

Heredity—Environment Influences on Early Childhood Literacy: The Example of Sweden

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Abstract

The aim of this paper is to present some results from longitudinal twin research, illustrate these results in an educational interaction model and relate research on early childhood literacy to this model. It can be maintained that in a more permissive setting pupil factors such as genes and home background will be more influential on early literacy outcome than in a more restrictive setting where educational factors such as management, organization, resources and teaching competence will reduce variation. Genetic influences are clearly evident and particularly so for children who are at risk for developing reading and writing difficulties. Phonological awareness seems to be a key factor in this process. For all children there are also interaction effect so that a home environment stimulating print awareness and book reading will protect children from school failure. Early preschool programs adjusted to each child's prerequisites and interests will also be helpful in this respect. The competence of the teacher and a progressive early training of phonological and vocabulary skills are necessary at school start to promote early literacy success in all children. Organizational and societal influences can also contribute to a structured and encouraging learning environment.

In the ideological school debate permissiveness is often considered advantageous for child development. Children should take responsibility for their own learning and, at least in Swedish schools, freedom of choice regarding book reading and free text writing prevails. This might be stimulating for gifted children but non-stimulating for children at risk. Instead it can be maintained that both a restrictive and a permissive educational environment can be stimulating as well as non-stimulating depending on the setting.

Introduction

Childhood literacy and literacy in general is dependent upon both prerequisites in *the individual and the environment* where this individual is growing up. *Individual variations* in the acquisition of literacy can of course depend upon cognitive and verbal ability as well as specific language difficulties such as articulatory and perceptual phonetic factors. In addition to this home environment plays a decisive role in the development of linguistic competence. In a home where the parents read for the child and where children's questions are encouraged and responded to in an elaborated way the chances for a successful reading and writing competence are much better than in a linguistically deprived environment. *Genetic factors* also are influential since parents with reading and writing problems often get children with the same type of difficulties. Naturally it also works the other way around so that parents who are excellent readers and writers both genetically transfer this and show their children all the joys of being part of the world of letters and books. Also in intellectually proficient families there are children at risk of developing reading and writing difficulties. The parents could be too occupied to notice the need of stimulation in their child. Resources of the school might be insufficient in areas where most of the children are expected to read and write without problems, and the child might feel different and stupid in comparison to the classmates. In addition to this there are substantial differences in *physical maturation* between boys and girls contributing to the boys having more difficulties in young ages to adapt to the traditional school system. This might increase the number of boys being referred to special education.

Migration is another circumstance that might influence childhood literacy. In Sweden we have had during the past twenty years increased the percentage of immigrants in the population to around 12%. This means that in some areas of Sweden (mostly in the larger

cities) there can be schools and classes with practically no children who have Swedish as their native language. Depending on both at which age the children came to Sweden and what their mother tongue is, they can have considerable or minor difficulties in adjusting to the Swedish school and language structure. In some areas the children get all their basic education in their mother tongue. There is a debate however considering the problems with not getting enough training in the Swedish language which will, in the long run, negatively influence these children's adjustment to the Swedish society.

Teacher education and competence concerning early literacy training is another area which has been much criticized lately in Sweden. Almost all children attend preschool and the last year before formal schooling begins when the child is 6 years of age is compulsory. Traditionally, however, preschools have refrained from literacy teaching which implies that preschool teachers have not received any knowledge of early literacy training. Some years ago teacher education generally changed towards more free choice for the students implying that they could refrain from taking courses in early reading and writing even if they were going to be teachers in the first grades of formal schooling. The debate about how to teach children to read and write (syntheticized or whole language) has also contributed to confusion and a lack of formal training in this field. We are now in Sweden going back to a more traditional teacher education with compulsory training in early childhood literacy. In addition to this a special teacher education program has been initiated with more focus on early reading and writing as well as mathematics teaching.

School organization and the neighbourhood in which the (pre)school is situated are other external factors important for early discovery and training of children at risk of developing reading and writing difficulties. The head of the (pre)school has an important role both with regard to finding resources and for distributing these to those who are most in need of support. Research also shows that the principal is the most important factor for making a school effective in relation to its goals. Which (pre)school a child attends therefore has a big influence on their to early literacy training.

Finally, which *country* and socioeconomic circumstances surround the child will be influential on their early literacy. Even in Western societies there is a variation in percentage of illiteracy in the population and since literacy, contrary to language acquisition, is dependent upon formal teaching, this will be related to the functioning of the school system in the country. The focus in this paper will be on hereditary and environmental influences on early literacy development.

More specifically the *aim* is to

- present some results from longitudinal twin research
- illustrate these results in an educational interaction model and
- relate research on early childhood literacy to this model.

Heredity—Environment influences: Examples from twin research

In a Swedish longitudinal study (the SLU-project) we followed more than 300 pairs of twins and around 1100 controls attending the same classes as the twins. The study started when they were 10 years of age in grade 3 and they were followed through school (Fischbein 1978; 1979). When the twins were in their forties we contacted them again and investigated their current life situation and how they perceived their own upbringing and school experiences (Lange & Fischbein 1992; 1996; Lange 2000). Twins are used as a method to study hereditary and environmental influences on human behaviour and development. The main research question in this project was therefore how genetic and environmental factors influence individual development in different respects. Monozygotic (MZ) twins with identical genes were compared to dizygotic (DZ) twins who have 50% of their genes in common. The twins could also be compared to their classmates who, of course, have no genetic similarity but share the classroom environment. Twin studies thus focus on the similarity within pairs and the question *why* we are different and not the magnitude of the differences.

The twins in the SLU-project grew up together and thus shared both their home and school environment. When we compared within-pair similarity (intra-pair correlations) for MZ and DZ twins as well as their controls over time we found that:

1. Genetic influences vary depending on *type of characteristic*. Verbal ability tended for instance to be more influenced by environmental stimulation than logical-abstract thinking which seemed to be more dependent on physical maturity (Fischbein 1979).
2. In a “*permissive*” environment genetic factors will be more influential than in a more “*restrictive*”. Children from higher socioeconomic strata tended to have more pressure to achieve at school compared to children from working class homes. For these children genetic and biological factors thus were more influential (Fischbein 1990).
3. In a “*stimulating*” environment the child’s dispositions will develop optimally while they are suppressed in a “*non-stimulating*” environment. In an educational situation this could for instance imply that the child is subjected to demands that are not too high or too low (Fischbein 1980).

When we contacted the twins and controls 25 years later in their forties we asked them how they perceived their own childhood and how they wanted to raise their children (Lange and Fischbein 1996). The majority of both men and women underlined the importance of emotional security, to be loved and nurtured and to have someone who listens and understands. The ability to be fair, to show respect for the child and to be able to set limits, to tell what counts and to be consistent was also appreciated by many respondents and those were mostly men. Many answers stressed the importance of showing confidence and giving freedom with a lot of responsibility. It is thus evident that both restrictiveness and stimulation are important themes in the answers from the respondents. There is also research showing that destructive home environments are characterized by *either* neglect of the child which implies too much freedom and too little stimulation *or* control and punishment with excessive

restrictiveness and lack of stimulation. Such situations are not necessarily linked to socioeconomic circumstances (Baumrind 1971; Stattin & Kerr 2000).

At the follow up it seemed that those respondents who had been rated by the teachers as more dependent and in need of special support as adults thought that they had difficulties in managing their lives, that is they were less independent. This vulnerability and helplessness thus seems to be visible early in life (Lange 2000). This might mean that some children are more dependent on external support, supervision and security and that they also are more prone to be referred to special education. One reason for this could be that the school is unable to offer a sufficiently stable and secure learning environment (Westling Allodi and Fischbein 2000).

The respondents in our sample of middle-aged twins could also be compared to an older cohort of twins (above 60 years of age) in a longitudinal project at the Karolinska Institute based on the national twin registry (the SATSA-project). In this group genetic factors were more influential regarding educational level for men than for women while there was no sex difference for the younger sample. This could be interpreted as an effect of change towards more equality in the Swedish society. When women get the same chances to choose (more permissiveness) the genetic influences increase (Fischbein et al 1997).

An interactional model

The results from the SLU-project have been used to develop an interactional model that has been particularly useful in educational settings (Fischbein 1987; Fischbein et al 1990; Fischbein and Folkander 2000; Westling Allodi 2002; Carlsson 2001; Kapborg 1995). The teacher is responsible for reaching the goals but he/she can be more or less restrictive in letting the children decide how to achieve these. Generally it can be maintained that in a more permissive setting pupil factors such as genes and home background will be more influential on outcome than in a more restrictive setting where educational factors such as management, organization, resources, teaching competence will reduce pupil variation.

Other restrictions in an educational environment at different levels can also influence what is happening in the teaching situation. These could be principals, colleagues and parents as well as the use of control instruments such as assessments and grades. Restrictions can be of different kinds. They can be *obstacles* such as poverty, deprivation or lack of special resources at (pre)school which are difficult to influence as a child. They can however also be *control* factors decided in the school system but these can often be affected by the child and targeted to those who create more turbulence in the system. Another kind of restrictions is practised by the teacher through *structuring and planning* of the educational situation.

Restrictions are however not only visible at the micro level but also at the institutional, regional and societal levels. This is illustrated in figure 1.

Model of interaction between educational influences and individual prerequisites

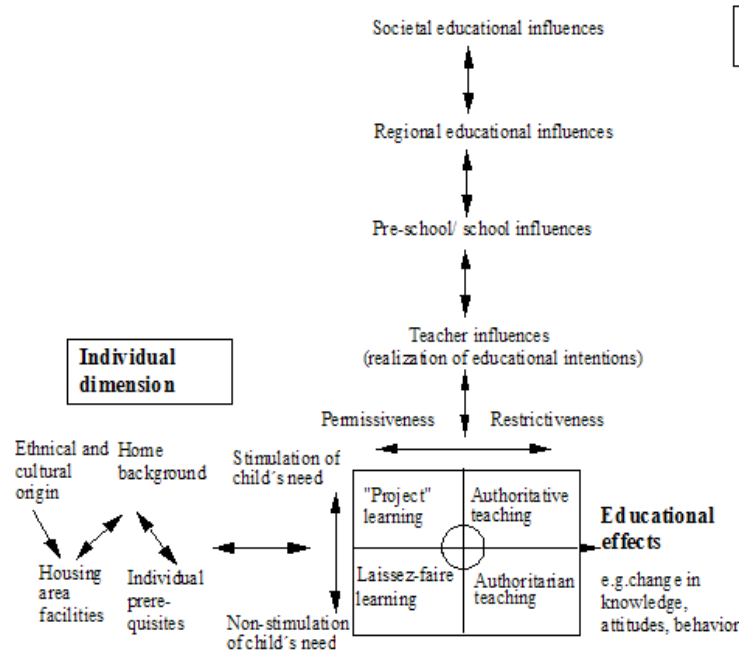


Figure 1. Model of the interaction between individual prerequisites and educational influences at different levels.

The variation between schools increased in Sweden after decentralization when the municipalities took responsibility for decisions that were earlier made by the state. In that way both economic resources and recruitment of pupils depend on geographical location. The special school for intellectually disabled children was some years ago decentralized to the municipalities and this caused the number of pupils to increase by 100% in some places while it remained the same in others. Research has also shown that special educational resources and functioning is highly dependent upon decisions made by the principal of the school. All this will influence the situation at the classroom level and affect individual children and parents. Resources for follow up and examination of children's progress in, for instance, reading and writing will also vary considerably between municipalities and (pre)schools.

At the societal level there has also been a trend towards more individual freedom. It is now allowed for independent (pre)schools to be established which has increased the number of these particularly in the big cities. Profiling of schools in varying directions is encouraged as long as they follow the national curriculum. This has increased the possibility for parents to choose a specific (pre)school for their child which in some areas tend to affect the cultural and socioeconomic variation. Children from higher socioeconomic strata tend to attend (pre)schools in the inner cities while children from working class families and with a non-Swedish background remain in the suburbs. At the societal level there has also been a

tendency for national curricula to focus on subject and social goals but leave the means to accomplish these goals for the municipalities to decide. Westling Allodi (2002) has shown that in some schools and areas there is a lot of competition and segregation and in other schools there may be more focus on caring and comfort. Effective schools tend to combine these goals (Grosin 2004).

The examples given are taken from the vertical dimension in the interaction model (fig.1) which has to do with *intentional educational influences*. This dimension interacts with the horizontal dimension characterized by *individual or pupil influences*. The children coming to an educational encounter bring their prerequisites and individual experiences into that situation. This will influence not only the children's ways of handling the situation but will also influence the teacher's actions. The home background, the area where they live and the friends they have will also have significant importance for what happens in the educational process. In addition to this, ethnic-cultural background of the children and teachers has during the past twenty years in Sweden become more decisive for the variation in achievement in different areas and schools. This will be visible in early childhood literacy.

Individual and educational factors are continuously interacting in the educational process. The children are influencing the teachers and this is a reciprocal interplay. Individual expectations and goals encounter the official goals and expectations in the educational system and the strategies of teachers to realize these. The four squares in the model are based on the results from the SLU-study and illustrate the meeting between the school system and the pupil variation during the educational process.

The *permissive and stimulating* educational situation is called "project learning" and is characterized by the teacher being non-directive and supervising trying to stimulate each child by adjusting content and methodology and being encouraging and supportive. The *permissive and non-stimulating* educational situation is characterized by "laissez-faire" where the children are free to choose but they get very little feed-back. The *restrictive and stimulating* educational situation is characterized by an "authoritative" teacher who is striving towards a specific goal but at the same time trying to stimulate each child and adjust the content and means in relation to each child's prerequisites. The *restrictive and non-stimulating* educational situation is characterized by an "authoritarian" teacher who is striving towards a specific goal and uses control and punishment as means to reach it.

In the centre a circle is illustrating the movement of teachers in this model. Depending on the content, the group of children, and how the teacher feels, teachers tend to vary and to be in different squares. As a person you can be more lenient or more firm but you will never be in only one square all the time. You can also be more lenient towards some children and more firm towards others. Early literacy training is a field where you can see, at least in Sweden, that school systems have moved towards more freedom for the children to choose their own books and less formal syntactical and grammatical training. This will, according to the model, increase the variation due to individual prerequisites and earlier experiences.

Since the SLU-study was published there has been a huge interest in applying behaviour genetic models to twin data and these models have become more and more sophisticated. Basically they divide the variation into estimates of genetic influences, shared environmental influences and non-shared environmental influences, thus they are additive models. Typically you tend to get high heritability estimates for literacy measurements such as verbal ability and perceptual speed tests (Pedersen 2002). The shared environmental influences tend to decrease with age and instead the non-shared variance is increasing. This seems plausible since twins tend to share much of their environmental experiences when they are small but tend to choose different environments when they get older (Plomin & Daniels 1987; Harris 1998; Pinker 2006). Petrill et al (2004) have investigated the effect of chaotic and low income in comparison to well-organized and effective home environments. They found that in the former type of environment genetic influences decreased and shared environmental influences increased. The authors have also criticized the additive behaviour genetic models for not taking into account the interaction between genetic and environmental influences. In a study of early reading in adoptive children their conclusion was that aspects of the family environment were associated with early literacy and that this finding could not be attributed to genetic effects. They maintain that genetic influences are overestimated in additive behaviour genetics modelling due to interaction and correlation effects. "In other words, identical twins may be more similar to fraternal twins not only because of direct effects of their genes but also because their genes might increase the probability of experiencing similar environments. Thus, the experiences related to positive reading outcomes (e.g., book reading and educational opportunities) may be increasingly associated with child-driven effects that are influenced, in part, by the child's genes associated with reading." (Petrill et al 2005, p.256). Similar conclusions could be drawn in the SLU-project. Although we could not estimate the quantitative estimate of environmental variations we could see that interaction and correlation effects were powerful as children are both affected differently by the same environment and are influencing their environments in different ways (Plomin et al 1977; Fischbein 1979; Scarr & McCartney 1983). Recently Samuelsson et al (2005) have reported from an ongoing longitudinal behavioural-genetic study of early reading development in preschool through the second grade. Several countries are participating in this investigation: Australia, Scandinavia (Norway, Sweden) and the United States. The twins were all in their final preschool year and had attended a preschool program. The programs varied however between countries in literacy related activities. Particularly the Scandinavian countries with late school start (age 7) had very little of these activities and this environmental constraint was hypothesized to show up in the variance estimates. This hypothesis was also confirmed in the sense that children in Scandinavia had lower print knowledge due to less frequent parent-child literacy activities. In all countries general verbal ability and print awareness were related to home literacy practices. Phonological awareness, verbal memory and rapid naming were more influenced by genetic factors while vocabulary, grammar/morphology and print awareness had a stronger relationship to shared environment. One conclusion from this and other studies is that "individual children in all countries who are at genetic and/or environmental risk might avoid failure in early reading development if their prereading skills were strengthened prior to formal instruction." (op.cit. p.719).

Mostly heredity-environment influences have been studied for reading and writing difficulties/dyslexia and generally specific difficulties related to weakness in phonological awareness tend to show genetic influences (Höien et al 1995; Byrne et al 2005; Pinker 2002).

In the Colorado longitudinal study twins were specifically selected for having a history of reading difficulties (Wadsworth et al 2007). Those 124 twins were compared with 154 twins with no history of reading difficulties and they were followed during a 5- to 6-year interval. Cognitive and reading assessment performances were highly stable and significant deficits remained for the sample with reading difficulties. This has also been demonstrated in other studies (Jacobson & Lundberg 2000; Svensson & Jacobson 2005; Spira et al 2005). Genetic influences are important for individual differences in the stability of reading for both groups while shared environmental influences are non-significant. Non-shared environmental influences differ for the two groups and tend to be more significant for the poor readers. This could be an indication of larger interaction effects. Twins in the Colorado study are also part of a larger cross-cultural study of reading development (Olson 2006). In all countries genetic influences on dyslexia are strong and interestingly enough hereditary influences on reading and writing seem to be even stronger in countries where the children have started school early. This could be explained by the variation in home background being more influential before school start.

Summarizing hereditary/environmental influences on early childhood literacy it can be maintained that genetic influences are clearly evident and particularly so for children who are at risk for developing reading and writing difficulties. Phonological awareness seems to be a key factor in this process. For all children there are also obvious interaction effects so that a home environment stimulating print awareness and book reading will protect children from school failure. Early preschool programs adjusted to each child's prerequisites and interests will also be helpful in this respect.

Variation in early language and literacy development

Children acquire language proficiency in communication with the environment. Language development is thus linked to both a cognitive and a socio-cultural perspective. Language learning is an adaptive process consisting of biological prerequisites to process information as well as the communication patterns and language structures that the child encounters. The child stores information and adapts to new stimuli by reorganizing and adapting. This is however a reciprocal process since the social environment also adapts to the child. When the child begins to talk, the child possesses a powerful tool that can be used in influencing the social environment. Speech starts with an increase in vocabulary which is followed by morphology and grammar in typically developing children. This process is dependent upon the social environment of the child but does not require specific training. Literacy on the other hand does not occur by itself but has to be taught in an educational process. It is therefore not self-evident that children who are orally advanced are not encountering difficulties in learning to read and write. On the other hand children who are orally advanced can show profound difficulties learning to read. This can of course be very bewildering for teachers who often assume that these abilities are highly correlated (Hill 2009). The variation

in language development is therefore dependent upon perceptual, motor and cognitive abilities relevant for language learning but also on the interplay between the child and its social and educational environment (Strömqvist 2003). In the following I will use the educational interaction model to structure some of the recent research in the area of early childhood literacy. I will start with the horizontal dimension and illustrate the importance of children's prerequisites and early stimulation in the home environment.

In a recently published Swedish thesis children from one and a half to three years were followed in a preschool environment and their literacy development was documented (Björklund 2008). The children's actions in literacy practice and participation in literacy events were video recorded with the aim of studying how they conquer and express literacy in their daily lives at preschool. A second purpose was to investigate whether children's literacy had an impact on the social and cultural context. Two different kinds of literacy appear: one is narrative stories and the other is reading and drawing/writing. The author concludes that these results contribute to a deeper understanding of small children's early literacy as something they have created in preschool as a social and cultural environment.

Educational researchers have shown most interest in children at risk of school failure but there are also some studies focussing on precocious language learners who despite their advantages drop out of school (Fischbein & Folkander 2000). Chiappe et al (2002) followed children with varying proficiency in English from kindergarten through the first grade. They found that particularly alphabetic knowledge and phonological processing were important contributors to early reading skill both for native English speakers and for those who spoke English as a second language. Although the literacy performance was higher for the native speakers it seemed that the acquisition of basic skills developed in a similar manner irrespective of language background. Several researchers have found that phonological awareness is a necessary precursor to successful reading and writing (Höien et al 1995; Casalis & Louis-Alexandre 2000). Dyslectic children seem to have specific problems with perceiving, identifying and manipulating syllables and phonemes. This will affect their ability to decode and understand written text. These difficulties are therefore not primarily environmentally induced but the language structure (more or less regular) or home background (socioeconomic or ethnic) can reinforce these problems. On the other hand a depriving childhood environment can produce similar difficulties in children originally having no language problems (Windsor et al 2007).

Children with early speech problems who are late talkers have also been followed longitudinally to investigate their language development (Mirak & Rescorla 1998). The results indicated delayed rather than deviant phonetic development in the late talkers. The severity of expressive delay showed a significant relationship to language outcome. This might at least partly be an effect of lacking social interaction. Lyytinen et al (2006) followed Finnish children from birth to school age. Half of these children had a family history of reading problems and were considered to be at risk for dyslexia. The researchers found four subgroups with differential developmental trajectories to early reading: dysfluent trajectory, declining trajectory, unexpected trajectory and typical trajectory. Children in the first

subgroup showed naming speed problems and their relative scores decrease as a function of age. Their lower performance persisted during the first two school years. Reading instruction promoted reading accuracy but not fluency. Practically all children in this group came from at risk families. The declining trajectory group decreased continuously relative to the other children and overall reading achievement across first and second grade was lowest for this group. Also in this group there was an excess of at risk children. The unexpected trajectory group had about equal numbers of children from at risk and control families. These children were relatively strong in their early language acquisition but later declined and encountered problems in beginning reading. Finally the typical trajectory group was proficient in all reading-related activities and continued to be so at school. More than one third of at risk children belonged to this group. The authors conclude that there are different routes for children who may encounter difficulties in reading. In addition to phonological awareness, naming speed and letter knowledge seem to be critical for further development.

In a methodological study by Bornstein & Haynes (1998) the focus was on different measurements that could predict later literacy development in small children (less than 2 years of age). Observations of child's speech with mother, experimenter assessments and maternal reports were compared regarding prediction of language development. All measurements correlated and predicted later outcome. This was true for both boys and girls but the latter were more precocious on all measures. Muter et al (2004) found in their longitudinal study that different linguistic factors contributed to word recognition and reading comprehension. They followed British children for two years from school start at age 4-5 and found that letter knowledge and phoneme sensitivity predicted later word recognition skills. Word recognition, vocabulary knowledge and grammatical skills were more decisive for reading comprehension. Burke et al (2009) were interested in predicting reading skills in the second grade by using an instrument called "Dynamic Indicators of Basic Early Literacy Skills" (DIBELS) in the American school system. Four subtests from this instrument were used to predict reading acquisition: Initial sound fluency, Phoneme segmentation fluency, Letter naming fluency and Nonsense word fluency. The authors conclude that all the early literacy indicators were effective in predicting literacy outcomes and that this knowledge can be used for early detection of difficulties and to improve word reading and comprehension skills. Snow et al (1998) have published an overview of several studies where a positive correlation has been found between phonological awareness during preschool age and reading proficiency in school. Stanowich (1986) has been frequently cited for illustrating the so called Matthew effect meaning that those children who have developed an early understanding of print are particularly favoured since they can train their understanding of texts instead of being occupied with decoding of words. In an international study of reading competence in grades 3 and 4 Swedish results indicated some changes from grade 3 to 4 that could not be seen in other countries (Rosén et al 2005). Low-achieving children in grade 3 improved their results more than their high-achieving peers. This is an interesting result since it is contrary to the Matthew effect and inconsistent with results in other countries. The authors speculate that this may be due to a change of teacher in grade four and a massive contribution of special educational resources. This study also showed a strong relationship

between parental education and interest in reading as well as the children's reading habits in their leisure time.

Educational influences on literacy development

If we look at educational influences both preschool and school activities have been investigated. The influence of the environment in prekindergarten in the United States and the existence of literacy activities were for example studied by Rowell (2009). There seemed to be a large variation in literacy activities and materials were sometimes old and in bad shape. Work on alphabet and phonics was often a part of daily activities which is very different from Scandinavian preschools. Reading-like or writing-like activities were however rare also in the American preschools. A more sophisticated study of preschool effects on children's literacy development was made in England (Sammons et al 2004). The researchers followed children from 141 pre-school centres in different regions. The children attending preschool were compared to a sample of children with no preschool attendance. Duration of time in preschool was found to have a significant and positive impact on children's attainments in pre-reading, early number concepts and language skills. This was especially evident for children from disadvantaged home environments. Types of activities in preschool were not registered but evidently they were more stimulating for early literacy than poor home environments. Frost (2002) has written a brief introduction to two educational traditions in teaching children to read. These have often been contrasted and based on holistic and decoding strategies respectively. The holistic method maintains that reading must be linked to speech and is part of the linguistic development, texts must be meaningful for the reader and therefore children should not have the same textbooks. The decoding method is based on the alphabetic system and the child must learn to interpret the symbols in texts. This must be learned systematically with the help of adjusted text material. Often the two methods are combined but research indicates that children at risk of developing reading and writing difficulties benefit more from a more structured decoding method. Preventing Reading Difficulties in Young Children is a report published by the American National Research Council and Carrell (1999) has given a brief overview of the recommendations for teaching early reading favoured in that document. Literacy training should begin already in preschool and preschool teachers should be aware that some children might be at risk of developing reading and writing difficulties and might need special support. Literacy stimulation for all children should include adult-child shared book reading that stimulates verbal interaction to enhance language, activities that direct children's attention to the phonological structure of spoken words and activities that highlight the relation between print and speech. In the early grades at school learning should concentrate both on the mechanics of reading and on comprehension of texts. The former strategy includes mapping the letters and the spellings of words onto the sounds and speech units that they represent. Explicit instruction is also necessary to direct children's attention to the phonological structure of oral language and to the connections between phonemes and spelling. Comprehension can be promoted through instruction that is focused on vocabulary growth and the syntax and rhetorical structures of written language. Reasoning about texts, summarizing the main idea, predicting what will follow, drawing inferences and discussing intent are all helpful strategies for that purpose. Center for the Improvement of Early Reading achievement has followed up the

recommendations given in the previous document and are reported by Stahl & Yaden (2004). They underline that research findings strongly support that “learning processes are highly complex interactions between inherited and environmental factors and are selectively affected by variations in child-rearing practices, socio-economic circumstances, family structures, adult-child interactions, educational environments, and other contextual and developmental factors” (op.cit. p.142). “Understanding written language involves knowledge of vocabulary, text structure, comprehension strategies, decoding knowledge, automatic recognition of sight words, fluency, and so on. In addition, children need to be motivated to learn to read and to continue reading” (op.cit. p.144). Teachers who were asked to point out which factors are important for children’s proficiency in reading constantly chose progress in more general language and literacy areas such as understanding texts and using complex sentence structure. They were, however, unaware of the importance of phonological awareness as a predictor of reading success (Hill 2009). This underlines the necessity of instruments capable of identifying children in risk of developing reading and writing difficulties. The authors recommend developmental models of instruction starting in preschool with children’s emergent readings and writings. At school start different teacher strategies, code-oriented and whole language inspired, were compared. It seemed that the code-oriented instruction provided children with a mechanism for self-teaching of word recognition. This was especially helpful for low-achieving children. Whole language instruction on the other hand was very stimulating for high-achieving children but at least initially this did not help to attend to the smaller language units that enable children to develop the deeper knowledge of spelling patterns that lead to self-teaching. In the developmental literacy theory proposed by Stahl & Yaden they identify four distinct phases in learning to recognize words: the prealphabetic, partial alphabetic, full alphabetic and consolidated alphabetic. In learning to spell there is a progression of development of phonological awareness and command of the alphabetic principle. Children also develop insights about written words: phonological awareness, word recognition, spelling, and morphology. Variation among the children in all these respects merits that preschool and school literacy instruction should include knowledge of child development, timely and accurate assessment and stimulating literacy as a way to relate to the world and not merely a skill to be learned. In a Consensus-project in Sweden Myrberg & Lange (2005) interviewed researchers in the literacy field concerning best practice in teaching children how to read and write. They stress the necessity of a systematic and well-organized methodology keeping track of children’s reading and writing abilities. The school work must be motivating and meaningful for the children. Written language is a way of communicating and must involve all children. A collective communication regarding texts is important to develop comprehension and strategies. Diagnostic testing should be used to inform teachers of strengths and weaknesses in individual children and adequate measures should be taken to avoid failure in the literacy process. In Germany the development of reading proficiency has shown the same trend as in Sweden with gradually declining scores in recent years. An intervention program has therefore been introduced already in preschool and an evaluation of this program has been presented (Gasteiger Klicpera 2009). Comparing an intervention and a control group there seemed to be no significant differences after the first year. In the second cohort however the intervention group tended to show better results in phonological working memory, syntax and semantics. These results are discussed and a

possible explanation might be that the preschool teachers were becoming more skilled in implementing these abilities in the children. In an article by Iaquina (2006) a research-based method called guided reading is recommended in order to improve literacy. When children read texts they are encouraged to become conscious of semantic meaning, language structure and graphophonemic systems. Important steps in guided reading are to selecting texts, introducing texts, reading the texts, discussing and revising text, enhancing processing strategies, extending the meaning of texts and working with selected words. In this way children can learn how to adapt self-sufficient strategies in reading and writing.

Missall et al (2007) used an instrument in preschool Early Literacy Individual Growth and Development Indicators (EL-IGDIs) to assess children's literacy skills and a follow-up was made in the first grade. Multiple regression models were used to analyze the relation between results on this instrument and later reading ability. It seemed particularly important to increase children's early literacy skills with respect to language, rhyming, and alliteration in order to improve later reading skills. Lundberg et al (1988) developed a training program consisting of metalinguistic games and exercises in order to stimulate preschool children to discover and attend to the phonological structure of language. The hypothesis was that this would prevent reading difficulties and give a better preparation for school start. The experimental group consisted of 235 Danish preschool children at the island of Bornholm and these children were exposed to the training program in daily sessions for 8 months and a follow-up was made of their reading and spelling in the first and second grades. A control group attending preschool in another part of Denmark was compared to the experimental group. Pre- and post-tests were given to both groups. The authors found small but significant effects on phonological awareness and that this can facilitate subsequent reading and spelling acquisition. Explicit instruction of phonemic skills in preschool thus seems to make children more conscious of the structure of language which will be an advantage at school start.

Researchers seem to be unanimous in their recommendations of combining phonically based reading instruction with phonological training for children in risk of developing reading and writing difficulties (Vellutino et al 2004). There are however some children particularly resistant towards intervention and showing persistent reading deficiency. Duff et al (2008) have evaluated a strategy designed to improve the reading of these children who have specific problems with phoneme segmentation, rapid naming and phonological decoding. The intervention consisted of both phonological and vocabulary training. The intervention group was given an assessment battery of literacy measures, phonological awareness, oral language, speed processing and behaviour ratings. The training lasted for 9 weeks and consisted of reading intervention and rich vocabulary instruction. Children made significant gains in word reading, letter-sound knowledge, phoneme awareness, grammar, expressive language and knowledge of taught vocabulary. These gains seemed to last six months later at a follow-up. The authors conclude that children with deficits in both oral language and phonological skills, using a reading with vocabulary intervention program, can improve "the foundation skills for literacy, namely phoneme awareness, vocabulary and expressive language" (op.cit. p.332).

Another way of improving early reading instruction is through integrated learning systems involving both teacher and computer instruction. One such system, aiming at training in basic print concepts, the alphabet and phonological awareness, has been evaluated by Paterson et al (2003). This was accomplished through teacher surveys, observational data, teacher interviews and reading achievement data in kindergarten and the first grade at school. An important finding was that it was not the use of an integrated learning system but primarily teaching strategies that made a difference in early reading acquisition. Teachers were categorized as high-, moderate-, or low-literacy facilitators and the high-literacy facilitators were most successful in promoting early reading. They were characterized by devoting much time to literacy instruction but divided that time between teacher-directed and student-directed activities. Teacher's intent was to communicate information about or engage children in different aspects of literacy such as reading, writing, speaking and listening. Both content and methods varied and as a result children in these classrooms talked more, wrote more, and read more than those who had moderate- or low-literacy facilitators as teachers. The conclusions of the authors are that children learn best in classrooms with a lot of time on task, the use of language for authentic purposes in a social context where the teacher in continuous interaction with the children both directed activities and invited student contributions. Finally the authors cite Garner and Gillingham (1996) who stress the importance of good teachers since "they link student interest to subject-matter learning, they view technology as a means rather than an end, and they believe that all of their students can succeed" (p. 135).

Summarizing findings from research on educational influences at the micro-level we can conclude that a systematic and progressive early training of phonological and vocabulary skills is necessary to promote early literacy especially for those children who are at risk of showing reading and writing difficulties at school start. In addition to this the role of the teacher seems particularly important since he/she is responsible for the organization of the setting, initiation of activities and stimulating learning by creating a positive social interaction.

Organizational and societal influences on early childhood literacy

We have seen that teachers matter but there are also studies demonstrating the importance of the management of (pre)schools. Differences between schools have often been explained by the recruitment of students from different areas having varying prerequisites regarding social background, ethnic/cultural circumstances and cognitive abilities. School achievement was assumed to depend upon individual factors and not the functioning of the school. There are however research demonstrating the importance of the culture or "ethos" of the school for enhancing children's well-being and achievement controlling for the influence of individual factors (Sammons et al 1997; Grosin 2004). School effectiveness is assessed by students' test results and grades. An effective school should be able to supply a sufficiently good educational environment in order to guarantee that all children should achieve the goals irrespective of genetic and social prerequisites. Characteristic for efficient schools are common values and norms ("ethos") shared by the principal, teachers and all personnel which will be demonstrated in practical actions. Effective schools tend to show visible and

democratic management involving the staff, cooperation concerning goals and content, high expectations and a positive relationship with the students irrespective of their background, stimulation of good work through encouragement and rewards, flexible instruction involving both classroom and individual teaching, explicit norms and sanctions, viewing teachers as authorities, continuous evaluation and cooperation between parents and the school. Grosin (2004) found that children prerequisites and the educational and social climate of the school were the primary explanations of effectiveness. These schools were characterized by a focus on the individual child which made the person visible and appreciated for his/her specific assets. These schools also managed to create a synthesis between achievement and social goals. To reach the former the students must feel that they are treated respectively as human beings and that there are common social rules. It could be maintained that these schools favour restrictiveness and structure but also the necessity of using stimulating activities at the individual level. Westling Allodi (2002) has shown that in schools where achievement and social goals are separated, a negative climate tends to prevail including a fear in the children of being transferred to another group and excluded from participation. These schools are characterized by competition and marginalization meaning that the children who lag behind will be transferred to “a small group” or another school where social goals are more evident, thus separating instruction and caring.

A necessary requirement for (pre)schools to function well is of course well educated and dedicated teachers. The principal has the responsibility to recruit teachers with different types of competencies but for that they are also dependent upon a well-functioning teacher education. We have seen that both preschool teachers and teachers in the first and second grades must have thorough knowledge of children’s speech and language process as well as how to prevent failures in reading and writing. In a recent Swedish thesis Swärd (2008) followed four teachers with documented skills in early literacy instruction. They all used a well-structured method developed by Maja Witting called ‘The Witting method’. The results showed that the teachers systematically strive to ensure each student’s reading and writing development through what is labelled ‘didactic arranging’. They also show an ability to adapt to situation, material and space without losing track of their long-term goals. They reflect over their students’ progression in close cooperation with their families. This way of working also entails diagnostic measures and tools that help teachers keep track of the progress of each student. Teachers, students and the didactic procedures are in constant interaction and the teachers never stop believing that every person can succeed in learning to read and write. “The Witting method” therefore seems to be based on both structured and restrictive measures as well as stimulation of the individual’s own assets and interests.

Based on data from an international reading literacy study (Progress in Reading Literacy Study, PIRLS) Myrberg (2007) investigated the influence of Swedish teacher competence on student reading achievement. Around 10000 Swedish students in the third grade from both public and independent schools participated. Decentralization of the school system in Sweden beginning in the late 1980s has resulted in a larger variation between schools in different areas. Both independent and public schools are however tax-financed and decision-making is for both school types generally delegated to local and school level. This has opened up for

parents to decide what school their children should attend and a tendency can be seen for well-educated parents to place their children in the independent school system. When Myrberg compared reading achievement for children in independent and public schools she found higher scores among the former but this difference disappeared when parent's education was controlled for. Instead teacher competence seemed to be a decisive factor in promoting children's reading. Teacher certification for teaching in the early grades had a strong effect on student's mean reading test scores in both school types. Other studies have found the same effect on student achievement (Hanushek 1986; Greenwald et al 1996). Based on a number of studies in this field Myrberg (op.cit. p. 151) maintains that "teacher competence is likely to be a mix of subject-specific knowledge and pedagogical competence where a crucial skill is the ability to use different teaching approaches adapted to individuals and groups." Lack of didactic knowledge among teachers in the lower grades tends to have a detrimental influence on children's early reading education. Teachers need to know something about the importance of phonological awareness, literacy development, suitable literature and a number of methods for teaching early childhood literacy. In Sweden teacher education during the 1990's has reduced the content related to children's literacy development and evaluated methods of teaching early reading. This had the consequences that younger teachers in the lower grades might lack relevant knowledge in this field. Instead teacher students could combine their own profiles and a common certificate has been valid for the entire compulsory school from the first to the ninth grade. This has been criticized by Myrberg & Lange (2005) who maintain that knowledge of children's early literacy development, the variation among children of the same age and didactic competence must be compulsory for all teachers in the lower grades.

Historically Sweden has a very long tradition of literacy (Johansson 1981). By 1700 a reading campaign had started with the purpose of teaching every citizen how to read the bible. This was accomplished at home where the head of the household was responsible for teaching all the members of the family how to read and this competence was controlled by the church. The ability to write was not as wide-spread as the ability to read. Heavy sanctions were introduced where adults who failed the examinations were excluded from both communion and marriage. This societal restrictiveness is not as compelling today when we have a drop-out from the upper secondary school in Sweden around 20-25%. Many of these young people lack the literacy skills necessary to be successful in a modern society. You could maintain that in this respect the Swedish school has failed to reach its goals (Fischbein & Folkander 2000). Finland also has a long tradition of general literacy among its population and originally Finland was part of the Swedish territory. In the cross-national comparisons of early reading competence Finland has the highest achievement of all the participating countries (PIRLS 2001) while the mean scores for Sweden have decreased over the past years. Analyzing the reading scores for these two countries shows no difference for the high-achievers but the low-achievers tend to be more proficient in Finland. This could be due to the longer and more traditional teacher education in the latter country.

At the societal level there are some studies relating biological factors to language structure and to phonological awareness in early childhood literacy. Finland has a transparency of

letter-sound mappings which might enhance literacy development for Finnish children. In a recent investigation (A. Reis, personal communication, paper in progress) five countries with different language transparency were compared: Finland, Hungary, Netherlands, Portugal and France. The researchers investigated the role of phonological awareness, memory, vocabulary, rapid naming and nonverbal intelligence in reading and spelling development for grade 2 children in the different countries. In all languages phonological awareness was the main factor predicting reading and spelling. This influence was however modulated by the transparency of the languages with stronger effect in less transparent languages. General nonverbal cognitive abilities seem to be of minor importance compared to specific phonological skills. These results indicate a universal theory of reading development where individual prerequisites in the children interact with language structure in different countries. Another recent study by Petersson et al (2007) demonstrates the reciprocal interaction of biological and social influences on literacy development. The researchers were interested in the cultural transmission of reading and writing skills on hemispheric lateralization and therefore used a Portuguese sample of women living in a small village where the tradition had been to keep the oldest daughter at home and sending the younger to school. It was therefore possible to include literate and illiterate women coming from the same social circumstances. Twenty-eight participants (14 illiterate) carefully matched except for formal education were included in the study. They were instructed to repeat words or word-pairs during positron emission tomography (PET) scanning. The literate group performed better on all tasks and both groups performed better on semantic than on phonological word pairs. The results also suggested that literate subjects are relatively left-lateralized compared to illiterate subjects. The authors conclude that “aspects of sublexical phonological processing appear to differentiate the two literacy groups.” (op.cit. p. 797). This is an interesting study since it has always been accepted that brain functions influence reading and spelling abilities but obviously it is also the other way around that literacy instruction influences brain functions.

Summarizing research reports relating to the organizational and societal levels it can be shown that a structured and encouraging management tends to enhance children’s early literacy development. Teacher competence seems to be an especially decisive factor and some factors, such as the importance of systematic training of early reading development and the need for individual stimulation and encouragement, are fairly universal across countries and languages. The reciprocal interaction of biological and psychological characteristics in the individual and sociocultural and physical environmental influences is also demonstrated in recent research on early childhood literacy. Maryanne Wolf (2008) has in a recent exposé outlined the history of reading in mankind and she uses the metaphor Proust and the Squid to illustrate the dependence of reading on both intellectual abilities (Proust) and connections in the brain (the Squid). This book gives you an understanding of the mystery of reading in a historical perspective.

Conclusion

Early childhood literacy development is dependent upon both hereditary and other individual prerequisites as well as influences in the home, peer group, school and society. An interactional model based on results from twin research illustrates the importance of

restrictive and stimulating factors in the environment at various levels. A permissive setting tends to increase the literacy variation depending upon heredity and home background influences. This might be detrimental for children who are at risk for developing reading and writing difficulties. In the ideological school debate permissiveness is often considered more advantageous for child development. Children should take responsibility for their own learning and freedom of choice regarding book reading and free text writing prevails. This might be more stimulating for gifted children but non-stimulating for children at risk. Instead it can be maintained that both a restrictive and permissive educational environment can be both stimulating and non-stimulating.

From the research regarding heredity-environment influences on early childhood literacy it can be concluded that genetic aspects are evident and particularly so for children at risk for developing reading and writing difficulties. Phonological awareness seems to be a key factor in this respect. Children who have difficulties combining sounds and letters need structured and encouraging reading instruction by preschool in order to protect them from school failure later on. Parents are both transferring their genes to their children and a home environment where reading and writing might be more or less encouraged. In an interesting study by Olson (2006) it could for instance be shown that genetic and environmental sources of variance influencing early reading were dependent upon the time of school start in different countries. When school begins genetic influences seem to increase indicating decreasing home environment influences. Such interactional effects are of particular importance to the understanding of the role of structured and encouraging early reading instruction. There are many studies showing that a systematic and progressive training of phonological and vocabulary skills is necessary to promote early literacy in all children.

Myrberg (2007) has also demonstrated the importance of teacher competence regarding the stimulation of children's early reading and writing development. In Sweden this used to be a compulsory part of teacher education for the lower grades. There is also a tendency to exaggerate the importance of children's experiences and being unwilling to acknowledge biological differences. In recent years however there has also been a trend towards more freedom of choice for teacher students in composing their individual courses and profiles. This can have a detrimental effect on children's early reading proficiency. At the school level there has also been a trend in Sweden towards larger variation. A contributing factor is the decentralization of the school system which gives a municipality more influence on the local school and makes it vulnerable to the socioeconomic structure of the neighbourhood where the school is situated. In addition to this parents can choose where to place their children, in the communal or in an independent school. Freedom of choice tends to increase the variation in a group of children because of the influences from heredity and home background. In the long run this will decrease equality in the societal system. Sweden has a long tradition of literacy in the total population and has been in the lead in international comparisons of reading and writing proficiency. Lately this trend has been broken and Sweden is slowly sliding downwards in these comparisons. In addition to this around 20 to 25 % of learners are dropping out of the upper secondary school without grades in all subjects. These discouraging circumstances of course have several explanations such as increasing migration and

fluctuations in the labour market but changes in the school system are also part of the explanation. Too many children in Sweden are experiencing a permissive school setting where the parents are told that their child will mature and learn to read in due time. In the meantime the differences between them and their more fortunate classmates will increase and in the end turn out to be insurmountable (Heimdahl Mattson et al, in press).

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