Emergent Literacy in Children with Cerebral Palsy

Marieke Peeters

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Dit proefschrift draag ik op aan opa, Mathieu Hendrickx

Contents

Voorwoord

Heerlijk, mijn proefschrift is klaar en het enige wat nog hoeft te gebeuren is het schrijven van het voorwoord.

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Introduction

Chapter 1

In the current society, being literate is a critical skill in life, as an individual's opportunity for academic success, career development and personal fulfillment increases with the acquisition of literacy. Besides, literacy skills facilitate access to technological tools such as Internet and e-mail, and therefore the communication with others. Previous studies have shown that children with cerebral palsy (CP) with additional impairments such as speech and intellectual impairments have a hard time acquiring literacy skills. Especially for these children with additional speech impairments that limit their communication opportunities with others, being literate and participating in society is of enormous importance. According to Smith (2005, p.2) "unlocking the literacy code opens up tremendous opportunities, minimizing the disabling effects of underlying speech and motor impairments and supporting participation in society". For example, literacy skills can enhance face-to-face communication for individuals with severe speech impairments and provide more control over augmentative and alternative communication (AAC) devices for communication with others. However, although studies have shown that children with CP with additional impairments such as speech and intellectual impairments have difficulties acquiring literacy skills, little is known about how these children acquire literacy skills and what role additional impairments play in this process. Even less is known about the environment in which children with CP acquire literacy skills.

The present thesis focuses on the emergent literacy development of children with CP. This introduction chapter starts by describing the emergent literacy development of non-disabled children. In addition, a description of the characteristics of children with CP is provided, followed by a description of the International Classification of Function, Health, and Disability Children and Youth model (ICF-CY) that provides a scientific basis for studying the emergent literacy of children with CP. This chapter ends with the results of previous studies of the emergent literacy development of children with CP, and finally an explanation of the present thesis will be given.

Emergent Literacy

The emergent literacy theory states that literacy learning is not an all-or-nothing phenomenon that starts when children begin to receive formal reading and writing instruction. In contrast, emergent literacy is seen from a developmental perspective of literacy, in which literacy learning starts at a very young age, even during the first years of a child's life. From this age, emergent literacy skills develop concurrently and interrelatedly, rather than sequentially (Teale & Sulzby, 1986), and are crucial for later conventional forms of literacy learning (Gunn, Simmons, & Kameenui, 1998; Lonigan, Burgess, & Anthony, 2000). According to Whitehurst and Lonigan (1998, p. 849) "emergent literacy consists of the skills, knowledge, and attitudes that are presumed to be developmental precursors to conventional forms of reading and writing and the environments that support these developments". The environments in which literacy learning takes place are important for emergent literacy skills, as research has shown that both reading and writing develop most readily in meaningful contexts, that is, contexts in which meaningful interaction with oral and written language is promoted (Gunn et al., 1998; Sulzby & Teale, 1991). The emergent literacy skills and environments in which literacy learning takes place will be further explained.

Emergent Literacy Skills

Literacy skills can be subdivided into letter knowledge, phonological awareness, comprehension of text structuring, relationship of print to speech, and awareness of print (van Kleeck, 1990). Of all these areas of literacy skills, phonological awareness is considered to be one of the most important precursors of later word-decoding abilities in children without disabilities (Adams, 1990; Wagner & Torgesen, 1987). According to Adams (1990) and Stanovich (1992), phonological awareness can be seen as a hierarchy of phonological complexity. Children become aware of syllables and intrasyllabic units (i.e., onset-rime) prior to phonemes (Adams, 1990; Christensen, 1997; Lonigan, Burgess, & Anthony, 2000). This implies that rhyme, which indicates onset-rime awareness, is one of the first phonological abilities to emerge. Given the established importance of phonological awareness for later reading development, researchers have explored the origin of its development in normally developing children. As a result, general intelligence and language abilities such as speech perception, articulation accuracy, vocabulary, and auditory short-term memory (STM) have been identified as foundations that facilitate the development of phonological awareness (McBride-Chang, 1995; Storch & Whitehurst, 2002; Webster & Plante, 1995).

Emergent Literacy Environments

One environment in which literacy learning takes place at already a very young age is the home literacy environment (HLE). The HLE is considered a setting in which language and literacy are typically encountered first, and consists of the literacy experiences, the literacy support, and the opportunities the child encounters for verbal interactions (Snow, Burns & Griffin, 2001). For example, in supporting HLEs children gain experiences with books by observing parents reading or by shared book reading sessions. According to previous studies, the HLE can be seen as a multifaceted construct consisting of various interrelated aspects that are differentially associated with reading precursors and reading development (Bus, van IJzendoorn, & Pellegrini, 1995; Leseman & de Jong, 1998). Earlier studies have shown that aspects of the HLE are related to reading precursors and reading skills. For instance, exposure to storybook reading is related to oral language skills, such as vocabulary and syntactic skills (Payne, Whitehurst, & Angell, 1994; Sénéchal, LeFevre, Thomas, & Daley, 1998; Whitehurst & Lonigan, 1998), while the opportunities for verbal interaction and the active participation of the child during storybook reading are related to phonological awareness (Burgess, 1997), and vocabulary (Sénéchal, Thomas, & Monker, 1995). Parent teaching activities about rhymes and phonemes have also been shown to be related to phonological awareness (Foy & Mann, 2003). In addition, parent teaching activities about letters and words, a child's literacy interest, and parents' own literacy habits such as their own reading and writing habits are related to the child's letter knowledge and word decoding skills (Frijters, Barron, & Brunello, 2000; Haney & Hill, 2004; Sénéchal et al., 1998; Sénéchal & LeFevre, 2001). Furthermore, parents' literacy expectations are supposed to influence the literacy skills of the child, as the expectations are considered to lead to different literacy opportunities. For example, parents who hold high literacy expectations for their child are believed to provide their child with more opportunities to learn (Light & McNaughton, 1993).

A second environment in which children acquire experiences with literacy is the educational environment. Even before the start of formal reading and writing instruction, through different activities such as shared storybook reading, book-reading corners, riddles and rhymes, children learn about the functions of written language and acquire skills of emergent literacy, such as: print awareness, oral language skills, and phonological awareness. In addition, the teacher expectations of the children's literacy development are also considered an important component of literacy learning in the educational environment, because these expectations will influence the opportunities for literacy learning that they provide the children with (Light & McNaughton, 1993).

As stated above, skills of emergent literacy and early experiences with literacy are important for conventional literacy learning. Bearing in mind the fact that literacy can be seen as a valuable tool for achieving cultural and social power, and for making effective use of AAC-devices, the development of literacy is especially important for children who are vulnerable for limited literacy learning, such as children with cerebral palsy. The literacy development of children with CP with severe speech and physical impairments is considered both quantitatively and qualitatively different from that of children without impairments (Koppenhaver, Coleman, Kalman, & Yoder, 1991), as the process of literacy learning is often complicated by their additional impairments, such as speech and intellectual impairments.
In the next section, a description of characteristics of children with CP and the ICF-CY model that functions as a framework for studying these children is given.

Emergent Literacy in Children with Cerebral Palsy

In this section, characteristics of children with CP will be described, followed by an explanation of the ICF-CY model, which will be used as a methodological framework for the study of emergent literacy of children with CP. After that, previous studies about the emergent literacy skills and environments of children with CP will be described.

Children with Cerebral Palsy

According to Bax et al. (2005, p. 572), CP can be described as “a group of disorders of the development of movement and posture, causing activity limitation that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of CP are often accompanied by disturbances of sensation, cognition, communication, perception, and/ or behaviour, and/or by seizure disorders”. The incidence of CP in the Netherlands is 1.51 per 1000 live births (Wichers, van der Schouw, Moons, Stam & van Nieuwenhuizen, 2001). Classification of CP is based on type, location or topography, and the level of motor impairments (Schenker, Coster, & Paush, 2005). There are three different types of CP, based on the predominant neuromotor abnormality: spastic (persistent increased muscle tone in one or more limbs), dyskinesia (involuntary movement and paroxysmal muscle tone change, with dyskinetic further differentiated into dystonia and choreo-athetosis), and ataxia (primary disorder of coordination) (Bax et al., 2005; Nelson & Grether, 1999; Wichers, Odding, Stam, & van Nieuwenhuizen, 2005). Spastic features occur in most of the cases (about 80% or more) (Krigger, 2006), followed by the dyskinetic and ataxic type (Surveillance of Cerebral Palsy in Europe, 2000). Subtypes of spastic CP are described according to the localization unilateral or bilateral. Unilateral CP refers to hemiplegia, which can be right or left side. Bilateral CP can be subdivided into diplegia (legs more affected than arms) and quadriplegia or tetraplegia (both arms and legs equally affected). Classification of motor disorders shows that bilateral spastic CP is the most occurring subtype (Johnson, 2002). Further subdivision than the unilateral and bilateral spastic types of CP is considered unreliable (Evidence Based Richtlijn Onderzoek, 2006).

Various combinations of place, type and severity can occur (Mecham, 2000). Severity can vary from mild, moderate, severe to profound. Classification of severity is based on clinical judgment in rehabilitation settings. A commonly used instrument to indicate the severity of gross motor function is the GFMCS (Palisano et al., 2000). As stated before, CP is often characterized by additional impairments, such sensory and hearing problems and seizures. In addition, children with CP often have dysarthria, a speech production problem that may be a direct result of the motor impairment (Pirila et al., 2007). Kent (2000, p.399) described dysarthrias as “speech disorders that result from neurologic impairments associated with weakness, slowness, or incoordination of the musculature used to produce speech”. In addition, the disturbed neuromuscular control of the speech mechanisms may in a minority of the children result in such severe speech impairments that these children are unable to speech, and are therefore called non-speaking children. In order to communicate these children use some sort of AAC (e.g., Bliss symbols, picture communication board, voice output devices, and signs). According to Hetzroni (2004) AAC can be seen as the supplementation of natural speech by using aided and/or unaided symbols and the related means of selection and transmission of such symbols. Symbols can be graphic symbols, sign language, pictures or objects.

The neurological damage that causes speech impairments often also results to some degree in lower intellectual abilities (cf. Bishop, 1988; Dormans & Pellegrino 1998; Koppenhaver & Yoder, 1992; Mirenda & Mathy-Laikko, 1989). Dormans and Pellegrino (1998) state that the prevalence of mental retardation is approximately 50%, with 25-30% of the children with CP having lower IQ scores than normally developing children, while Koppenhaver and Yoder (1992) report that approximately 60% to 70% of children with CP demonstrate some degree of cognitive impairment. The speech production and intellectual impairments that often accompany CP may have far-reaching consequences for the language and literacy development of these children. Previous studies of children with CP with additional speech impairments reveal language problems and a low incidence of literacy in this population (Berninger & Gans, 1986; Browning, 2002; Card & Dodd, 2006; Koppenhaver & Yoder, 1992; Koppenhaver, Evans, & Yoder, 1991; Smith, 1989).

The ICF-CY Model

In 1980, the WHO published the International Classification of Impairments, Disabilities and Handicaps (ICIDH) model (World Health Organization, 1980) that focused on the consequences of disease. Recently, a model has been developed, the International Classification of Function, Health, and Disability (ICF) model, which focuses on components of health rather than on the consequences of disease (Rosenbaum & Stewart, 2004), by looking at the interactive relationship between health conditions and contextual factors (see Figure 1). The ICF model can be used as a framework that produces reliable and comparable data on the health of individuals and populations. In addition, the model can be used to establish a common language for describing health and health-related states, and can be applied as a classification system, as it provides a systematic coding scheme for health information systems. In this model, disability is no longer seen as something that refers to the person, but is now an umbrella term that represents the dynamic interaction between the person and his or her environment (Lollar & Simeonsson, 2005; Rosenbaum & Stewart, 2004). In addition, participation is now seen as an important dimension of health. Two contextual dimensions that may influence the health status of the person, namely environmental factors (e.g., family environment, school environment) and personal factors (e.g., age, interest), have been added to the new model. The bi-directional arrows indicate the interactions between the dimensions, and it is now formally recognized that any aspect of function can affect others in a non-linear manner.

Recently, an extension of the ICF model has been developed that is especially adapted to children and youth, the ICF-CY model (WHO, 2007). Different subjects that are especially applicable to the development and growth of children, such as playing, cognition and language, behavior and the behavior of the developing child, have leaded to an adaptation and extension of the model. Special attention has been paid to the following four themes: the child within the family (i.e., interactions within the family), delay in development, participation, and environment. A difference with the ICF model is that the activity and participation dimensions are clustered. In addition, the dimensions environmental factors and personal factors are now clustered and are called external factors (Nederlands WHO-FIC Collaborating Centre, 2008; WHO, 2007)

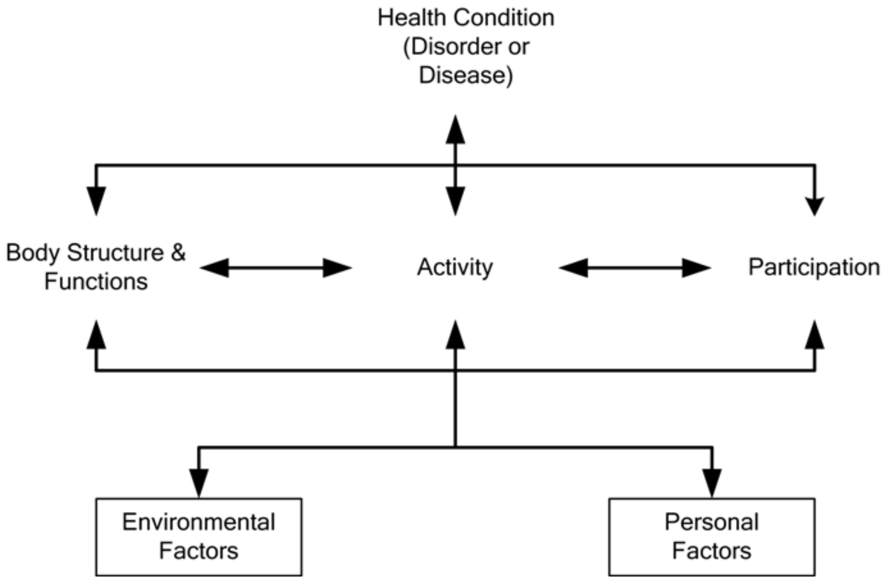

Figure 1

Interactions between Components of ICF (WHO, 2001)[1]

The ICF-CY model has consequences for studying children with CP, as Rosenbaum and Stewart (2004, p.9) stated that "studies of children and youth with CP should include dimensions of activity, participation as well as environmental factors, to capture the complex interactional nature of the life experiences of these children and their families". Translated to the present thesis this means that, when investigating the emergent literacy development of children with CP, it is important to look not only at additional impairments within the individual that can limit literacy learning, such as speech and intellectual impairments, but also at the environments in which literacy learning takes place

[1] Definitions of key terms of the ICF model (WHO, 2001)
Body functions: The physiological functions of the body system (including psychological functions).
Body structures: Anatomical parts of the body, such as organs, limbs and their components.
Impairments: Problems in body function or structure as a significant deviation or loss.
Activity: Execution of a task or action by an individual.
Participation: Involvement in a life situation.
Environmental factors: The physical, social, and attitudinal environment in which people live and conduct their lives.
Personal factors: The particular background of an individual's life and living composed of features of the individual that are not part of a health condition or health status.

and what impact these environments have on the literacy learning process of the children (Browning, 2002; Smith, 2001). In the next section, previous studies on the emergent literacy development and the home and educational environment of children with CP will be discussed.

Emergent Literacy Skills

In studying the emergent literacy skills of children with CP, it is important to uncover what role additional speech and intellectual impairments play in the development of emergent literacy skills, such as for example in the development of phonological awareness and ultimately reading development. Results of studies on phonological awareness by children who use AAC are conflicting. Dahlgren Sandberg (2001) conducted a longitudinal study on the reading and spelling abilities of seven school-aged children with severe speech impairments and normal intelligence (Dahlgren Sandberg, 2001). She found that the children in both groups performed almost equally well on the phonological awareness measures. These results matched earlier studies, in which non-vocal cerebral palsied children and non-disabled preschool children performed comparable on tests of phonological awareness (Dahlgren Sandberg & Hjelmquist, 1996b). In contrast, Vandervelden and Siegel (1999) found that children who used AAC scored significantly lower than speaking students on a variety of tasks used to assess phonological recoding and phoneme awareness. In a study of Dahlgren Sandberg and Hjelmquist (1996a, 1996b) they argued that it should be possible for non-speaking children to achieve awareness of the sound structure of words, but that the difficulties to be encountered deal with phoneme-grapheme correspondences. These studies show that the role of speech impairments for phonological awareness is not inconclusive.

With regard to reading development, the role of phonological awareness as the strongest reading precursor for children with CP with speech impairments is debated.
Despite equal performance on phonological awareness tests, non-speaking children with CP scored lower on reading and writing skills than speaking children with CP (Dahlgren Sandberg & Hjelmquist, 1996a, 1996b, 1997). In a longitudinal study on non-speaking children with CP, Dahlgren Sandberg (2001, 2006) further showed that these children had difficulties acquiring literacy skills, although their intellectual level and phonological abilities predicted otherwise. These results question the predictive value of phonological awareness for the early reading development of non-speaking children with CP. As explanation for these unexpected low reading scores, Dahlgren Sandberg (2002) suggested that the non-speaking children may have had problems with subvocal or covert rehearsal of phonological information, which is necessary for the more complex phonological tasks, such as reading and writing tasks. These studies seem to indicate that speech impairments may hinder the

development of reading skills, although it is not yet clear in what way. In conclusion, the role of speech production in the early stages of the reading development of children with CP is not clear. Although some studies indicate a major role of speech production for the emergence of phonological awareness as well as early reading skills, these studies are not convincing. At the moment, it is still unclear whether phonological awareness is the most important predictor of reading skills in children with CP or whether speech production and/or intellectual skills also play a dominant role in reading development.

Previous studies have limitations. To begin with, longitudinal studies investigating the reading development of children with CP are very scarce. The only longitudinal study so far has been conducted by Dahlgren Sandberg (2001). She investigated the longitudinal development of reading and spelling abilities of seven school-aged children with normal intelligence and severe speech impairments who used Bliss symbols to communicate. First of all, the participants in this study were a very specific group of children with CP, as these children were all non-speaking, had normal intellectual capabilities and were also all using Bliss symbols for communication. Therefore, results of this study can not be generalized to the whole population of children with CP. Furthermore, as no correlations were computed between the measured variables, it is difficult to find out how variables are related and what influence, for example, phonological awareness will have on reading development. Longitudinal studies investigating reading development while taking into account the relative importance of different reading precursors in a single design are lacking. Therefore, it is not possible on the basis of previous studies to determine what reading precursors are most important for early reading skills like word-decoding skills, and how reading precursors relate to each other.

Secondly, previous studies mainly compared groups of children and adults based on their speech ability (e.g., no speech impairment, dysarthria or anarthria) without measuring the participant's actual degree of speech intelligibility on a continuous scale. Given that the level of speech intelligibility within a dysarthric group can be very heterogeneous (cf. Mecham, 2002), such between-group comparisons are likely hampered by a high level of within-group variation. Based on these studies it is difficult to uncover what role speech ability plays in the development of reading precursors and early reading skills.

Emergent Literacy Environments

With regard to the HLE, previous studies showed that children with CP, and particularly those children with additional speech impairments, were less involved in storybook reading sessions compared to their non-disabled peers, that is, they were less active in using linguistic expressions like labeling pictures and answering questions (Dahlgren Sandberg, 1998). Moreover, the children's mothers mostly dominated the interaction, leaving little space for the child to communicate (Light, Binger, & Kelford Smith, 1994). In addition, Light and Kelford Smith (1993) showed that AAC-using children with severe speech and physical impairments had less opportunity to use printed materials and to participate in writing and drawing activities in comparison to non-disabled peers. Furthermore, studies of Marvin (1994) and Weikle and Hadadian (2003) concluded that parents of children with disabilities undertook fewer literacy-teaching activities (e.g., reading aloud to the child and encouraging the child to write letters) with their children than parents of preschoolers without disabilities.

The relationship between HLE and reading development has hardly been studied in children with CP. Dahlgren Sandberg (1998) conducted a study on the HLE of non-vocal Bliss-using children with CP. Because there were practically no differences in HLE between non-vocal children who were able to read and those who were not, Dahlgren Sandberg concluded that the HLE only had a marginal influence on the reading development of the non-vocal children. However, no data was available of the relationship between the different HLE aspects and the reading scores of the children. Furthermore, Koppenhaver, Yoder, & Evans (1991) conducted a retrospective survey with 22 literate adults with congenital severe speech and physical impairments. The authors concluded that the successful literacy development of the respondents could partly be attributed to the supportive literacy experiences within their homes, as these adults grew up in homes were literacy materials and literate models were widely available to them. In addition, these authors also concluded that the expectations the parents had for their child was another important factor that led to the successful literacy development of the respondents.

Previous studies on the home literacy of children with CP are limited and often focused on only a few aspects of the home literacy environment, making the picture incomplete. In addition, to understand whether the HLE of these children is limited and what factors may influence this, it is necessary to relate the child's impairment to different aspects of the HLE. Furthermore, studies indicating a relationship between aspects of the HLE and reading precursors and reading skills of children with CP are lacking, not to mention the longitudinal influence of aspects of the HLE on reading development.

With respect to the educational environment, the regularly occurring additional impairments of children with CP influence the opportunities they have for literacy learning. For example, the educational opportunities may often compete with other priorities such as medical or therapy appointments (Light & Kelford Smith, 1993), and the physical limitations that may restrict the degree of active child-initiated or independent learning (Smith, 2001). In addition, schooling will be affected by the impairments of the children, as school absence will be more frequent than in children without disabilities (Bishop, Byers Brown, & Robson, 1990). Jenks, de Moor, van Lieshout, and Withagen (in press) investigated the arithmetic instruction time for children with CP in special education. The authors showed that children with CP in special education received dramatically less instruction time in arithmetic, not because of more school absence, but because less instruction time was planned.

Another factor that may influence the opportunities the children have for literacy learning is the expectations teachers have for the literacy development of the children with CP. Studies on children without disabilities show that teacher expectations influence the interaction with the students, because teachers of high-expectation students tend to engage more often in academic contact (Cooper & Tom, 1984), give praise more often and give more support to their students (Brophy & Good, 1970). Previous studies on teacher expectations of children with CP are scarce. So far, only studies have been conducted that show that teachers of children using AAC expected that the literacy level of these children would improve in the future (Light & McNaughton, 1993). A limitation of previous research is that there are no studies investigating the teacher literacy expectations of children with CP. To understand the teacher literacy expectations of these children, studies should investigate how expectations are related to the impairments of the children and whether the expectations are realistic given the current strengths and weaknesses of the child in emergent literacy skills.

The Present Thesis

Aims

As follows from the discussion above, there are some previous studies on the literacy development of children with CP. However, these studies only investigated literacy skills fragmentarily. No longitudinal studies have yet been conducted with a large group of children with CP. In addition, while a lot of studies report that children with CP lag behind in the emergent literacy development, it is still unclear what role the additional impairments of these children play in their emergent literacy development. Furthermore, studies that include the literacy environment of children with CP are scarce. Therefore, a lot of questions about the literacy development of these children remain unanswered. In the present thesis, an attempt will be made to answer these questions by using a multi-factor design in which the longitudinal development of emergent literacy in children with CP is studied. Child variables that influence literacy learning, such as physical, speech, and intellectual impairments, are included. Besides, important external factors in the process of literacy development, such as the home literacy environment and teacher literacy expectations, will be explored. The goal of the present thesis is to give a comprehensive view of the emergent literacy development of children with CP in the Netherlands.

In the Netherlands, children with CP either attend mainstream schools or are enrolled in special education for children with physical and multiple disabilities, known as Mytylschools[2]. Teachers of children with CP working at mainstream schools receive additional guidance from professionals working at schools for special education. A total of thirty-two schools for children with physical and multiple disabilities are located throughout the Netherlands. In the present study, we only included children who were attending special education. Schools could participate if they had children who fitted the inclusion criteria. Inclusion criteria for the children with CP were Dutch as their native language, intellectual levels ranging from mild intellectual disabilities to average intelligence or above, hearing and vision within the normal range, being able to respond intentionally, either through speaking or by means of alternative communication (e.g., looking, pointing or gesturing), and being five years old at the beginning of the longitudinal study. A total of 18 schools were able and willing to participate, as they had children who fulfilled the inclusion criteria, with a total of fifty-four children with cerebral palsy. A control group was also included, consisting of 71 children without disabilities and following education in mainstream schools.

To obtain a comprehensive view of the literacy development of children with CP in the Netherlands, five research questions were addressed.

Research Questions

In the present thesis an attempt will be made to find answers to the following questions:

1. To what extent can the variation in emergent phonological awareness (i.e., rhyme ability) be explained by the children's scores on the literacy precursors?
2. What roles do speech and intellectual ability play in the longitudinal development of early reading skills? In other words, what precursors are predictive of the longitudinal development of word decoding skills?
3. What are the differences in the home literacy environment between children with CP and their peers without disabilities, and to what extent are child variables related to aspects of the home literacy development?

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[2] The names Mytyl and Tyltyl originate from the fairy tale *l'Oiseau Bleu* of Maurice Maeterlinck and became generic names for students with physical and multiple disabilities

4. What direct or indirect influence do variables of the home literacy environment of children with CP have on the reading development?
5. What are the differences between teacher literacy expectations for the children with CP and the children in the control group, and to what extent are the teacher literacy expectations of the children with CP predicted by child variables and the child's current level of emergent literacy skills?

Design of the Present Thesis

To answer the research questions, a longitudinal study on the emergent literacy development of children with CP in comparison to peers without disabilities was conducted. Special attention was paid to the role of speech and intellectual skills in the development of phonological awareness and early reading skills. The three measurement points of the longitudinal study were the beginning of the 2nd year of kindergarten, the end of 2nd year of kindergarten and the end of grade 1. The home literacy environment was explored at the end of the 2nd year of kindergarten. It was also explored what long-term effects the HLE, assessed at the end of the 2nd year, had for the literacy skills at the end of grade 1. Finally, teacher literacy expectations were also explored at the end of the 2nd year of kindergarten. Table 1 shows the tasks and questionnaires used in the present thesis at each measurement time.

Table 1

Survey of Tests and Questionnaires used in the Longitudinal Study

Time 1	Time 2	Time 3
Beginning 2nd year Kindergarten	End 2nd year Kindergarten	End Grade 1
Reading precursors - Non-verbal reasoning - Auditory perception - Rhyme perception - Vocabulary - Auditory short-term memory - Word articulation - Pseudoword articulation	*Reading precursors* - Auditory perception - Rhyme perception - Rhyme recognition - Phonemic awareness - Auditory short-term memory - Vocabulary - Syntactic skills - Word articulation - Pseudoword articulation	*Reading precursors* - Auditory perception - Rhyme perception - Rhyme recognition - Phonemic awareness - Auditory short-term memory - Vocabulary - Syntactic skills - Word articulation - Pseudoword articulation
	Motor functioning	*Early reading skills*

	(questionnaires)	- Letter knowledge
	- Gross motor function	- Word decoding
	- Fine motor function	
	Home literacy environment (questionnaires)	
	- Child's literacy interest	
	- Child's activities during storybook reading	
	-Materials and parental activities	
	- Parent's own literacy materials and activities	
	- Parents' literacy expectations	
	Educational environment (questionnaire)	
	- Teacher literacy expectations	

Outline of the Present Thesis

The present thesis is a compilation of five (online) published papers, followed by general conclusions and a discussion[3]. The five studies were written as independent articles.

In Chapter 2 *(Foundations of phonological awareness in children with cerebral palsy: The impact of intellectual disability)*, an attempt will be made to compare the emergent phonological awareness skills as well as the precursors of phonological awareness of both children with CP and a control group normally developing children. It will be investigated to what extent children with CP lag behind their peers in skills of emergent literacy. Furthermore, by means of correlation and regression analyses, it will be investigated what precursors best can predict rhyme ability in both groups separately.

In Chapter 3 (*Importance of speech production for phonological awareness and word decoding: the case of children with cerebral palsy),* the longitudinal development of the reading precursors that predict early reading skills will be examined. First, it will be investigated to what extent differences in the reading precursors and early reading skill (i.e., word decoding) between children with CP and the comparison group peers without disabilities exist. Reading precursors are measured at the beginning and end of the second

[3] The terminology in the chapters may differ as these chapters were written as independent articles and for different journals.

year of kindergarten, while early reading skills (i.e., word decoding) are measured at the end of the first grade. Then, by means of structural equation modeling (SEM) it will be examined what reading precursor or precursors best predict word decoding. Also, the structural relationships between the reading precursors will be examined for both groups separately. Special attention will be given to the role of speech and intelligence in the development of early reading skills of children with CP.

In Chapter 4 *(Home literacy environment: Characteristics of children with cerebral palsy),* aspects of the home literacy environment will be compared between the group of children with CP and the comparison group peers. Five self-administrated questionnaires, which concern the child's literacy interest, the child's activities during storybook reading, materials and parental activities for child literacy development, parents' literacy materials and activities, and parents' expectations of their child's literacy development are used. By means of factor analyses, items of the first four questionnaires will be subsumed to different factors. In addition, the last questionnaire, concerning parents' expectations, will be analyzed by means of Chi-square tests. In addition, it will be examined, by means of correlation and regression analyses, to what extent speech, fine motor and intellectual impairments limit the home literacy experiences of children with CP.

In Chapter 5 (*Home literacy predictors of early reading development of children with cerebral palsy),* an attempt will be made to answer the fourth research question. The home literacy factors of chapter 4 will be used to investigate what long-term influence these home literacy factors have on the development of reading precursors and ultimately early reading skills. Vocabulary, rhyme, phonemic awareness, and syntactic skills will be considered reading precursors, while letter knowledge and word decoding will be considered early reading skills. First, correlations between home literacy factors and reading precursors and early reading skills will be computed. The home literacy factors that show significant relationships with reading precursors and early reading skills will be subjected to further regression and path analyses (SEM analyses) to test whether these home literacy factors are directly related to early reading skills or whether they are indirectly related, through the development of reading precursors.

In Chapter 6 *(Teacher literacy expectations for kindergarten children with cerebral palsy in special education),* the fifth research question will be answered. The goal of this study is to uncover whether teachers of children with CP have lower literacy expectations of these children compared to children without disabilities. The expectation is that teacher literacy expectations are lower for the children with CP as children with CP often lag behind in their emergent literacy development. Moreover, it will be investigated, by means of correlation and regression analyses, to what extent teachers are able to differentiate their literacy expectations of the children with CP based on the severity of the impairments of these children and their current level of emergent literacy skills in the 2nd year kindergarten.

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Foundations of Phonological Awareness in Children with Cerebral Palsy: The Impact of Intellectual Disability [1]

Chapter 2

[1] This chapter has been published as: Peeters, M., Verhoeven, L., van Balkom, H. & de Moor, J. (2008). Foundations of rhyme perception in children with cerebral palsy: The impact of cognitive impairment. *Journal of Intellectual Disability Research, 52*(1), 68-78.

Abstract

Background: Children with cerebral palsy (CP) and accompanying disabilities are prone to reading difficulties. The aim of the present study was to examine the foundations of phonological awareness in preschool children with CP in comparison with a normally developing control group. Rhyme perception was regarded as an early indicator of phonological awareness, whereas nonverbal reasoning, speech ability, auditory perception, auditory short-term memory and vocabulary were regarded as foundation measures. *Method:* A number of tasks were administrated to examine group differences in rhyme perception and its foundation measures. Correlations between the tasks were analyzed for both groups followed by multiple regression analyses wherein rhyme perception was predicted by its foundation measures.

Results: Children with CP scored below their normally developing peers on emergent phonological awareness and its foundation measures. Regarding the prediction of phonological awareness, nonverbal reasoning followed by pseudoword articulation, were found to predict phonological awareness, i.e., rhyme perception, in the group of children with CP. In the control group, auditory perception was a significant predictor of emergent phonological awareness. The CP group was further split up in two groups according to the children's nonverbal reasoning skills, i.e., general IQ. The below-average IQ group scored below the average IQ group on phonological awareness and on most foundation measures. In addition, the average IQ group of the children with CP scored lower than the control group.

Conclusions: The results of this study indicate that general intelligence and speech ability (i.e., pseudoword articulation) can be seen as important facilitators of emergent phonological awareness in children with CP. These findings support the role of intelligence in the emergence of phonological awareness in children with CP. Children with CP with intellectual disabilities seem to have a disadvantage in acquiring phonological awareness, especially when their speech abilities are also impaired. However, general intelligence is not enough to predict phonological awareness as other foundation measures are also important for phonological awareness independent of general intelligence.

Introduction

The aim of the present study is to investigate to what extent children with cerebral palsy (CP) are at-risk for impaired development of phonological awareness. Phonological awareness is the awareness of the sound structure in spoken language (Dahlgren Sandberg, 2002) and can be seen as one of the most important precursors of reading (Adams, 1990). Children starting school with low levels of phonological awareness are more prone to reading difficulties than children with high levels of phonological awareness (Adams, 1990). According to Adams (1990) and Stanovich (1992), phonological awareness can be seen as a hierarchy of phonological complexity. Children become aware of syllables and intrasyllabic units (i.e., onset-rime) prior to phonemes (Adams, 1990; Christensen, 1997; Lonigan, Burgess, & Anthony, 2000). This implies that rhyme, which indicates onset-rime awareness, is one of the first phonological abilities to emerge. Awareness of rhyme develops in the preschool years, before the start of formal reading instruction and usually without explicit instruction (Foy & Mann, 2001).

Given the established importance of phonological awareness for later reading development, researchers have explored the origin of its development in normally developing children. As a result, general intelligence and language abilities such as speech perception, articulation accuracy, vocabulary, and auditory short-term memory (STM) have been identified as foundations that facilitate the development of phonological awareness (McBride-Chang, 1995; Storch & Whitehurst, 2002; Webster & Plante, 1995). The question arises as to how phonological awareness develops in children with CP.

According to Bax et al. (2005, p. 572), cerebral palsy can be described as “a group of disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of CP are often accompanied by disturbances of sensation, cognition, communication, perception, and/ or behaviour, and/ or by seizure disorders”. Disturbances in speech-related abilities and intellectual disabilities (Dormans & Pellegrino, 1998) occur in the majority of children with CP (cf. Mirenda & Mathy-Laikko, 1989), and these disturbances may result in phonological awareness problems in normally developing children (McBride-Chang, 1995; Storch & Whitehurst, 2002; Webster & Plante, 1995). It may be expected that these disturbances may have far-reaching consequences for the development of phonological awareness in children with CP.

Studies regarding the emergence of phonological awareness in children and adults with CP are scarce. The few studies that have been done with preschoolers illustrate that the rhyme judgments made by non-speaking children with CP who have an average intelligence, are comparable to those of normally developing control groups matched on sex, chronological age and mental age (Dahlgren Sandberg, 2001, 2002). In addition, Bishop and Robson (1989) showed that the rhyme abilities of congenitally speechless adults with CP, with near-average or average intelligence, were not impaired.

The very few studies that investigated the foundations of phonological awareness in people with CP have also mainly been done with school-aged children and adults who have average or near-average intelligence. In these studies speech-impaired participants with CP are commonly compared with participants with CP without speech-impairments. These few studies show that whereas the speech-impaired scored lower on auditory perceptual skills (Bishop, Byers Brown, & Robson, 1990; Smith, 2001) and receptive vocabulary (Bishop et al., 1990), conflicting results were found regarding the short-term memory abilities of speech-impaired participants with CP (Bishop & Robson, 1989; Dahlgren Sandberg, 2001, 2002; Dahlgren Sandberg & Hjelmquist, 1997; Foley & Pollatsek, 1999). As speech ability was not a continuous variable in these studies, and only participants with near-average or average intelligence were included, it is difficult to infer how these foundations measures relate to each other in a more representative group of children with CP.

Another limitation of previous research is that the important foundation variables for phonological awareness, such as general intelligence, auditory STM, speech ability, auditory perception, and vocabulary have not been studied jointly in a single design with a large representative group of children with CP. Therefore, it remains unclear which foundations of phonological awareness are underdeveloped in preschool children with CP with varying intellectual abilities, how these foundations relate to each other, and which foundations play an important role in the emergence of phonological awareness. In the present study, an attempt will be made to uncover these relations using a multiple-group, multiple-factor design. Because rhyme is one of the first aspects of phonological awareness that emerges, rhyme was used as the focal measure of phonological awareness.

The present study is a nation-wide study on emergent phonological awareness in 5-year-old children with CP, living in the Netherlands. In the present study, a number of tasks were administrated to look at rhyme abilities and foundation measures in the domains of general intelligence, articulation, auditory perception, auditory (STM), and vocabulary. The results of a group of 54 children with CP attending special education were compared with 71 normally developing peers. The following research questions will be addressed:

1. To what extent do children with CP and normally developing children attain differential levels in rhyme ability and foundation measures?

2. To what extent can the variation in rhyme ability in the two groups of children be explained from the children's scores on foundation measures?

With respect to the first question, the prediction was that children with CP score below the normally developing peers on rhyme ability as well as on the foundation abilities. With regard to the second question, our prediction was that the level of rhyme abilities in the CP group is substantially predicted by their level of general intelligence. It was expected that the children's speech abilities prove to be an additional predictor of their rhyme performance.

Method

Participants

All thirty-two schools for children with physical and multiple disabilities in the Netherlands were asked to participate in the study and to obtain written consent of the parents of the children with CP who fit the inclusion criteria. Inclusion criteria for the children with CP were Dutch as their native language, intellectual levels ranging from mild intellectual disabilities to average intelligence or above, hearing and vision within the normal range, being able to respond intentionally, either through speaking or by means of alternative communication (e.g., looking, pointing or gesturing), and a chronological age between 5 and 6½-year-old. Fifty-four preschool children were given permission to participate, 35 boys and 19 girls; they originated from 18 of the 32 schools. Forty-nine children had spastic CP (90.7%), 3 children had ataxic-spastic CP (5.6%), 1 child had mixed athetoid-spastic CP (1.9%), and 1 child had ataxic CP (1.9%). The spastic children with CP were subdivided in 22 quadriplegic children (41.5%), 21 diplegic children (39.6%), and 10 hemiplegic children (18.9%). Nine children had seizures (16.7%). The speech-language therapists of the children with CP reported that 23 children had no speech difficulties (42.6%), 20 children (37.0%) were dysartric in a mild to moderate form, and 11 children (20.4%) were anarthric.

The control group consisted of 71 normally developing children, 39 boys and 32 girls, who originated from five mainstream schools. The mean age of both groups was 67 months; they did not differ significantly on chronological age ($p > .05$).

Materials

Nonverbal reasoning. Nonverbal reasoning was measured with the Raven Coloured Progressive Matrices (Raven, 1956). This task was used because it correlated highly with general intelligence (Duncan et al., 2000). This task measures nonverbal reasoning with a minimal interference of language and is a commonly used instrument to assess intelligence, or general reasoning ability in the non-speaking population. Children were asked to point, aided or unaided, to one of the six pictures that completed the presented figure. The task consisted of 36 items. Raw score were converted to standard scores ranging from .5 to 9.5 using Dutch norms (van Bon, 1986).

Speech ability. In order to assess children's speech ability, standardized tasks of the Specific Language Impairment Screening test for Word Articulation and Pseudoword Articulation were administrated (Verhoeven, 2006). In the Word Articulation task the child was asked to repeat real words, in the Pseudoword Articulation task the child was asked to repeat pseudowords. In both tasks, the words were presented one-by-one by a computer with recorded voice, whereby the tasks started with words containing only one syllable and increased to words containing up to five syllables. When a child made five successive errors, the task was ended. Eighty-four percent of the children with CP were able to do this task since they had some level of understandable speech; the other children who were given a score of zero. The maximum score was 40. The test manual reported good internal consistencies with Cronbach's alpha's of .94 for the Word Articulation task and .95 for the Pseudoword Articulation task. These internal consistency measures are based on children without disabilities. As children with CP have varying speech abilities, the reliability scores of the speech tasks could be reduced. Since the number of children with CP was limited in this study, it was not possible to investigate these reliabilities for this sub-sample.

Auditory perception. To assess auditory perception abilities, the Auditory Discrimination Task from the standardized Dutch Language Proficiency Test was administrated (Verhoeven & Vermeer, 2001). In this task, the child was presented with minimally differing word pairs and had to indicate whether the words in a pair sounded alike. Response adaptations for children with speech difficulties consisted of nodding or pointing to left or right to indicate if the words sounded the same or different. The maximum score was 50. The task was highly reliable with a Cronbach's alpha of .97 (Verhoeven & Vermeer, 1999).

Auditory short-term memory. The task was based on a serial-recognition experiment of Gathercole, Pickering, Hall, & Peaker (2001) and did not require physical or speaking abilities. In the constructed task, the child heard a string of words and after two seconds the child heard another string of words (e.g., [boat], [knife], [cap], versus [boat], [window], [cap]). The child had to decide whether the two successive strings of words were identical or not. The task consisted of strings of words that increased in length, starting with a length of one word and increasing to a length of eight words. For this task, a set of ten highly frequent monosyllabic consonant-vowel-consonant (CVC) words were used which occurred in a list of words used in the context of kindergarten education (Schaerlaekens et al., 1999) and differed phonologically and semantically as much as possible from each other. There were a total 48 items; six items of each string length. If the child had only three or less items of a string length correct, the task was ended. The internal consistency of this task in this study was very high with a Cronbach's alpha of .97 (See Appendix A at the end of this thesis).

Vocabulary. Receptive vocabulary was assessed using a Dutch version (Schlichting, 2005) of the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997). The task of the child was to point, aided or unaided, to one of the four pictures that corresponded to the word spoken by the test leader. Raw scores were converted to age-equivalent standard scores. The test manual described an internal consistency interval of Cronbach's alpha between .92 and .94.

Rhyme perception. The Rhyme Perception (Irausquin, 2001) task was used to measure emergent phonological awareness. The task consisted of ten highly frequent Dutch CVC word pairs. The child had to decide, aided or unaided, whether the auditorily presented word pairs rhymed or not. After four successive failures the task was ended. The internal consistency in this study was sufficient with a Cronbach's alpha of .72.

Procedure

All children were individually tested in a quiet room in their schools by a trained test assistant. In the group of children with CP, an assistant teacher was present as well. Prior to each task, there was a training phase, to make sure the children understood the test. The test order was the same for all children and the tests were divided over two or three sessions. Response adaptations for children with speech difficulties were nodding or pointing, aided or unaided.

Statistical Method

Statistical analyses were performed to provide answers to the research questions. Descriptive statistics, followed by Analyses of Variances (ANOVAs) were carried out to investigate differences between CP children and their normally developing peers on rhyme perception and its foundation measures. To verify that group differences were not due to differences in nonverbal reasoning alone, Multiple Analysis of Covariance (MANCOVA) were performed with nonverbal reasoning as a covariate. To examine the variation in rhyme perception ability, Pearson correlations were computed between all measures for both groups. These correlations were followed by multiple regression analyses, one for each group, in which rhyme perception functioned as criterion variable and nonverbal reasoning, speech ability (i.e., pseudoword articulation), auditory perception, auditory STM, and receptive vocabulary as predictor variables.

Results

Comparison of Children with CP and Normally Developing Children

Table 1 shows the means and standard deviations of the observed variables for both groups. As can be seen in Table 1, the group of children with CP scored below the normally developing children on all tasks. Furthermore, ANOVAs were conducted to test if the groups differed significantly from each other on the tasks. The results, which are also presented in Table 1, show that this is the case for all tasks being administrated (all *p*s < .001). MANCOVA results revealed that the group differences remained significant after controlling for nonverbal reasoning (all *p*s < .04). The effect sizes (partial eta², η_p^2) for the different tasks were rather small; word articulation ($\eta_p^2 =$ .80), pseudoword articulation ($\eta_p^2 =$ .04), auditory perception ($\eta_p^2 =$ .07), auditory STM ($\eta_p^2 =$ .05), receptive vocabulary ($\eta_p^2 =$ .11), and rhyme perception ($\eta_p^2 =$ .11). This indicates that nonverbal reasoning could not explain the lower scores of the children with CP in comparison with the normally developing children.

Table 1

Results of ANOVAs to Test Group Differences on Each Task

		Cerebral palsy	Normal control	*df*	*F*	η_p^2	*p*
Nonverbal Reasoning	*M*	2.24	6.83	1,123	203.58	.62	.0001
	SD	1.67	1.86				
Word Articulation	*M*	16.09	28.50	1,123	85.88	.41	.0001
	SD	10.68	3.20				
Pseudoword Articulation	*M*	6.25	14.62	1,123	68.52	.36	.0001
	SD	6.42	4.90				
Auditory Perception	*M*	31.39	45.14	1,123	98.50	.45	.0001
	SD	11.07	3.26				
Auditory STM	*M*	14.61	32.18	1,123	98.49	.45	.0001
	SD	8.68	10.58				
Vocabulary	*M*	78.04	106.31	1,123	137.14	.53	.0001
	SD	15.03	11.96				
Rhyme Perception	*M*	6.33	9.44	1,123	144.48	.54	.0001
	SD	1.65	1.24				

Foundations of Rhyme Perception in Children with CP and Normally Developing Children

Table 2 shows the correlations between the tasks within the CP group and within the group of normally developing children. In the CP group, most tasks are highly significantly correlated ($p < 0.01$), only pseudoword articulation and auditory STM correlated moderately significantly ($p < .05$). Moreover, all foundation measures do substantially correlate with children's rhyme perception. Nonverbal reasoning was also highly correlated with all other foundation measures ($p < .001$). In the control group, all variables were significantly correlated ($p < .01$), except vocabulary and rhyme perception. The lower correlations between rhyme perception and its foundation measures in the control group in comparison with the group of children with CP could be explained by the fact that within the control group ceiling effects tended to occur on the rhyme perception task.

Table 2

Task Intercorrelations for the Children with CP and Normally Developing Children (Pearson)

	1	2	3	4	5	6	7
			Children with CP (*n* = 54)				
1 Nonverbal Reasoning	-		.				
2 Word Articulation	.30*	-					
3 Pseudoword Articulation	.40**	.82**	-				
4 Auditory Perception	.41**	.37**	.47**	-			
5 Auditory STM	.41**	.23	.33*	.65**	-		
6 Vocabulary	.41**	.50**	.47**	.56**	.38**	-	
7 Rhyme Perception	.65**	.48**	.59**	.59**	.51**	.54**	-
			Normally developing children (*n* = 71)				
1 Nonverbal Reasoning	-		.				
2 Word Articulation	.42**	-					
3 Pseudoword Articulation	.32**	.60**	-				
4 Auditory Perception	.49**	.60**	.41**	-			
5 Auditory STM	.43**	.60**	.62**	.43**	-		
6 Vocabulary	.46**	.53**	.36**	.36**	.43**	-	
7 Rhyme Perception	.30**	.45**	.26*	.48**	.29*	.18	-

* Correlation is significant at 0.05 level (2-tailed), ** Correlation is significant at 0.01 level (2-tailed)

To establish which variables are good predictors of rhyme perception, two multiple regression analyses were conducted, one for each group. First, the correlation tables were inspected to check for possible collinearity within the foundation measures. Regarding the speech ability tasks, the correlation table shows a very high correlation between word articulation and pseudoword articulation in the group of children with CP ($r = .82$), and the group of normally developing children ($r = .60$). As these two variables are highly correlated and tap into the same pool of variance, putting these variables together in a regression analysis results in unstable regression models (see for details Belsey, Kuh, & Welsch, 1980). Because of this collinearity, pseudoword articulation was selected as the only speech ability task to predict rhyme perception. Moreover, pseudoword articulation is considered a more pure measurement of speech ability as it does not draw on the mental lexicon of the children and thus the pseudowords are unknown words for all participants.

Table 3 shows the multiple regression analyses in which rhyme perception of children with CP and normally developing children was predicted by all foundation variables. As can be seen in Table 3, the multiple regression analysis for the group of children with CP resulted in a significant model, $F(5, 48) = 16.08$, $p < .001$, that explained 59% of the variance in rhyme perception. In this model, nonverbal reasoning turned out to be the most important predictor of rhyme perception ($p = .001$), followed by pseudoword articulation ($p < .05$). None of the other foundations were significant predictors of rhyme perception in the group of children with CP ($p > .05$). These results stress the importance of nonverbal reasoning and pseudoword articulation for predicting rhyme perception.

Although there tended to be ceiling effects on rhyme perception within the control group, it is still informative to find out which foundation measures are responsible for the variation in rhyming skills and to compare these measures with those of the children with CP. The regression analysis for normally developing children resulted in a significant model, $F(5, 65) = 4.21$, $p < .01$, that explained 19% of the variance in rhyme perception. In this model the only significant predictor of rhyme perception was auditory perception ($p < .01$).

Table 3

Summary of Multiple Regression Analyses for Variables Predicting Rhyme Perception of Children with CP (n = 54) and Normally Developing Children (n = 71)

Variable	*B*	*SE B*	β
Children with CP			
Nonverbal Reasoning	.37	.10	.37***
Pseudoword Articulation	.07	.03	.27*
Auditory Perception	.03	.02	.17
Auditory STM	.02	.02	.12
Vocabulary	.01	.01	.13
Normally Developing Children			
Nonverbal Reasoning	.05	.09	.08
Pseudoword Articulation	.01	.04	.04
Auditory Perception	.16	.05	.41**
Auditory STM	.01	.02	.08
Vocabulary	-.01	.01	-.06

Note. ** $p < .01$, *** $p \leq .001$

As nonverbal reasoning is the main predictor of rhyme perception within the group of children with CP, and there are large differences within this group on nonverbal reasoning, this group was split up in two groups according to their general intelligence, i.e., nonverbal reasoning. This resulted in a below-average intelligence group with general intelligence scores lower than 85, and an average intelligence group with general intelligence scores of 85 or above. T-tests were conducted to explore group differences on rhyme perception and its foundation measures. These results and the descriptive statistics are presented in Table 4.

Table 4

Descriptive Statistics of the Below-Average IQ Group and the Average IQ Group of the Children with CP

	Below-average IQ group (*n* = 38)		Average IQ group (*n* = 16)		Significance (one-tailed)
	M	*SD*	*M*	*SD*	*p*
Nonverbal Reasoning	1.39	.90	4.25	1.31	.0001
Word Articulation	14.40	10.49	20.10	10.35	.038
Pseudoword Articulation	4.72	5.01	9.87	8.00	.014
Auditory Perception	29.55	11.05	35.75	10.16	.028
Auditory STM	12.53	7.63	19.56	9.25	.007
Vocabulary	75.95	15.30	83.00	13.55	.052
Rhyme Perception	5.87	1.38	7.44	1.75	.002

Table 4 illustrates that the average IQ group with CP scored higher than the below-average IQ group with CP on almost all tasks ($p < .05$). In addition, the mean scores of the average IQ group of the children with CP were found to be lower than those of the control group (as shown in Table 1), and t-tests indicate that these group differences are significant (all *p*s < .05). These results indicate that intelligence to some extent gives an explanation of the differences of the three groups. In Figure 1, the variation in rhyme perception and its foundation measures is graphically displayed. It can be seen that there is a large variance on most variables within both groups of children with CP in comparison with the normally developing children. Splitting up the group of children with CP according to their general intelligence did not reduce the variances on rhyme perception and its foundation measures.

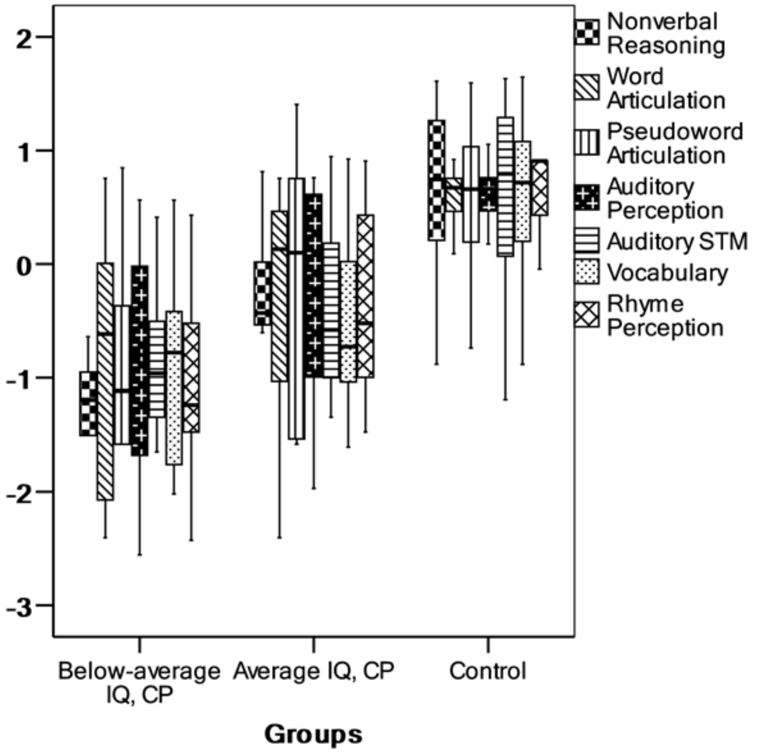

Figure 1

Boxplots of the Standardized Scores for All Tasks (Z-Profiles).

Moreover, it can be concluded that at least some of the children with CP in the below-average IQ group perform better on rhyme perception than children in the average IQ group. In order to explore the relationships between rhyme perception and the foundation measures in the CP group while controlling for intelligence, partial correlations were computed with nonverbal reasoning partialled out. These partial correlations with rhyme perception were significant for all tasks (all *p*s ≤ .01) and were .39 for word articulation, .48 for pseudoword articulation, .47 for auditory perception, .36 for auditory STM, and .40 for vocabulary. These partial correlations illustrate that independently of nonverbal reasoning, all foundation measures were significantly related to emergent phonological awareness of children with CP. The highest partial correlation was between rhyme perception and pseudoword articulation (p*r* = .48), which was previously found to be the second best predictor of rhyme perception after nonverbal reasoning.

Conclusions and Discussion

Several conclusions can be drawn from the present study. First, it can be concluded that the children with CP scored below their normally developing peers on all measured foundations of phonological awareness and on phonological awareness itself. However, it is also clear that within the group of children with CP, the variation on rhyme perception and the foundation measures is substantial.

Multiple regression analysis showed that nonverbal reasoning followed by pseudoword articulation were the most important predictors of rhyme perception in the group of children with CP. These results stress that children with CP with a lower intellectual level, experience an additional barrier in acquiring phonological awareness, especially when their speech abilities are also limited. For the group of the normally developing children, only auditory perception was an important predictor of rhyme perception. These results are in line with previous research where auditory perception was seen as an important precursor of rhyme ability in normally developing children (Foy & Mann, 2001). Children must be able to distinguish the phonological representations of the words before they can decide if the words rhyme or not. The fact that in this group auditory perception is an important predictor of rhyme perception, whereas nonverbal reasoning and speech production are not, can be explained by the fact that these children already had a reasonably level of nonverbal reasoning skills and speech abilities. A higher level of these skills did not seem to improve their rhyme perception abilities.

Regarding the role of intelligence in relation to emergent phonological awareness, a few things can be concluded. First, intelligence is related to all other foundation measures of phonological awareness and is the most important predictor of rhyme perception in children with CP. However, the role of intelligence should not be overestimated, since splitting the CP group up according to their general intelligence did not imply that all children in the below-average IQ group were weaker on rhyme perception than the children in the average IQ group of CP. In predicting phonological awareness, other foundation measures should be taken into account, especially pseudoword articulation.

The impact of speech abilities on rhyme perception in children with CP is not in line with previous findings (Bishop & Robson, 1989; Dahlgren Sandberg, 2006; Dahlgren Sandberg & Hjelmquist, 1996). Those studies show that children with a speech-impairment or congenitally speechless children did not score lower on rhyme abilities in comparison with children with no speech-impairment, suggesting that there was no relationship between speech abilities and rhyming. An explanation for the difference in results between our study and previous research is that previous studies investigated the difference between matched groups, such as a speech-impaired group versus a matched control group, or a nonspeaking versus a speaking control group, and previous research is mainly restricted to children with an average intelligence.

In the present study, the measurement of the children's intelligence can be debated. As in earlier studies with children with CP (Card & Dodd, 2006; Dahlgren Sandberg & Hjelmquist, 1996), the Raven was used as a measure of general IQ, or intellectual functioning. In the present study, the Raven CPM was used as a measure of general intelligence. The Peabody Picture Vocabulary Test (PPVT) (Schlichting, 2005) was used to assess receptive vocabulary and was not regarded as a measure of verbal intelligence, since previous research has indicated that physical difficulty in speaking was associated with limited vocabulary acquisition (Bishop, Byers Brown, & Robson, 1990), which may result in an underestimate of the children's verbal intellectual abilities. The results of this study indicated that general intelligence did not fully account for the lower scores of the children with CP in comparison with their normally developing peers on rhyme perception and its foundation measures. It would nevertheless be good to find out to what extent the PPVT task could account for the group differences on rhyme perception and foundation measures. Therefore, an additional MANCOVA was conduced with PPVT as covariate. The results show more or less the same picture as when controlling for general intelligence and evidenced that vocabulary could not significantly account for group differences on the different tasks (all *p*s < .04). The effect sizes of the different tasks were rather small; word articulation ($\eta_p^{2\,=}$ .07), pseudoword articulation (η_p^2 = .05), auditory perception (η_p^2 = .09), auditory STM (η_p^2 = .11), and rhyme perception (η_p^2 = .20).

A few clinical implications can be made from this study. First, because children with CP already show a delay in emergent phonological awareness, early intervention in the preschool years seems especially necessary for those children with a lower intellectual level and speech difficulties. One potential method of intervention could be playing language games with educational software. Earlier research (Segers & Verhoeven, 2004) has indicated that children with specific language impairments can benefit from computer training for phonological awareness. As this intervention stimulates the language development through language games, it is especially suited for children with a younger developmental age. However, at the moment, there are only very few opportunities for children with physical impairments to use educational software for language learning, as most software is not adapted to the physical needs of these children (Steelman, Pierce, & Koppenhaver, 1993). Given the importance of language stimulation in the early years and the importance of prevention of later literacy problems, there is an urgent need for software that is adapted to the needs of these children.

Regarding future research, it would be interesting to find out how phonological awareness develops further in children with CP. In this study, it was not possible to look at other phonological awareness measures such as auditory blending or analysis, because most children with CP would be unable to perform such tasks at this early age. At older age levels, it would be interesting to look at other measures of phonological awareness and investigate which foundations are important for these measures. In addition, it would be interesting to find out to what extent differences between the children with CP and normally developing children can be explained by their school and home environment. Concerning the school environment, a possibility is that children who attend special schools for children with physical or multiple disabilities receive less instruction in phonological awareness or literacy learning, because a lot of time is allocated to speech therapy and physiotherapy. Furthermore, the home environment of these children could be different from normally developing children as their physical disabilities can limit the interactions with their parents during storybook reading or other language related activities. Future research is needed for exploring these relationships.

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Importance of Speech Production for Phonological Processing and Early Reading: The Case of Children with Cerebral Palsy[1]

Chapter 3

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Abstract

The goal of this longitudinal study was to investigate the precursors of early reading development in 52 children with cerebral palsy (CP) at kindergarten level in comparison to 65 children without disabilities. Word decoding was measured to investigate early reading skills, while phonological awareness, phonological short-term memory (STM), speech perception, speech production and nonverbal reasoning were considered reading precursors. Children with CP lag behind on all reading precursors at the beginning of the second year of kindergarten. For the children without disabilities, early reading skills in grade 1 were best predicted by phonological awareness and phonological STM while speech production was the most important predictor of early reading success for the children with CP, followed by phonological awareness and speech perception. Furthermore, for children with CP, speech production appears to dominate the reading development, as speech production measured at the beginning of the second year of kindergarten was strongly predictive of all other reading precursors measured at the end of the second year of kindergarten. The results of this study reveal that children with CP with additional speech impairments are at risk for limited literacy development. Clinical implications are discussed.

Introduction

The aim of the present study was to investigate the precursors of word decoding and the structural relationships of these precursors for children with cerebral palsy (CP) in comparison to children without disabilities. Special attention is paid to the role of speech production in the development of phonological awareness and word decoding. There is now widespread consensus that phonological awareness is one of the most important precursors of future reading success (Wagner et al., 1997). Phonological awareness refers to “one’s awareness of and access to the sound structure of oral language” (Wagner et al., 1997, p. 469). Phonological awareness can be arranged according to a hierarchy of phonological complexity (Adams, 1990; Stanovich, 1992); children first become aware of onset-rime and syllables before they become gradually aware of the individual phonemes of the words, also called phonemic awareness. Other skills that have shown strong direct relationships with future reading development and indirectly through the development of phonological awareness include: phonological short-term memory (STM) (Wagner & Torgesen, 1987), speech perception (Elbro & Pallesen, 2002; McBride-Chang, 1995a, 1995b), articulation accuracy or speech ability (Carroll, Snowling, Hulme, & Stevenson, 2003; Foy & Mann, 2001; Webster & Plante, 1995), and intelligence (McBride-Change, 1995b; Stanovich, 1992).

Given the role that reading precursors play in the development of early reading skills of children without disabilities, the question arises as to what role these precursors play in the reading development of children with disabilities, such as children with CP. According to Bax et al. (2005, p. 572), CP can be described as “a group of disorders of the development of movement and posture, causing activity limitation that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain”. Children with CP often have disturbed neuromuscular control of the speech mechanisms, resulting in speech production problems, such as dysarthria (Pirila et al., 2007). In addition, the neurological damage that causes speech impairments often results in some degree of lower intellectual abilities (cf. Bishop, 1988; Dormans & Pellegrino 1998; Koppenhaver & Yoder, 1992; Mirenda & Mathy-Laikko, 1989). The speech production and intellectual impairments that often accompany cerebral palsy may have far-reaching consequences for the literacy development of these children. Although previous studies of children with CP with additional speech impairments revealed a low incidence of literacy in this population (Berninger & Gans, 1986; Koppenhaver, Evans, & Yoder, 1991; Smith, 1989), it remains unclear if and how speech production skill are related to these low literacy scores.

Studies investigating the influence of speech production on the development of phonological awareness in children with CP are conflicting. Some studies found no differences in phonological awareness between non-speaking and speaking children with CP (Card & Dodd, 2006) or control groups matched for age and intellectual level (Dahlgren Sandberg & Hjelmquist, 1996a, 1996b). Other studies have shown that children with speech impairments scored below their reading-level matched control group on phonological awareness tasks (Vandervelden & Siegel, 1999). In addition, Peeters, Verhoeven, van Balkom, and de Moor (2008) investigated the rhyme perception abilities of a group of children with CP with varying speech production abilities and concluded that articulation ability was strongly related to the rhyme perception scores, even after controlling for intelligence.

With regard to reading development, the role of phonological awareness as the strongest reading precursor for children with CP with speech impairments is debated. Despite equal performance on phonological awareness tests, non-speaking children with CP scored lower on reading and writing skills than speaking children with CP (Dahlgren Sandberg & Hjelmquist, 1996a, 1996b, 1997). In a longitudinal study of non-speaking children with CP, Dahlgren Sandberg (2001, 2006) further showed that these children had difficulties acquiring literacy skills, although intellectual level and phonological abilities predicted otherwise. These results question the predictive value of phonological awareness for the early reading development of non-speaking children with CP. An explanation for these unexpected low reading scores, Dahlgren Sandberg (2002) suggested that the non-speaking children could have had problems with subvocal or covert rehearsal of phonological information, which is necessary for the more complex phonological tasks, such as reading and writing tasks.

In conclusion, the role of speech production in the early stages of the reading development of children with CP is not clear. Although some studies indicated a major role of speech production for the emergence of phonological awareness as well as early reading skills, these studies are not conclusive. At the moment, it is still unclear whether phonological awareness is the most important predictor of reading skills of children with CP or if speech production plays a dominant role in reading development. One limitation of previous studies is that they mainly compared groups of children and adults based on their speech ability (e.g., no speech impairment, dysarthria, anarthria) without measuring the participant's actual degree of speech intelligibility on a continuous scale. Given that the level of speech intelligibility within a dysarthric group can be very heterogeneous (cf. Mecham, 2002), such between-group comparisons are likely hampered by a high level of within-group variation. In addition, it is important to bear in mind that previous studies used different matching procedures and different tasks with different levels of phonological complexity, making comparisons between studies difficult. Moreover, longitudinal studies investigating reading development while taking into account the relative importance of different reading precursors in a single design are lacking.

The present nation-wide study attempts to overcome previous limitations by investigating the longitudinal development of early reading skills and its precursors in a group of 52 children with CP and a comparison group of 65 peers, all living in the Netherlands. By measuring all variables on a continuous scale, this study makes it possible to investigate structural relationships between all variables by means of linear structural equation modeling (SEM). First, the groups will be compared on reading skills, i.e., word decoding, and its precursors. Then, separate SEM analyses will be conducted for each group to investigate which reading precursors predict early reading skills and to investigate the structural relationships between reading precursors. Early reading skills were measured by a word decoding task, while phonological awareness, phonological STM, speech perception, speech production, and nonverbal reasoning were considered reading precursors. The main research questions that will be addressed in the present study are:

1. What precursors are predictive of word decoding in children with CP and their nondisabled peers?
2. To what extent do the structural relationships between the precursors of word decoding differ between children with CP and their nondisabled peers?

With regard to the first question, the expectation is that there will be group differences in the set of precursors that are predictive of word decoding. Based on previous studies, word decoding of children without disabilities is expected to be predicted by phonological awareness and phonological memory (Wagner & Torgesen, 1987; Wagner et al., 1997), whereas speech production is expected to be the major predictor for word decoding for the group of children with CP. Although phonological awareness is expected to also be important for reading development in children with CP, the prediction is that these skills will be overshadowed by the major role that speech production plays. With regard to the second question, the prediction is that the groups will differ in the structural relationship between the precursors. Based on previous research (e.g., Wagner et al., 1997), the expectation is that speech perception is strongly related to the emergence of phonological awareness of the comparison group (McBride-Chang, 1995a), whereas speech production will influences the emergence of phonological awareness (Peeters et al., 2008) in children with CP.

Method

Participants

For this longitudinal study, all thirty-two schools for children with physical and multiple disabilities in the Netherlands were asked to participate and obtain written consent from the parents of children with CP who fit the following inclusion criteria: Dutch must be their native language, the intellectual level must range from a mild intellectual disability to average intelligence or above, hearing and vision must be within the normal range, with the ability to respond intentionally, either through speaking or by means of alternative communication (e.g., looking, pointing or gesturing), and they must be five years old at the beginning of the longitudinal study. Fifty-two children with CP participated in the present study; 33 boys (63.5%) and 19 (36.5%) girls. Fifty children (96.1%) had spastic CP and 2 children had ataxia (3.8%). Of the children with spastic CP, 13 children (26.0%) had quadriplegia, 22 children (44%) had diplegia, 8 children (16%) had hemiplegia, 5 children (10%) had a combination of spastic-ataxic CP, 1 child (2%) had spastic-hypotonia CP, and 1 child (2%) had spastic-dyskinetic CP. Nine of the 52 children (17.3%) had seizures. The speech-language therapists of the children reported that 24 children (46.2%) had no speech difficulties, 10 children (19.2%) had mild dysarthria, 6 children (11.5%) had moderate dysarthria, 9 children (17.3%) had severe dysarthria and were unable to speak, 1 child (1.9%) had moderate dyspraxia, and 2 children (3.8%) had a combination of severe dysarthria and dyspraxia. The average age of the children was 67 months (SD = 5.8) at Time 1, 72 months at Time 2 (SD = 5.7), and 84 months at Time 3 (SD = 6.1). Twelve children (23.1%) use some sort of Augmentative and Alternative Communication (AAC) to communicate. All children with CP attended special schools for children with physical and multiple disabilities across the Netherlands. The average score of the fine motor function as measured by the Dutch version of the Manual Ability Classification System (Eliasson et al., 2006), which ranges from one (low impairment) to five (high impairment), was 2.52 (SD = .94). The average gross motor skills as measured by the Dutch version of the Gross Motor Function Classification System (Palisano et al., 2000), which also ranges from one to five, was 2.71 (SD = 1.26).

The comparison group consisted of 65 children who originated from five mainstream schools; 34 (52.3%) boys and 31 (47.7%) girls. The children had no known impairments and all spoke Dutch as their native language. The average age of the children was 67 months at Time 1 (SD = 3.6), 72 months at Time 2 (SD = 3.6), and 84 months at Time 3 (SD = 3.7). The groups did not differ in average age, $t(115) = .31$, $p > .05$, or gender, χ^2 (1, N = 117) = 1.47, $p > .05$. All parents of the children in the present study had given written consent for their children to participate. At Time 1 and 2, all children were second-year kindergartners, while at Time 3 they were following education in the first-grade.

Materials

Nonverbal reasoning. Nonverbal reasoning was measured with the Raven Coloured Progressive Matrices (Raven, 1956). This task was used as it correlated highly with general intelligence (Duncan et al., 2000). The task measures nonverbal reasoning with a minimal interference of language and is a commonly used instrument to assess intelligence, or general reasoning ability, in the non-speaking population (Pueyo et al., 2008). Children were asked to point, aided or unaided, to one of the six pictures that completed the presented figure. The task consisted of 36 items. Raw score were converted to standard scores ranging from .5 to 9.5 using Dutch norms (van Bon, 1986).

Speech production. In order to assess children's speech production ability, the standardized Word Articulation task of the SLI Screening test was administrated (Verhoeven, 2006). In the Word Articulation task the child was asked to repeat real words. Words were presented one-by-one by a computer with recorded voice, whereby the task started with words containing only one syllable and increased to words containing up to five syllables. When a child made five successive errors, the task was ended. Eighty-four percent of the children with CP were able to do this task since they had some level of understandable speech; the other children who were given a score of zero. The maximum score was 40. The test manual reported a good internal consistency with Cronbach's alpha's of .94 for the Word Articulation task.

Phonological short-term memory (STM). The task was based on a serial-recognition experiment of Gathercole, Pickering, Hall, and Peaker (2001) and did not require physical or speech production abilities. In the newly constructed task, the child heard a string of words and after two seconds the child heard another string of words (e.g., [boat], [knife], [cap], versus [boat], [window], [cap]). The child had to decide whether the two successive strings of words were identical or not. The task consisted of strings of words that increased in length, starting with a length of one word and increasing to a length of eight words. For this task, a set of 10 highly frequent monosyllabic consonant-vowel-consonant (CVC) words were used which occurred in a list of words used in the context of kindergarten education (Schaerlaekens et al., 1999) and differed phonologically and semantically as much as possible from each other. There were a total 48 items; 6 items of each string length. If the child had only three or less items of a string length correct, the task was ended. The internal consistency of this task in this study was very high with a Cronbach's alpha of .97 for Time 1 and .95 for Time 2 (cf. appendix A at the end of the thesis).

Speech perception. To assess auditory perception abilities, the Auditory Discrimination Task of the standardized Dutch Language Proficiency Test was administrated (Verhoeven & Vermeer, 2001). In this task, the child was presented with minimally differing word pairs and had to indicate whether the words in a pair sounded alike. Response adaptations for children with speech difficulties consisted of nodding or pointing to left or right to indicate if the words sounded the same or different. All items were tested and the maximum score was 50. The task was highly reliable with a Cronbach's alpha of .97 (Verhoeven & Vermeer, 1999).

Rhyme perception. The Rhyme Perception (Irausquin, 2001) task was used to measure emergent phonological awareness. The task consists of 10 highly frequent Dutch CVC word pairs. The child had to decide, aided or unaided, whether the auditorily presented word pairs rhymed or not. After four successive failures the task was ended. The internal consistency in this study was sufficient with a Cronbach's alpha of .72 for Time 1 and .73 for Time 2.

Phonemic awareness. To test phonemic awareness skills, the First-phoneme Recognition Task was used (de Jong, van Otterloo, & Regtvoort, 2006). This task consists of 10 items with CVC words. Each item consists of five pictures, one stimulus picture and four response pictures. During the exercise items, the test assistant pointed at the stimulus picture and named that picture (e.g., roof). Subsequently, the test assistant explained that the stimulus word could be split up in two parts, the first-phoneme of that word versus the rest of the word (e.g., rrrrr-oof). The test assistant subsequently named all four response pictures with explicitly emphasis on the first-phoneme of the words. The child had to point at one of the four response pictures that started with the same first-phoneme as the stimulus word (i.e., r). During the test items, the test assistant named the stimulus picture and the response pictures without explicitly emphasizing the first-phoneme of the word. The internal consistency of this task in this study was good with a Cronbach's alpha of .83.

Word decoding. Word decoding ability was assessed using a shortened version of the Reading Technology Test (Krom, 2001). Twenty items were selected that covered all Dutch sound categories. In this task, each item consisted of one picture presented by five written words, one of which corresponded to the picture. The task of the child was to point at the written word that matches the picture. Three exercise items preceded the task. All words differed minimally from each other and increased in complexity from CVC words at the beginning of the task to CVCVC words as the last items. The test manual reported a good reliability with a Cronbach's alpha of .89 (Krom & Kamphuis, 2001).

Statistical Method

To answer the research questions, data were analyzed in several steps. First, descriptive statistics (means and standard deviations) were computed for nonverbal reasoning at Time 1, rhyme perception, phonological STM, speech perception, and speech production at Time 1 and Time 2, phonemic awareness at Time 2, and word decoding at Time 3. Secondly, a Multivariate analysis of variance (MANOVA) was performed to investigate group differences on all measured tasks.

Furthermore, in order to investigate the longitudinal development of all precursors of word decoding and the structural relationships between the precursors, two series of SEM analyses were conducted by using AMOS 5 for Structural Equation Modeling (Raykov & Marcoulides, 2006) for each group separately. SEM affords not only to account for measurement errors while examining the influence of reading precursors on early Word Decoding (Baron & Kenny, 1986; Wagner, Torgesen, & Rashotte, 1994) but also to look at the independent contribution made by each reading precursor and the interrelationships among the reading precursors (Arbuckle & Wothke, 1999). The corresponding correlation matrices are presented in Appendices A and B. The first series of SEM analyses for the comparison group concerned the longitudinal influence of alternatively phonological awareness, phonological STM, speech perception, and speech production at Time 1 and Time 2, and word decoding at Time 3. In the second series of SEM analyses, the longitudinal influences of phonological awareness, phonological STM, and speech perception were combined (model 5), along with speech production (model 6), and finally with nonverbal reasoning (model 7). For this second series of SEM analyses, the error terms of tasks measured at the same time point were allowed to correlate. Both series of SEM analyses were repeated for the group of children with CP.

The goodness of fit of all estimated models was assessed by seven fit indices: χ^2, with degrees of freedom and *p*-value, Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Normed Fit Index (NFI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean square Residual (SRMR). A model fits well if the ratio of the Chi-square value to the degrees of freedom is smaller than two (Ullman, 2001), GFI, NFI, and CFI are between .90 and 1.00, and close to 1.00 (Bentler, 1990; Hu & Bentler, 1999; Jaccard & Wan, 1996), and AGFI is greater than .85 (Kline, 1998). In addition, Hu and Bentler (1999) advised a cutoff value of .06 for RMSEA and .08 for SRMR. Based on the relatively small sample size, not only significant standardized Beta (β) values are presented, but all βs with values >.10 are shown.

Results

Descriptive Statistics

Table 1 shows descriptive statistics for all tasks for both groups, along with the results of the MANOVA. The results of the MANOVA indicate that there is a multivariate effect for group, Wilks' lambda = .276, F (11, 105) = 24.98, p < .001, and η_p^2 = .72. Descriptive statistics show that the group of children with CP scored below the comparison group of children without disabilities on all tasks and univariate tests reveal that all these differences were significant, see Table 1.

Table 1

Results of the MANOVA for all Precursors at Time 1 and Time 2, and Word Decoding at Time 3 for the Group of Children with CP (n = 52) and the Comparison Group (n = 65)

Task	Group							
Time 1	Comparison		Cerebral Palsy					
	M	*SD*	*M*	*SD*	*df*	*F*	η_p^2	*p*
Speech Perception	45.22	3.26	31.75	11.04	1,115	87.37	.43	<.001
Nonverbal Reasoning	6.82	1.79	2.29	1.68	1,115	195.22	.63	<.001
Rhyme Perception	9.43	1.25	6.35	1.68	1,115	129.71	.53	<.001
Speech Production	25.85	3.16	16.32	10.64	1,115	77.37	.40	<.001
Phonological STM	32.51	10.30	14.94	8.66	1,115	96.64	.46	<.001
Time 2								
Speech Perception	45.74	3.81	35.58	9.80	1,115	58.93	.34	<.001
Rhyme Perception	9.23	1.48	6.94	2.09	1,115	48.01	.30	<.001
Phonemic Awareness	7.99	2.39	4.48	2.41	1,115	61.99	.35	<.001
Speech Production	33.80	4.33	17.27	13.31	1,115	88.74	.44	<.001
Phonological STM	29.71	6.74	16.69	8.63	1,115	83.94	.42	<.001
Time 3								
Word Decoding	15.48	4.57	3.85	5.96	1,115	142.90	.55	<.001

Structural Equation Modeling for the Children without Disabilities

To answer the second research question, two series of SEM analyses were conducted in a stepwise manner. In model 1, the predictive value of phonological awareness at Time 1 and Time 2 for word decoding at Time 3 was tested. In this model, phonological awareness at Time 1 was measured by rhyme perception. A confirmatory factor analysis revealed that, together, rhyme perception and phonemic awareness at Time 2 represented the latent variable phonological awareness at Time 2, see Figure 1. Table 2 shows that model 1 has a reasonably good fit. In this model 22.0% of the variance in word decoding at Time 3 is explained by the latent variable phonological awareness at Time 2.

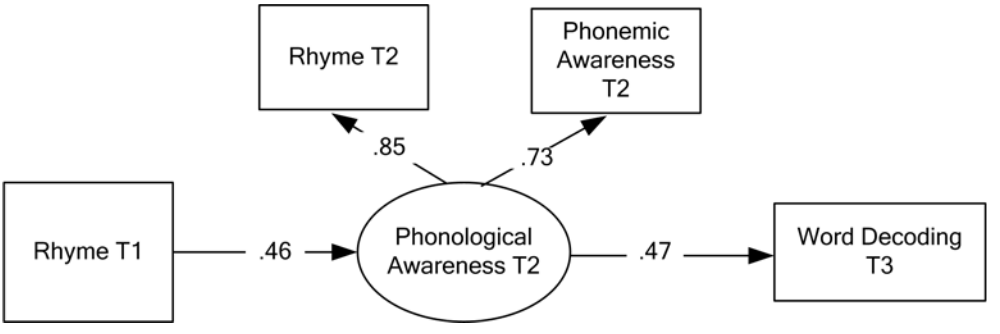

Figure 1

SEM model 1 for the Children Without Disabilities with Rhyme Perception at Time 1, the Latent Variable Phonological Awareness at Time 2, i.e., Rhyme and Phonemic Awareness, and Word Decoding at Time 3. Rectangles Represent Observed Variables and the Oval Represents a Latent Variable.

Model 2 tested the development of phonological STM as a predictor for word decoding. This model shows a moderate to good fit; see Table 2 for the fit indices. In this model, the β between phonological STM Time 1 to Time 2 was .28, and the β for phonological STM Time 2 for word decoding at Time 3 was .29. This model explained 8% of the variance in word decoding.

Table 2

Summary of SEM Analyses for the Children without Disabilities

	Model	χ^2	df	*p*	GFI	AGFI	NFI	CFI	RMSEA	SRMR
1	Phonological Awareness T1, T2 > Word Decoding (WD) T3	5.66	2	.059	.96	.80	.91	.93	.17	.07
2	Phonological STM T1, T2> WD T3	1.70	1	.192	.98	.90	.86	.93	.11	.06
3	Speech Perception T1, T2> WD T3	3.49	1	.062	.97	.80	.51	.39	.20	.09
4	Speech Production T1, T2 > WD T3	.62	1	.432	.99	.96	.98	1.00	.00	.03
5	Phonological Awareness, Phonological STM, Speech Perception T1, T2 > WD T3	10.68	8	.221	.96	.84	.91	.97	.07	.04
6	Phonological Awareness, Phonological STM, Speech Perception, Speech Production T1, T2 > WD T3	12.01	11	.363	.97	.84	.94	.99	.04	.04
7	Final Model T1, T2, and T3. Phonological Awareness, Phonological STM, Speech Perception, Speech Production T1, T2, and IQ T1> WD T3	14.02	13	.373	.97	.83	.94	.99	.04	.04

Note. GFI = Goodness of Fit Index, AGFI = Adjusted Goodness of Fit Index, NFI = Normed Fit Index, CFI = Comparative Fit Index, RMSEA = Root Mean Square Error of Approximation, and SRMR = Standardized Root Mean square Residual.

Model 3 tested the development of speech perception as a predictor for word decoding. As can be seen in Table 2, the fit of the model is not satisfactory. Speech perception at Time 2 was not a strong predictor of word decoding at Time 3 (β = .17). Model

4 tested the development of speech production in kindergarten for the prediction of word decoding in grade 1. The fit indices indicate a close fit. Speech production at Time 1 and Time 2 shows a strong relationship (β = .51), and therefore speech production at Time 1 was a good autoregressor for speech production at Time 2. The standardized Beta coefficient between speech production at Time 2 and word decoding at Time 3 is .28. In this model 25.5% of the variance in speech production at Time 2 is explained by speech production at Time 1, while only 7.9% of the variance in word decoding is explained by speech production at Time 2.

In the second series of SEM analyses the models were combined in a stepwise manner. First, model 5 was tested, wherein the development of the three most important predictors of early reading skills were combined, i.e., phonological awareness, phonological STM, and speech perception. The fit indices indicate a good fit for the model. In this model the most important predictor for word decoding was phonological Awareness at Time 2 (β = .43), followed by phonological STM (β = .17). In model 6, the development of speech production was added to the previous model. Again, phonological awareness (β = .42) and phonological STM (β = .17) turned out to be the best predictors of word decoding. This model explained 25.1% of the variance in word decoding. Furthermore, speech production at Time 1 was a good predictor of phonological awareness at Time 2 (β = .27).

In the final model, i.e., model 7, the variable nonverbal reasoning at Time 1 was added to the previous model. Adding nonverbal reasoning to this model did not change important structural relations between the variables. However, the addition of nonverbal reasoning resulted in a small decrease of the standardized Beta weight of speech perception at Time 1 for phonological STM at Time 2 from .32 to .26. Nonverbal reasoning turned out to only be predictive for phonological STM at Time 2 (β = .21). Figure 2 shows that phonological awareness, followed by phonological STM turned out to be the two most important predictors of word decoding one-year later. With regard to the development of phonological awareness at Time 2, apart from its autoregressor rhyme perception at Time 1, these skills were best predicted by speech production at Time 1 (β = .26). Model 7 explained 25.4% of the variance in word decoding.

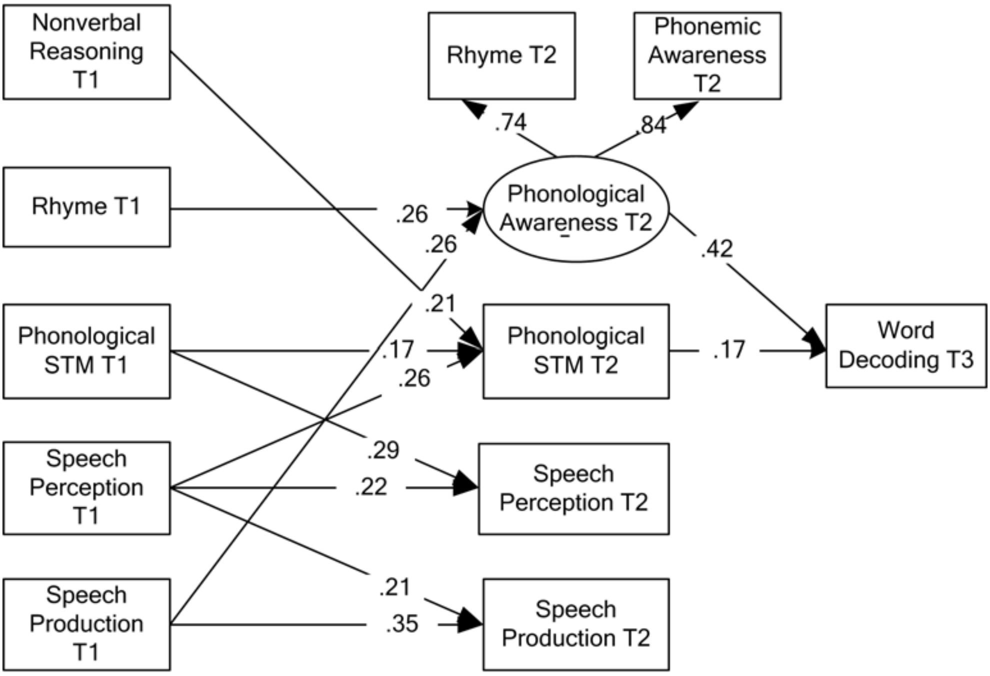

Figure 2

Final SEM Model 7 for theGroup of Children Without Disabilities, with Nonverbal Reasoning Time 1, Phonological Awareness, Speech Perception, Auditory STM, and Speech Production at Time 1 and Time 2, and Word Decoding at Time 3

Structural Equation Modeling for the Children with CP

The same series of SEM analyses were repeated for the group of children with CP. The first model tested the development of phonological awareness at Time 1 and Time 2 to predict word decoding at Time 3. A confirmatory factor analysis was performed to test if rhyme perception and phonemic awareness at Time 2 constituted the latent factor phonological awareness at Time 2. This turned out to be the case, as can be seen at the standardized Beta coefficients in Figure 3. The model shows a good fit (Table 3). The high standardized Beta coefficient of the latent variable phonological awareness for word decoding shows its high predictive value (β = .69). In addition, rhyme perception at Time 1 turned out to be a good autoregressor of phonological awareness at Time 2. This model explained 48.2% of the variance in word decoding at Time 3.

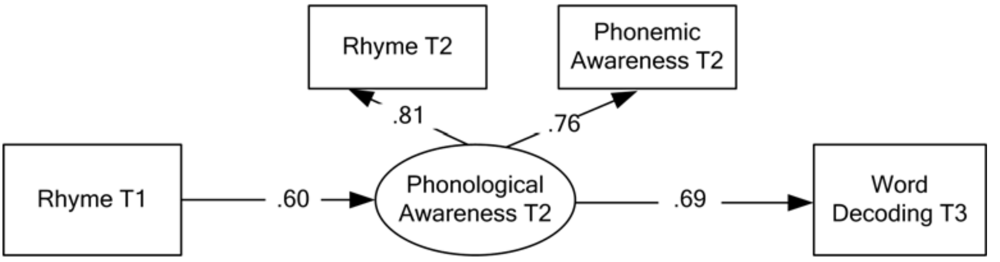

Figure 3

SEM Model 1 for the Group of Children with Cerebral Palsy with Rhyme Perception at Time 1, Phonological Awareness at Time 2, i.e., Rhyme and Phonemic Awareness, and Word Decoding at Time 3. Rectangles Represent Observed Variables and the oval Represents a Latent Variable

Table 3 shows that the development of phonological STM and its predictive value for word decoding resulted in a model with a close fit. Phonological STM was a good predictor of word decoding (β = .58) and phonological STM at Time 1 turned out to be a good autoregressor of phonological STM at Time 2 (β = .59). This model explained 33.1% of the variance in word decoding. Model 3 investigated the development of speech perception and its predictive value for word decoding. Table 3 indicates that this model has a close fit. Speech perception at Time 2 was a good predictor of word decoding at Time 3 (β = .58). In addition, speech perception at Time 1 was a good autoregressor of speech perception at Time 2 (β = .77). This model explained 33.5% of the variance in word decoding. Model 4 tested the development of speech production for word decoding at Time 3. Table 3 shows that the fit of the model is good again. Speech production at Time 2 was predicted by its autoregressor at Time 1 (β = .91). Furthermore, speech production was revealed as a good predictor for word decoding (β = .61). This model explained 36.5% of the variance in word decoding.

Table 3

Summary of SEM Analyses for the Group of Children with CP

	Model	χ^2	df	*p*	GFI	AGFI	NFI	CFI	RMSEA	SRMR
1	Phonological Awareness T1, T2> Word Decoding (WD) T3	1.84	2	.399	.98	.92	.97	1.00	.00	.03
2	Phonological STM T1, T2> WD T3	.00	1	.955	1.00	1.00	1.00	1.00	.00	.00
3	Speech Perception T1, T2> WD T3	.48	1	.487	.99	.96	.99	1.00	.00	.02
4	Speech Production T1, T2 > WD T3	.40	1	.528	1.00	.97	1.00	1.00	.00	.01
5	Phonological Awareness, Phonological STM, Speech Perception T1, T2 > WD T3	5.04	8	.753	.98	.90	.98	1.00	.00	.02
6	Phonological Awareness, Phonological STM, Speech Perception, Speech Production T1, T2 > WD T3	3.41	11	.984	.99	.94	.99	1.00	.00	.01
7	Final Model T1, T2, and T3. Phonological Awareness, Phonological STM, Speech Perception, Speech Production T1, T2, and Nonverbal Reasoning T1> WD T3	5.88	13	.950	.98	.90	.99	1.00	.00	.02

Note. GFI = Goodness of Fit Index, AGFI = Adjusted Goodness of Fit Index, NFI = Normed Fit Index, CFI = Comparative Fit Index, RMSEA = Root Mean Square Error of Approximation, and SRMR = Standardized Root Mean Square Residual

In the second series of SEM analyses the models were combined. In Model 5, the development of phonological awareness, phonological STM, and speech perception were used to predict word decoding. This model shows a good fit. The best predictor of word decoding in this model was phonological awareness (β = .42), followed by speech perception (β = .18), and phonological STM (β = .17). This model explained 47.5% of the variance in word decoding. Phonological awareness was the most important precursor of word decoding, in correspondence with the results of the SEM analyses for the group of children without disabilities. This model explained 26.2% of the variance in word decoding.

In model 6, speech production at Time 1 and Time 2 was added to the previous model. The fit indices indicate a good fit. Whereas in model 5 phonological awareness was the main predictor of word decoding, as was also found in the final model of the children without disabilities, when speech production was added to the model this variable became the main predictor of word decoding (β = .34), followed by phonological awareness (β = .24), and speech perception (β = .24). These results show that when taking speech production into account, the importance of phonological STM and phonological awareness decreased. The role of speech production was not limited to the prediction of word decoding, as speech production at Time 1 was also good a predictor of phonological awareness (β = .34), phonological STM (β = .29), and speech perception (β = .14) at Time 2. This model explained 55.2% of the variance in word decoding.

In the final model, nonverbal reasoning at Time 1 was added to the previous model and this model shows a very good fit. Adding nonverbal reasoning to the model did not change many of the structural relationships between the variables, except that nonverbal reasoning proved to have predictive value for phonological awareness and phonological STM at Time 2. Figure 4 shows the final SEM model for the children with CP. This final model explained 55.4% of the variance in word decoding. Furthermore, the model indices did not indicate any potential for improving the fit of the model.

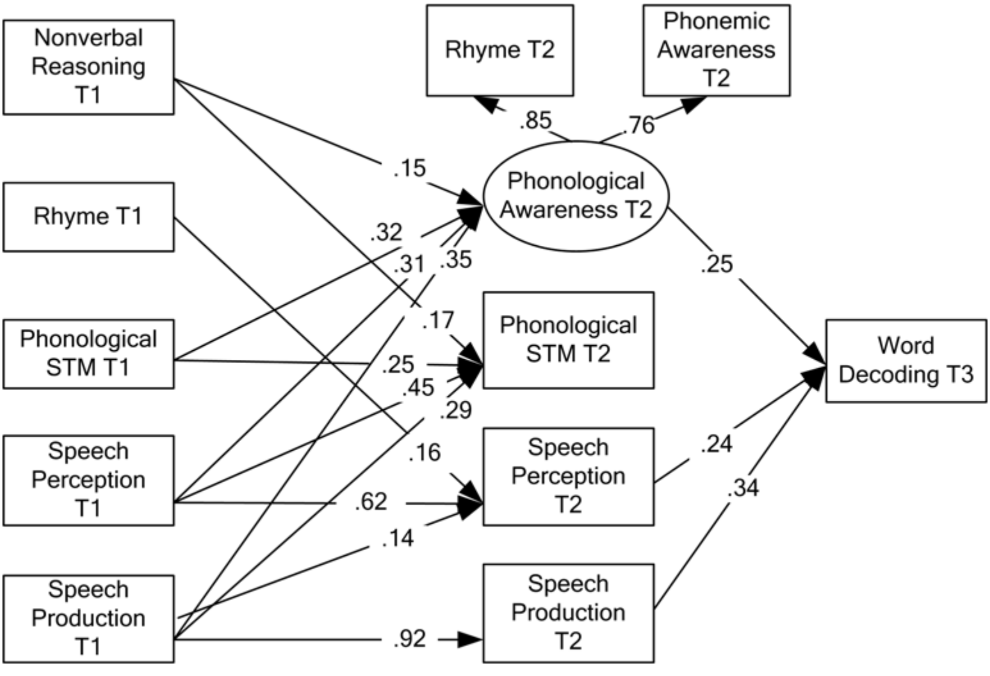

Figure 4

Final SEM Model 7 for the Group of Children with CP, with Nonverbal Reasoning at Time 1, Phonological Awareness, Speech Perception, Phonological STM, and Speech Production at Time 1 and Time 2, and Word Decoding at Time 3

Conclusions and Discussion

Several conclusions can be drawn from the present study. First of all, children with CP lag behind their peers in the development of precursor skills for reading as early as the second year of kindergarten. These results are in line with previous studies indicating that children with CP show a delay in emergent literacy skills, even before the start of formal reading and writing education (Peeters et al., 2008; Peeters, Verhoeven, de Moor, van Balkom, & van Leeuwe, 2009).

The SEM model for children without disabilities reveals that, in accordance with previous studies, phonological awareness and phonological STM are the most important precursors for word decoding (Wagner & Torgesen, 1987; Wagner et al., 1997). The results show that when controlling for phonological awareness at Time 2, phonological STM at Time 2 played an independent role in the prediction of word decoding. This implies that, in order to decide which written word matches a presented picture (i.e., the task of the word decoding test), children must be aware of the word's individual phonemes and remember the phonemes when recoding the graphemes into phonemes in order to blend them together to form a word. Then, the child is able to decide whether the recoded word matches the presented picture or if he or she should consider the next word as a possible match.

As expected, the set of precursors that were predictive of word decoding skill differ for the group of children with CP and the comparison group. The SEM model for children with CP revealed that speech production was the most important precursor of word decoding for these children. A potential explanation for the importance of speech production for the development of word decoding in children with CP may lie in the problems children with speech impairments experience with the retrieval of whole-word phonology, or the access and retrieval of phonological lexical representations. Vandervelden and Siegel (1999) investigated the effect of speech impairments on retrieval of whole-word phonology by looking at the difference between the scores of two conditions in a word-to-print matching task. Following the presentation of a picture (condition one) or a spoken word (condition two), the task of the student was to select the written word that matches one of three pictures/spoken words. The results pointed out that the picture-presentation was more difficult than the spoken word condition. This design was also used in a rhyme judgement task and a word spelling task. Results indicated that the group of AAC-users with no intelligible speech scored lower than the reading-level matched control group on all tasks. Furthermore, the AAC-user group scored significantly lower on almost all tasks compared to the speech-impaired group with impaired but intelligible speech. These results suggest that non-speaking students who use AAC may have problems in retrieving the phonological form of words, which may interfere with their phonological recoding skills. As in the present study, word decoding was assessed by presenting a picture, rather than a spoken word, that needed to be matched to a written word. The fact that the test assistant did not name the picture, requiring the child to cognitively access the phonology of the word, may have complicated the task for children with low speech production.

Some conclusions can be drawn with regard to the structural relationships between reading precursors for the group of children without disabilities. First of all, speech production at Time 1 was important for the development of phonological awareness at Time 2. These results are in line with previous studies indicating that the quality of articulation, or articulation accuracy, is an important determinant of growth in phonological awareness (Webster & Plante, 1995).

The structural relationships between reading precursors in the group of children with CP show a strong effect of speech production at Time 1 on the other reading precursors at Time 2. First of all, speech production did play a major role in the development of phonological awareness. Children with CP who had better word articulation skills were more aware of the sound structure of the language. These results are in line with previous studies (Peeters et al., 2008). Though we know from previous research that the ability to articulate is not necessary for phonological awareness to emerge (Card & Dodd, 2006; Foley & Pollatsek, 1999), the results of this study show that the extent to which a child is able to articulate influences his or her phonological awareness development. These results highlight the facilitating role of overt or covert speech; the more children can use overt or covert speech in order to determine which picture starts with the same first-phoneme, or to find out whether two words rhyme, the better their phonological awareness skills are. Therefore, children with low levels of articulation and non-speaking children are disadvantaged in their development of phonological awareness. Furthermore, the present study points out that the facilitating role of speech production is not limited to the development of phonological awareness. Also, the better the articulation skills of the child, the longer the string of words the child can remember and thus the better the phonological STM spans of the child. These results show a linear relationship between the quality of the articulation and the memory spans of the children with CP.

Although the present study reveals an important role for speech production in the development of word decoding and its precursors, the study has some limitations. To begin with, the present study showed that the speech production of children with CP was related to the development of their phonological STM. However, although speech production, i.e., articulation accuracy, was included in the present design, speech rate was not. Previous studies have shown that speech rate is closely related to performance of short-term memory tasks (Hulme, Thomson, Muir, & Lawrence, 1984; Raine et al., 1991). Future research should include speech rate in order to uncover whether this variable plays an additional role in explaining phonological STM skills of children with CP. Moreover, future research should investigate what role speech production skill plays in the later stages of reading development, when basic levels of decoding skills are achieved. Do reading skills then depend more on phonological STM for the automaticity of word identification or on understanding complex syntactic and text comprehension skills instead of speech production skills? Longitudinal studies including word decoding and text comprehension skills could answer these questions.

Furthermore, in the present study the group of children with CP was considered as one group. The reason was that subdividing the group of children into subgroups would result in very small groups. In addition, studies investigating the reliability of the classification of type of CP report at best a reasonable reliability and reliability regarding further subdivisions has hardly been studied (Blair & Stanley, 1985; Krageloh-Mann et al., 1993).

The results of the present study have a number of implications for clinical practice. First of all, the role that speech production plays in the development of reading precursors and word decoding stresses the need for early intervention for children with speech impairments. One way to improve the speech production skills or speech intelligibility skills in general of children with CP is by providing them with AAC devices with a speech-output component. In a research review Millar, Light, and Schlosser (2006) stated that, in general, AAC intervention lead to at least modest gains in speech production skills of participants, although they stated that more research is needed to better understand the relationship between AAC intervention and speech production across a wider range of participants and AAC interventions.

The role of speech-generating devices is not limited to improving natural speech production. Researchers have hypothesized that speech-generating devices, also known as voice-output communication aids, can be effective in developing subvocal articulatory rehearsal and phonological awareness (e.g., Blischak, 1994; Schlosser, 2003; Schlosser, Blischak, Belfiore, Bartley, & Barnett, 1998). For example, Blischak, Lombardino, and Dyson (2003) hypothesized that speech-generating devices can play a role in the development of an internal phonology. Experiences with sound patterns provided by speech-generating devices can help children to become more aware of the individual phonemes of the language and can support the internal phonological information needed for reading and writing development. Furthermore, Steelman, Pierce, and Koppenhaver (1993) stated that speech feedback in computer-aided instruction can improve the literacy skills of children with speech impairments, because it gives them the opportunity to map oral language onto written language. Up to now, the role of speech output for promoting literacy skills has only been systematically studied in children without disabilities (cf. Olofsson, 1992; Wise & Olson, 1992). Studies investigating the use of speech feedback for improving phonological awareness and literacy skills of children with CP are scarce. Dahlgren Sandberg (1997) indicated a positive effect of synthetic speech for reading skills in a group of children with CP. She concluded that a subgroup of non-vocal readers who used speech synthesis in spelling and reading training at school scored higher on tasks of phonological awareness and vocabulary than a subgroup of non-vocal non-readers who did not use synthetic speech. In addition, Schlosser, et al., (1998) showed that the spelling skills of a non-speaking child with autism improved when computer-based speech-output feedback was given.

As children with CP lag behind in phonological awareness and the fact that these skills are also important precursors of literacy in this population, early intervention for phonological awareness is needed in order to prevent these children from developing limited word decoding skill. One method of intervention could consist of playing language games with educational software. Earlier research (Segers & Verhoeven, 2004) has indicated that children with specific language impairments can benefit from computer training for phonological awareness. However, considering the physical and speaking barriers children with CP often encounter, it is important that any intervention be adapted by means of AAC devices. One potential multimedia tool that has been adapted to these physical and speech limitations is LinguaBytes; an interactive, tangible play and learning system to stimulate the language development of toddlers with multiple disabilities (Hengeveld et al., 2008; Voort et al., 2008). The system uses a variety of input and display modules for play and learning activities. The content is based on interactive storytelling and anchored instruction (Stoep & van Elsäcker, 2005). Eight themes were selected, such as animals, in and around the house, people, toys, and traffic. Each theme starts with a story which consists of several scenes. In each scene a part of the story is told using audio, pictures, and animations. Following the story, each theme offers a set of playful exercises, primarily to train language skills, speech perception, and phonological awareness. For each theme, phonological exercises with incremental levels of complexity are presented. For example, in the theme 'animals' the easiest phonological awareness exercises consist of playing songs and rhymes. The toddler can place an animal on the module and the system reacts by playing a well-known song about that animal and by showing the animal with meaningful animations on the screen. Because LinguaBytes combines phonological awareness intervention by using a multimedia tool that can be adapted to the physical needs of the child, this is a valuable tool that speech and language therapists can use when training phonological awareness and other language skills in children with CP and other disabilities.

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Appendices

Appendix A

Input Correlation Matrix for Structural Equation Modeling Analyses for the Children without Disabilities

		1	2	3	4	5	6	7	8	9	10	11	12
1	Speech Per T1	1											
2	STM T1	.38	1										
3	Rhyme T1	.45	.26	1									
4	Speech Pro T1	.58	.35	.41	1								
5	NR T1	.46	.38	.29	.40	1							
6	Speech Per T2	.17	.22	.13	.10	-.11	1						
7	STM T2	.37	.28	.23	.21	.36	.01	1					
8	Rhyme T2	.30	.23	.33	.35	.23	.21	.21	1				
9	Phon T2	.33	.26	.37	.39	.26	.24	.24	.62	1			
10	Phon factor T2	.40	.32	.44	.47	.32	.28	.29	.74	.84	1		
11	Speech Pro T2	.43	.35	.24	.51	.27	.23	.31	.41	.46	.55	1	
12	Word T3	.23	.19	.23	.23	.18	.17	.29	.35	.40	.48	.28	1

Note. Speech Per= Speech Perception, STM= Phonological STM, Speech Pro= Speech Production, NR= Nonverbal Reasoning, Phon= Phonemic Awareness, Phon factor= factor Phonological Awareness, Word= Word Decoding.

Appendix B

Input Correlation Matrix for Structural Equation Modeling Analyses for the Children with CP

		1	2	3	4	5	6	7	8	9	10	11	12
1	Speech Per T1	1											
2	STM T1	.64	1										
3	Rhyme T1	.60	.52	1									
4	Speech Pro T1	.35	.20	.49	1								
5	NR T1	.39	.39	.65	.28	1							
6	Speech Per T2	.77	.51	.62	.44	.43	1						
7	STM T2	.70	.59	.52	.48	.44	.74	1					
8	Rhyme T2	.56	.52	.48	.45	.39	.55	.55	1				
9	Phon T2	.50	.46	.42	.40	.35	.49	.49	.64	1			
10	Phon factor T2	.65	.61	.56	.53	.46	.65	.65	.85	.76	1		
11	Speech Pro T2	.31	.20	.42	.91	.26	.34	.45	.49	.44	.58	1	
12	Word T3	.51	.39	.48	.59	.34	.58	.58	.56	.50	.65	.60	1

Note. Speech Per= Speech Perception, STM= Phonological STM, Speech Pro= Speech Production, NR= Nonverbal Reasoning, Phon= Phonemic Awareness, Phon factor= factor Phonological Awareness, Word= Word Decoding.

Home Literacy Environment: Characteristics of Children with Cerebral Palsy[1]

Chapter 4

[1] Reference: Peeters, M., Verhoeven, L., van Balkom, H. & de Moor, J. (in press). Home literacy environment: Characteristics of children with cerebral palsy. International Journal of Language and Communication Disorders (2008), DOI: 10.1080/13682820802464759

Abstract

Background. Various aspects of the home literacy environment (HLE) are considered to stimulate the emergent literacy development in children without disabilities. It is important to gain insight into the HLE of children with cerebral palsy (CP), given that they have been shown to have difficulty acquiring literacy skills.

Aims. The aims of the present study were to investigate whether the HLE of children with CP was comparable to that of peers without disabilities and to investigate to what extent speech, fine motor, and intellectual impairments limit their home literacy experiences.

Method & Procedures. Questionnaires addressed to the parents of the children were devised to investigate differences in the HLE in 40 children with CP and 62 peers without disabilities who were comparable on chronological age, i.e., 6-years-old, socioeconomic status (SES), and sex. The relative influence of speech intelligibility, fine motor skills, and intelligence skills for the HLE factors of children with CP was investigated.

Outcomes & Results. Only a few group differences were significant: children with CP were less interested in participating in writing activities, and less involved in word orientation activities during shared storybook reading. On the other hand, parents of children with CP were doing more leisure activities with their child. The speech intelligibility scores of the children with CP predicted the amount of emergent literacy activities they were doing with their parents, as wells as their active participation in word related activities during storybook reading. In addition, the active participation of the child in story related activities could be predicted by his or her fine motor skills. Furthermore, parents of the children in the comparison group often had high expectations, while parents of the children with CP often did not know what expectations to have for their child's literacy level at the end of elementary school.

Conclusions & Implications. Although both groups have stimulating home literacy environments, children with CP with speech or fine motor impairments are disadvantaged in a small number of literacy activities. Teachers and SLTs can work with parents to give them suggestions how to conduct emergent literacy activities with their child with speech impairments as well as how to involve their child with speech and fine motor dysfunctions more actively in storybook reading activities. Furthermore, parents should be given more information about their child's language development in order to better understand what goals are achievable so they may begin to form realistic expectations.

What this paper adds.

Section 1: What is already known about this subject?

Earlier studies have shown that children with CP received fewer literacy experiences and were less actively involved in storybook reading. However, it is difficult to interpret and use the results of previous studies as they studied different populations and different aspects of the HLE without relating these aspects to the child's level of speech intelligibility, fine motor skills or intelligence.

Section 2: What this study adds.

By investigating the HLE in a broad perspective through the use of composite scores instead of individual items, the current study gives reliable outcomes on the differences in the HLE of children with CP and peers without disabilities. The study supports earlier findings that the HLE of children with CP in many ways is comparable to that of nondisabled peers. Furthermore, the present study reveals that not only speech intelligibility, but also fine motor skills play a role in the amount of literacy activities and the active involvement in storybook reading of the children with CP.

Introduction

The home literacy environment (HLE) is considered to be the setting in which language and literacy is typically first encountered, e.g., children first acquire experiences with books at home by observing parents reading or by shared book reading sessions. Though shared book reading sessions have traditionally been considered the most important aspect of the HLE, the HLE is currently seen as a multifaceted construct that consists of various interrelated aspects associated with language and literacy development (Bus, IJzendoorn, & Pellegrini, 1995; Leseman & de Jong, 1998). Roughly, the HLE can be subdivided into aspects related to home literacy materials and activities, and the quality of the interaction, i.e., the active involvement of the child in literacy activities. In addition, parents' expectations for their child's literacy development are considered to influence the child's literacy development indirectly through the opportunities they give their child to develop literacy skills (Light & McNaughton, 1993).

Concerning home literacy materials and activities, this can be divided in the aspects: child's interest and experiences with literacy materials (Roberts, Jurgens, & Burchinal, 2005), the amount of emergent literacy activities parents provide their child that stimulate the literacy development, i.e., rhyming and playing language games (Burgess, Hecht, & Lonigan, 2002; Foy & Mann, 2003; Haney & Hill, 2004), parents' provision of literacy materials for their child (Sénéchal, Lefevre, Thomas, & Daley, 1998), and the literacy materials, activities and habits of the parents (Foy & Mann, 2003). Although previous studies indicate an association between the frequency of shared book reading and the language and literacy development of the child, according to a review of Scarborough and Dobrich (1994) these associations are modest at best. Possibly, it is not the frequency of shared book reading that matters, but the quality of the activities and interaction that promote language and literacy development.

Regarding the quality of parent-child interaction during shared book reading, previous studies indicate that dialogic reading supports children's oral language and emergent literacy skills (Hargrave & Sénéchal, 2000; Reese & Cox, 1999). While during traditionally shared book reading the adult reads the story and the child listens, in the intervention method dialogic reading the child learns to become the active storyteller. The adult assumes the role of an active listener by asking questions and prompting the child to give more elaborated descriptions, for example, descriptions of the pictures of the story. Gradually, the responsibility for telling the story will be shifted from the adult to the child, and the active participation of the child is assumed.

Although the above aspects of the HLE are related to the language and emergent literacy development of the children, it is important to take into account the socioeconomic status (SES) of the family when investigating the HLE. Previous studies indicate that SES is related to some aspects of the HLE, such as the availability and use of printed materials of the children (Feitelson & Goldstein, 1986; McCormich & Mason, 1986) and parental literacy habits (Weigel, Martin, & Bennett, 2006).

Taking into account the importance of early literacy experiences at home for language and literacy development, these experiences seem to be particularly important for children with cerebral palsy (CP). Besides their motor impairments, these children are often characterized by additional speech and cognitive impairments (cf. Bax. et al., 2005) that put them at risk for limited language and literacy development, even at preschool age (Feldman, Janosky, Scher, & Wareham, 1994; Peeters, Verhoeven, van Balkom, & de Moor, 2008). For example, Peeters et al., (2008) indicated that preschool children with CP lagged behind their peers without disabilities in emergent literacy skills, such as oral language and phonological awareness.

Previous research to the HLE of children with CP is scarce. Concerning the home literacy materials and activities, there were differences between children with CP and children without disabilities. For instance, Light and Kelford Smith (1993) showed that children with severe speech and physical impairments who used augmentative and alternative communication (AAC) had less opportunity to use printed materials and to participate in writing and drawing activities in comparison to a control group of younger children without disabilities. In addition, Dahlgren Sandberg (1998) indicated that nonvocal children with CP who used Bliss symbols to communicate showed considerable less interest in participating in writing activities in comparison to the nondisabled group matched for mental age and sex. According to Weikle and Hadadian (2003) and Marvin (1994) differences in HLE are not limited to the above. These authors reported that parents of children without varying disabilities used general literacy practices, i.e., reading aloud to their child, and encouraging their child to write letters, more frequently than parents of preschoolers with disabilities. With regard to the parents' own reading and writing habits, no differences were found between a group of AAC-using children with CP and a control group without disabilities (Light & Kelford Smith, 1993).

Regarding the active involvement of the child in shared storybook reading sessions, previous studies all drew similar conclusions. The involvement of children with CP during shared storybook reading was limited; often the interaction was dominated by the mother, leaving little space for the child to participate (Dahlgren Sandberg, 1998; Light, Binger, &

Kelford Smith, 1994). Dahlgren Sandberg (1998) further reported that the nonvocal Bliss using children with CP, in comparison to their peers without disabilities, were less active in using linguistic expressions during shared book reading, e.g., labeling pictures, asking and answering questions, or guessing what will happen in the story. With regard to parents' expectations, Marvin (1994) reported that parents' expectations for their child's literacy learning differed from those of parents with children without disabilities. Furthermore, parents' expectations were lower for the group of children with multiple disabilities in comparison to the group of single disabilities.

It is difficult to draw conclusions from earlier research for the HLE of a representative group of children with CP, as previous studies investigated either wide ranges of populations and age groups (Marvin, 1994) or just very specific groups of children with CP, i.e., non-vocal Bliss-using children with CP (Dahlgen Sandberg, 1998). In addition, few studies have made use of composite scores instead of individual items based on factor analyses in order to increase reliability (cf.Dahlgren Sandberg, 1998). Also, in studying the HLE of children with CP it is important to take into account the fact that these children often have additional impairments that can limit their literacy experiences. For example, speech impairments can limit the interaction during storybook reading (Pennington & McConachie, 2001), fine motor impairments can lead to difficulties in handling literacy materials, e.g., books or crayons, and can affect the ability to scribble or draw (Pierce & McWilliams, 1993), and lower levels of intellectual functioning are associated with lower levels of independent book reading, i.e., letter or word reading (cf. Stanovich, Cunningham, & Feeman, 1984). Previous studies mainly compared groups of children with and without speech impairments instead of relating speech abilities to the HLE, and without taken into account the lower fine motor and intellectual skills children may have. At the moment, research that has taken the relative impact of speech, cognitive, motor, and language impairments into account on different aspects on the HLE is lacking.

The present study aims to overcome the limitations of previous research. To obtain a comprehensive overview of the HLE, extensive parent questionnaires were administrated covering aspects related to home literacy materials and activities, and the active involvement of the child during shared book reading sessions. Furthermore, parents' expectations of their child's literacy will be investigated. The HLE of a group of 40 children with CP will be compared to that of a group of 62 peers without disabilities. Furthermore, the relative influence of the child variables, i.e., speech intelligibility, fine motor function, and intelligence on HLE will be investigated. In addition, the SES and language scores of the children will also be taken into account to check if these are related to some of the HLE aspects and should be controlled for in further analyses. The following research questions will be addressed in this study:

1. What differences are there in aspects of HLE between children with CP and peers without disabilities?
2. What is the relative influence of speech intelligibility, fine motor function, and intelligence on the different HLE factors?
3. Are there differences between the parents of the children with CP and the comparison group regarding the expectations of their child's reading and writing levels? To what extent are parents' literacy expectations related to the child variables?

With regard to the first question, the expectation is that there will be differences in the HLE in the different groups in terms of the amount of writing experiences the children have and the level of active involvement of the child during storybook reading, as in accordance with the results of previous studies. Additionally, no differences are expected in parents' own literacy habits. Concerning the second question, it is expected that for children with CP, the fine motor skills, speech intelligibility, and intellectual skills will all be related to some or more aspects of the HLE. For example, the active involvement of the child during storybook reading is expected to be related to speech, intellectual, as well as fine motor skills of the children. Regarding the expectations parents have for their child's literacy level at the end of elementary school, the prediction is that parents of children with CP will have lower expectations for their child's literacy development than the parents of the children without disabilities, as children with CP often lag behind in the acquisition of emergent literacy skills. In addition, the prediction is also that these expectations to some extent are related to the current language level of their child.

Method

Participants

The children in the present study were all participants of a longitudinal study investigating the emergent literacy development of children with CP and their peers without disabilities (cf. Peeters et al., 2008). For that longitudinal study, all thirty-two schools for children with physical and multiple disabilities in the Netherlands were asked to participate and obtain written consent of the parents of children with CP who fit the inclusion criteria. Inclusion criteria for the children with CP were as follow: Dutch must be their native language, the intellectual level must range from a mild intellectual disability to average intelligence or above, hearing and vision must be within the normal range, with the ability to respond intentionally, either through speaking or by means of alternative communication (e.g., looking, pointing or gesturing), and they must be five years old at the beginning of the longitudinal study. Fifty-four children with CP and 71 children without disabilities participated in the longitudinal study. However, the response rate of the parent questionnaires was 74% for the children with CP and 87% for the comparison group, resulting in a total participation of 102 children in the present study: 40 children with CP and 62 children without disabilities. All parents of these children had given written consent for their children to participate in this study.

The group of children with CP consisted of 23 boys and 17 girls with an average age of 72 months (*SD* = 5.8). Thirty-five children had spastic CP (87.5%), 2 children had a combination of spastic-ataxic CP (5%), 1 child had spastic-hypotonia CP (2.5%), 1 child had spastic-dyskinetic CP (2.5%) and 1 child had ataxia (2.5%). Of the children with spastic CP, 15 (38.5%) had quadriplegia, 16 (41%) had diplegia, and 8 (20.5 %) had hemiplegia. Seven children (17.5%) had seizures. The speech and language therapists of the children reported that 19 children (47.5%) had no speech difficulties, 6 had mild dysarthria (15%), 6 had moderate dysarthria (15%), and 6 children were unable to speak. Furthermore, three children (7.5%) had a combination of dyspraxia and severe dysarthria. The average speech intelligibility scores (Verhoeven, 2006) of the 19 children without speech impairment, 12 children with mild to moderate speech impairments, and nine children with severe speech impairments were respectively: 28.53 (*SD* = 6.92), 13.08 (*SD* = 7.85), and .56 (*SD* = 1.67).

The comparison group consisted of 62 children who originated from five mainstream schools: 33 boys and 29 girls with an average age of 72 months (*SD* = 3.5). These children had no known impairments and all spoke Dutch as their native language. As these children did not have any problems with fine motor functioning, these children were all given the maximum score on fine motor functioning.

The group of children with CP and the comparison group were comparable on: average age, i.e., 72 months, $t(100) = .443$, $p > .05$, socioeconomic status (SES) measured by the average educational level of the parents, χ^2 (12, N = 102) = 14.36, $p > .05$[2], family constellation, χ^2 (1, N = 102) = 3.27, $p > .05$[2], birth order, χ^2 (4, N = 102) = 3.36, $p > .05$[2], gender, χ^2 (1, N = 102) = .179, $p > .05$, language spoken at home χ^2 (2, N = 102) = 1.51, $p > .05$, age of the parent who actually responded to the questionnaire, $F(1, 100) = .045$, $p > .05$, and the number of siblings of the children in their home, χ^2 (2, N = 102) = 2.81, $p > .05$[2].

[2] The results of this Chi-square should be interpreted with caution, since more than 20% of the cells have expected cell frequencies less than 5 and/ or the minimum expected cell frequency is less than 1.

Table 1

Background Characteristics of the Children and Families

Group	CP	Comparison
Gender	23 girls; 17 boys	33 girls; 29 boys
Age	72 months, *SD* = 5.8	72 months, *SD* = 3.5
Place of the child in the child row/ birth order [a]	Mean: 1.50 Range: 1-4	Mean: 1.76 Range: 1-5
Mode of communication in daily life	6 children used one or more communication devices, or used one or more sorts of symbols to communicate instead of speech, and 1 child used AAC besides speech, 33 children used only speech to communicate	All 62 children use speech to communicate
Use of AAC during storybook reading	2 children use signs	-
Family constellation	1 One parent-family 39 Two-parents family	8 One parent-family 54 Two-parents family
Siblings	Brothers Mean .65, range 0-2 Sisters Mean .60, range 0-2	Brothers Mean = .65, range 0-2 Sisters Mean = .60, range 0-2
Language in the home	32 Dutch 8 Dutch and a second language (i.e., dialect)	46 Dutch 16 Dutch and a second language (i.e., dialect)
Actual respondent	7 fathers 32 mother 1 both parents	7 fathers 54 mothers 1 both parents
Age of the parent who responded to the questionnaire	Mean: 36.88 years Range: 25-52	Mean: 37.10 years Range: 23-47
SES, average educational level of the parents [b]	Mean: 4.9 Range: 2-7	Mean: 4.5 Range:1-7

Note. [a] 1= first child, 2=second child to 6=sixth child, [b] 1= no education to 7 = academic education

Materials

The materials used for this study were: five self-administrated parent questionnaires regarding the HLE, standardized tasks for speech intelligibility, intelligence, and language were administrated, and a questionnaire concerning fine motor skills was used.

Home literacy variables

Five parent questionnaires regarding the HLE were constructed based on earlier research (Dahlgren Sandberg, 1998; Light & Kelford Smith, 1993; Marvin, 1994; Stoep, Bakker, & Verhoeven, 2002). These self-administrated questionnaires were composed of open-ended and multiple-choice items, each questionnaire referred to another aspect of the HLE.

Child literacy interest. There were a total of thirteen items regarding the child's literacy experiences and interests. Ten of these items addressed the frequency of using literacy materials on a 5-point scale ranging from: never or almost never, weekly, a few times a week, daily, to a few times a day. Two items addressed the child's interest in reading, writing and drawing activities and were asked on a 3-point scale ranging from: no interest, a little interest, to a lot of interest. It was explained that writing and drawing activities could also be done on an AAC device or a computer. One item concerned the frequency the child asked to be read to on a 6-point scale ranging from almost never to a few times a day. The internal consistency of this questionnaire was sufficient (α =.69).

Child's activities during storybook reading. Twelve items addressed the extent to which the child actively participated in certain activities during storybook reading in comparison to the parent on a 4-point scale. The response options ranged from: only the parent participates in this activity, the parent usually participates in this activity and the child participates occasionally, the child usually participates in this activity and the parent participates occasionally, to only the child participates in this activity. Examples of the activities are: turning the page, asking a question about the book or retelling the story. The internal consistency of this questionnaire was sufficient (α = .69).

Materials and parental activities for child literacy development. A total of twenty-two items addressed materials and activities for the child. Eight of these were open-ended items concerning the amount of literacy materials available to the child. One open-ended item addressed the child's age when the parent first began introducing him or her to storybook reading activities and the other item concerned the duration of storybook reading sessions. Furthermore, one item concerned the extent to which the parent enjoyed reading to the child, measured on a 3-point scale ranging from: (1) I don't like to read to my child, e.g., because I prefer to play with my child or because I don't know the best way to go about it,

(2) sometimes I like to read to my child, to (3) Yes, I like to read to my child. Items regarding the frequency of play activities, picture-book reading, and library visits ranged on a 5-point scale from: almost never, weekly, a few times a week, daily, to a few times a day. Three items addressed the frequency of participating in literacy related activities together with the child, and the four response options ranged from: almost never, a few times a month, weekly, to daily. Two questions addressed how often the child was involved in own reading or writing activities of the parent. The four response options ranged from: almost never, very rarely, sometimes, to mostly. The internal consistency of this questionnaire was sufficient to good (α = .78).

Parents' literacy materials and activities. Five open-ended items concerned the parent's amount of literacy materials. Eight items concerned the frequency with which literacy activities took place on a 5-point scale and ranged from: almost never, weekly, a few times a week, daily, to a few times a day. The internal consistency of this questionnaire was sufficient (α =.73).

Parents' expectations for their child's literacy development. Parents' literacy expectations for their child at the end of elementary school, i.e., the end of the 6th grade at an average age of 12 ½ years, were assessed with two multiple-choice items regarding reading and writing expectations. Response options ranged from: I don't know what to expect, child won't be able to read, child will be able to read symbols, e.g., Bliss symbols, PCS symbols or picto's, i.e., pictures, illustrations or photos, child will be able to read letters, child will be able to read words, child will be able to read easy texts, to child will be able to independently read a book. The response options for the writing expectations were: I don't know what to expect, child will not be able to write or type with an AAC device or computer, child will be able to write or type some letters, child will be able to write or type words, child will be able to write or type an easy text, to child will be able to write or type a long text or story.

Child Variables

Speech intelligibility. In order to assess children's speech intelligibility, a standardized subtest of the Dutch Speech Language Impairment (SLI) Screeningtest was administrated (Verhoeven, 2006). The child was asked to repeat real words, presented individually by a recorded voice. The task started with words containing only one syllable and gradually increased in difficulty to words containing up to five syllables. The task was ended if the child made five successive errors. Eighty percent of the children with CP were able to participate in this task since they had some level of intelligible speech and the other children were given a score of zero. The maximum score was 40. The test manual reported good internal consistency with a Cronbach's alpha of .94 (Verhoeven, 2006).

Intelligence. Nonverbal reasoning was measured with the Raven Coloured Progressive Matrices (Raven, 1956). This task measures nonverbal reasoning with a minimal interference of language and is a commonly used instrument to assess intelligence, or general reasoning ability in the nonspeaking population (cf. Dahlgren Sandberg, 1998). Children were asked to point to the correct one of six pictures that completed the presented figure. The task consisted of 36 items. Raw score were converted to standard scores ranging from .5 to 9.5 using Dutch norms (van Bon, 1986). The reliability of the test is considered satisfactory (Evers, van Vliet-Mulder, & Groot, 2000). This task was administrated six months earlier during a measurement of the longitudinal study.

Fine motor function. The fine motor function skills were assessed by means of the Dutch version of the Manual Ability Classification System (MACS) for children with CP (Eliasson et al., 2006). The purpose of the MACS is to assess the child's ability to handle objects and his or her need for assistance or adaptation in order to be able to perform tasks in everyday life on five different levels. A particular emphasis is placed on handling objects in an individual's personal space. According to the manual, the higher the level that is applicable the more the child is impaired in his or her fine motor skills, but to make interpretations easier the levels were recoded. Therefore, level one refers to children who can not handle objects and have severely limited abilities to perform even simple actions, while level five refers to handling objects easily and successfully. Research has indicated that the MACS has good validity and reliability (Eliasson et al., 2006).

Vocabulary. Receptive vocabulary was assessed using a Dutch version (Schlichting, 2005) of the Peabody Picture Vocabulary Test III (Dunn & Dunn, 1997). In this standardized test, the task of the child was to point to one of the four pictures that corresponded with the word spoken by the test assistant. Raw scores were converted to standard scores (M = 100, SD =15). The test manual described an internal consistency interval of Cronbach's alpha between .92 and .94.

Factor Analyses

First, missing values were computed with the estimated means (EM) method for an average 2% of the items of the parent questionnaires. Subsequently, responses to open-ended questions were converted into categorical scores ranging from 1 to 5. Factor analyses were conducted to subsume items to different factors. Separate factor analyses were performed for the first four HLE questionnaires, using Principal Axis Factoring (PAF).

PAF was used since it allows the factors to be interrelated but also to tap into different pools of variance within the HLE. These factors were submitted to promax rotation with Kaiser Normalization. The number of factors extracted was determined by eigenvalues greater than one (Kaiser's criterion) and interpretability. Factor loadings ≥ .30 were interpreted as salient. Items with loadings <. 30 were not included in the composite scores. The last questionnaire was analysed by means of Chi-square tests.

Tables 2 to 5 show the results of the factor analyses of the five parent questionnaires for the group of children with CP and the comparison group together. As can be seen in these tables, each questionnaire can be subdivided into three or four factors. In all analyses, the extracted factors together explained at least 48% of the observed variance. Each factor explained at least 7.25% of unique variance and the factors were not mutually exclusive, but often interrelated (all *r*s < .42). Cronbach's alpha values are presented.

Table 2

Factor Analysis of Child Literacy Interest

Items		Factor 1	Factor 2	Factor 3
Child literacy interest		Child writing experiences	Child experiences with literacy materials	Child storybook reading interest
Use of child magazines		.06	**.53**	-.10
Use of child books		-.02	**.33**	.20
Use of comic books		-.40	**.40**	-.03
Use of dictionaries and/ or encyclopedias		.07	**.51**	-.07
Use of tape-recorded stories		-.21	**.38**	.10
Use of songbooks		-.14	**.55**	.03
Use of play-do books		.11	**.55**	.08
Use of a typewriter or computer		.17	.28	-.05
Use of writing stuff		**.91**	.03	.03
Use of drawing stuff		**.93**	.04	.00
Interest in writing, drawing or painting		**.59**	-.09	.01
Interest in storybook reading		.02	.00	**.80**
Frequency of asking to be read to		.02	-.04	**.93**
Reliability coefficients		.85	.66	.60
Eigenvalue		2.94	2.27	1.50
Percent explained variance		22.59	17.44	11.54
			Intercorrelations	
	1	-		
	2	.19	-	
	3	.01	.33	-

Table 3

Factor Analysis of Child's Activities during Storybook Reading

Items *Child's activities during storybook reading*	Factor 1 Story orientation activities	Factor 2 Word orientation activities	Factor 3 Book orientation activities
Turning the pages	.15	-.08	**.79**
Holding the book	-.10	-.01	**.76**
Indicating the tempo	-.09	.14	**.36**
Naming pictures	.10	**.32**	-.15
Pointing at letters or words	.03	**.84**	.07
Reading aloud letters or words	-.09	**.78**	.04
Asking the meaning of words	.25	**.31**	.02
Asking questions about the story	**.30**	.21	.03
Retelling the story, in own words or by using AAC	**.72**	.00	-.05
Guessing how the story will end	**.66**	-.17	-.00
Give comments on the story	**.56**	.07	.06
Relating the story to experiences in daily life	**.39**	.17	-.07
Reliability coefficients	.71	.64	.65
Eigenvalue	3.19	1.84	1.54
Percent explained variance	24.50	14.17	11.83
		Intercorrelations	
1			
2	.35		
3	.04	.06	

Table 4

Factor Analysis of Materials and Parental Activities for Child Literacy Development

Items *Materials and parental activities for child literacy development*	Factor 1 Provision of literacy materials	Factor 2 Parent storybook reading interest	Factor 3 Parent literacy mediation	Factor 4 Parent leisure activities
Number of own books	**.31**	.11	.07	-.16
Number of magazines available	**.65**	-.21	.01	-.14
Number of child books	**.67**	.17	-.05	-.08
Number of comic books	**.58**	-.08	.03	-.05
Number of dictionaries or encyclopedias	**.64**	-.00	.00	.00

Number of taped-recorded stories	**.65**	.04	-.10	.19
Number of songbooks	**.72**	-.07	-.11	.28
Number of play-do books	**.59**	.02	.25	-.08
Enjoying storybook reading to the child	-.13	**.75**	-.01	.01
Age of the child first storybook read	.15	**.45**	.22	-.33
Number of visits to library	-.05	**.50**	.01	-.10
Frequency of reading to the child	.04	**.74**	-.17	.14
Frequency of picture-book reading together with the child	.09	**.58**	.01	.12
Duration of storybook reading	.02	-.03	.20	.03
Frequency of playing with the child	.03	.24	.02	**.51**
Frequency of playing outside the home with the child	-.07	-.05	.04	**.64**
Frequency of watching child programs on television with the child	.04	-.05	.18	**.45**
Frequency of involving the child in own reading	-.03	.24	**.42**	.09
Frequency of involving the child in own writing	-.07	-.03	**.46**	.18
Frequency of playing rhyme games with the child	.07	-.04	**.42**	-.18
Frequency of reading names or letters with the child	.02	-.04	**.59**	.02
Frequency of reading recipes or shopping lists with the child	-.02	-.04	**.65**	.31
Reliability coefficients	.82	.69	.66	.57
Eigenvalue	4.21	3.04	1.74	1.60
Percent explained variance	19.13	13.81	7.92	7.25
		Intercorrelations		
1	-			
2	.17	-		
3	.12	.37	-	
4	.14	.37	.17	-

Table 5

Factor Analysis of Parent's own Literacy Materials and Activities

Items	Factor 1	Factor 2	Factor 3
Parent's own literacy materials and activities	Parent book reading	Parent email use	Parent magazine reading
Number of newspapers	-.03	-.03	**.33**
Number of magazines	.04	-.08	**.73**
Number of reading books	**.76**	-.06	-.12
Number of study books	**.64**	-.02	.08
Number of dictionaries and encyclopedias	**.61**	.06	.05
Frequency of reading the newspaper	.12	.09	.03
Frequency of reading books	**.49**	-.04	-.10
Frequency of reading informative books	**.54**	.17	.12
Frequency of reading magazines	-.11	.06	**.69**
Frequency of writing a letter or a story	.10	.13	.08
Frequency of drawing a picture or painting	.16	.00	-.12
Frequency of reading e-mail	.07	**.78**	-.08
Frequency of writing e-mail	-.07	**1.00**	.02
Reliability coefficient	.73	.88	.57
Eigenvalue	3.17	1.66	1.44
Percent explained variance	24.35	12.79	11.08
		Intercorrelations	
1	-		
2	.32	-	
3	.41	.13	-

Procedure

Parent questionnaires were sent to the contact person of the schools who handed the questionnaires to the parents of the participating children. We asked the parent who read most often with their child to complete the questionnaires. Concerning the motor functions of the children with CP, a small questionnaire was sent to a pediatric neurologist or a specialist in rehabilitation medicine who was familiar with the child. Intelligence, speech intelligibility and vocabulary were assessed by individually testing the children in a quiet room in their schools by an instructed test assistant; an assistant teacher was present as well for the children with CP. Prior to these tasks, there was a training phase, to make sure the children understood the tests. Response adaptations for children with speech difficulties for the intelligence and vocabulary task were nodding or pointing, aided or unaided.

Statistical Analyses

To compare the HLE of children with CP with the comparison group on factors that have items with different range of scores, items with salient loadings on the factors were first converted to standard scores (*M* = 0, *SD* = 1) for both groups together. Subsequently, a composite score was computed for each factor, consisting of the average standard score of the items. Then, Cronbach's alpha values were calculated for each questionnaire and each factor. Moreover, descriptive statistics for both groups were computed regarding their speech intelligibility, intelligence, fine motor functioning, vocabulary, and HLE factors followed by two Multivariate analyses of variance (MANOVAs). MANOVAs were calculated to investigate if the groups differed regarding the child variables and the HLE factors. Furthermore, four separate multiple analyses of covariance (MANCOVAs) were carried out to investigate if group differences could be attributed to one of the child variables.

In order to compare the relative influence of speech intelligibility, intelligence, and fine motor skills on the HLE factors, first, separate composite scores for the HLE were computed for the children with CP and the comparison group, based on the average standard scores of items with salient loadings for each group (*M* = 0, *SD* = 1). Subsequently, separate correlations were computed (Pearson or Spearman) for both groups among the composite scores of the HLE and the child variables. Correlations were also computed between the HLE factors with SES and receptive language, i.e., vocabulary, to find out if these variables should be controlled for in further regression analyses.

For the HLE factors that show a significant relationship with one or more of the child variables, stepwise regression analyses were conducted to find out which child variable or variables explained unique variance in that HLE factor. Variables that did not explain unique variance were excluded by this method, resulting in a model with only variables that explained unique variance and are predictors of the HLE factor.

In order to compare the parents'expectations regarding the reading and writing levels of the children between the groups, first, categories with frequencies less than three were combined, i.e., the reading categories: no reading, symbol or picto reading, letter reading, and word reading, and the writing categories: no writing, letter writing, and word writing were combined. Then, Chi-square tests were calculated to compare parents' expectations for children with CP and the comparison group. Finally, Spearman's correlations were computed for both groups regarding the relationship between the parents' expectations and the child variables. For these correlation analyses only the categories that could be placed on an ordinal scale were included, consequently, the category “I don’t know what to expect” was excluded.

Results

Home Literacy Environment of Children with CP and Nondisabled Children

Table 6 shows the means and standard deviations of the home literacy factors for both groups, followed by the results of MANOVAs. The results of the first MANOVA indicate a main effect for GROUP, Wilks’ lambda = .240, $F(4, 96) = 76.07$, $p < .001$, and $\eta_p^2 = .76$, showing that the groups, on average, differed with regard to the child variables. Furthermore, univariate tests showed that this main effect of GROUP applied to all child variables, as can be seen in Table 6; children with CP, on average, scored below the comparison group on all child variables. The second MANOVA shows a main effect for GROUP for the HLE factors, Wilks’ lambda = .55, $F(13, 88) = .5.64$, $p < .001$, and $\eta_p^2 = .45$. These results point out that, in general, there were group differences with regard to the HLE factors. Inspection of Table 6 indicates that although the mean score of the group of children with CP was lower on almost HLE factors, the children with CP scored only significantly lower in terms of the following factors: Child writing experiences and Child word orientation activities. The children with CP had, on average, fewer experiences with writing activities; i.e., they used writing and drawing materials less frequently, and had less interest in using these materials. In addition, children with CP were less involved in word orientation activities during storybook reading than the comparison group, i.e., pointing at letters or words, or asking the meaning of words. Although children with CP scored below the comparison group on the other two aspects of the active involvement in storybook reading, these differences were not significant. On the other hand, parents of the children with CP reported that they participated more frequently in leisure activities with their child, i.e., playing, playing outside or watching a television program, in comparison to the parents of the comparison children.

The groups did not significantly differ from one another with regard to Child’s interest in literacy materials and storybook reading, the amount of emergent literacy activities parents and child do together, i.e., storybook reading and playing language games, and the parents’ amount of reading materials and habits. Furthermore, MANCOVA results show that intelligence was the only significant covariable, Wilks’lambda = .75, $F(13, 87) = 2.28$, $p < .05$, and $\eta_p^2 = .25$, although when taken into account the intelligence scores of all children differences between the groups remained significant, Wilks' lambda = .73, F (13, 87) = 2.47, $p < .01$, and $\eta_p^2 = .27$.

To sum up, the results indicate that there were a few differences in the HLE of the groups. While children with CP were showing less interest in writing activities and were less involved in word related activities during storybook reading, parents of children with CP were doing more leisure activities with their child in comparison to the comparison group. No other significant differences between the groups were apparent. In addition, differences between the groups remained significant even when intelligence scores were controlled for.

Table 6

Descriptive Statistics and MANOVA Results of the Child Variables and the Home Literacy Factors for the Group of Children with CP and the Comparison Group

Variables and HLE Factors	CP		Comparison					
	M	*SD*	*M*	*SD*	df	*F*	*p*	η_p^2
Child variables								
Intelligence	2.16	1.74	6.84	1.82	1, 99	164.38	<.001	.62
Speech intelligibility	17.95	13.08	33.62	4.42	1, 99	76.31	<.001	.44
Fine motor functioning	3.46	.97	5.00	.00	1, 99	157.17	<.001	.61
Receptive vocabulary	77.79	14.93	109.58	11.85	1, 99	140.62	<.001	.59
HLE factors								
Child writing experiences	-1.14	3.16	.73	1.89	1,100	14.18	<.001	.12
Child experiences of literacy materials	-.29	4.48	.18	3.68	1,100	.33	.566	.00
Child storybook reading interest	-.13	2.09	.09	1.71	1,100	.34	.559	.00
Child story orientation activities	-.62	4.26	.40	3.50	1,100	1.74	.190	.02
Child word orientation activities	-1.17	3.15	.75	2.23	1,100	13.00	<.001	.12

Child book orientation activities	-.39	2.62	.25	2.06	1,100	1.91	.170	.02
Provision of literacy materials	-1.22	5.32	.79	5.16	1,100	3.61	.060	.04
Parent storybook reading interest	-.07	3.33	.07	3.50	1,100	.04	.844	.00
Parent literacy mediation	-.61	3.41	.39	3.13	1,100	2.31	.131	.02
Parent leisure activities	1.12	1.85	-.27	2.14	1,100	19.82	<.001	.17
Parent own book reading	-.10	3.52	.06	3.59	1,100	.05	.823	.00
Parent Email use	-.21	1.94	.13	1.86	1,100	.78	.378	.01
Parent own magazine reading	.25	2.12	-.16	2.24	1,100	.87	.355	.01

Relationship between Home Literacy Factors and Child Variables

To investigate if the additional limitations in speech intelligibility, fine motor skills, and intelligence form a barrier for receiving home literacy experiences, correlations were computed between the home literacy factors and the child variables for both groups separately. In addition, correlations were also computed between the HLE, SES, and language scores. The correlations between the child variables are presented at the end of Table 7; above the diagonal for the comparison group and below the diagonal for the group of children with CP.

Table 7

Correlations of the Home Literacy Factors with the Child Variables and SES, and Language Skills for both Groups

	Factors	Speech intelligibility (*r*)	Fine motor function (*ρ*)	Intelligence (*r*)	Voc (*r*)	SES (*ρ*)
Comparison group						
	Child writing experiences	-.09	-	-.10	-.19	-.09
	Child experiences with literacy materials	.13	-	.06	.01	-.03
	Child storybook reading interest	-.04	-	-.24	.03	.14
	Child story orientation activities	-.15	-	-.05	-.17	.15
	Child word orientation activities	-.04	-	.30*	-.03	.23
	Child book orientation activities	.00	-	-.03	-.01	.11
	Provision of literacy materials	.05	-	.19	.01	-.10
	Parent storybook reading interest	-.02	-	.03	.24	.13
	Parent literacy mediation	.04	-	-.13	.00	.18
	Parent leisure activities	.00	-	-.04	.04	.07
	Parent own book reading	.10	-	.32*	.08	.35*
	Parent Email use	.02	-	.18	-.04	.30*
	Parent magazine reading	-.09	-	.08	-.08	.19
Children with CP						
	Child writing experiences	.14	-.07	.24	.29	.16
	Child experiences with literacy materials	.03	-.17	.16	.23	.21
	Child storybook reading interest	.10	.02	-.03	.04	.16
	Child story orientation activities	.38*	.39*	.14	.19	-.10
	Child word orientation activities	.47**	.26	.40*	.26	.02
	Child book orientation activities	.09	.09	.30	.04	.04
	Provision of literacy materials	.13	-.18	.09	.04	.01
	Parent storybook reading	.02	-.02	-.20	.02	.37*
	Parent literacy mediation	.37*	.34*	.32*	.30	.22
	Parent leisure activities	-.11	-.17	.11	-.04	.17
	Parent own book reading	.11	-.07	.15	.04	.42*
	Parent Email use	-.15	-.19	.28	.03	.11
	Parent magazine reading	-.15	-.09	-.01	-.10	-.09
Intercorrelations between child variables and SES for children with CP (below) and comparison group (above)						
		1	2	3	4	5
1	Speech intelligibility	1	-	.27*	.55**	.09
2	Fine motor function	.42**	1	-	-	-

3	Intelligence	.29	.16	1	-	.16
4	Vocabulary	.09	.06	.03	1	-
5	SES	.55**	.35*	.34*	.02	1

Note. Voc = vocabulary, * p <.05, ** p < .01

For the comparison group, the speech intelligibility and language skills were not related to any of the HLE factors. The intelligence scores of these children were only significantly correlated with the factor Child word orientation activities, indicating that the higher the intelligence score of the child, the more actively the child is involved in activities related to the word level during storybook reading. In addition, there was a significant correlation between the amount of book reading of the parents and the intelligence scores of the child. The socioeconomic status of these children was only related to the amount of book and email reading of the parents, and not to any of the activities and experiences of the child.

For the group of children with CP, the vocabulary scores showed no significant relationship with any of the HLE factors. In addition, the SES scores showed only a significant relationship with the factor Parent storybook reading and Parent own book reading. These relations indicate that the higher the socioeconomic status of the child, the more the parents value storybook reading and the more parents read themselves. Furthermore, there were significant relationships between HLE factors and child variables. Three HLE factors: the involvement of the child in both word related as well story related activities during storybook reading, and the frequency of emergent literacy activities in which the child is engaged with the parent were related to more than one of the child variables, i.e., speech intelligibility, fine motor functioning or intelligence. However, Table 7 shows that for the group of children with CP, these child variables were significantly intercorrelated, what makes it difficult to conclude which variable or variables explained unique variance in the prediction of these activities.

To find out which child variable or child variables explained unique variance in the prediction of these three different HLE factors, three stepwise regression analyses were conducted. For these analyses, SES and receptive language were not included as these variables were not significantly related to these HLE factors. The first stepwise regression analysis was conducted to find out which variable or variables predicted the HLE factor Parent literacy mediation. The regression model turned out to be significant, F (1, 37) = 5.00, p < .05, and explained 11.9% of the variance in Parent literacy mediation. In this model, the only significant predictor was speech intelligibility, t = 2.24, p < .05, and β = .35, other variables were excluded as they did not explain unique variance when speech intelligibility scores were taken into account.

With regard to the HLE factor Child story orientation activities, the stepwise regression analysis resulted into a significant model, F (1, 37) = 7.38, p < .05, with one predictor variable, i.e., fine motor functioning, t = 2.72, p < .05, and β = .41, what explained 16.6% of the variance in Child storybook reading activities.

Concerning the factor Child word orientation activities, the stepwise regression analysis resulted into a significant model, F (1, 37) = 9.90, p < .01 that was also predicted by one variable, i.e., speech intelligibility. The speech intelligiblity turned out to be a significant predictor of the Child word orientation activities, t = 3.15, p < .01, and β = .46, and explained 21.1% of the variance in Child word orientation activities. The other two child variables did not add significant unique variance to the model and were excluded. However, the excluded predictor variable intelligence was a marginally significant predictor of the model, t = 1.97, p < .06.

Parents' Expectations for their Child's Literacy Level at the End of Elementary School

Regarding the parents' expectations for their child's reading level at the end of elementary school, there were significant differences between the groups, χ^2 (3, N = 102) = 29.87, p < .001[2]. Almost all parents of the children in the comparison group had high expectations. It may be noted that 37.5% of the parents of children with CP reported that they did not know what expectations to have for their child's reading level compared to 4.8% of the parents of the comparison group children. Figure 1a shows that when parents of children with CP did have expectations, those were reasonable high, i.e., they expected that their child would be able to read easy texts or to read books without parents' help. For the 25 parents of the children with CP who did have an expectation of their child's reading level, Spearman's correlations indicate that parents' expectations are significantly related to the current language level of their child, ρ = .62, p < .01, and marginally significantly correlated to the speech intelligibility scores, ρ = .38, p < .10. No significant correlation was found between the reading expectations and the intelligence scores of the children, ρ = .30, p > .05 or the fine motor skills, ρ = .18, p > .05. For the 59 children in the comparison group, no significant correlations were found between the reading expectations and any of the child variables (all ps >.05).

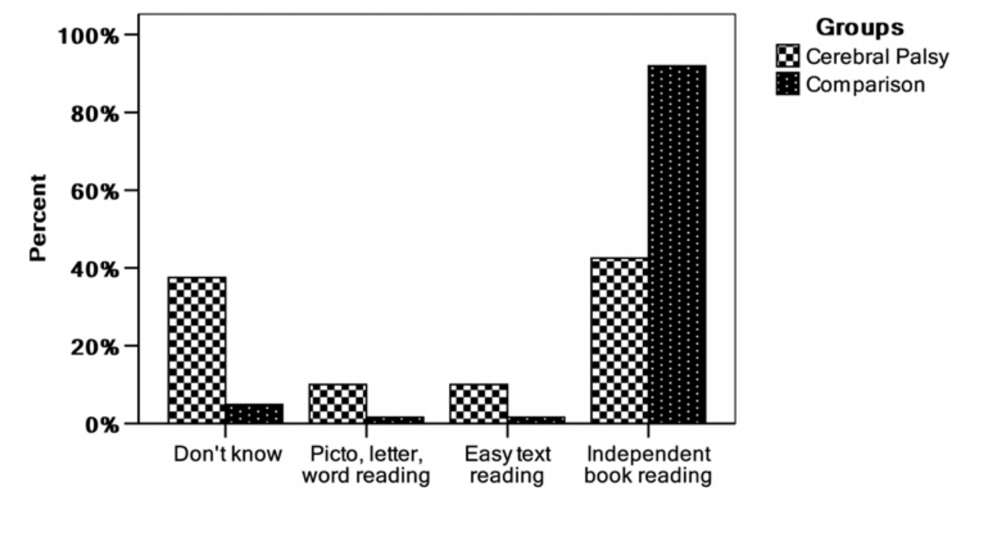

Figure 1a
Parents' Expectations for their Child's Reading Skills

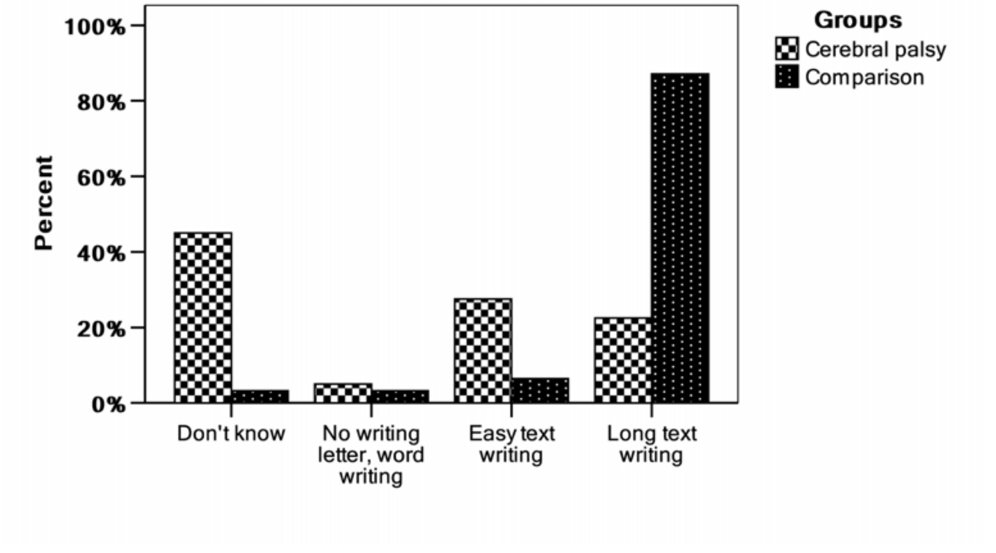

Figure 1b
Parents' Expectations for their Child's Writing Skills

The same pattern of expectations was observed for the writing levels of the children at the end of elementary school. Again, there were significant differences between the groups, χ^2 (3, N = 102) = 45.56, p <.001[2] (see Figure 1b). Again, a lot of parents of children with CP, i.e., 45%, did not know what expectations to have for their child's writing skills compared to 3.2% of the parents of the comparison group children. The parents of 22 children with CP who did have expectations, again, had reasonably high expectations, i.e., most parents expected their child to be able to write easy texts or even long texts and stories. The writing expectations for the children with CP were significantly related to their speech intelligibility scores, ρ = .56, p < .01, as well as to their fine motor skills, ρ = .45, p <.05, and the language skills, ρ = .45, p < .05. The writing expectations were not significantly related to the intelligence scores, ρ = .20, p >.05. For the 60 children in the comparison group, no significant correlations were found between the writing expectations and any of the child variables (all ps >.05).

Conclusions and Discussion

Several conclusions may be drawn from this study. First of all, in general, the children with CP scored lower on all aspects of the HLE, indicating that the HLE for children with CP is less stimulating than for their peers. However, inspection of the individual factors revealed that although the children with CP scored lower on almost all factors, only a few HLE factors turned out to be significantly lower for this group. With regard to HLE factors related to home literacy materials and activities, the only significant differences existed in children's interest in writing activities. As the HLE factor Child writing experiences was not related to the fine motor skills of the children with CP (ρ = -.07, p >.05), we may state that in general children with CP had less interest in doing writing activities with a pencil or on their AAC device or computer, regardless of their fine motor skills. These results are in line with previous research of Light and Kelford Smith (1993) in which AAC-using children participated less frequently in writing and drawing activities. However, the results remained hard to compare as only children with speech impairments were included in that study. In addition, it is important to conclude that the HLE with regard to the aspects: Child's experiences with literacy materials, Provision of literacy materials, Child storybook reading interest, and Parent storybook reading interest did not significantly differ between the groups. These results showed that children and parents in both groups enjoyed storybook reading together, and that although the children with CP had marginally significantly less literacy materials, the children with CP were given just as many opportunities for individually exploring literacy materials as their peers. Furthermore, no differences were found with regard to the parents' own amount of literacy materials and behaviours. These results point out that both groups had literate role models in their homes, one of the aspects that are considered to be important for the literacy development of young children (cf. Koppenhaver, Coleman, Kalman, & Yoder, 1991).

On the contrary, children with CP were found to be more engaged in leisure activities with their parents in comparison to their peers without disabilities. Inspection of individual items revealed that the parents of the children with CP were playing inside and outside with their child as well as watching child programs on television together with their child more frequently than parents of the nondisabled children. A possible explanation therefore is that these children, because of their physical disabilities, spend more time at home instead of playing outside with friends, and thus rely more on their parents for doing activities. As most children with CP go to schools for children with physical and multiple disabilities that are further away than mainstream schools, it is difficult for these children to play with friends of their schools that live far away or to make friends in the neighbourhood as they do not know many other children to play with. Therefore, it is possible that these children rely more on their parents for doing leisure activities.

Concerning the activities related to storybook reading, children with CP were found to be generally less involved as is in accordance with previous research (Dahlgren Sandberg, 1998; Light & Kelford Smith, 1993). Nevertheless, differences between the groups were only significant with regard to the active participation in word related activities. Children with CP were less actively involved in activities such as naming pictures and reading aloud letters or words than the children in the comparison group. Stepwise regression analysis revealed that the speech intelligibility scores formed the most important limitation for these children to become an active participant. Furthermore, although children with CP scored lower in comparison to the comparison group on story orientation and book orientation activities, these differences were not significant. However, within the group of children with CP the main predictor for the active involvement in story orientation activities turned out to be fine motor skills. Therefore, we may conclude that speech intelligibility as well as fine motor functioning can be seen as important skills that can promote the active involvement of the child during storybook reading.

Parents' expectations regarding the reading and writing level of their child at the end of elementary school differed significantly between the groups. While most parents of the comparison group were having high literacy expectations for their child, a lot of parents of children with CP did not know what they could expect for their child's literacy development. Earlier research has indicated that especially for children with disabilities, high expectations can serve as an important stimulating force to the child's literacy development (Koppenhaver, Evans, & Yoder, 1991). However, it is also important that expectations are realistic (Light & McNaughton, 1993). For the parents who did have expectations of their child's literacy development, these expectations are among other things related to the language skills of their child, what an indication is that these expectations may be realistic given the current language skills of the children. Nevertheless, the high incidence of another group of parents of children with CP who did not know what to expect for their child's literacy development, suggests that they lack the information necessary to develop realistic expectations for their child's performance. Possibly, one of the reasons parents did not know what to expect for their child's literacy development can lie in the fact that they lack appropriate role models showing how children with disabilities develop literacy skills and what expectations are appropriate in which stages of literacy development.

Conclusively, in general the households of the two groups of children did not differ with regard to the most HLE aspects. However, children with CP seem to be less interested in writing activities, and less actively involved in word related activities during storybook reading. Furthermore, the additional speech and fine motor impairments of children with CP appear to limit various literacy activities of these children.

The results of the present study should be interpreted with great caution. As parent questionnaires were used to investigate the HLE of the children, there may have been some response bias in terms of social acceptability. For future research it would be important to engage in focused interviews with parents in order to uncover why parents of children with CP with low levels of speech intelligibility engaged in fewer emergent literacy activities with their child. Do these parents think these activities are too difficult for their child? Or do parents lack suitable materials and knowledge of how to do emergent literacy activities, e.g., rhyming, with their child with speech impairments? Earlier studies on children without disabilities indicated that a teaching focus in the homes where parents play rhyming games and practise letters and words with their children has a positive influence on phonological awareness (Foy & Mann, 2003) and emergent reading development of children (Haney & Hill, 2004; Sénéchal, LeFevre, Thomas, & Daley, 1998). The fact that children with CP with speech impairments participated in rhyming and reading activities less often could have far-reaching consequences. Future research should investigate what impact this teaching focus and other aspects of the HLE will have on the language and emergent literacy development of children with CP.

An important aspect that should be looked at more precisely is why children with CP were less actively involved in activities during storybook reading. Are parents aware of the importance of linguistic activities during storybook reading for their child's language development? Or do parents lack the skills and knowledge to adapt the storybook reading session to suit their child's speech and physical impairments and make it a more accessible and interactive activity? In addition, it is important to find out if parents valued literacy for their child and what roles parents consider they could play in the literacy development of their child. Furthermore, focused interviews could uncover why parents participated more frequently in leisure activities with their child with CP and to what extent these leisure activities stimulate the language and emergent literacy skills of these children. For example, it could be possible that during these leisure activities extended verbal exchange takes place between the parent and child that could stimulate the verbal experiences and language development of the child. Possibly, time spend together could stimulate the language development, and therefore partly compensate for the time that parent and child do not spend on reading activities. Focused interviews should reveal what parents and child exactly do during leisure activities and how parents feel they could stimulate the language and literacy development of his or her child.

A final aspect that should be looked at more carefully in future research is if parents of children with CP offer their child activities that are appropriate to the linguistic and intellectual level of the child. Although differences between groups could not accounted for by the receptive vocabulary skills nor by the intellectual skills of the children, the correlations in Table 7 between Child literacy experiences, Child story orientation activities, and Parent literacy mediation with the vocabulary skills of the children indicated that there are some trends towards positive relationships, i.e., between children's vocabulary skills, on the one hand, and their experiences with literacy materials and emergent literacy activities, on the other hand. However, from the results of the present study no final conclusions can be drawn as regards the appropriateness of the children's home environments in relation to their linguistic and intellectual levels as more indicators of language comprehension are needed.

The results of the present study have a number of clinical implications. First of all, considering the fact that children with low levels of speech intelligibility are disadvantaged in the amount of literacy activities parents do together with their child at home, indicates that it is important that teachers as well as speech and language therapists (SLTs) work with parents in order to increase the literacy opportunities for those children with speech impairments. For example, teachers and SLTs can hand parents suitable books and literacy materials for children with physical as well as speech impairments or give parents suggestions of how they can integrate literacy activities in the daily routines of these children. In addition, both teachers as well as SLTs can play an important role in informing parents about their child's language development and helping them to create realistic expectations for their child's short-term as well as long-term literacy development. Realistic expectations can help parents motivate to provide their child adequate literacy activities that stimulate the emergent literacy development of the child.

It is also important to note that only a few children in the present study used their AAC during storybook reading. This finding is in line with previous studies, all showing low incidence of AAC use during storybook reading (Dahlgren Sandberg, 1998; Light, Binger, & Kelford Smith, 1994). This implies that these children are unnecessarily disadvantaged in being able to become actively involved in storybook reading sessions. Perhaps the lack of control these children have in the handling of books and responding to questions affects their parents' behaviors toward them. If parents do not receive responses from their child it is possible that they steadily adapt their behavior to their passive child and demand less and less of their child, or stop trying literacy activities with their child as they do not enjoy it. However, in order to give a response for a child who relies on AAC to communicate, it is necessary that this child has access to his or her AAC device during literacy activities. Teachers and SLTs can help parents by informing parents of the importance that their child has access to his or her AAC during literacy activities. In addition, teachers and SLTs can help parents by informing them about the importance of being actively involved during storybook reading for the language development of the child and help parents selecting strategies to increase the involvement of their children during storybook reading. For example, SLTs therapists can work with parents and explain them how they can make children actively involved during storybook reading, e.g., by letting the child select symbols that represent the story, therefore permitting the child to retell the story. Parents can also make use of a communication board that enables the child to select books, ask questions or make comments on the story. Pebly and Koppenhaver (2001) made an example of a generic storybook communication board (cf. Pebly & Koppenhaver, 2001, p. 224). Before as well as during the storybook session, parents can provide additional background information to the context of the story that facilitates comprehension of the story for the child (Pebly & Koppenhaver, 2001). In addition, SLTs can inform parents of the importance of rereading the same books with the child; therefore the child becomes familiar with the story and can react more easily on the storyline.

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Home Literacy Predictors of Early Reading Development in Children with Cerebral Palsy[1]

Chapter 5

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Abstract

The goal of the present one-year long longitudinal study was to determine which home literacy variables were effective in stimulating early reading skills of children with cerebral palsy (CP) directly or indirectly via the reading precursors. Parents of 35 children with CP completed questionnaires regarding aspects of the home literacy environment (HLE). The reading precursors: vocabulary, syntactic skills, and phonological awareness, i.e., rhyme and phonemic awareness, were assessed at the end of Kindergarten and the end of Grade 1, while the early reading skills letter knowledge and word recognition were assessed only at the end of Grade 1. Three HLE variables were found to be related to reading precursors and early reading skills: Parent literacy mediation, Word orientation, and Story orientation activities during shared book reading. Path analyses showed that these three HLE variables were not directly related to early reading skills in Grade 1, but indirectly via the reading precursors, in particular phonological awareness.

Introduction

The reading development of children does not start once children enter school. Before children learn to read and write they have already acquired skills that precede the actual reading development and are good precursors of later reading success, such as: vocabulary (Wagner et al., 1997), syntactic skills, i.e., sensivity to word order (Chaney, 1992; Scarborough, 1990), and particularly phonological awareness, i.e., the awareness of the sound structure in spoken language (Adams, 1990; Dahlgren Sandberg, 2002). Research has shown that children with adequate skills of reading precursors are better prepared to benefit from formal schooling and that they even maintain their advantage in reading development over time (Sénéchal & Lefevre, 2001; Stanovich, 1992). Partly, these differences in reading precursors are considered to be attributed to the home literacy environment (HLE) of the children. The HLE is considered a setting in which language and literacy are typically first encountered, and consists of various interrelated aspects such as the child's literacy interest (Frijters, Baron, & Brunello, 2000), home literacy materials and experiences, e.g., exposure to storybook reading (Payne, Whitehurst, & Angell, 1994), child opportunities for verbal interaction (Snow, Burns, & Griffin, 2001), parental literacy teaching activities (Foy & Mann, 2003), and parent's literacy habits (Weigel, Martin, & Bennett, 2006).

Although correlational studies indicate a direct relationship between aspects of the HLE and reading skills (Frijters et al., 2000; Haney & Hill, 2004), longitudinal studies including HLE, reading skills and reading precursors in one design, pointed out that the relationship between the HLE and learning to read is mediated by reading precursors. For instance, de Jong and Leseman (2001) concluded that the home literacy effects on reading comprehension in Grade 3 were mediated by the reading precursor oral language skills in Grade 1, i.e., vocabulary and listening comprehension. In a similar vein, Sénéchal, LeFevre, Thomas, and Daley (1998) concluded that the influence of home literacy activities, i.e., parent teaching activities and storybook reading, on reading scores in Grade 1 was mediated by children's phoneme awareness, vocabulary, letter knowledge, and word decoding skills, measured at an earlier time period. Taken into account the importance of the HLE for later reading skills of children without disabilities, the question arises if and how aspects of the HLE can be effective in stimulating reading skills of children with developmental disabilities. Insight into the aspects of the HLE most effective for facilitating the development of early literacy in children from special populations can serve as a starting-point for intervention that enhances reading precursors and ultimately reading outcomes for these children and prevent further delays. In this article, an attempt will be made to shed light on the role of the HLE in the literacy development of children with cerebral palsy (CP).

Besides their physical disabilities, children with CP are often characterized by additional impairments, such as speech and cognitive impairments (cf. Bax. et al., 2005; Dormans & Pellegrino, 1998). These additional impairments delay their language and reading development (Browning, 2002; Card & Dodd, 2006; Koppenhaver & Yoder, 1992), even already at preschool-age. For example, in a study of Peeters, Verhoeven, van Balkom, and de Moor (2008), the emergence of phonological awareness of preschool children with CP and a typically developing control group was studied. Children with CP and especially those with lower levels of speech intelligibility and cognitive skills lagged behind in rhyming skills compared to the control group. In a small number of studies the HLE of children with CP has been explored. It was shown that the HLE of children with CP tends to be less supportive, as these children, and particularly those children with additional speech impairments were less actively involved in storybook reading sessions (Dahlgren Sandberg, 1998; Peeters, Verhoeven, van Balkom, & de Moor, in press), had less opportunity to use printed materials and to participate in writing and drawing activities (Light & Kelford Smith, 1993), and were to a lesser extent challenged to become literate in the home (Marvin, 1994) as compared to their nondisabled peers.

The relationship between the HLE, reading precursors, and early reading skills has hardly been studied in children with CP and conclusions are not equivocal. Dahlgren Sandberg (1998) conducted a study on the role of the HLE in the early reading success of nonvocal Bliss-using children with CP. Since practically no differences existed in the HLE of nonvocal children who could read and nonvocal children who were unable to read, Dahlgren Sandberg concluded that the HLE only had a marginal influence on the reading development of the nonvocal children. In contrast, Koppenhaver, Yoder, and Evans (1991) conducted a retrospective survey with 22 literate adults with congenital severe speech and physical impairments. The authors concluded that the successful literacy development of the respondents could partly be attributed to the supportive literacy experiences within their homes, as these adults grew up in homes where literacy materials and literate models were widely available to them. In addition, Smith (1992) presented results on two literate non-speaking children with CP and concluded that one of the factors that influenced these children's reading ability was their supportive home environment, as both children came from homes where reading was highly valued and parents visited libraries with their child and bought books for leisure reading on a regular base. However, longitudinal studies on the relationship between HLE aspects and the development of reading and its precursors are generally lacking. Thus it is by no means clear how the HLE of children with CP affects the development of reading precursors and reading skills over time.

In the present study, the relationship between aspects of the HLE, reading precursors and early reading skills was examined following a longitudinal design with 35 children with CP, living in the Netherlands. In Kindergarten and Grade 1 reading precursors were documented along with children's speech intelligibility and intellectual skills. In Grade 1 children's early reading skills were also assessed. The following aspects of the HLE were administrated by means of parent questionnaires: child's literacy interest, child's activities during storybook reading, child's literacy materials, parental activities for child literacy development, and parent's own literacy materials and activities. By means of regression analyses and path analyses, the direct and indirect influence of the HLE variables on the children's reading development was explored. It was predicted that variables of the HLE are indirectly related to the early reading skills of the children with CP, as this relationship is expected to be mediated by reading precursors.

Method

Participants

The children in this study were all participants of a larger longitudinal study investigating the emergent reading development of children with CP. For that longitudinal study, all thirty-two schools for children with physical and multiple disabilities in the Netherlands were asked to participate and obtain written consent of the parents of children with CP who fit the following inclusion criteria: Dutch must be their native language, the intellectual level must range from a mild intellectual disability to average intelligence or above, hearing and vision must be within the normal range, with the ability to respond intentionally, either through speaking or by means of alternative communication (e.g., looking, pointing or gesturing), and they must be five-years old at the beginning of the longitudinal study. Fifty-four children with CP participated in that longitudinal study. Forty of the 54 parents responded to the parent-questionnaires (74%) and five children were not tested on Time 2, resulting in a total of 35 children with CP for the present study.

Thirty-four children had the spastic type of CP and one child had ataxia (2.9%). The children with spasticity were subdivided in 10 children (29.4%) with quadriplegia, 15 children (44.1%) with diplegia, five children (14.7) with hemiplegia, two children (5.9%) had a combination of spastic-ataxic CP, one child (2.9%) had spastic-hypotonia CP (2.9%), and one child had spastic-dyskinetic CP (2.5%). Six of the 35 children (17.1%) had seizures. The speech-language therapists of the children reported that 17 children (48.6%) had no speech difficulties, 12 children (34.3%) had mild to moderate dysartria, two children (5.7%) had dyspraxia, and four children (14.4%) were unable to speak. The mean age of the children was 72 months (*SD* = 5.54) at Time 1 and 84.0 months (*SD* = 5.55) at Time 2. At Time, 1 all children were preschoolers, while at Time 2 the children were following education in the first-grade. All children were following special education in schools for children with physical and multiple disabilities across the Netherlands. Table 1 gives information about the background characteristics of the children and families.

Table 1

Background Characteristics of the Children and Families (n = 35)

Gender	21 girls; 14 boys
Age	Time 1: Mean age is 72 months, *SD* = 5.8 Time 2: Mean age is 84 months, *SD* = 5.9
Place of the child in the child row/ birth order [a]	Mean: 1.51 Range: 1-4
Mode of communication in daily life (use of AAC)	6 children use one or more communication devices, or use one or more sorts of symbols to communicate besides or instead of speech. 29 children use speech as their primary mode of communication
Use of AAC during storybook reading	None of the children used any augmentative or alternative communication during storybook reading
Family constellation	One parent-family: 2.9% Two-parents family: 97.1%
Siblings	Brothers Mean .65, Range 0-2 Brothers sisters .60 Range 0-2
Actual respondent	6 fathers (17.1%) 28 mother (80%) 1 both parents together (2.9%)
Age of the parent that responded to the questionnaire	Mean: 37.1 years Range: 25-52
SES, Average educational level of the parents [b]	Mean: 4.9 Range: 2-7

Note. [a] 1= first child, 2=second child to 6=sixth child, [b] SES was based on parental education. Parental education was measured on a 7-point scale ranging from 1 (no education) to 7 (academic education).

Materials

The materials used for this study consisted of four HLE parent questionnaires, a set of tasks for reading precursors and early reading skills, and a standardized speech and intelligence task. As some materials were developed for the larger longitudinal study, the reliability calculations of the parent questionnaires and tasks were based on the larger sample children participating in the longitudinal design.

HLE variables

Four self-administrated parent questionnaires were constructed based on earlier research (Dahlgren Sandberg, 1998; Light & Kelford Smith, 1993; Marvin, 1994; Stoep, Bakker, & Verhoeven, 2002) each referring to another aspect of the HLE (cf. Peeters et al., in press), i.e., child literacy interest, child's activities during storybook reading, materials and parental activities for child literacy development, and parent's own literacy materials and activities. These questionnaires were composed of open-ended and multiple-choice items and subdivided into HLE variables. The HLE variable subdivision was based on factor analyses of earlier research (Peeters et al., in press) with a larger sample of children with CP and peers without disabilities (n = 102), see Appendix. Separate factor analyses were performed for all four questionnaires, using Principal Axis Factoring (PAF). These factors were submitted to Promax rotation with Kaiser Normalization. The number of factors extracted was determined by eigenvalues greater than one (Kaiser's criterion) and interpretability. In all analyses the extracted factors together accounted for at least 48% of the explained variance. Variable scores were created for all HLE variables based on the average standard scores of items with salient loadings on the factor. Factor loading ≥.30 were interpreted as salient loadings. The factor analyses resulted in total of 13 HLE variables. Accordingly, the following variables were taken as predictor measures of HLE:

Child's literacy interest consisted of three HLE variables:

- *Child's interest in writing* (e.g., frequency of using writing and drawing stuff),
- *Child's use of literacy materials* (e.g., frequency of using magazines, books)
- *Child's storybook reading interest* (e.g., frequency of asked to be read to)

Child's activities during storybook reading consisted of three HLE variables:

- *Child story orientation activities* (e.g., asking questions about the story, retelling, and relating the story to daily life experiences)
- *Child word orientation activities* (e.g., naming pictures, reading and pointing at letters or words)
- *Child book orientation activities* (e.g., turning the page, holding the book)

Materials and parental activities for child's literacy development consisted of four HLE variables:

- *Availability of written materials* (e.g., number of books, magazines, tape-recorded stories)

- *Parent storybook reading interest* (e.g., frequency of storybook reading, number of visits to library with child, age of first storybook reading)
- *Parent literacy mediation* (e.g., frequency of rhyming games, reading letters, involving child in own reading activities)
- *Parent leisure activities* (e.g., frequency of playing outside with child, television watching together)

Parent's literacy materials and activities consisted of three HLE variables:

- *Parent own book reading* (e.g., frequency and number of diverse books)
- *Parent e-mail use* (e.g., frequency of reading and writing email)
- *Parent magazine reading* (e.g., frequency and number of magazines)

Reading precursors and early reading skills.

Four tasks were administrated to assess the following reading precursors: Rhyme, Phonemic awareness, Vocabulary, and Syntactic skills. Two early reading tasks were administrated, i.e., one for Letter knowledge and one for Word recognition.

Rhyme. A Rhyme recognition task was constructed to measure the rhyme skills of the children. The task consisted of 20 items of highly frequent Dutch CVC words. The test assistant asked to child to look at the three presented pictures and subsequently named the pictures. Then, the test assistant named a stimulus word and asked the child which picture made a rhyme with the stimulus word. In all 20 trials there were unrelated distracters, while in ten of the 20 trials a phonological distracter was presented. The 20 stimulus words were distributed over the different sound categories of the Dutch language, i.e., plosives, fricatives, nasals, liquids, and glides. The internal consistency in this study was good with a Cronbach's alpha of .86 for Time 1 and .84 for Time 2 (cf. Appendix B at the end of the thesis).

Phonemic awareness. To test phonemic awareness skills, the First-phoneme recognition task was used (de Jong, van Otterloo, & Regtvoort, 2006). This task consists of ten items with CVC words. Each item consisted of five pictures, one stimulus picture and four response pictures. The test assistant pointed at the stimulus picture and named that picture (e.g., roof). Subsequently, the test assistant explained that the stimulus word could be split up in two parts, the first-phoneme of that word, and the rest of the word (e.g., rrrrr-oof). The child had to point at one of the four response pictures that started with the same first-phoneme as the stimulus word (i.e., r). The internal consistency of this task was good with a Cronbach's alpha of .83 for Time 1 and .90 for Time 2.

Vocabulary. Receptive vocabulary was assessed using a Dutch version (Schlichting, 2005) of the Peabody Picture Vocabulary Test III (Dunn & Dunn, 1997). The task of the child was to point to one of the four pictures that corresponded with the word spoken by the test assistant. The test manual described an internal consistency interval of Cronbach's alpha between .92 and .94.

Syntactic skills. To assess the syntactic skills a Syntactic pattern subtest of the Dutch Language Proficiency Test was administrated (Verhoeven & Vermeer, 1986). In this task, the child heard a sentence which constitutes a syntactic pattern, and had to indicate which of the three pictures matches that syntactic pattern. All 32 items were scored. The task was highly reliable with a Cronbach's alpha between .90 and .97 (Verhoeven & Vermeer, 1999).

Letter knowledge. A standardized subtest of the Dutch Specific Language Impairment (SLI) Screening Test Battery for letter knowledge was administrated (Verhoeven, 2006). This task consisted of 32 items; each item consisted of one target grapheme and five grapheme distracters. The test assistant asked the child to point to the grapheme that matched the phoneme spoken by the test assistant, e.g., the grapheme [b] of [bird]. All items were scored. The internal consistency of this task in the longitudinal study was very good with a Cronbach's alpha of .97 (at Time 2).

Word recognition. Word recognition ability was assessed using a shortened version of the Reading Technology Test (Krom, 2001). Twenty items were selected that covered all Dutch sound categories. In this task, each item consisted of one picture presented with five written words. The task of the child was to point at the written word that matches the picture. All words differed minimally from each other and increased from CVC word at the beginning of the task till CVCVC words for the last items. The test manual reported a good reliability with a Cronbach's alpha of .89 (Krom & Kamphuis, 2001).

Other child variables

Speech intelligibility. In order to assess children's speech intelligibility, a standardized subtest of the Dutch SLI Screening test was administrated (Verhoeven, 2006). The child was asked to repeat real words, presented individually by a recorded voice. The task started with words containing only one syllable and gradually increased in difficulty to words containing up to five syllables. The task was ended if the child made five successive errors. Eighty percent of the children with CP were able to participate in this task since they had some level of intelligible speech and the other children were given a score of zero. The maximum score was 40. The test manual reported good internal consistency with a Cronbach's alpha of .94 (Verhoeven, 2006).

Intelligence. Nonverbal reasoning was measured with the Raven Coloured Progressive Matrices (Raven, 1956). This task measures nonverbal reasoning with a minimal interference of language and is a commonly used instrument to assess intelligence, or general reasoning ability in the non-speaking population (cf. Dahlgren Sandberg, 1998). Children were asked to point to the correct one of six pictures that completed the presented figure. The task consisted of 36 items. Raw score were converted to standard scores ranging from .5 to 9.5 using Dutch norms (van Bon, 1986). The reliability of the test is considered satisfactory (Evers, van Vliet-Mulder, & Groot, 2000).

Procedure

Parent questionnaires were completed at Time 1. We asked the parent who read most often to the child to complete the questionnaires. The four tasks for reading precursors were administered during both Time 1, at the end of Kindergarten, and Time 2 at the end of Grade 1. The two early reading tasks were only administrated at the end of Grade 1, at Time 2. Regarding the two child variables, the Speech intelligibility task was administrated together with the tasks for reading precursors at Time 1, while the Intelligence task was administrated a half-year earlier during an earlier measurement of the longitudinal study.

All children were individually tested in a quiet room in their schools by a trained test assistant; an assistant teacher was present as well. Prior to each task, there was a training phase, to make sure the children understood the test. The task order was the same for all children and the tasks were divided over two sessions. Response adaptations for children with speech difficulties were nodding or pointing, aided or unaided.

Statistical Analyses

Descriptive statistics were computed along with repeated measure Multivariate analysis of variance (MANOVA). To investigate if the child variables Speech intelligibility and Intelligence were separately related to the progression in reading precursors, a repeated measure Multiple analysis of covariance (MANCOVA) was conducted with Speech ability and Intelligence as covariables. To examine the relationship between HLE aspects, on the one hand and reading precursors and reading skills on the other hand, first of all, Pearson correlations were computed for all measures. Based on the outcomes of the correlation analyses, the HLE variables related to reading precursors and early reading skills were subjected to further regression and path analyses to test whether these HLE variables are directly or indirectly related to the early reading skills. Since the best prediction of a reading precursors at Time 2 is typically that same reading precursor at an earlier time period (Burgess, Hecht, & Lonigan, 2002; Wagner, Torgesen, & Rashotte, 1994), the reading precursors at Time 1 were included as control variables.

According to Baron and Kenny (1986), a variable functions as a mediator if there is a relationship between the independent variable and the mediator, a relationship between the mediator and outcome variable, and a relationship between the independent variable and the outcome variable. This was tested by means of regression analyses. The second assumption in order for a variable to function as a mediator is that when the relationship between the independent variable and the mediator, and the relationship between the mediator and outcome variable is controlled for, the relationship between the independent variable and outcome variable is no longer significant (Baron & Kenny, 1986). Hierarchical regression analyses were conducted with all reading precursors at both times as control variables between the relationship of the HLE variables and the early reading skills. To further examine the longitudinal influence of the HLE variables on early reading skills and the mediating effect of the reading precursors, two path analyses were undertaken using AMOS 5 (Raykov & Marcoulides, 2006). A path analysis affords not only to account for measurement errors while examining both the direct and indirect influences of HLE variables on early reading skills (Baron & Kenny, 1986; Wagner et al., 1994), but also to look at the independent contribution made by each variable, and the interrelationship among the variables (Arbuckle & Wothke, 1999). In a first analysis, the indirect influence of the HLE variables on early reading skills through the reading precursors at Time 2 was investigated. In a subsequent analysis, the same was done while taking into account both Time 1 and Time 2 reading precursors. In both analyses, error terms of tests measured at the same time period were allowed to correlate.

Results

Development of Reading Precursors and Early Reading Skills

The descriptive statistics of the reading precursors at Time 1 and Time 2 and the early reading skills at Time 2 can be seen in Table 2 along with the results of the repeated measures MANOVA. The data show a multivariate main effect of Time, Wilks' Lambda = .297, $F(4, 31) = 18.37$, $p < .001$, and $\eta_p^2 = .70$, meaning that there is an overall improvement between Time 1 and Time 2 in reading precursors. Table 2 further shows that this main effect of Time applies to all tasks administrated at both times. The effect sizes indicate that the progression during a time period of one-year was large. Furthermore, while a lot of children have knowledge of different letters of the alphabet, the word recognition skills of most children is still low.

Table 2

Descriptive Statistics and Repeated Measures (MANOVA) Results of the Reading Precursors and Early Reading Skills at Time 1 (end of Kindergarten) and Time 2 (end of Grade 1)

Tasks	Time 1		Time 2		*df*	*F*	*p*	η_p^2
	M	*SD*	*M*	*SD*				
Rhyme	12.54	3.76	14.91	3.61	1,34	15.93	.0001	.32
Phonemic awareness	4.31	2.22	5.69	3.38	1, 34	7.88	.008	.19
Vocabulary	63.60	12.36	74.69	13.62	1, 34	51.21	.0001	.60
Syntactic skills	20.83	5.38	23.60	5.24	1, 34	17.64	.0001	.34
Letter knowledge	-	-	15.80	9.85	-	-	-	-
Word recognition	-	-	3.89	5.84	-	-	-	-

To investigate if Speech intelligibility or Intelligence influences the progression of the reading precursors from Time 1 to Time 2 a repeated measures MANCOVA was conducted with Speech intelligibility and Intelligence as covariables. The mean raw scores are 18.63 (SD = 12.96) for the Speech intelligibility and 2.33 (SD = 1.75) for Intelligence. No interaction effects existed between Time* Speech intelligibility, Wilks' lambda = .846, F (4, 29) = 1.32, p > .05, η_p^2 = .15 and between Time* Intelligence, Wilks' lambda = .873, F (4, 29) = 1.06, p >.05, η_p^2 = .13. The progression in reading precursors remains significant, even when controlling for the two covariables together, Wilks' lambda = .469, F (4, 29) = 8.22, p < .001, and η_p^2 = .53. Furthermore, there was a significant main effect of Speech intelligibility Wilks' lambda = .614, F (4, 29) = 4.55, p < .01, and η_p^2 = .39, indicating that the children differed significantly from one another regarding their speech intelligibilities. Conclusively, the results of the MANCOVA indicate that the progression of the reading precursors of the children is neither significantly influenced by Speech intelligibility nor by Intelligence. Therefore, in further analyses the children with CP with varying speech and intellectual skills were analyzed as one group together and Speech intelligibility and Intelligence were not included in further analyses.

The intercorrelations among the reading precursors and the early reading skills at both Time 1 and Time 2 were computed and are shown in Table 3. Table 3 demonstrates a large significant correlation between Rhyme and Phonemic awareness skills at Time 1 (r = .52) and Time 2 (r = .57), and between the early reading tasks Letter knowledge and Word recognition at Time 2 (r = .85). Vocabulary and Syntactic skills also turned out to be highly intercorrelated (r = .63 at Time 1 and r =.79 at Time 2).

Table 3

Pearson's Intercorrelations among the Reading Precursors at Time 1 and Time 2 and the Early Reading Skills at Time 2 (n = 35)

		1	2	3	4	5	6	7	8	9
1	Rhyme T1	-								
2	Phon T1	.52**	-							
3	Voc T1	.48**	.51**	-						
4	Synt T1	.32	.31	.63**	-					
5	Rhyme T2	.55**	.47**	.53**	.53**	-				
6	Phon T2	.40*	.53**	.69**	.73**	.57**	-			
7	Voc T2	.33	.34*	.76**	.70**	.45**	.64**	-		
8	Synt T2	.51**	.19	.66**	.73**	.60**	.57**	.79**	-	
9	Let T2	.50**	.46**	.63**	.57**	.67**	.69**	.60**	.66**	-
10	Word T2	.54**	.45**	.56**	.49**	.66**	.69**	.38*	.45**	.85**

Note. Phon= Phonemic awareness, Voc= Vocabulary, Synt= Syntactic skills, Let= Letter knowledge, Word= Word recognition, * $p < .05$ (two-tailed), ** $p < .01$ (two-tailed).

Correlation Analyses

Table 4 shows the correlations between all HLE variables and the reading precursors and early reading tasks at Time 1 and Time 2. Three HLE variables showed highly significant correlations with the reading precursors at Time 1 and 2, and the early reading skills at Time 2: Parent literacy mediation, Child story orientation activities, and Child word orientation activities. The amount of Parent literacy mediation (i.e., playing rhyme games, reading letters, names and recipes, and involving the child in own reading and writing) turned out to be positively related to Rhyme, Phonemic awareness, Vocabulary, Syntactic skills, and ultimately Letter knowledge and Word recognition skills. In addition, the amount of child involvement during storybook reading (i.e., asking questions about the story, retelling the story in own words) and the word orientation activities during storybook reading (i.e., pointing at words or letters, asking the meaning of words) showed a high positive correlation with Rhyme, Phonemic awareness, and early reading skills.

Table 4

Pearson's Correlations between all HLE Variables with the Reading Precursors at Time 1 (first row) and Reading Precursors and Early Reading Skills at Time 2 (second row) (n = 35)

HLE variables	Rhyme	Phon	Voc	Synt	Let	Word
Child writing experiences	.18	-.07	.12	.38*	-	-
	.09	.08	.14	.19	.14	.18
Child experiences of literacy materials	.13	.16	.14	.27	-	-
	.37*	.26	.11	.01	.18	.25
Child storybook reading	.24	.31	.07	.09	-	-
	.22	.22	.12	.13	.25	.19
Child story orientation activities	.39*	.15	.31	.31	-	-
	.45**	.54**	.29	.51**	.54**	.53**
Child word orientation activities	.37*	.27	.37*	.29	-	-
	.35*	.38*	.30	.37*	.51**	.43**
Child book orientation activities	.05	.14	.08	.35*	-	-
	.26	.15	.00	.09	.12	.20
Provision of literacy materials	.00	-.06	-.12	.14	-	-
	.06	.08	-.10	-.12	.02	.11
Parent storybook reading	.21	.19	-.07	-.02	-	-
	.25	.13	.01	.05	.16	.25
Parent literacy mediation	.36*	.43*	.49**	.55**	-	-
	.47**	.69**	.49**	.50**	.70**	.62**
Parent leisure activities	.15	.14	.12	-.02	-	-
	-.04	.07	.00	-.11	.36*	.36*
Parent own book reading	.07	-.18	-.11	.19	-	-
	.00	.06	-.13	-.01	.09	.12
Parent Email use	-.17	-.06	-.11	.20	-	-
	-.09	.11	.01	.00	.04	.02
Parent magazines reading	-.45**	-.23	-.18	-.10	-	-
	-.12	-.13	-.07	-.07	-.13	-.12

Note. Phon= Phonemic awareness, Voc= Vocabulary, Synt= Syntactic skills, Let= Letter knowledge, Word= Word recognition, * $p < .05$ (two-tailed), ** $p < .01$ (two-tailed)

Regression Analyses

Table 5 shows the results of the regression analyses predicting: reading precursors Time 1 by HLE variables, reading precursors Time 2 by reading precursors Time 1, early reading skills by reading precursors Time 2, and early reading skills by HLE variables. As can be seen in Table 5, all three HLE variables were related to one or more reading precursors at Time 1. Furthermore, there was a strong relationship between the reading precursors at Time 1 and Time 2, and between the reading precursors at Time 2 along with the early reading skills. In addition, the three HLE variables were also strongly related to the early reading skills at Time 2.

Table 5

R^2 of the Multiple Regression Analyses Predicting: Reading Precursors Time 1 by HLE Variables, Reading Predictors Time 2 by Reading Precursors Time 1, Early Reading Skills by Reading Precursors Time 2, and Early Reading Skills by HLE Variables

	Reading precursors Time 1				Early reading skills	
HLE variables	Rhyme	Phon	Voc	Synt	Let	Word
Parent literacy mediation	.13*	.18*	.15*	.30**	.49**	.38**
Child story orientation activities	.16*	.02	.08	.10	.29**	.28**
Child word orientation activities	.14*	.07	.06	.09	.26**	.19**
Reading precursors Time 2						
Rhyme	.30**				.48**	.44**
Phon		.28**			.48**	.48**
Voc			.43**		.30**	.13*
Synt				.53**	.45**	.21**

Note. Phon= Phonemic awareness, Voc= Vocabulary, Synt= Syntactic skills, Let= Letter knowledge, Word= Word recognition, * $p < .05$ (two-tailed), ** $p \leq .01$ (two-tailed)

In the hierarchical regression analyses, it was tested whether the three HLE variables were effective in explaining unique variance in the early reading skills once controlled for the mediators, the reading precursors at Time 1 and Time 2. Separate hierarchical regression analyses were carried out for Letter knowledge and Word recognition. In step 1, all four reading precursors at Time 1 and Time 2 were included, and in step 2, alternatively, Parent literacy mediation, Child Story orientation activities or Child word orientation activities was included. Table 6 shows that 66 percent of the variance in Letter knowledge can be explained by the reading precursors in Kindergarten and Grade 1, and that none of the HLE variables was effective in explaining unique variance in the scores of Letter knowledge once controlled for the reading precursors. In addition, 64 percent of the variance in Word recognition can be explained by the reading precursors at both times, and none of the HLE variables is effective in adding unique variance in the scores of Word recognition once controlled for the reading precursors.

Table 6

Incremental R^2 of the Hierarchical Multiple Regression Analyses Predicting Grade 1 Letter Knowledge and Word Recognition from Kindergarten and Grade 1 Reading Precursors and HLE variables

Step	Predictors	Letter knowledge	Word recognition
1	Reading precursors Time 1 and Time 2	.66**	.64**
2	Parent literacy mediation	.04	.03
2	Child story orientation	.00	.01
2	Child word orientation	.03	.01

Note. Phon= Phonemic awareness, Voc= Vocabulary, Synt= Syntactic skills, ***p* < .001 (two-tailed)

Path Analyses

The results of the hierarchical multiple regression analyses showed that HLE variables were not good predictors of early reading skills once controlled for the reading precursors at Time 1 and Time 2. These results indicated that the influence of the HLE variables on early reading skills was mediated by the reading precursors. This was further tested by path analyses. In the first path analysis a model was tested wherein the three HLE variables indirectly influence the early reading skills, namely through the reading precursors at Time 2. The Pearson correlation between Parent Literacy mediation and Child story orientation activities was $r = .45$, $p < .01$, the correlation between Parent literacy mediation and Child word orientation activities was $r = .55$, $p < .01$. Furthermore, Child word orientation activities and Child story orientation activities were also significantly related, $r = .51$, $p < .01$. Figure 1 shows the direct influences of the three HLE variables on Rhyme, Phonemic awareness, Vocabulary and Syntactic skills at Time 2, and the indirect influences of these HLE variables on Letter knowledge and Word recognition.

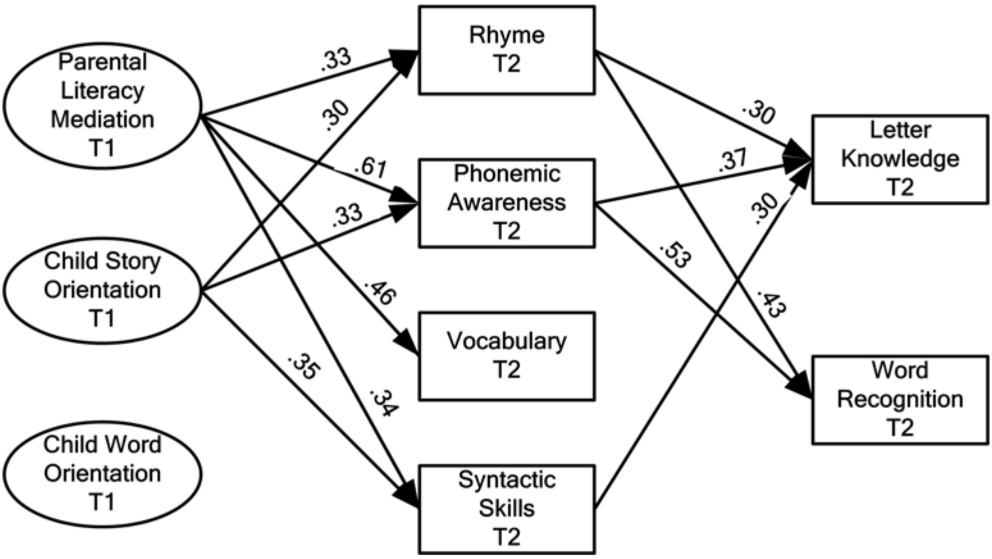

Figure 1

A Path Analysis Showing the Direct and Indirect Influences of Three HLE Variables on Rhyme, Phonemic awareness, Vocabulary, Syntactic skills, Letter Knowledge, and Word Recognition at Time 2. The Numbers Indicate Standardized Beta Coefficients. Betas > .15 are Presented (n = 35)

Figure 1 shows that the HLE variable Parental literacy mediation is a good predictor of Phonemic awareness in Grade 1 (β = .61). The emergent literacy activities that parents and children do together at home such as rhyming, reading letters and recipes, seem to influence all reading precursors. Figure 1 also shows that the influence of the HLE variable Parental literacy mediation on Letter knowledge and Word recognition was mediated by Phonemic awareness, Rhyme, and Syntactic skills. The involvement of the child in story orientation activities during shared storybook reading did influence the Syntactic abilities in Grade 1, even as both phonological skills, i.e., Rhyme and Phonemic awareness, and through these skills indirectly Letter knowledge and Word recognition skills. Though Table 4 shows significant correlations between the HLE variable Child word orientation activities and Rhyme (r = .35), Phonemic awareness (r = .38), and Syntactic skills (r = .37) at Time 2, these direct relationships were no longer evident in the path analysis. Child word orientation activities did not add direct influence on the reading precursors once the other two HLE variables are accounted for. The influence of Child word orientation activities was mainly through the other two HLE variables.

Due to the limited number of cases, the model fit was only judged by the Chi-square test, χ^2 (6) = 7.55, *p* = .273, the goodness of fit index (GFI), GFI = .957, and the normed fit index (NFI), NFI = .965. Following Hu and Bentler (1999), and Jaccard and Wan (1996) a model fits reasonably well if the Chi-square value does not exceed a limited multiple (3) of its degrees of freedom, and GFI and NFI are close to 1. It may therefore be concluded that the fit of the model is satisfactory. This model explained 63.2 percent of the variance in Letter knowledge and 59.4 percent of the variance in Word recognition. In addition, the percent of the explained variance in Rhyme, Phonemic awareness, Vocabulary, and Syntactic skills at Time 2 was respectively 29.8, 55.2, 20.1, and 35.0. The model tested in the path analysis was good applicable to the data and was in accordance with previous studies of children without disabilities.

However, although the tested model had a good fit and showed to be a good model for the data, the longitudinal development of the reading precursors was not taken into account. Therefore, the independent contributions of the different HLE variables on reading precursors at Time 2 were investigated by using the same reading precursor at Time 1 as control variable, i.e., the autoregressor. In this model we tested whether HLE variables were influencing the early reading skills indirectly through the longitudinal development of the reading precursors. Both direct and indirect influences of the HLE variables on the reading precursors at Time 2 are computed.

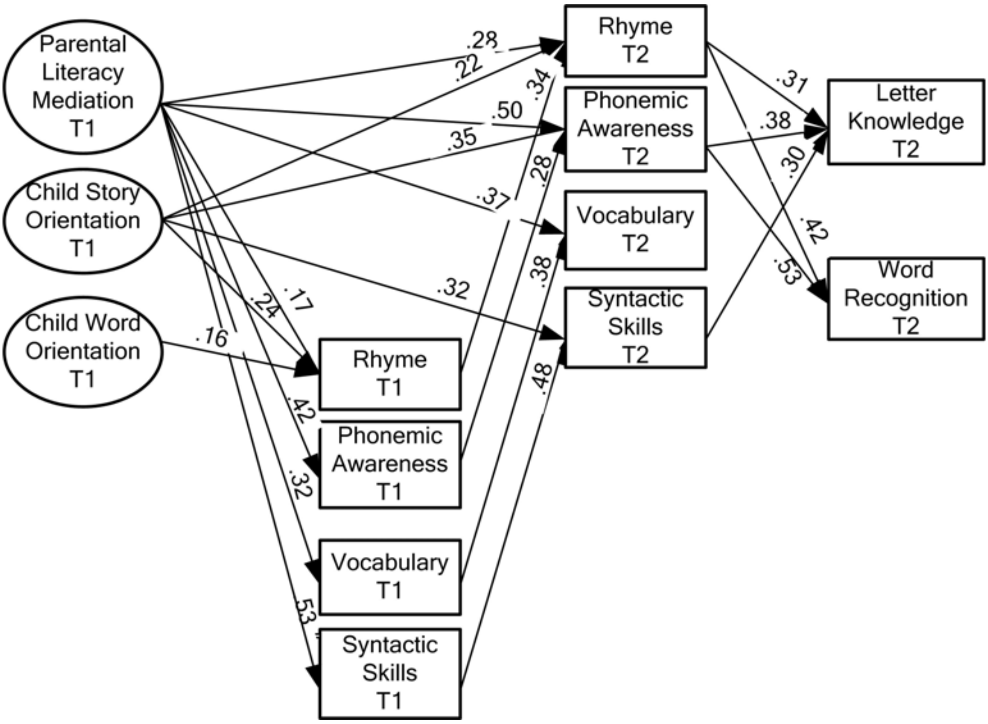

Figure 2

A Path Analysis Showing the Direct and Indirect Influences of Three Kindergarten HLE Variables on Reading Precursors at Time 1 and 2, and Letter Knowledge and Word Recognition at Time 2. The Numbers Indicate Standardized Beta Coefficients. Betas > .15 are Presented (n = 35)

Figure 2 shows that Parent literacy mediation strongly predicted almost all reading precursors at Time 1 as well as Time 2. Furthermore, the reading precursors and particularly Rhyme and Phonemic awareness, predicted Letter knowledge and Word recognition skills. Thus, it is indicated that the HLE variable Parent literacy mediation was a strong predictor of ultimately early reading success through the development of the reading precursors Rhyme and Phonemic awareness. The HLE variable Child story orientation activities predicted Rhyme at Time 1 and Syntactic skills at Time 2. Syntactic skills, on its turn, predicted Letter knowledge. The HLE variable Child word orientation activities only predicted Rhyme at Time 1. It can tentatively be concluded that the influence of word-related activities during storybook reading stimulated the early reading skills indirectly through the development of the Rhyme skills at Time 1 and 2.

Based on criteria of Hu and Bentler (1999), the fit of the model is not very satisfactory, χ^2 (26) = 60.40, $p < .001$, GFI = .825, and NFI = .826. Therefore, the model should be interpreted with caution as it is not sure if the influence of the HLE on early reading skills indirectly as stated in the model is in accordance with reality. However, as the fit indices were partly based on the number of cases, and in the presented model a lot of parameters were estimated based on a small number of cases, it is no surprise that the model did not show a good fit. This model explained 60.4 percent of the variance in Letter knowledge and 59.2 percent of the variance in Word recognition. Furthermore, the percent explained variance in Rhyme, Phonemic awareness, Vocabulary, and Syntactic skills at Time 2 is respectively 39.5, 62.4, 35.4, and 55.3.

Based on the fit indices, model 1 did show a better fit with the data than model 2. However, when adding the reading precursors at Time 1 to the model the percentage explained variance of the reading precursors at Time 2 increased, indicating that model 2 explained more variance in the reading precursors at Time 2 than model 1. Furthermore, the difference between model 1 and 2 was that the Beta coefficients that indicated the influence of the HLE variables on the reading precursors of model 1 were higher than those of model 2. In model 2, the Beta coefficients were divided by the relationship between the HLE variables and the reading precursors at Time 1 and the interrelationship of the reading precursors from Time 1 to Time 2.

Conclusions and Discussion

Several conclusions can be drawn from the present study. First of all, the children with CP showed significant growth in all reading precursors from the end of Kindergarten till the end of Grade 1. Furthermore, it was found that the HLE has a significant impact on children's early literacy development. Three HLE variables were significantly related to both reading precursors and reading skills, i.e., Parent literacy mediation, Child story orientation activities and Child word orientation activities. It should be mentioned that all of these variables involve parental mediation. This finding is in line with the outcomes of previous studies. For instance, Burgess, Hecht, and Lonigan (2002) concluded that the active elements of the HLE conceptualizations, such as parental efforts that directly engage the child in activities designed to foster literacy and language development (e.g., rhyming games, shared reading) remained significantly related to phonological sensivity and word recognition once earlier measures of these outcomes variables were accounted for. Likewise, Dahlgren Sandberg (1998) concluded in her study to the HLE of nonvocal children with CP that availability alone is not enough for positive development of literacy abilities, and that it is rather the interaction mode, which concerns the participants' type and degree of activity which seems to have a considerable impact.

The results of the hierarchical regression analyses predicting early reading skills indicated that the influences of home literacy experiences and support on early reading skills are mediated by reading precursors. The results of the path analyses are in line with the results of the hierarchical regression analyses, indicating that the HLE variables indirectly influence the early reading skills, namely through the development of the reading precursors, and in particularly through the development of Rhyme and Phonemic awareness. The results of the present study are in line with previous studies to the longitudinal influence of the HLE on the reading development of children without disabilities, showing that the effects of the home literacy environment on reading acquisition were indirectly through the children language and emergent literacy skills (cf. Burgess et al., 2002; Leseman & de Jong, 1998; Sénéchal et al., 1998; Whitehurst & Lonigan, 1998). The results of the path analyses in the present study made clear that the best predictor of early reading skills is Phonemic awareness. This finding is fully commensurate with previous studies indicating that phonemic awareness can be seen as a very strong predictor of early word recognition skills (Adams, 1990; Torgesen et al., 1997). Conclusively, the results of the path analyses showed the important role of both phonological awareness skills, but particularly phonemic awareness in the early reading development of the children. Phonemic awareness and to a lesser degree Rhyme, function as important mediators between HLE and early reading skills, rather than Vocabulary skills.

The results of the present study should be interpreted in the light of several limitations. To begin with, it is important to point out that the present study was an explorative study, investigating if the HLE variables predicted the early reading skills directly or via the reading precursors. As the results of this study are based on a small group of children (*n* =35) we therefore can not draw hard conclusion of the results of the path analyses. More research is needed before we can conclude that there is an indirect relationship between the HLE and reading skills. Furthermore, the operationalisation of HLE by means of parent questionnaires can be questioned. The use of questionnaires may have led to some response bias in terms of social acceptability. Moreover, it should be acknowledged that the use of parent questionnaires can just be seen as a first step toward answering questions about the role of the HLE in the early literacy development of children with CP. A more complete answer can be expected from longitudinal studies in which literacy data and detailed observations concerning the literacy support in the home environment are collected. Furthermore, the present study investigated the one-year long longitudinal influence of the HLE on reading precursors and early reading skills for children at the end of Kindergarten till the end of Grade 1. As the children start formal reading instruction in Grade 1, future research may take into account the amount of reading instruction the children received during this period and investigate if the amount of reading instruction could influence the relationship between HLE variables and reading skills.

There are several clinical implications from the present study. Considering the fact that the activities that parents do at home with their child do have an effect on the reading precursors of these children, more directed literacy stimulation at home can be recommended. As the results showed that the early reading skills are stimulated through the development of the reading precursors, it is important that parents focus on the stimulation of reading precursors in perspective of emergent literacy. Therefore, interactive aspects of the HLE need to be highlighted. This means that parents must not just give their child a lot of books to play with and think that will stimulate the development of reading precursors and reading development of the child. Rather, they should do activities together with their child that foster the emergent literacy development such as involving the child in own reading and writing activities, reading letter and words with their child and play rhyming games. Besides, it is not the amount of storybook reading that counts, but the engagement of the child during storybook reading that matters. Parents should be aware that just reading a lot of books to their child is not the best way to stimulate the emergent literacy development of their child. Possibly, parents can better do fewer shared reading activities, but when they do these activities be aware that their child is taken an active role throughout these activities. The dialogic reading intervention of Whitehurst and Lonigan (1998) could be applied to parents who do not know how to involve their child in shared reading sessions. In this intervention, parents learn how they can stimulate their child to become the storyteller instead of them. While in typical shared reading sessions the adult is the one who reads to the child and the child listens, now the adult has to become the active listener, ask questions, add information and prompt the child to give more elaborated descriptions of the materials in the books.

Finally, it is important for parents to keep in mind that in order to become more involved in the storybook reading session the child must have the opportunity to communicate. While six of the participating children in this study use one or more AAC devices or methods in daily life, none of these children was using AAC during storybook reading sessions. The low incidence of AAC use during shared storybook reading is in accordance with previous studies (Dahlgren Sandberg, 1998; Light, Binger, & Kelford Smith, 1994) and asks for action. Intervention studies with the purpose of stimulating the involvement of the child during shared book reading should also include information and instruction about how parents could use the AAC of their child during book reading (cf. Pebly & Koppenhaver, 2001, p. 224; Justice & Kaderavek, 2002).

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Appendix

Appendix A. Results of the factor analyses of the four parent questionnaires

Factor Analysis of Child's Literacy Interest

Items	Factor 1	Factor 2	Factor 3
Child's literacy interest	Child's writing experiences	Child's experiences with literacy materials	Child's storybook reading interest
Use of child magazines	.06	**.53**	-.10
Use of child books	-.02	**.33**	.20
Use of comic books	-.40	**.40**	-.03
Use of dictionaries and/ or encyclopedias	.07	**.51**	-.07
Use of tape-recorded stories	-.21	**.38**	.10
Use of songbooks	-.14	**.55**	.03
Use of play-do books	.11	**.55**	.08
Use of a typewriter or computer	.17	.28	-.05
Use of writing stuff	**.91**	.03	.03
Use of drawing stuff	**.93**	.04	.00
Interest in writing, drawing or painting	**.59**	-.09	.01
Interest in storybook reading	.02	.00	**.80**
Frequency of asking to be read to	.02	-.04	**.93**
Reliability coefficients (Cronbach's α)	.85	.66	.60
Eigenvalue	2.94	2.27	1.50
Percent explained variance	22.59	17.44	11.54
	Intercorrelations		
1	-		
2	.19	-	
3	.01	.33	-

Factor Analysis of Child's Activities during Storybook Reading

Items	Factor 1	Factor 2	Factor 3
Child's activities during storybook reading	Story orientation activities	Word orientation activities	Book orientation activities
Turning the pages	.15	-.08	**.79**
Holding the book	-.10	-.01	**.76**
Indicating the tempo	-.09	.14	**.36**
Naming pictures	.10	**.32**	-.15
Pointing at letters or words	.03	**.84**	.07
Reading aloud letters or words	-.09	**.78**	.04
Asking the meaning of words	.25	**.31**	.02
Asking questions about the story	**.30**	.21	.03
Retelling the story, in own words or by using AAC	**.72**	.00	-.05
Guessing how the story will end	**.66**	-.17	-.00
Give comments on the story	**.56**	.07	.06
Relating the story to experiences in daily life	**.39**	.17	-.07
Reliability coefficients (Cronbach's α)	.71	.64	.65
Eigenvalue	3.19	1.84	1.54
Percent explained variance	24.50	14.17	11.83
	Intercorrelations		
1			
2	.35		
3	.04	.06	

Factor Analysis of Materials and Parental Activities for Child Literacy Development

Items	Factor 1	Factor 2	Factor 3	Factor 4
Materials and parental activities for child literacy development	Provision of literacy materials	Parent storybook reading interest	Parent literacy mediation	Parent leisure activities
Number of own books	**.31**	.11	.07	-.16
Number of magazines available	**.65**	-.21	.01	-.14
Number of child books	**.67**	.17	-.05	-.08
Number of comic books	**.58**	-.08	.03	-.05
Number of dictionaries or encyclopedias	**.64**	-.00	.00	.00
Number of taped-recorded stories	**.65**	.04	-.10	.19
Number of songbooks	**.72**	-.07	-.11	.28
Number of play-do books	**.59**	.02	.25	-.08
Enjoying storybook reading to the child	-.13	**.75**	-.01	.01
Age of the child storybook reading began	.15	**.45**	.22	-.33
Number of visits to library	-.05	**.50**	.01	-.10
Frequency of reading to the child	.04	**.74**	-.17	.14
Frequency of picture-book reading together with the child	.09	**.58**	.01	.12
Duration of storybook reading	.02	-.03	.20	.03
Frequency of playing with the child	.03	.24	.02	**.51**
Frequency of playing outside the home with the child	-.07	-.05	.04	**.64**
Frequency of watching child programs on television with the child	.04	-.05	.18	**.45**
Frequency of involving the child in own reading	-.03	.24	**.42**	.09
Frequency of involving the child in own writing	-.07	-.03	**.46**	.18
Frequency of playing rhyme games with the child	.07	-.04	**.42**	-.18
Frequency of reading names or letters with the child	.02	-.04	**.59**	.02
Frequency of reading recipes or shopping lists with the child	-.02	-.04	**.65**	.31
Reliability coefficients (Cronbach's α)	.82	.69	.66	.57
Eigenvalue	4.21	3.04	1.74	1.60
Percent explained variance	19.13	13.81	7.92	7.25

	Intercorrelations			
1	-			
2	.17	-		
3	.12	.37	-	
4	.14	.37	.17	-

Factor Analysis of Parent's own Literacy Materials and Activities

Items	Factor 1	Factor 2	Factor 3
Parent's own literacy materials and activities	Parent book reading	Parent email use	Parent magazine reading
Number of newspapers	-.03	-.03	**.33**
Number of magazines	.04	-.08	**.73**
Number of reading books	**.76**	-.06	-.12
Number of study books	**.64**	-.02	.08
Number of dictionaries and encyclopedias	**.61**	.06	.05
Frequency of reading the newspaper	.12	.09	.03
Frequency of reading books	**.49**	-.04	-.10
Frequency of reading informative books	**.54**	.17	.12
Frequency of reading magazines	-.11	.06	**.69**
Frequency of writing a letter or a story	.10	.13	.08
Frequency of drawing a picture or painting	.16	.00	-.12
Frequency of reading e-mail	.07	**.78**	-.08
Frequency of writing e-mail	-.07	**1.00**	.02
Reliability coefficient (Cronbach's α)	.73	.88	.57
Eigenvalue	3.17	1.66	1.44
Percent explained variance	24.35	12.79	11.08
	Intercorrelations		
1	-		
2	.32	-	
3	.41	.13	-

Teacher Literacy Expectations for Kindergarten Children with Cerebral Palsy in Special Education[1]

Chapter 6

[1] Reference: Peeters, M., Verhoeven, L., & de Moor, J. (in press). Teacher literacy expectations for kindergarten children with cerebral palsy in special education. International Journal of Rehabilitation Research (2009), DOI: 10.1097/MRR.0b013e32832c0da9.

Abstract

Teacher expectations are important for the literacy development of children. The goal of this study was to investigate to what extent teacher expectations for future literacy success at the end of elementary school differed for children with cerebral palsy (CP) as compared to peers without disabilities in kindergarten. In addition, we investigated to what extent teacher literacy expectations of children with CP were related to additional impairments such as speech, intellectual, and physical impairments, and to the current level of emergent literacy skills. Forty-nine teachers of children with CP and 71 teachers of non-disabled children responded to the questionnaire. The results showed that teacher expectations for future reading and writing success of children with CP were lower (all *p*s $<.001$) but also of a different nature, as eight teachers had no idea what to expect for the future reading development and twelve teachers did not know what to expect for the future writing development of the child with CP. Multiple regression analysis showed that Teacher Reading Expectations could best be predicted by both Intelligence and Emergent Literacy skills ($p < .001$), while Teacher Writing skills could best be predicted by Intelligence ($p < .001$).

Introduction

Teacher expectations play an important role in literacy development and progress of children because teachers often act upon the expectations they have for the children. For example, teacher expectations influence interaction with students since teachers tend to engage more often in academic contact (Cooper & Tom, 1984), praise more often and give more support to high expectation students (Brophy & Good, 1970). Teacher expectations can be categorized into three general types: estimates of the present ability or achievement of the student, expected improvement of the student, and natural discrepancies between teachers and test, i.e., the degree to which teachers under or overestimate the present performance level (Cooper & Tom, 1984). In addition to these three types of expectations, two expectation side-effects may influence students' performance: self-fulfilling prophecies and sustained expectation effects. A self-fulfilling prophecy can be said to occur when teachers who have inaccurate expectations for a student's achievement act upon these inaccurate expectations, thereby making these inaccurate expectations come true (Brophy, 1983; Jussim & Eccles, 1992). A sustained expectation effect happens when a teacher responds on the basis of their existing accurate expectations instead of on the basis of changes in performance caused by sources other than the teacher. In that case, no or few improvements in student performance can occur because teacher expectations are not open to corrective feedback (Cooper & Tom, 1984). Although inaccurate teacher expectations and teacher expectations not open to feedback may negatively influence academic performance, studies of children without disabilities have shown that teacher expectations are often accurate, based on the best available information and open to corrective feedback. Therefore self-fulfilling prophecy effects only explain about 5% of student achievement (Brophy, 1983).

Considering the fact that teacher expectations are often accurate and based on the best available data for children without disabilities, the question arises as to whether this is also true for children with disabilities, such as children with cerebral palsy (CP). In addition to their physical impairments, children with CP often have additional impairments such as speech and intellectual impairments making literacy development both quantitatively and qualitatively different from that of children without impairments (Berninger & Gans, 1986; Koppenhaver, Coleman, Kalman, & Yoder, 1991; Koppenhaver, Evans, & Yoder, 1991; Peeters, Verhoeven, van Balkom, & de Moor, 2008; Smith, 1989). These additional impairments may limit literacy development directly, but also indirectly since they have consequences for the expectations teachers hold for literacy development of the child. Especially for these children, it is important that teachers have high but also accurate and realistic expectations for their literacy development and improvement and offer these children as many literacy learning opportunities as possible. Taking the complex literacy development of children with CP into account, the question arises as to whether teachers do have expectations for the literacy improvement of these children and what the nature of these expectations is. Because there can be enormous variation in intellectual and speaking abilities within a classroom of children with disabilities in special education, it is also important that teachers differentiate their expectations according to the type and level of impairments and related to that, the learning potential of the individual child.

Previous studies investigating teacher expectations for children with CP are scarce. Koppenhaver, Evans, and Yoder (1991) conducted a retrospective study of 22 literate adults with congenital severe speech and physical impairments. Respondents believed that literacy might have been made more accessible to them. Five respondents cited higher teacher expectations and more teacher assistance as possible suggestions for better literacy stimulation. In addition, Light, Koppenhaver, Lee, and Riffle (in Light & McNaugton, 1993) studied parental and teacher expectations for literacy development in students who use augmentative and alternative communication (AAC), the majority of whom had CP. Most teachers expected that their student would achieve functional literacy skills by age 25. Also, teacher expectations were lower compared to parent expectations for almost half of the students. Furthermore, most teachers expected the student's literacy skills to improve by the age of 25, although there were also a lot of teachers who did not expect improvement in literacy skills. Light and McNaughton (1993) stressed that expectations for progress should be positive, but also realistic. Given the design of the study by Light et al. (1992, in Light & McNaughton, 1993), it was not possible to ascertain whether teacher expectations were realistic.

Previous studies have shown that teacher expectations for literacy improvement for children with CP are lower compared to children without disabilities (cf. Light & McNaugton, 1993). However, there is a lack of studies investigating the extent to which teachers can differentiate their literacy expectations according to the level of additional impairments and emergent literacy skills of individual children with CP that may limit their literacy development. In addition, so far no research has been conducted to uncover the extent to which teacher expectations for literacy improvement of children with CP are accurate based on the child's current literacy level. The present study aims to overcome the limitations of previous research. To obtain more insight in teacher expectations, a teacher expectation questionnaire was administrated to teachers of children with CP and teachers of children without disabilities. For the group of children with CP, we investigated the extent to which teacher expectations are related to the current child variables: speech intelligibility, intelligence, motor function. We also investigated the extent to which teacher literacy expectations are related to the children's current level of emergent literacy skills, i.e., auditory perception, phonological awareness, vocabulary, and syntactic skills. Skills of emergent literacy precede actual literacy development and are good predictors of later literacy success (Peeters et al., 2008; Peeters, Verhoeven, de Moor, & van Balkom, in press). In addition, we investigated what variable or variables best predicted teacher expectations. Research questions addressed in the present study include:

1. Are there differences between teacher literacy expectations for children with CP and the comparison group? If so, what is the nature of these differences?
2. How are teacher literacy expectations related to child variables and the current level of emergent literacy of the children with CP? And what is the relative influence of these variables on teacher expectations?

Method

Participants

All 32 schools for children with physical and multiple disabilities in the Netherlands were asked to participate and obtain written consent from the parents of children with CP who fit the following inclusion criteria: Dutch must be their native language, the intellectual level must range from a mild intellectual disability to average intelligence or above, hearing and vision must be within the normal range, with the ability to respond intentionally, either through speaking or by means of alternative communication (e.g., looking, pointing or gesturing). All children with CP attended special schools for children with physical and multiple disabilities across the Netherlands. Forty-nine of 54 teachers of children with CP who were willing to participate returned the questionnaire (90.7%). The comparison group consisted of 71 children who attended five different mainstream schools. Inclusion criteria for the comparison group were: Dutch as their native language and no known impairments. All teachers of comparison group children returned the questionnaire. Group characteristics are shown in Table 1. The groups did not differ in average age or gender (*p*s >.05). All children were attending the second year of kindergarten[2].

[2] All children were participating in a larger longitudinal study to the emergent literacy development of children with CP (cf. Peeters, et al., 2008; Peeters et al., in press).

Table 1

Group Characteristics, Means (SD)

	CP (*n* = 49)	Comparison (*n* = 71)
Age (months)	71.88 (5.82)	72.21 (3.69)
Gestational age (weeks)	34.14 (4.93)	-
Birth weight (grams)	2264.93	-
SES[1]	4.96 (.94)	4.60 (1.50)
	Percentages	
Gender (% male)	63.3	53.5
Diagnosis		
Unilateral spastic CP		
Right	6.1	-
Left	8.2	-
Bilateral spastic CP[2]	83.7	-
Ataxic CP	2.0	-
Epilepsy	18.4	-
Speech impairment		
Dysathria mild	16.3	-
Dysartria moderate	12.2	-
Anartria	22.5	-
Dyspraxia mild	0.0	-
Dyspraxia moderate	2.0	-
Unknown	4.1	-
No speech impairment	42.9	100.0
AAC use[3]	24.5	-

[1]Socioeconomic status (SES) was measured by the average educational level of the parents, range 1-7.

[2]Some of the children were having a combination of spastic bilateral CP with another subtype.

[3]Percentage of children using Augmentative or Alternative Communication (AAC) in daily life.

Child Variables

Speech Intelligibility. A standardized subtest of the Dutch Speech Language Impairment (SLI) Screening test was administrated (Verhoeven, 2006) to children with CP to assess their speech intelligibility. The child was asked to repeat real words, presented individually by a recorded voice. The task started with words containing only one syllable and gradually increased in difficulty to words containing up to five syllables. The task was ended if the child made five successive errors. The maximum score was 40. The test manual reported good internal consistency with a Cronbach's alpha of .94 (Verhoeven, 2006).

Intelligence. Intelligence was measured with the Raven Coloured Progressive Matrices (Raven, 1956). The task measures nonverbal reasoning or intelligence with a minimal interference of language and is a commonly used instrument to assess intelligence in the nonspeaking population (Pueyo, Junqué, Vendrell, Narberhaus, & Segarra, 2008). Children were asked to point, aided or unaided, to one of the six pictures that completed the presented figure. The task consisted of 36 items. Raw scores were converted to standard scores ranging from 0.5 to 9.5 using Dutch norms (van Bon, 1986). The reliability of the test is considered satisfactory (Evers, van Vliet-Mulder, & Groot, 2000).

Fine Motor Function. Fine motor function skills were assessed by means of the Dutch version of the Manual Ability Classification System (MACS) for children with CP (Eliasson et al, 2006). The purpose of the MACS is to assess the child's ability to handle objects and his or her need for assistance or adaptation in order to be able to perform tasks in everyday life. A particular emphasis is placed on handling objects in an individual's personal space. The fine motor skill of each hand is categorized as one of five levels, with a higher score indicating a higher level of impairment. Level one refers to handling objects easily and successfully, while level five refers to severely limited abilities to perform even simple actions. Research has indicated that the MACS has good validity and reliability (Eliasson et al., 2006) as the intraclass correlation coefficient between therapists was 0.97, and between parents and therapist was 0.96, indicating excellent agreement.

Gross Motor Function. To assess the gross motor function of children with CP, a Dutch version of the Gross Motor Function Classification System (GMFCS) (Palisano et al., 2000) was used. The GMFCS consists of five levels based on self-initiated movement with particular emphasis on sitting and walking. The purpose of the GMFCS is to determine what level best represents the child's present abilities and limitations in motor function. Level one refers to walking without restrictions, while in level five self-mobility is severely limited even with the use of assistive technology. Research has indicated that the GMFCS has good reliability and validity. The interrater reliability of two blinded raters applied four times during the study was high ($G= 0.93$), even as the test-retest reliability ($G = 0.79$). The GMFCS can validly predict motor function for children with CP, as the positive predictive value of the GMFCS at 1 to 2 years of age to predict walking by age 12 years was 0.74, and the negative predictive value was 0.90 (cf. Wood & Rosenbaum, 2000).

Emergent Literacy Tasks

*Auditory Perception.*To assess auditory perception abilities, the Auditory Discrimination Task of the standardized Dutch Language Proficiency Test was administrated (Verhoeven & Vermeer, 2001). In this task, the child was presented with minimally differing word pairs and had to indicate whether the words in a pair sounded alike. The words were pronounced at normal intensity level by a test assistant. Response adaptations for children with speech difficulties consisted of nodding or pointing to left or right to indicate whether the words sounded the same or different. All 50 items were tested and each correct item yielded one point. The task was highly reliable with a Cronbach's alpha of .97 (Verhoeven & Vermeer, 1999).

Rhyme. A Rhyme recognition task was constructed consisting of 20 items of highly frequent Dutch CVC words. The test assistant asked the child to look at the three presented pictures and subsequently named the pictures. Then, the test assistant named a stimulus word and asked the child which picture rhymed with the stimulus word. Each correct response yielded one point. The internal consistency in this study was good with a Cronbach's alpha of .86.

Phonemic Awareness. The First-phoneme Recognition Task (de Jong, van Otterloo, & Regtvoort, 2006) consists of 10 items with CVC words. Each item consists of five pictures, one stimulus picture and four response pictures. During the exercise items, the test assistant pointed at the stimulus picture and named that picture (e.g., roof). Subsequently, the test assistant explained that the stimulus word could be split up in two parts, the first-phoneme of that word versus the rest of the word (e.g.,rrrrr-oof). The test assistant subsequently named all four response pictures with explicit emphasis on the first-phoneme of the words. The child had to point to one of the four response pictures that started with the same first-phoneme as the stimulus word (i.e., r). The internal consistency of this task in this study was good with a Cronbach's alpha of .83.

Vocabulary. Receptive vocabulary was assessed using a Dutch version (Schlichting, 2005) of the Peabody Picture Vocabulary Test III (Dunn & Dunn, 1997). In this standardized test, the task of the child was to point to one of the four pictures that corresponded with the word spoken by the test assistant. Raw scores were converted to standard scores (M = 100, SD =15). The test manual described an internal consistency interval of Cronbach's alpha between .92 and .94.

Syntactic Skills. The Syntactic Pattern subtest of the Dutch Language Proficiency Test was administrated (Verhoeven & Vermeer, 1986), in which the child heard a sentence which constitutes a syntactic pattern, and had to indicate which of the three pictures matched that syntactic pattern. For example, response pictures for the item 'It is the boy who pushes the girl' are: the correct picture in which the boy pushes the girl (sitting in a buggy), the incorrect picture in which the girl pushes the boy (sitting in a buggy), and the second incorrect picture in which the boy and the girl together push a buggy. All correct responses yielded one point with a maximum of 32 points. The task was highly reliable with a Cronbach's alpha between .90 and .97 (Verhoeven & Vermeer, 1999).

Teacher Literacy Expectations

Teacher Reading Expectations. Teacher reading expectations for the child's future reading success at the end of elementary school, i.e., the end of the 6th grade, when children will have an average age of 12 ½ years, were assessed with one multiple-choice item. Response options included: I don't know what to expect, child won't be able to read, child will be able to read symbols (e.g., Bliss symbols), PCS symbols or picto's (i.e., pictures, illustrations or photos), child will be able to read letters, child will be able to read words, child will be able to read easy texts, or child will be able to independently read a book.

Teacher Writing Expectations. Teacher writing expectations for the child's future writing success at the end of elementary school were assessed with one multiple-choice item. It was explained that writing and drawing activities could also be done on an AAC device or a computer. The response options included: I don't know what to expect, child will not be able to write or type with an AAC device or computer, child will be able to write or type some letters, child will be able to write or type words, child will be able to write or type an easy text, to child will be able to write or type a long text or story.

Procedure

Data was collected at the end of the second year of kindergarten. A teacher questionnaire was sent to the contact person of the schools who gave the questionnaire to the participating teacher. For the group of children with CP, each teacher assessed only one child. Twenty teachers of the comparison children participated in this study; therefore some children in the comparison group were assessed by the same teacher. Concerning the motor functions of the children with CP, a small questionnaire was sent to a pediatric neurologist or a specialist in rehabilitation medicine who was familiar with the child. Emergent literacy skills and Speech Intelligibility were assessed by individually testing the children in a quiet room in their schools by an instructed test assistant; an assistant teacher was present as well for the children with CP to make them more comfortable. Response adaptations for children with speech difficulties were nodding or pointing, aided or unaided. This study was proposed to the Dutch Association of Rehabilitation Physicians [Vereniging van Revalidatieartsen] and the Dutch Association of Schools for Children with Physical Disabilities [Vereniging van Mytyl- en Tyltylscholen] who gave their full official cooperation. This study did not need permission of the medical ethical committee because only behavioral data and existing medical information was collected.

Statistical Method

In order to compare teacher reading and writing expectations between the groups, first, categories with frequencies less than three were combined. Although fine and gross motor functions were measured on an ordinal scale, inspection of the data showed good distribution of these variables and a linear relationship with the child variables and emergent literacy skills, therefore making it possible to conduct correlation analyses. For all further analyses, only the categories that could be placed on an ordinal scale were included, consequently, the category “I don’t know what to expect” was excluded. To investigate group differences in teacher’s expectations, Mann-Whitney U tests were conducted. Furthermore, descriptive statistics of child variables and emergent literacy skills for the children with CP were carried out.

A factor analysis with Principal Axis Factoring (PAF) was conducted for the tasks of emergent literacy. The results of the factor analysis showed that these skills of emergent literacy measured one construct. The factor analysis extracted only one factor that explained 62.27 % of the variance, and had an Eigenvalue of 3.11. All tasks had factor loadings > .61. Subsequently, a composite score for the Emergent Literacy factor was created based on the average standard scores of the emergent literacy tasks. Furthermore, Spearman’s correlations were computed between teacher expectations, child variables and emergent literacy factor for the group of children with CP. This was done separately for the reading and writing expectations. In addition, variables that showed a significant relationship with teacher expectations were entered in the stepwise multiple regression analysis. Variables that did not explain unique variance were excluded by this method, resulting in a model with only variables that explained unique variance.

Results

Teachers Future Literacy Expectations for both Groups

Considering the fact that children with CP lag behind their peers in mainstream schools (Peeters et al., 2008), it is no surprise that teacher literacy expectations for future literacy success for children with CP were below those for children without disabilities. Regarding Teacher Reading Expectations, eight teachers of children with CP did not know what future expectations to have for the reading level of the child, while all teachers of the children in the comparison group had expectations for their child. For the teachers who did have expectations, there were significant differences between the groups, Mann-Whitney $U = 690.50$, $p < .001$ (two-tailed). Almost all teachers ($n = 65$) of the children in the comparison group had high expectations, i.e., that the child would be able to read long texts and stories at the end of elementary school. For 6 children in the comparison group, the teachers expected that the child will be able to read easy texts. In addition, teacher expectations for children with CP were lower: only 17 teachers expected that the child would be able to read long and difficult texts, while 12 teachers expected the child to be able to read easy texts, and 12 teachers expected the child to read with picto's or to read letters or words only.

With regard to Teacher Writing Expectations, 12 teachers of the children with CP did not know what to expect of the future writing skills of the children, while again all teachers of the comparison group children had expectations. For the teachers who did have expectations, there were again significant differences between the groups, Mann-Whitney $U = 638.00$, $p < .001$ (two-tailed). Again, almost all teachers ($n = 64$) in the comparison group had high expectations for their child, i.e., they expected the child to be able to write difficult texts or stories at the end of elementary school. Only six teachers expected the child to be able to write easy texts or stories and only one teacher of the comparison group expected the child to be able to write just letters or words. Independent sample T-tests indicated that there were no differences in the reading expectations teachers had for boys and girls for group of children with CP, $t(39) = 0.36$, $p > .05$, and the comparison group, $t(69) = -0.67$, $p > .05$. The same was true for the writing expectations for the group of children with CP, $t(35) = 0.31$, $p > .05$, and the comparison group, $t(69) = -1.82$, $p > .05$. Furthermore, reading expectations for the children with CP and the comparison group were not related to the SES of the children, $\rho = .32$, $p > .05$, and $\rho = -.04$, $p > .05$ respectively. In addition, writing expectations were not related to the SES of the children with CP, $\rho = .36$ and $p > .05$, and the comparison group, $\rho = .01$, $p > .05$.

Relationship between Teacher Literacy Expectations with Child Variables and Emergent Literacy Skills for Children with CP.

Table 2 shows the descriptive statistics of the child variables and emergent literacy skills for the total group of children with CP and for the subgroups of children with CP who were subdivided into a subgroup of whom teachers had and did not have expectations. It can be seen that the children of whom teachers had no expectations for the future reading and writing development scored, on average, below the group of children of who teachers did have expectations of the future reading and writing development. However, the range of scores was large and therefore we cannot conclude that teachers only had no expectations for low scoring children.

Table 2

Descriptive Statistics of the Child Variables and Emergent Literacy Skills for the Group of Children with CP

	All CP children (*N* = 49)		No reading expectation (*n* =8)		Reading expectation (*n* =41)		No writing Expectation (*n* =12)		Writing expectation (*n* = 37)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Child variables										
Intelligence	2.3	1.7	2.0	1.6	2.3	1.8	1.4	1.0	2.5	1.8
Speech Intelligibility	17.0	13.3	9.4	9.4	18.5	13.6	10.2	10.4	19.2	13.6
Fine Motor Function	2.6	0.9	3.4	0.7	2.4	0.9	3.3	0.8	2.3	0.81
Gross Motor Function	2.8	1.3	3.5	1.6	2.7	1.2	3.8	1.2	2.5	1.1
Emergent literacy skills										
Auditory Perception	35.6	10.1	33.4	9.9	36.0	10.1	30.9	10.6	37.1	9.4
Rhyme	12.6	3.9	12.3	4.1	12.6	3.9	10.3	4.3	13.3	3.5
Phonemic Awareness	4.5	2.5	2.6	1.9	4.9	2.4	2.8	1.7	5.1	2.4
Vocabulary	81.5	17.2	74.6	12.7	82.8	17.8	70.9	12.7	84.9	17.2
Syntactic Skills	20.5	5.8	17.0	3.9	21.1	5.9	16.4	5.4	21.8	5.4

Table 3 shows the Spearman's correlations between teacher expectations, child variables, and the emergent literacy factor. Teacher Reading Expectations were related to child's Intelligence, Speech Intelligibility, Gross Motor Function, and Emergent Literacy. Teacher Writing Expectations were only correlated with Intelligence and Speech Intelligibility. Teacher Reading and Writing Expectations were both not correlated with the Fine Motor Skills of the children. Multiple Regression Analysis with Intelligence, Speech Intelligibility, Gross Motor Function, and Emergent Literacy showed a significant model, $F(2, 40) = 13.25$, $p < .001$, that explained 38.0% of the variance in Teacher Reading Expectations. In this model, two significant predictors turned out; the best predictor was

Intelligence (β = .41, t = 2.72, and p =.01), followed by Emergent Literacy (β = .32, t = 2.1, and p <.05). The other two child variables did not add significant unique variance to the model and were excluded.

Regarding Teacher Writing Expectations, the Multiple Regression Analysis showed a significant model, F (1, 36) = 13.76, p = .001, that explained 26.2% of the variance in Teacher Writing Expectations. In this model the only significant predictor turned out to be Intelligence (β = .53, t = 3.71, and p = .001). Speech Intelligibility did not add significantly unique variance in explaining Teacher Writing Expectations and was excluded.

Table 3

Spearman's Correlations between Teacher Expectations, Child Variables, and Emergent Literacy Skills for the Children with CP[3]

	Teacher Reading Expectations (n = 41)				
	IQ	Speech	Fine motor	Gross motor	Emergent literacy
Reading exp	.61**	.40**	-.24	-.34*	.55**
IQ	-	.33*	-.13	-.25.	.51**
Speech		-	-.48**	-.48**	.58**
Fine motor			-	.65**	-.43**
Gross motor				-	-.44**
Emergent literacy					-
	Teacher Writing Expectation (n = 37)				
	IQ	Speech	Fine motor	Gross motor	Emergent Literacy
Writing exp	.57**	.37**	-.08	-.18	.31
IQ	-	.27	-.07	-.23	.37*
Speech		-	-.39*	-.38	.56**
Fine motor			-	.57**	-.34*
Gross motor				-	-.28
Emergent literacy					-

Reading exp = reading expectation, writing exp =writing expectation, IQ = Intelligence, Speech = speech intelligibility, Fine motor= fine motor function, gross motor= gross motor function, Emergent literacy = emergent literacy factor

*p <.05 (two-tailed), ** p <.01 (two-tailed)

[3] The negative correlation between Gross and Fine Motor Function with literacy expectations indicates that the more severe the fine and gross motor skills, the lower the literacy expectations.

Conclusions and Discussion

Conclusions

The results of the present study show that there are differences in teachers expectations for future literacy development of children with CP compared to the comparison group of children without disabilities. Teacher expectations for children with CP were not only lower but also of a different nature. A subgroup of teachers of children with CP did not even know what to expect for the literacy development of the children. Given the fact that previous studies have shown that children with CP lag behind already in their emergent literacy development compared to peers without disabilities (Peeters et al., 2008; Peeters et al., in press), the lower literacy expectations of the teachers for the children with CP in the present study seem to be realistic given the lower level of emergent literacy skills of children with CP in kindergarten.

Although Teacher Reading Expectations were related to Intelligence, Speech Intelligibility, Gross Motor Function, and Emergent Literacy, Intelligence and Emergent Literacy were the only two significant predictors of Teacher Reading Expectations. Regarding the Teacher Writing Expectations, although these were related to Intelligence and Speech Intelligibility, Intelligence turned out to be the only significant predictor of Teacher Writing Expectations. Considering the fact that intelligence (cf. Stanovich, 1992) as well as emergent literacy skills (Peeters et al., in press) have been shown to be related to later reading skills, it is not surprisingly that teacher expectations for reading literacy can be predicted by the child's intelligence and (a global measurement) of emergent literacy skills. Teachers do have information about the child's emergent literacy development and intelligence skills as each child in special education should all have an Individual Educational Plan (IEP). This IEP contains information about results of: content-based tests of emergent literacy, national student monitoring system tests, psychological assessment (e.g., intelligence) and often tests of the speech-language pathologist. Teachers see the child's information on a regular base as goals for emergent literacy development and other educational areas are based on the information in the IEP.

The fact that Teacher Writing Expectations could only be predicted by Intelligence and not emergent literacy skills could be explained by the fact that writing skills are to a lesser degree related to the emergent literacy skills than reading skills. For example, a lot of studies have shown that phonological awareness, an aspect of emergent literacy, is a strong predictor of later reading success (Adams, 1990). The relationships between aspects of emergent literacy and writing skills are less clear. Perhaps it is for teachers more difficult to base their expectations for future writing skills on the child's current skills of emergent literacy. These teachers base their writing expectations on the child's intelligence, what is often seen as a general indicator of learning potential.

From the results, it can be concluded that teachers are able to differentiate in their literacy expectations according to the level of intelligence and, for the reading expectations, also the level of the child's emergent literacy skills.

Limitations and Suggestions for Future Research

In the present study, data was collected about teacher literacy expectations at the end of elementary school. No information was as yet available about the extent to which these expectations would be accurate in grade 6. In addition, it was beyond the scope of the present study to verify whether teacher expectations were unrealistic or inaccurate and could have influenced their behaviors towards the child and the learning opportunities they offer the child. Longitudinal studies investigating teacher expectations and literacy development over time should be conducted to unravel this issue in order to determine whether self-fulfilling prophecies occur.

Studies have pointed out that teacher expectations of child's future literacy skills at the end of the school year are influenced by the perceptions teachers have of parental involvement. The higher teachers' perceptions of parental involvement in the education of the child, the higher the teacher expect the child's educational outcomes to be (cf. Bakker, Stoep, van de Heuvel & Bouts, 2002). Future research can investigate if teachers' perceptions of the children with CP are also partly based on their perceptions of parental involvement, and what impact these perceptions of parental involvement have on academic outcomes.

One possible reason that some teachers did not show literacy expectations is that teachers might not have enough knowledge about the literacy development of children with disabilities and therefore do not know what expectations might be realistic for their specific child. At the moment, research regarding the literacy development of children with disabilities such as CP and the factors that influence their development is just arising (Peeters et al., 2008; Peeters et al., in press). Results and implications of such studies should become familiar to teachers so they can better form realistic expectations.

Clinical Implications

The results of the present study have some clinical implications. First of all, the children of whom teachers did not have reading or writing expectations had lower levels of intelligence, motor skills, speech intelligibility, and emergent literacy. Considering the fact that this a rather complex subgroup of children with cerebral palsy, it is difficult for teachers as well as other professionals working with these children to assess the literacy development with traditional assessment tools. Therefore, less information is available on the child's current level of emergent literacy as well as the strengths and weaknesses in the literacy development. This complexity makes it hard for teachers to know what level of literacy development to expect and to formulate short-term goals for the literacy development of the child. Future research should be conducted to design literacy assessment tools that are appropriate for this complex subgroup of children with CP.

For the children of whom teachers indeed hold expectations it is important that teachers, in collaboration with other professionals working with the same child, formulate long-term and short-term goals to promote literacy development. Children in special education should all have an IEP in which the strengths and weaknesses of the child are described and goals are formulated for the academic development of the child. It is not possible based on the data of the present study to uncover whether IEPs for children with CP include these long-term and short-term goals. However, previous research into the quality of arithmetic instruction for children with CP (Jenks, de Moor, van Lieshout, & Withagen, in press) has shown that the majority of the IEPs did not include well-formulated arithmetic goals and that many were not based on optimal assessment. Not formulating goals for a child can have consequences for what will be learned.

Finally, it is important to stress that high teacher expectations can only be fulfilled by providing high quality instruction. In order to realize the expectations teachers have for children with CP, it is important that these expectations will be translated into adequate activities that foster the literacy development of the child. In addition, it is only by providing high quality education in response to high expectations that the early literacy development of children with CP can be optimally promoted. The results of the study by Jenks et al. (in press) showed that children with CP in special education received dramatically less instruction time in arithmetic, not because of more school absence, but because less instruction time is planned due to the fact that children received paramedic therapies during the school day. Furthermore, it is important that professionals working with the same child adjust the therapy time to the time planned for classical instruction so the child will not miss important literacy instruction.

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General Conclusions and Discussion

Chapter 7

In this chapter I will discuss some of the general findings of the five studies. I start this chapter by describing the findings of chapters 2 and 3, which were concerned with the emergent literacy skills of children with cerebral palsy (CP) and the role of speech and intellectual skills in the development of emergent literacy skills. After that, the conclusions of chapters 3, 4, and 5, which were concerned with the home literacy and educational environments of children with CP, will be discussed. First, the home literacy environment of children with CP was explored, and it was investigated what role this environment played in the emergent literacy development of these children. Secondly, an aspect of the educational environment, namely teacher literacy expectations, was explored. In addition, it was examined to what extent this was related to the level of additional impairments in these children and to the children's current emergent literacy skills. Based on an integrative view of the findings of the present thesis, I will revisit the emergent literacy development of children with CP. Finally, I will end this chapter by providing suggestions for future research and practical and clinical implications based on the results of the present thesis.

Emergent Literacy Skills of Children with Cerebral Palsy

With reference to the emergent literacy skills at the end of the second year of kindergarten (Chapter 2) it was studied to what extent differences in the level of emergent literacy between children with CP and a group normally developing children existed. From the results can be concluded that children with CP already lag behind in emergent literacy skills at the start of the longitudinal study. A second goal of this study was to unravel which reading precursors best predicted emergent phonological awareness. In the control group, rhyme ability was best predicted by auditory perception, which is in accordance with previous studies on normally developing children (Foy & Mann, 2001). For the group of children with CP, emergent phonological awareness was best predicted by intelligence, followed by speech ability (i.e., pseudoword articulation). It can be concluded that children with CP with additional intellectual and speech impairments are at risk for a delay in the development of phonological awareness and, therefore, for a delayed or limited literacy development.

Regarding the longitudinal development of reading precursors and early reading skills (Chapter 3), word decoding was best predicted by phonological awareness and phonological short-term memory, both aspects of phonological processing (Wagner & Torgesen, 1987; Wagner et al., 1997), for the comparison group children without disabilities. For the group of children with CP, the best predictor of word decoding was speech intelligibility. These results show that speech production (i.e., speech ability) is an important skill for early reading development. Regarding the structural relationships between the reading precursors, speech production played a dominant role in the development of the reading precursors. These results stress a dominant role of speech production in the development of reading precursors and early reading development of children with CP. The role of intelligence in the longitudinal development of reading precursors and early reading skills is of less importance than speech intelligibility, as intelligence was only related to the development of phonological awareness, and not to word decoding.

Literacy Environments of Children with Cerebral Palsy

With reference to the home literacy environment, it was studied to what extent the HLE of children with CP was comparable to that of a comparison group consisting of peers without disabilities (Chapter 4). The results showed that although both groups have stimulating home literacy environments, some group differences were significant: children with CP were less interested in participating in writing activities and less involved in word orientation activities during shared storybook reading. In addition, parents' literacy expectations for the children with CP at the end of elementary school were lower compared to those for the comparison group. On the other hand, parents of children with CP engaged in more leisure activities with their child. It was also investigated to what extent additional impairments of children with CP limit their literacy learning opportunities. The results showed that children with CP with speech and/ or fine motor impairments are disadvantaged in a small number of literacy activities: the amount of emergent literacy activities they did with their parents, and their active participation in word and story related activities during storybook reading. It can be concluded that, to some extent, children with CP are less involved in some seemingly important activities that promote literacy, and the more their speech and/or fine motor were impaired the fewer the children were (actively) involved in these activities.

Regarding the HLE, in another study it was investigated which home literacy variables were effective in stimulating early reading skills of children with CP directly or indirectly, through the development of reading precursors (Chapter 4). Three HLE variables were found to be related to reading precursors and early reading skills: parent literacy mediation, word orientation and story orientation activities during shared book reading. These results are in line with outcomes of previous studies investigating the HLE of children without disabilities (Burgess, Hecht, & Lonigan, 2002). It should be mentioned that all of these variables involve parental mediation. The fact that both word and story orientation activities were related to emergent literacy skills is in accordance with previous studies. Dahlgren Sandberg (1998) concluded in her study of the HLE of non-vocal children with CP that availability alone is not enough for positive development of literacy abilities, and concluded that it is rather the interaction mode, which concerns the participants' type and degree of activity, which seems to have a considerable impact. Regarding the direct and indirect influence of these three HLE variables on the children's reading development, it can be concluded that they were not directly related to early reading skills, but indirectly, through the reading precursors, in particular phonological awareness. The results of the present study are in line with previous studies on the longitudinal influence of the HLE on the reading development of children without disabilities, showing that the effects of the home literacy environment on reading acquisition were indirect, through the children's language and emergent literacy skills (cf. Burgess et al., 2002; Leseman & de Jong, 1998; Sénéchal, LeFevre, Thomas, & Daley, 1998; Whitehurst & Lonigan, 1998).

The educational environment of children with CP and a comparison group was also studied (Chapter 6). It was investigated what reading and writing expectations teachers had of these children. The results showed that the literacy expectations teachers had of children with CP were lower compared to the literacy expectations teachers had of children without disabilities. The expectations were also of a different nature, that is, teachers of children with CP often did not know what to expect. When teachers did have expectations of the reading levels of the children with CP at the end of elementary school, these were best predicted by the child's intellectual level and the level of emergent literacy skills. When teachers did have expectations of the writing levels of the children with CP at the end of elementary school, these were best predicted by the child's intellectual level. The results of this study suggest that teachers of children with CP are able to differentiate their literacy expectations according to the severity of the impairments of the children with CP. The results also suggest that teacher future reading expectations of the children with CP are also based on the children's current level emergent literacy skills.

Literacy Development of Children with Cerebral Palsy Revisited

In accordance with previous research, the results of this thesis underline that children with CP with additional speech and intellectual impairments are at risk for delays in their literacy development (Browning, 2002; Card & Dodd, 2006; Feldman, Janosky, Scher, & Wareham, 1994; Koppenhaver & Yoder, 1992). These impairments do not only affect the development of emergent literacy skills directly, but also indirectly, because the level of additional impairments influences the amount of literacy learning opportunities children with CP have, as well as the literacy expectations teachers have of these children.

With reference to the development of emergent literacy skills, the results of the present thesis emphasize the fact that even limited speech abilities may facilitate the development of reading skills (Peeters et al., 2008a, 2008b), although previous studies have shown that speech production is not essential for learning to read and write, that is, it is possible for non-speaking children to acquire reading and writing skills (Berninger & Gans, 1986; Dahlgren Sandberg, 2006; Smith, 1989). The results of the present thesis are in accordance with the suggestion Dahlgren Sandberg (2001, 2006) offers about the importance of speech production for literacy development. She found that non-speaking children with CP had difficulties acquiring literacy skills, although their intellectual level and phonological abilities predicted otherwise. She therefore questioned the predictive value of phonological awareness for the early reading development of non-speaking children with CP. As a suggestion for the unexpected low reading scores, she states that the non-speaking children may have had problems with subvocal or covert rehearsal of phonological information, which is necessary for more complex phonological tasks, such as reading and writing tasks.

The role of speech production skills is also highlighted in the psycholinguistic model of Stackhouse and Wells (1997). In their psycholinguistic model, Stackhouse and Wells ascribe a major role to speech ability in the literacy development. They propose that an intact speech processing system is fundamental to the development of phonological awareness, as well as to the development of spoken and written language. According to these authors, *speech processing* refers to “all the skills included in understanding and producing speech, including peripheral skills such as articulatory ability and hearing” (p.8). This model views speech problems as derived from a breakdown at one or more levels of input (encoding and producing speech), representation (stored linguistic knowledge about words and other units) or output (encoding and producing speech). The authors state that an intact speech processing system is necessary for the development of phonological awareness (see Figure 1): "through developing the speech processing system for the purpose of spoken communication, children develop awareness of the sound structure of their language… children with poor phonological awareness have a faulty or immature speech processing system. Consequently, these children have a faulty or weak foundation for the development of literacy skills" (pp 57-58).

In the present thesis, we studied children with CP who had motor impairments that often resulted in additional speech impairments, such as dysarthria. Applying the model of Stackhouse and Wells (1997), this means that the breakdown in the speech processing system of these children is on the output level, at the level of producing speech, and will affect phonological awareness and literacy. The results of the present thesis have shown the link between speech processing on one side, and phonological awareness and literacy on the other side. The link between phonological awareness and literacy has also been confirmed in the present thesis. Therefore, the psycholinguistic model of Stackhouse and Wells (1997) provides a suitable framework for studies on the literacy development of children with CP. However, even though the present thesis supports this psycholinguistic model, the model does not take into account the role that intellectual skills play in the development of phonological awareness. More research is needed to unravel the complex relationships between speech ability and phonological awareness and literacy, and to find out what role intellectual skills play in the development of phonological awareness and literacy. In conclusion, although the psycholinguistic model can be used as a framework for the study of the literacy development of children with CP, more research is needed to develop an elaborated model that can be used to map the literacy development of children with CP.

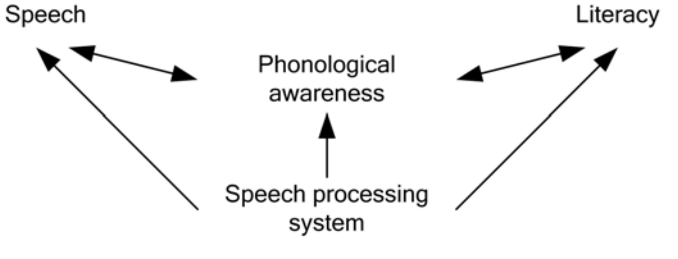

Figure 1
Connection between speech and literacy (Stackhouse & Wells, 1997, p. 58).

The present thesis has shown that the (level of) additional impairments in children with CP affect the amount and quality of the home literacy experiences they receive (Peeters, Tissen, de Moor & Verhoeven, 2008; Peeters, Verhoeven, van Balkom, & de Moor, in press). For example, the severity of the speech impairment of the children is related to the amount of emergent literacy activities children and parents do together, and the severity of fine motor impairments is related to the active participation of the child during storybook reading. The results of the present thesis are in accordance with previous studies (Dahlgren Sandberg, 1998; Light & Kelford Smith, 1993; Weikle & Hadadian, 2003). Considering the fact that the active involvement of children with CP is strongly related to the development of emergent literacy skills and ultimately early reading skills, the impairments of children with CP impede the literacy development of these children. The level of additional impairments in children with CP also has consequences for the literacy expectations teachers have of children with CP (Peeters, Verhoeven & de Moor, in press). The more severe the intellectual impairment is, the lower the future literacy expectations are. Unfortunately, it was beyond the scope of the present thesis to investigate what consequences teacher expectations have for the literacy learning opportunities of the children. In conclusion, it is important that studies take the level of additional impairments of the children into account, as these impairments influence the learning opportunities and ultimately the literacy learning process.

Directions for Future Research

Although the present thesis has revealed some aspects of the emergent literacy development of children with CP, more research is needed to understand the literacy development of children with special needs, such as children with CP.

One of the major challenges that are to be dealt with is the development of more suitable standardized assessment tools for children with severe speech and physical impairments. At the moment, few assessment tools of emergent literacy are available and standardized. For the present thesis we developed several tools to assess the phonological short-term memory skills and rhyming skills of the children (see Appendices A and B). However, more tools that take into account the physical as well as the speaking barriers are needed to evaluate the maximal potential of these children (cf. Iacona & Cupples, 2004).

In the present thesis, the group of children with CP was examined as one group and not subdivided into subgroups. The reason for that was that subdividing the group of children into subgroups would result in very small groups that are difficult to study. In addition, studies investigating the reliability of the classification of types of CP into unilateral and bilateral CP report at best a reasonable reliability, while further subdivisions have hardly been studied at all (Blair & Stanley, 1985; Krageloh-Mann et al., 1993). Therefore, it was decided to study the group of children with CP as one group. It would, however, be interesting to explore whether there are differences between children with unilateral and bilateral types of spasticity in future research.

Although the present thesis has shown that teachers have lower literacy expectations of children with CP compared to peers without disabilities, more research is needed for a better understanding of the literacy learning opportunities of the children with CP at school. Future research may consist of in-depth observational studies as well as focused interviews with teachers to uncover the amount and type of literacy instruction children are exposed to, what sort of instructional adaptations these children receive, and how many instruction time children miss because of sickness, speech-language therapy or physiotherapy. These focused interviews with teachers of children with CP can be conducted to find out what priority literacy development has according to the teachers of the children with CP.

In the present thesis only one control group was included. In future research it may be useful to include an additional control group of children with the same developmental age as the children with CP. As children with CP often have an additional intellectual impairment, their developmental age may be below their chronological age. Differences between the children with CP and a comparison group peers may therefore be ascribed to differences in developmental age instead of other differences between the groups. For example, regarding the HLE of children, it may be that children with CP with a lower developmental age are not yet interested in reading books or picture-books or that parents do fewer rhyming games with their child, because they think their child is not ready for it yet. Although it is beyond the scope of the present thesis, in another study on HLE an additional comparison group of more than 100 4-year-old children without disabilities, attending the first year of kindergarten, will be studied. In this study, this group will be compared to a group of children with developmental disabilities with a chronological age below 6 years. One of the goals of the study is to uncover whether any differences between the groups remain when developmental age is taken into account. The results of this study may yield important clinical implications for children with developmental disabilities (cf. van der Schuit, Peeters, Segers, van Balkom, & Verhoeven, submitted).

Phonological awareness is considered to be one of the main precursors for the reading development of children without disabilities as well as for children with CP. As children with CP with additional speech impairments lag behind in their phonological development, it is important that these children receive effective interventions. Studies investigating the effectiveness of different interventions to foster literacy development of children with severe speech impairments are scarce, and more studies are needed investigating the effectiveness of interventions to make them more evidence-based. One of the few studies conduced so far was done by Blischak, Shah, Lombardino, and Chiarella (2004). They investigated the effect of phonemic awareness instruction on the encoding skills of children with severe speech impairments. The authors found that phoneme-grapheme correspondence and phonemic awareness instruction were effective in stimulating the encoding skills of these children. As speech production is important for the development of phonological awareness, future intervention studies for phonological awareness may incorporate voice output communication aids (VOCA) technology or multimedia software with an auditory feedback component.

Practical and Clinical Implications of the Present Thesis

The results of the present thesis have a number of clinical implications. With respect to the important role of phonological awareness for the reading development of children with CP, and to the fact that, on average, these children already lag behind in the emergence of phonological awareness in kindergarten (Peeters, Verhoeven, van Balkom & de Moor, 2008a, 2008b), interventions are needed to prevent further delays. Many researchers (e.g., Blischak, 1994; Peeters, Verhoeven, de Moor, & van Balkom, 2009; Schlosser, 2003; Schlosser, Blischak, Belfiore, Bartley et al., 1998) have hypothesized that speech generating devices, also known as voice output communication aids (VOCAs), can be effective in developing subvocal articulatory rehearsal and phonological awareness. For example, Blischak, Lombardino, and Dyson (2003) hypothesized that speech generating devices can play a role in the development of an internal phonology. Experiences with sound patterns provided by such speech generating devices may help children to become more aware of the individual phonemes of the language and may support the internal phonological information needed for reading and writing development. In a study by Steelman, Pierce, and Koppenhaver (1993) it is stated that speech feedback in computer-aided instruction can improve the literacy skills of children with speech impairments, because it gives them the opportunity to map oral language onto written language.

Phonological awareness skills can also be promoted by speech language therapists (SLT). Catts (1991) has stressed that SLTs should incorporate speech-sound awareness training in their individual or group therapy sessions with these children (cf. Catts for suggestions for phonological awareness activities).

When promoting phonological awareness skills, it is important that activities and interventions are embedded in meaningful contexts for the child to foster learning (Blischak, 1994; Peeters, Verhoeven, de Moor & van Balkom, 2009). One way of doing this is by stimulating the phonological awareness development by using a multimedia tool that provides activities that are adapted to the interests of the children. A multimedia tool to stimulate the emergence of phonological awareness that is suited for children with physical and speaking impairments is Linguabytes, an interactive, tangible play and learning system that stimulates the language development of toddlers with multiple disabilities (Voort, et al., 2008; Hengeveld et al., 2008). The system uses a variety of input and display modules for play and learning activities. The content is based on interactive storytelling and anchored instruction (Stoep & van Elsäcker, 2005). It consists of eight themes, such as animals, in and around the house, people, toys and traffic. Each theme starts with a story that consists of several scenes. In each scene, a part of the story is told using audio, pictures, and animations. Following the story, each theme offers a set of playful exercises, primarily to train language skills, speech perception, and phonological awareness. For each theme, phonological exercises with incremental levels of complexity are presented. For example, in the theme 'animals' the easiest phonological awareness exercises consist of playing songs and rhymes. The toddler can place an animal on the module and the system reacts by playing a well-known song about that animal and by showing the animal with meaningful animations on the screen. Because LinguaBytes combines phonological awareness intervention with using a multimedia tool that can be adapted to the physical needs of the child, it is a valuable tool that speech and language therapists can use when training phonological awareness skills and other language skills in children with CP and other disabilities.

Regarding the HLE of the children with CP, the activities that parents do at home with their child have an effect on the reading precursors of these children. More directed literacy stimulation at home is therefore recommended (cf. Peeters, Verhoeven, de Moor, van Balkom & van Leeuwe, 2009; Peeters, Verhoeven, van Balkom & de Moor, in press). As early reading skills are stimulated through the development of the reading precursors, it is important that parents focus on the stimulation of reading precursors in perspective of emergent literacy. As the results of this thesis have shown, interactive aspects of the HLE need to be highlighted. This means that parents should not just give their child a lot of books to play with and assume that this will stimulate the development of reading precursors and reading development of the child. Rather, it is important that they and their child engage in joint activities that foster the emergent literacy development, such as involving the child in own reading and writing activities, reading letters and words with their child, and playing rhyme games. In order to accomplish this focus on literacy, teachers and SLTs can provide parents with suitable books and literacy materials for children with physical and speech impairments or they can give parents suggestions about how they can integrate literacy activities in the daily routines of these children. In addition, teachers and SLTs can help parents by informing them about the importance of being actively involved during storybook reading for the language development of the child and they can help parents to select strategies to increase the involvement of their children during storybook reading (cf. Peeters, Tissen, de Moor, & Verhoeven, 2008). For example, SLT therapists can work with parents and explain to them how they can make children actively involved during storybook reading, for example, by letting the child select symbols that represent the story, thus permitting the child to retell the story. Parents can also make use of a communication board that enables the child to select books, ask questions or make comments on the story (cf. Pebly & Koppenhaver, 2001).

Regarding teacher literacy expectations, it should be stressed that having high literacy expectations alone is not enough to promote the literacy development of children with CP. High teacher expectations can only be fulfilled by providing high quality instruction. In order to realize the expectations teachers have of children with CP, the expectations need to be translated into adequate activities that foster the literacy development of the child. It is only by providing high quality education in response to high expectations that the early literacy development of children with CP can be optimally promoted. A suggestion to promote the literacy opportunities for children with CP is to give them as much literacy instruction and literacy learning opportunities as possible. One way of doing this is to adjust the paramedic therapies to the planned literacy instruction times in the classrooms, so children will not miss important literacy instruction. Furthermore, teachers, in collaboration with other professionals working with the same child, can formulate long-term and short-term goals for each child to promote literacy development.

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Appendices

Appendix A

Stimuli of the self-constructed Auditory Short-term Memory task

	Testleader	Doll	Same or Different
A	Kam [comb]	Kam	Same
B	Pet [cap]	Tak [twig]	Different
C	Zon-raam [sun] [window]	Zon-wip [sun] [seesaw]	Different
D	Boot-mes [boat] [knife]	Boot-mes [boat] [knife]	Same
1	Wip [seesaw]	Mes [knife]	D
2	Boot [boat]	Boot [boat]	S
3	Pet [cap]	Pet [cap]	S
4	Mes [knife]	Kam [comb]	D
5	Tak [twig]	Tak [twig]	S
6	Zon [sun]	Mug [mosquito]	D
	Nu ga ik 2 woorden zeggen en de pop zegt ook 2 woorden		
7	Tak -wip	Tak-wip	S
8	Raam-zon	Mes -zon	D
9	Pet- kam	Pet- boot	D
10	Mes-tak	Mes-tak	S
11	**Wip**-zon	**Kam** -zon	D
12	Boot-pet	Boot-pet	S
	Nu ga ik 3 woorden zeggen en de pop zegt ook 3 woorden		
13	Wip-teen-boot	Wip-teen-boot	S
14	Mug-boot-pet	Mug-boot-pet	S
15	Kam-pet-mes	Kam-pet-mes	S
16	Raam-mes-**tak**	Raam-mes-**mug**	D
17	Tak-**zon**-pet	Tak-**raam**-pet	D
18	**Kam**-zon-wip	**Teen**-zon-wip	D
	Nu ga ik 4 woorden zeggen en de pop zegt ook 4 woorden		
19	**Tak**-wip-boot-zon	**Kam**-wip-boot-zon	D
20	Teen-kam-mes-boot	teen-kam-mes-boot	S
21	Mes-zon-raam-wip	Mes-zon-raam-wip	S
22	Boot-zon-**tak**-pet	Boot-zon-**wip**-pet	D
23	Wip-mug-kam-pet	Wip-mug-kam-pet	S
24	Kam-**tak**-mes-zon	Kam-**pet**-mes-zon	D
	Nu ga ik 5 woorden zeggen en de pop zegt ook 5 woorden		
25	Tak-boot-teen-mes-wip	Tak-boot-teen-mes-wip	S
26	Pet-mes-**tak**-zon-raam	Pet-mes-**boot**-zon-raam	D
27	Kam-zon-wip-mes-pet	Kam-zon-wip-mes-pet	S
28	Zon-mug-mes-**boot**-tak	Zon-mug-mes-**kam**-tak	D
29	Boot-pet-kam-tak-zon	Boot-pet-kam-tak-zon	S
30	**Wip**-mes-boot-raam-tak	**Kam**-mes-boot-raam-tak	D

	Nu ga ik 6 woorden zeggen en de pop zegt ook 6 woorden		
31	Boot-**tak**-pet-teen-mes-zon-wip	Boot-**wip**-pet-teen-mes-zon-wip	D
32	Wip-pet-kam-tak-boot-teen-**mug**	Wip-pet-kam-tak-boot-teen-**zon**	D
33	Kam-boot-pet-wip-tak-zon-mes	Kam-boot-pet-wip-tak-zon-mes	S
34	Zon-wip-mes-pet-tak-boot-tak	Zon-wip-mes-pet-tak-boot-tak	S
35	Tak-mes-boot-zon-wip-pet-raam	Tak-mes-boot-zon-wip-pet-raam	S
36	**Mes**-zon-wip-pet-tak-boot-teen	**Kam**-zon-wip-pet-tak-boot-teen	D
	Nu ga ik 7 woorden zeggen en de pop zegt ook 7 woorden		
37	Raam-teen-**mug**-wip-mes-kam-pet	Raam-teen-**tak**-wip-mes-kam-pet	D
38	Wip-pet-raam-boot-zon-tak-teen	Wip-pet-raam-boot-zon-tak-teen	S
39	Mug-tak-zon-raam-pet-wip-boot	Mug-tak-zon-raam-pet-wip-boot	S
40	Teen-boot-kam-**mes**-mug-tak-wip	teen-boot-kam-**zon**-mug-tak-wip	D
41	Tak-mes-boot-zon-wip- kam-raam	Tak-mes-boot-zon-wip-kam-raam	S
42	**Pet**-mes-raam-wip-zon-teen-tak	**Boot**-mes-raam-wip-zon-teen-tak	D
	Nu ga ik 8 woorden zeggen en de pop zegt ook 8 woorden		
43	Mes-raam-teen-pet-kam-wip-boot-mes	Mes-raam-teen-pet-kam-wip-boot-mes	S
44	Wip-Mes-mug-boot-teen-zon-kam-**tak**	Wip-Mes-mug-boot-teen-zon-kam-**raam**	D
45	Kam-teen-tak-**zon**-boot-wip-pet-raam	Kam-teen-tak-**mes**-boot-wip-pet-raam	D
46	Boot-raam-mug-wip-teen-kam-zon-tak	Boot-raam-mug-wip-teen-kam-zon-tak	S
47	Raam-boot-zon-pet-kam-mes teen-**wip**	Raam-boot-zon-pet-kam-mes teen-**tak**	D
48	Mug-wip-raam-boot-teen-mes-pet-zon	Mug-wip-raam-boot-teen-mes-pet-zon	S

Appendix B

Stimuli of the self-constructed Rhyme Recognition Task

	Stimuli	1	2	3	Correct response
Example Oefenitems	Haan [cock]	Pil [pill]	Veer [spring]	Maan [moon]	3
	Mat [mat]	Kat [cat]	Raam [window]	Juf [teacher]	1
	Kuif [curl]	Sop [soapsuds]	Duif [pigeon]	Teen [toe]	2
Testitems					
1	Boek [book]	Raam [window]	Muis [mouse]	Doek [textile]	3
2	Jeuk [irritation]	Reuk [smell]	Pet [hat]	Reus [giant]	1
3	Vuur [fire]	Poot [claw]	Teen [toe]	Muur [wall]	3
4	Noot [peanut]	Poes [kitten]	Boot [boat]	Rook [smoke]	2
5	Rug [back]	Mug [mosquito]	Boek [book]	Zon [sun]	1
6	Kam [comb]	Lam [lamb]	Bad [bath]	Hol [cave]	1
7	Wol [wool]	Vis [fish]	Mol [mole]	Haar [hair]	2
8	Zus [sister]	Hut [hut]	Kus [kiss]	Hoed [hat]	2
9	Mier [ant]	Kar [cart]	Rok [skirt]	Dier [animal]	3
10	Ren [run]	Zak [bag]	Pen [pen]	Mes [knife]	2
11	Pot [pot]	Kaas [cheese]	Huis [house]	Bot [bone]	3
12	Wip [seesaw]	Kin [chin]	Kip [chicken]	Riem [belt]	2
13	Zeep [soap]	Wiel [wheel]	Lijn [line]	Reep [bar]	3
14	Rok [skirt]	Sok [sock]	Zoen [kiss]	Dop [shell]	1
15	Kaal [bald]	Paal [pole]	Weg [road]	Lijm [glue]	1
16	Kop [head]	Bos [forest]	Pop [doll]	Hek [fence]	2
17	Jas [jacket]	Tas [bag]	Boer [farmer]	Bus [bus]	1
18	Haas [hare]	Pijl [arrow]	Maan [moon]	Vaas [vase]	3
19	Man [man]	Pan [pan]	Voet [foot]	Hok [storeroom]	1
20	Doos [box]	Boor [brace]	Duim [thumb]	Roos [rose]	3

Summary

The present thesis reports on the emergent literacy development of children with cerebral palsy (CP). Besides their physical impairments, these children often have additional speech and intellectual impairments that limit their literacy development. Although children with CP with additional impairments are at risk for limited literacy learning, little is known about how these children acquire literacy skills and what role additional impairments play in this process. Even less is known about the environment in which children with CP acquire literacy skills. In order to come to a better understanding of the emergent literacy development of these children, in the present thesis the development of emergent literacy skills and the different kinds of environment in which these emergent literacy skills develop were studied. This was done by means of a longitudinal study on the literacy development of 54 children with CP who were enrolled in special education and a comparison group of 71 peers without disabilities who were enrolled in mainstream schools. The thesis starts with an introduction (Chapter 1), followed by chapters 2 and 3 that report on the development of emergent literacy skills and chapters 4, 5, and 6 that are concerned with the different kinds of environments in which literacy learning takes place.

In Chapter 1, the emergent literacy development of children without disabilities is described. In addition, the classification of children with CP and their additional impairments is described, and the International Classification of Function, Health, and Disability Children and Youth model is explained. This model was used as a framework for studying the emergent literacy development of children with CP in this thesis. Furthermore, previously conducted studies on the emergent literacy development and the impact of the variation in the home and school environment of children with CP are discussed, as well as the limitations of previous studies. The chapter ends with the research questions and an outline of the present thesis.

In chapter 2, it was examined to what extent children with CP lag behind in emergent phonological awareness. In this chapter, the precursors of phonological awareness at the beginning of the second-year of kindergarten were also explored. Considering the fact that children with CP and accompanying disabilities are prone to reading difficulties, it was investigated what influence these additional intellectual and speech impairments have on emergent phonological awareness that precede the reading development. It was therefore examined which precursors predicted early phonological awareness in children with CP in comparison with a normally developing control group. Rhyme perception was regarded as an early indicator of phonological awareness, whereas nonverbal reasoning (i.e., IQ), speech ability (i.e., pseudoword articulation), auditory

perception, auditory short-term memory, and vocabulary were regarded as precursors of phonological awareness. The results of this study, first of all, indicate that children with CP scored below their normally developing peers on emergent phonological awareness and its precursors. Phonological awareness was found to be predicted by nonverbal reasoning and pseudoword articulation in the group of children with CP. In the control group, auditory perception was a significant predictor of emergent phonological awareness, which was in accordance with findings in previous studies. To illustrate the importance of intelligence for emergent literacy skills, the CP group was then split up into two groups according to the children's IQ. The results show that the group with a IQ below-average scored lower on phonological awareness and on most precursors than the group with an average IQ. In addition, the children with CP with an average IQ scored lower than the control group, which consisted of normally developing children. From the results of this study, it can be concluded that general intelligence and speech ability can be seen as important facilitators of emergent phonological awareness in children with CP. Children with CP with intellectual disabilities appear to have a disadvantage in acquiring phonological awareness, especially when their speech abilities are also impaired.

In chapter 3, the longitudinal development of emergent literacy was explored. The goal of this longitudinal study was to investigate the precursors of early reading development in 52 children with CP at kindergarten level in comparison to 65 children without disabilities. Word decoding was measured to investigate early reading skills, whereas phonological awareness, phonological short-term memory (STM), speech perception, speech production, and nonverbal reasoning were considered reading precursors. The results showed that children with CP lag behind on all reading precursors at the beginning of the second year of kindergarten and that they have not caught up with their peers at the end of grade 1. For the children without disabilities, early reading skills in grade 1 were best predicted by phonological awareness and phonological STM, while speech production was the most important predictor of early reading success for the children with CP, followed by phonological awareness and speech perception. For children with CP, speech production dominated reading development as a whole, as speech production measured at the beginning of the second year of kindergarten was strongly predictive for all other reading precursors measured at the end of the second year of kindergarten. The results of this study further reveal that children with CP with additional speech impairments are at risk for limited literacy development.

Chapter 4 was concerned with the home literacy environment (HLE) of children with CP in comparison to peers without disabilities. As various aspects of the home literacy environment are considered to stimulate the emergent literacy development in children without disabilities, it is important to gain insight into the HLE of children with CP, given that they have been shown to have difficulty acquiring literacy skills. Besides, by comparing the different aspects of the HLE between the group of children with CP and the comparison group, the study investigated to what extent speech, fine motor, and intellectual impairments limit the home literacy experiences of children with CP. Questionnaires addressed to the parents of the children were used to investigate differences in the HLE in 40 children with CP and 62 peers without disabilities who were comparable on chronological age (i.e., 6-years-old), socioeconomic status and sex. The results of this study showed that only a few group differences were significant: children with CP were less interested in participating in writing activities, and less involved in word orientation activities during shared storybook reading. On the other hand, parents of children with CP were doing more leisure activities with their child. Regarding the role of additional impairments of the children with CP, speech intelligibility scores of the children with CP predicted the amount of emergent literacy activities they were doing with their parents, as wells as their active participation in word-related activities during storybook reading. In addition, the active participation of the child in story-related activities was predicted by his or her fine motor skills. Parents of the children in the comparison group often had high expectations, while parents of the children with CP often did not know what expectations to have for their child's literacy level at the end of elementary school. The results of the present study indicate that although both groups have stimulating home literacy environments, children with CP with speech or fine motor impairments are disadvantaged in a small number of literacy activities.

In chapter 5, the HLE of children with CP was further explored by investigating what influence this environment had on the development of reading precursors and early reading skills. By means of a one-year longitudinal study it was investigated which home literacy variables were effective in stimulating early reading skills of children with CP directly or indirectly via the (development of) reading precursors. Parents of 35 children with CP completed questionnaires on aspects of their home literacy environment. The reading precursors vocabulary, syntactic skills, and phonological awareness (i.e., rhyme and phonemic awareness) were assessed at the end of kindergarten and at the end of grade 1, while the early reading skills letter knowledge and word recognition were assessed only at the end of grade 1. Three HLE variables were found to be related to the reading precursors and the early reading skills: parent literacy mediation, word orientation, and story orientation activities during shared book reading. Path analyses showed that these three HLE variables were not directly related to early reading skills in grade 1, but indirectly via the reading precursors, in particular phonological awareness.

In chapter 6, an aspect of the educational environment was explored, namely teacher literacy expectations. As teacher expectations are important for the literacy development of children without disabilities, this study focused on teacher literacy expectations for children with CP. The goal of this study was to investigate to what extent the literacy expectations of kindergarten teachers for children with CP at the end of elementary school differed compared to peers without disabilities. In addition, it was investigated to what extent teacher expectations for children with CP were related to the level of impairments of these children, such as speech, intellectual and physical impairments, and to the current level of emergent literacy skills of the children. Forty-nine teachers of children with CP and 71 teachers of non-disabled children responded to the teacher questionnaire. The results showed that teacher expectations for the literacy development of children with CP were not only lower but also of a different nature, as eight teachers did not know what to expect of the reading development and 12 teachers did not know what to expect of the writing development of the children with CP. Multiple regression analysis showed that teacher reading expectations could best be predicted by both intelligence and emergent literacy skills ($p < .001$), while teacher writing skills could best be predicted by intelligence ($p < .001$). Based on the results of the present study, it can be concluded that teachers of children with CP are able to differentiate in their expectations of the children's reading and writing skills.

Finally, in chapter 7 the general findings of the studies of the present thesis are described, followed by an integrative view on the emergent literacy development of children with CP. From an integrative point of view, it can be concluded that the additional speech and intellectual impairments play an important role in the emergent literacy development of these children. First, the level of additional speech and intellectual impairments were shown to be related to the level of emergent phonological awareness, and the severity of the speech impairment dominated the longitudinal development of emergent literacy skills. Secondly, the severity of the additional impairments of the children with CP has consequences for the amount and quality of the home literacy experiences and the expectations regarding literacy that teachers have of these children at school.

Considering the role of additional speech impairments for the literacy development of children with CP, it is proposed that the psycholinguistic model of Stackhouse and Wells (1997) can be explored further by studying the literacy development of these children. The chapter ends with suggestions for future research and practical and clinical implications. Considering these implications, it is important that parents, teachers and other professionals working with children with CP have all a responsibility in stimulating the literacy development of these children.

Reference

Stackhouse, J., & Wells, B. (1997). *Children's speech and literacy difficulties: A psycholinguistic framework*. London: Whurr Publisher Ltd.

Samenvatting

Het huidige proefschrift behandelt de beginnende geletterdheid bij kinderen met cerebrale parese (CP). Naast hun fysieke beperkingen hebben deze kinderen vaak bijkomende spraak- en intellectuele beperkingen, waardoor ze belemmerd worden in hun leesontwikkeling. Er is tot op heden maar weinig bekend over de manier waarop deze kinderen beginnende geletterdheid verwerven en welke rol bijkomende beperkingen in dit proces spelen. Daarnaast zijn er weinig studies verricht naar omgevingen waarin kinderen met CP vaardigheden van beginnende geletterdheid verwerven. Om meer te begrijpen over de ontwikkeling van beginnende geletterdheid richt dit proefschrift zich zowel op ontwikkeling van vaardigheden van beginnende geletterdheid, als omgevingen waarin kinderen deze vaardigheden verwerven, zoals de thuis- en schoolomgeving. Dit is gedaan aan de hand van een longitudinale studie naar de beginnende geletterdheid van 54 kinderen met CP uit het speciaal onderwijs en een controlegroep van 71 leeftijdsgenoten uit het reguliere onderwijs. Het proefschrift start met een inleidend hoofdstuk (hoofdstuk 1), gevolgd door de hoofdstukken 2 en 3 die over de ontwikkeling van vaardigheden van beginnende geletterdheid rapporteren. In de hoofdstukken 4, 5 en 6 wordt gekeken naar de omgevingen waarin deze ontwikkelingen plaatsvonden.

In hoofdstuk 1 wordt allereerst de ontwikkeling van beginnend geletterdheid bij kinderen zonder beperkingen beschreven. Daarna wordt de classificatie van kinderen met CP beschreven evenals het model “International Classification of Function, Health, and Disability Children and Youth” dat als raamwerk dient bij dit proefschrift. Vervolgens worden studies behandeld die zich gericht hebben op beginnende geletterdheid bij kinderen met CP en worden de beperkingen van deze studies belicht. Het hoofdstuk eindigt met de onderzoeksvragen die in dit proefschrift behandelend zullen worden en sluit af met een opzet van de hoofdstukken van dit proefschrift.

Hoofdstuk 2 richt zich op de vaardigheden van beginnende geletterdheid bij kinderen met CP in vergelijking met leeftijdsgenoten zonder beperkingen. Het doel van dit onderzoek was na te gaan in welke mate kinderen met CP al een achterstand lieten zien op fonologisch bewustzijn en voorlopers ervan aan het begin van groep 2. Een tweede doel was te achterhalen door welke vaardigheid of vaardigheden beginnend fonologisch bewustzijn het beste voorspeld kon worden. Aangezien kinderen met CP met bijkomende beperkingen vatbaar zijn voor leesproblemen, is nagegaan welke invloed spraak- en intellectuele beperkingen hadden op beginnende fonologisch bewustzijn. Rijmperceptie werd beschouwd als een vroege indicator van fonologisch bewustzijn, terwijl non-verbaal redeneren (IQ), spraakvaardigheid (pseudowoordarticulatie), auditieve perceptie, auditief kortetermijngeheugen (KTG) en woordenschat gezien werden als voorlopers van fonologisch bewustzijn. De resultaten van deze studie tonen allereerst aan dat kinderen met CP lager scoorden in vergelijking met de controlegroep kinderen zonder beperkingen op het fonologisch bewustzijn evenals de voorlopers ervan. Fonologisch bewustzijn bij kinderen met CP kon het beste voorspeld worden door intelligentie en spraakvaardigheid. Auditieve perceptie was de beste voorspeller van fonologisch bewustzijn bij de controle groep, zoals in overeenstemming is met eerder onderzoek. Om het belang van intelligentie voor fonologisch bewustzijn bij kinderen met CP te illustreren, is deze groep vervolgens in tweeën opgedeeld: een groep met een beneden gemiddeld IQ en een groep met en een gemiddeld IQ. De beneden gemiddelde IQ-groep scoorde lager op fonologisch bewustzijn en de voorlopers ervan vergeleken met de gemiddelde IQ-groep. De gemiddelde IQ groep scoorde lager op deze taken in vergelijking met de controlegroep kinderen zonder beperkingen. De conclusie van deze studie is dat intelligentie en spraakvaardigheid gezien kunnen worden als belangrijke vaardigheden voor fonologisch bewustzijn bij kinderen met CP. Kinderen met CP met bijkomende intellectuele beperkingen zijn benadeeld in het verwerven van fonologisch bewustzijn, in het bijzonder wanneer zij ook beperkingen ondervinden in spraakvaardigheden.

In hoofdstuk 3 is de longitudinale ontwikkeling van beginnende geletterdheid onderzocht. Het doel van deze longitudinale studie was om de voorlopers van vroege leesontwikkeling te onderzoeken bij 52 kinderen met CP en een vergelijkingsgroep van 65 kinderen zonder beperkingen. De taak woorddecoderen is gebruikt als indicator voor beginnend lezen, terwijl fonologisch bewustzijn, fonologisch/ auditief KTG, spraakperceptie, spraakproductie en non-verbaal redeneren werden beschouwd als leesvoorwaarden. Uit de resultaten bleek dat kinderen met CP een achterstand hadden ten opzichte van de vergelijkingsgroep aan het begin van groep 2 en dat deze achterstand aan het eind van groep 3 nog niet was ingehaald, integendeel. Voor de kinderen met CP werd woorddecoderen in groep 3 het beste voorspeld door fonologisch bewustzijn en fonologisch KTG. Spraakperceptie bleek de belangrijkste voorspeller van vroege leesvaardigheid te zijn bij de kinderen met CP, gevolgd door fonologisch bewustzijn en spraakperceptie. De spraakproductievaardigheden van de kinderen met CP speelden een prominente rol in de gehele leesontwikkeling; deze vaardigheden waren van grote invloed op alle andere leesvoorwaarden aan het begin van groep 2 en woorddecoderen in groep 3. De resultaten van deze studie tonen aan dat kinderen met CP met bijkomende spraakbeperkingen een risico lopen op een beperkte leesontwikkeling.

Hoofdstuk 4 behandelt de geletterde thuisomgeving van kinderen met CP in vergelijking met leeftijdsgenoten zonder beperkingen. Verschillende aspecten van de geletterde thuisomgeving spelen een rol bij het stimuleren van de beginnende geletterdheid bij kinderen zonder beperkingen. Dit roept de vraag op of deze aspecten ook een rol spelen bij de beginnende geletterdheid van kinderen met CP. Naast het vergelijken van verschillende aspecten van de geletterde thuisomgeving van kinderen met CP en een vergelijkingsgroep, is onderzocht in welke mate spraak, fijn motorische en intellectuele beperkingen de geletterde ervaringen thuis van de kinderen met CP belemmerden. Veertig ouders van kinderen met CP en 62 ouders van kinderen zonder beperkingen met vergelijkbare sociaal economische status beantwoordden de zelfontwikkelde oudervragenlijsten. De resultaten gaven aan dat er tussen de groepen slechts een paar verschillen waren op de geletterde thuisomgevingen: kinderen met CP hadden minder interesse in schrijfactiviteiten en waren minder actief betrokken bij woordgerelateerde activiteiten tijdens het voorlezen. De ouders van de kinderen met CP ondernamen echter meer vrijetijdsactiviteiten met hun kind. Er kan geconcludeerd worden dat de mate van spraakverstaanbaarheid de hoeveelheid geletterde activiteiten die ouders en kind gezamenlijk doen voorspelde, evenals de actieve participatie van het kind in woordgerelateerde activiteiten tijdens het voorlezen. De actieve participatie van het kind met CP in verhaalgerelateerde activiteiten kon voorspeld worden door hun fijn motorische vaardigheden. Terwijl ouders van kinderen zonder beperkingen vaak hoge verwachtingen hadden van het lees- en schrijfniveau van hun kind aan het einde van de basisschool, wisten ouders van kinderen met CP vaak niet wat ze van hun kind konden verwachten. Aan de hand van de resultaten kan geconcludeerd worden dat beide groepen kinderen een stimulerende geletterde thuisomgeving hebben, ook al zijn kinderen met CP met bijkomende spraak- en fijn motorische beperkingen benadeeld in een aantal geletterde activiteiten.

In hoofdstuk 5 is de geletterde thuisomgeving van kinderen met CP nader bestudeerd. Er is achterhaald welke invloed de thuisomgeving heeft op de ontwikkeling van leesvoorwaarden en vroege leesvaardigheid. Door middel van een longitudinale studie is nagegaan welke geletterde thuisvariabelen effectief zijn voor het stimuleren van vroege leesvaardigheid direct, of indirect via de ontwikkeling van leesvoorwaarden. Vijfendertig ouders van kinderen met CP vulden oudervragenlijsten in. De leesvoorwaarden woordenschat, zinsbegrip en fonologisch bewustzijn (i.e., rijm en fonemisch bewustzijn) waren onderzocht aan het begin en aan het einde van groep 2. De beginnende leesvaardigheid letterkennis en woordherkenning alleen aan het einde van groep 3. Drie geletterde thuisvariabelen waren gerelateerd aan zowel de leesvoorwaarden als de beginnende leesvaardigheden. Dit waren de beginnende geletterdheidactiviteiten die ouders en kind gezamenlijk doen thuis en de woord- en verhaalgerelateerde activiteiten tijdens het voorlezen. Aan de hand van padanalyses kunnen we concluderen dat de geletterde thuisvariabelen de vroege leesvaardigheden van de kinderen in groep 3 niet direct, maar indirect stimuleren via de ontwikkeling van de leesvoorwaarden.

In hoofdstuk 6 zijn verwachtingen van de leerkrachten over de lees- en schrijfontwikkeling van de kinderen aan het einde van de basisschool onderzocht. Aangezien verwachtingen van de leerkrachten belangrijk zijn voor de lees- en schrijfontwikkeling bij kinderen zonder beperkingen, richtte dit onderzoek zich op de verwachtingen van de leerkrachten van kinderen met CP. Het doel van deze studie was na te gaan in welke mate de verwachtingen van de leerkrachten over het lees- en schrijfniveau aan het einde van de basisschool van de kinderen met CP verschilden ten opzichte van de kinderen zonder beperkingen. Ook is onderzocht in welke mate de verwachtingen van de leerkrachten van de kinderen met CP gerelateerd waren aan het niveau van spraak-, fijn motorische en intellectuele beperkingen van de kinderen, evenals het huidige niveau van beginnende geletterdheid. Negenenveertig leerkrachten van kinderen met CP en 71 leerkrachten van de kinderen zonder beperkingen hebben de leerkrachtvragenlijst ingevuld. De resultaten gaven aan dat de verwachtingen van de leerkrachten van de kinderen met CP lager waren in vergelijking met de controlegroep. Daarnaast wisten acht leerkrachten niet wat ze konden verwachten van het leesniveau en 12 leerkrachten wisten niet wat ze konden verwachten van het schrijfniveau van deze kinderen. Meervoudige regressie analyse liet zien dat de leesverwachting het beste voorspeld konden worden door intellgentie en het huidige niveau van beginnende geletterdheid ($p < .001$), terwijl de schrijfverwachtingen het beste voorspeld konden worden op basis van de intelligentie van de kinderen ($p < .001$). De conclusie van deze studie is dat leerkrachten van de kinderen met CP in staat zijn te differentiëren in hun niveau van verwachtingen over de kinderen.

In het laatste hoofdstuk, hoofdstuk 7, worden de algemene conclusies uit de verschillende hoofdstukken eerst per hoofdstuk beschreven, gevolgd door algemene conclusies die uit dit proefschrift getrokken kunnen worden. Een algemene conclusie betreft dat de bijkomende spraak- en intellectuele beperkingen een belangrijke rol spelen in de ontwikkeling van beginnende geletterdheid bij kinderen met CP. Zo blijkt het niveau van spraakvaardigheid en intelligentie gerelateerd te zijn aan beginnend fonologisch bewustzijn. De spraakvaardigheden spelen tevens een prominente rol in de gehele ontwikkeling van beginnende geletterdheid van begin groep 2 tot eind groep 3. Daarnaast is het zo dat, kinderen met CP belemmerd worden in de mate waarin ze geletterde ervaringen thuis opdoen, en dit met name afhankelijk van de ernst van de bijkomende beperkingen. Als laatste hangt de ernst van de beperkingen sterk samen met de hoogte van de lees- en schrijfverwachtingen die ouders en leerkrachten hebben.

Gezien de belangrijke rol die met name de spraakvaardigheden van kinderen met CP spelen in de beginnende geletterdheid wordt het psycholinguïstische model van Stackhouse en Wells (1997) aanbevolen bij de toekomstige bestudering van de beginnende geletterdheid van deze kinderen. Het is echter belangrijk dat er meer onderzoek plaatsvindt naar dit model, aangezien dit model geen rol toekent aan intelligentie. Dit hoofdstuk eindigt met het geven van suggesties voor vervolgonderzoek evenals praktische en klinische implicaties. Zo wordt gesteld dat ouders, leerkrachten en andere professionals die met kinderen met CP werken, allen een verantwoordelijkheid hebben in het stimuleren van de leesontwikkeling van deze kinderen.

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Curriculum Vitae

Marieke Peeters is geboren op 7 april 1981 te Tegelen. Na het behalen van haar VWO-diploma op het Bisschoppelijk College Broekhin te Roermond in 1999, startte zij in datzelfde jaar haar studie Pedagogische Wetenschappen aan de Katholieke Universiteit Nijmegen (KUN), tegenwoordig de Radboud Universiteit Nijmegen (RU). Na het behalen van de propedeuse Pedagogische Wetenschappen vervolgde ze deze opleiding met afstudeerrichting Orthopedagogiek: Leren en Ontwikkeling en begon daarnaast met de doctoraal studie Onderwijskunde. In 2004 rondde ze de studie Orthopedagogiek met specialisatie 'Leerproblemen' en de studie Onderwijskunde beide met genoegen af. Haar scriptie voor de studie Orthopedagogiek had betrekking op auditief temporele verwerkingtaken bij kinderen met een risico op dyslexie. Haar scriptie voor Onderwijskunde ging over een interventie ter stimulering van het fonologisch bewustzijn van deze kinderen.
In 2005 ontving ze voor deze scripties de eerste prijs bij de Frater Rombouts scriptieprijzen.

In 2004 startte zij als junioronderzoeker bij de sectie Orthopedagogiek: Leren & Ontwikkeling aan de RU. Eind 2008 ontving zij voor haar onderzoekswerkzaamheden het dr. I.B.M. Frye Stipendium voor 'veelbelovend vrouwelijk onderzoeker'.

Vanaf het begin van haar promotietraject heeft zij haar onderzoekswerkzaamheden gecombineerd met een docentschap bij Orthopedagogiek. Zij heeft onderwijs verzorgd voor verschillende cursussen binnen de Bachelor- en Masteropleidingen van Pedagogische Wetenschappen. Haar werkzaamheden bestonden onder andere uit het begeleiden van scriptiestudenten en het begeleiden van werkgroepen bij zowel het vak Onderzoeksseminar als het vak Inleiding Orthopedagogiek. Begin 2009 ontving zij haar Basiskwalificatie Onderwijs (BKO), een kwalificatie voor het geven van academisch onderwijs.

Na het afronden van haar proefschrift in december 2008 is zij gaan werken bij het Expertisecentrum Nederlands te Nijmegen.

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