Catch-as-catch-can: in pursuit of ways to enhance emergent literacy skills

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The project *Ready to Learn* is designed to examine how we might improve school readiness skills for high poverty children ages 2-8. High poverty children often start with gaps in basic skills such as phonemic awareness. Longitudinal data show that disadvantaged students who begin school with poorer reading skills than their more advantaged peers fail to close the early gaps in reading at a later age in school (Davison, Seo, Davenport, Butterbaugh, & Davison, 2004). On the *No Child Left Behind* website we read that the reading problems faced by adolescents and adults are the result of problems that could have been prevented by good instruction in the early childhood years but it is our impression that many children lag behind despite of early interventions. Studies have revealed that at-risk children progress less satisfactorily than non-at-risk controls (e.g., Hindson, Byrne, Fielding-Barnsley, Newman, Shankweiler, & Hine, 2005), but so far we fail to find explanations for this. A more complete picture of how at-risk children respond to early intervention programs is needed to improve the design and delivery of appropriate interventions. The aim of a new research project that we recently started at Leiden University is therefore to test:

(1) whether responsiveness to early interventions can be taken as a sign of future prospects;

(2) why some children at-risk fail to fully benefit from early instruction of basic skills such as phoneme awareness or letter knowledge;

(3) how this problem can be tackled and the efficacy of early interventions can be raised. New incentives for research into these questions are training programs on the computer that enable researchers to chart children's responses in detail in order to test whether children profit from the intervention programs and why some children profit less than other children. The programs save a database that stores two kinds of information about the visitors: information about each child that is logged in (name, age, classroom, etc.) and, linked to that, online registration of children's behavior while they interact with the program. In this article, we describe computer programs designed by a team of educators, designers and computer experts and we outline research questions to be tested with the help of these intervention programs on the computer. We speculate about the new opportunities offered by computer programs for the very young with built-in modalities to register children's responses to the interventions. Our research will focus on kindergarten students in the bottom 30th percentile in terms of their phonemic and alphabetic skills selected for intervention at the start of kindergarten in schools serving large numbers of students at risk for reading difficulties.

The urgency of early interventions for groups at-risk

Early interventions are more likely to be successful interventions than interventions in later stages of reading development. Several groups who examined reading skills in older children found that after a few years of reading instruction, genes are the primary force in shaping familial resemblance in reading skills (e.g., Harlaar, Spinath, Dale, & Plomin, 2005; Petrill, Deater-Deckard, Thompson, DeThorne, & Schatschneider, 2006). The suggestion that the effects of genes 'amplify' later in school careers makes sense in light of an appealing theory, once formulated by Jorm and Share (1983). They assumed that, as reading skills mature, learning to read is to an increasing extent the result of a so-called self-teaching model that locates phonological recoding as a foundation for reading acquisition. According to this model, skill in translating print to sound requires knowledge of the alphabetic principle and skill in blending phonemes, and these skills allow the child to develop, over time and across many practice opportunities, efficient word recognition to support comprehension. As reading skills improve, children are able to practice reading by themselves thus enabling them to become more skilled readers. As a consequence, the environments associated with reading become more and more a function of children's reading skills. As a result the learning process becomes less easily influenced by external support. This would explain the remarkable stability in reading skills across time in primary school. For instance, Juel (1988) reported an 88% probability that a child who is a poor reader at the end of first grade will remain a poor reader at the end of fourth grade.

By contrast, in preschool age learning depends more on external input. Twin studies with younger children are important to test to what extent learning is indeed conditional upon a stimulating environment in preschool-age. Some time ago I therefore seized the opportunity to test Monozygotic (MZ) and Dizygotic (DZ) twins in order to determine the role of the environment in becoming secure in understanding phonemic awareness. Identical and same sex fraternal twins share home and preschool environment. MZ twins also share all their genes, whereas DZ twins share half their genes on average. Because MZ twins share all their genes and family environment, anything less than a perfect intraclass correlation for MZ twins shows the influence of nonshared environment including test error (e^2). There is clear evidence for genetic influences on a particular trait when MZ twins resemble each other more than DZ twins do. A simple method for estimating the level of genetic influence (h^2) is to double the difference between MZ and DZ correlations. Evidence for a strong shared-environmental influence on individual differences is obtained when the correlations for MZ and DZ twins are similarly high. Resemblance on a particular trait does not suggest genetic influences but indicates environmental influences that make twins more alike. Shared environment influences (c^2) can be estimated from the MZ correlation minus h^2.

Our study with a sample of 27 MZ and 39 DZ pairs showed that rhyming as indicator of phoneme awareness mainly depends on the environmental component. Based on previous studies we assumed that rhyming would be a better indicator for phoneme awareness in a group of four-year-olds than more complex variables such as phoneme identification (Hindson et al., 2005). To test how representative this finding was we carried out secondary analyses to test to what extent outcomes of this small-scale Dutch twin study correspond to outcomes of similar twin studies in the same age range carried out in Scandinavia, Australia and the United States. Rhyming was assessed in all three studies and therefore appropriate for a secondary analysis. The results upheld our finding that the shared environment is a main factor even though in this larger group genetic influences were significant as well. Shared environmental influences were significant and substantial, accounting for one third of the variance in rhyming when we base this on an estimate based on a secondary analysis of several studies. This result fits in with other research showing that systematic phonics instruction produces the biggest impact on growth in reading when it begins in kindergarten (e.g., Bus & Van IJzendoorn, 1999; Vadasy, Sanders, & Peyton, 2006). Taking into account that early literacy skills such as phoneme awareness do not just depend on genes but also depend on adult tutoring about literacy (Aram & Levin, 2004), we have to link lags in emergent literacy skills such as phoneme awareness to a disadvantaged environment or poor interventions.

Rates of progress in phoneme awareness as predictors of later reading

Programs presented on the computer offer better possibilities than traditional training of skills such as phoneme awareness for carefully registering how children respond to tasks and how much repetition, support, encouragement and feedback is needed before children are judged to be secure in their understanding of phoneme identity. In line with previous findings we hypothesize that children's responses to practicing phoneme awareness can add a tremendous amount of predictive power to the determination of reading ability during the early years of elementary school. We expect that children's responses to a training program predict reading skills better than tests of emergent literacy. Children who fail to profit from early interventions may not be capable of significant improvement beyond that point. Put differently, diagnostics that do not include children's ability to develop emergent literacy skills as potential predictors of improvement may be missing a vital piece of information. In this line, Byrne, Fielding-Barnsley and Ashley (2000) proposed that a general learning-rate parameter needs to be factored into accounts of reading development and reading disability, counterbalancing the tendency to analyze development largely in terms of static variables, measured on a one-time basis. Hindson et al. (2005) reported that growth rates, typically visible during attempts to foster skills such as phoneme awareness prior to school, were the best predictors of later reading independent of insights achieved. Preschool children at familial risk for reading disability were less responsive to a program promoting phoneme awareness at segment and rhyme levels than a group not at-risk in terms of both outcome level and amount of instruction required to reach that level. Furthermore, the group not at-risk was more successful at transferring their newfound phoneme awareness to the task of decoding. Hindson et al. concluded that responsiveness to early instruction can be taken as a sign of future prospects, especially responsiveness measured by the rate variable that they called progress.

Often it is relatively difficult to interpret outcomes of an intervention because we miss information about how children deal with the tasks (Pressley, Graham, & Harris, 2006). A new generation of computer programs may offer a great deal of information about how treatment participants respond to instruction. Based on a series of prototypes previously developed for the littlest ones with a build-in capacity to register children's responses while they are working with programs, we are developing increasingly sophisticated educational computer programs. We assume that those programs can go far in understanding whether an educational intervention works and why. Properly executed, such programs can provide detailed portraits of how children respond to interventions on the basis of registering mouse manipulations. We intend to stimulate early literacy by constructing programs that imitate realistic learning arrangements. In the development of such programs, including a program to stimulate phoneme awareness, educators were responsible for the pedagogical aspects of the programs and computer specialists and designers for the technology.

Features of a computer program training phoneme awareness

With the basic concept being that a program to stimulate phoneme awareness should be playful, engaging, interactive, and social (Yopp, 1995), the content was based on procedures found to be effective in daily life. The program uses realistic learning arrangements (name writing or stories) as a starting point of the learning process and makes more use of pictures, videos and sounds than traditional instruments. The computer program is related to the reading and writing behavior of young children and how adults react to such behavior. Similar to what happens in real life, the starting point is the child's own name, or other names such as mama to sensitize the child to letter-sound relations in words. *Own names* seem to play a special role in the acquisition of knowledge about writing. Because children often see their own name on chairs, coat hooks and on their work in the kindergarten and many preschoolers are very keen to learn to write their own name, they learn to write these letters first (Levin, Both, Aram, & Bus, 2005). They do not generally just learn the form of the letters but also the names of the sounds as a consequence of the reactions by adults. Parents may refer to the first letter of the name saying: "that is your letter, the */d/* from *David*.'

Recent studies indeed indicate that knowledge about the own name does have an effect on the manner in which young children write although it is not yet exactly clear what children learn from their own name. Children can name letters from their own name earlier than other letters; if they write words they make more use of the letters from their own name than other letters; they often reproduce typical characteristics of their own name in other words. If, for example, there are doubles (the *n's* in *Anna*) or other typical characteristics, these are often found in other words. There is also evidence that the letters from their own name set children on the path to phonetic writing. Children make use of letters from their own name earlier than other letters when they write words. In addition, children start to recognize the sounds of letters from their own name earlier and phonetic writing starts with the first letter of the name or with the first letter of other well-known words like Mom or Dad. The first letter of the name, whichever it is, is more than any other letter written phonetically at the very start of phonetic writing (Both-de Vries, 2006).

In line with these results, the computer program intended to stimulate phoneme awareness includes tasks fine-tuned to the name of the child, thus creating a pathway for improving school readiness for high-poverty children. Instructions are centered on the first letter of the name analogous to what often happens in daily life. Following a phase with tasks that help children to familiarize with the orthography of their own name, children do games of increasing complexity with the first letter of the name. This part of the program includes tasks that stimulate kindergarten children to practice letter sounds and to recognize letters of the name in written and spoken words as is illustrated below. The computer program consisting of 40 tasks is part of an experimental Internet site for preschoolers and kindergartners.

Example 1

Where is your name written? A child named Anneke has a choice of three strings of symbols, for instance: Anneke, 2854391, =+\⌂≠∟

Example 2

Where do you hear 'your letter' when the child's name is Anneke: apple, milk, sweet

The complexity of the tasks varied by:

- *The number of choices*; children choose the correct item from a series of two, three or five items. Bram, for instance, has a choice of: bram, jswlt, ogfq or kjito, peys, bram, juxzvc.
- *The similarity between alternatives*, assuming that alternatives that include similar letters complicate the selection process: bram, bbbb, rrrr.
- *The similarity in length*, assuming that a length similar to children's proper name complicates the selection; bram in the series bram, jsdf, ktyupdke is easier than bram in bram, jsdf, ktyu.

Attention deficits as obstacles to benefit from academic experiences

Explanations for gaps in emergent literacy are primarily searched for in chances that children have to encounter written language such as book reading (e.g., Bus, van IJzendoorn, & Pellegrini, 1995). Another obvious hypothesis is that children do not benefit from experiences with written language because preschool problems of inattention, hyperactivity, and impulsivity interfere negatively with informal experiences with written language. Spira and Fischel (2005) hypothesized that problems of inattention, hyperactivity, and impulsivity affect emergent reading skills and later reading, as a consequence of gaps in emergent reading skills. In other words, we hypothesize that difficulties with impulse control, attentional capacity, and hyperactivity hinder the ability to benefit from early academic experiences (Spira & Fischel, 2005). We therefore planned to explore which behavioral problems link to early literacy skills and how these problems create barriers to benefiting from early intervention programs on the computer.

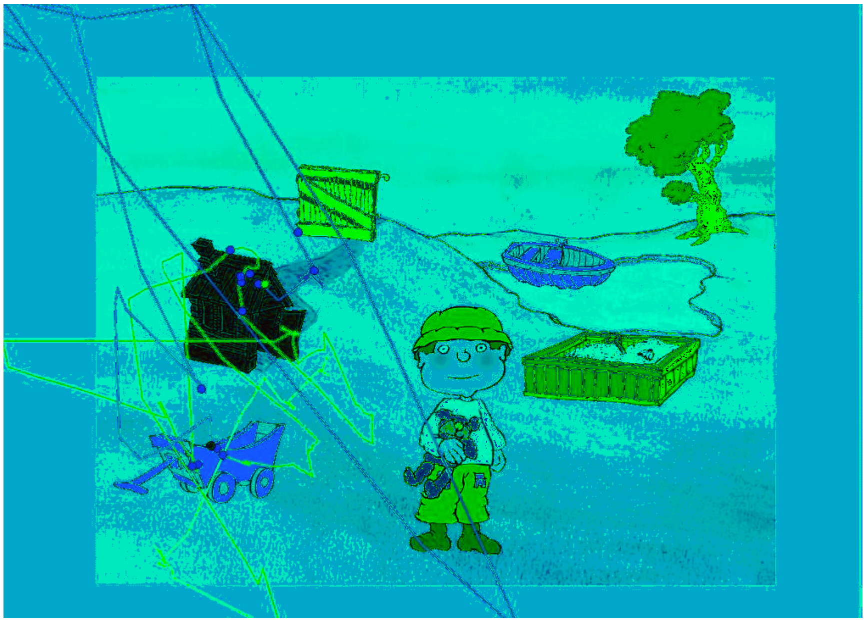
Research shows that problems with disinhibition (hyperactivity/ impulsivity) arise around 3-4 years of age when children normally become increasingly able to voluntarily direct attention to less interesting stimuli and to inhibit responses to salient but irrelevant aspects. After 3 years of age, children become more able to inhibit their behavior in response to external demands. Under 3 years of age, children are able to follow instructions to initiate a behavior but are less able to follow instructions to prevent or stop a behavior. This development is reflected in neurological changes that occur throughout the preschool years and seems essential to profit from informal experiences with written language, but an exploration of the literature hardly produced any studies that test this assumption. In contrast to the extensive research conducted on attentional problems in elementary school-aged children, few studies have been conducted on the relationship between preschool inattentive, hyperactive and impulsive behavior and emergent literacy or later learning. The paucity of research in this area is surprising, given the fact that a significant number of young children are unable to direct attention to aspects of the environment that are relevant to a task and to inhibit responses to salient but irrelevant aspects. Given that the symptoms of impulsivity are related to academic achievement and that one of the significant correlates of preschool ADHD is academic underachievement, it is critical to understand the nature of that association more fully. In so far as studies testing the link between inattention/hyperactivity and early reading are available, the results are somewhat contradictory.

Velting and Whitehurst (1997) explored the hypothesis that children with poor attentional capacities acquire fewer reading skills but failed to confirm a relationship. They did find that emergent literacy skills were strongly related to reading skills but hyperactivity was not significantly related to the development of emergent literacy. Lonigan, Bloomfield, Anthony, Bacon, Philips, and Samwel (1999) included inattention as a problem in addition to hyperactivity and concluded that attentional problems were most consistently and strongly associated with emergent literacy. Lonigan et al explained the difference between their study and that of Velting and Whitehurst with the assertion that inattention, and not hyperactivity, seems to be the strongest correlate of emergent literacy. Thus, while the literature does not decisively support emergent literacy as a mediator of the relationship between preschool behavior and later achievement, it also does not reject this model.

Do attention problems counteract positive impacts of interventions to improve emergent literacy?

We designed an experiment devoted to the methodologically rigorous testing how attentional problems counteract positive effects of early interventions and affect the number of sessions before children are judged secure in their understanding of phoneme identity. Rabiner et al. (2004) reported that tutoring in first grade had a positive effect on reading on condition that poor readers did not suffer from attentional problems. Although tutoring led to significant improvements in reading skills for poor early readers with normal attention, positive effects of tutoring were severely mitigated for children with pre-existing reading and attention problems. In the same vein, Spira and colleagues (2005) found that behavioral attributes (i.e., hyperactivity, classroom conduct) play a role in determining children's ability to improve after initial reading difficulties. They reported that children who experienced reading difficulties in first grade and who were described by their teachers as being unable to follow directions were less likely to improve from first to fourth grades. Behavioral attributes measured in kindergarten predicted differential 4th grade outcomes. Spira and Fischel (2005) hypothesized therefore that inattention may be the most salient predictor of interventions, especially when they are present early in the child's career. Traditional interventions may not sufficiently address the needs of these children. In line with the above presented results we hypothesize that attention problems may counteract the positive impact of interventions to improve emergent literacy (cf. Rabiner et al., 2004). In other words, behavioral attributes may contribute substantively to the differential outcomes of early interventions.

Computer programs that register children's responses may enable a better understanding of strategies that hamper learning from the programs thus testing these hypotheses. We may expect that impulsive children manipulate the mouse in a different way than other children: there may be more evidence of random clicking instead of strategic behavior. The programs developed so far register the mouse position every tenth of a second, which enables us to reconstruct how children proceeded while solving the task. The appended example illustrates mouse manipulations of an impulsive child characterized by a high number of high frequency clicks and by mouse movements that are longer, faster and more awkward than average scores. The stripes and dots represent a three-year-old's responses to the task to find out behind which object Sanne is hiding. Beforehand Sanne had told the child that she would hide behind something yellow. When the child manages to click on the correct object Sanne appears. The colors in this example represent the stage in which the mouse was being moved, red during the instruction, green during solving the problem or blue during feedback, resulting in a reconstruction of children's mouse manipulations during the session. The dots represent clicks. This child shows many random and uncontrolled movements: a substantial number of high frequency clicks are visible and the mouse manipulations are in comparison to scores of most other children in the same age range faster and more awkward.



The forms of help built in the program, are composed of three levels: repetition of the task, giving a cue and modeling the solution. We expect that these forms of help may respond to attention problems that interfere with learning. Some children may respond impulsively and just do something without any reflection. Repetition may be required before children are able to deal with the task. Some children may have sufficient knowledge and skills but they may not be able to transform the knowledge into an adequate strategy. These children need cues before they are able to solve the problem. Build-in efforts aimed at facilitating children's learning behavior are effective when behavioral problems disappear as the program continues.

The help function in the phoneme awareness program is offered by a friend who is attractive to children but at the same time acts with authority. Sim who is about the same age as children who play the game, asks questions and challenges the child to join in solving a problem. He looks like children's peers and motivates the child to play the game by behaving like a good friend of the child. Not Sim but his teddy bear – a non-intimidating and safe figure - provides feedback when the child has made an attempt to solve the problem. This figure, the teddy bear, plays a central role in promoting learning from attempts. Apart from a high level of cuddliness, it seems important that children have a chance to familiarize with these figures in a secure way. At the start of the program it is explained how support will be offered and how the friend will fix and direct children's attention.

Neutralizing weaknesses by using a variety of programs

We assume that the link between phoneme awareness and later reading can be moderated by other aspects of emergent literacy and that therefore a variety of educational programs is required to enable at-risk kindergarten students to attain a positive trajectory of development in critical early reading skills. Relative strengths in certain emergent literacy skills may be useful in neutralizing the effects of weaknesses in skills related to decoding. Another goal of our research program is therefore to isolate skills that may act as buffers against long-term reading failure and to aid in the construction of interventions targeting children who experience initial difficulties with reading. We hypothesize that effects of phoneme awareness on later reading skills vary with children's oral language proficiency. Some researchers have downplayed the role of oral language during the transition to school, either failing to find any unique predictive relation to first-grade reading or finding an indirect association through code skills. Their findings reveal that the direct association between oral language skills, including vocabulary and accuracy of word decoding, disappears after kindergarten but that oral language re-emerges to significantly predict reading comprehension in third to fourth grade (Storch & Whitehurst, 2002). In contrast, other researchers have found evidence that oral language skills play a crucial role in reading acquisition independent of phonological skills. For instance, Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, and Poe (2003) reported that vocabulary played a role in early reading competence even when phonological sensitivity was controlled. In line with these findings an NICHD study (2005) showed that 54-month comprehensive oral language competence (though not vocabulary) relates both indirectly and directly to first-grade word recognition. In collaboration with our Zambian colleague Tambulukani we found additional support for models that stress the important role of oral language skills in early reading. Especially in African countries there are extreme differences in children's familiarity with the language in which reading is taught resulting in an interesting natural experiment.

In recent years Zambian schools teach beginning reading skills preferably in the children's first language whereupon in second grade a switch is made to English, the common language. Because some parts of the country are inhabited by families with various language backgrounds, this policy is not always (or mostly not) successful. Testing children from three different provinces it appeared that most pupils (76% of the children) were taught in their first language but only in Mongu province. However in

Lusaka and Chipata only a small minority of 5% was familiar with the Zambian language in which reading was being taught in the schools despite of the policy teaching all children in the Zambian language with which they are most familiar. In each province, four schools were sampled and in each school, twenty children were tested:10 high achievers and 10 low achievers based on the literacy course assessment and grouping by the class teacher. In addition to information provided by the teacher, the children's ability to name objects in a picture in a Zambian language over a 5-minute period was used as a proxy for their verbal skills in the language of teaching. The teachers' classification matched well with the test results: When teachers reported that the language of instruction was the children's first language, children preferred that language when they were asked to name objects in a picture. Whereas children with another first language preferred another Zambian language when they named objects. A series of tests at the start of second grade revealed that high achievers who, contrary to the low achievers, could recognize some words were more proficient in word recognition when the language of teaching was their first language. The two groups (the language of teaching is the first language versus second/third language) differed in word recognition but not in phoneme awareness or letter knowledge. In other words, familiarity with the language plays an important role in developing word recognition but does not affect basic skills such as letter knowledge or phoneme awareness. According to an ANOVA, familiarity with language explains about 25% of word recognition skills suggesting that oral language plays a crucial role in the growth of decoding skills. Yet language proficiency seems important as a basic skill that enables children to become proficient in word recognition and not just because language has an impact on comprehension skills or makes communication to teachers possible.

We expect therefore that children who do not benefit much from training in phoneme awareness but who do benefit from training in narrative comprehension are less vulnerable to the consequences of a gap in phoneme awareness. Poor decoding skills can be compensated by using strengths in oral language skills to decode more on the basis of context (Spira et al., 2005), thus neutralizing an insecure understanding of phoneme awareness. A recent study by Spira et al. (2005) suggested that children who close the gap compensate for weak decoding skills by using strengths in oral language to decode on the basis of context. The children in this study were all deficient in decoding skills in first grade. However, those children who improved by fourth grade possessed stronger oral language skills in kindergarten than children who did not improve by fourth grade. In line with this result, recent research by Shaywitz et al. (2003) showed that poor early readers who catch up later on in life rely on general cognitive and language ability to compensate for weak decoding skills. Elaborating on these findings, we expect better results from early interventions when narrative comprehension is practiced in addition to phoneme awareness. To test this hypothesis, a portion of the experimental children do a computer program focused on phoneme awareness spread out over a 20-week period whereas other children in the same period do another program focused on narrative comprehension in addition to the program training phoneme awareness.

Multimedia stories on the computer

Another set of computer programs is therefore designed to promote vocabulary development and other advantages known to accrue from storybook encounters. Our Internet site with educational programs for the very young also includes multimedia stories on the computer. These stories not only include an oral reading of the story (Reinking, Labbo, & McKenna, 1997) but also other formal features that can independently define content. They are techniques that can, in principle, be used to present many types of messages, program themes, and story plots (Wright & Huston, 1983). Visual features include cuts, pans, dissolves, and special effects; auditory features include music, sound effects, dialogue, and laughter tracks; and more holistic characteristics are pacing (rates of scene and character change), physical movement (action), and variation. In our current studies we excluded multimedia stories with engaging but largely peripheral animations and other effects that may encourage children to think of the story as a game because such incongruity may interfere with their comprehension of the story (cf. de Jong & Bus, 2002, 2004; and make children more passive viewers.

From previous studies it was apparent that children's narrative comprehension improves as an effect of these programs (e.g., Verhallen, Bus, & de Jong, 2006). The five-year-old participants in the The Hague study profited to some extent from repeated encounters with a storybook with static pictures but more from repeated encounters with the animated version of the same storybook. A unique result of this study is that the new processing tools have advantages that extend beyond static pictures, which only give a selective indication of story events, and that seem to compensate for a high percentage of unknown words. As an effect of using multimedia, retellings mainly jumping from one action to the next without explaining the connections between actions were replaced by more coherent retellings actually explaining the transitions between actions. Moreover, children learned about seven new words in the multimedia situation (12-14% of words we suspected children would not know), twice as many as the average number they learned with static pictures (three or four new words). Note that in this study two versions of the same book, *Winnie the Witch*, were presented on the computer; however, one version included static images and the other included multimedia additions (e.g., cinematic techniques such as zooms, pans, cuts, film, sound effects). The main character in this story – a witch – has a problem: because her house and everything in it is black, including the cat, she often stumbles over the cat. The multimedia version often adds to the static version, for instance by zooming in on the facial expressions of the witch and thereby emphasizing her emotional responses to events.

Currently we are constructing programs that also include the hallmark of structured, interactive book reading, namely a dialogue between adult and child in which the child is questioned about the story and encouraged to relate to his or her experience. A new series of award-winning picture storybooks by well-known authors is being completed with dynamic, cinematic effects and sounds. After each story fragment the computer prompts a factual question (“Where do you see paving stones?”) or an inferential question (“Will the butterfly be happy with the egg cosy?”), which the child answers by selecting one of three spots on the screen (cf. Storch & Whitehurst, 2002). We are searching for appropriate forms of help and feedback as incentives for learning. In the version that is in the making, a friend – an appealing figure with some odd features like wings and a propeller - comes forward, looks at the child from the screen and asks a question: “Do you think that Tim’s dad will be angry?” When the child does not succeed in answering the question by choosing from the three alternatives on the screen, the friend’s teddy bear hastens to help, first by just repeating the question, and, when the child fails again, by presenting a clue to find the correct solution (“Do you remember what his dad said?”). The program discourages random clicking (“Maybe you did not listen very well”) or passive behavior (when there is no response for some time, the computer says, “Have a go”) and adapts the level of difficulty of the questions to prior reactions.

Towards an Internet site with educational programs for at-risk preschoolers and kindergarten students

The implications of the emergent literacy model for social and educational policy are that reading achievement in children can be enhanced substantially by investing resources such as experiences with names and stories and that it is too late to wait until children begin formal reading instruction to help those who are at risk of reading delays. The beginning of each school year – including kindergarten – is not a completely fresh start for students. Rather, it is the beginning of the next leg in a journey that begins in the preschool years.

Very often we consider practices of mainstream-culture families such as parent-child book reading as being the best way to prepare the child for mainstream classroom practices. Emergent literacy research is biased towards practices of traditional forms of instruction to best prepare the child for classroom practices. We hypothesize that the number of relevant experiences might be broader. Computer programs and other new media can play a significant role in the process of becoming literate. A new generation of interactive and adaptive computer programs shows great promise for the teaching of young children. Even though there is no established tradition of using computer programs in early education we have the impression that the tide is turning now that operating a computers has become easier and to an increasing degree evidence-based Internet programming is available. Furthermore, computer programs substitute for supplemental reading interventions that are difficult to provide (major obstacles include funding and scheduling).

The hypothesis that narrative comprehension may neutralize gaps in phoneme awareness would have implications for Internet sites with educational functions for the very young. A teaching emphasis on phoneme awareness and phonics should not be at the expense of vocabulary enrichment and narrative understanding (Ouellette, 2006). From the research so far there is evidence that a variety of programs including book-based programs in addition to programs focused on phoneme awareness seem to be more promising than interventions limited to phoneme awareness and alphabetic activities.

We outlined a study that tests the usefulness of other information sources provided by computer programs such as registering the time children need to complete a program and their responses while completing the tasks. Programs on the computer may thus provide information that strengthens the diagnostics of early reading problems and that helps educators to plan future reading instruction. Referring to previous studies we argued that responsiveness to early experiences with written language can probably be taken as a better sign of future prospects than standardized tests of variables that are linked to early reading. Registration built into computer programs can provide exact data that reflect children's responsiveness to programs and why some children go astray. Mouse manipulations may be indicators of children's reflexivity or attention while interacting with programs. In other words we thus test why some children fail to create meaning from experiences with words and letters and stories. Responses to help and support might provide clues about how to tackle such problems.

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