstract level) is a higher level. The SOLO taxonomy, developed by Biggs and Collis (1982), is based on a full appreciation of the difficulties of measuring understanding, and its use is accordingly, very time consuming. It is well-suited to the study described here. It has a clear theoretical foundation that is consistent with the understanding of understanding in the orientation to studying tradition. It gives guidelines for using the taxonomy: It has nine scorable levels of understanding—a range sufficient to identify significant differences among student groups. Finally, it was originally developed for use with elementary, high school, and college students.

7. 4. The SOLO Taxonomy

Biggs argues that "learning quality is reflected in the level of complexity with which the learning outcome is structured, regardless of whether the item learned is a skill, a concept, or a problem" (Biggs, 1988, p. 197). The SOLO taxonomy arose from the discovery of problems in measuring Piagetian stages of development. In Piaget's theory (for a review see Ginsburg & Opper, 1988) children go through different well-defined stages of cognitive development—from simple to more complex ones that can be characterized by specific achievements in answering questions and solving problems. Children give answers and solve problems according to their level of cognitive development.

After analyzing hundreds of responses of students from different age levels, Biggs and Collis (1982) concluded that the "assumptions of stage theory didn't hold" (p. 21). The main problem for them was that students did not perform consistently. The same student could show different developmental levels across and within subjects. Biggs and Collis solved this problem "by shifting the label from the student to his response to a particular task" (p.22). Their system scores not a hypothetical cognitive structure but the Structure of the Observed Learning Outcome (SOLO) of each unit of understanding. Developing the SOLO taxonomy made it possible to measure performance, rather than a general developmental level. They argue that students' developmental stages certainly "might determine the upper limit of functioning" (p. 22) but other factors, such as motivation and prior knowledge, influence actual achievement. The taxonomy can be applied to a variety of subjects, and the usefulness of the method is widely acknowledged. SOLO taxonomy is used not only in school tasks (Boulton-Lewis, 1994, 1995; Hawkins & Hedberg, 1986; Lake, 1999; Van Rossum & Schenk, 1984), but also in, for example, the study of social communication, perceptual discrimination and decision making (Biggs and Collis, 1982), and the learning outcomes of counseling (Burnett, 1999).

The main idea behind the SOLO taxonomy is that individuals go through quantitative and qualitative changes in their understanding as they study a new subject (Biggs & Collis, 1982). First to occur are quantitative changes in the number of facts the person possesses. The facts or information are the "bricks" of understanding (Biggs, 1999). The qualitative change is the elaboration of these facts—their connection to related thoughts and to previous knowledge. Biggs and Collis identified five primary and four transitional levels of understanding that must be operationalized to fit a particular subject or task. Here I give general descriptions of the levels with a few examples of the operationalization of the taxonomy used to score the question, "What are the differences between Mars and Earth?" Appendix G contains the detailed scoring manual for each question.

1. Prestructural. No apparent understanding of question or text (e.g., student repeats the question without giving any real answer, or simply says "I don't know"): "The Earth is an ellipsoid."

2. Prestructural transitional. Seems to reach toward stating one relevant idea but doesn't quite make a clear or substantial point: "The color is different." The student doesn't elaborate, so the level of the answer is higher than in the case of the Prestructural, but does not reach the level of the Unistructural.

3.Unistructural. Mentions one aspect of the problem (e.g., from an argument picks one point as if only that was mentioned):"The Earth is bigger than Mars".

4. Unistructural transitional. Offers one relevant point plus one not relevant, as if thinking there was more than one thing relevant to the topic but can't really figure it out: "There is no air on Mars and other life circumstances are different."

5. Multistructural. Mentions several aspects of the answer separately, but does not integrate them (it is more like a collections of facts to prove the same point): "Mars is red, smaller than Earth, and contains less oxygen."

6. Multistructural transitional. Mentions several aspects and shows a tendency to integrate them, but it is at best only partly successful—only a few aspects are connected: "Mars is smaller than Earth. It has different atmosphere, there is little oxygen so we could not survive there. It is red. We call it the red planet. There are canals on it but there is no water in them."

7. Relational. Integrates parts into a coherent whole, with each part contributing to the overall meaning, but stays within the text: "There are many differences between Mars and Earth. First Mars is smaller, so its atmosphere is less thick. The atmosphere also contains different substances than the Earth's. Its gravitation is smaller, so we can jump higher there. Its surface has a reddish color, with canals on it; although these don't contain water."

8. Relational transitional. Uses all important information, inter-relates them, mentions a more abstract idea, but doesn't elaborate on the idea. No answers in this category were found. An answer from this category could begin: "From the point of view of humans there are big differences," but without continuing the thought. An extended abstract level response would elaborate on it this idea, saying, e.g., "From human point of view the main differences are that there is not enough water, oxygen, and other materials that are crucial for life, life as we define it." Without elaboration the answer stays only on a transitional level.

9. Extended abstract. Integrates the whole text at a rational level and conceptualizes it at a high level of abstraction. This may allow generalization to a new topic area (e.g., they can recognize that concepts are relative), and using deductive logic can draw conclusions beyond what is present in the text. No extended abstract answers were found, but one could be: "Although Mars is our neighbor, and it is not much smaller than Earth, Mars and Earth are quite different in many aspects. The main differences are that there is no or little water on Mars, and not much oxygen compared to Earth. That makes life (as we define life) impossible. At least humans as they are now would not be able to live on Mars. But life might have developed in other directions than it did on Earth."

adequate distinctions among levels of understanding in each of the groups. (Two additional questions that asked about facts mentioned in the text were scored according to degrees of accuracy, not SOLO.

7. 5. Developing the Questions

The SOLO taxonomy is keyed to specific questions about a text or subject matter. I generated six questions about the Mars text. The questions ranged from requests for simple definitions that students could answer with information that was in only one paragraph, to requests for descriptions, comparisons, and explanations that required integrating information across two or more paragraphs. These questions were used for three reasons. One, because they are the types of questions typically asked in everyday school testing situations. Two, the answers to them could be evaluated using the SOLO taxonomy. Three, the anticipated answers ranged from prestructural to at least relational transitional level, allowing for As these questions are not related to the hypotheses in the study, they are not discussed further here.)

7. 6. Developing a Scoring Manual for the Experimental Texts

As the main goal of SOLO taxonomy is to measure performance, rather than a general developmental level, the taxonomy always has to be operationalized to fit a specific context. In the case of the present experiment, I developed a scoring manual for every question, closely following the above-described general SOLO levels. I familiarized myself with the general SOLO levels and then imagined possible answers at each level for each of the questions (e.g., What are the differences between Mars and Earth?). This yielded a rough draft of the scoring manual. I then randomly and blindly chose actual answers from the students in the study and scored them. This led to a refinement of the descriptions of the levels and better examples of each.

7. 7. Scoring Process

The answers were scored by myself and two independent raters. The independent judges were psychology graduate students who did not know the goal of the study. After developing the rating manuals, I trained the two raters. In the first session (about three hours) I gave the raters the scoring manuals, general instructions for each questions, and examples (all identifying information was removed from the answer sheets). We discussed the meaning of the SOLO levels in general and in the case of each question. The raters then worked individually at home and categorized 10 responses to each question. In the next session (again approximately three hours long), we discussed the disagreements in ratings in order to make possible questions clear and to avoid misunderstandings. We all made a few mistakes, mostly involving not noticing details. Then the raters and myself worked independently and coded all of the answers to all of the questions. The inter-rater agreement of the three raters scores were between .85 and .97.

The SOLO taxonomy is usually used to evaluate answers given in written form in classroom settings. This method shares a disadvantage with other group testing methods. The procedure doesn't allow asking follow-up questions or encouraging a child to elaborate, so it may not reveal students' true depth of understanding. On the other hand, this method reflects typical, almost universal, classroom practice (Biggs and Collis, 1982). Certainly the taxonomy can be used to evaluate answers collected in individual settings. That would be give a better picture of actual understanding, but would be too time-consuming to be practical.

7. 8. Method

7. 8. 1. Subjects

Two hundred and seventy-three 6th graders (aged, 12-13 years old) participated in the experiment. They were from four middle-sized public, elementary schools, two in a larger Hungarian town and two in a smaller one. The subjects in the interview study were fifth through eight graders. To reduce variance in the experiment, all students were from a single grade.

Eighth graders are the oldest students in traditional elementary schools, and, especially in their last semester (when the study was run), they tend to be "cool" and may not take an experiment seriously. Fifth graders do not read quickly, and the youngest group Entwistle and Kozéki (1985) used the Approaches to Studying Inventory was sixth graders. So, of the grade levels addressed in my interviews, sixth or seventh graders seemed to be the best. I picked sixth graders simply because I had easier access to them.

7. 8. 2. Materials

Mars Texts

Abstract, concrete, and mixed imagery versions of a text about Mars were created for the purpose of the experiment. The length, readability, and information of the three versions were approximately the same. The only difference among the three versions of the text was their rated concreteness.

As there were no suitable texts in Hungarian, texts were created for use in the study. The process of creating the text is described in detail in Chapter 6. The account in the next two paragraphs is a summary of that chapter.

The first step was to create or collect abstract and concrete pairs of text passages. I wrote some passages; others were chosen from science text books and modified, if necessary, to make them more abstract or concrete. In an attempt to avoid prior knowledge effects, the text contained information the students in the study had not yet covered in school. That the meaning and content of the pairs was approximately the same was confirmed by two Hungarian adults (a Hungarian literature and grammar teacher and a scientist). The readability level of the passages were also kept constant.

In the second step, the passage pairs were tested on a group who were in every respect similar to the subjects of the experiment. A group of sixth graders rated the ease with which they could picture the passages on a five point Lickert scale—from "I cannot picture it at all" (1) to "I can picture it very well" (5). Fifteen of 40 passage pairs showed significant differences in their imagery evokingness.

The third step consisted of building texts from the 15 passage pairs. Three kinds of experimental texts were created: abstract, concrete, and mixed. The abstract text contained only abstract passages, the concrete text only concrete passages, and the mixed text, half abstract and half concrete passages.

Only 10 of the 15 passage pairs that were rated significantly different in their concreteness were used for the experimental texts. Using all 15 passages would have yielded texts of about three pages. This would have been too long, too demanding, and too tiring for the sixth graders in the experiment. In order to have a mixed condition of half abstract and half concrete passages, there had to be an even number of passages. A ten passage text at a page and a half length, about 490 words, including an introduction and connecting sentences, seemed a good length. Ideally, only the pairs with the greatest effect sizes would have been used in the texts. But in order to create texts that hung together and made a fluent story, I left out one passage pair with a great effect size (Table 6.1. II/5 d=1.68) included another with a relatively small effect size (Table 6.1. I/9, d=0.66).

To connect the passages I created a story, a conversation between a writer who wants to write a science fiction novel set on Mars and a scientist who supplies the writer with technical knowledge about Mars. The conversational form allowed for maximum flexibility in connecting passages with somewhat different content. To make the story flow, a short introduction and a few connecting sentences were added. The additional material was identical in all three versions.

In short, the final texts were approximately 490 words long including a 50 word introduction and some connecting sentences. One version was abstract, one was concrete, and one was mixed—yielding three levels of the independent variable of text condition. The texts were the same in length, readability, and information. The only difference among the three versions of the text was their rated concreteness or imagery evokingness (for the rough translation of the text see Appendix F).

Approaches to Studying Inventory

The Hungarian version of the ASI, Approaches to Studying Inventory (Entwistle & Kozéki, 1985; Kozéki & Entwistle, 1986; Balogh, 1995) was used to measure learning styles—the same instrument used in the interview study. The description of the questionnaire can be found in Chapter 5.

Solo Taxonomy

Judging the validity of the SOLO taxonomy involves two questions: 1. Does the taxonomy itself reflect Biggs and Collis' and other researchers' ideas about understanding? That is, does the taxonomy reflect what we mean by levels of understanding? 2. Does a particular implementation of the taxonomy correctly operationalize the levels?

The answer to the first question is clearly, yes. The taxonomy has a clear theoretical background that is consistent with many researchers' conceptions of understanding. The levels of understanding range from simple to more complex quantitatively—the number of ideas remembered from the text, and qualitatively—the connection of text ideas to each other and to non-text ideas. The strongest evidence for this point comes from a study on the relationship of SOLO levels and LPQ, Learning Process Questionnaire, categories (Biggs, 1985, 1993). The LPQ is similar to Entwistle's Approaches to Studying Inventory (ASI). Results showed that those students who scored high on SOLO levels also scored high on Meaning Strategy (deep approach), and low on Reproducing Strategy (surface approach), and they were also intrinsically motivated. This was true for 9th graders and for university undergraduates.

The second question refers to how well I operationalized the SOLO taxonomy to create a scoring manual for the Mars text questions. Validity in this matter is mostly a matter of content validity. For each of the six essay-type questions on the Mars text that students were asked to answer, I created a scoring manual following the general descriptions of the SOLO levels. I read many examples from Biggs and Collis (1982) and other studies (e.g., Burnett, 1999) to become familiar with the conceptualization of each level and examples of each level. The manual seems to be a good operationalization of the Biggs and Collis (1982) system. It includes both Biggs and Collis' descriptions of the levels and descriptions and examples related to the Mars text.

Typical reliability measures, such as inter-item consistency or test-retest reliability do not apply to the taxonomy. The taxonomy was devised precisely because students do not perform consistently. Students may find one question more difficult than another or be more motivated at one time than another. The only relevant aspect of reliability is inter-rater agreement. In Biggs and Collis's (1982) study the correlation between raters fell in the range of .71 to .95 for history and poetry texts and creative writing responses. Of course, inter-rater agreement is mostly a matter of amount of training in using the scoring system.

Question Sheets

The question sheets were two pages long (two questions on the first pages and four on the second) with a space for the answers after each questions. On the first page there was an additional space for the student's name, school and class (which were later removed). The first two questions, which could be answered with information that was in only one paragraph, had less space for an answer than did the next four, which drew on in information that was in two or more paragraphs. The order of the questions was the same on all of the question sheets.

Final grades of the previous semester were self-reported by the students on the back of the question sheet. In Hungary, students are graded on a scale of one to five, where one is the worst and five is the best. I collected grades of subjects they have to actually study and have tests on: Literature, History, Geography, Biology, Physics, Math, and Foreign language. I left out grades for Gymnastic, Music, and Art, which depend on physical and other skills far removed from traditional academic skills. A few students with learning problems got an official relief from studying foreign language. These data were treated as missing.

7. 8. 3. Procedure

Participants were randomly assigned to one of the three text conditions. Assignment was carried out by putting the text sheets into a repeating sequence of abstract, concrete, and mixed texts and handing these out to students in the order they were sitting in the classroom. Students usually sit in a random manner or with friends, except that tall students sit in the back rows and students who talk too much to each other are separated. The assignment procedure effectively produced random assignment.

The experiment was conducted in the students' typical classrooms, one class of approximately 25 students at a time. Teachers informed students about the study in advance. I arrived with the teacher at the beginning of the class. I introduced myself, saying that I was doing research on how to write better textbooks for school children. To establish rapport, I chatted with the students for a few minutes about their experiences with textbooks. I said then that I had texts with me and I would like to see how they understood these texts and that I also wanted to know about their study habits and school grades. I told them their work in the study would not be graded and that I would not show their teachers anything they gave to me. I assured them that their responses would be anonymous. Finally, I said that everyone who completed the study would receive cookies. Everyone received cookies.

After the introduction and chat, each student received a pack of papers stapled in two places and consisting of the text, the question sheet, and the ASI. At this point I instructed the students to read the text carefully, twice, so that they would be able to answer questions afterwards. I then asked them to rip off one staple and begin reading the text. After everyone had finished reading I collected the texts and asked them to rip off the second staple to open up the next sheets with questions on them about the texts. I asked them to read the questions carefully before answering them. I asked the students to answer all the questions, and I reminded them of this several times while they were answering questions. After answering the questions, students took a few minutes rest, then started to answer the ASI. After they finished, they were free to pick up cookies and leave the room.

7. 9. Structure and Reliability of the Approaches to Studying Inventory

Twenty-four of the 270 ASIs were not used as they had missing responses or the responses suggested that students did not pay attention or did not take the task seriously (had too many of one type of responses, e.g. all 60 responses were 1s), leaving 246 complete sets of data for analysis. The structure of the Deep Approach, Surface Approach, Holist Style, and Serialist Style Scales were examined by means of exploratory principal component analysis. If the scales worked as designed, four factors would have emerged. As in the interview study, the four factor solution did not reveal a clear pattern and was difficult to interpret. A Varimax rotated two factor solution was clearer. The two components explained 22.59% of the total variance. The first component had moderate loadings from five items of the Deep Approach Scale (01, 11, 21, 31, and 51), two items of the Holist Style Scale (32 and 52), and one item of the Serialist Style Scale (25). The second component had moderate loadings from five items of the Surface Approach Scale (04, 14, 24, 44, and 54), and one item of Serialist Style Scale (item 45). In other words, as in the Interview study, the items of the Deep Approach Scale more or less loaded together on one factor and the items of the Surface Approach Scale more or less loaded together on the other factor. The items of the Holist and Serialist Styles Scales did not show any clear pattern of loadings. The Holist and Serialist Styles Scales are actually the weak points of the ASI (Entwistle & Kozéki, 1985, Kozéki, & Entwistle, 1986). In the Entwistle and Kozéki study of elementary/middle school students, the Cronbach's alpha of the Holist Scale was .49, Scottish sample and .51, Hungarian sample and of the Serialist Scale, .45, Scottish and .32, Hungarian. The Holist and Serialist Styles Scales were dropped, and only the original six-item Deep and Surface Approach Scales were used in the next step of the present analysis.

A principal component analysis was then completed using only the Deep and Surface Approach Scales. Two components emerged rather clearly, one with moderate to high loadings from five items of the Deep Approach Scale (01, 11, 21, 31, and 51) and a second with moderate to high loadings from five items of the Surface Approach Scale (04, 14, 24, 44, and 54). Item 41 of the Deep Approach Scale and item 34 of the Surface Approach Scale had low loadings on any of the components, and they were dropped. The final analysis yielded a two factor solution that explained 39.7% of the total variance of the original Deep and Surface scores. Table 7.1. shows the Varimax rotated component matrix.

A reliability analysis confirmed the necessity of leaving out items 34 and 41. Dropping item 41 yielded a Cronbach's alpha of .63 for the Deep Approach Scale. Dropping item 34 yielded a Cronbach's alpha of .55 for the Surface Approach Scale.

Table 7. 1.
Varimax Rotated Component Loadings of the Items of the Deep and Surface Approach Scales

Items	Components	
	1	2
01. I always try to connect what I study to topics we have studied in other subjects	.58	.13
11. I always try to understand things, even if it seems difficult at the beginning	.51	.10
21. I often ask questions of myself about what I have read or heard in class	.70	-.08
31. I try to connect what I read to my personal experience	.69	-.19
51. To understand what I am learning about I try to connect it to my everyday experience	.59	-.14
04. To be well-prepared, I have to study lots of things word by word (by heart)	.11	.54
14. If I read a book I can't spend time thinking about what it is about	-.26	.68
24. I understand the concepts best if I remember definitions in the textbook word by word	.30	.55
44. I only write down something in class when the teacher tells us to	-.05	.54
54. I usually read only what I have to	-.16	.65

Both alphas indicate a moderate reliability. That the Cronbach's alphas of the scales in this study are only moderate is consistent with the findings of Páskuné (2002). With a sample of Hungarian middle school students, she found that the consistency of all the scales on the ASI ranged between .25 and .59. In Entwistle & Kozéki's (1985) study of Hungarian middle school students, the Cronbach's alpha of the Deep and Surface Approach Scales were somewhat higher but still only moderate, .64 and .61. As only two scales were used in the analysis, and one item of each of the two scales were left out, the results of this study cannot be directly compared to results of other studies that use the ASI.

The items of the Deep Approach Scale used in the present study:

01. I always try to connect what I study to topics we have studied in other subjects

11. I always try to understand things, even if it seems difficult at the beginning

21. I often ask questions of myself about what I have read or heard in class

31. I try to connect what I read to my personal experience

51. To understand what I am learning about I try to connect it to my everyday experience

(Dropped: 41. I like to take my own notes whenever I can.)

Students described by these items try to understand what they read. They ask questions about a text and try to connect information in a text to previously learned information and to their personal, everyday experiences. They have a personal engagement with the material they read. This description corresponds to Entwistle's (1988) definition of deep approach. The item left out is about note taking preferences and does not really belong to the concept of deep approach.

The items of the Surface Approach Scale used in the present study:

04. To be well-prepared, I have to study lots of things word by word (by heart)

14. If I read a book I can't spend time thinking about what it is about

24. I understand the concepts best if I remember definitions in the textbook word by word

44. I only write down something in class when the teacher tells us to

54. I usually read only what I have to

(Dropped: 34. I like having precise explanations of what I have to do in written assignments.)

Table 7.2.
Descriptive Statistics of Grades, Deep Approach, Surface Approach and SOLO Levels

	N	Mean	Std. Deviation
Deep Approach	246	3.64	.72
Surface Approach	246	3.10	.82
Grades (Mean grades level)	266	3.45	.94
Question 1 SOLO level	270	4.00	1.42
Question 2 SOLO level	270	3.57	1.51
Question 3 SOLO level	270	3.66	1.34
Question 4 SOLO level	270	3.85	1.30
Question 5 SOLO level	270	3.14	2.22
Question 6 SOLO level	270	3.59	1.50

Students described by these items do not have much personal engagement with the material they are learning. They do not think about what they are reading and do not read or write anything beyond what they absolutely have to. These students try to remember a text word by word. This description is very similar to Entwistle's (1988) description of a surface approach. The item left out does not really fit with this description, as it refers to a need for knowing exactly what an assignment is.

7. 10. Results of the Experiment

The primary goal of the analysis of the data from the experiment was to determine if there were differences in text understanding as shown in SOLO scores due to text conditions (abstract, concrete, and mixed) or differences associated with deep and surface approaches in understanding and with grade levels. Following Biggs and Collis (1982), SOLO levels were treated as interval level data. All analyses were conducted using SPSS 10.0 or 11.0.

Descriptive statistics of Grades, Deep Approach, Surface Approach, and SOLO for the entire sample for each the six questions can be seen in Table 7.2. (Appendix H shows the same information by text condition; Appendix I shows inter-item correlations among the six questions, and Appendix J shows correlations between SOLO levels, Deep Approach, Surface Approach and Grades).

Table 7. 3.
Multivariate Tests for Grades, Deep Approach, Surface Approach, Text Condition, and Possible Interactions

	Effect	Wilks' Lambda	F	p	Effect size
Grades	.82	8.03	.000	.176	
Deep Approach	.96	1.41	.210	.036	
Surface Approach	.96	1.62	.142	.041	
D1 (A-C)	.82	8.32	.000	.181	
D2 (M-C)	.83	7.20	.000	.160	
Grades * D1	.95	1.85	.091	.047	
Grades * D2	.98		.83	.542	.022
Deep App. * D1	.98		.93	.473	.024
Deep App. * D2	.95	1.90	.082	.048	
Surface App. * D1	.99		.40	.879	.010
Surface App. *D2	.98		.86	.525	.022

Hypoth. DF: 6
Error DF:226

Multivariate multiple regression analysis was used to assess the unique effects of text condition, learning approaches, and grades on understanding (SOLO scores) on the six questions and the interaction effects of text condition and grades and of text condition and learning approaches. This way each effect is tested controlling for the other variables in the model. The effects of text condition were tested using dummy variables. The variable D1 is the average of the abstract scores minus the average of the concrete scores. It signifies the effect of the abstract condition compared to the concrete condition. The variable D2 is the average of the mixed scores minus the average of the concrete scores. It signifies the effect of the mixed condition compared to the concrete condition. Table 7.3 shows the results of this analysis.

Table 7. 4.
Multivariate Tests for Grades, Deep Approach, Surface Approach, and Text Condition

Effect	Wilks'Lambda	F	p	Effect Size
Grades	.73	14.51	.000	.273
Deep Approach	.97	1.28	.267	.032
Surface Approach	.95	1.84	.093	.045
D1 (A-C)	.81	8.79	.000	.185
D2 (M-C)	.82	8.24	.000	.176

Hypoth. DF: 6
Error DF: 232

Because none of the interaction effects were significant, the interaction terms were dropped from further analysis (see Table 7.4.). Though the deep and surface effects were not significant either, they were retained because they are part of the main concerns of the study.

The results of both multivariate analyses revealed significant main effects only for text condition and grades (Table 7.4.). The independent effects of grades, text condition, and learning approaches for each of the six questions were further tested using six Univariate Multiple Regression Analyses. Table 7.5. shows the results of the regression analyses. We can see that the dummy variables (D1, D2) for text condition had significant main effect in Questions 2, and 5; grades had a significant main effect in all the questions; deep approach had a significant main effect on Questions 1 and 3; surface approach had a significant main effect on Question 6. The results for each question are as follows.

Question 1

The effect of grades ($p < .01$) and deep approach ($p < .05$) on SOLO level were significant. Grades accounted for 8% of the variance (beta = .31), deep approach accounted for 1.1% of the variance (beta = .11). Students with higher grades and higher scores on deep approach reached higher SOLO scores than students scoring lower on grades and deep approach. Text conditions and surface approach made no significant contribution to SOLO scores.

Question 2

The effect of grades ($p < .01$) and text condition ($p < .05$) on SOLO scores were significant. Grades accounted for the 7.1% of the variance in scores (beta = .29). Students with higher grades reached higher SOLO scores. The dummy variables used to determine the effects of text condition showed that membership in the concrete condition as opposed to the abstract condition accounted for the 1.5% of the variance (beta = -15, d = -0.32), and membership in the concrete as opposed to the mixed accounted for the 1.3% of the variance (beta = -.13, d = -0.30). Students in the concrete condition reached higher SOLO scores than students in both the abstract and mixed conditions. Neither deep nor surface approach contributed significantly to SOLO scores.

Question 3

The effect of grades ($p < .01$) and deep approach ($p < .05$) on SOLO level were significant. Grades accounted for 7.3% of the variance (beta = .30), deep approach accounted for 1.6% of the variance (beta = .13). Students with higher grades and higher scores on deep approach reached higher SOLO levels than students scoring lower on grades and deep approach. Text conditions and surface approach made no significant contribution to the SOLO scores.

Question 4

The effect of grades ($p < .01$) on SOLO scores was significant. Grades accounted for 18.2% of the variance (beta = .47) in scores. Neither text condition, nor deep or surface approach had a significant main effect on the results.

Question 5

The effect of grades ($p < .01$) and text conditions ($p < .01$) on SOLO scores were significant. Grades accounted for the 7.4% of the variance in scores (beta = .29). Students with higher grades reached higher SOLO scores. Membership in the concrete condition as opposed to the abstract condition accounted for 10.8% of the variance (beta = -.39, d = -0.98), and membership in the concrete as opposed to the mixed condition accounted for accounted for the 13.1% of the variance (beta = -.42, d = -1.05). Students in the concrete condition reached higher SOLO scores than students in the abstract or mixed conditions. Neither deep nor surface approach contributed significantly to SOLO scores.

Question 6

Grades ($p < .01$) and surface approach ($p < .01$) had significant effects on SOLO level. Grades accounted for 11.3% of the variance (beta = .37), surface approach accounted for 2.6% of the variance (beta = -.17). Students with higher grades obtained higher SOLO scores than students scoring lower on grades. Students with higher scores on surface approach obtained lower SOLO scores then students with lower scores on surface approach. Text conditions and deep approach had no significant contribution to the SOLO scores.

Table 7.5. a

Multiple Regression Analyses for Questions One, Two Three, R Square Change (R^2) and (Partial) Effect Size (d)

Dep. Var.	Predictor	b	SE(b)	β	R^2	d
Question One	(Constant)[a]	4.08				
	Grades[b]	0.46	0.10	.31	.080**	
	Deep approach[b]	0.20	0.12	.11	.011*	
	Surface approach[b]	-0.05	0.11	-.03	.001	
	Condition: abstract[c]	0.15	0.21	.05	.002	0.11
	Condition: mixed[c]	-0.16	0.21	-.05	.002	-0.12
	Condition (df=2)				.008	
	Full model (df=5)				.127**	
	Adjusted R Square				.109	
	(MS error: 1.73)					
Question Two	(Constant)[a]	3.97				
	Grades[b]	0.46	0.11	.29	.071**	
	Deep approach[b]	-0.08	0.13	-.04	.002	
	Surface approach[b]	-0.04	0.12	-.02	.000	
	Condition: abstract[c]	-0.45	0.23	-.15	.015*	-0.32
	Condition: mixed[c]	-0.42	0.22	-.13	.013*	-0.30
	Condition (df=2)				.019	
	Full model (df=5)				.119**	
	Adjusted R Square				.101	
	(MS error: 1.96)					
Question Three	(Constant)[a]	3.66				
	Grades[b]	0.41	0.09	.30	.073**	
	Deep approach[b]	0.23	0.11	.13	.016*	
	Surface approach[b]	0.09	0.10	.06	.003	
	Condition: abstract[c]	-0.01	0.20	.00	.000	-0.01
	Condition: mixed[c]	0.10	0.20	.04	.001	0.09
	Condition (df=2)				.002	
	Full model (df=5)				.105**	
	Adjusted R Square				.087	
	(MS error: 1.52)					

* $p<.05$ ** $p<.01$ (one sided for the separate predictors); df error 237

a. Mean of the concrete condition evaluated at the mean of grades, deep and surface approach

b. Centered

c. Dummy variable

Table 7.5. b
Multiple Regression Analyses for Questions Four, Five and Six, R Square Change (R^2) and (Partial) Effect Size (d)

Dep. Var.	Predictor	b	SE(b)	β	R^2	d
Question Four	(Constant)[a]	3.82				
	Grades[b]	0.64	0.09	.47	.182**	
	Deep approach[b]	0.01	0.10	.01	.000	
	Surface approach[b]	0.11	0.10	.07	.004	
	Condition: abstract[c]	0.31	0.19	.12	.010	0.27
	Condition: mixed[c]	-0.04	0.18	-.02	.000	-0.04
	Condition (df=2)				.015	
	Full model (df=5)				.202**	
	Adjusted R Square				.185	
	(MS error: 1.33)					
Question Five	(Constant)[a]	4.50				
	Grades[b]	0.71	0.14	.30	.074**	
	Deep approach[b]	0.07	0.17	.02	.000	
	Surface approach[b]	-0.12	0.16	-.04	.002	
	Condition: abstract[c]	-1.84	0.31	-.39	.108**	-0.98
	Condition: mixed[c]	-1.99	0.30	-.42	.131**	-1.05
	Condition (df=2)				.159**	
	Full model (df=5)				.289**	
	Adjusted R Square				.274**	
	(MS error: 3.62)					
Question Six	(Constant)[a]	3.62				
	Grades[b]	0.58	0.10	.37	.113**	
	Deep approach[b]	0.03	0.12	.01	.000	
	Surface approach[b]	-0.31	0.11	-.17	.026**	
	Condition: abstract[c]	-0.03	0.21	-.01	.000	-0.02
	Condition: mixed[c]	-0.01	0.21	.00	.000	-0.01
	Condition (df=2)				.000	
	Full model (df=5)				.213**	
	Adjusted R Square				.196	
	(MS error: 1.72)					

* p<.05 ** p<.01 (one sided for the separate predictors); df error 237
a. Mean of the concrete condition evaluated at the mean of grades, deep and surface approach
b. Centered
c. Dummy variable

7. 11. Discussion

The present experiment is based on the idea that text concreteness has an important role in text comprehension. Researchers in the orientation to studying tradition argue that only students with a deep approach to learning can reach a deep understanding of a text. Only they try "to extract personal meaning from the text, and this leads to an active process of learning" (Entwistle, 1988, p.24) and so to deep understanding. Students with a surface learning approach focus their attention on the text itself; they have "little or no personal engagement [with the text]. . . and the outcome is a more or less complete reproduction of the text" (Entwistle, 1988, p.25).

Theories and research in cognitive psychology suggest that text comprehension is highly dependent on the text itself (e.g., Kintsch, 1995; Sadoski & Paivio, 2001). Sadoski and Paivio (2001) emphasize the role of text concreteness in understanding: The more concrete a text is, the more students understand it. In an attempt to quantify the role of text and style in understanding in a group of Hungarian 6th graders, this study examined the role of text concreteness, learning approaches, and grades on understanding as measured by the SOLO taxonomy.

In brief, the results of the experiment offered mixed and weak support for the hypotheses. In the multivariate analysis grades had a large effect, deep and surface approaches had a small effect, and the effect of text condition fell in between medium and large. The main effects analysis showed that text concreteness as opposed to mixed and abstract conditions increased comprehension in two questions (as predicted), and had no effect in four. Deep learning scores were positively associated with understanding in two questions (as predicted) but the effect was small; surface scores were negatively associated with understanding in one of six questions (as predicted) but the effect was also small; and school grades (a measure of general ability and academic self concept), positively associated with text comprehension in all questions (as predicted).

Considering that only two questions out of six showed the expected, positive effect of the concrete text condition on understanding the present findings offer weak support for Sadoski & Paivio's (2001) claim that imagery evokingness facilitates comprehension. Learning approach scores had a weak and opposite relationship to understanding, and only in a few questions. This challenges the idea that deep and surface learning approaches play an important role in text comprehension (Entwistle, 1988).

The following sections examine each hypothesis in detail, taking a close look at the questions and the answers students gave.

7. 11. 1. Hypothesis 1

Students in the concrete text condition will understand a text better than students in the abstract or mixed conditions, regardless of learning approach (surface or deep) and grades.

Results offer weak support for the idea that imagery evokingness has an important effect on text comprehension. For Questions 2 and 5, text condition had a main effect on SOLO scores: Membership in the concrete condition as compared to both the abstract and mixed conditions explained 1.3% to 1.5% of the total variance (d=-0.30 and -0.32) for Question 2 and 10.8% to 13.1% (d=-0.98 and -1.05) for Question 5. The inclusion of a mixed text condition did not, as hoped, yield information about the degree of change in concreteness needed to produce a significant change in understanding.

There are several plausible explanations for why only three questions showed a relationship between text condition and understanding and for why in one question the relationship was in the opposite direction. 1. Text concreteness does not contribute to text comprehension as much as Dual Coding Theory suggests (Sadoski & Paivio, 2001). 2. Texts built from independent passage pairs with different imagery evokingness do not have the same average difference in their imagery evokingness as the passage pairs do. 3. When integrating independent abstract passages into coherent texts, passages even each other out in their comprehensibility. 4. The effect of prior knowledge and "laziness" override the effect of imagery evokingness in shaping answers.

1. Text concreteness does not contribute to text comprehension as much as Dual Coding Theory suggests (Sadoski & Paivio, 2001).

Only a handful of studies provide evidence of the importance of text concreteness in comprehension. Sadoski et al. (1993, 2000) did not measure comprehension; instead, the students in their study rated the concreteness and comprehensibility of passages. Kolker and Terwilliger (1986) performed an experiment in which they did measure comprehension. They found significant differences in the understanding of the abstract and concrete passages. But, they did not match the information in the passages they used, raising the possibility that differences in understanding were due to differences in the comprehensibility and content of the topics. Wharton (1980, 1987) measured comprehension in an experiment in which the information and readability of the passages were both matched. He found significant differences in comprehension between concrete and abstract text conditions. Unfortunately, he did not report effect sizes, or even means and standard deviations, and so it is impossible to determine the magnitude of the effect of text condition on understanding in his study. On the basis of these few studies, it is premature to conclude that concreteness has a large, positive effect on understanding.

Another reason to think that text concreteness does not have a powerful influence on understanding is that the effect sizes of the imagery evokingness of abstract and concrete passages in the preliminary study reported in Chapter 6 do not predict understanding of the passages in the experiment. Sadoski et al. (1993, 2000) found strong correlations between rated imagery evokingness (concreteness) and rated comprehensibility of text passages ($r = .91$, $r =.89$, $r =.96$). This suggests that as the imagery evokingness of a passage increases, its comprehensibility also increases. In this dissertation, however, there was no relationship between differences in the effect sizes of passages pairs and understanding scores on questions that drew on the passages. Passage pairs with large effect sizes were related to questions that showed no differences in understanding and to those that did show differences. For example, questions five and six could be answered by one passage each. The effect sizes of the passages belonging to these questions were relatively large in both cases (in case of Question 5 $d=1.11$, in case of Question 6, $d=1.38$), and yet question five showed differences in the understanding levels between the abstract and concrete groups and question six did not.

This finding clearly challenges the idea that the more imagery evoking a text is, the easier it is to understand (Sadoski & Paivio, 2001). Indeed, the explanation that concreteness contributes relatively little to text comprehension, is plausible and rather tempting, but there are other explanations of the results that do not call into question the idea that text concreteness has a significant positive effect on understanding.

2. Texts built up from independent passage pairs with different imagery evokingness do not have the same average difference in their imagery evokingness as the passage pairs do.

Building concrete and abstract texts from independent passages that are different in their imagery evokingness according to student ratings does not necessary result in texts with the same difference in their imagery evokingness as the passages that build them. Students may be able to form a vivid image from two or more low imagery evoking passages. For example, passage I/5 (Appendix E) contains "two-thirds of Mars is built from reddish-brown material," and Passage I/4 (Appendix E), "[canals on Mars] do not contain water." (The translations do not preserve the imagery evokingness of the Hungarian). Both passages are rated relatively low on imagery evokingness, yet students reading them together may be able to form a vivid image of a dry landscape with reddish brown color and give answers to Question 1 (What are the differences between Mars and Earth?) at the same SOLO level as do students in the concrete condition.

In other words, it is possible that imagery evokingness does cause greater understanding *and* that the imagery evokingness of passages even each other out or change in unpredictable ways when they integrated into a text. This possibility does not challenge Sadoski and Paivio's idea that imagery evokingness leads to better understanding. Rather, it suggests that imagery evokingness is not a constant (stable) feature of passages, but varies in some way related to context.

This is a possibility, even though my method of building texts from abstract and concrete passages was analogous to what Wharton (1980, 1987) did in his experiment. Wharton created passages with different imagery evokingness by changing abstract words to their concrete synonyms in one version of the passages. I did something similar, only with bigger chunks: I built up the concrete text from concrete passages, the abstract text from abstract passages, and the mixed text with half concrete and half abstract passages. Wharton changed words in his passages, and I changed passages in my texts. The only difference is that I added some connecting sentences while he did not add connecting words to his sentences.

This possibility raises the important methodological question of how to create large text units of different imagery evokingness. Sadoski et al (1993, 2000) had students rate the imageability of entire text units of 150-200 words. At first glance, this seems more methodologically sound than my approach, as the text chunks students rate are the ones used in the experiment. This avoids the problem of the text units interacting in unpredictable ways when combined, but raises other questions.

When students rate a long passage, it is very difficult to determine exactly what they rate. They might give a sort of average rating of the whole passage, or they might rate the passage highly imagery evoking if there is just some part of it they can picture clearly, or they might rate the first or the last sentences. We don't know. This can be a problem if there is a systematic difference in how students assess imageability, especially if they assess it differently when asked to rate imageabilty than they do when they are reading for understanding. In this case, we do not know what the imagery evokingness of a text actually means. This problem of validity makes predicting the imagery evokingness of texts and designing texts with certain imagery evokingness difficult.

We can conclude that both ways of constructing long texts with known imageability have problems that must be addressed in future research. If we decide to have smaller passages rated and then build experimental texts from these passages, we have to examine how the concreteness of the smaller texts changes when they are integrated into longer passages. If we decide to have longer passages rated by the students and then use these passages in the experiment, we have to determine if the imageability of the texts is the same in both conditions.

3. When integrating independent abstract passages into coherent texts, passages even each other out in their comprehensibility.

Another way of looking at why there were few differences among text conditions is that when two or more passages are put together, they change not in their imagery evokingness but in their comprehensibility. Passages that independently are abstract and difficult to comprehend, when made part of a larger text may yield clues that make aspects of them easier to understand. For example if a student only understands from an abstract passage that if a "planet is too big or too small something happens to some gases on it" and from the next abstract passage that "there is little oxygen on Mars," the student might be able to figure out from the two together that the size of the planet and the presence of oxygen itself are somehow connected. The student may then be able to mention a relevant point in answering Question 3 (What is needed for life to develop on a planet?) and get a score comparable to those achieved in the concrete condition.

Researchers agree that text understanding cannot be reduced to understanding individual words. On the basis of this logic it is possible that understanding of texts built up from passages with different content cannot be reduced to understanding the independent passages. The reader has to connect sentences and paragraphs and create even greater meaning units. Thus the effect of text concreteness on understanding might be attenuated, because putting together many passages may result in a more comprehensible text.

Marschark (1985) makes a similar point in relationship to the effect of concreteness on memory of sentences and passages. In his experiment, the concreteness effect of sentences disappeared if the sentences were connected in large units. He was led to question the explanation of Dual Coding Theory for concreteness effect. According to his explanation, "concrete sentences are more distinctive at retrieval than abstract sentences" (Marschark & Hunt, 1989, p.711) and the superior memory for concrete sentences in unrelated lists is due to this factor. But if sentences are connected, "salient relations among sentences of a coherent passage encourage processing of relational information at the expense of distinctive processing of individual sentences" (Marschark & Hunt, 1989, p.711). He considered images to correspond to "isolated aspects of a larger episode, such as the physical appearance of the protagonist, or to units larger than a single sentence, such as a scene described in a paragraph or a chapter" (Marschark & Hunt, 1989, p. 711). Thus the most important factor that helps in understanding texts is not imagery evokingness, but the relations among sentences in the text.

It is possible that the effect of concreteness on understanding varies in the same way. This idea receives support from Kintsch (1994). According to his theory of text comprehension, well-structured texts are easier to understand than ill-structured texts. Texts contain cues (extralinguistic, syntactic, semantic, and rhetorical) that the reader can use to comprehend a text. Without these cues, understanding is made more difficult or impossible, depending on the text and the reader. It is possible that arranging passages into a coherent text and adding connecting sentences creates a text with good structure and gives cues that also make it easier to understand, even if it is built up from abstract passages.

In building texts for the experiment, I used a conversational form to make the somewhat independent passages hang together, and I also gave short connecting sentences to make the text more coherent. One connecting sentence was: "What does this planet look like?" This might have served as a rhetorical cue; after this question, students probably expected a description. Or when the writer asks the scientist, "What is needed for life to develop on a planet?" students probably expected a list of properties or elements, and so on. These cues could have increased comprehensibility to the point that students in the abstract and mixed groups were able to answer some of the questions as well as students in the concrete group. We can conclude, that in future research we have to contend with the possibility that connecting independent passages into longer texts and adding common material changes the overall or average comprehensibility of the text.

4. The effect of prior knowledge and "laziness" overrun the effect of imagery evokingness in shaping students answers.

I am aware that in examining this possibility I take the risk of overinterpreting the results. I am also aware that not all of the questions fit this explanation. Still, I believe the idea is worth investigating. The hypothesis, partly supported by the results, is that the imagery evokingness of a text has a greater effect when information is new than it does when the information is on a familiar topic.

The questions students had to answer in the experiment can be grouped into two categories: those that had results supporting the hypothesis that text condition effects understanding and those that did not:

Questions that yielded significant difference among the abstract and concrete groups in the expected direction:

Question 2: What would a Martian animal be like?

Question 5: What is an ellipsoid?

Questions yielded no significant difference between the abstract and concrete conditions:

Question 1: What are the differences between Mars and Earth?

Question 3: What is needed for life to develop on a planet?

Question 4: What does Mars look like?

Question 6: Who was Tycho Brache and what did he do?

Questions 1 and 3, and 4, which did not evoke different answers among the groups are questions that students could probably have said something about without reading the text. (Question 6 is an exception and is discussed below.) Although students had not covered Mars at school—indeed, the topic was chosen for this reason—in retrospect it seems likely that they could have had picked up information from everyday life that would have helped them answer Questions 1, 3, and 4.

On the other hand, it is very unlikely that students would have picked up information from everyday life that would have helped with Questions 2 and 5, on which the text groups did differ in the expected direction. They could not have figured out answers without reading the text. The definition of an ellipsoid is not knowledge that 12-year olds can easily pick up in their everyday lives. The description of the Martian animal was absolutely my idea, and it is highly unlikely that they had read the same thing before.

An examination of the answers given by students for each question (Table 7.6.) shows that in case of Questions 1, 3, and 4, students in both the concrete and abstract groups did use mostly information they could have picked up in their everyday lives (e.g., "Mars is red"). In many cases the information was not in the text and must have come from prior knowledge (e.g., "for life we need water" in Question 3). Table 7.6. also shows that students in both groups used this information to a similar extent. For example, "Mars is small"— 35.2% for the abstract and 36.0% for the concrete group in Question 4; "Mars is smaller then Earth"—58.2% for the abstract and 57.3% for the concrete group in Question 1. In Questions 2 and 5, on the other hand, students used mostly new information from the text. For example, "the Martian animal would have different breathing system"—40.7% for the abstract and 50.6% for the concrete group in Question 2; the main point of the definition of an ellipsoid11.0% for the abstract and 47.2% for the concrete group. The above analysis suggest that concreteness has an effect only when information is new.

At first sight this claim seems to contradict theory and research presented in earlier chapters that understanding involves connecting new information to previous knowledge and prior knowledge actually helps understanding (Kintsch, 1994). But Kintsch also argues (see Chapter 3) that prior knowledge does not always increase understanding. When the overlap between information in a text and prior knowledge is great, the effect can be just the opposite. Knowledgeable readers may think they understand and not pay much attention to the text: Prior knowledge reduces motivation to acquire new understanding. The next few paragraphs explore the possibility for a role of prior knowledge in attenuating understanding in he present experiment.

When the information of the passage or the question was probably familiar, many students gave trivial answers that did not show evidence of having read the text. It is as if students retrieved relevant prior knowledge more readily than the new information, no matter if it was in the text or not. This idea is expressed by Gardner (1991). Gardner cites Vygotsky who makes a distinction between "spontaneous" concepts and "scientific" ("non spontaneous," "systematically learned") concepts.
"Spontaneous concepts (like *brother* or *animal*) are picked up in everyday life, whereas scientific concepts (like *gravity* or *mammal*) are learned primarily in a school setting" and "are mastered more readily" (p.135). But Gardner argues that these concepts just appear to be mastered more readily than spontaneous concepts: "The scientific knowledge may often be quite fragile and readily overridden by more deeply entrenched spontaneous concepts" (p.136). Some information in the Mars texts may have functioned like scientific knowledge as Gardner describes it, easily lost and easily overridden by everyday knowledge. This argument might explain why both groups tended to use their previous knowledge from everyday life for their answers, but leaves unanswered two questions: 1) Why might students have drawn on *only* old knowledge? 2) How does the explanation account for no differences in SOLO levels, which involve integration and abstraction, not only recall of bits of information?

Table 7.6. a
Answers Categorized by Presence in the Text and Likely Familiarity for Questions 1, 2, 3

		Abstract group		Concrete group	
		N	%	N	%
Question 1					
Not in the text:	No life on Mars	28	30.8	26	29.2
	Others (Earth is blue)	13	14.3	14	15.8
	Average	*20.5*	*22.5*	*20*	*22.5*
In the text, But common	Mars is smaller	53	58.2	51	57.3
	Different air (O2)	62	68.1	53	59.6
	Mars is red	33	36.3	43	48.3
	No water	16	17.6	19	21.3
	Canals	13	14.3	13	14.6
	Average	*35.4*	*38.9*	*35.8*	*40.2*
In the text, not common	Gravity	26	28.6	19	21.3
	Less thick atmosphere	5	5.5	14	15.7
	We can jump higher	9	9.9	17	19.1
	Dark (misunderstood)	10	11.0	2	2.2
	Average	*12.5*	*13.8*	*13*	*14.6*
Question 2					
Not in the text:	Stronger	1	1.1	7	7.9
	Others	21	23.1	17	19.1
	Average	*11*	*12.1*	*12*	*13.5*
In the text, but common:	Look different - not directly in the text	10	11.0	8	9.0
In the text, not common:	Diff. breathing system	37	40.7	45	50.6
	Color blind	20	22.0	26	29.2
	Jump higher	29	31.9	32	36.0
	Red color	13	14.3	32	36.0
	Average	*24.8*	*27.2*	*33.8*	*38.0*
Question 3					
Not in the text:	Food	13	14.3	9	10.1
	Water	16	17.6	20	22.5
	Humans, animals, plants	29	31.9	23	25.8
	Others	17	18.7	17	19.1
	Average	*18.8*	*20.6*	*17.3*	*19.4*
In the text, but common:	Air (O2) - not directly in the text	60	65.9	45	50.6
In the text, not common:	Carbon	25	27.5	34	38.2
	Size of the planet	4	4.4	7	7.9
	Average	*14.5*	*16.0*	*20.5*	*23.5*

N of students = 270 (Abstract group: 91; Concrete group: 89; Mixed Group, not shown: 90)

Table 7.6. b
Answers Categorized by Presence in the Text and Likely Familiarity for Questions 4, 5, 6

		Abstract group		Concrete group	
		N	%	N	%
Question 4					
Not in the text:	Globe shape	9	9.9	5	5.6
	Craters	5	5.5	7	7.9
	Other	29	31.0	26	29.2
	Average	*14.3*	*15.5*	*12.7*	*14.2*
In the text, but common:	Red	69	75.8	62	69.7
	Small	32	35.2	32	36.0
	Canals	28	30.8	30	33.7
	No water	11	12.1	13	14.6
	Average	*35*	*38.5*	*34.3*	*38.5*
In the text, not common:	Dark parts	19	20.9	7	7.9
Question 5					
Not in the text:	Other, does not make sense (axis, point, etc)	33	36.3	17	19.1
In the text, but common:	-				
In the text, not common:	Some features	10	11.0	7	7.9
	Good (main point)	10	11.0	42	47.2
	Similar to a circle	3	3.3	12	13.5
	Average	*7.7*	*8.43*	*20.3*	*22.9*
Question 6					
Not in the text:	Mix up with another name	10	11.0	8	9.0
	Examined Mars	4	4.4	6	6.7
	Other	4	4.4	7	7.9
	Average	*6.3*	*7.0*	*7*	*7.9*
In the text, but common:	Sun orbits the Earth	24	26.4	16	18.0
In the text, not common:	Astronomer/Scientist	62	68.2	58	65.1
	Examined planets	9	9.9	26	29.2
	Without a telescope	19	20.9	25	28.0
	Took notes	2	2.2	11	12.4
	No law discovered	2	2.2	6	6.7
	Average	*18.8*	*20.7*	*25.2*	*28.3*

N of students = 270 (Abstract group: 91; Concrete group: 89; Mixed Group, not shown: 90)

One answer to the first question might be that old knowledge interferes with the new information and new information is not retrieved (Wixted & Rohrer, 1993). Or, students simply do not make any effort to retrieve the newly learned information or reflect on the text, they just write down the first few ideas that pop into their minds without making any effort to retrieve everything they know or think or reflect on what they read.

Another obvious answer is that there is no new knowledge. As mentioned in Chapter 3, Kintsch and Kintsch (1995) argued that students with high background knowledge might get bored reading a text they find familiar, have the illusion that they understand the text, and not make any effort while reading so that actual learning (with understanding) does not occur. They also argue that students have the tendency to make the least amount of cognitive effort they have to while reading, so high knowledge readers benefit less from "well written texts" than low-knowledge readers because they read the text in a more superficial way. The only way to avoid this effect according to the authors is to make the students read actively by leaving gaps in the text or give some tasks students have to accomplish while reading. According to this idea, students in the present experiment had a background knowledge of Mars, and the illusion they knew Mars, so they did not read the text carefully, especially not parts that looked familiar.

Laziness could have occurred not only while answering the questions but also while reading the text. On the basis of the present study it is impossible to decide if one or the other or both played a role in students answer levels. The idea of laziness and not making much effort itself is quite possible as I was not a teacher and did not grade them. Hungarian school students are generally undermotivated in school related tasks (according to the results of the PISA study 38% of Hungarian children directly stated that they did not like to go to school), so it would not be surprising if that they did not work with full attention and effort. As studies in interest and motivation show, if students are not interested in a learning task, their learning and quality of understanding is diminished (Krapp, 1999, see Chapter 2).

In the SOLO taxonomy, not only the number of ideas stated indicates level of understanding, but also the connectedness of the ideas and the presence of abstractions. Even if the students in the concrete condition generated the same the number of ideas as the abstract group, they could have received higher scores if they had more connecting ideas and abstraction. But, in questions in which the SOLO scores of the groups did not differ, neither the number of ideas generated nor the organization or abstraction of the answers was better in the concrete group than in the abstract group.

Students' answer rarely went beyond the Multistructural level (students mention several relevant points, but do not connect them). This can show a developmental feature of students thinking. According to Biggs and Collis (1982) we cannot expect students answer on a Relational level before the age 13. Students in the study were between 12-13 years old, just around the time of being able answering on Relational level. But the average SOLO scores of students in the study was 3.45 a little above Unistructural (that is giving one relevant point). This is below even Multistructural level (level 5— giving several relevant ideas in the answer) and well below the Relational level, level 7. Thus, we do not have to talk about a ceiling effect in students' answers.

Question 6 (Who was Tycho Brache and what did he do?) causes trouble for this analysis. It does not completely fit into the above line of thought. Why did this question not work like Questions 2 and 5, which also could not be answered without reading the text? Students had not yet studied Tycho Brache. He is not a very well-known scientist, so the information about him in the text was probably new to the students in the study. Looking into the answers, we see (Table 7.5) that many students gave answers that are not common knowledge, but which do not touch the heart of the passage (e.g., scientist or an astronomer—68.2% for the abstract and 65.1% for the concrete group). The passage itself described Tycho Brache's work, and this was hardly mentioned by any of the groups. We can speculate that even the abstract group could gather from the text that Brache was a scientist, which the concrete groups also understood, and that few students in any of the groups made an effort to retrieve newly learned information about Brache and just wrote down the first thing that popped into their minds. But, if this speculation is correct, why did answers to the question about an ellipsoid and a Martian animal show a significant difference between the abstract and concrete groups? The answer is not known. The results are sufficient to suggest that further research on the interaction between prior knowledge and text condition is needed.

The four explanations for the generally small effect of text condition on understanding are probably not mutually exclusive. It is quite possible that in some cases they together determine level of understanding. An analysis of the results for Question 5 supports this conjecture. Text condition explains 10.8-13.1% of the variance in SOLO scores in Question 5 (What is an ellipsoid?). Any explanation for why the concrete text condition produced higher SOLO scores than the mixed or abstract condition for this question cannot simply be that the concrete condition more easily evoked an image related to the question. If this was true, there would be a systematic relationship between effect sizes of the imagery evokingness of abstract and concrete passages in the preliminary study and SOLO scores for all questions. But, as we saw above, there was no systematic relationship. A more likely explanation is that the factors previously suggested—a large effect size for imagery evokingness, lack of context that could help the abstract group better comprehend the text, and likely absence of prior knowledge that might diminish the power of the concrete text—interacted to influence text understanding. In addition, in Question 5 one especially powerful image in the concrete condition may have facilitated understanding for the concrete group.

As discussed earlier in this chapter, when passages are connected into a coherent text, salient relationships among sentences may encourage the processing of relational information and possibly increase the comprehensibility of an abstract text. We can speculate that because in Question 5 only one passage referred to an ellipsoid and none of the other passages conveyed any information relevant to understanding an ellipsoid, the students in the abstract group could not pick up any clues from other passages that could raise their answer levels close to that of the concrete group. So, the possible context effect suggested above was not likely to have attenuated differences between the groups.

This chapter also argued that when a topic is familiar, students in many cases give the most trivial answers, as if they never read the text. When students had prior knowledge of the topic, they seemed to retrieve relevant prior knowledge no matter if it was in the text or not. As both the abstract and the concrete group used mostly their background knowledge in their responses to the questions about familiar topics (and in the same extent) their answer levels became similar. The chapter offered several explanations for this: 1) Because of the interference between old knowledge and new information new information cannot be retrieved (Wixted & Rohrer, 1993). 2) Students simply make little effort to retrieve the newly learned information, they just write down the first few ideas that first pop into their minds. 3) Students with high background knowledge may get bored reading a familiar text, have the illusion that they understand the text, not make any effort while reading, and not learn with understanding (Kintsch & Kintsch, 1995). The information in the passage defining an ellipsoid, however, was very likely completely new to Hungarian six graders. Thus to answer Question 5 students had to rely completely on what they understood from the text, which was different for the concrete and the abstract groups. So, the possible effect of previous knowledge suggested above was not likely to have attenuated differences between the groups.

The image of a "squashed circle" in the concrete version of the passage contains comparative information that may make it especially useful in understanding what an ellipsoid is. The image of a squashed circle portrays the concept of an ellipsoid with a comparison (analogy). It compares the ellipsoid to a circle. Using a very familiar concept as a reference point maybe especially helpful in understanding (Simons, 1984).

7. 11. 2. Hypothesis 2.

The higher students score on deep approach the higher level of understanding of the text they will show, regardless of text condition, surface approach, and grades. The higher students score on surface approach, the lower understanding of the text they will show regardless of text condition, deep approach, and grades.

Surface approach was associated with lower understanding in one question out of the six (Question 6). This was expected and in agreement with previous findings (e.g., Entwistle, 1988), but in the present research the effect is small. Deep approach was associated with understanding in two questions. In Questions 1 and 2, it was associated with higher SOLO scores. This result is in accord with expectations and previous findings (e.g., Martin & Ramsden, 1987). Text condition explained more of the variance in SOLO scores than learning approach in only one question (Question 5) and approximately the same portion as learning approach in another question (Question 2). In Question 2, the effects of both text condition and learning approaches are so small that comparison hardly matters.

The question arises: Why did scoring high on deep approach and scoring low on surface approach have an effect on understanding in so few instances? Are learning approaches not as important in understanding as studies in the Learning Orientation Tradition suggest?

One answer has to do with the low reliability and questionable validity of the Approaches to Studying Inventory with 6th grade students. These problems mean that we can only tentatively interpret results involving the questionnaire. These problems were discussed earlier and are addressed in detail in the final chapter. The reliability of the scales in this study was not high (the Cronbach's alpha of the Deep Approach Scale was .63, the Cronbach's alpha of the Surface Approach Scale was .55). As discussed in Chapter 5, the Deep Approach Scale seems to more or less measure intentions, not practice. It is quite possible that students with the intention to learn deep might have failed to fully act on this intention (Entwistle, 1988). There is a distinction between "what one is actually doing in learning situations, what one is trying to do in learning situations, and what one thinks one is doing in learning situations" (Marton, 1988, p.76).

A second answer is that the effects of learning approaches are partly confounded with motivation. Students did not get grades, and the task itself was very much like an every day school task. This may have not have inspired students to work hard. As discussed in the second chapter, being undermotivated pushes even deep learners toward a more surface approach (e.g., Martin & Ramsden, 1987). Considering the generally low level of understanding in all conditions of the study (average 3.45 SOLO levels, which means expressing a little more than one idea), it is quite likely that being undermotivated played a role in shaping answers. Thus many students who reported using a deep approach in the ASI might have remained on a surface level reading the text and answering the questions. They might not have gone deep in processing the material, or they did not pay attention, thus their understanding was not better than the understanding of surface learners.

7. 11. 3. Hypothesis 3.

The better school grades students have, the higher level of understanding of the text they will show regardless of text condition or learning approach.

The variable of grades was included in this study because the learning task of the experiment was very similar to other school tasks and it was reasonable to think that students with higher grades would understand the experimental text better than students with low grades. Grades were not a focus of the theoretical basis for the work. The experiment found, however, that grades generally explained between 7.1% and 18.2% of the variance in SOLO scores indicating level of understanding, much more than either learning approach or text condition (except in the case of one question, Question 5).

The results show that for all groups (abstract, concrete, and mixed) for all questions, better students gave answers with higher SOLO levels than did worse students. School grades have been found to be strongly connected to intelligence scores. This suggests that general intelligence has an effect on understanding. It is also possible that not abilities or not only abilities are important here, but also academic self concept connected to being a good or bad student (see introduction to the experiment, section 7. 1.). Good students have positive past experiences with solving school-related problems. Bad students may have lower expectations of themselves and higher anxiety levels related to school-like tasks. Thus, good students may have approached the task in the study with more ability and more confidence and ease than did bad students, leading to higher understanding.

7. 12. Summary

The present experiment offered weak support for the idea that text concreteness has a role in understanding. It would be wrong, however, to conclude on the basis of these results alone that text concreteness does not have an important role in text comprehension. Text understanding is clearly a complicated process. Text concreteness is one factor in the understanding process, and it seems to interact with other factors, such as the structure of the text, cues in the text, prior knowledge, and motivation. Furthermore, as this study suggests, we do not know much about what exactly makes a text more imagery evoking, certainly not in Hungarian and perhaps not in English. The imagery evokingness of texts built up from independent passages may change in their imagery evokingness in poorly understood ways. Text features that may affect understanding may also affect the imagery evokingness of texts.

The experiment gave weak support for the idea that deep and surface approaches have an important role in shaping students answers. The weak relationship between approach and understanding may be due to the moderate internal reliability of the Approaches to Studying Inventory (Entwistle & Kozéki, 1985) and its possible validity problems with elementary/middle school students. The lack of motivation of students to complete school related tasks is another possible explanation for the results. Low motivation can push even deep learners towards surface approach, which results in less deep understanding and lower SOLO levels.

The only factor that systematically had an effect on understanding in this study was school grades. In every question, grades showed a main effect and explained the most variance of all the variables. Thus the results support earlier findings that general abilities (or academic self concept) that are expressed by school grades have an important role in understanding. It is worth noting that the full model explained only between 10.5% and 28.9% of the total variance. It is clear that other very important covariates were not taken into account. This discussion has suggested what some of these might be.

CHAPTER 8
GENERAL DISCUSSION

8. 1. Introduction

The research reported here consisted of two studies: an exploratory interview study that included the administering of the Approaching to Studying Inventory (ASI), and an experiment accompanied by a preliminary study. The interview explored the circumstances under which a group of elementary/middle school Hungarian students studied by heart, with special attention to the text as a factor, whether students see relationships between understanding and picturing a text, and relationships among students' answers and their scores on ASI. The experiment examined the effect of text concreteness on text understanding as shown in answers to essay-type questions and the relationship of learning approach and grades to text understanding in a group of sixth grade Hungarian students. The interview study, the preliminary study for the experiment, and the experiment itself all revealed problems and questions for both the fields of learning styles and text comprehension. On the following pages, I discuss the results of the studies together, concentrating on the main problems and questions the dissertation addressed.

8. 2. Validity and Reliability of the Approaches to Studying Inventory

Several questionnaires in the orientation to studying tradition measure learning styles (e.g., Biggs, 1985; Entwistle & Ramsden, 1983; Vermunt, 1998), but the only one translated and used in Hungary is the ASI, Approaches to Studying Inventory (Entwistle & Kozéki, 1985; Kozéki & Entwistle 1986). The original version of the ASI was designed for use with English-speaking students in higher education (Entwistle & Ramsden, 1983). The goal of its authors was to operationalize Marton and Saljö's (1976) concepts of deep and surface learning approaches and Pask's (1988) concepts of holist and serialist learning styles.

A deep approach involves "the intention to reach personal understanding and the learning processes involved in achieving that intention" (Entwistle, 1988, p. 29); a surface approach involves focusing attention on the text itself with little or no personal engagement, and "the outcome is a more or less complete reproduction of the text" (Entwistle, 1988, p. 25). Students with a serialist style focus attention "narrowly on the facts and details and on logical relationships or procedures" (Entwistle, 1988, p. 26), while students with a holist style are "much more interested in grasping general relationships between ideas" (Entwistle, 1988, p. 26). The inventory also measures a third learning approach (strategic) and different forms of motivation that are associated with the approaches and styles. The inventory was altered to make it suitable for use with middle school students and translated into Hungarian (Entwistle & Kozéki, 1985). The final inventory consisted of ten scales, each containing six items (three approaches, two styles, and five motivational scales; see Table 5.1.).

The internal reliability of some of the scales in one study comparing Scottish and Hungarian students—between .45 and .79 for the Scottish students and .32 and .76 for the Hungarian students—"suggested weaknesses" in the instrument (Entwistle & Kozéki, 1985, p. 128). The reliability analyses of the two administrations of the ASI in the present studies showed an even more discouraging picture of the reliability of the scales of the questionnaire.

Four of the ten ASI scales were initially chosen for both the interview and the experiment: Deep Approach, Surface Approach, Holist Style, and Serialist Style. Principal component analyses of the data in both studies did not reveal any clear pattern for two of the four scales, Holist and Serialist, and they were left out of further analysis. These scales had the lowest Cronbach's alphas in Entwistle and Kozéki's study: Holist, .49 Scottish, .51 Hungarian; Serialist, .45 Scottish, .32 Hungarian.

The Deep Approach Scale, leaving out one item in both studies, showed moderate levels of internal reliability (Cronbach's alpha, .70 and .62). In the experiment, a moderate level of internal reliability for the Surface approach scale was reached by leaving out one item (Cronbach's alpha, .55), but in the interview study, three items had to be dropped t yield moderate reliability (Cronbach's alpha, .62). Thus, of four studies (Entwistle and Kozéki's Scottish and Hungarian groups, and the interview and the experiment of the present dissertation), the holist and serialist scales could not be interpreted in two studies and had low internal reliability in two others. The reliabilities of the Deep Approach and Surface Approach Scales were moderate in all four studies (Cronbach's alphas between .53 and .65). These results call into question the reliability of the questionnaire for elementary/middle school students and make tentative every interpretation of the ASI results of the present studies. The problem with reliability also calls the validity of the ASI into question.

If the Deep Approach Scale measured, as designed, "the intention to reach personal understanding," and "the learning processes involved in achieving the intention of deep understanding" (Entwistle, 1988, p 29), and the Surface Approach Scale measured student's reliance on the text while reading and rote memorizing as the only possible outcome of learning, the scales should have shown stronger relationships with other variables in the two studies of the present dissertation. The results of the two studies, then, raise additional challenges to the validity of the ASI as a measure of deep and surface learning approaches of elementary/middle school students.

On the basis of Entwistle's definition of deep and surface learners and of what the Deep and Surface Approach Scales of the questionnaire are supposed to measure, we would expect students who score high on deep approach: 1) to report using deep approach more often; and 2) at least sometimes show better understanding than students who score high on surface approach. In the interview study, however, most students reported using surface approach in some situations, and these responses showed no relationship to ASI deep and surface scores. This means that whether or not students scored high on deep approach, it said nothing about whether they reported use of surface learning. In the experiment, learning approach did not have any relationship to understanding in three of six questions and even in the ones they did, the effect was very small (learning approach explained 1.1%-2.6% of the total variance).

I examined the items of the scales, hoping to find an explanation for why the questionnaire did not show any relationship with the interview questions or SOLO scores. One idea is that the Deep Approach Scale actually measures only intentions, not actual learning processes. It is possible that students who intend to understand fail to carry through the full process of understanding (Entwistle, 1988). As Marton (1988) suggests, there is a difference between what students intend to do, what they think they do, and what they actually do. Thus, students may have reported their intentions on the ASI, but in the interview study they reported their self-perceived behavior in certain situations and in the experiment they exhibited actual behavior in a situation. The questionnaire, the interview, and the experiment might measure three completely different things, although in theory these constructs are connected (Marton, 1988).

If the ASI Deep Approach Scale does in fact measure intention, it is probably does not measure the intentions of elementary/middle school students very well. The ASI's wording and use of a strength of agreement scale with frequency of intention statements may be confusing to students. This may lead students to interpret questions in many different ways and answer according to these different interpretations, which would lower the validity of the inventory. Take the following item, for example: "I always try to connect what I study to topics we have studied in other subjects." The question asks students to judge the strength of their agreement with the idea that they "always try." This task can be confusing to young students. Students may vary widely in how they estimate the frequency of trying to make connections and in what they mean by a level of agreement. Changing the wording of the statement and the Lickert scale items would help. For example: "I try to connect what I study to topics we have studied in other subjects": Always, Most of the time, Sometimes, etc.

Another possible problem with the ASI is that it evokes socially desirable answers from students. Watkins (1996) raised the same question about Biggs's LSQ. It is possible that even though Hungarian teachers test for surface learning, they uphold the value of deep learning and look down on studying by heart, and students echo this value in their ASI responses.

Finally, scores on the Deep and Surface Approach Scales did showed a low correlation in the interview or in the experiment: -.24 for the interview, -.08 for the experiment. This means that students who scored high on the Deep Approach Scale did not necessarily score low on the Surface Approach Scale, and students who scored low on the Deep Approach Scale did not necessarily score high on the Surface Approach Scale. This result might seem to be puzzling at first glance. If styles are more or less stable characteristics, and if students generally had one or the other style, we would expect a significant, strong negative correlation between the scales. On a closer look, the absence of a relationship between scale scores suggests that students are not simultaneously deep and surface learners, but vary their learning approaches according to situation (e.g., subjects, teachers, or available time).

In conclusion, the present study raises serious questions about both the reliability and the validity of the Hungarian version of the Approaches to Studying Inventory for elementary/middle school students. According to Riding and Ryner (1998), the versions of the ASI developed for college students (e.g., Entwistle & Ramsden, 1983; Entwistle & Tait, 1994) do not have such problems. Young students may be simply not be well able to give an accurate account of their behaviors or minds.

8. 3. Consistency of Styles

The problem of consistency puzzles researchers in many areas of psychology. For example, in personality research, it is a question if features of persons are stable traits or change according to situation. The question of the consistency of styles is not much different: Are learning styles consistent or do they change from situation to situation?

What we think about the question will shape our predictions about the effects of situational factors on learning styles. If styles are consistent and depend on student characteristics, then we would not expect text concreteness to have a great effect on students choice of learning approaches. If styles vary according to situation, then text concreteness might have a bigger role in shaping students' choice of their actual learning approach. It is widely accepted in the literature that approaches are both stable and context dependent, but this by itself does not say anything about what we can expect from a deep or surface learner in a given situation.

One explanation for why we do not have a clear answer to this question is that many researchers use only questionnaires to get a picture of student learning styles. These questionnaires can show interesting results about broad changes in styles or approaches, but they hide details about important matters, such as the choice of a learning approach for particular subjects or topics. In other words, we cannot get a picture of the variability of learning styles if we ask only questions about the learning process in general. As I was interested in one of the situational factors, the text itself, I used an interview and a learning style inventory.

Results of the interview study suggest that learning approaches vary among topics and situations. Most of the students reported using a surface approach in certain situations. The interview data did not show any relationship with the scores on Deep and Surface Approach Scales on the ASI. Rather, students seemed to judge the situation they are in (the material, their tiredness, the teacher, and so forth) and make a conscious choice in order to have the greatest chance of getting the best grade and avoiding punishment. The importance of grades follows from the structure of the Hungarian education system where grades play an extremely important role in advancement. Getting better grades has a very important role in students' lives, probably more important than understanding the material they learn. If getting better grades requires only surface learning, and students do not have enough time or interest in the subject itself, they will probably not make much effort to understand the texts they have to study.

The assessment system, tiredness, lack of time, and many other factors have been identified in learning styles research as leading deep learners to choose a surface approach (e.g., Entwistle, 1988, Ramsden, 1988). In the interview study, the most frequently mentioned factor for choosing a surface approach was not understanding the material. The findings support previous research showing that students choose learning approaches depending on a variety of factors.

As discussed it in the previous section and in Chapter 5, it is very difficult to draw a clear line between being consistent but occasionally using another approach and not being consistent at all. The number of students in the interview study who reported using surface approach in certain situations and the lack of a correlation between their self-reports and the results of the learning styles questionnaire suggest that students are not consistent in their learning styles. Their choice of approach seems to be based on the actual situation they are in. As researchers agree that most students do not seem to be completely consistent, from a practical point of view the important goal is to create circumstances that help students chose a deep learning approach. Perhaps an even more fundamental question is: Do students have the skill to learn deeply? Good intentions and ideal circumstances alone are not enough to reach a deep understanding.

8. 4. The Role of Learning Approaches in Understanding

Students with a deep learning approach are supposed to understand material better than do students with a surface approach (Entwistle, 1988). The experiment offered weak support for the idea that deep and surface approaches have an important role in understanding. Learning approach was related to understanding in only a handful of instances. Deep approach was related, positively, two of six times; surface approach was related, negatively, one of six times. Learning approach had a small effect on understanding in all three instances. As argued above, the results of the present study (and Entwistle & Kozéki's, 1985 study) raise serious questions about the reliability and validity of the Approaches to Studying Inventory with elementary/middle school students. Because of the poor reliability and questionable validity of the ASI it may not be true that learning approach has no relationship to understanding, but simply that the questionnaire does not measure well enough what it is supposed to measure and poor reliability attenuated correlations with understanding.

8. 5. Imagery Evokingness of Texts

The results of the interview study suggest that whether a text evokes images in a student depends on both the text and the student. Most students in the interview study reported forming mental images of novels they liked. Novels are usually written in a highly vivid way with colorful and detailed descriptions of places, characters, and actions. But of the students who could picture novels, reports of picturing school subjects varied widely. The reason for this is not clear, but we cannot close the debate by simply stating that students who do not picture all subjects do not have the ability to do so, or do not prefer using mental images, because in that case they probably would not report forming images of novels. The reason probably has something to do with the nature of the subject (some subjects are generally easier to picture) and the relationship between the student and the subject (e.g., with whether the student is interested in or understands the subject). Students reported a subject to be difficult to picture when they thought the subject itself was not possible to picture (e.g., Math), when they did not like the subject, and when they could not understand it for some reason, e.g., the textbook was not good, they had never seen such a thing (e.g., a strange animal), or the phenomena described by the text extends over many years (e.g., the formation of mountains).

In order to conduct the experiment, I had to create parallel texts with different degrees of imagery evokingness. One very important conclusion of the present dissertation is that this task is more complicated than earlier studies suggest. There are two aspects of the problem: determining how to create texts with different imagery evokingness, and determining the best way to rate the imagery evokingness of longer texts.

The problem of creating texts with different imagery evokingness

The number of abstract and concrete words in the text, the factor of concreteness that Wharton (1980, 1987) and Kolker and Terwilliger (1986) changed in their experiments, seems to be only one factor in whether students form images in their heads while reading. As I argued above, whether a text evokes images depends on both the text and the reader. The present studies suggest that on the student side, the important factors are interest, motivation to understand, and prior knowledge of the topic. On the text side, (besides the ratio of abstract and concrete words in the text), the structure of the text and cues presented in the texts (rhetorical, semantical, etc.) affect imagery evokingness.

The difficulty of creating texts that differ in their imagery evokingness but not in other features that might affect comprehension was obvious in the preliminary study. The goal of the preliminary study was to create passage pairs (the building blocks of the texts used in the experiment) with different degrees of imagery evokingness and identical readability, and information. I could not simply change abstract words to their concrete synonyms, as Wharton (1980, 1987) did. There are no standardized word lists for concreteness in Hungarian and most of the abstract words in Hungarian come from Latin and Greek, which students start learning in high school, at the earliest. Students certainly cannot form images of words they do not know. Using such words in this study would have confounded "abstract" and "unfamiliar." Researchers should make sure that students know all the words in the experimental texts.

I made concrete texts by using more verbs, especially active ones expressing motion or activity which I hoped would evoke images easier than the passive voice or static verbs (e.g., "to be"). I did the opposite in creating the abstract versions. This involved making changes in the grammatical structure and other aspects of the texts. Fewer than half of the passage pairs showed significant differences in student ratings of imagery evokingness. Reviewing these pairs suggested that the abstract/concrete difference was due to more than voice or verb tense. The abstract passages referred to relationships involving constants and ratios and used more scientific language and more complicated grammar; the concrete passages tended to have a very vivid image illustrating a concept.

These results suggest that sentences or passages with a complicated or unclear grammatical structure will be difficult to picture, while passages with clear grammar and semantic and syntactic cues (as suggested by Kintsch's Propositional Theory) are more imageable and more comprehensible. This is one point at which Kintsch's Propositional Theory and Paivio's Dual Coding Theory meet. The effects of word concreteness and grammatical structure and other text features that appear to be related to imagery evokingness can be systematically varied and their effects measured.

The results of the experiment also suggest the importance of a systematic investigation into the effects of context on imageability. One explanation for the relative absence of an effect of concreteness on understanding is that building texts from independent passages that are different in their imagery evokingness may not result in texts with the same average difference in their concreteness as the passages that built them. Putting two abstract passages together may help students form mental images that they could not create from either passage alone. Thus, the imagery evokingness of the two passages together might be higher than their average imagery evokingness. This means that passages might even each other out in their imagery evokingness or change in unpredictable ways when they are in a text.

In short, the results of the present studies suggest that in order to create texts with specific degrees of imagery evokingness for different groups of students we have to know much more about what makes texts more imageable and we have to take both student and text factors into account. It is important, for example, how much students are interested in the text or how well they know the words and expressions used by the texts. On the text side, in addition to the imagery evokingness of words used by the text, other text features, such as grammar, cues, and structure, probably have a role in imageability.

The problem of rating the imagery evokingness of texts

Experimenters cannot rely on their own judgment as to the imageability of a text. After developing apparent abstract and concrete versions of a text, the texts should be rated by a group of students similar to the experimental group. The rating process itself is quite easy if the experiment involves words, sentences or short paragraphs, but it can be rather problematic when the text is longer. As students usually have to learn from long texts, we also have to use long texts in our studies. There are basically two ways of creating long texts with known differences in imagery evokingness: rating short passages and building a longer text from them, as I did, or rating an entire long text. Both solutions have problems.

Because a text built from short passages might not have the average imagery evokingness of the short passages, it might seem to easier and methodologically more correct to have the whole text rated by the students, as Sadoski et al. (1993) did. Students in their study rated entire 110-265 word passages. But when students rate a longer passage it is very difficult to decide what exactly they are rating: Do they give an average rating of the whole passage? Rate the passage highly imagery evoking if there is something in it they can picture clearly, without taking other parts of the passages into account? If experimental subjects "rate" imagery differently than do the raters, a significant source of variance will be introduced into the experiment. In future studies, text features could be systematically changed and then texts rated by students to determine which features students respond to in rating imagery evokingness. Such changes in the text could involve, for example, the place of certain details within the text, the structure of the text, or the presence of vivid passages.

Without determining what makes a text easy or difficult to picture and on the basis of which features students rate the imagery evokingness of texts, creating concrete and abstract texts remains at least in part a matter of chance.

8. 6. Text imagery and Text Understanding

The studies described here explored the idea that text concreteness affects understanding. The results of the study suggest that the relationship between concreteness and understanding may work in both directions and that text features that affect imageability also affect comprehension. This has important implications for future research and for theories of text comprehension.

Wharton's experiment (1980, 1987) showed a causal relationship between text concreteness and text comprehension: Changing abstract words to their concrete synonyms resulted in better understanding of the text. Sadoski et al. (1993, 2000) asked students to rate both the imagery evokingness and the comprehensibility of texts. Their results showed a strong correlation between reported mental images evoked by texts and reported comprehensibility of texts. One purpose of the interview study of this dissertation was to see if students themselves see a relationship between mental images evoked by a text and understanding of the text. Students did in fact see relationships between understanding and picturing a text. Many of the reasons they mentioned for not being able to picture certain subjects or topics related to understanding a text, e.g., "the text is not good"; "cannot understand it"; "have never seen such a thing"; or the phenomena described by the text was a "long process." Second, students who reported that they did not understand a subject usually also reported that they could not picture it. There were very few exceptions. Students more often reported understanding a subject and not picturing it, which suggests that it is difficult to picture something without understanding it, but that there are ways of understanding subjects without picturing them. Third, in response to direct questions, most students said they could picture what they understood and that they could not picture what they did not understand. Only a handful said that they could picture what they did not understand. Fourth, many students believed that all subjects could be taught in a way that enabled everybody to picture them and that in this case they would not have to study by heart and it would be easier to understand material.

These results suggest that students see relationships between picturing and understanding a text, and they experience the relationship working in both directions: They can picture what they can understand, and they can understand what they can picture. To an extent, this finding supports Sadoski et al.'s (1993, 2000) results of strong correlations between text concreteness and text comprehension. My direct questions (e.g., Can you picture what you understand?) and indirect questions (e.g., Do you understand Physics? Can you picture Physics?) of students showed that they too see a strong connection between picturing and understanding.

The experiment, however, gave weak support for the presence of a causal relationship between text concreteness and text understanding, challenging Wharton's (1980, 1987) finding and also Sadoski and Paivio's (2001) view of the importance of text concreteness in text comprehension. In my experiment, text concreteness had a positive effect on only two of six questions.

These results are puzzling. When we ask students about the relationships between picturing a text and understanding that text (my interview method) or we ask them to rate the concreteness and comprehensibility of texts (Sadoski et al.'s method), the conclusion is that there is a relationship between the two. When we change the abstract words of a text to their concrete synonyms while leaving other text features the same (Wharton's method), understanding is better. But when we build up texts from independent passages (my method), the effect of text condition is weak. This suggests that differences in the methods used by different studies influence results in important ways.

The two experiments, mine and Wharton's, raise the most significant issues about the affect of method on outcome. They get to the heart of the question of the causal relationship between imageability and comprehension. There are two main differences between Wharton's and my study: how the abstract and concrete texts were developed and how understanding was measured. It should be noted here that Wharton (1980, 1987) did not report effect sizes, so it is impossible to tell how much imageability affected understanding in his study. Wharton changed abstract words in his texts to more imagery evoking synonyms while leaving all other text features the same. I built up my texts from short abstract and concrete passage pairs based on students' rating of the imagery evokingness of the passages. Although I considered this method analogous to Wharton's, there might be important differences.

By changing only words in texts, Wharton did not touch the structure of the text or add any cues. Connecting passages into a coherent text in my experiment could have resulted in texts that changed in their imagery evokingness relative to the passages they are built of (see the discussion in the previous section of the problem of the imagery evokingness of texts). Or, even if the imagery evokingness of the texts did not change, the comprehensibility of the passages might have. The idea comes from Marschark (1985), who found that the concreteness effect on recall of sentences disappeared when the sentences were in connected prose. He speculated that the concreteness effect disappeared because relational information among the sentences gave important information that affected recall.

Kintsch's (1994) work also suggests that changing the structure of a text or adding cues affects understanding. This might have happened in my experiment. Connecting the passages into a coherent final text—putting them into a meaningful structure and adding connecting sentences—might have added cues that influenced comprehensibility.

Another methodological difference between Wharton's and the present experiment was that Wharton measured understanding with both multiple choice questions and free recall ones. My experiment used only open ended questions. Multiple choice questions can often be answered just by relying on memory (e.g., Gardner, 1991) and test-taking skills. Multiple choice tests are less able to reveal real and complex understandings, but demand less motivation and interest from students. Open-ended questions can elicit more complex responses that show students' real understanding, but require greater motivation and interest from students to reveal differences in understanding. The responses of unmotivated and bored students may look pretty much the same regardless of their real understandings. In my experiment, students were not graded and might have been too lazy to recall and properly write down everything they knew about the questions. The three text condition groups may not have shown any difference in their answers, even if they had different understandings of the texts they read. Wharton's results lend support to this possibility. He obtained more straightforward results from multiple choice questions and found significant differences between the abstract and the concrete group with free recall only after revising his free recall scoring manual.

Another source of the difference in outcomes between my experiment and Wharton's might be differences in students' prior knowledge. In my experiment, the effect of text conditions seemed to be the strongest in case of new information. Although my intention was to eliminate prior knowledge by choosing a topic students had not studied at school, it was apparent from the results that students could have picked up information about Mars in their everyday lives. Many of their answers could not have come from the Mars text they read. Most questions that could not be answered on the basis of previous knowledge showed the expected result of a difference between the concrete and abstract groups, while questions that could be answered by drawing on prior knowledge did not show any differences among the groups.

Although earlier studies found a strong relationship between understanding and prior knowledge (e.g., Alao & Guthrie, 1999), as Kintsch & Kintsch (1995) suggest, when students have much prior knowledge of a topic, they tend not to read the text actively and fail to learn new information. Laziness and complacency can affect both learning and demonstrating understanding. It seems highly likely that students in my experiment were not motivated to do their best work and, when they could, drew on prior knowledge rather than seriously engage the text or the task. The role of prior knowledge and motivation in Wharton's study are unknown. In any case, the results of my experiment suggests that these should be addressed in future research and controlled for in any study of text/understanding relationships.

The results of the studies described in the present dissertation suggest that the relationship between concreteness and understanding may work in both directions: If we read a text that is more imagery evoking for us we can better understand it, and the better we understand a text or topic the easier we can picture it. From practical point of view this has two implications: We can create texts for certain groups of students that they can picture better and understand better, and we can get information about their understanding of a topic or text by asking about their mental images.

The relationship between text concreteness and text understanding seems more complicated than earlier studies suggest. Probably, not only the imagery evokingness of a text, but also other text and student factors determine how well students understand a text; these other factors may include: the presence of an especially powerful image, the context and structure of the text, prior knowledge, motivation, interest, and intelligence/ academic self concept. Future research should address the question of which features of texts, students, and circumstances affect the role of text concreteness in understanding.

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SUMMARY

For many years, teaching students to acquire a deep understanding of material has been one of the main goals of schools. Yet, many students have serious difficulties comprehending basic texts and using the material they study (PISA study, OECD, 2001). Even at college level, many students cannot grasp the basic concepts of their field (e.g., Gardner, 1991; Ramsden, 1988). The motivation behind the present dissertation was to identify ways to help students better understand the material they read. Its main focus was the relationships between learning approach, the imagery evokingness of texts, and understanding.

Theoretical Context

The theoretical basis of the dissertation is located at a point where the orientation to studying tradition within the learning styles literature and theories of cognition in reading meet. Both fields address relationships among learning approaches, mental imagery, and understanding, take student and situational factors into account, and emphasize the importance of matching students and situations. The orientation to studying tradition approaches text understanding mostly from the student side, making a distinction between deep learners (who concentrate on the meaning of the text) and surface learners (who concentrate on the text itself). The reading literature approaches text understanding from the side of the text and seeks to identify text characteristics associated with comprehensibility.

A number of studies in the orientation to studying tradition address internal factors (e.g., personality, motivation, and metacognitive knowledge) and external factors (e.g., assessment, teaching styles, text features) that influence the choice of a learning approach. A review of the literature suggested that many factors together determine if a student uses a deep or a surface approach to learning. A deep approach seems to be very sensitive to disturbing events and difficult to ensure.

Researchers in the cognitive theories of reading field are mostly interested in features that make texts more comprehensible. The dissertation draws on two cognitive theories of comprehension for interpreting its results: Kintsch's

Propositional Theory (1994) and Paivio's Dual Coding Theory (Sadoski & Paivio, 2001). Both theories acknowledge the importance of mental images, clearly organized texts, and prior knowledge in understanding. Kintsch emphasizes the importance of prior knowledge and text organization, while Sadoski and Paivio emphasize the importance of mental imagery.

The main concerns, many concepts, and some research of the orientation to studying tradition and theories of cognition in reading overlap. For example, both fields see deep understanding as an active process that involves connecting new information to prior knowledge. Also, both mention many similar variables that affect deep understanding (e.g., prior knowledge, comprehension strategies, metacognitive strategies, motivation, and text variables). Thus, integrating the knowledge of the two fields seems to be fruitful. The integration can give new ideas for research and provide a more complex view of deep understanding.

The present dissertation identified one important connection between the orientation to studying tradition and cognitive theories of comprehension. It argued that if a text is too difficult to understand even deep learners will not be able to comprehend it unless they have endless time and motivation. The more comprehensible a text is, the greater chance students have to understand it, and the less circumstances (e.g., fatigue, lack of time) will disturb the process of understanding. The present research showed that integration of the two fields is not only promising, but also necessary. An adequate explanation for the results was possible only with ideas drawn from both fields.

Research

The research reported here consisted of two studies: an exploratory interview study and an experiment accompanied by a preliminary study that developed texts that differed only in imagery evokingness. The foci of the interview study were: examining the circumstances under which a group of elementary/middle school Hungarian students use the surface learning strategy, studying by heart, with special attention to the text as a factor; examining whether students form mental images while reading all texts or only while reading certain texts; and examining whether students see relationships between understanding and picturing a text. Also, the ASI, Approaches to Studying Inventory (Entwistle & Ramsden, 1983), was administered to measure learning styles in order to see if there was a relationship between students' interview responses and their scores on the questionnaire.

The experiment examined the effect of text concreteness on text understanding as shown in answers to essay-type questions about a short science text and relationships between learning approach (as measured by the ASI) and grades to text understanding in a second group of elementary/middle school Hungarian students. The experiment had three hypotheses: 1) students who read a concrete text understand the text better than students who read an equivalent but abstract text; 2) students with a deep approach understand a text better than students with a surface approach; 3) students with higher school grades understand a text better than students with lower school grades.

Results

The interview study found that students use different learning approaches in different situations. That is, students are not consistent in their learning styles; rather, they seem to judge the demands of each learning situation, and even though they know the disadvantages of studying by heart, they consciously chose it in order to get better grades and avoid punishment in class. Their most common reason for studying by heart was not understanding the material. There was no relationship between whether students reported using a surface approach and their scores on the ASI.

Most students reported forming mental images while reading novels they liked, but reports of forming mental images of textbooks varied across students and situations: Certain subjects are easier to picture for many students and also students differ in the subjects they can picture. The interview study supports the idea that there is a relationship between text concreteness and text understanding. It also suggests that the relationship may work in both directions. According to students' answers they can understand what they can picture and they can picture what they can understand.

The experiment, however, gave weak support for the idea that text concreteness has an effect on understanding, thus challenging findings of earlier research (Sadoski et al., 1993, 2000; Wharton, 1980, 1987). Only two of six short-essay questions showed a concreteness effect on understanding. An analysis of the texts and responses suggested that not only the imagery evokingness of a text, but also other text and student factors, such as the context and structure of the text and prior knowledge, determine text understanding. The concreteness effect may be severely attenuated by these factors.

The experiment gave weak support for the idea that deep learners understand texts better than surface learners. Learning approach did not have an important role in students' understanding of the experimental text. Deep learning scores on the ASI were positively associated with understanding in only two questions and surface scores were negatively associated with understanding in only one question.

The results of the experiment offer support for the idea that school grades as a measurement of intelligence and academic self concept has an effect on understanding. Students who had higher grades understood the text better than students with lower grades. In the present experiment school grades explained more of the results (had more to do with understanding) than text concreteness or learning approach did.

Conclusions and Implications of the Studies

The fact that not text concreteness or learning approaches but grades had the biggest effect on understanding was surprising. It suggests that student variables associated with grades (e.g., general intelligence, motivation, self-concept) may matter more to understanding than learning style, which has received much attention by researchers, or text concreteness, the focus of this dissertation. This conclusion, however, is attenuated by three considerations: the serious question the dissertation raises about the validity and reliability of the ASI as a measure of learning style, at least with Hungarian middle school students; the problems with creating Hungarian texts that differ only in imagery evokingness; and the complexity of the relationship between text features and understanding that this dissertation has identified.

Both the results of the interview and the experiment suggest that the validity and reliability of the Hungarian version of the Approaches to Studying Inventory for elementary/middle school students is questionable. The interview study found no relationship between reported studying by heart and ASI scores. In the experiment, the only moderate levels of the internal reliability of the ASI scales could account for the weak relationship between ASI scores and understanding. This suggests that the Hungarian version of the ASI does not measure what students think they do in learning situations.

The absence of a strong relationship between imagery evokingness and understanding may be due not only to the complexity of the relationship between text features and understanding, but also to difficulties in creating texts that differ only in imagery evokingness. Creating texts with different imagery evokingness is much more complicated than earlier studies suggested. It seems that whether a text evokes images or not depends on both the text and the student. From the student side, interest in the text, motivation, and prior knowledge of the topic, on the text side, the number of abstract and concrete words in the text, the structure of the text and the cues (rhetorical, semantical, etc.) presented in the text seem to be important. In order to better test hypotheses about the effect of imagery evokingness on understanding, it is necessary to gain a better understanding of the factors determining the imagery evokingness of texts. The theoretical work of integrating Kintsch (1994) on text features and Sadoski and Paivio (2001) on imagery evokingness and the work in integrating literature on learning styles and reading theories undertaken in this dissertation offer starting points for such research.

SAMENVATTING

Eén van de belangrijkste doelen van scholen is jarenlang geweest om leerlingen een diepgaand begrip van leerstof bij te brengen. Toch hebben veel leerlingen serieuze problemen met het begrijpen van teksten op basisniveau en met de toepassing van de leerstof die ze bestuderen (PISA onderzoek, OECD, 2001). Zelfs op universitair niveau kunnen veel studenten de basisconcepten van hun gebied niet volledig bevatten (bijv. Gardner, 1991; Ramsden, 1988). De motivatie achter dit proefschrift was om manieren te vinden die leerlingen helpen het materiaal dat ze lezen beter te kunnen begrijpen. Het belangrijkste punt was de relatie tussen de leerstrategie, de mate waarin teksten beelden oproepen en tekstbegrip.

Theoretische Context

De theoretische basis van dit proefschrift is het raakvlak van de literatuur over het vigerende onderzoek betreffende leerstijlen en theorieën van cognitieve processen bij het lezen. Beide terreinen behandelen relaties tussen leerstrategieën, mentale beelden en tekstbegrip, houden rekening met de student en situationele factoren, en benadrukken het belang van het op elkaar afstemmen van leerlingen en omstandigheden. Het onderzoek naar leerstijlen en –strategieën benadert tekstbegrip vooral van de kant van de student, waarbij het een onderscheid maakt tussen leerlingen met een diepgaande benadering (die zich concentreren op de betekenis van de tekst) en leerlingen met een oppervlakte benadering (die zich concentreren op de tekst zelf). De literatuur over cognitieve processen bij lezen benadert tekstbegrip vanuit de kant van de tekst en probeert de eigenschappen van een tekst te identificeren die verband houden met begrijpbaarheid.

Een aantal onderzoeken naar leerstijlen en –strategieën behandelt interne factoren (bijv. persoonlijkheid, motivatie en metacognitieve kennis) en externe factoren (bijv. waardering, leermethodes, teksteigenschappen) die de keuze van leerstrategie beïnvloeden. Uit een overzicht van de betreffende literatuur komt naar voren dat veel factoren samen bepalen of een student een diepgaande of een oppervlakte benadering voor het leren gebruikt. Een diepgaande benadering schijnt erg gevoelig voor verstorende gebeurtenissen en moeilijk te garanderen te zijn.

Cognitief theoretisch georiënteerde onderzoekers van het lezen zijn voornamelijk geïnteresseerd in kenmerken die een tekst beter begrijpbaar maken. Het proefschrift maakt gebruik van twee cognitieve theorieën van tekstbegrip bij het interpreteren van de resultaten: Kintsch' *Propositional Theory* (1994) en Paivio's *Dual Coding Theory* (Sadoski & Paivio, 2001). Beide theorieën erkennen het belang voor tekstbegrip van mentale beelden, tekststructuur en voorkennis. Kintsch benadrukt het belang van voorkennis en tekststructuur, terwijl Sadoski en Paivio de nadruk leggen op het belang van mentale beelden.

De belangrijkste onderwerpen, veel concepten en enig onderzoek in de leerstijltraditie en cognitieve leestheorieën overlappen elkaar. Zo zien beide terreinen diepgaand begrip als een actief proces dat het verbinden van nieuwe informatie aan voorkennis omvat. Ook noemen beide veel dezelfde variabelen die diepgaand begrip beïnvloeden (bijvoorbeeld voorkennis, begripsstrategieën, metacognitieve strategieën, motivatie en tekstkenmerken). Het lijkt er dus op dat integratie van de kennis van beide terreinen vruchtbaar zou kunnen zijn. De integratie kan nieuwe ideeën geven voor onderzoek en een complexer idee van diepgaand begrip opleveren.

Dit proefschrift heeft één belangrijke overeenkomst tussen beide onderzoekstradities geïdentificeerd. In het proefschrift wordt betoogd dat als een tekst te moeilijk te begrijpen is, zelfs leerlingen met een diepgaande leerstrategie niet in staat zullen zijn de tekst te begrijpen tenzij ze eindeloze tijd en motivatie hebben. Hoe beter begrijpbaar een tekst is, hoe groter de kans is dat leerlingen hem begrijpen, en hoe minder de omstandigheden (bijv. moeheid, tijdgebrek) het proces van begrijpen zullen verstoren. Dit onderzoek heeft aangetoond dat integratie van de twee terreinen niet alleen veelbelovend, maar ook noodzakelijk is. Een adequate verklaring voor de resultaten was alleen mogelijk met ideeën ontleend aan beide terreinen.

Onderzoek

Het onderzoek waar hier verslag van wordt uitgebracht bestond uit twee onderzoeken: een exploratief interviewonderzoek en een experiment, vergezeld van een pilot-onderzoek waarin teksten werden ontwikkeld die alleen verschilden wat betreft de mate waarin ze beelden opriepen. De aandachtspunten van het interviewonderzoek waren: het onderzoek naar de omstandigheden waaronder een groep van Hongaarse leerlingen van de lagere school en het voortgezet onderwijst de oppervlakte-leerstrategie – uit het hoofd leren – gebruiken, met speciale aandacht voor de tekst als een factor; onderzoeken of leerlingen mentale beelden vormen bij het lezen van alle teksten of slechts bij het lezen van bepaalde teksten; en onderzoeken of leerlingen verbanden zien tussen het begrijpen en het zich voorstellen van een tekst. Ook is de ASI, *Approaches to Studying Inventory* (Entwistle & Ramsden, 1983) toegepast om leerstijlen te meten, om te zien of er een relatie bestond tussen de reacties van leerlingen bij interviews en hun scores op de vragenlijst.

In het experiment werd onderzocht wat het effect van de concreetheid van een tekst op tekstbegrip is, zoals zichtbaar wordt in de antwoorden op essayvragen over een korte natuurkundetekst, en de verbanden tussen leerstrategie (zoals gemeten door de ASI) en cijfers voor tekstbegrip in een tweede groep Hongaarse leerlingen van een lagere school en een school voor voortgezet onderwijs. Het experiment had drie hypothesen: 1) leerlingen die een concrete tekst lezen, begrijpen de tekst beter dan leerlingen die een gelijkwaardige maar abstracte tekst lezen; 2) leerlingen met een diepgaande benadering begrijpen een tekst beter dan leerlingen met een oppervlakte benadering; 3) studenten met hogere schoolcijfers begrijpen een tekst beter dan leerlingen met lagere schoolcijfers.

Resultaten

Uit het interviewonderzoek bleek dat leerlingen verschillende leerstrategieën gebruiken in verschillende situaties. Dat wil zeggen dat leerlingen niet consistent zijn in hun leerstijlen; ze beoordelen eerder de eisen van elke leersituatie, en hoewel ze de nadelen van uit het hoofd leren kennen, kiezen ze er toch bewust voor om betere cijfers te krijgen en straf in de klas te voorkomen. Hun meest voorkomende reden om iets uit het hoofd te leren was dat ze het materiaal niet begrepen. Er was geen verband tussen de scores op de ASI en het gebruik van oppervlakte-strategieën zoals die uit het interview naar voren kwam.

De meeste leerlingen gaven aan dat ze mentale beelden vormen als ze romans die ze leuk vinden lazen, maar meldingen van het vormen van mentale beelden van tekstboeken varieerden van leerling tot leerling en per situatie: bepaalde onderwerpen zijn gemakkelijker voor te stellen voor veel leerlingen, en bovendien verschillen leerlingen in de onderwerpen die ze zich kunnen voorstellen. Het interviewonderzoek ondersteunt het idee dat er een verband bestaat tussen de concreetheid van een tekst en tekstbegrip. Het suggereert ook dat het verband in beide richtingen kan werken. Volgens de antwoorden van leerlingen kunnen ze begrijpen wat ze zich kunnen voorstellen en kunnen ze zich voorstellen wat ze kunnen begrijpen.

Het experiment gaf daarentegen slechts weinig steun voor het idee dat de concreetheid van een tekst effect heeft op het begrip ervan en gaat aldus in tegen de resultaten van eerder onderzoek (Sadoski et al., 1993, 2000; Wharton, 1980, 1987). Slechts bij twee van zes korte essayvragen was er een effect van concreetheid op tekstbegrip. Een analyse van de teksten en antwoorden suggereerde dat niet alleen de mate waarin een tekst beelden oproept, maar ook andere factoren in de tekst en van de leerling, zoals de context en de structuur van een tekst en voorkennis, het tekstbegrip bepalen. Het effect van de concreetheid kan ernstig worden afgezwakt door deze factoren.

Het experiment gaf weinig steun voor het idee dat leerlingen met een dieptestrategie teksten beter begrijpen dan leerlingen met een oppervlaktestrategie. Leerstrategieën speelden geen belangrijke rol in het begrijpen van de tekst in het experiment. De scores voor diepgaand leren op de ASI hadden bij slechts twee vragen een positief verband met tekstbegrip, en scores voor oppervlakte leren hadden slechts met één vraag een negatief verband.

De resultaten van het experiment ondersteunen het idee dat schoolcijfers als maat voor intelligentie en zelfconcept een effect hebben op tekstbegrip. Leerlingen die hogere cijfers haalden, begrepen de tekst beter dan leerlingen met lagere cijfers. In dit experiment verklaarden schoolresultaten meer van de resultaten (ze hadden meer te maken met tekstbegrip) dan de concreetheid van een tekst of leerstrategieën.

Conclusies en Discussie

Het feit dat niet de concreetheid van een tekst of leerstrateggieën, maar schoolcijfers het grootste effect hadden op tekstbegrip was verrassend. Het suggereert dat variabelen van leerlingen geassocieerd met cijfers (bijv. algemene intelligentie, motivatie, zelfbeeld) meer met tekstbegrip te maken kunnen hebben dan leerstijl, waarnaar veel aandacht is uitgegaan door onderzoekers, of concreetheid van een tekst, het aandachtspunt van dit proefschrift. Deze conclusie wordt echter afgezwakt door drie overwegingen: de twijfel die het proefschrift oproept over de geldigheid en betrouwbaarheid van de ASI als maat voor leerstijl, in ieder geval betreffende Hongaarse leerlingen in het voortgezet onderwijs; de problemen met het schrijven van Hongaarse teksten die alleen verschillen wat betreft de mate waarin zij beelden oproepen; en de complexiteit van de relaties tussen tekstkenmerken en tekstbegrip die dit proefschrift heeft geïdentificeerd.

Zowel de resultaten van het interview als die van het experiment suggereren dat de geldigheid en betrouwbaarheid van de Hongaarse versie van de *Approaches to Studying Inventory* voor leerlingen van de lagere school en het voortgezet onderwijs twijfelachtig zijn. Het interview-onderzoek vond geen verband tussen uit het hoofd leren en ASI scores. In het experiment kan de slechts matige interne betrouwbaarheid van de ASI-schaal de zwakke relatie tussen de ASI scores en tekstbegrip verklaren. Dit suggereert dat de Hongaarse versie van de ASI niet meet wat leerlingen denken dat ze doen in leersituaties.

De afwezigheid van een sterke relatie tussen de mate waarin een tekst beelden oproept en tekstbegrip kan niet alleen liggen aan de complexiteit van de relatie tussen tekstkenmerken en tekstbegrip, maar ook aan moeilijkheden met het maken van teksten die alleen verschillen in de mate waarin ze beelden oproepen. Het maken van teksten waarin dit verschilt ligt veel gecompliceerder dan eerdere onderzoeken suggereerden. Het lijkt erop dat het zowel van de tekst als van de leerling afhangt of een tekst beelden oproept of niet. Van de kant van de leerling lijken interesse in de tekst, motivatie en voorkennis van het onderwerp van belang te zijn; van de kant van de tekst hangt dit af van het aantal abstracte en concrete woorden in de tekst, de tekststructuur en de aanwijzingen (retorisch, semantisch, et cetera) die in de tekst naar voren worden gebracht. Om hypothesen betreffende het effect van de mate waarin een tekst beelden oproept op tekstbegrip beter te kunnen onderzoeken, is het nodig om een beter begrip te verwerven van de factoren die de mate waarin een tekst beelden oproept bepalen. Het theoretische werk van het integreren van Kintsch (1994) over teksteigenschappen en Sadoski en Paivio (2001) over de mate waarin een tekst beelden oproept en het integreren van literatuur over leerstijlen en leestheorieën die in dit proefschrift zijn ondernomen, bieden een startpunt voor dergelijk onderzoek.

APPENDIX A
INTERVIEW PROTOCOL

[Freely translated from the original Hungarian.]

1. Is it difficult for you to study?
2. What are your most difficult subjects? Why?
3. What are your easiest subjects? Why?
4. How many hours a day do you study?
5. How do you know when you have learned a text?
6. Do you usually check if you know it or not?
7. How do you check?
8. Are there any differences between studying by heart and studying word by word?

8/a. Is there any difference between picturing and imaging something?

9. Do you understand Literature (History, Geography, Biology, Physics, Chemistry, Math, and Foreign language)?
10. What do you do when you don't understand something?
11. If nobody is at home or you don't happen to find the answer to your questions, do you study what you don't understand?
12. If yes, why do you study what you don't understand?
13. What would happen if you showed up in class and said to the teacher that you could not study because you could not understand the material?
14. How do you study what you don't understand?
15. How do you know that you understand/don't understand a text?
16. Can you determine from someone's answer to a teacher's question if he understands a text or just learned it by heart
17. If yes how? What are the signs?

17/a. Does the teacher notice it?

18. How do you study a text if your goal is to prepare for the text next day? To understand a text? To use the knowledge later?
19. Do you study by heart? (if yes) When?
20. When do you study with understanding?

21. Do you think about what you are reading while reading?
22. If yes, how do you think about what you are reading?
23. Do you picture what you read?
24. Is it like a movie?
25. What about History? Do you picture what you read when you are reading a History book? (then, Literature, History, Geography, Biology, Physics, Chemistry, Math, and Foreign Language)

25/a. What makes it difficult to picture texts in Literature, History, Geography, Biology, Physics, Chemistry, Math, and Foreign Language?

26. Do you think about what the teacher says?
27. Do you usually think of examples?
28. Can the things you study in school be used in life?
29. Is it possible to teach every subject in a way that every student could picture it?
30. What would happen if all subjects were taught in a way that everyone could picture them?
31. Can you picture what you understand?
32. Can you picture what you do not understand?
33. Are there any differences between studying by heart and studying word by word?
34. If you were the school director, what would you change?
35. What do you think of studying by heart? Is it good or bad?
36. Do you know when you are studying by heart?

APPENDIX B
THE HUNGARIAN VERSION OF THE APPROACHES TO STUDYING INVENTORY (ENTWISTLE & KOZÉKI, 1985; KOZÉKI & ENTWISTLE, 1986)

[Freely translated from the original Hungarian.]

a: totally agree
b: partly agree
c: undecided
d: mostly disagree
e: totally disagree

1. I always try to connect what I study to topics we have studied in other subjects.
2. While reading I often can practically see what I read.
3. I'm interested in certain subjects so much that I would like to do something with them after finishing school.
4. To be well-prepared, I have to study lots of things word by word (by heart).
5. I like study everything in the way that I chunk it up into small parts and study the parts one after the other.
6. I think I am more interested in finishing school successfully than in what I am learning.
7. I am very nervous while answering the teacher's questions.
8. I can organize my study time very well.
9. I can't admit defeat even in small things.
10. If I have to do something, I think I have to do it very well.
11. I always try to understand things, even if it seems difficult at the beginning.
12. I like playing around with my thoughts, even if they don't lead to specific results.
13. Some school activities are really very interesting.

14. If I read a book I can't spend time thinking about what it is about.
15. In problem-solving I rather follow the ways that are already tried than unknown new ways.
16. I mainly study to be able to get a good job for myself.
17. I am very nervous when teachers evaluate my work.
18. I usually don't run out of time when I complete written assignments.
19. I very much enjoy competing with other students at school.
20. I consider as my duty working hard at school.
21. I often ask questions of myself about what I have read or heard in class.
22. I like doing things in which I can use my own ideas and imagination.
23. I mainly study to find out more about subjects I am really interested in.
24. I understand the concepts best if I remember definitions in the textbook word by word.
25. In my opinion, problems always have to be analyzed carefully and logically without depending on our intuition.
26. When I work hard, I only do it to be able to study further.
27. I always worry that I can't keep up with my work.
28. I always organize my work carefully.
29. It is very important for me to do everything better than the others, whenever I can.
30. I don't mind even having to work long in order to complete my work.
31. I try to connect what I read to my personal experience.
32. I like when teachers give many vivid examples and examples from personal experiences to help us understand the material.
33. I spend most of my free time dealing with interesting topics I have learned about.
34. I like having precise explanations of written assignments.
35. I always stick with a solution until it really proves to be a bad one.
36. If I work hard, it is only in order not to leave my parents in trouble.
37. Somehow I can never do my work as well as I think I should be able to.
38. If I have done something wrong, I always try to figure out why so that I am able to do better in the future.

39. If I really want something I can be very assertive.
40. If I have started something, I continue even if I find it very difficult.
41. I like to take my own notes whenever I can.
42. I think I tend to draw conclusions too early.
43. I meet topics at school that are wonderfully interesting.
44. I only write down something in class when the teacher tells us to.
45. I like the teacher to stay on the topic and not digress.
46. I suppose I go to school because I don't have any other possibility.
47. Others somehow always to do things better than me.
48. If the circumstances are not good for studying I always try to improve them.
49. I am always very nervous before an exam or when answering teachers' questions, but the nervousness helps me to do better.
50. I always take my job seriously whatever it is.
51. To understand what I am learning about I try to connect it to my everyday experience.
52. In written assignments I always try to relate my own opinion.
53. I like and enjoy a lots of things in school.
54. I usually read only what I have to.
55. If I explain something I try to go into detail.
56. I work hard only if the teacher really specifically requires me to.
57. Many times I can't fall asleep because I am worried about school matters.
58. I carefully plan my study time so that I can use it to best advantage.
59. I participate in all games to win not only for pleasure.
60. I finish my work even if I am tired.

APPENDIX C
READABILITY OF THE PASSAGES OF THE PRELIMINARY STUDY

Number of sentences, words and syllabi per passages

Passage	Abstract			Concrete		
	Sentence	Word	Syllabus	Sentence	Word	Syllabus
I/1	3	30	65	3	31	64
I/2	1	22	48	1	23	46
I/3	2	31	69	2	34	66
I/4	3	29	55	3	29	54
I/5	1	11	33	1	12	34
I/6	3	23	60	3	23	59
I/7	2	17	52	2	18	54
I/8	3	23	58	3	22	57
I/9	2	23	56	2	24	57
I/10	2	35	76	2	35	75
I/11	1	9	20	1	9	19
I/12	4	45	114	4	45	113
I/13	3	33	76	3	34	75
I/14	2	15	36	2	16	36
I/15	2	27	68	2	28	68
I/16	2	24	62	2	26	62
I/17	3	36	75	3	35	74
I/18	2	20	50	2	20	48
I/19	6	68	144	6	70	145
I/20	2	24	47	2	23	46
I/21	1	5	13	1	5	13
I/22	1	21	51	1	21	52
II/1	2	43	101	2	43	101
II/2	3	49	130	3	51	130
II/3	3	44	103	3	44	100
II/4	4	44	109	4	44	108
II/5	2	44	109	2	44	110
II/6	2	41	101	2	41	102
II/7	3	46	113	2	46	113
II/8	3	59	125	3	59	124
II/9	4	64	141	4	64	171
II/10	2	31	64	2	31	66
II/11	3	51	129	3	51	128
II/12	2	39	101	2	40	101
II/13	3	61	143	3	61	144
II/14	2	37	91	2	37	90
II/15	2	40	103	2	41	102
II/16	4	47	117	4	48	116
II/17	3	51	109	3	52	109
II/18	3	41	105	3	41	105
Mean	2.55	36.11	86.49	2.58	36.56	85.93

APPENDIX D
MEANS, STANDARD DEVIATIONS, AND T-TEST RESULTS OF PASSAGE RATINGS BY TEXT TYPE

Table D.1.
Means (SD), and t-tests (t-values, significance, and effect size) of Passage Ratings by Text Type for the First 22 Passages

	Mean (SD)					
Var.	abstract	concrete	t	p<	d	R
I/1	3.28 (1.06)	3.17 (1.07)	.34	.732	0.10	.001
I/2	3.00 (1.22)	3.88 (1.05)	-2.71	.009	-0.78	.135
I/3	3.60 (.99)	3.77 (1.11)	-.53	.597	-0.15	.006
I/4	3.52 (1.33)	4.38 (.82)	-2.72*	.010	-0.78	.134
I/5	4.17 (1.09)	4.48 (.92)	-1.09	.281	-0.31	.025
I/6	3.38 (1.21)	4.12 (78)	-2.55*	.015	-0.74	.123
I/7	4.12 (.93)	4.00 (1.06)	.42	.675	0.12	.004
I/8	4.09 (1.04)	2.96 (1.22)	3.46	.001	0.99	.203
I/9	3.96 (1.36)	3.08 (1.32)	2.29	.027	0.66	.100
I/10	2.17 (1.03)	3.42 (1.33)	-3.64	.001	-1.04	.220
I/11	4.20 (1.15)	4.17 (1.01)	.11	.915	0.02	.000
I/12	2.33 (1.09)	3.24 (1.01)	-3.02	.004	-0.89	.162
I/13	3.09 (1.20)	3.38 (1.30)	-.83	.411	-0.24	.014
I/14	3.68 (1.03)	4.33 (.82)	-2.46	.018	-0.70	.114
I/15	3.42 (.99)	3.52 (1.38)	-.29	.773	0.08	.002
I/16	3.85 (1.05)	4.26 (1.01)	-1.41	.166	-0.40	.040
I/17	3.68 (1.22)	4.25 (.94)	-1.83	.074	-0.52	.066
I/18	3.58 (1.17)	4.13 (1.14)	-1.67	.101	-0.48	.056
I/19	2.44 (1.04)	2.88 (1.15)	-1.39	.173	-0.40	.039
I/20	3.13 (1.19)	3.40 (1.19)	-.81	.423	-0.23	.014
I/21	3.92 (1.44)	4.13 (1.23)	-.54	.595	-0.16	.006
I/22	3.46 (1.03)	3.61 (1.20)	-.46	.645	-0.13	.005

N abstract = 21 Nconcrete = 20
*= equal variances not assumed

Table D.2.
Means (SD), and t-tests (t-values, significance, and effect size) of Passage Ratings by Text Type for the Second 18 Passages

	Mean (SD)					
Var.	abstract	concrete	t	p<	d	R
II/1	3.81 (1.29)	4.65 (.75)	-2.57*	.015	-.78	.142
II/2	3.24 (1.37)	4.05 (1.10)	-2.08	.044	-.65	.100
II/3	3.60 (1.10)	4.05 (1.07)	-1.32	.194	-.54	.043
II/4	3.53 (1.22)	3.14 (1.36)	.96	.342	.30	.023
II/5	2.18 (1.14)	4.05 (1.08)	-5.37	.000	-1.68	.425
II/6	2.50 (1.19)	3.42 (1.39)	-2.29	.027	-1.09	.119
II/7	2.84 (1.54)	3.09 (1.34)	-.55	.583	-.17	.008
II/8	2.70 (1.46)	3.44 (1.54)	-1.59	.120	-.50	.061
II/9	2.76 (1.26)	3.35 (1.23)	-1.51	.138	-.47	.055
II/10	2.95 (1.28)	3.86 (1.24)	-2.31	.026	-.73	.121
II/11	3.00 (1.17)	3.05 (1.28)	-.12	.902	-.04	.000
II/12	3.47 (1.43)	3.73 (1.32)	-.59	.558	-.18	.009
II/13	3.67 (1.28)	3.55 (1.23)	.30	.768	.10	.002
II/14	3.09 (1.15)	3.58 (1.43)	-1.21	.233	-.38	.036
II/15	3.42 (1.07)	4.59 (.59)	-4.24*	.000	-1.38	.333
II/16	2.00 (1.11)	3.41 (1.40)	-3.53	.001	-1.11	.242
II/17	3.85 (1.09)	4.05 (1.40)	-.50	.617	-.16	.006
II/18	3.09 (1.02)	2.58 (1.30)	1.41	.167	.44	.048

Nabstract = 24 Nconcrete = 25
* = equal variances not assumed
mean abstract: 3.09
mean concrete: 3.65

APPENDIX E
PASSAGE PAIRS WITH SIGNIFICANT DIFFERENCES IN IMAGERY RATINGS

ABSZTRAKT	KONKRÉT
1. I/2.A Marson ha az állat testtömegéhez viszonyított izomtömege ugyanakkora mint az emberé, több mint kétszer olyan ugrásmagasságot érhet el, mint az ember.	1. I/2.A Marson ha az állat ugyanakkora és ugyanannyi izma van mint az embereknek, több mint kétszer olyan magasra bír felugrani, mint az emberek.
2. I/4.Csak akkor gyorsabb a marslakó, ha egyik sem változtatja meg lakhelyét. Ne feledje, a Marson az ember ugrása is nagyobb. Persze, a szkafander súlyát sem lehet figyelmen kívül hagyni…	2. I/4.Csak akkor gyorsabb a marslakó, ha mindenki a saját bolygóján marad. Ne feledje, a Marson az ember is nagyobbat ugrik. Persze az űrruha is nehéz, ezt is vegyük figyelembe...
3. I/6.Több kiszáradt folyómederre emlékeztető kanyon és völgy is található. A Mars egyenlítői övezetét vulkánok jellemzik. A legnagyobb magassága a Mount Everestének a kétszerese.	3. I/6.Kanyonok és völgyek húzódnak, amik kiszáradt folyókra hasonlítanak. A Mars egyenlítője környékén sok vulkán magasodik. A legmagasabb a Mount Everestnél kétszerte magasabbra nyúlik
4. I/8.A Mars felszín kb két harmadát vöröses rozsdabarna területek takarják. A túlélés szempontjából a rejtőzködés kiemelkedő fontosságú lehet. Az állat színe vöröses barna.	4. I/8.A felszín kb két harmadát vöröses rozsdabarna anyagok alkotják. Ahhoz, hogy életben maradhasson, sokszor feltétlenül muszáj elrejtőznie. Legyen a színe vörösesbarna.

5. I/9.A Marson még szabálytalan mintázatú sötétebb területek is találhatók. A Mars sötét területei között futó vonalak, az úgynevezett "csatornák", bár nem tartalmaznak vizet.	5. I/9.A Marson még sötétebb területek is vannak, ezek szabálytalan alakúak. A Mars sötét területei között vonalakat láthatunk, ezeket hívják "csatornáknak", bár nincs bennük víz.
6. I/10.Ha minden úgyis csupán három színt mutat, akkor a szereplőim látószerve elég, ha a formák érzékelésére alkalmas, de a színekére nem. Vagy segítségükkel csak a vörös és a szürke színek érzékelése lehetséges, másra nincs szükségük.	6. I/10.Ha minden úgyis vörös, szürke vagy barna, akkor szereplőim színvakok is lehetnek, elég ha csak fekete-fehérben láthatják a tárgyak alakjait. Vagy szemükkel csak a vörös és a szürke színeket tudják megkülönböztetni, másra úgysincs szükségük.
7. I/12.A légkör a Marson sokkal ritkább, mint a Földi. Legfőbb összetevői: széndioxid, kevés nitrogénnel, még kevesebb oxigénnel, és más anyagokkal. Tehát az állat légzőszerve vagy annak működése különbözik az emberétől, ha egyáltalán rendelkezik ilyennel. A légkör magas széndioxid tartalma miatt felmerül széndioxid használatának lehetősége.	7. I/12.A marsi levegő sokkal ritkább, mint a földi. Leginkább széndioxidot tartalmaz, kevés nitrogénnel, még kevesebb oxigénnel és más anyagokkal. Tehát állatunk másképpen lélegzik, vagy tüdeje működik máshogyan, mint az emberé, ha egyáltalán fejlődött tüdeje. Mivel a légkörben rengeteg széndioxid található, lehetséges, hogy széndioxidot lélegzik be.
8. I/14.A marslakók számára a százszoros földi nyomás lenne kibírhatatlan. Így számukra a Földön szükséges szkafander.	8. I/14.Marslakóim nem maradnának életben a százszor nagyobb földi nyomáson. Ezért nekik a Földön kell űrruhát hordani.

9. II/1.Galilei tette azt az adott körülmények között meglepő kijelentést, hogy a testek egyformán esnek, mely megállapítását bizonyítani is tudta híres kísérleteivel. Nem adta meg viszont a szabadon eső testek mozgásának okát, mivel a szabadesés változó mozgás, milyen az az erő, amelyik ezt létrehozza.	9. II/1.Galilei bizonyította kísérleteivel, hogy ha különböző nagyságú tárgyakat ugyanolyan magasról egyszerre ejtünk le, akkor ezek a tárgyak egyszerre fognak földet érni. De nem tudta megmagyarázni, hogy ez miért történik, mert abban az időben nem ismerték, hogy miféle erő mozgatja a szabadon eső tárgyakat.
10. II/2.A XVII-XVIII. századra az égitestek mozgásának vizsgálata elterjedté vált. Ekkorra már teret hódított a heliocentrikus világkép, azaz a bolygók pályájának a Nap, mint központi égitest köré való helyezése. A bolygók pályaadatainak megfigyelései még mindig nem voltak elég pontosak ennek egyértelmű igazolásához, de eléggé kezelhetővé tette a bolygók mozgásának megfigyelését.	10. II/2.A XVII-XVIII. században eléggé sokan vizsgálták az égitestek mozgását. Ekkoriban már legtöbben úgy gondolták, hogy a világegyetem középpontjában a Nap áll, körülötte keringenek a bolygók (heliocentrikus világkép). Ezt bebizonyítani nem lehetett, mivel még nem voltak képesek kiszámítani, hogyan keringenek a bolygók, de a Nap középpontba állítása érthetővé tette a csillagászok megfigyeléseit.
11. II/5.A tüdőben levő érzékelő sejtek számára az ingert a tüdő feszülése jelenti, az így keletkező ingerületet a kilégzőközpontba jut, melynek eredménye a légzőizmok elernyedése lesz. Kilégzés közben csökken a tüdő feszessége, viszont nő a vér széndioxid tartalma, ezért ismét a belégzőközpont aktivitása fog fokozódni.	11. II/5.Ha a tüdő megtelik levegővel, kifeszül, mint egy lufi, ezt a tüdőben elhelyezkedő sejtek érzékelik, és üzennek kilégzőközpontnak. A kilégzőközpont parancsot ad a légzőizmok ellazítására. Kilégzéskor kifújjuk a levegőt, így nem feszül annyira a tüdő, viszont a széndioxid elkezd felgyűlni, ezért ismét belégzés

	következik.
12. II/6.Azt szinte biztosra vehetjük, hogy bármilyen élet csak szénvegyületekre alapuló lehet - tehát olyan, mint a miénk – minthogy egyetlen másik kémiai elem vegyületei sem mutatnak olyan szintű változatosságot, amilyen az élethez szükséges. Bármely kérdéses bolygónak tehát nagy mennyiségben kell szenet tartalmaznia.	12. II/6.Hozzánk hasonló élőlények valószínűleg csak akkor tudnak kialakulni, ha sejtjeik felépítésében a szénatom játssza a főszerepet, ugyanis más olyan elemet nem ismerünk, ami annyira sokféle anyagot tudna létrehozni, mint a szén. Tehát élet csak olyan bolygón elképzelhető, ahol sok szénatom található.
13. II/10.A levegő meglétének egy feltétele, hogy az adott bolygónk tömege bizonyos értékek között legyen. Ha ezt meghaladja, akkor légköre csak más összetételű lehet, ám ha alatta marad, a gázok távoznak róla.	13. II/10.A földi levegőhöz hasonló légkör csak akkor alakulhat ki, ha a bolygó megfelelő méretű. Ha túlságosan nagy, akkor légköre sokkal sűrűbb lesz, ha túlságosan kicsi, akkor pedig minden gáz elszökik róla
14. II/15.Tycho Brahe (XVI. sz.) csillagász az ég távcső nélküli megfigyelése által végezte a tapasztalatok több évtizeden át tartó feljegyzéseit. Voltak elképzelései, hogy az általa lejegyzett adatokból a bolygók mozgására vonatkozó törvényszerűségek adódhatnak, de ő maga tényleges fizikai törvényt nem tudott leírni.	14. II/15. Tycho Brahe (XVI. sz.) csillagász távcső nélkül végezte megfigyeléseit, és több évtizeden keresztül szorgalmasan feljegyezte az adatokat a bolygók és más égitestek mozgásáról, helyzetéről. Abban reménykedett, hogy a rengeteg adat elemzésével egyszer felfedezheti a bolygók mozgásának törvényeit, de ez neki nem sikerült.
15. II/16.Az ellipszis két szimmetriatengellyel rendelkező alakzat. Szerkesztése két fókuszpontja	15. II/16.Az ellipszis elnyújtott körhöz hasonló síkidom, de nem egyetlen középpontja van, mint a körnek,

és hosszabbik tengelyének nagysága alapján történik. A síkon tetszőlegesen felvett két fókuszpontot tekintjük kiindulási pontnak. Azokat a pontokat, melyeket az előbb említett két pontból úgy kapunk meg, hogy a két ponttól mért távolságuk összege állandó legyen, az ellipszispontok.	hanem két, úgynevezett fókuszpontja. Az ellipszis hosszában és keresztben is szimmetrikus. Ha megmérjük az ellipszis bármelyik pontjának távolságát a két fókuszponttól, és a kapott számokat összeadjuk, mindig ugyanakkora összeget kapunk. Ez alapján lehetséges megszerkeszteni.

APPENDIX F
THE EXPERIMENTAL TEXT

[This is a rough translation from the Hungarian of the text used to assess the effect of text condition on understanding. It reflects neither the abstract or concrete version of the Hungarian original, but, rather the general meaning of both.]

A writer, Roger Planet is thinking about a topic for his new sci-fi novel. The story would be set on Mars and Earth. To make the story believable he has to create Martian creatures that fit well into the Martian environment. Thus he visits an astronomer professor to ask for help. Here is a part of their conversation.

Writer: My novel could be set in older times when people did not know much about the planets. What did astronomers in the middle ages know?

Scientist: Mostly about the planets' routes. For example, the astronomer Tycho Brache (1546-1601) did his observations without a telescope. For decades, he diligently took notes of the motions and positions of planets and other celestial objects. By analyzing the data he hoped to discover the laws of the planet's movement, but he could not. He believed that the Sun orbited the Earth. Kepler (1571-1630) was the first to record that the planets' route were ellipsoid. After that it was possible to calculate their routes.

W: What is an ellipsoid exactly?

S: An ellipsoid is a figure that is similar to an elongated circle, but it has not one center, but two so-called focal points. The ellipsoid is symmetrical in two ways. If we measure the distance between any of the points of the ellipsoid and the two focal points, the addition of these two numbers will always give the same number. That's how you can draw it.

W: What do we need on a planet for life to develop?

S: Creatures similar to us can probably develop only if carbon atoms are the main components in their cells. We do not know any other element that can create so many kinds of material as carbon. Thus, we can imagine life only on planets with many carbon atoms.

W: Is there enough carbon on Mars?

S: Yes but it is more complicated. Atmosphere similar to the atmosphere of the Earth's can be found only if the planet has a proper size. If it is too big, the atmosphere will be much thicker, if it is too small, all the gases escape.

W: Mars is smaller than Earth as far as I know.

S: Exactly. And the atmosphere on Mars is much thinner than the atmosphere on Earth. It mostly contains carbon dioxide, with a little nitrogen, even less oxygen and other materials.

W: Thus my animal must breath differently or its lungs work differently than human lungs, if it has any lungs at all. As there is a lot of carbon dioxide in the air it is possible that it breathes carbon dioxide.

S: Another important thing. The gravity of Mars is less than half of the gravity of Earth.

W: Then if the animal has the same size and the same amount of muscles as humans, it can jump twice as high as humans on Mars. So it is also quicker.

S: Only if everyone stays on his own planet. Do not forget than on Mars humans jump higher too. Certainly the air suit is heavy. We have to take that into account, too.

W: What does Mars look like?

S: On Mars there are some darker areas with irregular shape. The lines among the dark areas are "canals," but they do not contain water. Two thirds of the surface is covered with reddish-brown material.

W: Being able to hide is important for survival. The color of the animal is then reddish brown. And if everything is red, gray, or brown then my characters can be color blind as well. It is enough for them to see objects in black and white. Or they can distinguish only between red or brown, they do not need to see other colors.

APPENDIX G
SOLO TAXONOMY SCORING MANUAL

[This is a rough translation from the Hungarian. In the original, the category descriptions were listed for each question for ease of use. Here, they are only given for the first question.]

Question 1: What are the differences between Mars and Earth?

1. *Prestructural*

No meaningful answer. The answers are not relevant or do not make any sense.
Examples: "People are different." "Earth is an ellipsoid." "There are lots of differences."

2. *Prestructural transitional*

As if the student was mentioning a relevant point but does not state it clearly and does not elaborate. The answer has only some relevance with the question or the text.
Examples: "The atmosphere is different and also the color." "On Earth humans live, and on Mars UFOs. "

3. *Unistructural*

Mentions one relevant point and stops, as if not seeing that there were more points or simply remembers only one thing. Chooses one point, probably of personal importance.
Examples: "Earth is bigger than Mars." "Earth is blue, Mars is red." "There is more oxygen on Earth than on Mars."

4. *Unistructural transitional*

Student seem to think that there are multiple point, but only mentions one good point and at least one that is not good or is irrelevant.
Examples: "There is no air on Mars, so it is impossible to live there, and the life circumstances are different." "There is air on Earth, and it is built from different material." "Earth is bigger than Mars, UFOs live on Mars"

5. *Multistructural*

Gives at least two relevant points. The points are independent, isolated; the answer is list-like. No integration of the points: does not make a whole out of them.

Examples: "Mars is red, smaller than Earth, there is less oxygen on it." "Mars is red, smaller than Earth, the gravity is less, and there is no carbon dioxide on it." (There is a mistake in the answer, but there are at least two relevant points.)

6. *Multistructural transitional*

A tendency to integrate the points but the integration is not complete. There may be two or three points that are integrated, but the answer does not give the impression of a whole.

Examples: "Mars is a smaller planet than Earth. It has a different atmosphere, there is less oxygen than on Earth, thus we would not stay alive there. It has a red color, it is called the red planet. There are canals on it, but without water."

7. *Relational*

Mentions several relevant points and integrates them. Portrays more than one side of a question, and understands the relationships between the points made. It is important that the answer is within the context of the text and does not mention that the concepts are relative (e.g., that "it depends" on what is meant by life.)

Examples: "There are many differences between Mars and Earth. First, Mars is smaller than Earth, thus its atmosphere is less thick. Its atmosphere is not only less thick, but is also built up from different materials. It has less gravity, and so, with the same muscles, we could jump higher there than on Earth. The color of Mars is reddish-brown, there are many so called canals, but these do not contain water."

8. *Relational transitional*

Meets criteria for transitional understanding and shows evidence of abstract understanding. May realize that the concepts are relative, but does not do anything with this knowledge, does not elaborate on it, or does not use the abstract concepts correctly.

Examples: There were no answers on this level, but one could be: "There are many differences between the two planets, but not all of them are important from our point of view. Mars is smaller than Earth, thus its atmosphere is less thick. The atmosphere is not only less thick, but is also made of different materials than on earth. Thus, we could not breathe there. It has a smaller gravity thus, with the same muscles, we could jump higher there than on Earth. The color of Mars is reddish-brown. There are many so-called canals, but these do not contain water."

9. Extended abstract

Meets criteria for relational and shows clear abstract understanding of the text. Shows understanding that concepts are relative and mentions possible contradictions.

Examples: There were no answers on this level, but one could be: "There are many differences between the two planets. From the point of view of humans it is a very important difference that Mars is smaller than Earth. Thus, the atmosphere of it is less thick and it is made of different materials, so we could not breathe there. It has a smaller gravity thus, with the same muscles, we could jump higher there than on Earth, like the astronauts on the Moon could jump much higher than on Earth. The color of Mars is reddish-brown, there are many so called canals, but these do not contain water."

Question 2: What would a Martian animal be like?

1. Prestructural

Examples: "The gravity of animals is different." "There are animals on Mars."

2. Prestructural transitional

Examples: "Animals would be different, more interesting."

3. Unistructural

Examples: "They would be bigger." "They would breathe differently."

4. Unistructural transitional

Examples: "The animals on Mars would be different, red and much stronger." "It would have no lungs, because there is no air on Mars." "It could move quicker, because the air is less thick on Mars."

5. Multistructural

Examples: "It would breathe differently, it would be color blind, and would jump higher." "It would be red, jump higher, and it would be ugly" (one point is not relevant but there are at least two other relevant points).

6. Multistructural transitional

Examples: "The animal would jump higher because it would be lighter there. Humans would die because of the lack of oxygen. But the animal would have a different breathing system. The whole body of it would be different, and would be red."

7. *Relational*

Examples: "The animal on Mars would be different from humans in many ways. The reason for this is that life circumstances are different on Mars. The atmosphere is different, there is more carbon dioxide and less oxygen in it, thus the animal could not use oxygen there. The surface of the planet is red, so the animal would be probably red to be able to hide, but it would not sense colors, because it would not need it."

8. *Relational transitional*

Examples: There were no answers on this level, but one could be: The answer could be the same as relational, with the addition of the idea that "it depends what we mean by life" but without continuing the thought and just writing down the features of the animal.

9. *Extended abstract.*

The students is able to make abstract conclusions or see the text in an abstract way. Sees that the concepts are relative and sees the contradictions.

Examples: There were no answers on this level, but one could be "Mars is different from Earth in many ways. There could not develop life on Mars the way we understand life under our own circumstances, but with using our fantasy we can imagine an animal that would feel fine on Mars."

Question 3: What is needed for life to develop on a planet?

1. *Prestructural*

Examples: "Animals have to be transported." "Need men and women."

2. *Prestructural transitional*

Examples: "Chemicals for life." "Oceans and plants."

3. *Unistructural*

Examples: "Carbon." "Water."

4. *Unistructural transitional*

Examples: "Water and dirt." "Carbon because many things can be formed from it."

5. *Multistructural*

Examples: "Air, water, carbon." "Air, carbon, and surface" (there is a mistake in the answer but there are at least two relevant points).

6. *Multistructural transitional*

Examples: "Water so that we would not die from thirst, and food to eat. Oxygen, and carbon."

7. *Relational*

Examples: "For the formation of life it is very important to have enough carbon atoms, because that can many materials that are important for life develop. It is important that the planet have a certain size, because if it is too big, its atmosphere will be too thick, and if it is too small all the gases escape from it."

8. *Relational transitional*

Examples: There were no answers on this level, but one could be the same as relational, with the addition of the idea that the concept of life is relative, with no elaboration: "It depends if we think of life as on Earth"

9. *Extended abstract*

Examples: There were no answers on this level, but one could be the same as relational, with the addition of the clearly stated idea that the concept of life is relative: "It depends what we mean by life. If we think of life as it is on Earth than it is sure that we need many carbon atoms on the planet, etc."

Question 4: What does Mars look like?

1. *Prestructural*

Examples: "Looks good." "I do not know."

2. *Prestructural transitional*

Examples: "Small." "Small and round." "It is a planet, maybe there was life on it once" (personal association).

3. *Unistructural*

Examples: "Red." "It has canals."

4. *Unistructural transitional*

Examples: "Red planet, there are no plants on it." "Red, that's why it is called the red planet."

5. *Multistructural*

Examples: "Smaller then Earth, red, and there is no water on it." "Red, it has canals on it, and it is bigger than Earth" (there is a mistake in the answer but there are at least two relevant points).

6. Multistructural transitional

Examples: "It is a smaller planet than Earth. Its surface is red form the materials that build it. There are dark areas on it, between them canals without water."

7. Relational

Examples: "Mars is a smaller planet than Earth. Its surface is built up from reddish-colored materials. No other colors can be found on the planet only some darker areas that have irregular shape. Between them we can find canals, but they do not contain water."

Question 5: What is an ellipsoid?

1. Prestructural

Examples: "An axis." "Planets have it."

2. Prestructural transitional

Examples: "What the Sun orbits around."

3. Unistructural

Examples: "It has two focus points. " "It is symmetric."

4. Unistructural transitional

Examples: "It has two focus points and the Sun has it. " "It is a route, symmetric."

5. Multistructural

Examples: "It has two symmetric axis. It has two focus points." " It has two symmetric axes, it has two focus points and planets have it" (there is a mistake in the answer but there are at least two relevant points).

6. Multistructural transitional

Examples: "An elongated circle." "A configuration with two focus points". The main idea of the ellipsoid is in this definition, but it is not enough for a complete definition.

7. Relational

Examples: It is a relational answer only if it mentions: "two dimensional figure or configuration" and at least one from the following: "It has two symmetric axes (centerline)." "It has two focus points." "It is oval or elongated (circle)."

8. Relational transitional and *9. Extended abstract*

Examples: There were no answers on this level.

Question 6: Who was Tycho Brache and what did he do?

1. *Prestructural*

Examples: "Writer." "Realized that planets have ellipsoids."

2. *Prestructural transitional*

Examples: "The person who tried to write it down." "Who was examining the movement of Earth."

3. *Unistructural*

Examples: "He was watching the sky without a telescope." "He believed that the Sun orbited the Earth."

4. *Unistructural transitional*

Examples: "Astronomer who realized that the Earth orbits the Sun." "Scientist who was watching without a telescope."

5. *Multistructural*

Examples: "Astronomer who believed that the Sun orbits the Earth." "Astronomer who was watching the sky without a telescope and believed that the Earth orbits the Sun" (there is a mistake in the answer but there are at least two relevant points).

6. *Multistructural transitional*

Examples: "Astronomer who believed that the Sun orbits the Earth, he had only ideas but he could not figure out the law".

7. *Relational*

Examples: "He was an astronomer, he was watching the movements of the planets, trying to describe their route, but because he believed that the Sun orbited the Earth, his calculations did not make sense to him."

8. *Relational transitional*

Examples: There were no answers on this level, but one could be the same as relational, with the addition of the unelaborated idea that it was not easy to figure out the route of the planets.

9. *Extended abstract*

Examples: There were no answers on this level, but one could be the same as relational, with the addition of the clearly stated idea that the understanding of orbits is relative: "In the Middle Ages according to the teachings of the church the Sun orbited the Earth. This belief made it extremely difficult to define the route of the planets."

APPENDIX H

DESCRIPTIVE DATA FOR THREE TEXT CONDITIONS

Table H.1.
N, Means and Standard Deviations of Grades, Deep Approach, Surface Approach and SOLO Levels for the Abstract Condition

	N	Mean	Std. Deviation
Deep Approach	84	3.77	.72
Surface Approach	84	3.15	.85
Grades (Mean grades level)	90	3.44	.90
Question 1 SOLO level	91	4.15	1.26
Question 2 SOLO level	91	3.33	1.43
Question 3 SOLO level	91	3.65	1.26
Question 4 SOLO level	91	3.99	1.28
Question 5 SOLO level	91	2.51	1.80
Question 6 SOLO level	91	3.47	1.44

Table H.2.
N, Means and Standard Deviations of Grades, Deep Approach, Surface Approach and SOLO Levels for the Mixed Condition

	N	Mean	Std. Deviation
Deep Approach	83	3.60	.65
Surface Approach	83	3.08	.82
Grades (Mean grades level)	90	3.45	.91
Question 1 SOLO level	90	3.86	1.45
Question 2 SOLO level	90	3.42	1.50
Question 3 SOLO level	90	3.68	1.27
Question 4 SOLO level	90	3.69	1.23
Question 5 SOLO level	90	2.59	1.82
Question 6 SOLO level	90	3.61	1.56

Table H.3.
N, Means and Standard Deviations of Grades, Deep Approach, Surface Approach and SOLO Levels for the Concrete Condition

	N	Mean	Std. Deviation
Deep Approach	79	3.53	.77
Surface Approach	79	3.08	.79
Grades (Mean grades level)	88	3.57	1.00
Question 1 SOLO level	89	3.98	1.54
Question 2 SOLO level	89	3.98	1.53
Question 3 SOLO level	89	3.66	1.50
Question 4 SOLO level	89	3.87	1.39
Question 5 SOLO level	89	4.34	2.48
Question 6 SOLO level	89	3.67	1.47

APPENDIX I

CORRELATIONS BETWEEN SOLO LEVELS OF QUESTIONS 1, 2, 3, 4, 5, 6

Table I.1.
Correlations Between SOLO Levels of Questions 1, 2, 3, 4, 5, 6 (N=270)

		Q1 SOLO-Level	Q2 SOLO-level	Q3 SOLO-level	Q4 SOLO-level	Q5 SOLO level	Q6 SOLO-level
Question1 SOLOlevel	PearsonCorrelation	1.000	.376	.317	.465	.283	.302
	Sig.(2tailed)	.	.000	.000	.000	.000	.000
Question2 SOLOlevel	PearsonCorrelation	.376	1.000	.167	.449	.349	.331
	Sig.(2tailed)	.000	.	.006	.000	.000	.000
Question3 SOLOlevel	PearsonCorrelation	.317	.167	1.000	.377	.211	.224
	Sig.(2tailed)	.000	.000	.	.000	.000	.000
Question4 SOLOlevel	PearsonCorrelation	.465	.449	.377	1.000	.329	.323
	Sig.(2tailed)	.000	.000	.000	.	.000	.000
Question5 SOLOlevel	PearsonCorrelation	.283	.349	..211	.329	1.000	.327
	Sig.(2tailed)	.000	.000	.000	.000	.	.000
Question6 SOLOlevel	PearsonCorrelation	.302	.331	.224	.323	.327	1.000
	Sig.(2tailed)	.000	.000	.000	.000	.000	.

Table I.2.
Correlations Between SOLO Levels of Questions 1, 2, 3, 4, 5, 6 for the Abstract Condition (N=91)

		Q1 SOLO-Level	Q2 SOLO-level	Q3 SOLO-level	Q4 SOLO-level	Q5 SOLO level	Q6 SOLO-level
Question 1 SOLO level	Pearson Correlation	1.000	.387	.242	.524	.141	.239
	Sig. (2 tailed)	.	.000	.021	.000	.183	.022
Question 2 SOLO level	Pearson Correlation	.387	1.000	.095	.498	.214	.330
	Sig. (2 tailed)	.000	.	.372	.000	.042	.001
Question 3 SOLO level	Pearson Correlation	.242	.095	1.000	.251	.025	.140
	Sig. (2 tailed)	.021	.372	.	.016	.813	.186
Question 4 SOLO level	Pearson Correlation	.524	.498	.251	1.000	.210	.363
	Sig. (2 tailed)	.000	.000	.016	.	.046	.000
Question 5 SOLO level	Pearson Correlation	.141	.214	..025	.210	1.000	.405
	Sig. (2 tailed)	.183	.042	.813	.046	.	.000
Question 6 SOLO level	Pearson Correlation	.239	.330	.140	.363	.405	1.000
	Sig. (2 tailed)	.022	.001	.186	.000	.000	.

a. CONDIT Texttype = 1 Abstract

Table I.3.
Correlations Between SOLO Levels of Questions 1, 2, 3, 4, 5, 6 for the Mixed Condition (N=90)

		Q1 SOLO-Level	Q2 SOLO-level	Q3 SOLO-level	Q4 SOLO-level	Q5 SOLO level	Q6 SOLO-level
Question 1 SOLO level	Pearson Correlation	1.000	.447	.371	.440	.262	.238
	Sig. (2 tailed)	.	.000	.000	.000	.013	.024
Question 2 SOLO level	Pearson Correlation	.447	1.000	.220	.327	.179	.363
	Sig. (2 tailed)	.000	.	.037	.002	.091	.000
Question 3 SOLO level	Pearson Correlation	.371	.220	1.000	.394	.151	.253
	Sig. (2 tailed)	.000	.037	.	.000	.156	.016
Question 4 SOLO level	Pearson Correlation	.440	.327	.394	1.000	.297	.251
	Sig. (2 tailed)	.000	.002	.000	.	.004	.017
Question 5 SOLO level	Pearson Correlation	.262	.179	..151	.297	1.000	.192
	Sig. (2 tailed)	.013	.091	.156	.004	.	.070
Question 6 SOLO level	Pearson Correlation	.238	.363	.253	.251	.192	1.000
	Sig. (2 tailed)	.024	.000	.016	.017	.070	.

a. CONDIT Texttype = 2 Mixed

Table I.4.
Correlations Between SOLO Levels of Questions 1, 2, 3, 4, 5, 6 for the Concrete Condition (N=89)

		Q1 SOLO-Level	Q2 SOLO-level	Q3 SOLO-level	Q4 SOLO-level	Q5 SOLO level	Q6 SOLO-level
Question 1 SOLO level	Pearson Correlation	1.000	..336	.332	.432	.456	.438
	Sig. (2 tailed)	.	.001	.001	.000	.000	.000
Question 2 SOLO level	Pearson Correlation	.336	1.000	.191	.543	.469	.290
	Sig. (2 tailed)	.001	.	.073	.000	.000	.006
Question 3 SOLO level	Pearson Correlation	.332	.191	1.000	.470	.405	.271
	Sig. (2 tailed)	.001	.073	.	.000	.000	.010
Question 4 SOLO level	Pearson Correlation	.432	.543	.470	1.000	.497	.373
	Sig. (2 tailed)	.000	.000	.000	.	.000	.000
Question 5 SOLO level	Pearson Correlation	.456	.469	.405	.497	1.000	.373
	Sig. (2 tailed)	.000	.000	.000	.000	.	.000
Question 6 SOLO level	Pearson Correlation	.438	.290	.271	.373	.411	1.000
	Sig. (2 tailed)	.000	.006	.010	.000	.000	.

a. CONDIT Texttype = 3 Concrete

APPENDIX J
CORRELATIONS BETWEEN SOLO LEVELS, LEARNING APPROACHES, AND GRADES

Table J.1.
Correlations Between SOLO Levels, Deep Approach, Surface Approach and Grades

		Deep Approach	Surface Approach	Grades (Mean Grades Level)
Deep Approach	Pearson Correlation	1.000	-.083	.123
	Sig. (2 tailed)	.000	.192	.055
	N	246	246	266
Surface Approach	Pearson Correlation	-.083	1.000	-.362
	Sig. (2 tailed)	.192	.000	.000
	N	246	246	266
Grades (Mean Grades Level)	Pearson Correlation	.123	-.362	1.000
	Sig. (2 tailed)	.055	.000	.000
	N	246	246	266
Question 1 SOLO level	Pearson Correlation	.153	-.149	.359
	Sig. (2 tailed)	.016	.019	.000
	N	246	246	266
Question 2 SOLO level	Pearson Correlation	-.018	-.127	-.354
	Sig. (2 tailed)	.775	.046	.000
	N	246	246	266
Question 3 SOLO level	Pearson Correlation	.154	-.062	.299
	Sig. (2 tailed)	.016	.336	.000
	N	246	246	266
Question 4 SOLO level	Pearson Correlation	.077	-.101	.443
	Sig. (2 tailed)	.226	.115	.000
	N	246	246	266
Question 5 SOLO level	Pearson Correlation	.021	-.144	.359
	Sig. (2 tailed)	.738	.024	.000
	N	246	246	266
Question 6 SOLO level	Pearson Correlation	.076	-.199	-.409
	Sig. (2 tailed)	.237	.000	.000
	N	246	246	266

Table J.2.
Correlations Between SOLO Levels, Deep Approach, Surface Approach and Grades for the Abstract Condition

		Deep Approach	Surface Approach	Grades (Mean Grades Level)
Deep Approach	Pearson Correlation	1.000	-.008	.034
	Sig. (2 tailed)	.000	.943	.762
	N	84	84	83
Surface Approach	Pearson Correlation	-.008	1.000	-.521
	Sig. (2 tailed)	.943	.000	.000
	N	84	84	83
Grades (Mean Grades Level)	Pearson Correlation	.034	-.521	1.000
	Sig. (2 tailed)	.762	.000	.000
	N	83	83	90
Question 1 SOLO level	Pearson Correlation	.096	-.204	.305
	Sig. (2 tailed)	.387	.063	.003
	N	84	84	90
Question 2 SOLO level	Pearson Correlation	-.036	-.058	.285
	Sig. (2 tailed)	.742	.600	.007
	N	84	84	90
Question 3 SOLO level	Pearson Correlation	.234	-.127	.331
	Sig. (2 tailed)	.032	.249	.001
	N	84	84	90
Question 4 SOLO level	Pearson Correlation	.025	-.145	.387
	Sig. (2 tailed)	.822	.188	.000
	N	84	84	90
Question 5 SOLO level	Pearson Correlation	.057	-.149	.195
	Sig. (2 tailed)	.605	.175	.066
	N	84	84	90
Question 6 SOLO level	Pearson Correlation	.034	-.316	.467
	Sig. (2 tailed)	.762	.003	.000
	N	84	84	90

a.CONDIT Texttype = 1 Abstract

Table J.3.
Correlations Between SOLO levels, Deep Approach, Surface Approach and Grades for the Mixed Condition

		Deep Approach	Surface Approach	Grades (Mean Grades Level)
Deep Approach	Pearson Correlation	1.000	-.012	.069
	Sig. (2 tailed)	.000	.916	.542
	N	83	83	81
Surface Approach	Pearson Correlation	-.012	1.000	-.330
	Sig. (2 tailed)	.916	.000	.003
	N	83	83	81
Grades (Mean Grades Level)	Pearson Correlation	.069	-.330	1.000
	Sig. (2 tailed)	.542	.003	.000
	N	81	81	88
Question 1 SOLO level	Pearson Correlation	.094	-.116	.376
	Sig. (2 tailed)	.399	.294	.000
	N	83	83	88
Question 2 SOLO level	Pearson Correlation	-.151	-.191	.428
	Sig. (2 tailed)	.172	.083	.000
	N	83	83	88
Question 3 SOLO level	Pearson Correlation	.104	-.078	.284
	Sig. (2 tailed)	.349	.485	.007
	N	83	83	88
Question 4 SOLO level	Pearson Correlation	.050	-.085	.488
	Sig. (2 tailed)	.651	.445	.000
	N	83	83	88
Question 5 SOLO level	Pearson Correlation	.156	-.047	.315
	Sig. (2 tailed)	.160	.672	.003
	N	83	83	88
Question 6 SOLO level	Pearson Correlation	.092	-.282	.316
	Sig. (2 tailed)	.409	.010	.003
	N	83	83	88

a.CONDIT Texttype = 1 Mixed

Table J.4.
Correlations Between SOLO levels, Deep Approach, Surface Approach and Grades for the Concrete Condition

		Deep Approach	Surface Approach	Grades (Mean Grades Level)
Deep Approach	Pearson Correlation	1.000	-.276	.321
	Sig. (2 tailed)	.000	.014	.004
	N	79	79	79
Surface Approach	Pearson Correlation	-.276	1.000	-.220
	Sig. (2 tailed)	.014	.000	.052
	N	79	79	79
Grades (Mean Grades Level)	Pearson Correlation	.321	-.220	1.000
	Sig. (2 tailed)	.004	.052	.000
	N	79	79	88
Question 1 SOLO level	Pearson Correlation	.248	-.138	.407
	Sig. (2 tailed)	.027	.226	.000
	N	79	79	88
Question 2 SOLO level	Pearson Correlation	.174	-.129	.324
	Sig. (2 tailed)	.125	.256	.002
	N	79	79	88
Question 3 SOLO level	Pearson Correlation	.140	.025	.289
	Sig. (2 tailed)	.219	.827	.006
	N	79	79	88
Question 4 SOLO level	Pearson Correlation	.130	-.081	.476
	Sig. (2 tailed)	.253	.479	.000
	N	79	79	88
Question 5 SOLO level	Pearson Correlation	.027	-.244	.493
	Sig. (2 tailed)	.814	.030	.000
	N	79	79	88
Question 6 SOLO level	Pearson Correlation	.131	-.298	.440
	Sig. (2 tailed)	.249	.008	.000
	N	79	79	88

a.CONDIT Texttype = 3 Concrete

CURRICULUM VITAE

Emese Vitális was born in Debrecen, Hungary on July 7, 1970. In 1994, she recevied her Masters degree in Psychology and Teacher of Psychology from the University of Debrecen, where she later did the coursework for her Ph.D. She is also a certified English translator and has training in hypnosis.

She is an experienced teacher, having worked with students of many ages and backgrounds. Her teaching career began in 1992, when, as a student instructor, she led seminars for lower grade psychology students. In 1994, she became an instructor and, in 1997, an assistant professor in the Educational Psychology Department of the University of Debrecen. As a member of the teacher training program faculty, she taught future teachers of a wide range of subjects and teachers seeking degrees in education. From 2001-2002, she was an Adjunct Assistant Professor of psychology at University of Maryland University College, Schwäbisch Gmünd, Germany, where she taught undergraduate students from a variety of cultural backgrounds.

For several years, she was a private instructor of psychology and prepared many students for their university entrance exams. She also led a University Entrance exam preparation course for high school students and developed a comprehensive study manual for the course.

She has been invited to towns in Hungary to lead teacher training seminars on learning and teaching strategies and styles and on gifted education. She also led several learning strategies seminars for 7th graders.

She has a number of publications and conference presentations in the areas of learning strategies and learning styles.

In 1998, she was accepted as a Ph.D. student at the University of Nijmegen.