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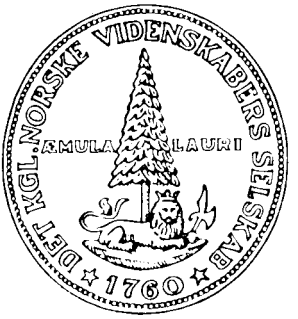

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Learning Strategies and Skill Learning

Essays in honour of Nils Søvik

DET KONGELIGE NORSKE VIDENSKABERS SELSKAB

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Learning Strategies and Skill Learning

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Preface

In the summer of 1998, Nils Søvik, Department of Education, Norwegian University of Science and Technology, (NTNU), Trondheim, retired from his post as a professor of education. Some of his colleagues, the editors of this report, organized a seminar in Trondheim, Fall 1998, to celebrate Nils Søvik's retirement and honour him for his long-lasting service (1963-1998) at NTNU. It should also be mentioned that Søvik was Secretary General at The Royal Norwegian Society of Sciences and Letters (DKNVS) from 1991 to 1996.

This report, which belongs to DKNVS's Transactions (Skrifter) of 1998, contains the papers written and presented at the seminar held in conjunction with Nils Søvik's retirement. As the majority of the seminar papers were written in English and covered problems in which Søvik himself was much involved during his recent research, it is hoped that researchers abroad who take interest in the subjects dealt with in this report, will find the reading of it useful to their work.

Forord

Professor Nils Søvik fylte 70 år 18. juni 1998. I det høvet ønskte nære samarbeidspartnarar ved Pedagogisk institutt, NTNU, å heidre han ved å arrangere eit forskingsseminar 23. og 24. oktober 1998.

Professor Søvik byrja si lange teneste innan pedagogikk som lærar i heimbygda Os i Hordaland etter lærarprøva 1954. I 1960 tok han magistergraden i pedagogikk ved Universitetet i Oslo, og dermed byrja hans karriere innanfor den akademiske verda. I perioden 1960-63 underviste han ved Trondheim lærarhøgskole, og i tidsrommet 1963-68 var han tilsett som universitetslektor i pedagogikk ved Universitetet i Trondheim. I 1972 vart han tilkjent doktorgraden ved Universitetet i Oslo, og han heldt då fram som førsteamanuensis ved Pedagogisk institutt, Universitetet i Trondheim. I tida 1980-1998 var han professor ved NTNU.

Nils Søvik har dermed ein lang akademisk karriere ved Universitetet i Trondheim, og han har lagt ned eit stort og omfattande arbeid innan forsking og formidling. Han har også vore involvert i universitetspolitisk verksemd på ulike nivå.

I tillegg vil vi trekke fram det arbeidet som Søvik har lagt ned ved Det Kongelige Norske Videnskabers Selskab i Trondheim. Han var medlem av styret i åtte år, då han mellom anna var generalsekretær i perioden 1991-96.

Når det gjeld forsking og vitskapleg produksjon, spenner dette vidt. Interessa for forskinga innan området psykomotoriske ferdigheter førte til at det i 1976 blei etablert eit Psykomotorisk laboratorium ved Pedagogisk institutt. I dei seinare åra har forskinga i hovudsak vore konsentrert om emna læringstrategiar, tekstforståing og tekstproduksjon. Vi viser til den

bibliografien som er laga i samband med denne rapporten. Her finn ein heile 102 vitskaplege artiklar og bøker. I tillegg kjem 24 bøker og artiklar der Søvik har vore redaktør eller medredaktør.

Nils Søvik har også vist stor interesse for og vore svært dyktig når det gjeld å etablere internasjonale kontaktar og samarbeid. Som dr.gradstipendiat hadde han eit opphald ved University of Wisconsin, Madison. Seinare har han hatt kontakt med, og delvis samarbeidd med fagfeller ved University of London, Institute of Education, University of Pittsburgh (LRDC) og Université de Bourgogne, Dijon i Frankrike. Som medlem av The Board of the International Graphonomic Society (IGS) arrangerte han i 1989 The Fourth International Conference of IGS i Trondheim. Han har også i samarbeid med nordiske kollegaer arrangert fleire nordiske forskingskonferansar og 'workshops'.

I samband med nemnde seminar ved Pedagogisk institutt var det nokre av Nils Søvik sine kollegaer som var inviterte til å halde innlegg og dessutan koma med eit manuskript til ein seminarrapport. I tillegg til dei som deltok på seminaret, blei også andre nære kollegaer kontakta og oppfordra til å koma med eit manuskript. Storparten av desse manuskripta vart skrivne på engelsk. Difor har rapporten fått ein engelskspråkleg tittel og eit meir kortfatta forord, slik at rapporten kan lesast av fleire utalandske forskarar. Stoffet i seminarrapporten er knytt til to hovedtema: læringsstrategiar og læring av ferdigheter. Dette er tema som Nils Søvik har vore opptatt av, og som går att i hans seinare forsking og vitskaplege produksjon.

Til slutt vil vi takke Pedagogisk institutt ved NTNU og Det Kongelige Norske Videnskabers Selskab i Trondheim som gjennom økonomisk støtte har gjort det mogleg å gjennomføre seminaret og utgi denne rapporten.

Trondheim, november 1998

Annlaug Flem Ragnheidur Karlsdottir

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Innhald

Learning strategy research: Some results, problems, and prospects

Joachim Lompscher

Introduction

During the 80-ies and 90-ies, learning strategies became one of the preferred topics of international research in developmental and educational psychology (for an overview, see, e.g., Alexander & Murphy, 1997; Biggs, 1993; Braten, 1993; Lompscher, 1996a; Mandl & Friedrich, 1992). This was closely connected with the growing orientation towards an „active learner" and „self-regulated learning".

Our approach to that topic was characterized by the effort to bring together knowledge and methodologies of two research paradigms having developed relatively independently of one another, but more and more moving in the direction toward each other and having potentialities to complement one another: The cultural-historical and activity-theoretical approach, on the one hand, and the cognitive-psychological one, on the other. We do not stand alone in this respect (see, e.g., Case, 1996; Greeno, 1997; Rogoff, Matusov & White, 1996; Shuell, 1996; Wertsch, del Rio & Alvarez, 1995).

In the *cognitive-psychological framework*, the analysis of internal mechanisms and interrelations between different variables - e.g., learning strategies and cognitive abilities, self-efficacy etc. - is stressed (Baumert, 1993; Blickle, 1996; Garcia & Pintrich, 1996 and many others), whereas the *cultural-historical and activity-theoretical psychology* is more oriented toward the complex activity, its subject, and psychological regulation as well as its embeddedness in and dependency on societal conditions of development (Leontyev, 1978, 1983; Lompscher, 1996b; Vygotsky, 1978, 1985/87, 1987). In this theoretical context, conditions for the acquisition of efficient methods and techniques and their influence on learning processes and results were studied with respect to the formation of independent and self-responsible learning (Galperin, 1989, 1992; Kabanova-Meller, 1968; Lompscher, 1973, 1975; Mentchinskaya, 1989 and many others). In studies aimed at the formation of learning activity as a special kind of activity (Davydov, 1988, 1996; Davydov, Lompscher & Markova, 1982), the strategy aspect played a central role, above all, in connection with the elaboration and implementation of teaching strategies, especially the teaching strategy of ascending from the abstract to the concrete (Lompscher, 1989a, b, 1996c). This was the starting point for the learning strategy research at Potsdam University. Theoretical

prerequisites, selected results, and unsolved problems of this research will be described in the following sections.

Learning strategies and learning activity

Learning necessarily is connected with activity: It may proceed in the framework of an activity directed towards other goals (as play, labor, every day communication etc., in special situations even without goal-oriented activity) or it may be directed toward learning goals. In this latter case we speak of *learning activity as an activity especially directed toward the acquisition of societal knowledge and skills*. This goal can be reached only by interacting with the respective learning object or its representatives, that is by individually reproducing and reconstructing societal knowledge and skills in this or that domain. But learning activity is not individual handling as such - it is a *component of societal culture*. Therefore, not only parts of the culture - especially selected, designed, and presented ones - have to be acquired, but the acquisition process itself as well. *Learning activity is not simply given, but has to be learned or formed.* Quality and efficiency of individual learning activity essentially depend on this formative process. Learning activity is not simply individual activity in yet another sense: It is always - directly or indirectly - embedded in social interaction, communication and cooperation with learners, teachers and other persons. It is impossible to abstract from this context, when individual learning processes, prerequisites, and results are to be analyzed and their development promoted. In analogy, the analysis and promotion of certain components of activity regulation - learning strategies as an example - must not be abstracted from the complexity of psychological regulation as a unity of motivational, emotional, volitional, cognitive, and strategic components. Of course, this does not mean that always all aspects have to be considered. In this case, no research would be possible at all.

In order to reach learning goals, the learner has to carry out special learning actions - acting practically, observing, listening, reading or problem solving, experimenting, discussing, practicing etc. Such classes or categories of learning actions are acquired in domain-specific ways and can be transferred to other objects and domains under certain conditions. In this process, learning strategies are developing as *individual characteristics and preferences of acting*. They may be promoted by transmitting knowledge about acting and/or by reflecting upon one's own actions. They result from learning processes in different activities and, at the same time, they are one of the psychological prerequisites of learning activity. They emerge either out of *unconscious adaptation* to the conditions of the respective activities or by *conscious orientation* toward certain goals and tasks (these are poles on a continuum). Depending on the conditions of their emergence and usage, learning strategies may develop in different directions: generalisation or specification, unfolding

or reduction, becoming conscious or automatized. Learning strategies may be promoted by instructional or other pedagogical actions organizing learning or other activity, but they may be hindered as well.

In the literature many and very different definitions of learning strategies can be found - beginning with the terminology (identification with or discrimination from skill, method, technique, plan, style etc.). Without going into details here, some differences of the strategy concept may be mentioned. Learning strategies are

- interpreted as intentional and conscious phenomena (by the majority) or as potentially conscious or automatized or strategies are distinguished from substrategies, operations, skills etc.;
- discriminated (or not) from learning styles, on the one hand, and learning techniques, on the other, with respect to complexity and stability;
- subdivided (or not) into cognitive and metacognitive strategies (elaboration, analysis etc., on the one hand, planning, regulating, monitoring etc., on the other), sometimes strategies of resource management (organisation of internal and external conditions of task accomplishment) are mentioned additionally;
- considered as a unity of external, observable and internal, not observable processes or limited to one of these aspects;
- divided into effective and ineffective ones or identified with effective ones only;
- considered either as a unity of performance and motivation/volition or limited to the performance aspect;
- identified with actions, action sequences or plans aimed at reaching a certain goal or limited to the quality or way of action execution;
- studied stressing general characteristics and regularities or individual differences and peculiarities.

In our opinion, learning strategies are *more or less complex and generalized, consciously or unconsciously used ways of approaching learning tasks*. Thus, learning strategies relate to the *individual ways* of how learning actions are carried out. In each case, they are *embedded in structure and context of an activity with concrete motives, means, conditions etc. and are interrelated with other psychic components of activity regulation.*

Learning strategy research in Potsdam

During the 70-ies and 80-ies we were engaged in the formation of learning activity by ascending from the abstract to the concrete. After the liquidation of the Academy of Pedagogical Sciences of the GDR and its experimental schools in 1990, no continuation of this work was possible. Under unsure and unclear conditions, a small research group began investigations into learning strategies

- a topic, which was not sufficiently considered in the work before. We made our first attempts to register and analyze learning strategies on the reflection level (via questionnaires) as well as on the action level (via individual and group experiments) and to relate them to selected motivational and cognitive regulation components. In 1993, an Interdisciplinary Center for Research on Learning and Instruction was founded at Potsdam University and we got a new basis for our work.

The following *aims* were formulated:

* Study learning strategies applied by students of different school years in different task domains and learning situations.

* State generalities and differences of learning strategies on the reflection level (questionnaires, interviews) and on the action level (when accomplishing concrete learning tasks) and their interrelations.

* Analyze interrelations between learning strategies and selected student characterictics.

* Study peculiarities of partial samples (by sex, cognitive performance level, learning motivation and other criteria) concerning their learning strategies and interrelations with other regulation components.

* Develop or improve on suitable methods.

* Determine starting points and conditions for the promotion and formation of learning strategies through instruction.

Several *studies* were carried out or are about to be completed:

1. A questionnaire „How do you learn?" for 4^{th} - 8^{th} grade students was developed and administered to 680 German, 120 British, 590 Polish, and 2700 Finish students. It contains items concerning surface, deep structure, metacognitive strategies and learning techniques applied to different categories of tasks as text comprehension, problem solving, instructional communication, memorizing and reproducing. For 9^{th} - 11^{th} grade students the questionnaire was modified corresponding to their developmental level and changes of their learning activity („My learning experience"). In this case two variants were used - a closed form and an open one, in which students were asked to describe their strategies in different task situations on their own. Both versions are utilized in ongoing studies together with a German adaptation of the „Inventory of Learning Processes - Revised" (Geisler-Brenstein & Schmeck, 1996), named „Multidimensional individual learning profile".
2. Individual experiments and interviews were carried out with about 270 4^{th} - 8^{th} grade students concerning text comprehension and problem solving. The questionnaire „How do you learn?" was used. Selected motivational,

emotional, and cognitive characteristics of the students were measured as well.

3. A combined cross-sectional and longitudinal study with about 150 9^{th} - 11^{th} grade students is finished now, in which the questionnaires were used and selected psychological characteristics measured.
4. A pilot study with 40 9^{th} and 10^{th} grade students will be finished soon, in which learners are working in a hypermedia environment at the computer. Learning strategies are in this case recoerded via an event-log (a control function of the computer) and then compared with interview data gathered during and immediately after the learning session. Data concerning psychological characteristics of these students are available as well.
5. A first step toward modification of learning strategies and attitudes is done with an investigation with 11 - 13 years old British students taught with the so-called CASE program (Cognitive Acceleration through Science Education - Adey & Shayer, 1994) compared with „normal" teaching in British and German classrooms. This is also a combined cross-sectional and longitudinal study. Several motivational and cognitive characteristics are measured.

Our research group reported on provisional results, methods, instruments, questions regarding these investigations at several international and national conferences and in the publication series of our center (Lern- und Lehrforschung, LLF-Berichte). Dissertations and other study reports will be finished this year. I'll try to give an overview about main results, unsolved problems and some prospects of further research in this field.

Main results of our learning strategy research

Our research efforts were directed toward classification of learning strategies, their task and domain specifity, interrelations between reflection level and action level concerning learning strategies, their interrelations with other psychic regulation components, and their developmental differences and changes during the school years (most learning strategy research up to now was carried out with college and university students and instruments were developed with that goal in mind). These are the main points of this section.

Classification of learning strategies: In the literature learning strategies are classified in different ways. Our classification was based on several aspects of the topic. Concerning the *quality of cognitive approach* to reality we distinguished surface and deep structure strategies (sensu Craik & Lockhart, 1972; Davydov, 1988) as did Biggs (1993), Entwistle & Ramsden (1983), Schmeck (1988) and others. Concerning the *quality of self-regulation* in learning we distinguished cognitive and metacognitive strategies - the latter ones in the sense of planning, monitoring, control and

evaluation of students' own approach and learning results (Brown, 1984; Pintrich & Garcia, 1991, and others). A third distinction was that between strategies proper and learning techniques (more or less automatized routines in the sense of means to be used in order to accomplish learning tasks - Mandl & Friedrich, 1992; Weinstein, Goetz & Alexander, 1988, and others). These four „dimensions" cover a great deal of what strategies are about. They are differently related to one another: Whereas deep structure and surface strategies are - to a certain degree - in mutual opposition, metacognitive strategies and learning techniques represent different planes and are closer related to deep structure strategies than to surface ones.

This distinction stood the test in principle as shown by reliability and factor analyses. Several items have to be changed yet in order to make the scales clearer for students' understanding. Some formulations gave too much room for different interpretations (Lompscher, 1995, 1996d).

For the students, deep structure and surface strategies do not represent absolute contradictions, because both may be applicable in a concrete situation, depending on task, goal, attitude etc. Nevertheless, certain individual preferences in this or that direction could be noted. The connections between deep structure and metacognitive strategies and, partially, learning techniques are clearly closer than with surface strategies. As a rule, students who try to reveal deep structures in the learning material are more conscious and reflective concerning their own activity, its planning and evaluation etc. and need learning techniques in order to find out connections, reasons, regularities etc., compared with students for whom certain phenomenon - not the essence of the object - is of interest or sufficient to be learned. Students with a higher level concerning metacognitive strategies give more differentiated answers in the open questionnaire, mention more strategies and techniques they use and show that they are more oriented toward the essential criteria and aspects when acquiring a learning object. Less „metacognitive" students are more oriented toward memorizing and repeating, use strategies less consciously and are less motivated than their counterparts (Brenstein & Neuser, 1998).

Students' strategy statements in the open questionnaire mostly could be related to the same four dimensions. But a fifth dimensions seems to be necessary as used by several authors - resource management with a clear differentiation between internal and external resources (Lompscher & Bartl, 1996).

Task and domain specifity: In many instruments, items are formulated without reference to specific learning tasks and domains. In reality however, learning is approached not „as such", but in different learning domains with a multitude of different learning tasks and situations. This cannot be without

influence on usage and evaluation of learning strategies. Indeed, students partially mentioned different strategies or evaluated strategies differently concerning such learning tasks as text comprehension or problem solving or listening during instruction or memorizing . For example, metacognitive strategies and learning techniques play a clearly different role in these task classes. A further discrimination into different learning domains (social and natural sciences, languages and the like) was not successful until now, because students felt overloaded by multiple differentiation request or were not able or not willing to report on those differences. (For some students already the discrimination between categories of learning tasks - see above - was too much.) In this respect more suitable methods of assessment have to be found. This problem cannot be solved with questionnaires and other self-report methods (on the reflection level) only.

Interrelations between reflection level and action level: Most investigations into learning strategies were carried out predominantly with questionnaires (Baumert, 1993; Garcia & Pintrich, 1996; Geisler-Brenstein & Schmeck, 1996; Metzger, Weinstein & Palmer, 1995; Pintrich, Smith, Garcia & McKeachie, 1993; Sageder, 1995; Weinstein, Zimmerman & Palmer, 1988; Wild, Schiefele & Winteler, 1992 etc.). This is a legitimate, but one-sided way, where students report on their experience concerning the use of learning strategies or evaluate given statements on this topic. What we can learn from these utterances, choices and the like depends on

- the level of their cognitive development and verbal ability,
- their experience concerning the respective learning tasks,
- their ability to relate questions or statements about strategies to learning tasks and experience and to make decisions on that basis,
- their willingness to analyze their own learning experience under the strategy aspect,
- their attitudes toward assessment situations, toward learning tasks and conditions, toward learning as such (including social desirability), and, last abut not least,
- relationship between conscious and unconscious strategies, on the one hand, and the level of reflection processes, on the other.

In a questionnaire - of what ever form - the task and situation reference can be established only approximately and understood, interpreted, operationalized in different ways. On the contrary, in an action situation it is not enough to reflect upon the own approach, to describe it verbally and/or to evaluate it - you have really to act. The task is more concrete and it has to be accomplished depending on the personal prerequisites and actual conditions of a respective situation.

Therefore it is astonishing only at a first glance that data gained by questionnaire, on the one hand, and in an action situation, on the other - concerning the same learning task category, e.g. text comprehension - differed a lot one from the other (Artelt & Schellhas, 1996). Significant correlations (not very strong ones) were found between deep structure strategies on the two levels and between surface strategies on the two levels, but not with respect to the other dimensions. In another study no such correlations were found at all or only between some singular questionnaire items and the respective strategy dimension - e.g., problem solving - on the action level (Giest, 1996) .

Correlations between deep structure and surface strategies on the reflection level were positive, on the action level negative. Often in the action situation strategies were observed which the same students did not agree to in the questionnaire or they stated the use of a certain strategy in the questionnaire or in the interview, but did not really use it in the respective task situation. For example, much more students declared they would look into a dictionary to find unknown words than were capable of doing it really (as a special learning technique). The difference was significant not only with 4^{th} graders, but also with 6^{th} and 8^{th} graders though less strong. Questionnaire data say that 4^{th} graders use more strategies than the older students. On the action level 4^{th} graders show significantly less deep structure and metacognitive strategies as well as learning techniques than the older students (Artelt, 1996, in press).

Strategies utilized to accomplish a real learning task (understanding text and answering questions about it) showed a clear influence on the learning outcomes. For example, deep structure strategies led to higher quality of learning outcomes. There was no such connection between questionnaire data concerning text comprehension and learning outcomes measured by school grades. (In the latter case the relationship between learning strategy and learning outcome is much more indirect and distant than in the former case). If students prefering more deep structure strategies or more surface ones were grouped, a closer connection between the two levels of analysis was noted.

It is obvious that methods applied at the two levels of analysis measure different aspects of learning strategies. This is true even when comparing open and closed versions of a learning strategy questionnaire. Self-report on strategies used for certain learning tasks presupposes knowledge about strategies and their application as well as awareness - to a certain degree - of one's own learning activity, whereas items in a closed questionnaire may be considered as an offer to be related to one's own learning experience and evaluated as useful (or not) without having used the respective strategy up to now.

The distinction of strategy knowledge into declarative, procedural, and conditional one - proposed by several authors - will be useful for further analysis and discussion. It seems to us, that the best way of a detailed learning strategy investigation is the combination of the two levels in one situation: Observation of certain learning processes under experimental conditions, followed (or in special cases interrupted) by an interview or other forms of inspiring the student to reflect on what he/she did in this situation, to give reasons for his/her approach etc. Of special interest are the students' comments when confronted with their own approach. We tried to do this by presenting the video-taped session immediately after the learning session, but were not very successful in doing so. There were a lot of organizational and procedural problems in this case. However, our first experience with using a protocol function (event-log) in hypermedia learning environments is very positive (Brenstein, 1996; Brenstein & Schellhas, 1998; Schellhas, 1996). But I am conscious of the fact that such an approach requires high expenditure concerning time, effort etc. Such investigations should be carried out as individual sessions with the necessary technological and methodological equipment and quality. In general, investigations into action processes allow a high level of differentiation and promise a high level of reliability and ecological validity, but for a high „price" and with a relatively low level of generality. Nevertheless, in my opinion, there is no other way.

Interrelations between learning strategies and other psychic regulation components: The complexity and multiple dependency of psychic activity regulation suggests that learning strategies do not function in an isolated and linear manner, but are interrelated with other psychological components in a more or less complicated way. Task- and situation-specific, ontogenetic, individual and other factors may create a network of interrelations which won't be revealed by one or several investigations. Our first steps in this respect showed remarkable differences in these interrelations depending on students' age and developmental level as well as comparison between reflection and action level.

For example, correlational analysis and structural equation models showed that learning strategy dimensions on the reflection level have more connections with one another as well as with other regulation components (examination anxiety, self-efficacy, achievement motivation, cognitive ability) than strategies on the action level. That means that in this case the relationships are less differentiated. Achievement motivation was connected with deep structure, metacognitive strategies, and learning techniques; self-efficacy with deep structure, surface, and metacognitive strategies; cognitive ability only with deep structure strategies. Examination anxiety only was related to learning techniques. On the action level we had a more

differentiated picture: Positive connections were noted between achievement motivation and deep structure strategies, between cognitive ability and deep structure as well as metacognitive strategies and learning techniques. These three strategy dimensions showed closer connections between one another as well. Negative connections were noted between cognitive ability and surface strategies, between examination anxiety and deep structure and metacognitive strategies. These relationships seem to be plausibel.

Further, it was found that learning strategies on the action level affect learning results either directly or indirectly - as a mediator of the influence of other psychological components, e.g. interest affects learning partially via using more deep structure strategies, whereas anxiety hinders the use of such strategies. On the reflection level, learning strategies were not found as such a mediator. In this case, learning strategies actually did not affect learning results (represented here by school grades which is, of course, a very weak criterion), whereas cognitive and motivational components did affect grades. On the action level, a strong effect of deep structure strategies on the concrete learning outcome was found (Artelt, 1998).

In a study with 9^{th} - 11^{th} grade students, the interrelations between learning strategies (reflection level) and cognitive characteristics measured with different instruments were analyzed (Schellhas & Klas, 1998). The results are contradictory: In some cases correlations were positive, in others negative - not very high in each case. More than half of the sample permanently selected high or low values in all strategy dimensions and the astonishing fact was that cognitively high developed students had low indicators of learning strategies they reported on. It could be assumed that these students more consciously and differentiatedly reflected on strategies they really use, whereas students on a lower level of cognitive development consider the questionnaire items as an offer of possible strategies they may accept, but did not really use then.

After all, the picture is not very clear yet. The question about the relationships between learning strategies and other regulation components and with achievement parameters seems to be the critical problem of learning strategy research to be solved by a variety of different approaches and methods. Though this can be done step-by-step only, it may contribute to a deeper understanding of the mechanisms of activity regulation as a whole as well as show the concrete participation of learning strategies in learning processes and results and thus show their relative significance (referred to other components) for the organisation and formation of an effective and independent learning activity. In order to study these interrelations more in detail it is necessary to conduct subgroup analyses (e.g., groups varying in cognitive ability, achievement motivation, anxiety,

preference for deep structure or surface strategies) and in different task situations and content domains, particularly on the action level.

Developmental differences and changes: A comparison between questionnaire data gained in 4th - 8th grade classes did not reveal essential and systematic developmental differences. Besides exceptions mentioned above, in principle 8th graders mentioned, preferred or rejected the same strategies and even reported using them to the same degree as 4th graders. In some cases, the younger the students were, the more they preferred certain strategies. Though these are cross-sectional data, we expected more differences in an age interval of two or four years. The absence of such systematic differences may have different causes. In our opinion, the most interesting ones are the following hypothetical causes:

1. As, in this case, we have questionnaire data, it may well be that items were understood and interpreted differently by students of different age level. Thus, developmental processes may have really happened, but the instrument did not register them.
2. May be, learning strategies do not develop continously, but depend on the general cognitive development and its levels. In this case, e.g., the development of a more or less distinct individual strategy profile or repertoire in the sense of stable preferences may be part of the personality development as a whole and a large step may be done in a later period, e.g. in grade 10 or 12 (Ames & Archer, 1988; Baumert, 1993; Zimmerman & Martinez-Pons, 1990).
3. Having in mind the (low) significance and quality of teaching to learn in our schools and the dependency of psychological development on education and instruction, the question must be put whether in a period of two or four years students did essentially learn something concerning learning strategies. The efficiency of instruction in this (as in some other) respect may be doubted. May be, the data are not only an artifact.

These hypotheses call for special investigations of the development of strategies. We hope that our longitudinal studies of older students with presumably higher degree of meta-awareness will provide some evidence in this respect. But these are very modest first steps only. These studies last only two years. Comparisons between reflection level and action level as well as application of different instruments may exclude or limit methodological artifacts and reveal real developmental processes and conditions. Our data of the action level concerning text comprehension show a developmental progress in that 4th graders applied less deep structure and metacognitive strategies, and learning techniques than older ones. The older the students were, the more they used metacognitive strategies and learning techniques (deep structure strategies are used in 6th and 8th grade classes at the same level). Concerning surface strategies the picture is not so clear: 6th

graders use less such strategies than 4th and 8th graders. Concerning problem solving strategies in an action situation no systematic developmental differences between 4th, 6th, and 8th graders could be noted at all. In this investigation differences between performance groups and between sexes were much stronger. One of the critical characteristics in this connection was the different level of self-confidence in girls and boys.

Problems and prospects

The overview of selected results shows that our investigations enriched and differenciated the knowledge about learning strategies in several respects. But at the same time each investigation raises new problems and hypotheses. Most important in our opinion are the following ones:

1. The instruments used in our investigations stood the test in principle, but they need further improvement and completion by other ones. The *questionnaires* „How do you learn?" and „My learning experience" have to be revised again in order to reach a higher level of internal consistency and validity. In this respect we have to examine possibilities of a stronger differentiation between the strategy dimensions - deep structure, metacognitive, surface strategies, and learning techniques - and of the necessity or usefulness to add resource management as a fifth dimension with a clear differentiation between internal and external resources. Another aspect in this respect is the problem of the interrelationships between these dimensions: They are not lying in one plane (deep structure and surface strategies refer to the quality of cognitive processing as distinguished from metacognitive awareness of it, the latter is closer connected with deep structure than surface approach, but with resource management as well, learning techniques serve as means for cognitive processing - more deep structure or more surface oriented ...), therefore they have to be distinguished from one another as well as related to one another more carefully. Intercorrelations between these two questionnaires and the questionnaire „Multidimensional individual learning profile" showed correspondences as well as differences concerning several strategy aspects (this last instrument contains other aspects yet). This is used as a measure of mutual control, but there are possibilities for economy as well. Most important in this context is the *interrelation between reflection level and action level*. It would not be correct to exclude questionnaires and to concentrate an action analysis only. Both levels really exist and show different aspects of learning strategies. Therefore, the interrelations between these two levels of analysis are of special interest. Until now, we could study them only with respect to text comprehension and problem solving. Even these task categories have to be studied in more detail, with different content, complexity etc. And other task categories have to be included. Such

action analyses are very time-consuming (individual experiments, detailed recording etc.). Our first attempts to study learning strategies in hypermedia environments with computer event-log encourage us to continue and broaden this approach. A whole research program has to be carried out in this regard: Usage and interpretation of learning strategies in different learning domains and differently organized learning environments, interview situations etc., relationships between learning strategies, on the one hand, and attitude towards computer and computer literacy, cognitive and other learning motives, self-concept, domain-specific knowledge and level of cognitive development etc., on the other. Though this seems to be a very promising direction, other methodological approaches to the study of learning strategies have to be found and implemented as well.

2. As we learned in our investigations, *interrelations between learning strategies and other psychic components of activity regulation* are neither linear nor identical in different situations. In this connection ontogenetic and individual differences (and correspondences) are of special interest. Cross-sectional and longitudinal studies allow to compare data and to reconstruct real *developmental processes*. It is open yet, whether there are distinct qualitative changes from one developmental or age level to another or a more gradual approximation toward a more or less markedly developed and differentiated strategy repertoire. We do not expect that all learners form relatively the same or an analogous repertoire. It would be more likely to expect a stronger distinction of individual differences, of strategic and content-related preferences connected with motivational, emotional and cognitive characteristics of students' personality development. In this respect the analysis of individual and subgroup particularities as well as cross-cultural studies of strategy knowledge and application and their subjective and objective conditions are of central significance. First steps in this direction are made.
3. Developmental and educational psychology are obliged to elaborate orientations and recommendations for the *advancement of psychological development* by pedagogical organisation of students' activity conditions. Of course, this is true for learning strategy research as well. As a rule, „pure" strategy training independent of certain content domains does not provide developmental effects at all or leads to certain changes for a short time only. As we saw, application and interpretation of learning strategies essentially depend on domain-specific tasks and situations. And the range of learning strategies is much broader than learning techniques and resource management which dominate in popular recommendations in this field. The efforts aimed at the *formation of strategies* (or promotion of their development) for independent, effective, and self-responsible learning have to correspond to the essence of learning strategies. This means, above all:

- As learning strategies are directed towards reaching certain learning goals and the latter are necessarily content-specific ones, formation of learning strategies calls for a *unity of declarative, procedural, and conditional knowledge and real strategy use* in connection with defined learning domains or objects or courses or the like. In order to acquire the respective domain, *domain-specific learning actions* have to be learned and carried out. Depending on special conditions, learning actions may be modified and transferred to other domains. In this process, learning strategies - as specific aspects or qualities of the way learning actions are carried out - may be abstracted from a certain content and generalized to a certain extent. In this process, strategies may become an object of reflection and evaluation, comparison and exchange of experience among students thus becoming more strategic and conscious learners.
- Learning strategies represent only one component of psychic regulation of learning activity. Therefore, they cannot be formed in isolation from other components. *Motivational and other aspects* have to be considered at the same time. That means, psychic regulation has to be inspired and promoted as a whole in its complexity. Without respective learning motivation and positive attitudes toward the learning object and learning activity, without understanding sense and usefulness of strategic thought and effort, without cognitive processing respective goal setting, recommendations, explications etc., no intended learning strategies will be formed or advanced by educational measures.
- In each case, learners have already some learning experience - may be, very one-sided and limited one. Therefore, the formation of learning strategies does never begin at point zero. The concrete *personal learning prerequisites* - in relationship to the *domain-specific learning tasks* and the *educational goals* to be reached - are the background for the strategic guidance and recommendations. Learning goals may be reached in different ways or with this or that accentuation. Particular students may have formed some preferences or aversions in prior learning experiences. Therefore, the same method or recommendation may not have the same meaning for or effect on different students. Thus, efforts have to be made to *help students find and use strategies most adequate and useful for them*.
- As a rule, relearning is more expensive than learning of new content or method. This is true for strategy formation as well. Therefore it is better to try to *avoid development of inadequate or ineffective strategies as early as possible* rather than later on to try to overcome them with large expenditure of time and effort on the part of students and teachers. Promotion of learning strategy development is a *long-lasting aspect* of

instructional design and implementation, a necessary component of the unity of content and method to be considered permanently.

- The effective formation of learning strategies in instructional processes calls for a close and long-lasting *cooperation between researchers and practitioners* (teachers). Essential prerequisites for such a team work - e.g., in experimental schools as an important precondition for changes in broader school practice - have to be created by *interdisciplinary cooperation* of psychologists, scientists in education, curriculum and instruction, and other specialists. The better learning strategies are studied, the more differentiatedly hypotheses may be formulated concerning mechanisms and conditions of their development as the foundation for practical efforts in school (and university as well). Vice versa, theoretically founded teaching experiments aimed at the formation of learning strategies may play a significant role in further revealing essence and developmental regularities of learning strategies.

References

Adey, P. & Shayer, M. (1994): Really raising standards. Cognitive intervention and academic achievement. London: Routledge

Alexander, P.A. & Murphy, P.K. (1997): College instruction and concomitant changes in students' knowledge, interest, and strategy use: A study of domain learning. *Contemporary Educational Psychology 22,* 125-146

Ames, C.. & Archer, J. (1988): Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology 80(3),* 260-267

Artelt, C. (1996): Stärken und Schwächen der Diagnose von Lernstrategien in realen Lernsituationen. *Lern- und Lehrforschung, LLF-Berichte Nr. 16,* 3-18. Potsdam: Universität Potsdam

Artelt, C. (1998): Lernstrategien und Lernerfolg - Ein Methodenvergleich. *Lern- und Lehrforschung, LLF-Berichte Nr. 18,* 24-50. Potsdam: Universität Potsdam

Artelt, C. (in press): Lernstrategien und Lernerfolg - Eine handlungsnahe Studie. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*

Artelt, C. & Schellhas, B. (1996): Zum Verhältnis von Strategiewissen und Strategieanwendung und ihren kognitiven und emotional-motivationalen Bedingungen im Schulalter. *Empirische Pädagogik 10(3),* 277-305

Baumert, J. (1993): Lernstrategien, motivationale Orientierung und Selbstwirksamkeits-Überzeugungen im Kontext schulischen Lernens. *Unterrichtswissenschaft 21(4),*327-354

Biggs, J.B. (1993): What do inventories of students' learning process really measure? A theoretical review and clarification. *British Journal of Educational Psychology 63,* 3-19

Blickle, G. (1996): Personality traits, learning strategies, and performance. *European Journal of Psychology 10,* 337-352

Braten, J. (1993): Cognitive strategies: A multi-componental conception of strategy use and strategy instruction. *Scandinavian Journal of Educational Research 37,* 217-242

Brenstein, E. (1996): Untersuchungsmöglichkeiten von Lernverhalten in hypermedialen Lernumgebungen. *Lern- und Lehrforschung, LLF-Berichte Nr. 16,* 45-55. Potsdam: Universität Potsdam

Brenstein, E & Neuser, A. (1998): Multidimensionale Individuelle Lernprofile in der differentiellen Lernstrategie-Diagnostik. *Lern- und Lehrforschung, LLF-Berichte Nr. 18,* 75-101. Potsdam: Universität Potsdam

Brenstein, E. & Schellhas, B. (1998): Differentielle Aspekte der Entwicklung von Lernstrategien bei Schülern 9. und 10. Klassen. *41. Kongreß der Deutschen Gesellschaft für Psychologie, 27.9.-1.10.,* Dresden

Brown, A.L. (1984): Metakognition, Handlungskontrolle, Selbststeuerung und andere, noch geheimnisvollere Mechanismen. In F.E. Weinert & R.H. Kluwe (Eds.), *Metakognition, Motivation und Lernen (60-109).* Stuttgart: Kohlhammer

Case, R. (1996): Changing views of knowledge and their impact on educational research and practice. In D.R. Olson & N. Torrance (Eds.), *The handbook of education and human development (75-99).* Cambridge, Mass.: Blackwell

Craik, F.J.M. & Lockhart, R.S. (1972): Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior 11,* 671-684

Davydov, V.V. (1988): Problems of developmental teaching. *Soviet Education 30(8),* 15-97, *30(9),* 3-83, *30(10),* 3-77

Davydov, V.V. (1996): *Theory of developmental teaching* (Russ.). Moscow: Intor

Dawydow, W.W., Lompscher, J & Markowa, A.K. (Eds.) (1982): *Ausbildung der Lerntätigkeit bei Schülern.* Berlin/Moskau: Volk und Wissen / Pedagogika

Entwistle, N. J. & Ramsden, P. (1983): *Understanding student learning.* London: Goom Helm
Galperin, P.Y. (1989): Organization of mental activity and the effectiveness of learning. *Soviet Psychology 27(3),* 65-82
Galperin, P.Y. (1992): Stage-by-stage formation as a method of psychological investigation. *Journal of Russian and East European Psychology 30(4),* 60-80
Garcia, T. & Pintrich, P.R. (1996): Assessing students' motivation and learning strategies in the classroom context: The Motivated Strategies for Learning Questionnaire. In M. Birenbaum & F.J.R.C. Dochy (Eds.), *Alternatives in assessment of achievements, learning processes and prior knowledge (319-399).* Boston: Kluwer
Geisler-Brenstein, E. & Schmeck, R.R: (1996): The revised Inventory of Learning Processes: A multifaceted perspective on individual differences in learning. In M. Birenbaum & F.J,R.C. Dochy (Eds.), *Alternatives in assessment of achievements, learning processes and prior knowledge (283-317).* Boston: Kluwer
Giest, H. (1996): Besonderheiten des Problemlösens bei Schülern 4., 6. und 8. Klassen. *Empirische Pädagogik 10(3),* 307-342
Greeno, J.G. (1997): On claims that answer the wrong questions. *Educational Researcher 26(1),* 5-17
Kabanowa-Meller, J.N. (1968): *Formation of methods of mental activity and mental development in students* (Russ.). Moscow: Prosvescenie
Leontyev, A.N. (1978): *Activity, consciousness, and personality.* Englewood Cliffs, NJ: Prentice-Hall
Leontyev, A.N. (1983): *Selected psychological works, vol 1-2* (Russ.). Moscow: Pedagogika
Lompscher, J. (Ed.) (1973): *Sowjetische Beiträge zur Lerntheorie. Die Schule P.J. Galperins.* Köln: Pahl-Rugenstein
Lompscher, J. (Ed.) (1975): *Theoretische und experimentelle Untersuchungen zur Entwicklung geistiger Fähigkeiten.* Berlin: Volk und Wissen
Lompscher, J. (Ed.) (1989a): *Psychologische Analysen der Lerntätigkeit.* Berlin: Volk und Wissen
Lompscher, J. (1989b): Formation of learning activity in pupils. In H. Mandl, E. de Corte, N. Bennet & H.F. Friedrich (Eds.), *Learning and instruction: European research in an international context, vol. 2.2 (47-66).* Oxford: Pergamon Press
Lompscher, J. (1995): Erfassung von Lernstrategien mittels Fragebogen. *Lern- und Lehrforschung, LLF-Berichte Nr. 10,* 80-136. Potsdam: Universität Potsdam
Lompscher, J. (1996a): Einleitung. Lernstrategien - Eine Komponente der Lerntätigkeit. *Empirische Pädagogik 10(3),* 235-244

Lompscher, J. (Ed.)(1996b): *Entwicklung und Lernen aus kulturhistorischer Sicht. Was sagt uns Wygotski heute.* Marburg: BdWi-Verlag
Lompscher, J. (1996c): Aufsteigen vom Abstrakten zum Konkreten - Lernen und Lehren in Zonen der nächsten Entwicklung. *Lern- und Lehrforschung, LLF-Berichte Nr. 16,* 98-118. Potsdam: Universität Potsdam
Lompscher, J. (1996d): Erfassung von Lernstrategien auf der Reflexionsebene. *Empirische Pädagogik 10(3),* 245-275
Lompscher, J. & Bartl, B. (1996): Lernstrategie-Fragebögen für ältere Schüler. *Lern- und Lehrforschung, LLF-Berichte Nr. 16,* 19-34
Mandl, H. & Friedrich, H.F. (Eds.)(1992): *Lern- und Denkstrategien. Analyse und Intervention.* Göttingen: Hogrefe
Mentchinskaya N.A. (1989): *Problems of learning and student's mental development* (Russ.). Moscow: Pedagogika
Metzger, C., Weinstein, C.E. & Palmer, D.R. (1995): *WLI - Schule.Wie lerne ich?* Harau: Sauerländer
Pintrich, P.R. & Garcia, T. (1991): Student goal orientation and self-regulation in the college classroom. In M.L. Maehr & P.R. Pintrich (Eds.), *Advances in motivation and achievement, vol. 7* (371-402). Greenwich: Jai Press
Pintrich, P.R., Smith, D.A.F., Garcia, T. & McKeachie, W.J. (1993): Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and Psychological Measurement 53,* 801-813
Rogoff, B. Matusov, E. & White, C. (1996): Models of teaching and learning: Participation in a community of learners. In D.R. Olson & N. Torrance (Eds.), *The handbook of education und human development (388-414).* Cambridge, Mass.: Blackwell
Sageder, J. (1995): Linzer Inventar zur Erfassung des Lern- und Studierverhaltens (LILEST). Linz: Johannes-Kepler-Universität
Schellhas, B. (1996): Befunde und Überlegungen zur handlungsnahen Untersuchung von Lernstrategien in hypermedialen Lernkontexten. *Lern- und Lehrforschung, LLF-Berichte Nr. 16,* 35-44
Schellhas, B. & Klas, E. (1998): Lernstrategien und kognitive Eigenschaften des Lerners. *Lern- und Lehrforschung, LLF-Berichte Nr. 18,* 51-74
Schmeck, R.R. (Ed.)(1988): *Learning strategies and learning styles.* New York: Plenum
Shuell, T.J. (1996): Teaching and learning in a classroom context. In D.C. Berliner & R.C. Calfee (Eds.), *Handbook of educational psychology (726-764).* New York: Macmillan
Vygotsky, L.S. (1978): *Mind in society. The development of higher psychological processes.* Cambridge, Mass.: Harvard University Press
Vygotsky, L.S. (Wygotski) (1985/87): *Ausgewählte Schriften, Bd. 1-2.* Berlin: Volk und Wissen

Vygotskiy, L.S. (1987): *Collected works, vol. 1. Problems of general psychology.* New York: Plenum
Weinstein, C.E., Goetz, E.T., Alexander, P.A. (Eds.)(1988): *Learning and study strategies: Issues in assessment, instruction, and evaluation.* San Diego: Academic Press
Weinstein, C.E., Zimmerman, S.A. & Palmer, D.R. (1988): Assessing learning strategies: The design and development of the LASSI. In Weinstein, C.E. et al. (Eds.), *Learning and study strategies: Issues in assessment, instruction, and evaluation (25-40).* San Diego: Academic Press
Wertsch, J.V., del Rio, P. & Alvarez, A. (Eds.)(1995): *Sociocultural studies of mind.* Cambridge, Mass.: Cambridge University Press
Wild, K.-P., Schiefele, U. & Winteler, A. (1992): *LIST - ein Verfahren zur Erfassung von Lernstrategien im Studium.* München: Universität der Bundeswehr
Zimmerman, B.J. & Martinez-Pons, M. (1990): Student differences in self-regulated learning: Relating grade, sex, and giftedness to self-efficacy and strategy use. *Journal of Educational Psychology 82(1),* 51-59

Motivational beliefs and learning strategy use

The relationship between motivational beliefs and learning strategy use among Norwegian college students

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During the last 10-15 years, the relationship between motivation and cognition has received increased attention within educational psychology. Research on student cognition has demonstrated important linkages between different cognitive learning strategies and academic performance (e.g., Pintrich, 1989; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Schiefele & Wild, 1994; Weinstein & Mayer, 1986). For example, Pintrich and associates (Pintrich, 1989; Pintrich & Garcia, 1991) have shown that North American college students who use more deep-processing strategies like elaboration and organization do better on several academic performance measures. In line with this, Schiefele and Wild's (1994) study of German university students showed that students' use of organizational strategies was the best predictor of their achievement. However, along with this emphasis on students' learning strategies, it has become increasingly clear that knowledge of strategies is not sufficient to promote achievement. Students must also develop the motivation to actually use this knowledge (e.g., Garcia & Pintrich, 1994; McKeachie, Pintrich, & Lin, 1985; Schutz, 1994). As Palmer and Goetz (1988) have pointed out, the fact that strategies are learner-initiated actions suggests that motivational factors play a very important role in strategy use. When students are not motivated, they may know about effective strategies, but still not use them. Alternatively, they may fail to transfer strategies to domains outside the specific instructional context (cf., Garcia & Pintrich, 1994).

Among the motivational factors most studied in connection with students' learning strategy use are goal orientation and self-efficacy. Goal

conceptions of motivation have distinguished between an orientation towards learning, task or mastery goals on the one hand and performance, ego, or ability goals on the other (Ames, 1984; Dweck, 1986; Nicholls, 1984). Whereas individuals who pursue the first type of goals seek to develop their competence by investing effort and tend to value learning for its own sake, individuals who pursue the second type of goals seek to demonstrate high competence by outperforming others and tend to value ability rather than learning. In general, it has been found that students who adopt the first type of goals (hereafter called learning goals) are more likely to be cognitively engaged through learning strategy use than students who adopt the second type of goals (hereafter called performance goals) (e.g., Ames & Archer, 1988; Meece, 1994; Pintrich & De Groot, 1990; Schiefele & Schreyer, 1994). Meece (1994) reported a correlation as high as .70 between fifth- and sixth-graders learning-goal orientation and their strategy use. This accords well with Pintrich and De Groot (1990), who found in their sample of seventh-grade students that learning-goal orientation correlated .63 with reported strategy use. In Ames and Archer's (1988) study, the learning-goal orientation of junior high/high school students correlated .49 with reported stategy use. Schiefele and Schreyer (1994) found in their recent meta-analysis that learning-goal orientation was mainly related to deep-processing strategies like elaboration and organization, but not to surface-level strategies like rehearsal. When it comes to college students, Pintrich and associates (Pintrich, 1989; Pintrich & Garcia, 1991) have generally found that orientation towards learning goals is positively correlated with cognitive strategy use at about the .40 level. However, Schiefele and Wild (1994) reported that in their sample of German university students a motivational orientation involving learning goals did not predict the use of learning strategies. Although a positive relationship between learning-goal orientation and strategy use has been documented in both younger and older students, this relationship may thus seem to weaken with increasing age and even become a bit shaky at the postsecondary level. Accordingly, there is still room for increased clarity concerning the relationship between learning-goal orientation and strategy use among adult students, not least in a non-American context.

Another motivational factor that seems to be linked to learning strategy use in important ways is the belief that one can successfully do what is necessary to perform the task and accomplish one's goals. While this factor has been referred to in different terms in the motivational literature (e.g., self-efficacy, perceived competence, perceived ability, personal agency beliefs, and confidence), the basic construct seems to

involve students' expectations of success based on their trust in their capabilities to perform the task (cf., Pintrich & De Groot, 1990). In general, research suggests that students' beliefs about their capabilities to perform the task (hereafter called self-efficacy) is positively related to learning strategy use (e.g., Ames & Archer, 1988; Meece, 1994; Pintrich & De Groot, 1990; Pintrich, Garcia, & De Groot, 1994). For example, Meece (1994) reported that self-efficacy beliefs correlated .16 with fifth- and sixth-graders' use of learning strategies. In Pintrich and De Groot's (1990) study of seventh graders, the correlation between self-efficacy and learning strategy use was .33. Ames and Archer (1988) showed through hierarchical regression analysis that self-efficacy when entered first accounted for 3 % of the variance in learning strategies among junior high/high school students. While Pintrich and associates' (Pintrich, 1989; Pintrich & Garcia, 1991) research with college students has generally found a positive correlation between self-efficacy and learning strategy use of about .40, these researchers have also identified certain groups of students where self-efficacy beliefs and learning strategy use are not related to one another (Pintrich & Garcia, 1994). Taken together, this research suggests that a rather weak but significant relationship exists between self-efficacy and learning strategy use. However, as Pintrich and Garcia (1994) has pointed out, there may well be groups of adult students in which this relationship is nonexistent.

Recently, Pintrich and associates (Garcia & Pintrich, 1994; Pintrich, Garcia, & De Groot, 1994) have developed a conception of self-efficacy that links self-efficacy beliefs to a larger network of self-related beliefs. In their view, students' self-efficacy beliefs constitute one dimension of self-schemas, also characterized by an affective, a temporal, and a value dimension. In a study of the relations between the efficacy dimension of the self-schema and the use of cognitive learning strategies, Pintrich et al. (1994) found that seventh-grade students' beliefs that they could remain successful in the domain correlated .26 with their strategy use in mathematics and .31 with their strategy use in English. In addition, students' beliefs that they could become more successful in the domain correlated .12 with strategy use in mathematics and .24 with strategy use in English. Finally, Pintrich et al. (1994) demonstrated a "buffering" effect of high self-efficacy by showing that students who perceived themselves to be unsuccessful in mathemathics (i.e., had negative self-schemas) still engaged in learning strategies if they thought they were capable of improvement. That is, these students were only lower in strategy use if they did not expect a change for the better.

The possibility that high self-efficacy may, in part, compensate for the adverse effect on learning strategy use of other, negative forms of motivational beliefs has also been noted by other researchers (e.g., Ames & Archer, 1988; Meece, 1994). For example, the results of Ames and Archer's (1988) study may be interpreted in support of the idea that self-efficacy has the greatest impact on learning strategy use when performance goals are adopted by students. Accordingly, a learning-goal orientation may seem to reduce the impact of self-efficacy on learning strategies (see also, Covington & Omelich, 1984; Meece & Holt, 1993).

It should also be mentioned that perceptions of low self-efficacy may generally drive high levels of strategic learning for some students. According to Garcia and Pintrich (1994), some students are "defensive pessimists", holding low expectations for success but using their concerns about lack of efficacy to drive strategic effort in an attempt to avoid failure.

In brief, the relationship between students' self-efficacy beliefs and their learning strategy use is still somewhat unclear and more studies are obviously needed in different contexts. Especially, it seems important to examine the contribution of self-efficacy to learning strategy use in combination with other forms of motivational beliefs.

The theoretical framework for conceptualizing the relationship between students' motivational beliefs and learning strategy use in the present research (Bråten & Olaussen, 1997, 1998), was the goals approach to motivation presented by Dweck and associates (e.g., Dweck, 1986; Dweck, Chiu & Hong, 1995; Dweck & Leggett, 1988; Heyman & Dweck, 1992). Dweck's research-based model holds that the most fundamental motivational force in achievement situations is the individual's implicit theory of intelligence, that is, the informal idea about the nature of intelligence that a person has constructed and has "in his or her head" (cf., Sternberg, 1990). While some students favor an incremental theory and conceive of intelligence as a malleable, increasable, and controllable quality, other students have constructed an entity theory and believe that intelligence is a fixed or uncontrollable trait. It is these different theories that, in turn, orient students towards different goals, with research consistently indicating that incremental theorists pursue the learning goals of increasing their intellectual quality, whereas entity theorists pursue the performance goals of gaining positive judgments of their intellectual gift or preventing negative judgments of it (cf., Dweck & Leggett, 1988). According to Dweck's model, learning goals lead to an adaptive or mastery-oriented pattern, where students seek challenges that promote learning and respond to difficulties with renewed strategic effort to overcome temporary setbacks.

Additionally, students with learning goals are supposed to maintain their focus on learning strategies even when their self-efficacy is low, thus risking to display their limited competence in order to acquire new skills and knowledge (Dweck, 1986). In contrast, performance goals create vulnerability to a maladaptive or helpless pattern, where students avoid challenging tasks and react to difficulties with decrements in their level of strategy use. Especially, this applies to students with performance goals who also have low self-efficacy. Only students with performance goals and high self-efficacy may sometimes display a mastery-oriented motivational pattern. Elliott and Dweck (1988) provided evidence that for students with learning goals self-efficacy was largely irrelevant, whereas the pattern displayed by students with performance goals was highly dependent on their level of self-efficacy. However, it should be noted that performance goals have been associated with the avoidance of challenge even with high levels of self-efficacy. Thus, performance-goal oriented students, with high self-efficacy, although more mastery oriented than students with low self-efficacy, may nontheless avoid challenge and sacrifice learning opportunities that pose the risk of errors and difficulties (Bandura & Dweck, 1985; Elliott & Dweck, 1988).

The belief that one's intellectual capacity is personally controllable may well reflect an individualistic optimism that is somewhat characteristic of the American world outlook or cultural model (cf., Wertsch, 1995), or, alternatively, its impact on achievement-related behavior may be somewhat peculiar to students who are ideologically committed to typical American values. Therefore, one purpose of the present research was to examine the relationship between an incremental theory of intelligence (with its associated learning-goal orientation) and learning strategy use among academically advanced college students in a different cultural context. The strength of the relationship between an incremental theory of intelligence and learning strategy use may also vary with different theory of intelligence assessments. Specifically, it is possible that asking students directly about how modifiable they think intelligence is may give another result than probing their theory of intelligence in a more indirect way, that is, by asking them about the modifiability of several intellectual characteristics but avoiding the term intelligence itself. Thus, a second purpose of our research was to examine if the relationship between an incremental theory of intelligence and learning strategy use was affected by the way students' theory of intelligence was assessed. Additionally, because previous research with adult students has reported somewhat inconsistent findings concerning both the relationship between learning-goal orientation and

strategy use and the relationship between self-efficacy and strategy use, a third purpose involved examining the relative contribution of an incremental theory of intelligence and self-efficacy to students' use of learning strategies. Finally, our fourth purpose was to examine potential differences in learning strategy use among students differing in their combination of theory of intelligence and self-efficacy. Consistent with Dweck's model, it may be expected that students combining a strong belief in the modifiability of intelligence with high self-efficacy and students combining a strong belief in the modifiability of intelligence with low self-efficacy should both use more learning strategies than students combining doubt about the modifiability of intelligence and low-self-efficacy. In comparison with these group profiles, students combining doubt about the modifiability of intelligence and high self-efficacy may possibly fall somewhere in between as regards their strategy use.

In summary, our research with Norwegian college students tried to answer these four questions: First, what is the relationship between an incremental theory of intelligence and the use of learning strategies? Second, does the strength of the relationship between an incremental theory of intelligence and learning strategy use depend on whether the students are asked directly or indirectly about their theory of intelligence? Third, what is the contribution of an incremental theory of intelligence to students' learning strategy use in relation to the contribution of their self-efficacy beliefs? Fourth, how do groups of students with high or low score on the theory of intelligence measure and on the self-efficacy measure differ in their use of learning strategies?

Method

Subjects

The subjects of our first study (Bråten & Olaussen, 1998) were 176 students at the Faculty of Education, Oslo College, who were in the second year of their teacher training. These were all students at this level of teacher training who were in attendance on the day of assessment. The sample included 131 women (74.4 %) and 45 men (25.6 %). The students ranged in age from 20 to 53 years ($M = 27.0$ years; $SD = 6.3$ years). Because of a severe competition for the admittance to the college's teacher training, our sample included only high-achieving students who had got very good marks in their previous school exams. The students in our sample had Norwegian as their native language and had completed their secondary education in a Norwegian school.

Materials

Data were collected in the following areas: learning strategies, theory of intelligence, and self-efficacy. All the tasks were administered to one class at a time. A description of each measure follows.

Learning strategies. Students' reported use of learning strategies were assessed with 24 items from a Norwegian adaptation of the Learning and Study Strategies Inventory - LASSI (Weinstein, Schulte, & Palmer, 1987). The LASSI has 77 items that focus on "both covert and overt thoughts and behaviors that relate to successful learning" (Weinstein, 1987). The 77-item inventory is divided into 10 subscales: Attitude, Motivation, Time Management, Anxiety, Concentration, Information Processing, Selecting Main Ideas, Study Aids, Self-Testing, and Test Strategies. In our study, only items belonging to the subscales of Information Processing, Study Aids, and Self-Testing were administered. The items on the Information Processing scale address to what extent students use strategies to elaborate and organize information, monitor comprehension, and relate new material to prior knowledge (sample item: I translate what I am studying into my own words). The Study Aids scale items are supposed to measure the use and generation of diverse technical solutions and materials aimed at supporting and increasing meaningful learning and retention (sample item: I use special helps, such as italics and headings, that are in my textbooks). The items on the Self-Testing scale address to what extent students monitor or check their own understanding as they go through and review study material (sample item: I test myself to be sure I know the material I have been studying). A factor analysis of our Norwegian version of the LASSI (Olaussen & Bråten, in press) indicated that these three subscales (i.e., Information Processing, Study Aids, and Self-Testing) constituted a cognitive activity factor, consistent with factor analyses of the American version of the instrument (Olejnik & Nist, 1992).

For each of the 24 items the students were to indicate on a 5-point scale how well the statement described them (1 = *not at all typical of me*; 2 = *not very typical of me*; 3 = *somewhat typical of me*; 4 = *fairly typical of me*; 5 = *very much typical of me*).

On our 24-item inventory of learning strategies the scores ranged from 51 to 103 points ($M = 79.44$; $SD = 9.85$). The reliability of the measure was .80 (Cronbach's alpha).

Theory of intelligence. To assess students' implicit theory of intelligence, we used the Conception of Intelligence Scale (CIS). On the CIS, the students read 13 descriptions of intellectual qualities and were asked to indicate on a 5-point scale to what extent they thought that each

quality could be further developed (1 = *can be further developed to a very little extent*; 2 = *can be further developed to a little extent*; 3 = *can be further developed to some extent*; 4 = *can be further developed to a fairly large extent*; 5 = *can be further developed to a very large extent*). The following directions were given: "Some researchers claim that many human characteristics are fixed, that is, that they can hardly be changed or affected. Other researchers think that to a large extent these characteristics can be further developed, that is, that they can easily be changed or affected. Listed below are a number of human characteristics. Please indicate by check marks to what extent you think that these characteristics can be further developed". The intellectual qualities listed were: Vocabulary, Understanding of the essence of a problem, Attention, Thinking speed, Application of knowledge to solve problems at hand, Reading comprehension, Logical reasoning, Approaching problems thoughtfully, Identification of connections among ideas, Intellectual curiosity, Assessing the relevance of information to a problem at hand, Learning speed, and Reading pleasure.

In the process of developing the CIS, a list of 60 behaviors associated with intelligence was presented to 70 teacher training students at another college in the south-eastern part of Norway. These 60 behaviors were adapted from behaviors included in the factors that emerged from Sternberg, Conway, Ketron, and Bernstein's (1981) analyses of laypersons' and experts' ratings of characteristicness of behaviors in an ideally intelligent person. We asked our 70 students to indicate on a 5-point scale how typical they thought that each of the 60 behaviors was of an intelligent person (1 = *not at all typical of an intelligent person*; 2 = *not very typical of an intelligent person*; 3 = *somewhat typical of an intelligent person*; 4 = *fairly typical of an intelligent person*; 5 = *very much typical of an intelligent person*). The 13 behaviors that got the highest average scores among the students formed the basis of the CIS items, with the average scores of these behaviors ranging from 4.25 to 3.64 points. It may thus be assumed that the qualities rated for modifiability on the CIS are associated with intelligence in these students' minds.

In our sample of 176 students, the scores on the CIS ranged from 20 to 65 points ($M = 48.30$; $SD = 5.81$). The reliability of this measure was .84 (Cronbach's alpha).

After the students had responded to the 13 CIS items, they were asked to indicate on the same 5-point scale to what extent they thought that "intelligence" could be further developed. This single intelligence item was used to probe students' theory of intelligence in a more direct way. The

scores on this item ranged from 1 to 5 points ($M = 2.98$; $SD = .98$).

Self-efficacy. As a measure of self-efficacy, students were asked to rate their perceived success in their studies ("How is your success in your studies?") on a 5-point scale (1 = *not good*; 2 = *fair*; 3 = *good*; 4 = *very good*; 5 = *excellent*). On this measure of self-efficacy, students ranged in score from 1 to 5 points ($M = 3.67$; $SD = .68$).

Procedure

All the instruments were administered as group measures to one class at a time. Data collection took place during the second semester of the second year of the students' teacher training. The students were informed that their participation in the project was purely voluntary, but none of the students present refused to answer the questions. The students did not give up their names; only their sex and age were reported. The order of administration varied at random for the measures of learning strategies, theory of intelligence, and self-efficacy, but the single intelligence item was always presented to the students after their completion of the CIS. Each group finished all of the tasks in the course of a 45-minute session.

Results

The research questions concerned the relationship between students' theory of intelligence and their use of learning strategies. In the analyses, therefore, we focused on examining how each student's adoption of an incremental theory of intelligence was related to his or her reported use of learning strategies. The first set of analyses involved zero-order correlations between an incremental theory of intelligence and learning strategies, with sex, age, and self-efficacy also represented in the correlation matrix. Regression analyses were then used to compare the unique contribution of self-efficacy and incremental theory of intelligence to students' reported use of learning strategies when variance due to differences in sex and age were first partialled out. Last, we made certain profile comparisons across students, asking, for example, whether students who score high on both the theory of intelligence measure and the self-efficacy measure differ in learning strategy use from those students who score high on the theory of intelligence measure but low on the self-efficacy measure.

Correlational Analysis

Students' scores on the Conception of Intelligence Scale (CIS) and the single intelligence item were correlated with the learning strategy measure. As

shown in Table 1, scores on the CIS were significantly related to learning strategies ($r = .31$). Thus, when students conceived of intelligence as a relatively modifiable quality, they also reported using more learning strategies.

Table 1

Zero-Order Correlations between Motivational Beliefs and Learning Strategies

Variable	1	2	3	4	5	6
1 Sex	-					
2 Age	.09	-				
3 Self-efficacy	.07	.08	-			
4 Conception of intelligence	.13	.17*	.10	-		
5 Intelligence item	.11	.04	.06	.47***	-	
6 Learning strategies	.17*	.27***	.24**	.31***	.05	-

Note. *:p<.05 **:p<.01 ***p:<.001

However, students' scores on the single intelligence item were not significantly related to learning strategies. Asking students directly about the modifiability of intelligence apparently did not tap motivational beliefs that were associated with their learning strategy use. Interestingly, the correlation between the CIS and the single intelligence item was not higher than .47, indicating that these tasks tap somewhat different perceptions of the nature of intelligence.

Paralleling the finding for the CIS and learning strategies, higher levels of self-efficacy were correlated with higher levels of learning strategy use ($r = .24$). Self-efficacy was not significantly correlated with the CIS.

Finally, both sex ($r = .17$) and age ($r = .27$) were significantly related to the learning strategy measure. This means that women reported using more strategies than men, and that older students reported using more strategies than younger students.

Regression Analysis

Recent research has suggested that there is an important linkage between self-efficacy and learning strategy use. In our study, hierarchical regression

analysis was used to assess the contribution of theory of intelligence in relation to the contribution of self-efficacy to the learning strategy use of Norwegian college students. In this analysis, presented in Table 2, sex was entered first, followed by age, then the self-efficacy measure was entered, followed by the CIS and the single intelligence item. This order of entry was dictated by our interest in determining whether an incremental theory of intelligence accounted for a significant proportion of the variance in learning strategy use after the variance due to other factors, most notably to self-efficacy, was extracted.

Table 2

Learning Strategy Use Uniquely Predicted by Incremental Theory of Intelligence

Predictors Order of entry	Multiple R	R^2 change
Sex	.174	.030*
Age	.306	.063***
Self-efficacy	.369	.043**
Conception of intelligence	.440	.058***
Intelligence item	.453	.012

Note. *:p<.05 **:p<.01 ***:p<.001

As shown in Table 2, the self-efficacy measure accounted for significant additional variance in the students' reported use of learning strategies after the variance associated with sex and age was partialled out (4.3 %, $p<.01$). And after the variance associated with the self-efficacy measure was partialled out, the CIS also accounted for a significant additional proportion of variance in learning strategies (5.8 %, $p<.001$). Thus, it was possible to establish the students' conception of intelligence as a predictor of learning strategy use independent of their self-efficacy beliefs. As could be expected from the correlational analysis, the single intelligence item did not account for significant additional variance when entered as a predictor subsequent to the other measures of motivational beliefs.

Group Comparisons

Because students' conception of intelligence and self-efficacy were found to be independent measures of their motivational beliefs, differences among profiles of students could also be examined. For example, how do students who score high on both the theory of intelligence and the self-efficacy measures differ in their use of learning strategies from those who score high on the theory of intelligence measure but low on the self-efficacy measure? To make these comparisons, students were divided into four groups on the basis of a median split on both the CIS and the self-efficacy measure. Students with above-median scores on both the CIS and the self-efficacy measure were classified as a high - high (Hi - Hi) group, and remaining students were categorized in high CIS - low self-efficacy (Hi - Lo), low CIS - high self-efficacy (Lo - Hi), and low CIS - low self-efficacy (Lo - Lo) groups (see Table 3). One-way analysis of variance (ANOVA) and Tukey Honestly Significant Difference (HSD) group comparisons were used to test differences among the four groups on the measure of learning strategies. Table 3 shows the statistics for these group comparisons.

Table 3

Comparisons among Learning Strategy Means for Four Groups Split on Conception of Intelligence and Self-Efficacy Scores

		Hi - Hi (n = 41)	Hi - Lo (n = 46)	Lo - Hi (n = 46)	Lo - Lo (n = 42)	F (3, 175)
Strategies	M	83.98a	79.20ab	78.22b	76.62b	4.56**
	SD	8.68	10.39	9.81	9.14	

Note. Hi - Hi = high CIS - high self-efficacy; Hi - Lo = high CIS - low self-efficacy; Lo - Hi = low CIS - high self-efficacy; Lo - Lo = low CIS - low self-efficacy. Group means sharing same letter are not significantly different at the $p < .05$ level.
**:$p < .01$.

As can be seen in Table 3, there were significant differences among the groups on the learning strategy measure. Students who conceived of intelligence as a highly modifiable quality and also scored high on the self-efficacy measure reported using more strategies than students who viewed

intelligence as a less modifiable quality, regardless of whether these students had high or low self-efficacy. Apparently, as far as students' strategy use is concerned, high self-efficacy could not compensate for their doubt about the modifiablity of intelligence. There were no significant difference between the two groups who conceived of intelligence as a highly modifiable quality. That is, when students favored an incremental theory of intelligence, low self-efficacy did not have an adverse effect on their learning strategy use. However, the differences between the group who scored high on the CIS but low on the self-efficacy measure and the two groups who scored low on the CIS were not significant at the $p<.05$ level.

Discussion

First, the findings from our first study showed that an incremental theory of intelligence was significantly related to reported use of learning strategies in our sample of high-achieving Norwegian college students. A relation previously established within American theory and research was thus extended to a different cultural context. Besides, even among high-achieving college students who could be expected to be relatively advanced strategic learners, the use of learning strategies seemed to depend on students' conceptions of the nature of intelligence.

Second, it was found that the strength of the relationship between an incremental theory of intelligence and reported use of learning strategies varied with the way that students' theory of intelligence was assessed. Only probing students' theory of intelligence in an indirect way, that is, asking about the modifiability of intellectual qualities (e.g., vocabulary, attention, reading comprehension) but avoiding the term intelligence itself seemed to yield a measure of motivational beliefs that was related to their learning strategy use. Possibly, these students were more prone to search for the right answer in terms of their educational psychology textbooks when the term intelligence was encountered. Thus, by referring to opinions that were not personally significant and relevant, their answers to this item may also have been less associated with their own achievement behaviors. It should be noted that the students' answers to the single intelligence item indicated that they viewed "intelligence" as less modifiable than the other intellectual qualities that were evaluated on the CIS.

Third, the relation between an incremental theory of intelligence and students' reported use of learning strategies remained significant when the effects of sex, age, and self-efficacy were partialled out. Although self-efficacy may seem to be an important motivational source underlying

effective strategy use, our findings suggested that a belief in the modifiability of intelligence may override the contribution of self-efficacy to students' use of learning strategies. This interpretation is consistent with Dweck's (1986; Dweck & Leggett, 1988) model of motivational processes and is supported by other research indicating that a learning-goal orientation may seem to reduce the impact of self-efficacy on learning strategies (e.g., Ames & Archer, 1988; Covington & Omelich, 1984; Meece & Holt, 1993).

Fourth, the relative importance of an incremental theory of intelligence and self-efficacy for students' learning strategy use was also examined by comparing students differing in their combination of theory of intelligence and self-efficacy. These group comparisons showed that students who believed that intelligence was a modifiable quality tended to report using more learning strategies than students who had more doubts about the modifiability of intelligence. There were no significant differences in students' strategy use within the groups who believed in the modifiability of intelligence or within the groups who had doubts about its modifiability, regardless of whether the students scored high or low on the self-efficacy measure. This is consistent with predictions that can be made on the basis of Dweck's (1986; Dweck & Leggett, 1988) model, in that students who believed in the modifiability of intelligence seemed to maintain their level of strategy use even when their self-efficacy was low, whereas high self-efficacy did not fully compensate for less strategy use in students who had doubts about the modifiability of intelligence.

There are several limitations to the findings of our first study, however. For example, both students motivational beliefs and their learning strategy use were assessed by self-report instruments. Several important studies in this area have also used this method to measure students' perceptions of motivation and learning strategies (e.g., Ames & Acher, 1988; Pintrich & De Groot, 1990). Still, using only self-reports is open to several criticisms, for example, that students may report using learning strategies they do not demonstrate using or that a large distance between actual processing and reporting may overtax student memory (see Garner, 1988). Therefore, self-reports should be supplemented with other methods like think-aloud procedures, stimulated-recall techniques, peer tutoring to externalize strategies, optimal- nonoptimal production activities, structured interviews, and behavioral observations (cf., Garner, 1988; Garner & Alexander, 1989).

Another limitation to the findings of this study is that questions about causality have not been adequately answered by our analyses. Certainly, data gathered through a cross-sectional survey study of students at a single

point in time seriously restricts inferences that can be reliably made about causal relations.

Moreover, our attempt to replicate the findings of our first study with a sample of 173 first-year teacher students at the same college some time later (Bråten & Olaussen, 1997), was not met with success. Our hypothesis that students` theory of intelligence was related to learning strategy use, was not confirmed in this sample. Another hypothesis concerned the relative contribution of an incremental theory of intelligence and self-efficacy to students' reported use of learning strategies. Contrary to our expectations, students' self-efficacy beliefs were found to be more important for their learning strategy use than an incremental theory of intelligence, with only self-efficacy being a significant predictor of students' learning strategies. Again, this result concerning the relative importance of an incremental theory of intelligence and self-efficacy for students' learning strategy use represented a replication failure.

The inconsistent results obtained in our second study are not easy to interpret. As mentioned earlier, in doing our first study, we thought it possible that a relation between the belief that one`s intellectual capacity is personally controllable and achievement-related behavior might be somewhat peculiar to students who are committed to typical American values (cf., Bråten & Olaussen, 1998). Of course, the replication failure might have caused us to reconcider the possibility of dealing with a more or less culture-specific relation. However, an acknowledgement of the contextualized nature of the relation between students' motivational beliefs and their strategy use (cf., Paris & Turner, 1994; Pintrich & De Groot, 1990), has led us more towards some speculations about the learning situations of our two samples.

First, after we collected the data for our first study, college education went through a structural reform in Norway. This reform involved a worsening of the economic conditions of teacher training that created much frustration and pessimism among college teachers. The students who took part in our replication study therefore had fewer lessons, less individual counselling, and, possibly, less motivated and enthusiastic teachers than the students in our first study. The reform also resulted in more students per teacher than before. Taken together, these changes may have brought about learning situations that were less favorable for the fusion of will and skill.

Second, the students in our first study had experienced more project-based learning than the students in our replication study. Project-based learning was a rather commonly used instructional method in these teacher training courses, and the students in our first study were in the second year

of teacher training whereas the students in the replication study were first-year students. According to Paris and Turner (1994), project-based learning is an example of innovative teaching methods that create situations promoting students' choices, challenges, control, and collaboration. These authors also indicate that learning contexts in which students experience genuine choices, challenging tasks, control over their own learning, and opportunities to collaborate with others may be specially suited to foster an integration between motivational beliefs and learning strategies (ibid.). In short, one cannot exclude the possibility that more good teaching may have produced a more intertwined set of motivation and cognition in our first sample. It should also be noted that the students in our first study tended to score somewhat higher on our measures of both conception of intelligence and learning strategies than the students in our replication study.

In comparion with the relation between an incremental theory of intelligence and learning strategies, the relation between students self-efficacy beliefs and their learning strategy use might be so robust that it can survive both cultural variations and variations in learning situations within cultures.

Admittedly, the post hoc explainations referred to above are speculative and in need of empirical investigation. I seems pertinent to attempt further cross-cultural validation of hypotheses concerning the relationship between students' motivational beliefs and their learning strategy use. In these studies, the effects of variations in learning situations within cultures should also be studied systematically.

References

Ames, C. (1984). Competitive, cooperative, and individualistic goal structures: A cognitive motivational analysis. In R. Ames & C. Ames (Eds.), *Research on motivation in education: Student motivation* (Vol. 1, pp. 177-208). New York: Academic Press.

Ames, C. & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivational processes. *Journal of Educational Psychology, 80*, 260-267.

Bandura, M. & Dweck, C.S. (1985). *The relationship of conceptions of intelligence and achievement goals to achievement-related cognition, affect, and behavior.* Unpublished manuscript, Harvard University.

Bråten, I. & Olaussen, B.S. (1998). The relationship between motivational beliefs and learning strategy use among Norwegian college students. *Contemporary Educational Psychology, 23*, 182-194.

Bråten, I. & Olaussen, B.S. (1997). *The relationship between motivational beliefs and learning strategy use among Norwegian college students: A replication study.* Manuscript submitted for publication.

Covington, M.V. & Omelich, C.L. (1984). Task-oriented versus competitive learning structures: Motivational and performance consequences. *Journal of Educational Psychology, 76*, 1038-1050.

Dweck, C.S. (1986). Motivational processes affecting learning. *American Psychologist, 41*, 1040-1048.

Dweck, C.S., Chiu, C., & Hong, Y. (1995). Implicit theories and their role in judgments and reactions: A world from two perspectives. *Psychological Inquiry, 6*, 267-285.

Dweck, C.S. & Leggett, E.L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*, 256-273.

Elliott, E.S. & Dweck, C.S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology, 54*, 5-12.

Garcia, T. & Pintrich, P.R. (1994). Regulating motivation and cognition in the classroom: The role of self-schemas and self-regulatory strategies. In D.H. Schunk & B.J. Zimmerman (Eds.), *Self-regulation of learning and performance: Issues and educational applications* (pp. 127-153). New York: Erlbaum.

Garner, R. (1988). Verbal-report data on cognitive and metacognitive strategies. In C.E. Weinstein, E.T. Goetz, & P.A. Alexander (Eds.), *Learning and study strategies: Issues in assessment, instruction, and evaluation* (pp. 63-76). San Diego: Academic Press.

Garner, R. & Alexander, P. (1989). Metacognition: Answered and

unanswered questions. *Educational Psychologist, 24*, 143-158.
Heyman, G.D. & Dweck, C.S. (1992). Achievement goals and intrinsic motivation: Their relation and their role in adaptive motivation. *Motivation and Emotion, 16*, 231-247.
McKeachie, W.J., Pintrich, P.R., & Lin, Y. (1985). Teaching learning strategies. *Educational Psychologist, 20*, 153-161.
Meece, J.L. (1994). The role of motivation in self-regulated learning. In D.H. Schunk & B.J. Zimmerman (Eds.), *Self-regulation of learning and performance* (pp. 25-44). New York: Erlbaum.
Meece, J. & Holt, K. (1993). Variations in students' goal patterns. *Journal of Educational Psychology, 85*, 582-590.
Nicholls, J.G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review, 91*, 328-346.
Olaussen, B.S. & Bråten, I. (in press). Identifying latent variables measured by the Learning and Study Strategies Inventory (LASSI) with Norwegian college students. *Journal of Experimental Education.*
Olejnik, S. & Nist, S.L. (1992). Identifying latent variables measured by the Learning and Study Strategies Inventory (LASSI). *Journal of Experimental Education, 60*, 151-159.
Palmer, D.J. & Goetz, E.T. (1988). Selection and use of study strategies: The role of the studier's beliefs about self and strategies. In C.E. Weinstein, E.T. Goetz, & P.A. Alexander (Eds.), *Learning and study strategies: Issues in assessment, instruction, and evaluation.* (pp. 41-61). San Diego: Academic Press.
Paris, S.G. & Turner, J.C. (1994). Situated motivation. In P.R. Pintrich, D.K. Brown, & C.E. Weinstein (Eds.), *Students motivation, cognition, and learning* (pp.213-237). Hillsdale, NJ: Erlbaum.
Pintrich, P.R. (1989). The dynamic interplay of student motivation and cognition in the college classroom. In C. Ames & M.L. Maehr (Eds.), *Advances in motivation and achievement: Motivation-enhancing environments* (Vol. 6, pp. 117-160). Greenwich, CT: JAI Press.
Pintrich, P.R. & De Groot, E.V. (1990). Motivation and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*, 33-40.
Pintrich, P.R. & Garcia, T. (1991). Student goal orientation and self-regulation in the college classroom. In M.L. Maehr & P.R. Pintrich (Eds.), *Advances in motivation and achievement: Goals and self-regulatory processes* (Vol. 7, pp. 371-402). Greenwich, CT: JAI Press.
Pintrich, P.R. & Garcia, T. (1994). Self-regulated learning in college

students: Knowledge, strategies, and motivation. In P.R. Pintrich, D.K. Brown, & C.E. Weinstein (Eds.), *Student motivation, cognition, and learning* (pp. 113-133). Hillsdale, NJ: Erlbaum.

Pintrich, P.R., Garcia, T., & De Groot, E. (1994, April). *Positive and negative self-schemas and self-regulated learning.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

Schiefele, U. & Schreyer I. (1994). Intrinsische Lernmotivation und Lernen: Ein Überblick zu Ergebnissen der Forschung [Intrinsic motivation to learn and learning: A review of research findings]. *Zeitschrift für Pädagogische Psychologie, 8,* 1-13.

Schiefele, U. & Wild, K.P. (1994, April). *Motivational predictors of strategy use and course grades.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

Schutz, P.A. (1994). Goals as the transactive point between motivation and cognition. In P.R. Pintrich, D.R. Brown, & C.E. Weinstein (Eds.), *Student motivation, cognition, and learning* (pp. 135-156). Hillsdale, NJ: Erlbaum.

Sternberg, R.J. (1990). *Metaphors of mind: Conceptions of the nature of intelligence.* Cambridge, MA: Cambridge University Press.

Sternberg, R.J., Conway, B.E., Ketron, J.L., & Bernstein, M. (1981). People's conceptions of intelligence. *Journal of Personality and Social Psychology, 41,* 37-55.

Weinstein, C.E. (1987). *LASSI user's manual.* Clearwater, FL: H & H Publishing.

Weinstein, C.E. & Mayer, R. (1986). The teaching of learning strategies. In M. Wittrock (Ed.), *The handbook of research on teaching* (pp. 315-327). New York: Macmillan.

Weinstein, C.E., Palmer, D.R., & Schulte, A.C. (1987). *LASSI: Learning and Study Strategies Inventory.* Clearwater, FL: H & H Publishing.

Wertsch, J.V. (1995). Sociocultural research in the copyright age. *Culture & Psychology, 1,* 81-102.

Dysleksi: Mangelfull automatisering av ordavkodingen

Av Torleiv Høien og Ingvar Lundberg

Hva er dysleksi?

Dysleksi innebærer at en har store vansker med å tilegne seg normal leseferdighet. Hvor vi setter grensen for dysleksi, må nødvendigvis bli noe tilfeldig. Det avhenger blant annet av hvilken leseferdighet en anser som nødvendig for å fungere i samfunnet. De som til tross for anstrengelser og god undervisning ikke kan oppnå et slikt nivå, blir gjerne betraktet som dyslektiske. En slik konstatering bringer oss imidlertid ikke så langt. Strengt tatt har vi bare sagt at personer med store leseproblemer er dyslektiske. Et lite skritt videre kan vi kanskje komme dersom vi ser nærmere på hva lesing er.

Lesing er både avkoding og forståelse

Noe forenklet kan en skille mellom to komponenter i lesingen: avkoding og forståelse. Avkoding er lesingens tekniske side, der det gjelder å utnytte skriftspråkets prinsipp eller kode for å komme frem til hvilket ord som står skrevet. Denne prosessen omfatter både de mer møysommelige og tidkrevende omkodingsprosesser (lydering, bokstavering og stavelseslesing) og den automatiserte, ikke-ressurskrevende ordgjenkjenningen som karakteriserer den gode leser. Forståelsesprosessen, derimot, krever mer kognitive ressurser. Det er spørsmål om å knytte det en leser til egne erfaringer og referanserammer, dra slutninger, gjøre tolkninger osv. Et slikt tankearbeid er i prinsippet av samme slag som den tenkning som foregår når en lytter til en tekst som andre leser. God leseferdighet er avhengig av at både avkodingsprosessen og forståelsesprosessen fungerer tilfredsstillende (Høien & Lundberg, 1997; Share & Stanovich, 1995).

Lesevansker oppstår dersom en eller begge av disse komponentene svikter. Grovt sett kan vi skille mellom tre grupper lesesvake elever. Hos mange elever er det selve avkodingen som representerer den største utfordringen. Disse har normal ferdighet til å forstå innholdet i teksten, men den dårlige avkodingsferdigheten vanskeliggjør forståelsesprosessen. Karakteristisk for denne gruppe lesesvake elever er at de lett forstår innholdet i en tekst dersom andre leser høyt for dem. Innen leseforskningen er disse elevene ofte kalt for dyslektikere (for oversikt, se Blachman, 1997; Hulme & Snowling, 1997). Hos andre elever er det forståelsesprosessen som volder størst vansker. Blant disse er det noen som avkoder bemerkelsverdig godt, samtidig som de har vansker med å forstå hva de leser (Oakhill & Yuill, 1996). Innen leseforskningen har termen «hyperleksi» blitt benyttet for å beskrive ekstremtilfeller av denne form for lesevansker (Stackhouse & Wells, 1997). Den tredje gruppe lesesvake har vansker både med avkodingen og med leseforståelsen. I forskningslitteraturen er disse leserne gjerne omtalt som «elever med generelle lesevansker». I dette kapitlet skal vi bare rette søkelyset på den første gruppe: De som har alvorlige vansker med ordavkodingen.

Ordavkoding og ferdighetslæring

Å avkode ord er en ferdighet, og tilegnelse av ferdighet i ordavkoding kan sammenlignes med annen ferdighetslæring. Et generelt kjennetegn ved all ferdighetslæring er at ferdigheten først oppnås etter omfattende trening/øving. Ingen blir eksperter i å spille tennis, sparke fotball, renne slalåm, spille piano etc. uten stor innsats. Bak alle store prestasjoner, uansett hvilke, ligger det omfattende øving. Dersom en person ikke er villig til å investere tid til dette, nytter det heller ikke om vedkommende har fått mye genetiske disposisjoner for å kunne lykkes med å nå gode resultater.

Barn med en legning som gjør dem særlig mottakelige for verbal stimulans, ber gjerne om at en leser historien en gang til; de søker seg aktivt til bøkenes verden, påvirker foreldrene slik at de får bøker i julegave eller fødselsdagspresang; stimulerer foreldrene til å fortelle, følge dem til biblioteket etc. Andre barn viser ikke samme interesse for bøkenes verden. De blir ikke sittende lenge på fanget ved høytlesing, men glir fort ned og finner på noe annet å gjøre. De virker nærmest døve for rim og regler. Det dårlige utgangspunkt som mange lesesvake elever har når de kommer til skolen, kan til en viss grad skyldes at de har mindre naturlig talent for språklige aktiviteter.

Genetiske disposisjoner kan vi ikke gjøre så mye med. Men genetisk disposisjon er bare én side av problemet. Vi kjenner vel til at de som har mindre talent for en ferdighet, ofte unngår å investere krefter i å trene nettopp på dette området. Treningen gir for lite utbytte. På mange områder

behøver ikke dette å bety så mye. De færreste stilles overfor krav om høy ferdighet i for eksempel svømming eller pianospill. Ja, mange kan ikke spille piano i det hele tatt uten at dette får noe som helst negative konsekvenser verken emosjonelt eller sosialt. Når det gjelder leselæring, er saken imidlertid ikke så enkel. Dette er en ferdighet som alle barn må tilegne seg dersom de skal lykkes i utdannelse og arbeidsliv, og tilkortkomming kan medføre alvorlige konsekvenser for personlighetsutviklingen. Derfor er det så viktig å kunne finne mer ut av hvorfor så mange barn mislykkes i leselæringen, og hva som kan gjøres for å hjelpe disse.

Dysleksi og diskrepansdefinisjonen

Omfattende forskning har vist at det primære problemet ved dysleksi kan lokaliseres til en svikt i avkodingsprosessen (for oversikt, se Høien & Lundberg, 1997). Forståelsesvanskene som kan iakttas hos dyslektiske elever, kan for det meste tolkes som sekundære problemer. De er i hovedsak en konsekvens av den dårlige ordavkodingen (Share & Stanovich, 1995). Den dyslektiske eleven klarer ikke å utvikle automatisert avkodings-ferdighet. Dyslektikere unngår å lese fordi de leser så dårlig, og dermed får de heller ikke den lesetrening som behøves for å oppnå automatisert ordavkodingsferdighet. Stanovich (1986) refererer i denne sammenheng til den såkalte «Matteus-effekten»: De som mye har, skal få mer. De som har mindre, skal enda fratas det de har.

Innenfor spesialpedagogisk og medisinsk forskning har det vært vanlig praksis å bruke termen dysleksi om de lesevansker der det er et klart avvik mellom prestasjonen i lesing og vedkommendes generelle evnenivå. Bak diskrepanstenkningen ligger antakelsen om at de som har normal eller over normal evnemessig utrustning, også bør ha normal leseferdighet. Forholdet mellom evnemessig utrustning og leseferdighet er imidlertid langt mer komplisert. Når det gjelder ordavkoding, er korrelasjonen mellom intellektuell utrustning og ordavkoding heller lav (mellom 0.30-0.40). Det betyr at variasjon i kognitive evner bare kan forklare omlag 10-15 % av variasjonen i ordavkodingsferdigheten. Resten av variasjonen må derfor skyldes andre forhold. Derfor kan en forvente å finne dysleksi på ulike intelligensnivåer, noe som gjør den tradisjonelle diskrepansdefinisjonen mindre egnet ved valid diagnostisering av dysleksi (Lyon, 1995; Reid, 1995; Siegel, 1992; Stanovich, 1991).

Dysleksi og fonologiske vansker

Dersom dysleksi ikke skyldes en generell kognitiv svakhet, kan det likevel stilles spørsmål om dysleksi kan være forårsaket av en mer avgrenset kognitiv dysfunksjon. Høien & Lundberg (1997) har følgende definisjon på dysleksi:

«Dysleksi er en forstyrrelse i visse språklige funksjoner som er viktige for å kunne utnytte skriftens prinsipper ved koding av språket. Forstyrrelsen gir seg i første omgang til kjenne som vansker med å oppnå en automatisert ordavkoding ved lesing. Forstyrrelsen kommer også tydelig frem i dårlig rettskriving. Den dyslektiske forstyrrelsen går som regel igjen i familien, og en kan anta at en genetisk disposisjon ligger til grunn. Karakteristisk for dysleksi er også at forstyrrelsen er vedvarende. Selv om lesingen etter hvert kan bli akseptabel, vedvarer som oftest rettskrivingsvanskene. Ved mer grundig kartlegging av de fonologiske ferdighetene finner en at svikten på dette området også ofte vedvarer opp i voksen alder» (s. 24).

Noe forenklet kan definisjonen sammenfattes til at dysleksi er en vedvarende forstyrrelse i kodingen av skriftspråket, forårsaket av en svikt i det fonologiske systemet. Omfattende forskning viser at det er en nær sammenheng mellom avkodingsvansker og vansker med å utføre en rekke fonologiske oppgaver (for oversikt, se Byrne, 1998). Når et barn skal lære seg å lese, må det bli bevisst fonologien. Barnet må oppnå bevissthet om at ordene kan atskilles fra hverandre gjennom den fonologiske strukturen som den alfabetiske skriften representerer (Goswami & Bryant, 1990; Høien & Lundberg, 1997; McGuinness, 1997). Hvorfor er det da så vanskelig for en del barn å oppfatte det alfabetiske prinsippet og få bevisst adgang til den fonologien som de allerede mestrer så godt i sitt naturlige talespråk?

En nybegynner som skal lære å lese, har ingen spontan grunn til å forstå at ordet «bok» inneholder tre forskjellige segmenter. Det barnet normalt hører, er en akustisk helhet, der ordformen er gjennomskinnelig og betydningen av ordet står i fokus. En kan heller ikke nå frem til fonemsegmenter ved å lytte. Koartikulasjonen gjør at segmenter ikke lar seg skille. Det å nå frem til de abstrakte og utilgjengelige fonemene i et ord, å bli seg dem bevisst, er altså ikke et spørsmål om å lytte. Det er et spørsmål om gradvis å forstå, å oppdage og bli bevisst (Byrne, 1998; McGuinness, 1997). Ved noen anledninger synes en del barn å ha særdeles store vansker med å oppnå denne lingvistiske innsikten. Det ser ut til at problemet er avgrenset nettopp til språket, ettersom barn med gode evner på andre områder kan ha særskilte problemer med å oppnå fonologisk bevissthet. Det er således ofte snakk om en svært begrenset forstyrrelse som enklest kan forklares med at

en helt spesiell modul i det kognitiv-språklige systemet ikke fungerer tilfredsstillende. Denne medfødte modulen har til oppgave å håndtere talespråkets lydsystem. Ved normal språkanvendelse trenger denne fonologiske forstyrrelsen ikke bety så mye. Det er først når kravene blir riktig høye, at problemene merkes. Å lære seg å lese og skrive innbefatter nettopp slike fonologiske krav som mange dyslektikere ikke så lett kan håndtere. De fonologiske vanskene medfører at dyslektikerne får diffuse forestillinger om ordenes lydstruktur, uklar artikulasjon, vansker med å dele et ord inn i lyder, vansker med å binde lyder sammen til ord og vansker med å lese nonord (Elbro, 1996; Høien et al., 1995; Lundberg & Høien, 1997; Rack et al., 1994; Snowling & Nation, 1997).

En rekke studier har påvist den nære sammenheng mellom dysleksi og fonologiske vansker (for oversikt, se Byrne, 1998; McGuinness, 1997; Rack, 1994). Her skal vi bare trekke frem noen resultater fra en undersøkelse av Scarborough (1990). Barn av dyslektiske foreldre ble fulgt opp fra 2½ år til 8 år. Ikke mindre enn 65 % av barna ble dyslektiske i 8-årsalderen, noe som kan indikere at dysleksi har et sterkt arvelig innslag. Alt i en alder av 2½ år viste de språkforstyrrelser. De hadde dårligere grammatisk evne og mer utydelig uttale enn en kontrollgruppe av barn med normallesende foreldre. Ved 3½ års alder hadde de dårligere ordforståelse og dårligere evne til å sette navn på bilder. Når barna til de dyslektiske foreldrene var 5 år gamle, kunne de færre bokstaver enn barna i kontrollgruppen. De hadde også en klart dårligere fonologisk bevissthet og dårligere evne til å navngi gjenstander. Undersøkelsen viser altså at det kan finnes tidlige tegn i barnets språklige utvikling som signaliserer at de kan få lese- og skrivevansker i skolen (se også Badian, 1995; Vellutino et al., 1996).

Minusvarians eller defekt

En kan stille spørsmål om de fonologiske vanskene som forårsaker de dyslektiske avkodingsvanskene, er utslag av en generell minusvarians på det fonologiske området, eller om de skyldes en genetisk betinget nevrologisk defekt.

På de aller fleste fonologiske prøvene vil resultatene til en gruppe elever fordele seg i overensstemmelse med den tradisjonelle normal-fordelingskurven. Med utgangspunkt i denne fordelingen blir det et definisjonsspørsmål hvor grensen skal settes mellom de som fonologisk sett er svake og resten av gruppen. Grensen blir skjønnsmessig og representerer ikke kvalitativt sett noe absolutt skille mellom gruppene. Det er heller ikke fullt ut sammenheng mellom resultatene på de fonologiske prøvene og avkodingsprøvene, selv om korrelasjonen mellom disse to ferdighetene er høy (se Høien & Lundberg, 1997).

Spørsmålet en kan stille seg, er om en alltid skal benytte termen dysleksi når dårlig ordavkoding opptrer parallelt med svak ferdighet på det fonologiske området. I så tilfelle vil omfanget av dyslektikere utgjøre 10-15 % av hele elevgruppen. Men det kan og tenkes tilfeller der de fonologiske vanskene ikke er utslag av normal minusvarians, men der vanskene skyldes en spesifikk nevrologisk dysfunksjon. Dersom dysleksi-termen bare benyttes om disse elevene, vil antall dyslektikere bli redusert til bare 1-2 % av elevgruppen (se Vellutino et al., 1996; Vellutino, Scanlon, & Sipay,1997). Vi skal her se litt nærmere på forskningsresultater som støtter opp om antakelsen at dysleksi kan skyldes en spesifikk nevrologisk dysfunksjon.

Dysleksiens biologiske basis

Flere forskere hevder at de alvorlige fonologiske vanskene ved dysleksi har en biologisk forankring (for oversikt, se Hynd & Hiemenz, 1997).

De siste tiårene har hjerneforskningen gjort store fremskritt ved at nye teknikker har gjort det mulig å studere hjernen på levende mennesker. Med de nye teknikkene kan en både se hvordan hjernen er oppbygd (hjernens struktur), og hvordan den arbeider (hjernen i funksjon).

Forskjellige studier har påvist ulikheter mellom dyslektikere og normallesere med hensyn til hjernens struktur. I en unik serie av studier har Galaburda og hans medarbeidere studert hjerner fra avdøde dyslektikere (Galaburda & Kemper, 1979; Galaburda, Rosen, & Sherman, 1989, 1990). Hittil er 8 slike hjerner undersøkt inngående. Hjernene er blitt preparert slik at en har kunnet betrakte enkelte nerveceller i mikroskop. I alle dyslektiske hjerner fant en misdannelser eller avvik fra det normale mønsteret. Disse var for små til å kunne oppdages med det blotte øye.

Ektopier. I hjernebarken kan en skjelne mellom seks forskjellige lag eller sjikt som alle har ulike slags celler. I det ytterste laget skal det normalt ikke finnes noen celler overhodet. Her fant en imidlertid hos dyslektikerne små ansamlinger av nerveceller flere steder i hjernen. I mikroskopet ser det ut som om en beskyttende hinne er gjennombrutt der et "vulkanutbrudd" av celler har dannet en liten ansamling. I visse hjerner fant en mange slike ektopier (opp til 130), mens en i normale hjerner høyst treffer på et par.

Et viktig spørsmål er om ektopiene virker inn på elementære sensoriske funksjoner på en måte som er til hinder for høyere funksjoner, eller om det tvert imot er slik at de høyere funksjonene i hjernebarken forårsaker problemer med lavere funksjoner.

Galaburda fant avvik hos dyslektikere også i talamus - den store omkoblingsstasjonen for sensoriske impulser fra sanseorganene. På hørselsområdet var den gjennomsnittlige cellestørrelsen mindre i dyslektiske

hjerner enn i normale. Dette skulle kunne bety at informasjonsbearbeidingen var mindre effektiv og langsommere. I synssystemet fins det to typer celler, magnoceller og parvoceller. Magnocellene tar hånd om raske forandringer og bevegelser. Hos dyslektikerne var disse cellene mindre enn hos normale. Det er derfor ikke så rart at en har søkt forklaringer på dysleksi på det magnocellulære nivået (for oversikt, se Hogben, 1997; Willows, Kruk, & Corcos, 1993). Det henvises til persepsjonspsykologiske eksperimenter der en har påvist at dyslektikere har problemer med å skille mellom lyssignal (eller lydsignal) dersom signalene presenteres med kort tidsintervall (Høien, 1979, 1982; Livingstone et al., 1991). Videre henvises det også til de funnene Galaburda gjorde på avdøde dyslektikere. I fem tilfeller fant han at magnocellene var mer uordnet i laterale geniculate, og at de i gjennomsnitt var 20 % mindre.

Grunntanken i den magnocellulære teorien for dysleksi er at de kognitive og språklige problemene som kjennetegner dyslektikere, egentlig skyldes forstyrrelser i svært elementære funksjoner. I Tallals teori (Tallal et al., 1997) har utgangspunktet vært elementære auditive funksjoner. En har funnet at barn med språkforsinkelser har vanskeligere for å oppfatte hurtige sekvenser av rene toner, tyngre for å oppdage en kort pause mellom tonene, og å holde rede på rekkefølgen mellom toner av ulik høyde. Her antas det at auditiv talamus (mediale geniculate) spiller en avgjørende rolle. Galaburda fant i noen hjerner fra avdøde dyslektikere at den gjennomsnittlige størrelsen på nervecellene var mindre enn i normale kontrollhjerner. Disse cellene med antatt dårligere funksjoner skulle altså være forklaringen på problemene med å håndtere raske lydforløp, hvilket i sin tur skulle kunne forklare de fonologiske problemene som er typiske ved dysleksi. For å kunne identifisere en stavelse av typen "da", må en kunne følge med på den meget raske lydglidningen (40 millisek.) som innleder selve stavelsen. En komplisert språklig forstyrrelse forklares således med avvik i en mye mer elementær funksjon (for en kritisk vurdering av Tallal's teori, se Studdert-Kennedy & Mody, 1995).

Planum temporale. I alle de åtte tilfellene som Galaburda, Rosen, & Sherman (1990) undersøkte, var planum temporale like stor på begge sider. I befolkningen generelt er imidlertid venstre planum temporale større enn høyre (Geschwind & Levitsky, 1968).

I en norsk studie ble hjernen studert ved hjelp av MRI (Larsen et al., 1990). I undersøkelsen deltok 37 elever fra 8. klasse. De var blitt valgt ut av hele populasjonen av elever på dette klassetrinnet i Stavanger (N=1250). 19 av elevene var dyslektikere ifølge en meget streng avgrensning (problemer med ordavkoding og rettskriving, normale evner, ingen motoriske eller nevrologiske forstyrrelser, ingen sosioemosjonelle forstyrrelser). Som

sammenligningsgruppe ble det valgt ut 18 elever i 8. klasse som hadde normal leseferdighet. Elevene i kontrollgruppen var ellers like elevene i dysleksigruppen med hensyn til kjønn, alder, begavelse, skolemiljø, hjemmemiljø osv. Hovedresultatet av MRI-undersøkelsen er vist i Tabell 1. Her blir det angitt hvor mange asymmetriske hjerner det fantes blant dyslektikerne i forhold til kontrollelevene.

Tabell 1
Frekvens av symmetri/asymmetri i planum temporale hos dyslektikere og normallesere

	Dysleksigruppen	Kontrollgruppen
Asymmetri	6	14
Symmetri	13	4

Flesteparten av dyslektikerne hadde symmetriske plana temporale, mens flertallet av kontrollelevene som ventet var asymmetriske. Asymmetri er som nevnt det normale, symmetri er det unormale. Så langt har vi fått en interessant bekreftelse på at tidligere funn på avdøde dysleksihjerner var riktige. Symmetriske plana synes å være assosiert med dysleksi, og for første gang kunne dette nå observeres hos levende dyslektikere. De elevene i dysleksigruppen som hadde de største fonologiske vanskene (N = 7), hadde alle symmetriske plana temporale.

Selv om en ved MRI-teknikk kan påvise symmetri mellom plana temporale i de to hjernehalvdelene, kan en ikke i enkelttilfeller anvende metodikken for å avgjøre om en har å gjøre med dysleksi eller ikke. For det første er målemetodikken beheftet med visse svakheter. For det andre fins det personer som ut fra andre kriterier klart kan klassifiseres som dyslektikere, men som likevel har den normale asymmetrien mellom hjernehalvdelene, mens mange normallesere har symmetriske plana temporale.

Hjernen i funksjon

Når en skal studere hjernen i *funksjon*, går en ofte ut fra blodstrømmen i ulike deler av hjernen. En har funnet ut at det er overraskende stor sammenheng mellom mengden av blod som strømmer gjennom et område, og den nevrale aktiviteten som pågår der. Med *PET-teknikk* (Positron Emission Tomography) måles blodstrømmen ved at en injiserer radioaktivt vann. I den senere tid er det utviklet en ny teknikk som ikke krever radioaktiv merking. Dermed blir det også mulig å undersøke yngre individer

med dysleksi. Teknikken kalles *fMRI* (functional Magnetic Resonance Imaging), og har en mer komplisert relasjon til blodstrømmen i hjernen. Utgangspunktet er at når blodstrømmen øker ved aktivering av hjernen, øker ikke surstofforbruket.

Vi skal her se på to studier som benyttet disse nye teknikkene. Raichle (1994) påviste at høytlesing av enkeltord ikke aktiverte de tradisjonelle språkområdene i hjernen. Det var først når en fikk en mer krevende språklig oppgave i tilknytning til ordene (å komme på verb), at Brocas og Wernickes områder ble aktivert. Et annet uventet funn var at lillehjernen ikke bare engasjeres i den motoriske handlingen det er å uttale ord høyt, men også i den kognitive og språklige oppgaven. Lillehjernens rolle kan således være betydelig mer omfattende enn bare å stå for motorisk kontroll og koordinasjon, slik en hittil har trodd (se også Nicolson & Fawcett, 1994a, 1994b).

Når en sammenligner hjerneaktiviteten hos dyslektiske personer og hos normallesere, vil en sannsynligvis finne flere forskjeller. Tolkningen byr imidlertid på et problem. Betyr forskjellene virkelig at de dyslektiske hjernene fungerer annerledes? Oppgaven med å lese ord er betydelig vanskeligere for dyslektikere enn for normallesere. Forskjellene i hjerneaktivitet kan da tenkes å være et utslag av ulik vanskelighetsgrad.

I en undersøkelse av Paulesu et al. (1996) prøvde en å omgå dette problemet ved å studere voksne (universitetsstudenter) som hadde kompensert for sin dysleksi. De hadde hatt store leseproblemer tidligere i skolen, men gjennom god spesialundervisning, god støtte i hjemmet og hardt arbeid hadde de overvunnet sine problemer, og leste nå nærmest på et normalt nivå. Spørsmålet var nå om deres tidligere dysleksi likevel gjorde seg gjeldende når de ble stilt overfor fonologiske oppgaver.

Både normallesere og kompenserte dyslektikere ble stilt overfor enkle rimoppgaver og korttidsminneoppgaver i en PET-undersøkelse. Både for rimoppgaven og hukommelsesoppgaven ble det gitt kontrolloppgaver som ikke krevde noen indre lydering, for eksempel visuelle symboler (koreanske tegn). Forskjellene i hjerneaktivitet mellom de fonologiske og de rent visuelle oppgavene ble svært tydelige. De fonologiske oppgavene aktiverte områdene rundt den sylviske furen i venstre hjernehalvdel (bl.a. Broca, Wernicke, insula og undersiden av isselappen). Hos normallesere ble alle disse områdene aktivert samtidig. Hos de kompenserte dyslektikerne var aktiviteten i *insula* tydelig redusert, noe som innebar dårligere sammenheng mellom de fremre (Broca) og de bakre (Wernicke) delene av språksystemet i hjernen. Til tross for at dyslektikerne klarte de fonologiske oppgavene like godt som normalleserne, hadde de likevel et avvikende aktivitetsmønster. Ifølge disse forskerne kan derfor dysleksi skyldes en forstyrrelse i koblingen mellom ulike språkområder i hjernen. Videre fant de at også voksne

dyslektikere hadde en redusert aktivitet i lillehjernen under utføring av motoriske oppgaver jevnført med hjerneaktiviteten blant normallesere (se også Leiner, Leiner, & Dow, 1991, 1993; Nicolson et al., under publisering).

Men fremdeles bør en utvise stor grad av forsiktighet ved tolkningen av resultatene. Det er ikke urimelig å anta at en person som daglig leser for eksempel 100 ganger mer enn en annen, etter hvert utvikler et annet aktivitetsmønster i hjernen. Selvsagt påvirkes hjernen av de virksomheter som individene engasjerer seg i. Derfor behøves det betydelig mer forskning, først og fremst longitudinelle studier, før en kan si noe mer sikkert om årsak-virkningsforholdet.

Dysleksi og arv

Nivået i lese- og skriveferdighet er til dels bestemt av arvelige faktorer. Dette er blant annet påvist i store tvillingsstudier (DeFries, Alarcón, & Olson, 1997).En har også forsøkt å finne ut hvor de genene som kan føre til dysleksi er å finne. Dette er imidlertid mye mer komplisert. For det første er det neppe sannsynlig at et så sammensatt fenomen som lese- og skrivevansker skulle være bestemt av ett gen. Sannsynligvis er flere gener innblandet. Samspillet mellom disse genene kan også være svært komplisert. Det andre problemet er at det er vanskelig å påvise dysleksi helt entydig. En unøyaktig diagnose kan skape store problemer ved genetiske studier som foreløpig bygger på statistiske sannsynlighetsberegninger.

Til tross for slike problemer har en i minst et par større undersøkelser (Cardon et al., 1994) ment å kunne lokalisere dysleksi-gen til kromosom 6. I en senere studie av Grigorenko (1997) ble det påvist genavvik både i kromosom 6 og 15. Grigorenko fant at kromosom 6 var forbundet med svikt i fonologisk bevissthet, mens vansker med ordlesing syntes å være koblet til avvik i kromosom 15. For å kunne bestemme mer eksakt hvor på kromosomene genene sitter, trengs imidlertid mer forskning. Det at en er på god vei til å identifisere gener for dysleksianlegg, gir naturligvis både fascinerende og skremmende perspektiver. Genkunnskapen kan gi mulighet for tidlig diagnostisering. Allerede på fosterstadiet vil en i prinsippet med en enkel prøve kunne fastslå om fosteret bærer på anlegg for dysleksi. En kan tenke seg hvilke etiske problemer dette vil kunne medføre.

Forebygging og behandling

Noen vil hevde at dersom elevenes problemer har et klart nevrologisk og arvelig grunnlag, er det lite som kan gjøres. Vi er ikke enige i et slikt pessimistisk syn. Lesing er i første rekke en kulturelt basert teknikk som skal læres ved hjelp av undervisning og omfattende øvelser. Av biologiske årsaker kan denne innlæringen bli mer krevende for enkelte mennesker enn

for andre. For pedagogen bør det bli en utfordring å veilede, stimulere og undervise enda bedre.

Pedagogiske tiltak i forbindelse med dysleksi må alltid ta utgangspunkt i en grundig og omfattende diagnostisering både av lese- og skrivevanskene. Det fins gode screeningsprøver, for eksempel Ordkjedetesten (Høien & Tønnesen, 1997) og diagnostiske tester som kan benyttes både ved kartlegging av avkodingstrategier og avkodingsprosesser [f.eks. KOAS-testen (Høien & Lundberg, 1998a, 1998b) og KOAP-testen (Oftedal & Høien, 1997a, 1997b)]. Også andre språklige og kognitive tester bør trekkes inn i diagnostiseringsarbeidet for å få en allsidig og grundig vurdering av vanskene. Det er og viktig å få undersøkt syns- og hørselsfunksjonene, slik at ikke lese- og skrivevansker som er forårsaket av sansemessige defekter, forveksles med dysleksi (for oversikt, se Willows, Kruk, & Corcos, 1993).

Vi skal her bare trekke frem fire mer generelle tiltak som har vist seg å være effektive i arbeidet med å forebygge og avhjelpe dysleksi: fonologisk stimulering, tidlig hjelp, innlæring av sikker avkodingsferdighet og godt læringsmiljø.

Fonologisk stimulering

Vi har alt nevnt hvordan fonologisk bevissthet er en nødvendig forutsetning for lese- og skrivelæringen, og at dyslektikere har spesielle vansker med å inndele ord i enkeltlyder.

Vi vet fra flere undersøkelser at fonologisk bevissthet kan utvikles gjennom stimulerende leker og øvelser alt i førskolealderen (Borstrøm & Elbro, 1997; Foorman et al., 1997; Lie, 1987, 1988; Lundberg, Frost, & Petersen, 1988; Vellutino et al., 1996; Vellutino, Scanlon, & Sipay, 1997). Barn som på en systematisk måte får leke med ord, rime, ta frem begynnelseslyden, dele opp setninger i ord, ord i stavelser osv., viser seg å få en bedre start på leseundervisningen.

I en undersøkelse (Lundberg et al., 1988) fikk noen førskolebarn (forsøksgruppen) daglige økter med leker og øvinger i språket med sikte på å øke barnas fonologiske bevissthet. De språklige øvingene pågikk i til sammen 8 måneder. I den andre gruppen (kontrollgruppen) ble det drevet normal førskoleaktivitet der selvsagt også språklig stimulans inngikk, men langt fra like systematisk og intensivt som i forsøksgruppen. Den språklige bevissthet til barna i forsøksgruppen utviklet seg sterkt i løpet av førskoleåret. Særlig markant var økningen i evnen til å hanskes med fonemer. Barna i kontrollgruppen viste her nesten ingen økning i det hele tatt. Barnas lese- og skriveutvikling i skolen ble senere undersøkt gjentatte ganger. Generelt viste det seg at førskolestimulansen var verdifull for de fleste barna. Lese- og skriveinnlæringen gikk signifikant bedre i

forsøksgruppen enn i kontrollgruppen. Språkøvingene i førskolen hadde åpenbart ført til at barnas møte med skriftspråket ble mykere og mer naturlig. Barn i risikosonen for å utvikle dysleksi senere i skolen hadde særlig stor nytte av programmet. De fonologiske oppgavene som ble benyttet i denne undersøkelsen, er alle av en slik karakter at de også uten vansker kan benyttes av foreldre/foresatte for å stimulere barnas fonologiske bevissthet. Videre har forskning vist at foreldre/foresatte kan bidra til å øke barnets lesemodenhet gjennom regelmessig høytlesing.

Tidlig hjelp

Forskning har klart dokumentert effekten av tidlig hjelp med hensyn til undervisningen av lesesvake elever. Et særtrekk ved flere nyere leseprogammer er nettopp vektlegging av tidlig hjelp og én-til-én undervisning, det vil si at læreren arbeider med bare én elev om gangen (se Wasik & Slavin, 1993). Vi skal her bare gi en kort omtale av ett av disse programmene: Early Steps (Santa, 1998).

Early Steps er ikke like godt kjent som Reading Recovery, et treningsopplegg som i sin tid ble utviklet av Clay (1985). Begge baserer seg på én-til-én trening med førsteklassinger som er i faresonen med hensyn til å utvikle lesevansker, og begge er faglig godt funderte. De gjør bruk av mange av de samme metodene: Lesing og gjenlesing av korte bøker, skriving av egne tekster og læring av lyderingsteknikker. Den viktigste forskjellen mellom disse oppleggene er at Early Steps også inkluderer et opplegg med systematisk fonologisk trening.

Elevene som skal være med i Early Steps, blir plukket ut gjennom observasjoner i klasserommet og ved hjelp av uformelle tester som gis individuelt i løpet av den første måneden. Elevene som skårer blant de laveste 20 %, blir tilbudt plass i treningsopplegget. Disse elevene får én-til-én undervisning med egen spesialutdannet lærer hver dag. Elevene går ut av opplegget når de leser like godt eller bedre enn gjennomsnittet i klassen. Hver økt (30 minutter) består av fire deler: gjenlesing av en kjent bok (bøkene er ofte svært korte), ordanalyse (dvs. fonologiske teknikker for lydering og staving), skriving av egen tekst (én eller flere setninger), og lesing av en ny bok.

I USA er det gjort mange positive erfaringer med brukere av Early Steps, og en undersøkelse av Santa & Høien (under publisering) viser at Early Steps opplegget er spesielt effektivt ved undervisningen av de dårligste lesere i 1. klasse.

Innlæring av sikker avkodingsferdighet

Dyslektikere trenger mye trening før ordavkodingen blir automatisert. Som vi tidligere konstaterte, har mange dyslektikere kommet inn i en vond sirkel

der de har lært seg å unnvike lesing, noe som ytterligere hindrer dem i å oppnå god avkodingsferdighet. Det store pedagogiske problemet er nå å bryte denne vonde sirkelen. Her fins ingen enkle løsninger. Det krever tålmodighet, innlevelse og forståelse; det gjelder å vise at mestring kan gi glede og tilfredsstillelse; det gjelder å vekke leselyst; det gjelder å få eleven til å tro på seg selv. Dyslektikerne har ofte dårlig selvbilde og ser på seg selv og sine lesevansker som et håpløst problem. En viktig oppgave er derfor å overbevise dyslektikeren om at han ikke er et håpløst tilfelle.

De fleste dyslektikere avslører sine avkodingsvansker alt tidlig i leselæringsprosessen. De strever med å lære bokstav-lyd forbindelsene, de får ikke til å binde lyder sammen til ord, og de makter ikke å tilegne seg et stort antall med parate ordbilder (Adams, 1990). Automatisert ordgjenkjenning er, som alt nevnt, en nødvendig forutsetning for å tilegne seg god leseferdighet. Derfor blir arbeidet i forbindelse med ordavkoding et viktig ledd i undervisningen av dyslektikere, men arbeidet med ordgjenkjenning må hele tiden foregå parallelt med mye lesing av adekvate tekster.

Undervisningsopplegget i forbindelse med ordavkoding vil selvsagt variere alt etter den enkelte elevs spesielle problemer. Mange dyslektikere har vansker med å lære hvordan bokstavmønster og ord kan gjenkjennes uten først å gå veien om møysommelig lydering. Det betyr at det må legges mye arbeid i å få barnet til å gjenkjenne bokstavsekvenser, enten det gjelder stavelser, morfemer eller hele ord. En fremgangsmåte som har vist seg å fungere godt for mange lesesvake, er å arbeide med "ordfamilier" (Santa & Høien, under publisering). Ordene "ringe", "klinge","vinge", springe" etc. hører alle til samme familie fordi de har noe felles, nemlig bokstavsekvensen "inge". Hovedpoenget er at leseren skal oppdage at det fins et system i ordgjenkjenningen. De fleste nye ord leseren møter, har en likhet med et annet ord som vedkommende kan gjenkjenne. Hva barnet må lære, er at han/hun bevisst må ta i bruk denne kunnskapen når vedkommende skal avkode et «nytt» ord. Forskning viser at det fins en liten gruppe (ca. 1-1½ %) av totalgruppen som profitterer lite selv om de får vel tilrettelagt undervisning (Vellutino et al., 1996). Disse elevene særmerker seg også ved alvorlige fonologiske vansker, og disse vanskene vedvarer opp i voksen alder (se også Elbro, Nilsen, & Petersen, 1994). For disse elevene kan det stilles spørsmål om det har noen hensikt å vektlegge for sterkt fonologiske ferdigheter. Kanskje har en mer å hente ved å ta utgangspunkt i større ortografiske enheter ved avkodingen av ord (Seymour & Evans, 1993).

Det er utviklet flere dataprogrammer for avhjelping av lese- og skrivevansker. Noen programmer er laget for å trene opp gjenkjenningen av enkeltord. Ordene kan presenteres på dataskjermen med avtakende eksponeringstid, og leseren «tvinges» dermed til å rette oppmerksomheten

på alle bokstavene i ordet i stedet for å fokusere på en enkelt bokstav om gangen.

Enda mer løfterik er imidlertid bruken av computer ved lesing av tekster. Ved hjelp av syntetisk eller digitalisert tale er det mulig å hente frem uttalen til de ord i teksten som leseren ikke greier å lese selv. Når leseren kommer til et ord som er vanskelig å identifisere, kan han bare peke på ordet med datamusen, og en syntetisk (eller digitalisert) stemme uttaler ordet. Databasert trening gir dermed dyslektikeren anledning til å lese tekster som innholdsmessig er mer tilpasset personens interessenivå.

Hos dyslektikerne er gjerne rettskrivingsvanskene større enn lesevanskene, og selv om lesevanskene etter hvert overvinnes, vedvarer ofte rettskrivingsvanskene. Det er ikke vanskelig å forstå at ortografiske vansker gjør skriveprosessen ulystbetont og bidrar til at dyslektikeren unngår skriveaktiviteter. Men også her kan computeren gi god hjelp. De fleste databaserte skriveprogrammer kan kontrollere ortografien fortløpende, og dermed slipper dyslektikeren frustrasjonene på grunn av de mange stavefeilene. Nyere datateknologi har også gjort det mulig for computeren å motta tale og deretter skrive ut det innleste budskap med korrekt ortografi.

Godt læringsmiljø

Når det gjelder læringsmiljøets betydning for barns leselæring, vil vi trekke frem noen forskningsresultater fra to studier utført av National Reading Research Center i USA. En av studiene rettet søkelyset på forhold i barnehage, 1. og 2. klasse (Pressley et al., 1996). En annen studie inkluderte spesialundervisningen (Rankin & Pressley, under publisering).

I hver undersøkelse ble lærerne bedt om å skrive ned de ti elementene de mente var av størst verdi for å skape et godt leselæringsmiljø. Deres svar dannet grunnlag for en survey-undersøkelse der 89 lærere og 34 spesialpedagoger deltok. De var alle pedagoger som hadde lang erfaring i leseundervisning og hadde utmerket seg ved at de oppnådde så gode resultater i leseopplæringen. Undersøkelsene viser at følgende særtrekk karakteriserte et godt leselæringsmiljø:

1. Et klasserom med rikelig med lesestoff (mange bøker med ulik vanskegrad)

2. Vektlegge både ferdighetstrening (f.eks. fonologisk bevissthet, fonologisk syntese etc.) og mye lesing av autentiske tekster

3. Varierte former for lesing (repetert lesing, korlesing, stillelesing)

4. Variert lesemateriell (fortellinger, fagtekster, lyrikk, lettleste

bøker)

5. Eksplisitt undervisning i skriveprosessen (prosessorientert skriving)

6. Samme elementer i undervisningen både for lesesvake og for de med god leseferdighet. De lesesvake trenger imidlertid mer:
   eksplisitt trening av fonologiske ferdigheter (bl.a. fonologisk bevissthet)
   eksplisitt trening i ordavkoding
   mer lærerstyrt undervisning

7. Gjøre leselæringen lystbetont (motivert lesing)
   redusere risikoen for tilkortkomming
   mye positiv tilbakemelding
   gi elevene tro på at de kan makte å lære å lese

8. Følge opp elevenes fremgang i lesing og skriving
   kartlegginger
   bruk av portofolios
   foreldrekonferanser

9. Individuell hjelp (én-til-én undervisning)

Andre undersøkelser støtter opp om disse funnene, for eksempel en studie av Vellutino et al. (1996). De skilte ut de elever i 1. klasse som hadde lesevansker og fonologiske vansker. Ca 15 % av hele elevgruppene ble klassifisert som risiko-elever. Disse fikk tilbud om intensiv undervisning, én-til-én undervisning. I undervisningen ble det lagt vekt på både opptrening av fonologiske ferdigheter samt lesetrening. Ved slutten av 1. klasse hadde de aller fleste elevene oppnådd en leseferdighet tilsvarende alderen. Men det var en liten gruppe elever, 1.5 % av totalgruppen, som trass i den intensive undervisningen, hadde gjort liten eller ingen fremgang, verken med hensyn til fonologiske ferdigheter eller i lesing. Vellutino et al. (1996) mener at det er den lille gruppen som bør betegnes som dyslektikere. Bak disse elevers hårdnakkede lesevansker ligger det trolig en konstitusjonell årsaksfaktor. Men når det gjelder de andre elevene som opprinnelig hadde vansker, mener disse forskerne at årsakene her er forbundet med læringsmiljøet.

Et godt læringsmiljø avhenger av ulike faktorer. Det er gjennomsyret av varme personlige relasjoner mellom elev og lærer. Når eleven opplever læreren som en person som "bryr seg", som viser tillit og varme, øker

mulighetene for utvikling og innlæring dramatisk. Mye tyder på at enkelte lesemetoder gir gode resultater fordi de gir rom for en én-til-én-relasjon mellom lærer og elev (Wasik & Slavin, 1993). I en slik relasjon øker sjansen for intensitet, utholdenhet og frekvens i arbeidet. Men fremfor alt gir den rom for tillit, varme, innlevelse og gjensidighet. I den sammenheng vil vi spesielt understreke betydningen av at elevene får tilfredsstilt sine grunnleggende behov for trygghet og kjærlighet, og at undervisningen blir tilrettelagt slik at de opplever å lykkes: «Nothing succeeds like success».

Summary

Reading consists of two main components, word-decoding and comprehension. Dyslexics are characterised by serious decoding and spelling difficulties. The disorder has commonly been defined through exclusionary criteria: dyslexia is those reading and writing problems that cannot be explained by traditional factors such as poor general intellectual ability, poor teaching, etc. This exclusionary definition provides no answer to the cause(s) of the disorder. Recent research, however, has given us insight into the etiology of dyslexia and has shown the importance of early intervention for the prevention or remediation dyslexic difficulties. Several researchers have claimed that the serious phonological deficit we see in connection with dyslexia has biological explanation. Dyslexics need extra training for their word-decoding to become automatic. They often wind up in a vicious circle: they don't read well, so they don't enjoy reading; therefore they avoid doing it, thereby denying themselves the training they need. The challenge is to get them out of the vicious circle. There are no easy solutions, but research has shown that preventive measures and early intervention are effective. A positive learning environment is essential for any remedial programme to work. Providing these children with enough love and support, and tailoring the teaching in such a way that they can «taste» success, is the key. Here, as elsewhere, nothing succeeds like success.

Referanser

Adams, M. (1990). *Beginning to read: Thinking and Learning about Print*. Cambridge, Mass.: MIT Press.

Badian, N. (1995). Predicting reading ability over the long term: The changing roles of letter naming, phonological awareness and orthographic processing. *Annals of Dyslexia, 45*, 79-96.

Blachman, B. (1997). Early intervention and phonological awareness: A cautionary tale. I B. Blachman (Red.), *Foundations of Reading Acquisition and Dyslexia. Implications for early Intervention* (s. 409-430). London: Lawrence Erlbaum Associates.

Borstrøm, I., & Elbro, C. (1997). Prevention of dyslexia in Kindergarten: Effects of phoneme awareness training with children of dyslexic parents. I C. Hulme & M. Snowling (Red.), *Dyslexia: Biology, Cognition, and Intervention* (s. 235-253). London: Whurr.

Byrne, B. (1998). *The foundation of literacy. The child's acquisition of the alphabetic principle*. East Sussex: Psychological Press.

Cardon, L., Smith, S., Fulker, D., Kimberling, W., Pennington, B., & DeFries, J. (1994). Quantitative trait locus for reading disability on Chromosome 6. *Science, 266*, 276-279.

Clay, M. (1985). *The early detection of reading difficulties*. Portsmouth, NH: Heinemann.

DeFries, J., Alarcón, M., & Olson, R. (1997). Genetic aetiologies of reading and spelling deficits. Brain, Mind, and Behaviour in Dyslexia. I C. Hulme & M. Snowling (Red.), *Dyslexia: Biology, Cognition, and Intervention* (s. 20-37). London: Whurr.

Elbro, C. (1996). Early linguistic abilities and reading development: A review and a hypothesis. *Reading and Writing: An Interdisciplinary Journal, 8*, 453-485.

Elbro, C., Nielsen, I., & Petersen, D. (1994). Dyslexia in adults: Evidence for deficits in non-word reading and in the phonological representation of lexical items. *Annals of Dyslexia, 54*, 205-226.

Foorman, B., Francis, D., Shaywitz, S., Shaywitz, B., & Fletcher, J. (1997). The case of early reading intervention. I B. Blachman (Red.), *Foundations of Reading Acquisition and Dyslexia. Implications for early Intervention* (s. 243-263). London: Lawrence Erlbaum Associates.

Galaburda, A., & Kemper, T. (1979). Cytoarchitectonic abnormalities in developmental dyslexia: a case study. *Annals of Dyslexia, 6*, 94-100.

Galaburda, A., Rosen, G., & Sherman, G. (1989). The neuronal origin of developmental dyslexia: Implication for medicine, neurology, and cognition. I A. Galaburda (Red.), *From Reading to Neuron* (s. 370-404). Cambridge, MA: MIT-Press.

Galaburda, A., Rosen, A., & Sherman, G. (1990). Individual variability in cortical organization: Its relationship to brain laterality and implications to function. *Neuropsychologia, 28*, 529-546.

Geschwind, N., & Levitsky, W. (1968). Human brain: Left - right asymmetries in temporal speech region. *Science*, 186-187.

Goswami, U. & Bryant, P. E. (1990). *Phonological Skills and Learning to Read.* London: Whurr.

Grigorenko, E. (1997). Linkage analyses on Chromosomes 1, 6 and 15. I G. Pavlidis (Red.), *Abstracts*. 4th World Congress on Dyslexia. Macedonia, Greece.

Hogben, J. (1997). How does a visual transient deficit affect reading. *Annals of Dyslexia, 45*, 59-71.

Hulme, C., & Snowling, M. (1997). *Dyslexia: Biology, Cognition and Intervention.* London: Whurr Publishers.

Hynd, G., & Hiemenz, J. R. (1997). Dyslexia and gyral morphology variation. I C. Hulme & M. Snowling (Red.), *Dyslexia: Biology, Cognition, and Intervention* (s. 38-58). London: Whurr Publishers.

Høien, T. (1979). *Ikonisk persistens og dysleksi.* Stavanger: Rogalandsforskning.

Høien, T. (1982). *Ekkoisk persistens og den auditive persepsjonen.* Linköping: Pedagogiska institutionen, Universitetet i Linköping.

Høien, T., & Lundberg, I. (1997). *Dysleksi. Fra teori til praksis.* Oslo: Ad Notam Gyldendal.

Høien, T., & Lundberg, I. (1998a). *KOAS-testen.* Stavanger: Stiftelsen Dysleksiforsking.

Høien, T., & Lundberg, I. (1998b). *Håndbok til KOAS-testen.* Stavanger: Stiftelsen Dysleksiforsking.

Høien, T., & Tønnesen, G. (1997). *Ordkjedeprøven.* Stavanger: Stiftelsen Dysleksiforsking.

Høien, T., Lundberg, I., Stanovich, K., Bjaalid, I.-K. (1995). Components of phonological awareness. *Reading and Writing, 7*, 1-18.

Larsen, J., Høien, T., Lundberg, I. & Ødegaard, H. (1990). MRI evaluation of the size and symmetry of the planum temporale in adolescents with developmental dyslexia. *Brain and Language, 39*, 289-301.

Leiner, H., Leiner, A., & Dow, R. (1991). The human cerebro-cerebellar system: Its computing, cognitive, and language skills. *Behavioural Brain Research, 44*, 113-128.

Leiner, H., Leiner, L., & Dow, R. (1993). Cognitive and language functions of the human cerebellum. *Trends in Neuroscience, 16*, 444-447.

Lie, A. (1987). *Ordanalyse som grunnlag for begynnaropplæringa i lesing.* Halden: Halden lærarhøgskule-skrifter.

Lie, A. (1988). *Lese- og skrivevansker i eit oppgåveanalytisk eller fagdidaktisk perspektiv.* Halden: Halden lærarhøgskule.

Livingstone, M., Rosen, G., Drislane, F., & Galaburda, A. (1991). Physiological and anatomical evidence for a magnocellular defect in developmental dyslexia. *Proceedings of the National Academy of Science, 88*, 7943-7947.

Lundberg, I., & Høien, T. (1997). Levels of approaching reading and its difficulties. I B. Ericson & J. Rönnberg (Red.), *Reading disability and its treatment* (s. 11-36). Linköping: Läspedagogiska Institutet EMIR.

Lundberg, I., Frost, J., & Petersen, O. (1988). Effects of an extensive program for stimulating phonological awareness in preschool children. *Reading Research Quarterly, 23*, 264-293.

Lyon, G. (1995). Toward a definition of dyslexia. *Annals of Dyslexia, 45*, 3-27.

McGuinness, D. (1997. *Why our children can't read and what we can do about it.* New York: The free press.

Nicolson, R., & Fawcett, A. (1994a). Comparison of deficits in cognitive and motor skills among children with dyslexia. *Annals of Dyslexia, 44*, 147-164.

Nicolson, R., & Fawcett, A. (1994b). Comparison of deficit severity across skills: Towards a taxonomy for dyslexia. I A. Fawcett & R. Nicolson (Red.), *Dyslexia in Children. Multidiscplinary Perspectives* (s. 215-239). London: Harvester Wheatsheaf.

Nicolson, R., Fawcett, A., Berry, E., Jenkins, I., Dean, P., & Brooks, D. (under publisering). *Cerebellar function is impaired in dyslexia: A PET activation study.*

Oakhill, J., & Yuill, N. (1996). Higher order factors in comprehension disability: Processes and remediation. I C. Cornoldi & J. Oakhill (Red.), *Reading Comprehension Difficulties. Processes and Intervention* (s. 69-91). Mahwah, NJ: Lawrence Erlbaum Associates.

Oftedal, M., & Høien, T. (1997a). *KOAP-testen. Kartlegging av ordavkodingsprosesser.* Stavanger: Stiftelsen Dysleksiforsking.

Oftedal, M., & Høien, T. (1997b). *Håndbok til KOAP. Et program for kartlegging av ordavkodingsprosesser.* Stavanger: Stiftelsen Dysleksiforsking.

Paulesu, E., Frith, U., Snowling, M., Gallagher, A., Morton, J., Frackowiak, R., & Frith, C. (1996). Is developmental dyslexia a disconnection syndrome? Evidence from PET scanning. *Brain, 119*, 143-157.

Pressley, M., Rankin, J., & Yokoi, L. (1996). A survey of instructional practices of outstanding primary-level literacy teachers. *Elementary School Journal, 96,* 363-384.

Rack, J. (1994). Dyslexia: The phonological deficit hypothesis. I A. Fawcett & R. Nicolson (Red.), *Dyslexia in Children.* London: Harvester Wheatsheaf.

Rack. J., Hulme, C., Snowling, M., & Wightman, J. (1994). The role of phonology in young children learning to read words: The direct mapping hypothesis. *Journal of Experimental Child Psychology, 57,* 42-71.

Raichle, M. (1994). Images of the mind: Studies with modern imaging techniques. *Annual Review of Psychology, 45,* 333-356.

Rankin, J., & Pressley, M. (under publisering). A survey of instructional practices of primary-grade special education teachers nominated as effective in promoting literacy. *Elementary School Journal.*

Reid, G. (1995). Toward a definition of dyslexia. *Annals of Dyslexia. 45,* 3-27.

Santa, C. (1998). *Lære å lese: Early Steps metoden.* Stavanger: Stiftelsen Dysleksiforsking

Santa, C., & Høien, T. (under publisering). Early Steps: A program for early intervention of reading problems. *Reading Research Quarterly.*

Scarborough, H. (1990). Very early language deficits in dyslexic children. *Child Development 61,* 1728-1743.

Seymour, P., & Evans, H. (1993). The visual (orthographic) processor and developmental dyslexia. I D. Willows, R. Kruk & E. Corcos (Red.), *Visual Processes in Reading and Reading Disabilities* (s. 347-376). Hillsdale, NJ: Lawrence Erlbaum Associates.

Share, D., & Stanovich, K. (1995). Cognitive processes in early reading development: Accommodating individual differences into a model of acquisition. Issues in Education. *Contributions from Educational Psychology, 1,* 1-57.

Siegel, L. (1992). An evaluation of the discrepancy definition of dyslexia. *Journal of Learning Disabilities, 25,* 619-629.

Snowling, M., & Nation, K. (1997). Language, phonology, and learning to read. I C. Hulme & M. Snowling (Red.), *Dyslexia: Biology, Cognition, and Intervention* (s. 153-166). London: Whurr Publishers.

Stackhouse, J. & Wells, B. (1997). How do speech and language problems affect literacy development. I C. Hulme & M. Snowling (Red.), *Dyslexia. Biology, cognition and intervention.* London: Whurr, 1997.

Stanovich, K. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly, 21,* 360-407.

Stanovich, K. (1991). Discrepancy definitions of reading disability: Has intelligence led us astray? *Reading Research Quarterly, 26,* 7-29.

Studdert-Kennedy, M., & Mody, M. (1995). Auditory temporal perception deficits in the reading-impaired: A critical review of the evidence. *Psychonomic Bulletine & Review, 2,* 508-514.

Tallal, P., Allard, P., Miller, S., & Curtis, S. (1997). Academic outcomes of language impaired children. I C. Hulme & M. Snowling (Red.), *Dyslexia: Biology, Cognition, and Intervention* (s. 167-181). London: Whurr Publishers.

Vellutino, F., Scanlon, D., & Sipay, E. (1997). Towards distinguishing between cognitive and experimental deficits as primary sources of early intervention in diagnosing specific reading disabilities. I B. Blachman (Red.), *Foundations of Reading and Dyslexia. Implications for early Intervention* (s. 347-379). London: Lawrence Erlbaum Associates.

Vellutino, F., Scanlon, D., Sipay, E., Small, S., Pratt, A., Chen, R., & Denckla, M. (1996). Cognitive profiles of difficulty-to-remediate and readily remediated poor readers: Early identification as a vehicle for distinguishing between cognitive and experimental deficits as basic causes of specific reading disability. *Journal of Educational Psychology, 88,* 601-638.

Wasik, H., & Slavin, R. (1993). Preventing early reading failure with one-to-one tutoring: A review of five programs. *Reading Research Quarterly, 28* 179-200.

Willows, D., Kruk, R., & Corcos, E. (1993). *Visual processes in Reading and Reading Disabilities.* Hillsdale, New Jersey: Lawrence Erlbaum.

LESELÆRING SOM FERDIGHETSLÆRING

Alfred Lie

I denne artikkelen blir *leselæring som ferdighetslæring* sett i fokus. Innleiingsvis prøver vi å definere lesing og med det avdekkje vårt grunnleggjande syn på lesing. Med utgangspunkt i den definisjonen vi ender opp med blir det så argumentert for kvifor leselæring kan bli sett på som ferdighetslæring, og det blir gjort greie for fasar i utviklinga av ferdighet /leseferdighet. I den siste delen av artikkelen blir så delferdigheter i leselæringa sett i fokus. Stoffet er organisert under følgjande overskrifter:

1. Eit grunnleggjande syn på lesing
2. Eit oppgåveanalytisk perspektiv på leselæring
3. Leselæring som ferdighetslæring
4. Fasar i utviklinga av leseferdighet
5. Delferdigheter i leselæringa
6. Avslutning

Eit grunnleggjande syn på lesing

Lesing er eigentleg eit svært vidt omgrep som dekkjer ei rad med varierte aktivitetar. Og synet på lesing dekkjer eit vidt spekter: Frå dei som legg hovudvekta på avkoding til dei som set meiningsoppfatning i fokus. Downing og Leong (1982) uttrykkjer det slik: *«There is not one kind of reading, but many kinds» (s 2),* og det er vel i dag semje om at spørsmålet om avkoding eller meining ikkje er eit enten-eller-spørsmål, men eit spørsmål om ulike nivå av prosessering.

I samsvar med dette synet gir Downing og Leong ein vid definisjon på lesing når dei definerer det slik: *«Reading is the interpretation of symbols» (ibid. s 4).* Her er det då ikkje berre

tale om tekstlesing, men òg lesing av andre symbolsystem som bilete, kart og notar. Med utgangspunkt i Downing og Leong sin definisjon har Lie (1987) gitt ein noko trongare definisjon på lesing: *«Lesing er tolking av skriven/trykt tekst som språk» (s 1).*

Med ein slik definisjon er det lagt eit språkpsykologisk og kognitivt perspektiv på å forstå leselæring. I samsvar med nyare straumdrag innan pedagogikk generelt og leseforsking spesielt har eg enda opp med følgjande definisjon:

> *Lesing er den prosessen som skjer når vi konstruerer meining frå skriven/trykt tekst. Det er ei aktiv, dynamisk og leserbasert ferdighet.*

Og vi kan leggja til: *Effektiv lesing* skjer når dei ulike *delferdighetene* i lesinga blir integrerte til ein lettflytande og heilskapleg prosess. Det er tale om ein interaktiv prosess der *lesaren, teksten* og *samanhengen* fungerer i eit gjensidig avhengighetsforhold til kvarandre. Og inne i denne likesida trekanten står det som det heile handlar om: *forståing* og *oppleving*.

Vi merkar oss at lesing her er definert som ei ferdighet, og det skal vi sjå nærmare på nedafor. Men først litt om det oppgåveanalytiske perspektivet på leselæring.

Eit oppgåveanalytisk perspektiv på leselæring

I dei siste 10-15 åra har omgrepet *«leseprosessen»* vorte mykje nytta av både leseforskarar og spesialpedagogar. Torleiv Høien (1984, 1986, 1997) har i vårt land sett dette omgrepet i fokus, og gjort framlegg om at Gjessing sin *funksjonsanalytiske* tilnærmingsmåte til lese- og skrivevanskeproblematikken måtte supplerast med ein *prosessanalytisk* tilnærmingsmåte. Vi kan og visa til at Dalby m.fl. (1983) i *Bogen om læsning - forudsetninger og status I* lar del III med kapittel 14 - 19 få overskrifta *Læseproces-teorier.*

Men omgrepet *prosess* er eit omgrep som det ikkje er lett å gi ein presis definisjon på. Prosess har inga spesifikk teknisk meining i psykologisk teori. Det er eit omgrep med eit vidt innhald som viser til ei eller anna systematisk endring i åtferd eller underliggjande mekanismar utan å spesifisera form eller karakteristika. Difor hevdar Downing (1984) at det er behov for å skifte ut det generelle og vage omgrepet prosess med meir spesifikk, forklarande terminologi, og meiner

ferdighet („skill„) er ei god erstatning i samband med lesing. Dette òg fordi ferdighet er ein vel etablert kategori i den psykologiske taksonomi, og forsking omkring ferdighetslæring er av dei eldste interesser i vitskapleg psykologi.

Vi har alt referert til at Høien har lagt seg på ein prosessanalytisk tilnærmingsmåte når det gjeld leselæring og lese- og skrivevanskar. Sjølv har eg - med utgangspunkt i Skjelfjord sitt forskingsarbeid og det grunnleggjande synet på lesing som det er gjort greie for innleiingsvis - gjort framlegg om å supplera dei ovafor nemnde tilnærmingsmåtane med det eg har kalla ein *oppgåveanalytisk* tilnærmingsmåte for å klårgjera leselærings- og lese- og skrivevanskeproblematikken (Lie 1992).

Det oppgåveanalytiske perspektivet har eg hevda (1992) kan vera

> . . . *utgangspunkt for både forsking omkring lese- og skrivevanskar og for metodiske opplegg for å førebyggja og gi hjelp til barn med lese- og skrivevanskar* (s 6).

Det sentrale i den oppgåveanalytiske tilnærmingsmåten er at ein tar utgangspunkt i ein grundig analyse av sjølve læringsoppgåva som barnet står ovafor, og så gjennom direkte arbeid med dei elementa som inngår i oppgåva, er målet å nå fram til meistring av desse. Her er det altså tale om ei meir åtferdsmessig tilnærming til lærevanskane, som ikkje treng å byggja på oppfatningar med omsyn til etiologiske samanhengar.

Slike tilnærmingsmåtar har det vore skort på i forsking omkring arbeid med lese- og skrivevanskar - noko som kan ha ført til at det førebyggjande arbeidet i leseopplæringsperioden ikkje har blitt tilgodesett på rett måte, og at barn med slike vanskar ikkje alltid har fått den beste hjelpa. Vi finn det òg noko underleg at dette perspektivet ikkje er nemnt av Hølen og Lundberg (1991, 1997) når dei gjer greie for ulike analytiske tilnærmingsmåtar i sine lærebøker om dysleksi.

I den oppgåveanalytiske tilnærmingsmåten til leselæringsproblematikken vil det høva godt å sjå på leselæring som ferdighetslæring fordi vi i analysen av læringsoppgåva vil finne *element* som barna må meistre for å makte leselæringa.

Leselæring som ferdighetslæring

Men kan vi no vera visse på at lesing kjem inn under

årferdskategorien ferdigheter? For å granska dette har Downing og Leong (1982) analysert oversyn over psykologiske studiar av trekk ved ferdigheter gjevne av Borger og Seaborne (1966), Cronbach (1977), De Cecco og Crawford (1974), McDonald (1965) og Whiting (1975). Dei fann 20 ofte nemnde karakteristika av ferdigheter. Vi tar med desse i avkorta form:

1. I samband med ferdigheter er det tale om *eit svært samansett* åtferdsmønster.

2. Den dyktige utfører dette åtferdsmønstret *lett og elegant* utan å feile.

3. Slik eleganse er resultatet av *integrering* eller koordinering av dei mange ulike åtferdsaspekt som er med i det samansette mønsteret.

4. *Tidsaspektet* („timing") er svært viktig i denne integreringa eller koordineringa. Fart kan stundom vera eit kriterium på høgt ferdighetsnivå, men ofte er *fleksibilitet* i utføring viktigare enn farten.

5. Den elegante utføringa er eit resultat av at utføraren er *klar for ei mengd hendingar* som kan inntreffa eller ikkje frå augneblink til augneblink.

6. Denne innstillinga på handling kjem av utføraren si *antisipering* av framtidige hendingar.

7. Den dyktige utføraren kan gå gjennom åtferdsmønstret *automatisk,* men går tilbake til meir fleksibel og medviten kontroll om ein uvanleg situasjon oppstår.

8. Det automatiske har som funksjon å *frigjera merksemda til utføraren for andre aktivitetar.*

9. *Medvit om eins eigne aktivitetar og deira funksjonar* er noen gangar eit karakteristikum for ferdigheter, men andre gangar ikkje.

10. Til utføring av ferdigheter høyrer ein kontinuerleg straum av reaksjonar på ytre og indre *signal («cues»).*

11. Desse reaksjonane er avhengig av utføraren si merksemd på relevante signal og hans *omsetting* av dei i høveleg handling.

12. Hovudkjeldene til signala er:
a. *endringar i det ytre miljøet* og
b. *indre endringar hos utføraren.*

13. *Tilbakemelding* er ein konstant regulator av åtferdsmønstret for å få til meir nøyaktig utføring.

14. Utføraren si utnytting av signal er avhengig av *selektiv merksemd.* Under innlæringa endrar utføraren sin sensitivitet for signal seg på fleire måtar.

15. Ein type endring i sensitivitet som skjer under innlæringa er *skiftet frå ytre signal til indre.*

16. Ein annan type endring som skjer under innlæringa er at utføraren nyttar *perseptuelle einingar av stigande storleik.*

17. Eit anna kjenneteikn på aukande grad av ferdighet er *større handlingseiningar.*

18. Ei anna endring ein kan observera i utviklinga av ferdigheter er både *reduksjon og auking i bruk av signal.*

19. *Evna til å hanskast med stress aukar* med aukande grad av ferdighet. I stressituasjonar vil dei mindre dyktige regredere til eit endå meir primitivt utføringsnivå.

20. Ferdigheter kan bli delte opp i mindre åtferdseiningar som ein kallar *«delferdigheter».* Nyare forsking tyder på at delferdighetene ikkje er hierarkisk ordna, men modulære i organiseringa. Delferdigheter som ein meistrar blir modular som er tilgjengelege for bruk i ein variasjon av kjende og

nye samanhengar. I høve til kontroll kan denne modulære organiseringa vera hierarkisk, utan at det finst ein nødvendig sekvens korkje for læring eller utføring (Lie 1987).

Downing og Leong (1982) nemner sjølve at det er overlapping mellom dei nemnde trekka. Dette fordi dei ville nytta originalkjeldene mest mogleg uendra.

Desse trekka blei så vurderte i relasjon til åtferdsanalyse i samanheng med lesing. Om vi ser bort frå trekk nr. 19, der det ikkje låg føre relevant forsking, var konklusjonen følgjande:

> *We found that the fit is very good. Therefore, we conclude that psychological research findings on skill acquisition in general can be applied with confidence to the specific skill of learning to read* (ibid. s 28).

Dette er bakgrunnen for at eg har valt å sjå på leselæring som ferdighetslæring.

Vi er likevel ikkje samde med Downing i at omgrepet prosess bør skiftast ut med omgrepet ferdighet i samband med lesing. Vi meiner det er behov for å nytta båe omgrepa. I vår samanheng vil ferdighet bli nytta som nemning på ei rad ulike verbale åtferdskategoriar som t. d. oppdeling av talte ord i lydar og samantrekking av lydar til ord, medan prosess står for dei endringane som skjer i dei underliggjande mekanismane i utføringsfasen. Ferdighet er med andre ord evna til å gjennomføra prosessen. Høien og Lundberg (1984, 1997) og Høien og Jansen (1986) har gitt grundige utgreiingar om delprosessane som ligg til grunn for dei kontekstfrie lesestrategiane, den direkte og den indirekte vegs strategi, og viser betydninga av å nytta prosessomgrepet i samband med lesing. Dette er ei tilnærming som ser ut til å vera fruktbar i og med at ein med utgangspunkt i den teoretiske modellen har utvikla diagnostiske hjelpemiddel som KOAS- og KOAP-testen.

Fasar i utviklinga av leseferdighet

Etter å ha konkludert med at leselæring er ei form for ferdighetslæring, vil det vera av interesse å gå litt nærmare inn på korleis ferdighetslæring utviklar seg og relatera dette til leselæring.

Fitts (1962 og 1964) har gjennom detaljert oppgåveana-

lyse og gjennomlesing av forskingslitteratur om ferdighetslæring kome fram til at all ferdighetslæring går føre seg i tre fasar som vi kan kalla:

1. kognisjonsfasen
2. meistringsfasen
3. automatiseringsfasen

Fasane finn stad i denne rekkefølgja, men dei overlappar kvarandre og er ikkje klårt skilde frå kvarandre. Dei viser heller ei endring av tyngdepunktet i løpet av læringsprosessen.

Vi bør og vera merksame på at i utviklinga av ei så kompleks ferdighet som lesing, vil desse tre fasane kontinuerleg koma tilbake etter som ein møter stadig nye delferdigheter i løpet av dei åra ein treng for å bli ein fullgod lesar.

Det er startfasen som blir kalla *kognisjonsfasen.* Dette fordi kognitive prosessar er i fokus i og med at nybegynnaren er i ein ukjend situasjon og må finne ut kva han skal gjera. Han må analysera og klårgjera for seg sjølv kva operasjonar som må utførast og forholdet mellom dei. Det er i løpet av denne fasen at overføring av tidlegare læring er svært viktig, og det er før og i løpet av denne fasen at pedagogen må vera med og byggja opp dei nødvendige læreføresetnadene/delferdighetene hos eleven. Då vil han lettare kunne finna fram til kva krav ferdighetslæringa stiller til han.

Det må vera denne fasen Calfee (1983) har i tankane når han hevdar at *«Reading acquisition is more a matter of learning by knowing than learning by doing.»* Og det nybegynnaren i lesing i første rekkje må ha innsikt i er det alfabetiske prinsippet - sjølve konstruksjonsprinsippet for alfabetiske skriftspråk: Ord kan delast i språklydar (fonem) og kvar lyd kan representerast ved hjelp av visuelle teikn som vi kallar bokstavar eller grafem. Utan innsikt i dette prinsippet er det tvilsamt om ein i det heile kan utvikla ferdighet i det vi kallar alfabetisk lesing.

I *meistringsfasen* blir dei mest adekvate handlingsmønstra som blir utprøvde i kognisjonsfasen, valde ut, øvde på og stadig betre koordinerte. Dette er øvingsfasen, og lengda på han vil sjølvsagt variera med grad av kompleksitet og høve til praktisering. Fitts (1964) hevdar at denne fasen er den lengste

og vanskelegaste. Nyborg (1976) har gjennomført ein analyse av ferdighetslæring i lys av Fitts sin oppgåveanalyse. Han peikar på at denne fasen ser ut til å vera avhengig av mykje øving for at *«ferdigheten skal bli mer og mer lettløpende og derved gli over til å bli 'automatisk'»* (s 17).

I og med at lesing er ei svært samansett ferdighet, kan vi gå ut frå at det her er behov for store mengder øving. På same måten som at ein ikkje kan læra bilkøyring utan å praktisera dette, kan ein heller ikkje læra lesekunsten utan gjennom lesing. Anderson og Dearborn (1952) hevdar at det er vanskeleg å finne betre råd for å få auka leseferdighet enn den resepten ein tidleg New England settlar utforma. Vi refererer han her:

1. Read.
2. Read.
3. Read some more.
4. Read anything.
5. Read about everything.
6. Read enjoyable things.
7. Read things you yourself enjoy.
8. Read, and talk about it.
9. Read very carefully some things.
10. Read on the run, most things.
11. Don't think about reading, but
12. Just read (s 165-166).

Problemet er at dei som lukkast med leselæringa, vil vanlegvis bli sjølmotiverte for slik aktivitet og får dermed den treninga dei treng, medan dei som har vanskar med denne læringsprosessen, og som difor treng ekstra mykje trening, vil bli lite motiverte for slik aktivitet. Bamberger (1976) uttrykkjer dette paradokset slik:

> *Many children do not read books because they cannot read well enough. They cannot read well because they do not read books* (s 61).

Automatiseringsfasen er karakterisert av at gjennomføringa går føre seg på ein rask og automatisert måte med eit minimum av feil. På dette nivået er gjennomføringa godt integrert og vil krevja liten grad av merksemd. Denne fasen når ein gjennom overlæring. Eventuell framgang i denne fasen er ikkje lett å registrere, men kan

på testar visa seg ved m.a. kortare reaksjonstid (jfr. Desse & Hulle 1967). Nyborg (1976) hevdar i denne samanhengen at det er grunn til å tru at ein i automatiseringsfasen sjeldan når den øvre grensa, men at ferdighetslæringa blir karakterisert av at ho stadig kan bli betre ved ny røynsle/meir øving livet igjennom inntil degenerering set inn.

I relasjon til leselæring er kanskje det viktigaste i denne fasen at utføringa krev liten grad av merksemd. Den dyktige lesaren kan gjennomføra avkuttinga automatisk utan at merksemda i nemneverdig grad er retta mot denne funksjonen. Dermed kan den som har nått dette nivået, rette storparten av merksemda mot meiningsinnhald og meiningsoppfatning, som er det eigentlege føremålet med stillelesing.

I den første fasen er det altså kognitive aspekt ved ferdighetslæring det blir fokusert på. I læring av ei så pass kompleks ferdighet som lesing, er denne perioden svært viktig, fordi dei kognitive krava i leseopplæring må karakteriserast som relativt høge. Det er kognitivt sett inga lett oppgåve å få innsikt i prinsippet om at skriftteikna representerer språklege formsegment på fonemnivå, at i alfabetiske skriftspråk er alle ord representerte av ein kombinasjon av eit avgrensa tal av visuelle symbol. Vernon (1971) uttrykkjer dette såleis:

> *But a thorough grasp of this principle necessitates a fairly advanced stage of conceptual reasoning, since this type of organization differs fundamentally from any previously encountered by children in their normal environment* (s 79).

I ein tidlegare grundig gjennomgang av forsking om årsaker til lesevanskar konkluderte ho med at *«the fundamental and basic characteristic of reading disability appears to be cognitive confusion ...»* (Vernon 1957, s 71).

Når kognitiv forvirring er hovudsymptomet på lesevanskar, kan vi postulera at kognitiv klårleik («clarity») skulle vera den typiske karakteristikken av den dyktige lesaren, hevdar Downing (1979). Det nybegynnaren i lesing må få klårleik i, kan i følgje Downing (1979) delast i to hovudområde:

1. *Funksjonelle omgrep*: dei kommunikative føremåla med skriving.

2. *Formmessige* ("featural") *omgrep*: trekka ved talt språk som blir representerte av skrivne symbol.

På bakgrunn av slike synspunkt lanserte Downing (1979) det han kalla den *«kognitive klårleiks-teorien»* om leselæring. Teorien er blitt formelt framstilt i 8 postulat om leselæring. Vi tar med postulat nr. 5, 6 og 7 fordi dei har direkte tilknyting til den kognitive fasen i leselæringa:

5. Barn nærmar seg vanlegvis oppgåvene i leseundervisninga i ein tilstand av kognitiv forvirring om føremåla med og tekniske trekk ved språket.

6. Under rimeleg gode vilkår vil barna arbeide seg ut av dette forvirringsstadiet og over i aukande kognitiv klårleik om funksjonane for og formelle trekk ved språket.

7. Endå om startfasen er den mest vitale, vil den kognitive forvirringa auka for så etter kvart å vika for kognitiv klårleik gjennom dei seinare undervisningsstadia etter som nye delferdigheter blir lagde til eleven sitt repertoar. (Downing 1979, s 37).

På grunnlag av seinare forskingsresultat frå Papua New Guinea (Downing & Downing 1983) har Downing måtta revidera synet sitt på graden av kognitiv forvirring hos nybegynnaren i lesing. Det viste seg nemleg at barn på skolar i Papua New Guinea som blei underviste i eit andre språk, var meir kognitivt forvirra enn dei som budde i landsbyar der det ikkje fans skolar. Vi tek med den reviderte versjonen av dei ovafor refererte postulata:

5. Barn nærmar seg oppgåvene i leseundervisninga med berre delvis utvikla omgrep om funksjonane for og formelle trekk ved tale og skriving.

6. Under rimeleg gode vilkår vil barna utvikle aukande kognitiv klårleik om funksjonane for og formelle trekk ved språket.

7. Endå om startfasen er den mest vitale, vil omgrepsmessige utfordringar auka på og slik auka vidda av kognitiv klårleik gjennom dei seinare undervisningsstadia etter som delferdigheter blir lagde til eleven sitt repertoar. (Downing 1984, s 37.)

Dette at Downing måtte revidera postulata sine om kognitiv forvirring hos nybegynnaren i lesing, endrar ikkje i vesentleg grad grunnlaget for hans klårleiksteori. Kognitiv klårgjering av funksjonelle og formmessige språklege omgrep vil i alle høve vera viktig i startfasen i leseopplæringa. Det er eit synspunkt som vi har relativt fyldig forskingsmessig dekning for å hevde. Når det gjeld betydninga av kognitiv klårgjering av funksjonelle språklege omgrep, viser vi til oversyn over relevant forsking hos Downing (1984, s 37-39). Når det gjeld betydninga av klårgjering av formmessige språklege omgrep, viser vi til kapittel 5 hos Lie (1987).

Vi har her lagt hovudvekta i framstillinga på den kognitive fasen i leselæringa. I samband med utvikling av ferdighet i ordanalyse er meistringsfasen òg av stor betydning. Det vil vi koma tilbake til i neste del av framstillinga.

Hittil har vi sett på leselæring som læring av ei generell ferdighet. Vi skal no sjå nærmare på kva delferdigheter vi kan dela denne i.

Delferdigheter i leselæringa

Eit vilkår for å kunne utarbeide ein brukbar metodikk for begynnaropplæringa i lesing, er at ein gjennomfører ein analyse av kva oppgåver ein kan dela innlærings arbeidet i. Det beste grunnlaget for ein slik analyse er, etter vår meining, at ein har innsett kva prinsipp som ligg til grunn for konstruksjonen av skriftsystemet.

Ved gjennomgang av forskingslitteratur på området, må ein stussa over kor få leseforskarar som har hatt dette som utgangspunkt for forskinga si. Men dei finst. Jfr. Downing (1979), Elkonin (1973), I. Liberman (1973), Lundberg (1977), Nyborg (1981), Skjelfjord (1977), Vernon (1957, 1971).

> Betydninga av dette har Fries (1963) uttrykt slik:
> *The basic «structure» of each particular writing system will necessarily determine what must be learned as the first steps to the reading of materials written in that system* (s 152).

Ut frå ein analyse av skilnader mellom ulike skriftspråk

skisserer Downing og Leong (1982) fire oppgåver som nybegynnaren møter når han skal læra skriftspråket. Han må læra:

1. Kva taleeining som er koda i skriftspråket.

2. Ein del visuelt presenterte todimensjonale former.

3. Reglane for å relatera taleeiningane til skrift-formene.

4. Måten som tidsordninga av talelydar er relaterte til den rommessige ordninga av skriftformene (s 56).

Om vi relaterer desse fire oppgåvene til alfabetiske skriftspråk, vil vi kunne setja opp ei liste over delferdigheter som elevane må læra i leselæringsprosessen. Skjelfjord (1977) har med utgangspunkt i ein grundig analyse av forholdet mellom koden for talt og koden for skrive språk, laga følgjande liste over oppgåver som eleven må makte for at han skal kunne lære lesa:

1. Han må *analysera* dei talte einingane i dei einingane (fonem) som er representerte i skriftsystemet.

2. Han må læra å skilje mellom og kjenne att *skrift-teikna* som visuelle einingar.

3. Han må læra å *assosiere* kvart skriftteikn med det tilsvarande fonemet.

4. Han må læra korleis ein går frå den visuelle rekke-følgja av skriftteikn til den tidsmessige rekke-følgja av fonem slik at resultatet blir eit talt ord: han må læra *samanlesing* eller *syntesedanning.*

5. Han må læra *leseretninga,* dvs. ei systematisk gjennomsøking av rekkefølgja av skriftteikna frå venstre mot høgre - der dette er leseretninga. Denne læringsoppgåva er nær knytta til oppgåve fire (s 14).

Tilsvarande lister over delferdigheter i leselæringa kan vi finne hos m.a. Vernon (1957, 1971), Nyborg (1976), Robeck og Wilson (1974).

Vi skal ikkje her gå inn på ein nærmare analyse av dei einskilde delferdighetene og relasjonen mellom dei, men nemne at Bachke og Gunnestad (1980) grupperer dei fem deloppgåvene som Skjelfjord har i si liste på følgjande måte:

1. *Fonemlæring,* som svarer til punkt 1 hos Skjelfjord og Nyborg.

2. *Bokstavlæring,* som svarer til punkt 2 og 3 hos Skjelfjord og Nyborg. Det omfattar både diskriminering og identifisering av bokstavformer og assosiasjon bokstavform - fonem. Grunngiinga for å føre dei saman er at dei frå ein omgrepslærings-synsstad kan bli sett på som *ei* læringsoppgåve som består av to delferdigheter.

3. Læring av *leseretning* og *samanlesing,* som svarer til punkt 4 og 5 hos Skjelfjord. Dette er to læringsoppgåver som heng nøye saman fordi samanlesing byggjer på at ein inspiserer skriftteikna i leseretninga.

Frå ein didaktisk synstad tykkjest dette vera ei forstandig inndeling, sjølv om vi ville nytta ei anna nemning på punkt 1 enn det Bachke og Gunnestad nyttar. I samsvar med det grunnleggjande synet på denne aktiviteteten som det er gjort greie for i kapittel 5 i Lie (1987) si doktoravhandling, vil vi kalla det *ordanalyse* på fonemnivå.

Det nyttige med ei slik oppdeling av det omfattande leseomgrepet i fem delferdigheter er at dette er ein god og enkel reiskap både som grunnlag for metodisk refleksjon i forhold til generell leseopplæring og til å diagnostisera kvar vanskane ligg når barn har avkodingsproblem. Då må vanskane reint logisk kunna lokaliserast til ei eller fleire av dei fem delferdighetene eller i å oppnå ei automatisering av ordavkodinga.. Og det er viktig å peika på at ein etter denne modellen ikkje treng kompliserte databaserte testar for å kunne gjennomføra kartlegginga. Kvar lærar med innsikt i den oppgåveanalytiske tilnærmingsmåten til leselæringsproblematikken vil kunne laga prøver for dei ulike

delferdighetene.

Når så vanskane er lokaliserte, blir det spørsmål om pedagogiske opplegg for å hjelpa det enkelte barnet. I tilleg til eigen fantasi og planleggingsevne kan læraren søkja hjelp i den etter kvart så rikhaldige metodisk-didaktiske litteraturen på området.

Av dei fem/tre ovafor nemnde delferdighetene er den første - ferdighet i ordanalyse på fonemnivå - den mest grunnleggjande i og med at utvikling av ferdighet på dette området er ein føresetnad for utvikling av ferdighet på dei andre områda. Vi hugsar at meistringsfasen var karakterisert av øving og at automatiseringsfasen vart nådd gjennom overlæring. Generelt sett skulle det bety at ferdighet i ordanalyse blir nådd gjennom øving.

LaBerge og Samuels (1976) har i sin informasjons-teoretiske modell av leseprosessen nettopp retta merksemda mot automatisering av delprosessane i lesing. I følgje desse forfattarane har den menneskelege merksemda si avgrensing i at ein berre kan vera merksam på ein ting om gongen. Ein kan t.d. ikkje lytta til og forstå kva to personar seier samstundes. Dei prøver å visa korleis delprosessane i lesing kan øvast opp slik at dei kan gjennomførast utan å krevja lesaren si fokale merksemd retta mot seg. Som andre døme på kompleks menneskeleg åtferd med delferdigheter som må automatiserast, nemner dei ballspel og sykling. I startfasen krev det spesiell merksemd å halda balansen ved sykling. Men når det er automatisert, kan merksemda skifte over på andre ting som trafikken, landskapet rundt osb.

Som indisium på at ideen om automatisering og delprosessar i leselæringa er rett, viser LaBerge og Samuels til at dugande lesarar har færre fikseringar under lesing enn dårlege lesarar, og at dugande lesarar er flinke i kvar einskild delprosess, medan svake lesarar vil ha vanskar med ein eller fleire delprosessar.

Når den dugande lesaren er karakterisert ved m.a. å ha oppnådd høg grad av automatisering av delprosessar, oppstår naturleg spørsmålet om korleis ein oppnår automatisering av ein delprosess. Svaret for LaBerge og Samuels er at når ein delprosess har blitt gjennomført mange nok gonger med fokal merksemd, har lesaren etter kvart oppretta faste «funksjons-mønster» slik at prosessen kan gjennomførast utan merksemda retta mot han. Skilnaden på den øvde og mindre øvde lesaren

er at den mindre øvde må fokusera merksemda på eit tidlegare steg i leseprosessen. Di meir dugande ein er, di «lenger inn» i leseprosessen kan ein leggja merksemda. Målet er at lesaren heilt og fullt skal kunne arbeide på det semantiske nivået med meiningsinnhaldet i teksta. I si klassiske bok om lesing uttrykkjer Huey (1908) det slik:

> *. . . repetition frees the mind from attention to details, makes facile the total act, shortens the time, and reduces the extent to which conciousness must concern itself with the process (s 104).*

Automatisering oppnår ein altså gjennom øving. Når det gjeld opplegg for å utvikle ferdighet i ordanalyse, kan vi mellom anna vise til kapittel 11 i Lie 1992.

Avslutning

Ein fare ved slik oppdeling av leselæringa i læring av ulike delferdigheter er at elev og lærar ikkje skal "sjå skogen for berre tre". Målet for leselæring - det å få tak i meiningsinnhaldet og sjølve leseopplevinga - må alltid stå sentralt i strevet med å læra delferdigheter. Meiningsoppfatning og leseoppleving må danne ramma som ein arbeider innanfor. Med eit slikt heilskapleg syn på leselæringa vil ein kunne unngå dei største ulempene ved ei slik analytisk tilnærming til denne læringsoppgåva. Og eg avsluttar med følgjande sitat frå del 1: *Effektiv lesing* skjer når dei ulike *delferdighetene* i lesinga blir integrerte til ein lettflytande og heilskapleg prosess. Det er tale om ein interaktiv prosess der *lesaren*, *teksten* og *samanhengen* fungerer i eit gjensidig avhengighetsforhold til kvarandre. Og inne i denne likesida trekanten står det som det heile handlar om: *forståing* og *oppleving*.

Summary

The focus of this article is *reading acquisition as skill learning*. At the beginning we try to define reading in an attempt to indicate our basic comprehension of the concept. With the concluding definition as a starting point we look at reading acquisition from a *job analytic* perspective, and try to find arguments for the assertion that reading acquisition can be regarded as skill learning. Then we try to find out what characterises the different *phases* into which we can divide the development of skill learning/reading acquisition. In the last part of the article our focus is *subskills in reading and*

learning to read. We finish the article by underlining the idea that *effective* reading takes place when the different subskills in reading are integrated into a smooth holistic process where *meaning* and *experience* are the central concepts.

Litteraturliste

Anderson, J.H., & Dearborn W.F. (1952). *The psychology of teaching reading.* New York: The Ronald Press Company.

Bachke, C. , & Gunnestad, A. (1980). *Den første leseundervisningen.* Oslo. Universitetsforlaget.

Bamberger, R. (1976). Literature and development in reading. I J.E. Merrit (red.), *New horizons in reading.* Newark, Del.: International Reading Association.

Borger, R., & Seaborne, A.E.M. (1966). *The psychology of learning.* Hammersworth, England: Penguin.

Calfee, R.C. (1983). The mind of the dyslexic. *Annals of dyslexia,* 33, 9-28.

Cronbach, L.J. (1977). *Educational psychology* (3. utg.). New York: Harcourt Brace Jovanovich.

Dalby, M.A., Elbro, C., Jansen, M., Krogh, T., & Christensen, W.P. (1983). *Bogen om læsning - forudsætninger og status I.* Copenhagen: Pædagogiske Institut.

De Cecco, J.P., & Crawford (1974). *The psychology of learning and instruction.* Englewood Cliffs, N.J., Prentice Hall.

Deese, J., & Hulse, S.H. (1967). *The psychology of learning.* New York: McGraw-Hill Book Company.

Downing, J. (1979). *Reading and reasoning.* W. & R. Chambers.

Downing, J. (1984 a). Task awareness in the development of reading skill. I Downing, J., & Valtin, R. (red.), *Language awareness and learning to read.* New York: Springer-verlag.

Downing, J. (1984 b). *Language awareness, cognitive clarity and reading readiness.* Paper presented at the annual meeting of the national Reading Conference, St. Petersburg, Florida.

Downing, J., & Downing M.(1983). Metacognitive readiness for literacy learning. *Papua New Guinea Journal of Education,* 19, 17-40.

Downing, J., & Leong, C.K (1982). *Psychology of reading.* New York: Macmillan.

Elkonin, D.B. (1973). U.S.S.R. I Downing, J. (red.). *Comparative reading.* New York: Macmillan.

Fitts, P.J. (1962). Factors in complex skill training. I Glaser, R. (red.) *Training research and education.* Pittsburg, Pa.: University of Pittsburg Press.

Fitts, P.J. (1964). Perceptual-motor skill learning. I Melton, A.W. (red.). *Categories of human learning.* New York: Academic Press.

Fries, C.C. (1963). *Liguistics and reading.* New York: Holt.

Høien, T., & Jansen, M. (1986). *Leseinnlæring, leseprosesser og lesemetoder.* Oslo: Universitetsforlaget.

Høien, T., & Lundberg, I. (1984). *Leseferdighet og skapende lesing.* Oslo: Universitetsforlaget.

Høien, T., & Lundberg, I. (1991). *Dysleksi.* Oslo: Gyldendal.

Høien, T., & Lundberg, I. (1997). *Dysleksi. Fra teori til praksis.* Oslo: Ad Notam Gyldendal.

Lie, A. (1987). *Ordanalyse som grunnlag for begynnar-opplæringa i lesing.* Halden lærerhøgskole - skrifter - 6.

Lie, A. (1992). *Lese- og skrivevanskar i eit oppgåveanalytisk perspektiv.* Halden lærerhøgskole - skrifter - 3.

Liberman, I.Y. (1973). Segmentation of the spoken word and reading acquisition. *Bulletin of the Orton Society,* 23, 65-77.

Lundberg, I. (1977). Kognitionspsykologiska aspekter på den första läsinlärningen. *Skolepsykologi* (dansk), 3, 165-189.

Nyborg, M. (1976). *Analyse av ferdigheter (skills) og innlæring av ferdigheter.* NAVF, B. 70-10-067, Notat nr. 2.

Robeck, M.C., & Wilson, J.A.R. (1974). *Psychology of reading.* New York: John Wiley & Sons.

Skjelfjord, V.J. (1977). *Metoden i den første leseundervisningen.* Oslo: Gyldendal.

Vernon, M.D. (1957). B*ackwardness in reading.* Cambridge: Cambridge University Press.

Vernon, M.D. (1971). *Reading and its difficulties.* Cambridge: Cambridge University Press.

Whiting. H.T.A. (1975). *Concepts in skill learning.* London. Lepus.

Utvikling av lese- og rettskrivingsferdigheter hos grunnskolebarn i Trondheimsområdet

Av Ragnheidur Karlsdottir

Skolens såkalte redskapsfag: lesing, rettskriving, skriftforming og matematikk er grunnleggende i den forstand at de senere tjener som instrumenter i tilegnelsen av andre fag. En svikt i elevenes utvikling innen disse fag vil senere kunne hindre deres utvikling i andre fag.

Kunnskap om de faktorer som influerer elevenes utvikling i redskapsfag er en forutsetning for at skolen skal være i stand til å fremme denne utvikling. I Norge har det vært utført flere undersøkelser i den hensikt å bygge opp slik kunnskap. Den mest omfattende av disse, det såkalte Bergen-prosjektet, ble utført av Solheim, Nygaard og Aasved (1984). I en longitudinell undersøkelse av over 3000 barn fra slutten av første til slutten av fjerde klassetrinn i grunnskolen undersøkte de ferdighetsutviklingen i lesing, rettskriving og matematikk hos enkeltelever og skoleklasser. For å forklare den individuelle variasjonen brukte de ulike prediktorvariabler som ble delt inn i tre bakgrunnsfaktorer: alder, foreldreyrke og kjønn; tre språklige kognitive faktorer: språkforståelse, språkproduksjon og modenhet; og fem sosioemosjonelle faktorer: innstilling, aspirasjon, kameratstatus, selvbilde og atferd. Av de undersøkte prediktorvariablene hadde de språklige kognitive faktorene størst direkte innflytelse på fagprestasjonene, mens foreldreyrke og de sosioemosjonelle variablene, spesielt selvbilde hadde indirekte innflytelse. Solheims (1984) analyse av utviklingen på klassenivå viste for det første en betydelig forskjell både i klassenes gjennomsnittsferdigheter og i spredningen i ferdigheter innen hver klasse.

For det andre at klassene hadde et forholdsvis ulikt utviklingstempo og ulike utviklingsmønstre. For det tredje at ferdighetene i ulike fag innen hver klasse var korrelerte dvs. at klasser som var dårlige i lesing var vanligvis også dårlige i rettskriving og matematikk. Denne korrelasjonen avtok med økende alder i noen av klassene. For det fjerde at det var høy grad av stabilitet i klassenes gjennomsnittsferdigheter. For det femte at i klasser med høye gjennomsnittsferdigheter var elevene mer modne og klassene hadde færre elever med spesialpedagogiske behov enn i klasser med lave gjennomsnittsferdigheter. Solheim (op.cit.) antydet, på grunnlag av studien, at klassetilhørighet kunne ha en betydning for hvordan et barn utvikler seg. F.eks. kunne to barn med like forutsetninger utvikles forskjellig hvis det ene havnet i en klasse med høye gjennomsnittsferdigheter og det andre i en klasse med lave gjennomsnittsferdigheter. Dette kan bl.a. skyldes at læreren, av praktiske grunner, må legge nivået på sin undervisning nærme ferdighetsgjennomsnittet i klassen. Nygaard (1984) konkluderte at ferdighetene på første og andre klassetrinn var sterke predikatorer for ferdighetene på tredje og fjerde klassetrinn i fagene lesing, rettskriving og matematikk (korrelasjonskoeffisienter henholdsvis r = 0.77, 0.76 og 0.79).

Undheim (1989) utførte en longitudinell undersøkelse av lese- og skriveutvikling på fjerde og sjette klassetrinn hos ca 900 elever. Han fant korrelasjoner både i leseferdigheter (r = 0.60) og rettskrivingsferdigheter (r = 0.72) mellom fjerde og sjette klassetrinn. Han forklarte korrelasjonene med at lesing og rettskriving har basis i det talte språk og at undervisningen de tre første årene i skolen er tilstrekkelig for å stabilisere disse ferdighetene.

Undheim (1989) og Lie (1994) sammenlignet rettskrivingsferdigheter hos barn med Asheims (1964) orddiktatnormer og konkluderte at på tredje og fjerde klassetrinn hadde skolebarn i slutten av 1980-årene svakere rettskrivingsferdigheter enn barn i begynnelsen av 1960 årene. Dette ble imidlertid tatt igjen i løpet av femte og sjette klassetrinn slik at rettskrivingsferdighetene på sjette klassetrinn var i samsvar med Asheims normer. Undheim forklarte avviket fra Asheims normer med endret praksis i retting og vektlegging på ortografi de første skoleårene. Han konkluderte at den gradvis sterkere vektlegging på dette området på femte og sjette klassetrinn var tilstrekkelig til å korrigere avviket. Dette kan indikere den effekt undervisningsmetoder kan ha på ferdighetsutvikling.

I 1991 ble det, i regi av The International Association for the Evaluation of Educational Achievement (IEA), utført en kartleggings-undersøkelse av leseferdigheter hos 9 og 14 år gamle barn i henholdsvis 27 og 31 land. I denne undersøkelsen havnet Norge på 7. plass når det gjaldt niåringenes leseferdighet og på 17. plass med hensyn til fjortenåringenes leseferdighet (Tønnesen, 1994). Også i denne undersøkelsen ble det gjort

forsøk på å finne årsaker til forskjellen i leseferdigheter hos barn. Det ble funnet stor forskjell mellom barn som daglig leste bøker, aviser, tidsskrifter eller tegneserier og de som ikke leste daglig. Det så ikke ut til at arten av lesestoff influerte på leseferdigheten, men leseforståelsen var bedre hos de som fortrinnsvis leste bøker eller aviser. Forøvrig viste undersøkelsen at Norge var blant de land som hadde størst forskjell mellom gode og dårlige lesere. I alle land hadde jenter bedre leseferdigheter enn gutter. Blant de norske elevene var denne kjønnsforskjellen imidlertid relativt stor. Klassestørrelse så derimot ikke ut til å influere på elevenes resultater i lesing. Det ble funnet positiv korrelasjon mellom leseferdighet og selvvurdering (Valgeirsdottir, 1993; Tønnesen, 1994). De konklusjoner man tilsynelatende kan trekke om norske skolebarn av IEA undersøkelsen er at leseferdighetene går tilbake fra ni til fjorten år sammenlignet med elever i andre land. Men man bør imidlertid være forsiktig med å trekke for bastante konklusjoner fra undersøkelsen. Rangeringen av nasjonene i IEA undersøkelsen bygget på normrelaterte målinger utført ved hjelp av ordinale måleskalaer hvor nullpunktet er ukjent og "måleenhetens" størrelse varierer langs skalaen. Man kan derfor ikke uttale seg om den relative forskjell i ferdigheter mellom barn i forskjellige land på grunnlag av den. F.eks. kan man ikke påstå at forskjellen i leseferdigheter mellom islandske og norske fjortenåringer hadde praktisk signifikans til tross for at Island kom på 6. plass og Norge på 17. plass. Nytteverdien av slike rangeringsundersøkelser er derfor tvilsom.

Det har allment vært antatt at kjennskap til bokstaver ved skolestart har positiv innflytelse på barns utvikling i lesing og rettskriving. Jansky og de Hirsch (1972) har bekreftet dette i sine undersøkelser av skolebarn i New York. Ingen slike undersøkelser av norske skolebarn har vært publisert. Imidlertid har Vormeland (1967), Søvik (1973) og Lie (1986) samlet inn opplysninger om barns kjennskap om bokstaver og lesing i forbindelse med etablering av like forsøksgrupper i forsøksprosjekter som studerte ulike metoder i norskopplæring. Et annet forhold som ikke har vært undersøkt i Norge er hvilken innflytelse elevenes "skolehistorie", dvs. faktorer som klassestørrelse, vikarbruk, lærerbytte, klassemiljø og elever med atferdsproblemer i klassen, har på ferdighetsutviklingen over tid.

I en longitudinell undersøkelse, utført i årene 1988 til 1993, kartla jeg ferdighetsutviklingen i lesing, rettskriving og skriftforming gjennom de fem første skoleårene hos elever i grunnskoler i Trondheimsområdet (Karlsdottir, 1996 a,b,c). Som en del av denne undersøkelsen utførte jeg forkunnskapstester ved skolestart i første klasse som bl.a. inkluderte bokstavkunnskap og førte en journal over elevenes "skolehistorie" gjennom hele undersøkelsen. I denne artikkelen vil jeg gi en preliminær analyse av forkunnskapenes innflytelse på elevenes utvikling av lese- og

rettskrivingsferdigheter og diskutere den innflytelse elevenes "skolehistorie" og kjønn har på denne utviklingen.

Metode

Forsøkspersoner
Forsøkspersonene var 407 barn, 217 gutter og 190 jenter, fordelt på 20 skoleklasser. De var gjennomsnittlig syv år og en måned da de begynte på skolen. Ved prosjektstart var antall barn 440, men 33 barn falt fra, hovedsakelig p.g.a. flytting. Forsøksgruppen utgjorde ca. 30% av alle barn i Trondheimsområdet som begynte i første klasse høsten 1988. Den antas derfor å være et representativt utvalg av førsteklassinger i dette området. Antall elever i klassene varierte fra 14 til 26. Denne undersøkelsen ble utført før Reform 97 slik at gamle klassetrinnsbetegnelser blir brukt.

Opplæringsprogrammer
Alle elevene fulgte lese- og skriveopplæring basert på LTG lesemetoden (Leimar, 1974). På første klassetrinn lærte den ene halvparten av elevene usammenbundet stavskrift og den andre halvparten trykkskrift. På andre klassetrinn lærte alle elevene sammenbundet stavskrift. Tekstene som ble brukt i leseopplæringen på første klassetrinn var skrevet med den skrifttype som var brukt i skriftformingsopplæringen, og i tillegg ble bøker med trykkskrift brukt for begge gruppene. Jeg fant ikke forskjell i lese- og rettskrivingsferdigheter hos elever som brukte usammenbundet stavskrift og de som brukte trykkskrift i begynneropplæringen (Karlsdottir, 1996 b). Derfor har jeg ikke analysert resultatene fra de to skriftformingsgruppene adskilt.

Tester
Forkunnskapene testet jeg ved skolestart med Wigforss og Malmquists (1960) individtest i lesing slik den er oversatt til norsk av Vormeland (1967). Testen består av 6 deler: gjenkjenning (med navn) av store og små bokstaver (maksimumsskåre 29 poeng på hver), lesing av ord med store og små bokstaver (maksimumsskåre 24 poeng på hver), lesing av tekst (maksimumsskåre 34 poeng) og skriving av store bokstaver etter diktat (maksimumsskåre 29 poeng).

Leseferdighetene testet jeg på andre og femte klassetrinn med Gjessings (1970) gruppetester i leseforståelse. Testene består av oppgaver som elevene skal lese og siden svare på spørsmål fra teksten. Testen for andre klassetrinn har 25 oppgaver og to spørsmål til hver, og det gis ett poeng for hvert spørsmål slik at høyeste skåre er 50 poeng. Testen for femte

klassetrinn har 18 oppgaver og fire spørsmål til hver slik at høyeste skåre er 72 poeng.

Rettskrivingsferdighetene testet jeg på andre, tredje og femte klassetrinn med Asheims (1964) gruppetest som består i et orddiktat på 50 ord. Ett poeng gis for hvert riktig ord slik at høyeste skåre er 50 poeng.

Resultater

Resultatene fra forkunnskapstestene er vist i Tabellene 1, 2 og 3.

Tabell 1 viser gjennomsnittsskårer for de enkelte deler av forkunnskapstesten i lesing for alle klassene samlet. Av tabellen fremgår

Tabell 1

Forkunnskaper ved skolestart. Maksimumsskåre (MX), gjennomsnittsskårer over alle klasser (M), standardavvik (SD) og skjevhet. N = 407

Tester	MX	M	SD	Skjevhet
Gjenkjenning store bokstaver	29	20.3	8.9	- 0.6
Gjenkjenning små bokstaver	29	16.5	9.6	- 0.1
Lesing av ord store bokstaver	24	6.2	8.7	+1.1
Lesing av ord små bokstaver	24	5.8	8.8	+1.2
Lesing av tekst	34	7.5	13.2	+1.3
Skriving av store bokstaver	29	19.8	9.3	- 0.5

at det var like resultater i gjenkjenning av store bokstaver og skriving av store bokstaver mens elevene hadde mindre kunnskap om de små bokstavene. Gjennomsnittsskårene for de tre lesetestene må tolkes med forsiktighet p.g.a. betydelig skjevhet i materialet. Skjevheten skyldes det store antall barn som ikke kunne lese, og som derfor fikk 0 poeng på disse testene. Alle testene viser stor spredning (SD) i ferdighetene.

Tabell 2 viser gjennomsnittsskårer etter klasser for gjenkjenning av store og små bokstaver og skriving av store bokstaver og andelen av elever som kunne lese og skrive alle bokstavene. Variansanalyse viste signifikante forskjeller mellom klassene i gjenkjenning av store og små bokstaver og skriving av store bokstaver, henholdsvis $F_{19,387}=1.72$, $p=0.031$; $F_{19,387}=2.04$, $p=0.006$; $F_{19,387}=1.78$, $p=0.023$. Av tabellen ser vi at klassene hadde svært ulikt utgangspunkt ved skolestart. F. eks. kunne 41% av elevene i Klasse 4 alle de store bokstavene mot ingen i Klasse 14. Klassene 1, 2 og 13 hadde laveste gjennomsnittsferdigheter i gjenkjenning av store og små bokstaver og skriving av store bokstaver. Tabellen viser videre tilnærmet like gjennomsnittsskårer fra testene gjenkjenning og skriving av store bokstaver. Dette indikerer at det var stort sett de samme store bokstavene som elevene både kunne gjenkjenne og skrive. Derimot ser vi at i enkelte klasser var det forholdsvis færre barn som kunne gjenkjenne alle bokstavene enn de som kunne skrive alle bokstavene. Dette kan skyldes testsituasjonen.

Tabell 2

Gjenkjenning av store og små bokstaver etter klasser ved skolestart. Gjennomsnittsskårer (M) og andel elever (A) som kunne gjenkjenne og skrive alle bokstavene.

Maksimumsskåre MX = 29

Klasse	Gjenkjenning av store bokstaver		Gjenkjenning av små bokstaver		Skriving av store bokstaver	
	M	A (%)	M	A (%)	M	A (%)
1	15.2	7.7	9.5	7.7	13.7	7.7
2	15.4	18.8	7.9	0	14.2	6.3
3	23.2	27.3	18.5	13.6	23.4	27.3
4	24.8	40.9	21.6	0	23.7	45.5
5	21.6	38.9	17.3	5.6	20.1	33.3
6	19.5	21.7	15.9	8.7	18.4	30.4
7	19.3	30.0	16.1	0	18.8	25.0
8	20.3	26.3	16.0	5.3	20.5	36.8
9	24.1	31.6	19.8	15.8	23.4	36.8
10	18.0	13.0	13.3	0	17.7	21.7
11	20.0	4.8	16.8	0	20.2	28.6
12	21.4	34.8	18.2	8.7	21.0	30.4
13	15.9	14.3	11.9	0	15.2	19.0
14	18.8	0	15.3	0	18.8	9.5
15	20.2	26.1	16.7	13.0	19.6	30.4
16	22.1	31.8	18.1	9.1	21.8	18.2
17	19.6	13.6	16.1	4.5	19.3	27.3
18	19.7	16.7	16.6	12.5	19.2	29.2
19	22.2	29.4	19.2	0	21.5	29.4
20	21.9	22.2	19.9	5.6	22.4	40.0
Alle	20.3	22.6	16.5	5.7	19.8	27.5

Skriving av store bokstaver ble utført sist i rekken av deltester mens gjenkjenningstestene ble utført først. Noen barn som ikke gjenkjente en bokstav når den ble presentert på gjenkjenningstesten greide, når bokstaven senere ble diktert til dem, å knytte lyden til grafemet de hadde sett tidligere og skrev den riktige bokstaven på skrivetesten. Dette gjaldt hovedsakelig bokstaver med lav hyppighet som bokstavene c, q og w. Alle elevene kunne gjenkjenne og skrive en eller flere av de store bokstavene og bare to elever (i Klassene 14 og 18) kunne ingen av de små bokstavene.

Tabell 3 viser resultatene etter klasser fra forkunnskapstestene lesing av ord med store og små bokstaver og lesing av tekst. Gjennomsnittsskårer gir, som nevnt foran, usikre opplysninger om ferdighetsnivået til de enkelte klasser p.g.a. stor skjevhet i materialet. For å trekke fram forskjellen mellom klassene har jeg i Tabell 3 valgt å oppgi testresultatene som den andel elever som henholdsvis mestret ingen av testoppgavene og som mestret alle testoppgavene. Her får vi bekreftelse av resultatene i Tabell 2 med Klasse 4 som den beste og Klassene 13 og 14 som de svakeste.

Tabell 3

Andel elever som henholdsvis mestret ingen av testoppgavene og alle testoppgaver i lesing av ord med store og små bokstaver og lesing av tekst etter klasser ved skolestart

Klasse	Andel som mestret ingen av oppgavene (%)			Andel som mestret alle oppgavene (%)		
	Ord store	Ord små	Tekst	Ord store	Ord små	Tekst
1	69.2	92.3	92.3	0	0	0
2	62.5	81.3	87.5	6.3	6.3	6.3
3	59.1	59.1	68.2	9.1	18.2	13.6
4	27.3	36.4	36.4	9.1	18.2	27.3
5	38.9	38.9	44.4	11.1	11.1	11.1
6	47.8	60.9	82.6	4.3	4.3	4.3
7	50.0	50.0	60.0	5.0	5.0	5.0
8	63.2	68.4	73.7	10.5	10.5	15.8
9	52.6	52.6	78.9	10.5	15.8	10.5
10	69.6	73.9	95.7	0	0	4.3
11	52.4	52.4	52.4	4.8	9.5	9.5
12	56.5	60.9	65.2	4.3	4.3	8.7
13	76.2	81.0	85.7	0	0	0
14	76.2	76.2	90.5	0	0	4.8
15	60.9	60.9	73.9	4.3	4.3	8.7
16	54.5	59.1	59.1	0	0	4.5
17	63.6	63.6	81.8	4.5	9.1	13.6
18	50.0	54.2	83.3	4.2	12.5	12.5
19	41.2	41.2	70.6	11.8	11.8	17.6
20	38.9	38.9	61.6	11.1	11.1	16.7
Alle	55.5	59.7	72.0	5.4	7.6	10.6

Ved å sammenligne Tabell 2 og 3 ser vi at i mange av klassene var det høyere prosent av elevene som leste hele teksten riktig enn de som leste alle de små bokstavene riktig. Dette kan forklares med at enkelte bokstaver som f.eks. bokstaven q var ukjent for mange av elevene til tross for at de leste godt. Litt over 10% av elevene mestret alle oppgavene på testen lesing av tekst.

Resultatene fra tester i lesing og rettskriving for alle klasser er vist i Tabellene 4 og 5. På grunn av at både lese- og rettskrivingstestene er klassetrinnstilpasset kan ikke testresultatene fra forskjellige klassetrinn behandles som tidsserier i utvikling av lesing og rettskriving. Variasjon av ferdighetsnivået for enkeltklasser i forhold til klassetrinnsgjennomsnittet gir imidlertid en indikasjon av klassenes ferdighetsutvikling fra klassetrinn til klassetrinn.

Tabell 4 viser gjennomsnittsskårer i lesing og avviket mellom klassenes gjennomsnittsskårer og klassetrinnsgjennomsnittet etter klasser på andre og femte klassetrinn. Variansanalyse viste signifikante forskjeller i lesing

mellom klassene på andre og femte klassetrinn, med henholdsvis $F_{19,387}=2.13$, $p=0.004$ og $F_{19,387}=2.49$, $p<0.001$. Tabellen viser at Klasse 4

Tabell 4
Ferdigheter i lesing etter klasser på andre og femte klassetrinn. Gjennomsnittsskårer (M), standardavvik (SD) og avviket mellom klassenes gjennomsnittsskårer og klassetrinnsgjennomsnittet (ΔM)

Klasse	Lesing 2. klasse			Lesing 5. klasse		
	M	SD	ΔM	M	SD	ΔM
1	21.5	9.9	-5.3	40.4	11.4	-6.7
2	18.9	9.4	-7.9	43.8	9.4	-3.3
3	29.7	10.2	2.9	48.4	8.5	1.3
4	34.6	9.7	7.8	53.9	9.8	6.8
5	27.5	13.9	0.7	45.4	12.4	-1.7
6	29.4	11.2	2.6	47.9	9.4	0.8
7	29.5	13.4	2.7	52.1	10.9	5.0
8	30.5	12.6	3.7	54.6	9.2	7.5
9	29.2	14.0	2.4	44.0	9.2	-3.1
10	22.6	11.5	-4.2	44.3	10.9	-2.8
11	29.5	11.3	2.7	48.1	9.4	1.0
12	22.8	12.8	-4.0	43.3	9.4	-3.8
13	23.9	10.6	-2.9	46.8	8.7	-0.3
14	23.3	11.4	-3.5	44.1	9.4	-3.0
15	27.2	12.5	0.4	49.2	9.3	2.1
16	24.7	11.7	-2.1	44.7	12.1	-2.4
17	25.9	15.1	-0.9	49.6	14.8	2.5
18	24.1	12.4	-2.7	43.3	13.1	-3.8
19	26.7	14.1	-0.1	46.0	9.9	-1.1
20	33.3	12.3	6.5	49.3	8.9	2.2
Alle	26.8	12.4		47.1	10.8	

hadde de beste resultatene i lesing på andre klassetrinn og deretter Klassene 20 og 8. På femte klassetrinn var det imidlertid Klasse 8 som hadde de beste resultatene etterfulgt av Klassene 4 og 7. Klassene 2, 1 og 10 hadde de svakeste resultatene i lesing på andre klassetrinn. På femte klassetrinn var Klasse 1 den aller svakeste og Klassene 12 og 18 de nest svakeste. Ved å se på klassenes utvikling i forhold til klassetrinnsgjennomsnittet ser vi at ni klasser lå stabilt under gjennomsnittet Klassene 1, 2, 10, 12, 13, 14, 16, 18 og 19, Klasse 17 hadde fremgang og Klassene 5 og 9 hadde tilbakegang.

Tabell 5 viser gjennomsnittsskårer i rettskrivning etter klasser på andre, tredje og femte klassetrinn. Variansanalyse viste signifikante forskjeller mellom klassene i rettskriving på andre, tredje og femte klassetrinn henholdsvis $F_{19,387}=3.19$, $p<0.001$; $F_{19,387}=2.44$, $p<0.001$; $F_{19,387}=2.83$, $p<0.001$. Av tabellen kan vi se at Klasse 4 hadde de beste resultatene på alle klassetrinn og den hadde den minste spredningen i ferdigheter.

Tabell 5

Ferdigheter i rettskriving etter klasser på andre, tredje og femte klassetrinn. Gjennomsnittsskårer (M), standardavvik (SD) og avviket mellom klassenes gjennomsnittsskårer og klassetrinnsgjennomsnittet (ΔM)

Klasse	Rettskriving 2. klasse			Rettskriving 3. klasse			Rettskriving 5. klasse		
	M	SD	ΔM	M	SD	ΔM	M	SD	ΔM
1	34.6	9.3	-2.1	37.8	12.0	-2.1	37.9	10.8	-2.9
2	30.4	6.2	-6.3	36.9	7.7	-3.0	38.7	8.6	-2.1
3	39.6	6.6	2.9	41.4	6.9	1.5	44.4	3.0	3.6
4	44.7	4.9	8.0	46.8	3.0	6.9	47.1	2.6	6.3
5	39.7	8.4	3.0	42.1	7.4	2.2	42.2	8.9	1.4
6	38.8	7.4	2.1	41.9	7.1	2.0	42.6	7.6	1.8
7	37.1	10.3	0.4	40.1	9.6	0.2	40.9	7.2	0.1
8	39.3	9.7	2.6	43.2	7.0	3.3	43.4	6.5	2.6
9	37.6	9.8	0.9	39.3	9.4	-0.6	41.6	8.3	0.8
10	36.6	6.4	-0.1	37.7	8.5	-2.2	40.4	5.9	-0.4
11	38.2	9.0	1.5	40.7	8.2	0.8	40.6	7.3	-0.2
12	31.0	9.4	-5.7	37.5	8.7	-2.4	38.7	8.3	-2.1
13	34.5	7.7	-2.2	37.8	5.4	-2.1	41.8	4.7	1.0
14	32.4	9.3	-4.3	34.1	10.5	-5.8	34.9	9.7	-5.9
15	33.3	9.3	-3.4	36.7	9.3	-3.2	37.2	8.5	-3.6
16	36.9	7.8	0.2	36.9	7.8	-3.0	41.2	6.8	0.4
17	35.1	11.3	-1.6	41.0	10.5	1.1	40.1	8.5	-0.7
18	35.1	10.8	-1.6	38.8	9.7	-1.1	38.1	9.9	-2.7
19	38.1	7.4	1.4	40.5	8.5	0.6	42.3	6.7	1.5
20	39.8	8.8	3.1	41.4	9.3	1.5	42.1	6.7	1.3
Alle	36.7	9.1		39.9	8.8		40.8	7.8	

Derimot varierte rekkefølgen hvert år på de fire klassene som også hadde gode resultater i rettskriving, dvs. Klassene. 3, 5, 8 og 20. Tabell 5 viser at Klassene 2, 12, 14 og 15 hadde de dårligste resultatene i rettskriving.

Når vi ser på klassenes utvikling i forhold til klassetrinnsgjennomsnittet var syv klasser stabilt under gjennomsnittet, Klassene 1, 2, 10, 12, 14, 15 og 18, Klasse 13 hadde fremgang, Klasse 11 hadde tilbakegang og Klassene 9, 16 og 17 var ustabile.

For å analysere i hvilken grad tidligere ferdigheter kunne brukes til å predikere senere ferdigheter har jeg i Tabell 6 vist noen korrelasjoner mellom tidligere og senere ferdigheter. Som tabellen viser var det meget høy korrelasjon mellom testene kunnskap om store og små bokstaver ($r = 0.94$) og de korrelerte bra med lesing og rettskriving på andre klassetrinn ($r => 0.5$). Det var også høy korrelasjon mellom lesing og rettskriving på alle klassetrinn ($r > 0.6$).

Tabell 6

Korrelasjon mellom tidligere og senere ferdigheter. A: gjenkjenning av store bokstaver, B: gjenkjenning av små bokstaver, C: = lesing andre klassetrinn, D: lesing femte klassetrinn, E: rettskriving andre klassetrinn, F: rettskriving tredje klassetrinn, G: rettskriving femte klassetrinn. N = 407, $p<0.001$

Test	A	B	C	D	E	F	G
A	1.00	0.94	0.51	0.45	0.57	0.51	0.46
B		1.00	0.53	0.44	0.58	0.51	0.45
C			1.00	0.77	0.73	0.68	0.67
D				1.00	0.64	0.64	0.65
E					1.00	0.85	0.81
F						1.00	0.84
G							1.00

For å analysere resultatene etter kjønn har jeg i Tabell 7 gjengitt gjennomsnittsskårer over alle klasser for gutter og jenter for hver av testene. En-veis variansanalyse viste signifikante forskjeller på gutter og jenter i lesing av store og små bokstaver og skriving av store bokstaver, henholdsvis $F_{1,405}=16.33$, $p<0.001$; $F_{1,405}=15.00$, $p<0.001$; $F_{1,405}=19.51$, $p<0.001$. Det ble ikke funnet signifikante forskjeller mellom kjønnenes leseferdighet på andre klassetrinn. På femte klassetrinn var forskjellen imidlertid signifikant,

Tabell 7

Ferdigheter etter kjønn. Gjennomsnittsskårer over alle klasser (M), standardavvik (SD). Gutter N= 217, Jenter N=190

Test	Gutter		Jenter	
	M	SD	M	SD
Gjenkjenning store bokstaver	18.6	9.5	22.1	7.8
Gjenkjenning små bokstaver	14.8	9.6	18.4	9.2
Skriving av store bokstaver	17.9	9.8	21.9	8.2
Lesing 2. klasse	26.0	12.0	27.8	12.9
Lesing 5. klasse	45.5	11.1	48.9	10.3
Rettskriving 2. klasse	34.8	9.4	38.7	8.3
Rettskriving 3. klasse	37.9	9.4	42.0	7.3
Rettskriving 5. klasse	39.3	8.5	42.6	6.6

$F_{1,405}=10.01$, $p=0.002$. Forskjellen i rettskriving mellom gutter og jenter var signifikant på alle klassetrinn, $F_{1,405}=19.40$, $p<0.001$; $F_{1,405}=23.63$, $p<0.001$ og $F_{1,405}=19.39$, $p<0.001$. Tabell 7 viser også at det var mindre spredning i ferdighetene hos jentene. På forkunnskapstesten lesing av tekst mestret 14% av jentene og 7.5% av guttene alle testoppgavene og 78% av guttene og 65% av jentene ingen av testoppgavene.

I fem av de 20 klassene var det flertall av jenter: Klassene 5 og 10 med 61% jenter, Klasse 9 med 58% jenter og Klassene 17 og 18 med 55% jenter. I fire klasser var det stor overvekt av gutter: Klasse 11 med 67% gutter og

Klassene 1, 12 og 14 med 62% gutter. I de andre klassene var det et lite flertall av gutter.

Diskusjon

Resultatene fra min undersøkelse av barn i Trondheimsområdet viser at forskjellen mellom skoleklassene i kjennskap til bokstaver og lesing ved skolestart ble tydelig reflektert i ferdighetene i lesing og rettskriving på andre og femte klassetrinn. Korrelasjonene varierte mellom r = 0.5 og r = 0.6. Størrelsen på disse korrelasjonene er sammenlignbar med korrelasjoner som Solheim (1984) fant mellom de tre språklige kognitive faktorene og leseferdigheter (r = 0.52) og rettskrivingsferdigheter (r = 0.52) på første og andre klassetrinn. Kjennskap om bokstaver og lesing ved skolestart ser derfor ut til å være en faktor som indikerer forholdsvis godt hvordan elevene vil prestere i lesing og rettskriving de første årene på skolen.

Elevenes forkunnskaper i gjenkjenning av bokstaver og i lesing kan betraktes som en indikator både på deres modningsnivå og på hvor godt de har vært trent i lesing og lesefremmende aktiviteter i hjem og barnehage før de begynte på skolen.

Elevene i min undersøkelse hadde gjennomsnittlig bedre kjennskap til bokstaver ved skolestart enn elevene i undersøkelsene til Vormeland (1967), Søvik (1973) og Lie (1986). Dette antyder at interessen for å forberede barn for læring av skolens ferdighetsfag ikke er avtagende i samfunnet. Men den store spredningen i forkunnskapene viser at mange barn burde forberedes bedre.

Sammenligning av Tabell 2 med Tabellene 4 og 5 viser at på andre klassetrinn hadde de fleste av klassene gjennomsnittsferdigheter som forventet ut i fra korrelasjonene mellom forkunnskapstester og ferdighetstester regnet for alle klasser samlet. I de tilfeller hvor det var stort avvik fra forventet utvikling i lesing og rettskriving, kan dette i noen grad forklares med en lærereffekt eller klassemiljøeffekt. For eksempel hadde Klasse 12 gode resultater på forkunnskapstest i lesing, men den var blant de aller dårligste i lesing både på andre og femte klassetrinn. I denne klassen var det barn med ulike problemer, bl.a. store atferdsvansker, som gjorde klassen krevende å undervise og mye tid måtte brukes til oppdragelse. Klasse 2 hadde også dårligere resultater i lesing på andre klassetrinn enn forventet. Utstrakt bruk av vikarer i lange perioder i løpet av de to første årene ledet til dårlig kontinuitet i undervisningen og kan være årsaken til manglende progresjon i fagene. På den andre sida kan vi si at noen klasser, bl.a. 8, 13 og 20 fikk bedre resultater på andre klassetrinn enn forventet. Årsaken til dette kan være godt klassemiljø og dyktige lærere. Klasse 4 skilte seg ut som den langt beste på nesten alle tester. I denne klassen

greide klassestyrer å holde et høyt arbeidstempo i klassen gjennom alle fem år.

Ved å ta utgangspunkt i resultatene i lesing og rettskriving fra andre klassetrinn og følge utviklingen til femte klassetrinn ser vi at de fleste klassene er stabile i sin ferdighetsutvikling over tid målt som avvik fra klassetrinnsgjennomsnittet. Dette er i overensstemmelse med Solheims studie (1984). Utvikling i lesing og rettskriving henger også tett sammen. Imidlertid finnes det klasser som ikke har forventet utvikling som f.eks. Klasse 9. Dette kan forklares med stort fravær hos klasselærer gjennom flere år, mye bruk av vikarer og bytte av lærer i fjerde klasse. Klasse 18 hadde heller ikke forventet utvikling men denne klassen byttet lærer med et negativt utfall og utviklet et dårlig klassemiljø. Størst avvik i positiv retning var det for Klasse 17 som byttet lærer på fjerde klassetrinn noe som ga positivt utslag på elevenes ferdigheter i lesing og rettskriving. Klasse 15 var overraskende dårlig i rettskriving sammenlignet med leseprestasjoner. Grunnen kan være at klasselæreren la lite vekt på rettskriving sammenlignet med lesing, fri skriving og skriftforming. Det ga utslag i gode leseferdigheter men dårlige rettskrivingsferdigheter. Dette er i samsvar med andre undersøkelser (Undheim, 1989; Lie, 1994). Klassene 2 og 12 var lavt presterende i lesing og rettskriving men begge hadde positiv utvikling på femte klassetrinn som sannsynligvis kan forklares med et forbedret læringsmiljø i klassene.

Som forventet fra IEA undersøkelsen fant jeg stor forskjell i ferdighetene mellom gutter og jenter. Dette influerte klassenes gjennomsnittsferdigheter på forskjellige måter. Klasse 5 som var en høyt presterende klasse med et godt klassemiljø fikk f.eks. bedre resultater enn forventet i rettskriving ut i fra resultater på lesetester. Hovedgrunnen til dette var sannsynligvis at klasselæreren la spesielt stor vekt på rettskriving, men en medvirkende grunn kan ha vært at det var et flertall av jenter i klassen. Det samme kan sies om klasse 10. Noe av variasjonen i ferdigheter kan forklares med ulikt antall kjønn i flere av klassene. Klasse 11 var den eneste klassen som hadde tilbakegang i rettskriving fra andre til femte klasse i forhold til de andre klassene. En medvirkende årsak til dette kan være det store antall (67%) gutter i klassen. Tre av de fire klasser (Klassene 1, 12 og 14) hvor det var mest gutter var også de klassene som hadde de laveste ferdighetene. Klasse 14 byttet dessuten lærer i perioden. Det var overraskende at det ikke var noen signifikant forskjell i lesing mellom gutter og jenter på andre klassetrinn. Det er vanskelig å forklare dette når man sammenligner med de øvrige resultatene.

Undheim (1989) mente at undervisning i lesing og rettskriving de tre første årene ledet til stabilitet av disse ferdighetene på fjerde til sjette klassetrinn. Mine resultater, med det høye samsvaret mellom lesing og

rettskriving på andre klassetrinn, tyder på stabilitet allerede fra de første klassetrinnene. Det kan indikere den innflytelse som den kunnskap barnet har tilegnet seg før skolestart har på videre ferdighetsutvikling.

Både Undheims (op.cit.) og Solheims (1984) undersøkelser og min undersøkelse tyder på at elever i skolen har vanskeligheter med å forbedre seg i forhold til klassegjennomsnittet. Årsaken til dette kan være den store spredningen i klassenes gjennomsnittsferdigheter ved skolestart som fører til at lærerne får ulike oppgaver. F.eks. måtte læreren i Klasse 1 konsentrere seg om bokstavinnlæring på den tid da læreren i Klasse 4 trente på lesing av tekster. Undervisningsmetoder og progresjon blir dermed influert av kunnskapsnivået ved skolestart. Det er også mulig at elevene i Klasse 1, som kunne alle bokstavene ved skolestart, hadde hatt raskere progresjon hvis de hadde tilhørt en klasse med høye ferdigheter slik som antydet av Solheim (1984).

Det ble ikke funnet noen sammenheng mellom klassestørrelse og prestasjoner. Dette er i samsvar med IEA undersøkelsen (Valgeirsdottir, 1993; Tønnessen, 1994).

Oppsummering og konklusjon

Resultatene av min undersøkelse av hvor stor innflytelse forkunnskaper og "skolehistorie" har på utvikling av ferdigheter i lesing og rettskriving hos grunnskolebarn i Trondheimsområdet i årene 1988 til 1993 kan oppsummeres slik: Elevenes kunnskap om bokstaver ved skolestart viste seg å være den faktor som sterkest predikerte elevenes utvikling i lesing og rettskriving. De fleste klassene hadde en utvikling i slutten av andre klassetrinn som i store trekk var i overensstemmelse med prediksjoner fra testresultatene ved skolestart. Det var stor grad av stabilitet i utvikling av ferdigheter fra andre til femte klassetrinn. Avvik fra forventet utvikling kunne i noen grad forklares med klassenes "skolehistorie", som stort fravær hos klasselærer, og ved bruk av ulike vikarer over lengre tid. Bytte av klassestyrer virket i noen tilfeller positivt og i andre tilfeller negativt. Lærerens vektlegging av enkelte fagområder ga også utslag, i hvert fall i en av klassene. Mange "krevende" elever og dårlig klassemiljø så ut til å påvirke ferdighetsutviklingen. Gutter hadde gjennomsnittlig dårligere resultater på alle tester, og det var også større variasjon i guttenes enn jentenes prestasjoner. Klassestørrelse så ikke ut til å påvirke den faglige utviklingen.

Konklusjonen er at forkunnskapstester i lesing, spesielt gjenkjenning av bokstaver, er en nyttig predikator på senere ferdigheter. Dette er i overensstemmelse med undersøkelser i andre land f.eks. av Jansky og de Hirsch (1972). Bokstavgjenkjenningstesten er enkel å utføre og krever ikke spesiell kompetanse. Testen kan brukes av alle lærere for tidlig å

identifisere elever med dårlig prognose i redskapsfag. Ved aktivt å gripe inn med remedielle tiltak for disse elever kan vi for det første forbedre elevenes prognoser og for det andre heve gjennomsnittsferdighetsnivået i klassene og slik forbedre ferdighetsprognosen til den enkelte klasse. Innføringen av 6-års reformen er en gylden anledning til å innføre en aktiv bruk av tidlige remedielle tiltak i grunnskolen.

Summary in English

The development of reading and spelling ability in 407 primary school children in Trondheim, Norway were followed from the first through to the fifth grade. The following factors assumed to influence this development were also investigated: (1) knowledge of letters at schoolstart, (2) number of children in the class, (3) teacher stability, (4) social environment in the class, and (5) the school-subjects the teacher emphasized. The results showed that knowledge of letters correlated with reading and spelling ability in 2nd grade with $r = 0.5$ and $r = 0.6$, respectively, and in the 5th grade with $r = 0.5$ in both subjects. The social environment and teacher stability were shown to be important factors while the other factors only had slight influence on the development of reading and spelling ability.

Litteraturliste

Asheim, S. (1964). *Standpunktprøver i skolen, orddiktat for 2.-6. klasse*. Oslo: Universitetsforlaget.

Gjessing, H. J. (1970). *Standpunktprøver i skolen. Stillelesing*. Oslo: Universitetsforlaget.

Jansky, J. J., og de Hirsch, K. (1972). *Preventing reading failure*. New York: Harper & Row.

Karlsdottir, R. (1996a). Print-script as initial handwriting style I: effects on the development of handwriting. *Scandinavian Journal of Educational Research*, 40, 161-174.

Karlsdottir, R. (1996b). Print-script as initial handwriting style II: effects on the development of reading and spelling. *Scandinavian Journal of Educational Research*, 40, 255-262.

Karlsdottir, R. (1996c). Development of cursive handwriting. *Perceptual and Motor Skills*, 82, 659-673.

Leimar, U. (1974). *Läsing på talets grund*. Lund: Liber Läromedel.

Lie, A. (1986). *Ordanalyse som grunnlag for begynneropplæringa i lesing*. Dr. avhandling Halden Lærerhøgskole.

Lie, A. (1994). Lese- og skriveferdigheit i grunnskolen. I F. Hertzberg, K. I. Vannebo og B. E. Hagtvet (red.), *Ferdigheter i fare? Om lesing og skriving i dagens samfunn.* (s. 145-161). Oslo: Ad Notam Gyldendal.

Nygaard, H. D. (1984). Skolefaglig utvikling fra overgangen 1.-2. klasse til overgangen 3.-4. klasse. I R. Solheim, H.D. Nygaard og H. Aasved, *Bergen-prosjektet II. Søkelys på småskolealderen* (s. 177-236). Bergen: Universitetsforlaget.

Solheim, R. (1984). Klassevariasjon og klassetilhørighet. I R. Solheim, H. D. Nygaard og H. Aasved, *Bergen-prosjektet II. Søkelys på småskolealderen* (s. 117-150). Bergen: Universitetsforlaget.

Solheim, R., Nygaard, H. D., og Aasved, H. (1984). *Bergen-prosjektet II Søkelys på småskolealderen.* Bergen: Universitetsforlaget.

Søvik, N. (1973). *Podin prosjektet.* Rapport nr. 3. Universitetet i Trondheim, Pedagogisk institutt.

Tønnesen, F. E. (1994). Leseferdigheten i norsk grunnskole. I F. Hertzberg, K. I. Vannebo og B. E. Hagtvet (red.), *Ferdigheter i fare? Om lesing og skriving i dagens samfunn* (s. 129-143). Oslo: Ad Notam Gyldendal.

Undheim, J. O. (1989). Lese- og skriveutvikling fra 4. til 6. Klasse. *Norsk pedagogisk tidsskrift*, 1, 16-23.

Valgeirsdottir, S. TH. (1993). *Læsi islenskra barna. (Leseferdighet hos islandske barn).* Reykjavik: Undervisningsdepartementet, Forskningsinstituttet for pedagogikk og undervisning, Islands Lærerhøgskole.

Vormeland, O. (1967). *Begynnerundervisningen i norsk og regning.* Oslo: Universitetsforlaget.

Strategy-use differences between mathematically normal and mathematically disables children

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Acquiring the cognitive motor skill of handwriting

by Arnold J.W.M. Thomassen

Cognitive motor skills

Human activity is extremely rich in its diversity, and the variety of circumstances under which it takes place is really amazing. Most of the tasks that an adult person can perform under many conditions, such as catching a ball, uttering a sentence, or solving a crossword puzzle, reflect the mastery of *skills*. These are fairly large classes of more or less complex activities that --following a period of practice-- can be performed by a human subject with a certain degree of proficiency. Skilled behaviour shows consistency and efficiency as well as adaptability, so that it is fluent, stable and relatively effortless across a range of situational contexts.

Every human skill appears to be concerned with the co-ordination of perception and action, and to rely on knowledge of various sorts as stored in memory. Certain skills (like radar scanning) have their primary focus in perception, others (like chess playing) are primarily cognitive, while again other skills (like dart throwing) rely predominantly on motor control. But in principle these three aspects are present in every skill so that, for instance, the performance of skilled motor tasks will always demand a certain amount of perceptual analysis and cognitive guidance (see, e.g., Colley, 1989).

This contribution presents the performance and the acquisition of handwriting as a *cognitive motor skill*, which shares many of its features with other skills, and with other cognitive motor skills in particular, as is discussed in the present first section. The underlying model of handwriting, and its implications are reviewed in the next section; it is a model that was specified and further developed in our laboratory, mainly by Van Galen (1991), over the past decades. Finally, the third section of this article will discuss the progress of young people who learn to write fluently; the data, often presented in terms of the kinematics of the handwriting movements, are to a large extent from the research performed by Zesiger (1995), who repeatedly puts these in the

perspective of our handwriting model that also has these kinematic features at its basis.

Hierarchical architecture

Most skills, and certainly cognitive skills, have a hierarchical control structure, in which different processing modules may be assumed to be located at higher and lower levels. For several cognitive motor skills these *hierarchical* structures have been postulated in more or less formalised models, such as for speech production (Mackay, 1982; Dell, 1986; Levelt, 1989), typewriting (Shaffer, 1975; Rumelhart & Norman, 1982), and handwriting (Van Galen, 1991; Thomassen & Van Galen, 1992). Typically, the higher levels in these models are concerned with global control and abstract concepts and representations, whereas the lower levels are charged with command structures, muscle recruitment and movement output.

Fluent handwriting, to which this chapter is devoted, may indeed be characterised as a cognitive motor skill, in which a meaningful verbal message --at a high cognitive level-- is somehow transformed into a sequence of finger, hand, and arm movements at a lower, motor level. Other cognitive motor skills, of similar complexity, and involving similar transformations, are speech and typewriting, already mentioned, but also signing and music performance. In all these skills, symbolic information at input is processed and translated into a movement sequence at output. To the extent that these tasks are indeed motor skills, they are largely *automatised* and only partly under conscious control, with the result that --as far as their very output is concerned-- the required attention capacity and controlled effort may be limited. This 'mental economy' implies that the structures at higher levels may devote themselves to such global aspects as maintaining the task goal (in this case, the message and its formulation), and to coping flexibly with unexpected situational demands during the performance of the task.

Within the motor system itself, there is also a hierarchy in which the high-level structures are concerned with the more general aspects of the movement sequence such as the large-scale co-ordination of the effector units and error monitoring. These levels, in turn, leave many of the necessary computations that are required to specify the details of the movement sequence, to lower, subordinate structures. Examples of such lower-level motor organisations are built-in autonomous subsystems such as reflexes, oscillator mechanisms, central pattern generators and *co-ordinative structures*. The latter are functional groupings of muscles, constrained to act as a single unit that can be organised temporarily to accomplish a particular behavioural goal. In the case of handwriting, a co-ordinative structure may be assumed to be responsible, e.g., for the efficient grip of the writing tool by two fingers and an opposed thumb. The preparation process, or the programming of a movement sequence, then, may involve the higher-level co-ordination and integration of

appropriate subsystems to achieve such a particular goal by selecting, ordering, timing, and parameterising the intermediate and lower-level organisations.

Skilled motor performance also relies on *motor programs*, i.e., schematic representations that are capable of controlling limited classes of specific actions. Motor programs are situated at an intermediate level in the hierarchy. They are functional segments of acquired motor knowledge representing relevant movement sequences. Motor programs are nowadays seen as abstract representations of action sequences whose details and components are specified at lower levels. It has become clear that motor programs are not concerned with the exact order, timing and amplitude of specific muscle contractions (as was originally thought), but rather that they are more general, functional schemas or dispositions that enable the subject to carry out particular classes of movements. They are stored in long-term motor memory, and addressed and retrieved from there during the preparation of the movement sequence required by the task. The sequence can then, in principle, be executed without feedback, although feedback processing is still possible.

For handwriting, the relevant motor programs are the generalised instructions to produce specific letter shapes, i.e., *allographs* (Teulings, Thomassen, & Van Galen, 1983). Whereas the term 'grapheme' represents an unspecified letter of the alphabet, irrespective of its case and font, the term 'allograph' is used for a certain well-defined letter shape (such as a specific, cursive, lower case *f*). The mental representations of allographs, including the motor programs associated with them, contain precise specifications in terms of their spatial appearance, and as built up from their component strokes including the directions and sequencing of these strokes.

To sum up, if the task is to write a word, the relevant skill is handwriting, the motor programs are allographic representations of letters in their specific motoric description of successive strokes in various directions, and the lower-level subsystems may involve the co-ordinated (coupled) contraction of the index finger and the thumb to hold the pen, the co-ordination of wrist and finger joints, and the automatic adjustment of forces to counteract friction with the writing paper and to apply an adequate pen pressure onto the graphic plane. It should be noted here that the outlined *hierarchical architecture* of the handwriting process does not constitute a rigid structure, but rather a dynamic, distributed control system, characterised by interactions within and between its different *levels*, where simultaneous activity goes on in *parallel*.

Learning cognitive motor skills

We saw that skills involve the co-ordination of muscle groups into co-ordinative structures. For a certain motor skill to be achieved, the timing and the amount of muscle contraction need to be learned. However, other muscle groups may, likewise, produce *functionally equivalent* results, so

that, e.g., writing is still possible if the wrist is immobilised, even in cases where the writer normally moves his or her wrist joint frequently and over a large range of movement. Learning the skill, then, occurs in interaction with the environment where, under the influence of *feedback*, the muscular involvement in one or more co-ordinative structures is *'tuned'* gradually to produce the required movement accuracy and timing. During early stages of learning to write, *closed-loop* feedback is essential. Especially in handwriting, with its permanent trace, exteroceptive, visual feedback plays a major role, while response-produced proprioceptive feedback via the receptors in the effector itself, becomes increasingly important. Gradually, *open-loop* performance emerges, in which handwriting is 'run', in principle, by the sequencing of allographic motor programs and by the automatic adaptation of co-ordinative structures.

The general principle is that the learner establishes a model, or *'template'* of the feedback that he or she should expect when the movement sequence is performed correctly. As the quality of the match between the actual, response-produced feedback and the expected sensory consequences of this model feedback increases, the task is gradually learned as a skill. Higher levels of mastery are associated with larger movement sequences without intermittent feedback ('open-loop') and with the ability to perform the task under a variety of situational and environmental conditions: A full-blown motor program, or *'schema'* for a generalised class of movements has then been acquired. This implies that the learning of motor skills will ideally occur in two stages, the first more strictly aimed at the acquisition of correct sequencing and timing, and the second devoted to the development of motor programs specifying, in a generic sense, the parameters needed to produce the required movement sequence under many circumstances.

Feedback is more essential, also in later stages of learning, when the environment is changing, when errors occur due to unexpected conditions, or when the accuracy demands are high, such as is generally the case in handwriting. In the low-velocity handwriting of a novice writer, a single stroke can be monitored for its accuracy and size, and corrected effectively on the basis of feedback; however, for the fast writing of an experienced adult writer, visual feedback arrives too late to affect the performance of the current stroke with its duration of only 125 ms (see Hawkins, Zelaznik & Kisselburgh, 1981 for estimates of the effectiveness of visual feedback in positioning tasks; see also below). The role of such feedback in fluent, adult script is mainly to monitor the number of repeated elements in letters and words with multiples, such as <m>, <w>, <ee>, <ll>, and to organise the letters and words on the line and on the page (see Van Doorn, 1993 for studies on the role of vision in adult handwriting).

Thus, the desirability of feedback from varied situational and

postural contexts applies primarily to the acquisition stage of handwriting. In many other tasks, when the desired output involves the repeated production of identical movement sequences, while the environment (desk, paper) is more or less stable, feedback processing is soon less necessary, but in handwriting acquisition it continues to play an essential role considerably longer. For one thing, the spatial demands are high. But, more importantly, during progressive handwriting, the effector configuration changes as the wrist extends, and as the fingers move rightward within and between words (Thomassen, Meulenbroek, Schillings, & Steenbergen, 1996; Thomassen & Meulenbroek, 1998). This must be regarded as a special difficulty for younger children (see Thomassen & Teulings, 1983; 1985). So, for fluent handwriting, there is a need for large amounts of *practice*, allowing a high degree of *variability* in the effector configuration involving shoulder, elbow, wrist, and finger joints.

Characteristic of children learning to write are, first, their development from gross, *proximal* movements to fine, *distal* movements; and, second, their limitation in information *processing capacity* and selective attention. These ask for appropriate guidance and simple instruction as to which movements to make, and which external and self-generated cues to attend to. Handwriting is indeed an extremely complex skill, demanding many hours of varied, but task specific practice. The child goes through the classical stages of the skill-acquisition process (*cognitive, associative, autonomous*; Fitts & Posner, 1967), with his or her different abilities playing different roles as the skill is gradually mastered. As it appears, in the complex task of handwriting, children achieve the greatest improvement between the ages of 5 and 12, i.e., considerably later than in simpler motor tasks, where the gain is greatest between 4 and 8 years of age (Singer, 1982; see also below).

We just mentioned the restricted role of visual feedback due to its relative slowness for fully developed, fluent writing. *Tactile* and *proprioceptive feedback*, however, may play a larger role in connection with the continuous need to adjust pressure both on the writing surface and on the writing instrument. An example of such rapid adjustment with relevance for the domain of handwriting is the following. If one picks up a small object, like a pen, with a precision grip between thumb and index finger, and the object is made to slip, the subject executes a well co-ordinated correction in as little as 60-80 ms. The correction consists of an increased grip force together with a decreased torque about the elbow joint which precisely counteracts the slip, so that there is hardly any movement of the object, and often the subject does not even notice it himself (Westling & Johansson, 1984; Johansson & Westling, 1987). As it appears, this sudden *adaptive reaction* is automatic, and difficult to suppress; it is reflex-like, being elicited through detection by receptors in the skin of the finger tips.

The degrees-of-freedom problem

A typical feature of motor behaviour is that a certain physical target can often be reached in a large number of ways. Every joint in a multi-segment effector limb (such as the arm-hand-finger system) is associated with one or more *degrees of freedom*. Since many combinations of joint rotations satisfy the target requirements, the system is urged to select just one from many different modes of performing the same task: In this sense, the effector system has to cope with *redundancy*. Given the almost unlimited number of degrees of freedom that are to be controlled during the guidance of each movement, and given the limited capacity of the information processing system, any reduction of the innumerable number of possibilities is a welcome reduction of the problem as to which combination of joint rotations to adopt.

One constraint is formed by the possibility that several joints, although having independent muscles, have a 'preference' to move in a *coupled* mode, i.e., to flex or extend in a systematic way, simultaneously and in a concerted direction. Such coupled arrangements --that are further examples of the co-ordinative structures discussed above-- have been termed *functional synergies*. They may be 'built in' into the hardware, or they could be the result of learning and generalisation. In the arm-hand-fingers effector system for handwriting, for example, even though this has as many as about 40 joints altogether, and a multitude of joint combinations resulting from these, there might thus be just a few such functional synergies. This limitation of the number of to-be-controlled functional units of action constitutes a very considerable reduction of the gigantic 'degrees-of-freedom problem' just sketched.

Modelling handwriting as a cognitive motor skill

The experimental research of handwriting has undergone a tremendous boost over the past twenty years. This was in part due to the technological and computational advances made, during this period, with respect to recording and analysing 2D and 3D movements. Another factor was the increasing tendency in researchers of experimental psychology and movement science to tackle processes and to design models of increasing complexity. Still, some of the handwriting models are limited to the physical forces involved in single strokes and stroke pairs (see Plamondon & Maarse, 1989), while others intend to cover more of the entire process from a computational point of view (e.g., Hollerbach, 1981; Schomaker, Thomassen, & Teulings, 1989), or from an information processing perspective (e.g., Ellis, 1982; Van Galen, 1991). More recently, also an extensive attempt has been made to model the handwriting process from a neuropsychological angle (Lecours, 1996), in which many types of writing error are accounted for at various stages in the supposed information processing system which is outlined in great detail. Below, we will briefly discuss a model following the *information processing* approach.

Reaction time and movement time

The information-processing capacity of the human brain is enormous. It has as many as 100 billion neurons; but still, every mental action, whether it takes place at input, at central processing, or at output, consumes a measurable amount of time. Experimental psychologists and their predecessors have known this for more than a century. In particular, they have taken advantage of the fact that the more complex a task is, or the more aspects of a task need to be performed, the longer it takes to prepare that task mentally. The duration of the involved delay is seen as an index of the amount of internal (mental, cognitive) processing. Thus, in the case of handwriting, to write a two-letter combination may be expected to require a longer latency, or *reaction time* (RT), than to write a single letter. The effects on RT, although systematic, are generally rather small, ranging from about 3 to somewhat like 300 milliseconds in most experiments.

This basic notion has been elaborated and exploited in human experimental, or cognitive psychology. It generated a body of sophisticated experimentation in which the principal interest naturally was in the exact duration of the latencies, i.e., in reaction times (RTs) as a function of a large number of well-defined, specific task variations. This research has led to the proposal of a series of *processing stages* in human task performance in the laboratory as well as in everyday life. Such stages have been postulated for sensory information processing, others for memory search and retrieval, for recognition, for response selection, and for response execution (see, e.g., Sanders, 1983; 1990).

The research paradigm, which was initiated by Sternberg (1969), has also been applied to the domain of graphic behaviour. It has helped us to identify the processing *'modules'* involved in the successive stages during the performance of the tasks of writing and drawing. These modules are held responsible for the transformation and transmission of information within the cognitive motor system. Each module is dedicated to its special function and operates at a specific stage in the processing sequence from perception to action, where it passes its product on to the next stage for further processing.

Within this framework, and in the footsteps of a suggestion by Ellis (1982), a rather elaborate model of handwriting has been designed in our laboratory by Van Galen and his colleagues (Van Galen, Meulenbroek, & Hylkema, 1986; Van Galen, 1991; Thomassen & Van Galen, 1992, 1997; Schomaker & Van Galen, 1996). The modules in the various drafts of this model make up a fairly complete picture of handwriting performance. The strictest version claims that the processing modules perform their specific tasks exclusively in the given *serial order* from top to bottom, where the output of a module constitutes the input for the next-lower module. In a more lenient interpretation of the handwriting model,

parallelism is introduced, and certain internal and external conditions are seen as calling for slightly different routes.

It should be noted that the RT paradigm works well with relatively simple, short-lasting tasks, such as button pressing or spoken word utterances, where the entire performance can be prepared at once. However, in a relatively slow, complex, and longer-lasting task like handwriting, only the first part of the response sequence is likely to be prepared in advance, while later parts are prepared in parallel with the execution of earlier parts. Due to the *limited capacity* of the information-processing system, then, such parallel activity results in competition between 'covert' program selection and momentaneous 'overt' activity which directly concerns the current writing movements. The effect is a slowing down of the pen in its trajectory, i.e., an increased *movement time*. Following Klapp and Wyatt (1976), this enables the use of movement time (MT) also as a research paradigm, to study programming within a lengthy sequence of responses.

Before discussing the announced model of handwriting, we need to look into some elementary facts and some basic data concerning the *kinematics* of handwriting. The smallest unit of handwriting is the *stroke*, which is normally defined as a writing segment bounded by inversions in its vertical velocity, i.e., where the pen's movement direction changes from going down to up, or vice versa. Individual cursive letters of the Latin alphabet are composed of two to six such strokes, which are globally downstrokes and upstrokes; the letters are joined by additional connecting strokes, usually upstrokes. The typical *duration* of a stroke produced by an experienced adult writer is 100 to 150 ms, so that in spontaneous cursive script an average of 8 strokes, or 2 letters are normally written per second. If we regard the production of a stroke pair (downstroke-upstroke) as a cyclical event, we thus observe a preferred cycle *frequency* of about 4 Hz. Of course, the actual rate depends on a number of factors such as age, development, practice, and skill of the writer. As we will see, writing speed is also determined by text complexity, spelling difficulty, letter shape, and stroke sequence, all of which may have systematic local effects. An essential feature of adult stroke production is, moreover, that it is normally generated *ballistically*, i.e., by just one co-ordinated agonist-antagonist activation, resulting in a unimodal (single-peaked) bell-shaped velocity profile per stroke.

A multi-stage model of handwriting

We will now pursue the macro-process of writing an intended message as accounted for by Van Galen's model. The message content is first conceptualised semantically, and then cast into a grammatical sentence frame. The elements of the precise phrasing, i.e., the words, are found in the *mental lexicon*, from which they are given their implicit sounds, or their phonemic features. Using the spelling rules of the language, the word's phonemes are translated into *graphemes*, i.e., abstract letter codes.

Now their transformation into actual letter shapes, or *allographs* can take place.

As we saw above, allographs are the specifications of graphemes in terms of their font (e.g., cursive) and case (e.g., lower case). They must be retrieved from an allographic long-term memory store, where they are represented in a predominantly spatial format, including the temporal sequence of their strokes. The retrieved allographic representations are then supplied with the required *parameter values*, e.g., for size and slant, following which the appropriate muscles can initiate the movement adaptively, complying with the prevailing geometrical and mechanical conditions.

Thus, let the sentence of one message be: "We look forward to celebrating Professor Søvik's merits at the occasion of his retirement". Now the first word is "we", and its first phoneme is /w/. The corresponding grapheme is <w>, and in its orthographic context the appropriate allograph to be retrieved is [cursive, upper case *W*]. Before this letter can now be written, specifications are required for the position where, and the size and slant at which it must be produced; this occurs in the next module. These specifications allow the selection of the best suited anatomical *end-effector*, whose precise joint involvement depends on the given spatial context. Finally, taking into account the required forces under the current mechanical conditions (paper friction, writing stylus) and biomechanical context (limb size and mass, viscosity, elasticity), the necessary *motor units* may be recruited to the amount needed, and in the sequence dictated by the shape of the first stroke of the particular [W], which is then generated.

Summarising, we have encountered processing modules at the semantic, syntactic, lexical, and phonemic levels; at graphemic and allographic levels; at the levels of task-space and joint-space geometry; and, finally, at the level of actual muscle involvement. One of the implications of the model is that its modules at the subsequent stages deal with entities, or *processing units of different size*, which tend to decrease as the sequence proceeds. The first module handles the content of an entire message; the last module deals with the muscles involved in no more than a single stroke. So, the output from one module may constitute the input to several units in the next-lower module. This is one reason for postulating a *buffer store* at the entrance of each module. Another reason is the following. However quick and efficient the modules perform their tasks, all these sub-processes take time; and because the modules operate independently, they may deliver their products at inappropriate moments, so that these need to be put in short-term buffers for temporary storage, even if for a few milliseconds only, until they can be dealt with.

Higher modules process their (larger) units earlier than lower modules deal with their (smaller) units. This implies that the former complete their task on a certain part of the message before the latter. This enables the higher modules to tackle the next part of the message sooner,

so that at higher and higher levels, processing is concerned with information further and further ahead of the part of the message that is currently being written. Application of this principle over all modules from high to low results in a *serial* system that processes the information sequentially, but that deals with different parts of the message at different levels simultaneously and in *parallel* .

The empirical argument for proposing this architecture comes from experiments in which *task difficulty* is manipulated very specifically at different levels, while such kinematic variables as local writing speed and spacing are being measured (see, e.g., Van der Plaats & Van Galen, 1990). The results show that handwriting movements are affected (slowed down) earlier in time when the enhanced difficulty is associated with a higher-level module. An example is the introduction of a difficulty at word level, which reduces writing speed earlier than difficulty at allograph level, which leads to speed reduction only one or two letters in advance, whereas difficulty at stroke level results in increased movement time merely of the current stroke itself.

Summing up, we have observed that the advance preparation of a longer or more complex writing sequence leads to more delayed movement initiation (longer RTs) and that the on-line preparation of further elements in the sequence results in a local slowing-down of the pen displacement (increased MTs) where the locus of the retardation is determined by the level of the involved processing module. Apart from these *temporal* consequences, certain processing demands also result in *spatial* effects. As it appears, inter-word spaces and inter-letter connection strokes are loci where spatio-temporal effects of further planning are likely to be found. We observed, for example, increased trajectory lengths and longer spacing distances (movements above the writing plane) due to increased difficulty.

Kinematic aspects of handwriting acquisition

Against the background of Van Galen's (1991) model of handwriting, Pascal Zesiger (1995) presents an overview of changes during handwriting development from a very young age to adulthood. This author performed extensive process-oriented, *kinematic studies* with relatively large numbers of subjects of different ages. Indeed, as we will see, in several instances, the kinematic data of these studies are suited to be related to some extent, to Van Galen's model. In the following paragraphs, we will rely to a large extent on Zesiger's (1995) summary of findings, both from his own work and from the literature, concerning the acquisition of the handwriting skill and the underlying cognitive processes.

Preliminary stages of writing

Learning to write takes place in the context of the general perceptuo-motor development of the child on the one hand, and in that of the

curriculum at his or her school on the other. It should be noted here that, of course, there are large interindividual differences in the onset time and rate of the child's development of motor abilities, and that in different cultures, using different curricula, the child may be taught different aspects of the handwriting skill at different ages. A child's first representational graphic movements are seen at the age of 3 to 4 years. The requirements of a reasonably balanced body posture, stable and yet somewhat flexible force control, and perceptual discrimination and kinesthetic sensitivity are met only gradually between the ages of 4 and 6, depending on the child's individual speed of perceptuo-motor development. During the first years of formal instruction (age 6-7), the child needs to get rid of trembling traces and to acquire the intented letter shapes; during the next two years (age 8-9), he or she normally develops a neat and regular script; but during the later years at primary school (age 9-12), this neatness of the letter shapes is often sacrificed to the benefit of economy and speed.

In a global sense, the motor development is seen to evolve from *proximal* to *distal*, i.e., from the involvement of the whole body (including, e.g., the trunk in a sitting posture) to the precise execution of graphic symbols with the wrist and fingers only (including, e.g., an optimal pen grip). In essence, handwriting control develops from large letters guided by visual feedback to smaller script under kinesthetic --or without-- feedback. During the early stages of writing, when the child spontaneously copies printed letters, he or she displays obedience to the rules of the *grammar of action* (Goodnow & Levine, 1973), and circles are generally drawn clockwise. This tendency changes, however, under the influence of formal writing instruction, which -- in the case of our cursive Latin script -- favours counter-clockwise rotation (see also Thomassen & Teulings, 1979; 1985).

Initial stages of formal writing

Between the ages of 6 and 9, i.e., during the first three years of formal writing, there is a marked improvement in terms of decreased writing time, dysfluency, pauses, letter size, temporal and (especially) spatial variability, and pen pressure. The mean velocity of writing, however, does not change much. In Zesiger's view, these changes witness the elaboration of an *internal representation* of the movement. This representation (motor program) changes quantitatively (larger unit size) and qualitatively (more stable representation). In his terminology, one might speak here of a transition from a primarily *retroactive* control strategy, involving feedback, to a more *proactive* one, involving feedforward. The sharp decline in pausing (number and duration of pauses) is seen as reflecting an increased capacity to execute a stroke simultaneously with programming and parameterising subsequent strokes.

In one study in the kinematic domain (Meulenbroek & Van Galen, 1986) it appeared that duration, size and maximum speed do not change

much between the ages of 7 and 9, whereas spatial variability tends to be greater at the age of 8 than either 6 or 9. This discontinuity could be interpreted as resulting from a change in the control mode. An initial, *ballistic* production makes place for visually *guided* and corrected strokes, following which the strategy again becomes ballistic. In another study by the same authors (Meulenbroek & Van Galen, 1988), involving 8-12 year-old children, again a discontinuity was observed, now with a temporary decline in performance at the age of 9 rather than 8. This is again seen as reflecting a change of *strategy* in the use of visual and kinesthetic feedback. The later age of the decline could be due to the greater complexity of the task: in the previous study the patterns were cycloids, waves and zigzags, while this time, letters were required. It was found in a third study, in which letter bigrams were written (Meulenbroek & Van Galen, 1989) that the observed discontinuity is only present in the strokes of the letters themselves, and not in the connection strokes. The speed and the fluency of the latter strokes are lower in the connection strokes, but, more importantly, these appear to develop continuously with age, in contrast to those of the letter shapes. This points to a *special status of allographs* as the relevant processing units that are gradually represented in the novice writer's long-term motor memory.

A dominant observation concerns a decline of the number and duration of pauses. This seems to indicate that the writing movements are increasingly determined by these internal representations of the required movements (*motor programs*), and that these representations also increase in extent (from stroke size to letter size). Furthermore, following Van Galen's model, these results could reflect the fact that writers of increasing ages possess increasing *processing capacities*, and thus are capable to an increasing degree, of executing one unit (stroke or letter) while simultaneously preparing the next.

The developing role of *visual feedback* has been studied by Søvik (1974). He found that such feedback is essential in every stage of learning to write: the more this feedback is distorted, the more the speed and the quality of handwriting will suffer. Søvik's (drastic) manipulations, however, did not show specific age effects. In contrast to these findings, Zesiger (1995, p. 186) does report stronger effects of withholding visual feedback in younger children (aged 8-9) than in older children (aged 10-12). This author sees the effect as resulting from the specific function of visual feedback in the acquisition of cursive script. As we saw above, the slow writing of a beginner does allow close *monitoring*, so that this facilitates the comparison of the expected outcome of the motor commands with the observed spatial results, a comparison that, as we also discussed, is required for the elaboration and refinement of the underlying motor program. With respect to *kinesthetic feedback*, which is also an essential aspect of the internal representations (motor programs)

of writing movements, the only evidence available from the quoted studies seems to indicate that it is correlated with handwriting quality of 'clumsy' children, but not of those with normal motor abilities.

Zesiger and his colleagues (Zesiger, 1995, p. 192 ff.) asked their subjects, aged 8-12 and adults, to write at sizes and speeds different from normal. Their older subjects did not follow the instruction to write smaller and faster as well as the younger subjects did. Probably, the older subjects' normal performance is very efficient, and thus nearer the limits of their ability, so that for them the margins are smaller than for the younger subjects. When asked to write slowly, however, all subjects showed a considerable increase in dysfluency. In Zesiger's view, this might mean that the motor system can only generate *motor units* of a fixed size, since dysfluency covaried with duration and not with size. Under the instruction to write fast, the youngest children appear to increase the size of writing in contrast to the older groups, whose writing size decreases. Apparently, the youngest children cannot use the force levels efficiently, i.e., well-timed. That they can actually recruit the required forces *per se* is demonstrated by the fact that the velocity peaks (maximum speeds) do not differ across the age groups.

In the younger age groups (6-9 years), handwriting performance is still strongly dependent on the current writing conditions. Thus, the programming capacity is as yet fairly rigid, rather than flexible. Indeed, size and speed may be varied, but these variations appear to entail side-effects. In particular, speed increase results in size increase. Zesiger sees this as reflecting a certain difficulty to master the relationship between the acceleration and deceleration phases of the movement, and to control the applied forces efficiently. A strong tendency towards *isochrony* --i.e., to produce a certain pattern in a constant amount of time, irrespective of its size-- appears to be present at a rather young age, at least from the age of 8, when a size increase is associated with an almost proportional speed increase. This tendency remains approximately the same until the age of 12, following which the compensatory speed increase steadily approaches its maximum in adults.

As we mentioned above, in Zesiger's terminology, the development of the handwriting skill evolves from *retroactive* (feedback) control to *proactive* (feedforward) control. This development is reflected, in his view, by a reduction of the duration, of dysfluency, of the number of pauses, and of an increase in mean writing velocity. The elaboration or strengthening of the *motor programs* should also lead to reduced spatial variability. The maturation of the entire motor system and the biomechanical changes that accompany this development could, moreover, be associated with the *'distalisation'* of the movements. Together, these factors may, in Zesiger's view, be held responsible for the reduced size of the script, for the increased accuracy, and for the decline in the axial pen pressure exerted on the writing surface.

Advanced stages of writing

The acquisition of stable representations is the next stage of handwriting development. In the older age groups (age 9 to 10), the children pass through an intermediate stage. Whereas writing time, dysfluency and number of pauses continue to decline, letter size and pause duration appear to settle at levels that may already be compared to those of adults. The most striking change is the strong increase in mean velocity as well as in the acceleration peaks. As it seems, these entail a temporary decrease in precision or in spatial stability and an increase in pen pressure. Zesiger sees this as an improvement in the internal *representation* of the movement, characterised by a *size increase* of the programmed units, which is further witnessed by the observed decrease in writing time and dysfluency. At the same time, a new acquisition may be observed, namely the advanced mastery of *parameterisation*: The child becomes able to vary the size of his productions by acting primarily on a single parameter, i.e., force. Moreover, the decreased number of pauses seems to indicate, following Zesiger, that the child's *processing capacity* to deal simultaneously with the execution of current strokes and the preparation of further writing movements continues to increase.

During the subsequent stage of development, between the ages of 10 and 11, the changes appear to be relatively minor. The most important effect is seen in a reduced *variability* of writing time and velocity, of letter size, and of pen pressure. There is also a loss of precision at age 10; this is, however, partly resolved at the age of 11, so that it seems to reflect, primarily, a stage of handwriting regularisation, a stage that continues between age 11 and age 12. Although Zesiger does not regard this as a real reorganisation, he points out that certain variables tend to indicate that the child at this age orients himself towards a *new stage* of mastery in handwriting production. In particular, according to certain data, the child would enlarge the size of his production with an accompanying velocity increase, so that neither writing time, nor dysfluency are increased. The author also notes a slight tendency towards greater variability in writing time, velocity and in the spatial trace. Although of a small size, these changes might indicate, in Zesiger's view, a search for a new, more *personal*, form of handwriting. The observed size increase might result from a strategy to realise and control these changes.

Various other modifications, leading to a gain in efficiency, automaticity, and economy, are observed, finally, between children of age 11-12 years and adults. In particular, there is a decrease in writing time, dysfluency, and number of pauses, while mean and peak velocity increase. This improvement, observed by Zesiger in the course of adolescence, is, however, not without consequence. In fact, it appears that the temporal and spatial structure of the productions is more variable in the adults than in the child, and certainly more than in the oldest children. But this intra-subject variability in adult writing is not present when identical stimuli

are presented repeatedly for production under identical conditions. It appears that maintaining temporal and *spatial invariance* is not the most characteristic feature of adult handwriting. Indeed, it was observed in our department (Van Gemmert & Van Galen, 1996) that spontaneous normal writing is rather variable, more so than 'forged' handwriting, in which one writer attempts to imitate another writer's script. The reason suggested by Zesiger is compatible with that of the latter authors, namely that the (spontaneous, efficient) subject just tends to trade off legibility against effort. Attention and effort are then distributed over the execution of the current letter strokes on the one hand, and the preparation of oncoming letters and strokes on the other. This distribution of a limited amount of attention and effort, could then be the cause of fluctuations at the different processing levels, and, ultimately, of variable handwriting output. Forged handwriting, in contrast, is typically given stroke-by-stroke attention rather than driven by anticipation and on-line preparation.

Conclusion

In the first of the above three major sections, we reviewed several aspects of handwriting performance and its acquisition as a cognitive motor skill. We emphasised the hierarchical structure of this skill involving, in turn, cognitive and motor hierarchies. The former are concerned with global, conceptual, syntactic, orthographic, symbolic and memory aspects; the latter with motor-program retrieval, parameterisation, co-ordinative structures, synergies, muscle recruitment and adaptive compliance. Learning the skill is discussed in the perspective of increasing automaticity and of the 'tuning' of co-ordinative structures under the influence of visual and tactile feedback in a large variety of spatial and anatomical conditions. As a special aspect of skill acquisition, we discussed the problem of coping with large numbers of degrees of freedom, and its solution by 'coupling' and other types of co-ordinative structures.

Next, we mentioned a few research paradigms and some basic kinematic data on fluent, cursive writing. Then we reviewed an elaborated multi-stage model of handwriting, characterised by the above hierarchical architecture (Van Galen, 1991). A central role in the model is assigned to allographic (specified letter form) representations, which are generalised motor programmes in long-term motor memory. The model, which typically has both serial and parallel features, generates a number of fairly precise predictions. It is supported by kinematic evidence and by results from reaction-time and movement-time experiments in which specific task variables are manipulated. The model takes a central place in the present contribution, serving as the connecting link between skill learning and performance on the one hand, and the study of handwriting development on the other.

Van Galen's model indeed served as a framework for much of Zesiger's (1995) research on the acquisition of the handwriting skill. The recurrent themes here are the development from gross proximal to fine distal motor control, and the changing role of feedback in the process of gradually acquiring and 'running' stable motor programs of allographic size. The development, furthermore, is characterised by increasing automaticity and processing capacity. This increase gradually results in the child's ability to perform one allograph fluently, while simultaneously retrieving the next allograph representation and preparing its flexibly adapted production, as accounted for by the above serial-and-parallel model. Discontinuity in the development is seen as evidence of a further stage in mastering the skill that ultimately develops towards a personal, somewhat variable writing style. Such a style entails, amongst other things, an 'optimum' between regularity and economy, trading legibility off against effort.

References

Colley, A.M. (1989). Cognitive motor skills. In D.H. Holding (Ed.), *Human skills* (2nd ed., pp. 229-248). New York: Wiley.

Dell, G.S. (1986). A spreading activation theory of retrieval in sentence production. *Psychological Review, 93,* 283-321.

Ellis, A.W. (1982). Spelling and writing (and reading and speaking). In A.W. Ellis (Ed.), *Normality and pathology in cognitive functions* (pp. 113-146). London: Academic Press.

Fitts, P.M., & Posner, M.I. (1967). *Human performance.* Belmont CA: Brooks/Cole.

Goodnow, J.J., & Levine, R.A. (1973). The grammar of action: Sequence and syntax in children's copying. *Cognitive Psychology, 4,* 82-98.

Hawkins, B., Zelaznik, H.N., & Kisselburgh, L. (1981). *The effects of concurrent visual feedback on spatial accuracy of single aiming movements.* Los Angeles: UCLA Technical Report.

Hollerbach, J.M., (1981). An oscillation theory of handwriting. *Biological Cybernetics, 39,* 139-156.

Johansson, R.S., & Westling, G. (1987). Signals in tactile afferents from the fingers eliciting adaptive motor responses during precision grip. *Experimental Brain Research, 66,* 141-154.

Klapp, S.T., & Wyatt, E.P. (1976). Motor programming within a sequence of responses. *Journal of Motor Behavior, 8,* 19-26.

Lecours, A.R. (1996). *Langage écrit: Histoire, théorie et maladie.* Molinchem, France: Ortho-Édition.

Levelt, W.J.M. (1989). *Speaking: From intention to articulation.* Cambridge MA: MIT Press.

Mackay, D.G. (1982). The problems of flexibility, fluency and speed-accuracy trade-off in skilled behavior. *Psychological Review, 89,* 483-506.

Meulenbroek, R.G.J., & Van Galen, G.P. (1986). Movement analysis of repetitive writing behaviour of first, second and third grade primary school children. In H.S.R. Kao, G.P. van Galen, & R. Hoosain (Eds.), *Graphonomics: Contemporary research in handwriting* (pp. 71-92). Amsterdam: North-Holand.

Meulenbroek, R.G.J., & Van Galen, G.P. (1988). The acquisition of skilled handwriting: Discontinuous trends in kinematic variables. In A.M. Colley & J.R. Beech (Eds.), *Cognition and action in skilled behavior* (pp. 273-281). Amsterdam: North-Holland.

Meulenbroek, R.G.J., & Van Galen, G.P. (1989). The production of connecting strokes in cursive writing: Developing co-articulation in 8 to 12 year-old children. In R. Plamondon, C.Y. Suen, & M.L. Simner (Eds.), *Computer recognition and human production of handwriting* (pp. 273-286). Singapore: World Scientific.

Plamondon, R., & Maarse, F.J. (1989). An evaluation of motor models of handwriting. *IEEE Transactions on Systems, Man and Cybernetics, 19,* 1060-1072.

Rumelhart, D.E., & Norman, D.A. (1982). Simulating skilled typists: A study of skilled cognitive-motor performance. *Cognitive Science, 6,* 1-36.

Sanders, A.F. (1983). Towards a model of stress and human performance. *Acta Psychologica, 53,* 61-97.

Sanders, A.F. (1990). Issues and trends in the debate on discrete vs. continuous processing of information. *Acta Psychologica, 74,* 1-45.

Schomaker, L.R.B., Thomassen, A.J.W.M., & Teulings, H.-L. (1989). A computational model of cursive handwriting. In R. Plamondon, C.Y. Suen, & M.L. Simner (Eds.), *Computer recognition and human production of handwriting* (pp. 153-177). Singapore: World Scientific.

Schomaker, L.R.B., & Van Galen, G.P. (1996). Computer models of handwriting. In T. Dijkstra & K. de Smedt (Eds.), *Computational psycholinguistics: AI and connectionist models of human language processing* (pp. 386-420). London: Taylor & Francis.

Shaffer, L.H. (1975). Control processes in typing. *Quarterly Journal of Experimental Psychology, 27,* 419-432.

Singer, R.N. (1982). *The learning of motor skills.* New York: Macmillan.

Søvik, N. (1974). Developmental trends of visual control in copying and handwriting performance of children aged 7 through 11 years. *Perceptual and Motor Skills, 39,* 919-930.

Sternberg, S. (1969). The discovery of processing stages: Extension of Donders' method. *Acta Psychologica, 30,* 276-315.

Teulings, H.-L., Thomassen, A.J.W.M., & Van Galen, G.P. (1983). Preparation of partly precued handwriting movements: The size of movement units in handwriting. *Acta Psychologica, 54,* 165-177.

Thomassen, A.J.W.M., & Meulenbroek, R.G.J. (1998). Low-frequency periodicity in the co-ordination of progressive handwriting. *Acta Psychologica* (in press).

Thomassen, A.J.W.M., Meulenbroek, R.G.J., Schillings, J.J., & Steenbergen, B. (1996). Adaptive shifts in hand-finger co-ordination during handwriting across the page. In M.L. Simner, C.G. Leedham, & A.J.W.M. Thomassen (Eds.), *Handwriting and drawing research: Basic and applied isues* (pp. 15-27). Amsterdam: IOS Press.

Thomassen, A.J.W.M., & Teulings, H.-L. (1979). The development of directional preference in handwriting. *Visible Language, 13,* 299-313.

Thomassen, A.J.W.M., & Teulings, H.-L. (1983). Constancy in stationary and progressive handwriting. *Acta Psychologica, 54,* 179-196.

Thomassen, A.J.W.M., & Teulings, H.-L. (1985). The development of handwriting. In M, Martlew (Ed.), *The psychology of written language* (pp. 179-213). New York: Wiley.

Thomassen, A.J.W.M., & Van Galen, G.P. (1992). Handwriting as a motor task: Experimentation, modelling, and simulation. In J.J. Summers (Ed.), *Approaches to the study of motor control and learning* (pp. 113-144). Amsterdam: Elsevier Science.

Thomassen, A.J.W.M., & Van Galen, G.P. (1997). Temporal features of handwriting: Challenges for forensic analysis. *Journal of Forensic Document Examination, 10,* 85-108.

Van der Plaats, R.E., & Van Galen, G.P. (1990). Effects of spatial and motor demands in handwriting. *Journal of Motor Behavior, 22,* 361-385.

Van Doorn, R.R.A. (1993). *Relevance of vision for adult handwriting.* PhD Thesis, Free University of Amsterdam.

Van Galen, G.P. (1991). Handwriting: Issues for a psychomotor theory. *Human Movement Science, 10,* 165-191.

Van Galen, G.P., Meulenbroek, R.G.J., & Hylkema, H. (1986). On the simultaneous processing of words, letters and strokes in handwriting: Evidence for a mixed linear and parallel model. In H.S.R. Kao, G.P. van Galen, & R. Hoosain (Eds.), *Graphonomics: Contemporary research in handwriting* (pp. 5-20). Amsterdam: North-Holland.

Van Gemmert, A.W.A., & Van Galen, G.P. (1996). Dynamic features of mimicking another person's writing and signature. In M.L. Simner, C.G. Leedham, & A.J.W.M. Thomassen (Eds.), *Handwriting and drawing research: Basic and applied issues.* (pp. 459-471). Amsterdam: IOS Press.

Westling, G., & Johansson, R.S. (1984). Factors influencing the force control during precision grip. *Experimental Brain Research, 53,* 277-284.

Zesiger, P. (1995). *Écrire: Approches cognitive, neuropsychologique et développementale.* Paris: Presses Universitaires de France.

A presentation of a social skills intervention program

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Introduction

Peer relationships play an important role in children's lives and development. Peer contacts, especially with friends, seem to be developmentally significant. Supportive relationships like friends, are for instance important resources for managing stressful situations. Friends may also serve as trusted confidants and critics (Asher, 1990; Hartup, 1996).

Some children experience difficulty gaining acceptance and friendship among peers. Many studies suggest that unpopular children are at risk for later emotional adjustment and mental health problems (for a review, see Parker and Asher, 1987). The quality of children's relationships with their peers has also been shown to be predictive of school problems (Coie, Dodge and Kupersmidt, 1990). Children with poor peer relationships are at risk of developing learning and behavioural problems and they need help.

Peer acceptance and positive social status have been found to be related to children's social competence and prosocial interactions (*ibid.*). To improve children's peer relationships, intervention programs have been developed to teach children appropriate social skills (for a review, see Cartledge and Milburn, 1986; La Greca, 1993). Some suggest that social skills training should be a part of the school

curriculum and that children should be taught skills that have been found to be important in achieving peer acceptance and close personal friendships (Ogden, 1990; Hargie and Hargie, 1995). According to La Greca (1993), such training programs should not focus only on the solitary child, view the child as having poor peer relationships owing to intra-individual behavioural deficits, and thus neglect the child's broader milieu.

The intention of this study was therefore to develop and evaluate an intervention program aimed at teaching social skills to a group of 6-year-old children, some of whom were at risk for developing behaviour problems. It was expected that the training program would significantly increase the children's positive behaviours and decrease their negative behaviours. It was also expected that there would be a gain in positive nominations and a decrease in negative nominations among the children on a sociometric assessment.

An important reason for focusing on young children is that early social rejection may be difficult to overcome. Hymel, Wagner and Butler (1990) found that by the middle school years, reputation and expectations within the peer group serve to maintain prior attitudes and beliefs about unpopular children. Even if such children later succeed in improving their social competence, it is difficult for them to gain acceptance from peers. Because of this, early intervention programs aimed at preventing children from establishing negative peer reputations seem to be important.

Our social skills intervention program was based on cognitive-social learning theory and Vygotsky's socio-cultural theory of children's cognitive development and the notion of «zone of proximal development» (ZPD). First, we will give an overview of how the concepts of social skills and social competence have been used and defined and give a description of the theoretical framework underlying our social skills intervention program. Then the intervention program will be presented. At last the results of the intervention program will be discussed.

The theoretical framework

According to Ladd and Mize (1983), social skills « - refer to children's ability to organise cognitions and behaviors into an integrated course of action directed toward culturally acceptable social or interpersonal goals» (p.127). However, the concepts of social skills and social competence have been used and defined in various ways (McFall, 1982; Cartledge and Milburn, 1986; Herbert, 1986; Ogden, 1995). Some researchers use these terms synonymously, while others prefer to

distinguish between them. When differentiated from social competence, social skills concern the observable behaviours identical with prosocial behaviours, while social competence is often used as a broader term including both the observable behaviours and affective and cognitive factors. Social skills are thus seen as one of several components of social competence (Gresham and Elliott, 1984; Haager and Vaughn, 1995). In this study we mostly use the term social skills, viewing the term according to the definition of Ladd and Mize (1983). However, we also consider affective factors to be important.

Ogden (1995) reviewed the literature about social competence and social skills. The most common factors included in definitions of social competence and social skills are: empathy, perspective-taking, social sensitivity and decentering, prosocial behaviours like co-operation and communication skills, ability to solve interpersonal problems and conflicts, assertive behaviour, and self-control or impulse/emotional control. Affective and cognitive processes are thus considered to be important factors in understanding how social skills develop. These factors are now often included in social skills training programs (Cartledge and Milburn, 1986; Fagen, Long and Stevens, 1995; Torres, Sanches and Sanches, 1995). In their skill model of interpersonal communication, Hargie, Saunders and Dickson (1994) emphasise factors like knowledge, motives, values, emotions, attitudes, expectations and dispositions when focusing on personal characteristics of the learner. They also emphasise that all communication is context-bound, and that socially skilled behaviours are goal-directed and can be learned.

It is reasonable to believe that children learn social skills in much the same ways as they learn from intervention programs in academic domains. That is to say, they learn primarily through observation, imitation, verbal instruction and feedback from the environment. Within the framework of cognitive-social learning theory, Bandura (1977a, 1977b) has developed a learning model to explain skill acquisition and how behaviour might change. Through modelling demonstrations and verbal instructions, children will form a concept of the targeted behaviour. This conceptual representation becomes the guideline for later performances. Motivation to perform the skill and feedback from the environment are also important factors in this model.

Bandura's cognitive-social theory provided the framework for previously developed models of social skills learning and instruction (Bornstein, Bellack and Hersen, 1977; Oden and Asher, 1977; Ladd, 1981; Ladd and Mize, 1983; Ladd, 1984). These models were usually based on three components: (1) instructions and information about the

social skill concept to be learned, (2) opportunities to practise the target skill in various interactive situations, and (3) evaluation or review of the skill outcomes. In addition, generalisation and skill maintenance were also considered to be of importance (Ladd and Mize, 1983; Mize and Ladd, 1990). This means that the newly acquired skills should not only be performed in a relatively controlled, risk-free context, but also in real-life situations when it is desirable to use them. The skills also have to be maintained over time.

The first component in this model focuses on giving children knowledge about the target social skill. The children are provided with information on the purpose or rationale for the target skill, helping them to understand the value of the social skill and to see the potential consequences of behaving in a certain way. The children might also be introduced to successful strategies for applying the target skill. This might occur, for instance, by providing examples of skilled social behaviours and how they can be practised in a specific social situation. The instruction may be provided verbally, through modelling, or by both means. The second component is concerned with enhancing children's skill proficiency, and the children have the opportunity to practise and rehearse the knowledge they have acquired about the social skill. The last component in this intervention program is concerned with the children's ability to evaluate and monitor their behaviour to see whether they have succeeded in performing the target skill. This three components model provided the basis of our intervention program.

In cognitive skills training, instructional principles and methods have also been influenced by Vygotsky's socio-cultural theory of children's cognitive development. According to Vygotsky (1962, 1978) all superior psychological functions first manifest themselves on the interpsychological plane, that is, between people in social interactions, and only later become interiorised on the intrapsychological plane, that is, as internal processes. All psychological processes or higher mental functions, such as thinking, reflection, reasoning and problem-solving are thus originally social processes. To study how children's social interactions with more experienced members of their culture influence their development, Vygotsky introduced the notion of the «zone of proximal development» (ZPD). The ZPD is defined as the distance between the «actual developmental level as determined by independent problem solving and potential development as determined through problem solving under adult guidance or in collaboration with more capable peers» (Vygotsky, 1978, p. 86). The concept makes a distinction between children's

performance in autonomous activities and their developmental capacities. The ZPD is thus a dynamic region of sensitivity in which children's mental functions develop in joint problem solving with more skilled members of their culture. As children's cognitive development occurs through participation in activities slightly beyond their competence, the task of the more skilled person is to structure and model the learning situation.

Contemporary interpretations of Vygotskyan theory use the concepts of «scaffolding» (Wood, Bruner and Ross, 1976) and «guided participation» (Rogoff, 1990) when teaching to the child's ZPD. In a learning situation the adult's role is, for instance, to: (a) model the performance of the task, (b) instruct the child about the overall goal, (c) motivate, (d) structure the activity and segment the tasks into manageable subgoals, (e) submit information and suggest strategies about how to solve a problem, and (f) be supportive and give positive feedback. Both adult and child are active and responsible in the learning activities, the child participating at a comfortable but slightly challenging level. As children's expertise grow, they take more and more responsibility for managing the tasks and gradually come to perform the tasks by themselves. Dialogue and a shared frame of reference are also important factors in the learning situation (Wood et al., 1976; Palincsar and Brown, 1984; Rogoff, Malkin and Gilbride, 1984; Wertsch, 1984; Brown and Ferrara, 1985; Rogoff, 1990; Karpov and Bransford, 1995). The instructional principles we used in our intervention program were influenced by the concept of ZPD and contemporary interpretations of Vygotskyan theory. Within this framework it is important to adapt the training to the needs and abilities of the individual child. Besides, the concepts of «scaffolding» and «guided participation» give specific instructions about how we can teach social skills to children.

The social skills intervention program

Students

Our intervention program was implemented at a small Norwegian primary school at which we had previously been doing research (Flem, Thygesen and Valås, 1995). This school was characterised by a positive school ethos; it was also found that the school was dealing successfully with children's behavioural problems. A pre-school with 12 children and a kindergarten with eight children were also located in the same school building. Once a week the kindergarten group received their own instruction in an ordinary classroom. The rest of the week they were integrated with the nursery school. When the

investigation took place, 6-year-olds were still kindergarten children in Norway.

All eight of the 6-year-old children, four boys and four girls, were selected for the social skills training program. All the names used in this article are pseudonyms. Before the intervention program took place the kindergarten group was observed over a period of two weeks during free-play and in more formal settings by two independent persons, one of the staff and one of the researchers. Among these, three boys were considered by the staff to be at risk of developing emotional and behavioural problems. Two of the boys had extra educational resources provided for them. The social behaviours and attitudes of the three children at risk were assessed by the use of a checklist developed by one of the researchers. The checklist included factors like learning skills, social and communication skills, attitudes towards self, behaviours towards other children and staff, and self-control. They were rated on a 1 to 5 point scale on all the items of the checklist. Space was also available to add further comments.

One of the boys (Per) was found to be anxious, passive, and thus tended toward internalising behaviours or to be socially withdrawn. Another boy (Tor) showed more externalising behaviours. He tended to be aggressive, especially toward younger children. The third boy (Are) exhibited both externalising and internalising behaviours. In certain situations, as a reaction to being insecure and anxious, he might, for example, scream or withdraw, not wanting to talk to anybody. Per and Are also seemed to have low self-esteem.

Research design

The design chosen for the study was a one-group pretest-posttest design. The study should therefore be regarded as a pilot project. Before the intervention program took place, the children were videotaped during three pretest sessions. Then the social skills training took place. When the training period was finished, the children were videotaped during three posttest sessions and assessed in the same way as in the pretest session. Sociometric interviews were also administered to the children as part of the pre- and posttest sessions.

In the first pretest (mixed group) the children played a co-operative board game. They were supposed to throw a die and then move a figure on the board. Co-operation, not competition, was essential in this game. In the next pretest they played the same game, but this time the group consisted of either boys or girls (same-gender group). This was done to see if there were any differences of the kind of social behaviours in a mixed group and a same-gender group.

However, due to the small number of children and the low level of measurements, this analysis could not be performed. In the last pretest the children were asked to cut pictures of animals and fishes and then glue them on a painting of a forest with a lake (mixed group). The three posttests were similar to the three pretests: a co-operative board game (mixed group and same-gender group), and a cut and glue task (same-gender group).

Skill training program

Procedure. All eight children in the kindergarten group were included in the training program. This was done because we did not want to focus on the solitary child and neglect the child's social milieu. The training lasted for a period of approximately one and a half months. The intervention program consisted of nine, 30-35 minute training sessions. Both the staff and three of the researchers were involved in and responsible for the training program. The children were mostly trained in the kindergarten group. A few times they were trained together with the nursery group. When the children received the information of the target skills, they were all together. Afterwards, they practised the skills in groups of four, two girls and two boys (mixed group). The evaluation of their behaviours also took place in the same groups.

Skills targeted. In selecting social skills to be taught, there are several factors to be considered. The child's age and developmental level and the behavioural norms among the peer group should be taken into account. The social skills should have value and be meaningful to the child. An effective intervention program depends on a close match between the maladaptive behaviours of the child and the social competence to be learned (La Greca, 1980). Intervention programs should also often focus on skills that contribute to positive peer relations. Previous studies have shown that popular or well-liked children are helpful, considerate of others, compliant to rules, co-operative, and actively engaged in prosocial peer interactions. On sociometric assessments, these children will have many positive nominations and few negative nominations (Coie *et al.*, 1990).

The social skills focused on in the intervention program were based on skills identified in the literature that contribute to positive peer relations. The targeted skills were thus supporting, co-operating and establishing social contacts with other children. The disruptive behaviours of the three children (Per, Tor, Are) were also taken into consideration. Consequently, participating (e.g., getting started, paying attention, performing the target task), handling conflict situations and

reducing aggression (e.g., how to deal with aggressive peers) were also addressed in the training program.

Components of the model. As previously mentioned the intervention program was based on the three component model of Ladd and Mize. The first step focused on giving the children knowledge about the target social skills. This introduction was mostly provided with the help of a hand-puppet named «Prikken» (a polar bear). The children were also introduced to successful strategies for applying the target skills. In the next step they practised the skills. At the last step the children evaluated their behaviour to see whether they had succeeded in performing the target skills. During all the three steps, the principles of the ZPD, «scaffolding» and «guided participation» were applied, especially in the social interaction situation where the children could practise and rehearse the new skills.

In the first training session the children were to play a co-operative board game. The target skills were participating (e.g., to perform the expected task, to throw the die, move a figure and give the die to the next child) and supporting (e.g. making positive statements to peers, giving peers help, or showing affection to peers). Because we wanted to adapt the intervention program to the children's needs, Per, the boy who tended to have internalising and passive behaviour, and Are, who exhibited both externalising and internalising behaviours, were given instructions on how to play the new game before the session started. During the practising step they were placed in two different groups. We did this to strengthen their self-confidence and give them a feeling of competence. Otherwise we followed the three-component model as mentioned.

During the second session, children were trained to cooperate on a cut and glue task. Supporting was again a target skills. In this session, the hand-puppet, «Prikken», was introduced. The following includes an example of «Prikken»'s introduction:

> *Hey, my name is Prikken. I am so fond of children and I like to be together with them. It is so fun. I am so happy when children are playing together and have a nice time. I like to see that children are friends and help each other. And I like to hear that children say something nice to each other. But I am so unhappy when children are fighting together and are angry at each other. I don't like that.*

Later, before the practising phase, the adult repeated what «Prikken» had said and suggested strategies for how to succeed when performing the cut and glue task: First they should discuss how to carry out the task and then come to an agreement. Everybody should say something

about how to do the task, and everybody should perform the expected task.

The third session was very much like the first. The children were to play a co-operative game, and the skills in focus were participation and supporting. During the practising step, the group with the internalising boy was videotaped because we wanted to use positive episodes in a later session.

In the next three sessions the staff was involved in role-playing. During the fourth and fifth sessions the children were engaged in how to establish social contacts with other children. First, the staff role-played a scene where a child did not succeed in establishing contact with another child. Then «Prikken» was introduced and asked the children if they had some ideas about what could be done in order to succeed. Afterwards, the staff role-played a scene with a positive outcome based on the children's suggestions. In the sixth session the role-playing focused on how to handle a conflict situation and reduce aggression. How to develop self-control and take a positive perspective of others were also in focus. In the seventh session the same themes were in focus. The children watched a video about a conflict situation, and they were also shown positive episodes from their own video-recording of playing the co-operation game. In the eighth session the children were to cooperate on a Lego-building task, and the skills in focus were co-operation, participation and supporting. The ninth session resembled the sixth, that is, the staff role-played how to handle a conflict situation and reduce aggression.

Assessment of social behaviours

Using the video-recordings of the pre- and postsessions, the social behaviours of the children were analysed and coded according to six behavioural categories. The assessment of the video-recordings, conducted by three of the researchers, was influenced by the way Heiling (1993) analysed children's social interactions on video. We developed detailed descriptions of the children's interactions with each others. The unit of analysis was an activity followed by a response, which could involve several sequences of interactions. We also noted situations when the children did not perform the expected task. Often it was necessary to review the video-recordings in slow-motion. We then grouped similar kinds of behaviour and formulated categories. In the beginning we had to reject some categories and try out other ones. Finally, when we had decided on the categories to use, we viewed the videos again to categorise the social behaviours of the children. When

we were unsure, we discussed the behaviour of the child and came to an agreement.

Three categories were positive and included: (1) solving problems in connection with co-operation tasks (verbal and non-verbal inquiries and/or responding to inquiries, discussing how to solve problems that arise, and clearing up misunderstandings), (2) positive self-assertion, (3) positive leadership (verbally or nonverbally instructing or directing peers, giving praise and encouragement to peers, and making constructive comments). Three categories were negative and included: (4) negative leadership (dominating peers and controlling how the peers perform a task), (5) introverted asocial behaviours (withdrawing from the situation, not watching or talking to peers and not doing the expected task), (6) extroverted asocial behaviours (directing aggressive verbal and non-verbal behaviours at peers, protesting in an aggressive way, and making destructive contributions).

Sociometric assessments. Sociometric interviews were also administered to all the kindergarten children using one of the staff as the interviewer. One category of questions asked who the children wanted to have as playmate, and who they wanted to be together with when eating; they were also asked to name their best friends among the kindergarten children (positive nominations). Another set of questions were related to perceived friends, asking the children to name peers they believed would like to play with them and be together with them when eating (perceived nominations). The children were also asked if there were any children in the kindergarten group with whom they did not want to play (negative nominations). The sociometric interviews were analysed by counting the number of nominations given to each child in each category. The same sociometric interview was administered to the children after the skills intervention program was finished.

Results and discussion

The results of this research showed that the intervention program was effective in increasing some of the positive social behaviours of the children and reducing some of their negative behaviours. The results were significant for the categories of solving co-operation problems and introverted asocial behaviour.[1] These results are generally consistent with result from similar studies on social skill training

[1] The results are described in more details in the article by Flem, Thygesen, Valås og Mangnes, 1998.

(Bornstein, Bellack and Hersen, 1977; Oden and Asher, 1977; La Greca and Santogrossi, 1980; Ladd, 1981; Bierman and Furman, 1984). However, due to the small number of children participating in the training program and the often low frequencies of behaviours, the results must be interpreted with care. Likewise, the design chosen was a one-group pretest-posttest design without a control group. Future intervention research should therefore include a larger number of children and a control group.

The studies cited have mostly focused on children who have evidenced difficulty in relating to peers, and the children were taken from their ordinary classrooms and trained. The present study was designed for training all the children belonging to the kindergarten group, either in the classroom or in the nursery setting. We did this because we did not want to stigmatise the children at risk of developing emotional and behavioural difficulties. We also wanted to try out a program that could include all the children in a classroom. This is in line with the suggestion that social skills training ought to be part of the ordinary school curriculum (Ogden, 1990; Hargie and Hargie, 1995).

Most of the children gained from the social skill training, but in different ways. Two of the boys at risk gained from the skill training. The boy who tended to have internalising and passive behaviour had a decrease on introverted asocial behaviours, and the boy with externalising and aggressive behaviour improved his behaviour. This shows that social skills training program ought to take into consideration the disruptive behaviours of the children and their specific social needs, as suggested by La Greca (1993). However, if the children have specific diagnoses like learning difficulties, the intervention program need to be substantially longer than those typically reported in the social skill training literature (*ibid.*).

There are several issues to consider when evaluating the effectiveness of the social skills intervention program. In addition to taking the disruptive behaviours of the children into consideration, it is important that the program is suited to the age of the group trained. Here, our experience was that the children loved «Prikken» and listened carefully to what he said. Including the staff in the training program also resulted in age-appropriate elements like role-playing. Thus, it seems to be essential that there is a good match between the developmental level and individual needs of the child and the design and delivery of the training program.

The intervention program was based on scaffolding and the three components model of Ladd and Mize (1983). Earlier projects have found this model to be effective. But what factors may account

for the treatment effects of the intervention model we used? Our impression was that the first step of introducing the target skills was successful. The children were eager, motivated, and attentive. During the next step the children practised their acquired knowledge of social skills. The children also seemed motivated to do this. According to Hargie *et al.* (1994), social competence can only occur if a person converts knowledge of skills into skilled behaviour and has the opportunity to develop a wide repertoire of social skills in order to adjust and adapt to varying social situations. Some children might also have difficulties in translating their social knowledge into appropriate behaviour though (Ladd and Mize, 1983), and for this reason the children must have the opportunity to practise the target social skills. We also saw that it was important for the children at this step to try out their new skills in a learning situation when the adult and children interacted according to the principles of the ZPD, «scaffolding» and «guided participation». At the last step the children were encouraged to evaluate their performance, how their peers had reacted and how they might adjust or improve their performance. We found that this step was difficult to carry out in a proper way. The children were inattentive and did not seem to be interested in talking about what they had done. One reason for this might be the mental age of the children. Self-evaluation is a complex matter; learning this skill takes time and requires adjustments for the children's age-level. Because of their difficulties with evaluation, the children were asked at the beginning of a new session how they succeeded last time. There is still a need, however, for more systematic and in-depth investigations to study in detail the effectiveness of the different components and the instructional principles of such training programs.

The sociometric assessment showed few changes from pretraining to posttraining. Thus, even for young children, friendship nominations seem to be stable. Because our research was based on a small group of children, it is difficult to draw reliable conclusions about the findings. Another factor was the short training period. Perhaps a longer training period would contribute to change in peer acceptance and friendship. Earlier findings about sociometric assessment are equivocal. Similar studies have reported that skills training was effective in increasing peer acceptance (Oden and Asher, 1977; Ladd, 1981), while other studies did not find significant changes in peer nominations (La Greca and Santogrossi, 1980; Bierman and Furman, 1984). This indicates that social interactions and peer nominations are complex, and that improvement of social skills will not automatically result in positive changes of a child's peer status. According to Hymel

(1986), peer acceptance and rejection is not only based on the behaviour itself, but may also depend on affective bias in peer perceptions and interpretations of the child's behaviour. It is also suggested that children's social networks and peer clusters in the classroom should be included when studying sociometric status among children (Farmer and Hallowell, 1994). Even if social competence seems to be an important factor in peer relationships, children tend to associate with peers who are similar to themselves. Thus, peers may continue to reject a child even though his or her behaviour has improved.

The results also showed that there was a tendency for both girls and boys to nominate individuals of their own gender as best friends. This is in line with other research results that have found that children have a tendency to prefer to affiliate with peers of their own gender (Johannesson, 1962; Cairns, Perrin and Cairns, 1985). We also found that the cross-gender nominations were mostly negative. This tendency might be normal and related to the children's age.

In summary, this study found that the intervention program seemed to be effective in teaching 6-year-old children social skills. The study thus confirms that socials skills intervention programs should be based on principles found to be effective in most learning situations. For optimal learning to occur, factors like motivation and the quality of the relationship between the child and the instructor are also important aspects. In this project, the personnel at the nursery school and kindergarten were involved in the training of social skills, and they seemed to have good relationships with the children. During the intervention, the importance of a warm and supportive adult was stressed.

The involvement of the staff is also important for the maintenance and generalisation of the social behaviours. Of course, for the effects to last, the training of social skills/competence ought to be a part of the kindergarten curriculum. Likewise, the parents of the children ought to be involved to ensure that the social skills are used in ecologically valid situations. This was not done in the present study. When involving teachers and parents in an intervention program, the importance of the children's social networks should be stressed as well as the idea that social behaviours always occur in a social context and in interaction with other people.

References

Asher, S.R. (1990). Recent advances in the study of peer rejection. In S. R. Asher, and J. D. Coie (Eds.), *Peer Rejection in Childhood.* Cambridge: Cambridge University Press.

Bandura, A. (1977a). Self-efficacy: Toward a unifying theory of behavior chang. *Psychological Review, 84,* 191-215.

Bandura, A. (1977 b). *Social Learning Theory.* Englewood Cliffs, N.J.: Prentice-Hall.

Bierman, K.L. and Furman, W. (1984). The effects of social skills training and peer involvement on the social adjustment of preadolescents. *Child Development, 55,* 151-162.

Bornstein, M.R., Bellack, A.S., and Hersen, M., (1977). Social-skills training for unassertive children: A multiple-baseline analysis. *Journal of Applied Behavior Analysis, 10,* 183-195.

Brown, A.L. and Ferrara, R.A. (1985). Diagnosing zones of proximal development. In J. V. Wertsch (Ed.), *Culture, Communication, and Cognition: Vygotskian perspectives.* Cambridge:Cambridge University Press.

Cairns, R.B., Perrin, J.E. and Cairns, B.D. (1985). Social structure and social cognition in early adolescence: Affiliative patterns. *Journal of Early Adolescence, 5,* 339-355.

Cartledge,G. and Milburn, J.F. (Eds.) (1986). *Teaching Social Skills to Children.* New York: Pergamon Press.

Coie, J.D., Dodge, K.A., and Kupersmidt, J.B. (1990). Peer group behavior and social status. In S. R. Asher, and J. D. Coie (Eds.), *Peer Rejection in Childhood.* Cambridge: Cambridge University Press.

Farmer, T.W. and Hollowell, J.H. (1994). Social networks in mainstream classrooms: Social affiliations and behavioral characteristics of students with EBD. *Journal of Emotional and Behavioral Disorders, 2,* 3, 143-155, 163.

Flem, A., Thygesen, R. and Valås, H. (1995). A study of a school in Norway dealing successfully with children's behavioural problems. Paper presented at 6th European Conference for Research on Learning and Instruction (EARLI), August 1995, University of Nijmegen.

Flem, A., Thygesen, R., Valås, H. and Mangnes, E. (1998). A social skills intervention programme for kindergarten children at risk of developing behavioural problems. *European Journal of Special Needs Education, 13,* 2, 208-215.

Fagen, S.A., Long, N.J. and Stevens, D.J. (1975). *Teaching Children Self-control.* Columbus-Ohio: Charles E. Merrill.

Gresham, F.M. and Elliott, S.N. (1984). Advances in the assessment of children's social skills. *School Psychology Review, 13,* 292-301.

Haager, D. and Vaughn, S. (1995). Parent, teacher, peer, and self-reports of the social competence of students with learning disabilities. *Journal of Learning Disabilities, 28,* 4, 205-215, 231.

Hargie, O., Saunders, C. and Dickson, D. (1994). *Social Skills in Interpersonal Communication.* London: Routledge.

Hargie, O. and Hargie, C. (1995). Sosiale ferdigheter må inn på skolens læreplan (Social skills must be a part of school curriculum). In F. F. Ask, and O. Sletta (Eds.), *Kommunikasjon som sosial og tverrkulturell kompetanse* (Communication as Social and Cross-cultural Competence). Trondheim: Tapir.

Hartup, W.W. (1990). The company they keep: Friendships and their developmental significance. *Child Development, 67,* 1-13.

Heiling, K. (1993). *'Dova barns utveckling i ett tidsperspektiv'* (Deaf Children's Development in a Time-perspective). PhD Thesis. Stockholm: Almquist & Wiksell International.

Herbert, M. (1986). Social skills training with children. In C. R. Hollin, and P. Trower (Eds.), *Handbook of Social Skills Training. Volume 1.* Oxford:Pergamon Press.

Hymel, S. (1986). Interpretations of peer behavior: Affective bias in childhood and adolescence. *Child Development, 57,* 431-445.

Hymel, S., Wagner, E., and Butler, L.J. (1990). Reputational bias: View from the peer group. In S R. Asher, and S. D. Coie (Eds.), *Peer Rejection in Childhood.* Cambridge: Cambridge University Press.

Johannesson, I. (1962). *Skolklassen som samhalle.* (The Schoolclass as solidarity). Lund: Gleerups Forlag.

Karpov, Y.V. and Bransford, J. D. (1995). L. S. Vygotsky and the doctrine of empirical and theoretical learning. *Educational Psychologist, 30,* 2, 61-66.

Ladd, G. W. (1981). Effectiveness of a social learning method for enhancing children's social interaction and peer acceptance. *Child Development, 52,* 171-178.

Ladd, G.W. (1984). Social skill training with children: Issues in research and practice. *Clinical Psychology Review, 4,* 317-337.

Ladd, G.W. and Mize, J. (1983). A cognitive-social learning model of social-skill training. *Psychological Review, 90,* 2, 127-157.

La Greca, A.M. (1993). Social skills training with children: Where do we go from here? *Journal of Clinical Child Psychology, 22,* 1, 288-298.

La Greca, A.M. and Santogrossi, D.A. (1980). Social skills training with elementary school students: A behavioral group approach. *Journal of Consulting and Clinical Psychology, 48,* 2, 220-227.

Mc Fall, R.M. (1982). A review and reformulation of the concept of social skills. *Behavioral Assessment, 4,* 1-33.

Mize, J. and Ladd, G. W. (1990). Toward the development of successful social skills training for preschool children. In S. R. Asher, and J. D. Coie, (Eds.), *Peer Rejection in Childhood.* Cambridge: Cambridge University Press.

Oden, S. and Asher, S.R. (1977). Coaching children in social skills for friendship making. *Child Development, 48,* 495-506.

Ogden,T. (1995). *Kompetanse i kontekst. Rapport nr. 3.* (Competence in Context. Report Nr. 3). Oslo: Barnevernets Utviklingssenter. (Norwegian Institute of Child Welfare Research).

Ogden, T. (1990). Sosial kompetanseutvikling - en oppgave for skolen? (Development of social competence - a task for the school?). In T. Ogden, and R. Solheim (Eds.), *Spesialpedagogikk. Perspektiver.* (Special Education. Perspectives). Oslo: Universitetsforlaget.

Palincsar, A. S. and Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1,* 2, 117-175.

Parker, J. G. and Asher, S. R. (1987). Peer relations and later personal adjustment: Are low-accepted children at risk? *Psychological Bulletin, 102,* 357-389.

Rogoff, B. (1990). *Apprenticeship in Thinking: Cognitive Development in Social Context.* New York: Oxford University Press.

Rogoff, B., Malkin, C. and Gilbride, K. (1984). Interaction with babies as guidance in development. In B. Rogoff, and J. V. Wertsch (Eds.), *Children's Learning in the «Zone of Proximal Development».* San Francisco: Jossey-Bass Inc., Publishers

Trianes Torres, M. V., Munos Sanchez, A., Sanches Sanchez, A.M. (1995). A social competence program to prevent racism and xenophobia. Paper presented at 6th European Conference for Research on Learning and Instruction (EARLI), August 1995, University of Nijmegen.

Vygotsky, L. S. (1962). *Thought and Language.* Cambridge, Mass.: M.I.T. Press.

Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes.* Cambridge, Mass.: Harvard University Press.

Wertsch, J. V. (1984). The zone of proximal development: Some conceptual issues. In B. Rogoff, and J. V. Wertsch (Eds.), *Children's Learning in the «Zone of Proximal Development».* San Francisco: Jossey-Bass Inc., Publishers.

Wood, D., Bruner, J. S. and Ross G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry, 17,* 89-100.

Social behavior, peer relations, loneliness, and self-perceptions in adolescents

By Harald Valås and Olav Sletta

Introduction

Loneliness is a persistent problem in contemporary society. Asher, Hymel, and Renshaw (1984) found that more than 10% of children in grades three to six reported feelings of loneliness, and estimates of lonely high school students range from 8% to 16% of all students (Page, Deringer & Scanlan, 1994). According to Brage, Meredith, & Woodward (1993) few adolescents escape the pain of loneliness, and many theorists and investigators suggest that loneliness is widespread and especially intense during adolescence.

Loneliness is difficult to define. Perplau and Perlman (1982) refer to loneliness as "the psychological state that results from discrepancies between one's desire and one's actual relationships", and Ponzetti & Cate (1988) define loneliness as "a self-perceived interpersonal problem in which a person's network of relationships is either smaller or less satisfying than desired". These authors emphasize that loneliness is a subjective experience, and that some people may claim to be lonely even though their telephone rings off the wall with people seeking their company. However, the effects of subjectively felt loneliness should not be underestimated. Recent research has demonstrated that loneliness in children and adolescents is associated with several indices of social functioning and measures of self-perceptions. Withdrawn social behavior, poor peer acceptance, and few or no friendships have been identified as correlates or antecedents to loneliness (Asher, Parkhurst, Hymel & Williams, 1990; Renshaw & Brown, 1991, 1993; Bukowski, Hoza, & Boivin, 1993), and loneliness is found to

be associated with depression (depressed mood) and inversely related to self-perceptions, such as perceived social competence and self-esteem (Boivin, Hymel, & Bukowski, 1995; Brage et 1993; Sletta, Valås, Skaalvik & Søbstad, 1996).

It has often been difficult to disentangle cause and effect in these studies (Durkin, 1995). Theoretical models to guide the research are needed to better understand the etiology of loneliness in children (Asher et al., 1990; Renshaw & Brown, 1993), and to examine the mediating role of peer experiences and loneliness in predicting self-perceptions (Boivin & Hymel, 1995; Sletta et al., 1996).

The present research was designed to develop and evaluate a theoretical model, in which loneliness is posited as a mediating variable between social behavior and peer relations on the one hand, and on the other hand (based on self assessments) self-esteem, mental health, and depression. Gender differences are considered. Variables are linked together with paths that indicate concurrent predictions. The model is tested as a whole, which means that the total pattern of hypothesized relationships is examined.

Theoretical model

Our proposed model (figure 1) begins with the behavioral characteristics Withdrawal and Aggression, which are expected to have an adverse influence on peer acceptance and friendship, as suggested by existing empirical evidence and theoretical considerations (Coie, Dodge, & Kupersmidt, 1990; Rubin, Chen, & Hymel, 1993). The model includes Popularity as classmate, Popularity as friend and Reciprocal friendship. Interrelations between these variables are indicated by positive paths. Popularity as classmate and Reciprocal friendship are hypothesized to be negatively predictive of Loneliness. The distinction between group acceptance and friendship as predictors of loneliness is based on previous research (Bukowski et al., 1993, Parker & Asher, 1993).

Previous research (Renshaw & Brown, 1991; Rubin et al., 1993) indicates that withdrawal is predictive of loneliness, whereas the findings do not consistently suggest a corresponding link from aggressive behavior to loneliness. In our model the behavioral variables are indirectly linked to Loneliness, through Popularity as classmate and Popularity as friend. A distinction is made between social behavior as assessed by teachers and peers, as teachers may be less concerned with withdrawal than with aggressive behavior in the classroom, which may affect their perceptions of behavioral characteristics in students (Sletta, Søbstad, & Valås, 1995).

The mediating role of loneliness is suggested by Boivin & Hymel (1995) and demonstrated in our earlier research (Sletta et al., 1996).

Loneliness is expected to have a strong negative effect on Self-esteem (Brage et al, 1993; Sletta et al., in press). Both Depression and Mental health (which is a more general indicator of students' well-being) are hypothesized to be affected by Loneliness, both directly and indirectly, through Self-esteem. Depression is expected to be negatively related to Mental health, as indicated in the model.

Previous research has reported moderately high negative correlations between shyness (withdrawal) and self-esteem (for a review see Crozier, 1995). We hypothesize that Withdrawal affects Self-esteem indirectly, through peer relation variables and Loneliness, as indicated by indirect links in the model.

Tentatively girls are expected to express more feelings of Loneliness, lower Self-esteem, and more mental health problems than boys. (The links are negative, owing to the scoring procedure). Evidence to indicate these relationships is reported in previous research (e.g. Renshaw & Brown, 1991; Brage et al.,1993; Margalit & Ronen, 1993), but there are some inconsistencies in the findings.

Method

Sample

Participants were 153 9th grade students (aged 14 to 15 years). The sample was drawn from five middle schools, one in a Norwegian city and the others in neighbouring communities. Seven classes participated in the study.

Procedure

The students completed two sets of questionnaires in two different periods of about 40 minutes each. The instruments were administered to whole classes by a a trained research assistant. It was explained to the students how their confidentiality was to be secured. Teachers completed a behaviour rating measure for each student in their class.

Sociometric measures

Two sociometric criteria were used, classmate and friendship. The criteria were selected to obtain information about integration into the group of classmates and emotional closeness (friendship). The unlimited method of choice was applied. Negative nomination questions could not be applied, because of the ethical problems associated with negative nomination procedures. Thus peer rejection is not included as a variable in the present study.

Teacher and peer assessments of students' behavioural characteristics
Teachers rated students on five behavioural dimensions: Prosocial, humourous, aggressive, disruptive, and withdrawn. The measure consisted of 15 items, with 3 items for each behavioural dimension. It was modelled after Cassidy & Asher's (1992) four dimension teacher assessment instrument, with humour added as the fifth dimension (see Sletta et al., 1995). For each student teachers were asked to indicate on each item how characteristic the behaviour in question was, using a five-point rating scale. The scale ranged from "never" to "always". The present study focused on the two behavioral dimensions aggression and withdrawal.

On the peer assessment measure students were asked to consider their classmates on items that described the behavioral dimensions in question. For each item students were asked to indicate all the classmates for whom the description applied. Details of method and procedure are given elsewhere (Sletta et al., 1995).

Self assessments
Self-esteem was measured with a 12-item scale without reference to any particular areas. The scale is modified from the Self Description Questionnaire SD Q II (Marsh, 1990). Details are previously reported by Skaalvik, Valås & Sletta (1994). *Loneliness and social dissatisfaction.* The 24-item Loneliness and Social Dissatisfaction Questionnaire designed by Asher, Hymel, & Renshaw (1984), and subsequently revised by Asher & Wheeler (1985) for use in a school setting, was adopted and translated into Norwegian. The Norwegian adaptation was kept as close as possible to the original American instrument, to obtain comparative data. The procedures outlined by Asher et al. (1984) were followed. Scores of the responses on the primary items can range from 16 to 80, with the higher scores indicating greater feelings of loneliness and social dissatisfaction.

Depression. A measure consisting of 8 items was developed by Johansen (unpublished data). It was modelled after Kovacs' (1985) instrument, which assess affective, cognitive, motivational, and somatic symptoms of depression. The students were asked to answer each item on a three-point scale. Scoring procedures as outlined by Kovacs were followed, with higher scores indicating a higher severity of depression.

Mental health was measured with a 20-item scale developed by Skaalvik (1989). Students were instructed to indicate on a 5-point scale (ranging from very often to never) if or how often during the last two weeks they had felt unhappy, anxious, restless, or proud, enthusiastic, etc. The scoring procedure gives higher scores for positive assessment of own mental health.

Results

The correlations for all measures are shown in the table below.
The proposed model was tested by using LISREL VIII (Jöreskog & Sörbom, 1989, 1993).

Some modifications were suggested. After modifications the fit indices for the model were; χ^2 (37) = 34.37, p = .59, GFI = .96, and standardised residuals less than 1.95 (in absolute value). Thus the modified model appears to be an excellent match to the data. Standardised path coefficients and t-values are given in figure 2.

The following modifications (with comments), based on theoretical considerations, and combined with the suggestions made by the LISREL program, were made:

1. Successively *fixing to zero* the following links:

(a) Negative paths from Aggression (both measures) to Popularity as classmate and friend. (Aggression may not be linked to peer status unless measures of rejection are included).

(b) The negative path from Popularity as friend to Loneliness. (However, Reciprocal friendship and Popularity as classmate are both negatively predictive of Loneliness, as anticipated).

(c) The direct link from Gender to Mental health, (which means that this relationship is an indirect one, through Depression).

2. Two direct links were *added*:

(a) From Withrawal to Loneliness, (a path that might be anticipated,- appearing as an indirect positive link in our theoretical model).

(b) From Aggression (teacher measure) to Depression. (This positive link was not hypothesized, although our previous research (Sletta et al., 1995) indicates that teacher comments to aggressive behavior in the long run (by 8th grade) may affect students' self-assessments negatively.

All the remaining hypothesized paths in the model were found to be significant at the .05 level.

Discussion

The purpose of this study was primarily to investigate a theoretical path model in which Loneliness was posited as a mediator between social behaviour and peer relations on the one hand and Self-esteem and mental health variables on the other hand. Some modifications were made, but in general, the identified pattern of links, direct or indirect, is consistent with the proposed model. Thus the results lend support to the hypothesized mediating function of Loneliness. Asher, Hymel & Renshaw (1984) distinguish between the subjective experience of loneliness and the objective condition of number of friends or quantity of sociometric choices received. In our study Loneliness is negatively predicted both by Popularity

Table 1
Zero-order Correlations among the Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Gender	1.00										
2. Withd., peer ass.	-.04	1.00									
3. Withd. teach. ass.	-.23	.42	1.00								
4. Aggr. peer ass.	-.19	.02	-.15	1.00							
5. Aggr. teach. ass.	-.18	-.11	-.04	.49	1.00						
6. Pop. as classmate	-.02	-.36	-.38	-.01	-.00	1.00					
7. Pop. as friend	.02	-.39	-.30	-.05	-.04	.65	1.00				
8. Recipr. friendship	.05	-.24	-.24	-.08	-.08	.47	.76	1.00			
9. Loneliness	.16	.32	.29	-.09	-.03	-.42	-.39	-.36	1.00		
10.Self-esteem	-.52	-.27	-.09	.08	.09	.14	.08	.04	-.51	1.00	
11.Depr. tendencies	.23	.21	.13	.07	.14	-.14	-.14	-.17	.49	-.64	1.00
12.Mental health	-.36	-.05	.01	.13	.02	.18	.07	.06	-.40	.47	-.63

Note. Withd., peer ass.= Withdrawal, peer assessment; Withd. teach. ass. = Withdrawal, teacher assessment; Aggr. peer ass. = Aggression, peer assessment; Aggr. teach. ass. = Aggression, teacher assessment; Pop. as classmate = Popularity as classmate; Pop. as friend =Popularity as friend; Recipr. friendship = Reciprocal friendship; Depr. tendencies = Depressive tendencies.

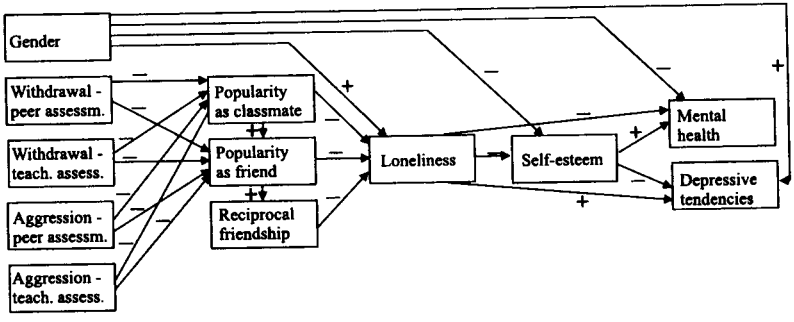

Figure 1
Theoretical model

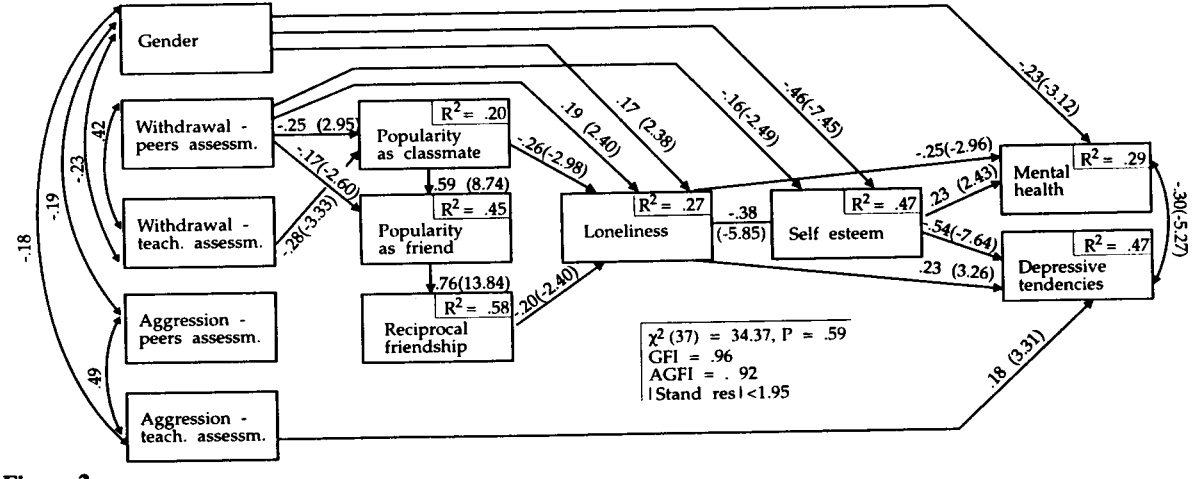

Figure 2
Empirical model

as classmante (number of classmate choices received) and Reciprocal friendship relations. Further research is needed to identify the specific contributions of low peer acceptance and lack of reciprocoal friendship relations to feelings of loneliness. Prominent within the total pattern of the model are the strong negative effects suggested by the links from Loneliness to Self-esteem and (direcly and indrectly) to Mental health and Depression. Notable is also the pattern of predictive links (direct and indirect) from Withdrawal to the peer relation variables, Loneliness, and Self-esteem, which suggests that educators should be particularly concerned with withdrawing students. It is important that teachers and classmates together find out how withdrawing students can be actively involved in formal and informal school activities. Gender differences were identified as anticipated. The links suggest that girls are more lonely, have lower Self-esteem, and perceive their own Mental health more negatively than boys. As Norwegian teachers tend to associate special problems with 14 to 15-year-old students, comments to the gender differences indicated should not be given until longitudinal data are available.

However, preliminary analyses of recently collected data from 9th grade students (Valås & Sletta, 1998) suggest a more balanced view of girls' and boys' self-perceptions. As anticipated, girls express lower self-esteem and have more worries than boys. On the other hand, compared to boys, girls perceive their own social behaviour more positively and have higher motivation for social activities. Further research is needed to examine more closely such gender differences and how self-perceptions are affected by loneliness in boys and girls.

References

Asher, S.R., Hymel, S., & Renshaw, P.D. (1984). Loneliness in children. *Child Development, 55*, 1456-1464.

Asher, S.R., Parkhurst, J.T., Hymel, S., & Williams, G.A. (1990). Peer rejection and loneliness in childhood. In S.R.Asher & J.D.Coie (Eds), *Peer Rejection in Childhood* (pp.253-273). Cambridge: Cambridge University Press.

Asher, S.R., & Wheeler, V.A. (1985). Children's loneliness: A comparison of rejected and neglected peer status. *Journal of Consulting and Clinical Psychology, 53*, 500-505.

Boivin, M. & Hymel, S. (1995) Peer experiences and social self-perceptions: A two-stage mediational model. (Draft, May 1995).

Boivin, M., Hymel, S. & Bukowski,W.M. (1995) The roles of social withdrawal, peer rejection, and victimization by peers in predicting loneliness and depressed mood in childhood. (Draft, May 1995).

Brage,D., Meredith, W., & Woodward, J. (1993) Correlates of loneliness among midwestern adolescents. *Adolescence, 28*, 685-693.

Bukowski, W.M., Hoza, B., & Boivin, M. (1993) Popularity, friendship, and emotional adjustment during early adolescence. In: Laursen, B. (Ed.) *Close friendships in adolescence*. San Francisco: Jossey-Bass Publishers (pp. 23-37).

Cassidy, J., & Asher, S.R. (1992). Loneliness and peer relations in young children. *Child Development, 63*, 350-365.

Coie,J.D., Dodge, K.A., & Kupersmidt, J.B. (1990). Peer group behavior and social status. In Asher, S.R. & Coie, J.D. (Eds) *Peer Rejection in Childhood*, pp.17-59). Cambridge: Cambridge University Press.

Crozier, W.R. (1995) Shyness and self-esteem in middle childhood. *British Journal of Educational Psychology, 65*, 85-95.

Durkin, K. (1995) *Developmental social psychology. From infancy to old age*. Cambridge, Mass.: Blackwell.

Jöreskog, K.G., & Sörbom, D. (1989). *Lisrel 7: A Guide to the Program and Applications*. Chicago: SPSS Inc.

Jöreskog, K.G., & Sörbom, D. (1993) *New features in LISREL 8*. Chicago: Scientific Software.

Kovacs, M. (1985) The children's depression inventory (CDI). *Psychopharmacology Bulletin, 21*, 995-998.

Margalit, M. & Ronen, T. (1993) Loneliness and social competence among preadolescents and adolescents with mild mental retardation. *Mental Handicap Research, 6*, 97-111.

Marsh, H.W. (1990). *SDQ II. Manual and Research Monograph.* New York: The Psychologial Corporation, Harcourt Brace Jovanovich.

Page, R.M., Deringer, N., & Scanlan, A. (1994) Childhood loneliness and isolation: Implications and strategies for childhood educators. *Child Study Journal, 24,* 107-118.

Parker, J.G., & Asher, S.R., (1993) Friendship and friendship quality in middle childhood: Links with peer group acceptance and feelings of loneliness and social dissatisfaction. *Developmental Psychology, 29,* 611-621.

Perplau, L. & Perlman, D. (1982) *Loneliness: A sourcebook of current theory, research, and therapy.* New York: Wiley.

Ponzetti, J.J. & Cate, R.M. (1988) The realtionship of personal attributes and friendship variables in predicting loneliness. *Journal of College Student Development, 29,* 292-298.

Renshaw, P.D. & Brown, P.J. (1991) Loneliness in middle childhood. *The Journal of Social Psychology, 132,* 545-547.

Renshaw, P.D. & Brown, P.J. (1993) Loneliness in middle childhood: Concurrent and longitudinal predictors. *Child Development, 64,* 1271-1284.

Rubin, K.H., Chen, X., & Hymel, S. (1993). Socioemotional characteristics of withdrawn and aggressive children. *Merril-Palmer Quarterly, 39,* 518-534.

Skaalvik, E. (1989) *Verdier, selvoppfatning og mental helse.* Trondheim: Tapir.

Skaalvik, E., Valås, H., & Sletta, O. (1994). Task involvement and self-presentation Concerns: Relations with academic achievement, academic self-concept, and self-esteem. *Scandinavian Journal of Educational Research, 38,* 231-243.

Sletta, O., Valås, H,, Skaalvik, E. & Søbstad, F. (in press). Peer relations, loneliness, and self-perceptions in school-aged children. *British Journal of Educational Psychology, 66,* 431-445.

Sletta, O., Søbstad, F & Valås, H. (1995). Humour, peer acceptance and perceived social competence in preschool and school-aged children. *British Journal of Educational Psychology, 65,* 179-175.

Valås, H. & Sletta, O. (1998). *Behavioral and relational predictors of psychological adjustment in adolescents.* Paper presented at the XVth Meetings of the International Society for the Study of Behavioural Development, Berne, July 1 to 4.

Bibliografi over Nils Søviks forfatterskap

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1959 *Ei gransking av effektiviteten i formskrift og skråskrift.* PFI. Universitetet i Oslo. (Stensilert magistergradsavhandling). (244 s.).

1960 Målet og oppgåvene for allmennskulen - eit resultat av samfunnsutviklinga? *Norsk Pedagogisk Tidsskrift,* nr. 9, 366-379.

1960 Skriveopplæringa. Ei gransking av effektiviteten i formskrift og skråskrift. *Norsk Skoleblad.* s. 1500-1542.

1961 Mål og midler i skriveundervisningen. I: T. Gabrielsen: *Veien til fremtiden.* B 1. Oslo: Norske Oppslagsverker A.S. s. 403-412.

1963 *Skrift og skriving. Ei gransking av skriftkvalitet og skrifttype-preferanse hos lærarskuleelevar.* Trondheim: Trondheim lærar-høgskule. (Stensilert). (48 s.).

1965 *Skrifttradisjon og skriftnormal.* Oslo: Universitetsforlaget. 63 s.

1966 *Folkeskolens skriveverk. Lærerhåndbok I, inkl. 3 oppgavebøker for elever.* Oslo: Brødrene Moltzau Forlag. (182 s.).

1966 *Folkeskolens skriveverk. Lærerhåndbok II, inkl. 2 oppgavebøker for elever.* Oslo: Brødrene Moltzau Forlag. (149 s.).

1966 *Folkeskolens skriveverk. Lærerhåndbok III, inkl. 1 oppgavebok for elever.* Oslo: Brødrene Moltzau Forlag. (128 s.).

1966 *Folkeskolens skriveverk. Lærerhåndbok IV, inkl. 1 oppgavebok for elever.* Oslo: Brødrene Moltzau Forlag. (139 s.).

1966 *Folkeskolens skriveverk. Lærerhåndbok V, inkl 3 oppgavebøker for elever.* Oslo: Brødrene Moltzau Forlag. (256 s.).

1968 *Skrivemodnad. Ei teoretisk orientering og ei preliminær, empirisk gransking.* Trondheim: Pedagogisk institutt. NLHT.(Stensilert). (193 s.).

1970 *Visuo-motor Coordination and Handwriting. A preliminary report of studies done with children from Madison Public Schools in 1969.* Madison - Wisconsin: Laboratory of Experimental Design and Department of Educational Psychology. (Mimeograph). (112 pages).

1971 *Skulemodnadsproblemet. Ein litteraturstudie.* Trondheim: Pedagogisk institutt, NLHT. (Stensilert). (135 s.).

1971 *Måling og evaluering av handskrift.* Innlegg (paper) lagt fram på eit forskingssymposium om «Evaluering och utbildning» ved Uppsala Universitet. (Stensilert). (14 s.).

1972 *Samanhengen mellom visuell persepsjon og lesing med spesiell orientering om gransking av effekten av visuo-perseptuelle modningsprogram i barnehage/førskule med omsyn til lesedugleik på primærsteget i grunnskulen.* Trondheim: Pedagogisk institutt, NLHT. (Stensilert prøveførelesing over sjølvvalt emne til dr. philos.graden). (27 s.).

1972 *Former for elevevaluering sett ut frå teoriar om reinforcement, informasjon og motivasjon.* Trondheim: Pedagogisk institutt, NLHT. (Stensilert prøveførelesing over oppgitt emne til dr. philos.-graden). (23 s.).

1973 Former for elevevaluering. *Norsk Pedagogisk Tidsskrift,* nr. 6. 191-203.

1973 *Læring av psykomotoriske dugleikar med særleg tanke på faget musikk.* Trondheim: Pedagogisk institutt, UNIT(Stensilert).(22 s.)

1973 *PODIN-prosjektet. Rapport nr. 1. Studiar av differensierings-problema i faget norsk på primærsteget.* Trondheim: Pedagogisk institutt, UNIT. (Stensilert). (157 s. + Appendiks 62 s.).

1973 *PODIN-prosjektet. Rapport nr. 2 a. Kasuistiske studiar av ein del tilkortkomarar i norsk på primærsteget.* Trondheim: Pedagogisk institutt, UNIT. (stensilert). (57 s. + Appendiks 17 s.)

1974 Problem ved seleksjon og organisering av lærestoff. *Norsk Pedagogisk Tidsskrift,* nr. 3. 91-106.

1974 Developmental trends of visual feedback control in copying and handwriting performances of children aged 7 through 11 years. *Perceptual and Motor Skills.* 39, 919-930.

1974 Mitt syn på pedagogikk og skuleforsking. *Norsk Pedagogisk Tidsskrift,* nr. 4. 167-170.

1975 *PODIN-prosjektet. Rapport nr. 2 b. Oppfølging av dei kasuistiske studiane av tilkortkomarane.* Trondheim: Pedagogisk institutt. UNIT. (Stensilert). (123 s.).

1975 *PODIN-prosjektet. Rapport nr. 3. Oppfølging av studiane i Rapport nr. 1.* Trondheim: Pedagogisk institutt, UNIT. (Stensilert). (280 s.).

1975 *Developmental cybernetics of handwriting and graphic behavior.* Oslo: Universitetsforlaget. (Doktorgradsavhandling). (329 s. + Appendiks 43 s.).

1975 *Sentrale psykologisk-pedagogiske teoriar.* Trondheim: Tapir Forlag. (Kompendium). 238 s.

1976 The effects of different principles of instruction in children's copying performances. *Journal of Experimental Education, 45,* 38-45.

1976 *EFIG-prosjektet. Rapport nr. 1.* Trondheim: Pedagogisk institutt, UNIT. (Stensilert). (119 s.).

1976 *EFIG-prosjektet. Rapport nr. 2.* Trondheim: Pedagogisk institutt, UNIT. (Stensilert). (188 s.).

1977 Individual instruction in Norwegian (The PODIN-project). *Scandinavian Journal of Educational Research, 21,* 197-232.

1977 *Identification and treatment of students with learning problems in Norwegian in a project of individualized instruction (The PODIN-project).* Trondheim: Pedagogisk institutt. (Stensilert). (22 s.).

1978 Søvik, N. & Lillemyr, O. Fr.: *INDUN-prosjektet. Forstudier med utprøving av metodisk opplegg for individualisering på 1. og 4. klassetrinn.* Trondheim: NAVFs Rettleiingskontor for samfunnsvitskapleg forskarutdanning, UNIT. (Stensilert). (119 s.).

1979 Some instructional parameters related to children's copying performances. *Visible Language, XIII 3,* 314-330.

1980 Dynamic vs. static model display related to children's tracing performances. *Journal of Experimental Education. 48,* 21-28.

1980 Developmental trends of visual feedback control and learning in children's tracing performances. *Journal of Experimental Education. 49,* 106-119.

1980 *The project INDUN. An experimental study of individualized learning/instruction in copying, tracking, and handwriting based on feedback theory.* Trondheim, NAVFs Rettleiingskontor for samfunnsvitskapleg forskarutdanning, UNIT. (Stensilert). (43 s.).

1980 *The project INDUN. A study of individualized instruction in reading and writing in grade 1.* Paper presented on a Nordic Research Seminar in Trondheim, June 1980. (Mimeograph). (24 s.).

1980 *The project INDUN. Individual profiles used in a study of individualized instruction in grade 1.* Paper presented on a Nordic Research Seminar in Trondheim, June 1980. (Mimeograph). (29 s.).

1981 An experimental study of individualized learning/instruction in copying, tracking, and handwriting based on feedback principles. *Perceptual and Motor Skills. 53,* 195-215.

1981 Background and motivation of doing research on individualized instruction. In: Søvik, N., Lysne, A. & Eikeland, H.-M. (eds.): *On individualized instruction.* Oslo: Universitetforlaget. pp. 9-38.

1981 Søvik, N. & Wostryck, A.: *Oppfølging av PODIN-prosjektet.* Trondheim, Pedagogisk institutt. UNIT. (Stensilert). (31 s.).

1981 Some basic questions in writing experiments: Comments on professor Kobayashi's paper. *Hiroshima Forum for Psychology. 8,* 39-41.

1982 Søvik, N., Arntzen, O. & Teulings, H. L. Interactions among overt process parameters in handwriting motion and related graphic production. *Journal of Human Movement Studies. 8,* 103-122.

1982 *Cybernetic theory and research with regard to learning/ performance of psychomotor skills, copying and handwriting in particular.* Paper presented at NATO's International Research Conference on «Acquisition of symbolic skills», University of Keele, U.K. July 5.-9. 1982. (Mimeograph). (23 s.).

1982 *Allmenn skrivemetodikk.* Oslo: J. W. Cappelens Forlag A/S. 152 s.

1982 *Skriveverk for grunnskolen. Lærerhåndbok I.* Oslo: J. W. Cappelens Forlag A/S. 38 s.

1982 *Skriveverk for grunnskolen. Lærerhåndbok II.* Oslo: J. W.Cappelens Forlag A/S. 78 s.

1982 *Skriveverk for grunnskolen. Grunnbok 1.* Oslo: J. W. Cappelens Forlag A/S. (32 s.).

1982 *Skriveverk for grunnskolen. Grunnbok 2.* Oslo: J. W. Cappelens Forlag A/S. (40 s.).

1982 *Skriveverk for grunnskolen. Grunnbok 3.* Oslo: J. W. Cappelens Forlag A/S. (40 s).

1982 *Skriveverk for grunnskolen. Grunnbok 4.* Oslo: J. W. Cappelens Forlag A/S. (48 s.).

1982 *Skriveverk for grunnskolen. Grunnbok 5.* Oslo: J. W. Cappelens Forlag A/S. (48 s.).

1982 *Skriveverk for grunnskolen. Grunnbok 6.* Oslo: J. W. Cappelens Forlag A/S. (48 s.).

1982 *Skriveverk for grunnskolen. Grunnbok 7.* Oslo: J. W. Cappelens Forlag A/S. (48 s.).

1982 *Skriveverk for grunnskolen. Kopieringsoriginaler 1-90* Oslo: J. W. Cappelens Forlag A/S. (90 s.).

1982 *Innføring i trykkskrift og løkkeskrift. Øvingshefte for lærere og lærerstudenter.* Oslo: J. W. Cappelens Forlag A/S. (48 s.).

1982 Forskarutdanning og forskarrettleiing i samfunnsvitskaplege fag. *UNIPED 3-4. 1982.* 11-25.

1982 *Individualisering i norsk. Eit oversyn over sentrale trekk og viktige resultat frå to forsøksprogram med differensie- ring i norsk etter 10 års skuleforsking i Trondheim.(PODIN- og INDUN-prosjektet).* Trondheim: Pedagogisk institutt. UNIT. (Stensilert). (39 s.).

1983 Søvik, N. & Teulings, H.L.: Real-time feedback of handwriting in a teaching program. *Acta Psychologica, 54,* 285-291.

1983 Søvik, N. & Helgetun, J.: Retting av elevarbeid. *Norsk Skoleblad* nr. 22, 22-24.

1984 Utvikling av skrivedugleik. Teoriar, forsking og pedagogiske retningsliner. I: Rønning, O. (Ed.) *Det Kongelige Norske Videnskabers Selskab Forhandlinger 1984,* s. 69-81.

1984 The effects of a remedial tracking program on writing performance of dysgraphic children. *Scandinavian Journal of Educational Research, 28,* 129-147.

1985 Søvik, N. & Thygesen, R.: *Learning disabilities in reading, spelling, and writing.* London: University of London Institute of Education. C.D.E.P. (Mimeograph). (42 pages).

1986 Søvik, N. & Flem, A.: Children with motor problems (clumsy children). *Scandinavian Journal of Educational Research, 30,* 39-53.

1986 Søvik, N., Arntzen, O. & Thygesen, R.: Effects of feedback training on «normal» and dysgraphic students. In: Kao, H.R.S., Van Galen, G. P. & Hoosain, R. (eds.) *Graphonomics: Contemporary Research in Handwriting.* Amsterdam: Elsevier science Publishers B.V. (North Holland) pp. 121-132.

1986 Søvik, N. & Arntzen, O.: A comparative study of the writing/spelling performances of «normal», dyslexic, and dysgraphic children. *European Journal of Special Needs Education, 1,* 85-101.

1986 Nokre særdrag ved nyare pedagogisk psykologi. I: Hole, N. & Søvik, N. (red.) *Rapport frå eit etterutdanningskurs i pedagogikk ved Universitetet i Trondheim, AVH, 1985.* Trondheim: Pedagogisk institutt, UNIT. (Stensilert). pp. 94-120.

1987 Learning disabilities in reading, spelling, and writing. An experimental study of interrelationships between reading, spelling, and writing skills and the prevalence of learning disabilities in this area. Rønning, O. (ed.): *Det Kongelige Norske Videnskabers Skrifter. Nr. 1.* Trondheim: Tapir. 42 pages.

1987 Søvik, N., Arntzen, O. & Thygesen, R.: Relation of spelling and writing in learning disabilities. *Perceptual and Motor Skills. 64,* 219-236.

1987 Søvik, N., Arntzen, O. & Thygesen, R.: Writing characteristics of «normal», dyslexic and dysgraphic children. *Journal of Human Movement Studies. 13,* 171-187.

1988 Handlingsinformasjon («feedback/reinforcement») i samband med læring av dugleikar. I: Gjesme, T. & Bø, O. (eds.): *Motivasjon og læring. Forskningsfunn og pedagogisk praksis.* Oslo: Universitetsforlaget. s. 107-124.

1989 Søvik, N., Flem, A. & Karlsdottir, R.: Contextual factors and writing performance of «normal» and dysgraphic children. In: Plamondon, R., Suen, C. Y. and Simner, M. L. (eds.) *Computer recognition and human production of handwriting.* Singapore: World Scientific Publishing Co. pp. 333-348.

1990 Oppgåveanalyse og lærestrategiar. I: T. Ogden & R. Solheim red.): *Spesialpedagogikk. Perspektiver.* Oslo: Universitetsforlaget. s. 234-246.

1991 Tracking techniques used in remedial teaching. In: I. Lundberg T. Høien (eds.): *Literacy in a world of change.* Center for Reading Research, Stavanger, UNESCO, pp. 166-176.

1991 Skriftforming og skriveopplæring. I: I. Austad (red.) *Mening i tekst. Teorier og metoder i grunnleggende lese- og skriveopplæring.* Cappelen: Oslo. pp. 255-275.

1991 Søvik, N. & Arntzen, O.: A developmental study of the relation between the movement patterns in lettercombinations and writing. In: Wann, J.,Wing, A. M. & Søvik, N. (eds.): *Development of graphic skills.* Academic Press: Cambridge. pp. 77-89.

1992 Søvik, N. & Arntzen, O.: Different tracking techniques in training graphic behaviour of 'normal' and dysgraphic children. *European Journal of Special Needs Education, Vol. 7,* No. 2. pp. 156-168.

1993 Development of children's writing performance: some educational implications. In: A. F. Kalverboer, B. Hopkins & R. Geuze (eds.): *Motor development in early and later childhood.* S. F. London: Cambridge. pp. 229-246.

1993 *Rapport om prosjektet «Oppgåveanalyse og lærestrategiar».* Trondheim: Pedagogisk institutt. UNIT. (mimeograph). (18 s.).

1993 Learning/instruction issues in basic skills. In: P. Kansanen (ed.): *Discussions on some educational issues IV. Research Report 21.* Helsinki: University of Helsinki. Department of Education. pp. 82-104.

1993 Søvik, N., Arntzen, O. & Samuelstuen, M.: A study of the relations between process and product variables in writing. In: G. Eigler (ed.): *Conference Volume of the SIG-meeting 'Writing'. October 30-31, 1992,* Hochschulverlag GmbH: Freiburg. pp. 29- 44.

1993 Søvik, N., Arntzen, O. & Karlsdottir, R.: Relations between speed and some other parameters in handwriting. *Journal of Human Movement Studie, 25,* 133-150.

1994 *Skriveverk. Elevbok 1.* Oslo: J. W. Cappelens Forlag A/S. (40 s.).

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1994 *Skriveverk. Elevbok 6.* Oslo: J. W. Cappelens Forlag A/S. (48 s.).

1994 *Skriveverk. Lærerveiledning.* J. W. Cappelens Forlag A/S. (112 s.).

1994 Søvik, N., Frostad, P. & Lie, A.: Can discrepancies between IQ and basic skills be explained by learning strategies? *British Journal of Educational Psychology, 64,* 389-405.

1994 Søvik, N., Arntzen, O., Samuelstuen, M. & Heggberget, M.: Relations between linguistic wordgroups and writing. In: C. Faure, P. Keuss, G. Lorette and A. Vinter (eds.) *Advances in handwriting and drawing: a multidisiplinary approach.* Paris: Europia. pp. 231-246.

1996 Søvik, N., Heggberget, M. & Samuelstuen, M.: Strategy-training related to children's text production. *British Journal of Educational Psychology, 66,* 169-180.

1996 Søvik, N., Samuelstuen, M., Svarva, K. & Lie, A.: The relationship between linguistic characteristics and reading/writing performances of Norwegian children. *Reading and Writing: An Interdisciplinary Journal. 8,* 199-216.

1997 Søvik, N. & Flem, A. (accepted for publication - in press): The effects of different tasks on children's process and product variables in writing. *Learning and Instruction.*

1997 Søvik, N., Arntzen, O. & Samuelstuen, M. (submitted for evaluation/publication): Eye-movement parameters and reading speed. A study of the oral and silent reading performances of twelve-year-old children. *Reading and Writing.*

1998 Søvik, N., Frostad, P. & Heggberget, M. (submitted for evaluation/publication): Relation between reading comprehension and task-specific strategies used in arithmetical word problems. *Scandinavian Journal of Educational Research.*

1998 Søvik, N., Samuelstuen, M. & Flem, A. (submitted for evaluation/publication): Cognitive and linguistic predictors of text comprehension. *European Journal of Psychology of Education.*

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1993 Flem, A. & Søvik, N.: Children with motor coordination problems and learning disabilities in reading, spelling, writing and arithmetic. *European Journal of Special Needs Education, Vol. 8,* No. 2 pp. 81-98.

1993 Valås, H. & Søvik, N.: Variables affecting students' intrinsic motivation for school mathematics. *Learning and Instruction, 3,* 281-298.

1995 Olsen, H. & Søvik, N.: Det Kongelige Norske Videnskabers Selskab 1990-1995. I: N. Søvik (red.): *Det Kongelige Norske Videnskabers Selskab Forhandlinger 1995.* Trondheim: Tapir. 51-61.

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1986 Hole, N. & Søvik, N. (red.): *Rapport frå eit etterutdanningskurs i pedagogikk ved Universitetet i Trondheim 1985.* Trondheim: Pedagogisk institutt. (Stensilert) (154 s.).

1991 Wann, J., Wing, A. M. & Søvik, N. (eds.): *Development of graphic skills. Research, perspectives and educational implications.* London: Academic Press. 309 pages.

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