The PhonicStick: A Swedish Study

How do children age 5 and 6 handle the PhonicStick and will the use of it affect their phonological awareness?

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ABSTRACT

Phonological awareness is the ability to recognise, identify and manipulate components in words. Phonological awareness is an important part of the early literacy learning, although researchers disagree on how the connection arises. In the United Kingdom, synthetic phonics is a recommended way to teach literacy and the Jolly Phonics is a common approach within this method. In Sweden, mostly synthetic but also analytic methods are used for literacy teaching. The PhonicStick is developed as a communication device for impaired people and is based on the Jolly Phonics. In this study, the PhonicStick was being tested on children aged 5 and 6 years in mainstream pre-school classes to evaluate the use of it and its use for improvement of phonological awareness. The participating children were randomly divided into a test and a control group. All children were pre- and post-tested to analyse the possible improvement of parts of the phonological awareness. The test group went through three PhonicStick sessions, including different games and tests. The results from the pre- and post-tests of phonological awareness showed no significant differences between the test and control group. However, four out of five PhonicStick tests showed a significant improvement between session 1 and session 3. This shows that the children in the study were able to handle the PhonicStick after only three sessions, including remembering phonics the without visual information and producing words including two or three phonics.

Keywords: Phonological awareness, The PhonicStick, Literacy teaching, Literacy learning, Pre-school class

SAMMANFATTNING


Nyckelord: Fonologisk medvetenhet, The PhonicStick, Läs- och skrivundervisning, Läs- och skrivinlärning, Förskoleklass
1. Introduction

The PhonicStick is a technical device developed at School of Computing, University of Dundee, Scotland to enable speech for, for example, motor impaired people with limited speech ability. The choice of the 6 phonics included in the prototype of the English PhonicStick is based on a literacy-teaching programme called The Jolly Phonics used in the United Kingdom (Black et al., 2008a). The present study aims to evaluate if the PhonicStick can be used to improve parts of the phonological awareness among Swedish preschool class children, which in its turn could have impact on literacy learning. It is also of interest to see how children use the PhonicStick, how they learn to handle it and to what extent they improve their handling of it.

The following chapters and sections will present previous research on phonological awareness and its relation to literacy learning. Literacy teaching in the United Kingdom in general and the often-used literacy teaching programme called Jolly Phonics will also be discussed. The literacy teaching in Swedish schools will be described to enlighten the need for training phonological awareness as part of literacy teaching. One chapter is dedicated to communication aids to give a picture of some devices that are used today and to give a more descriptive background about the development of the PhonicStick.

2. Phonological awareness

Phonological awareness, also referred to as phonological sensitivity, means that one can recognise, identify or manipulate components in words. These components include units, e.g. phonemes, rhymes or syllables (Ziegler & Goswami, 2005; Goswami 2006; Stahl & Murray, 1994). Some researchers differentiate phonological awareness from phonemic awareness. Phonological awareness is a more comprehensive term including the ability to recognise and manipulate both larger and smaller units of spoken words, e.g. syllables, rhymes and phonemes. Phonemic awareness is only focusing on the ability to distinguish, manipulate and recognise the sequence of individual phonemes in words, which are the smallest units to form meaningful contrasts in spoken language (Liberman et al., 1974; Ball & Blachman, 1991; Engstrand, 2004). In this thesis phonemic awareness will be included in the term phonological awareness, and phonological awareness will therefore be used to describe both phonemic awareness and phonological awareness.

The phonemes in spoken English are combined into larger units and form syllables and words. There are words consisting of only one phoneme, such as a, but most words consist of two or more phonemes, e.g. go with two phonemes and cat with three phonemes (Häggström, 2007; Ehri et al. 2001). According to Lundberg (2006) and Ehri (2001) it can be hard to distinguish the separate phonemes in spoken language since the phonemes are co-articulated without breaks or pauses in between. Therefore a child might need explicit instructions to be aware of and focus on the separate phonemes in the pronunciation of words. According to Goswami (2006) there is an apparently universal sequence of development from awareness of larger language units (syllables, onsets, rhymes) to awareness of smaller language units (phonemes). Of course there are cross-language differences in this universal sequence of development depending on variations in phonological structure and orthography.
2.1. Phonological awareness and literacy learning

Phonological awareness is supposed to be the best way to anticipate reading skills. This can be shown from over 30 years of worldwide research (Rvachew & Savage, 2006; Stahl & Murray, 1994). In an alphabetic orthography the written symbols, graphemes, represent the phonemes. Sometimes more than one grapheme represents a single phoneme (for example /ʃ/ in shoe) and sometimes one grapheme can represent more than one phoneme (for example /ks/ in box) (Häggström, 2007). Therefore, to become literate in an alphabetic language, one needs to develop the ability to explicitly analyse and control the phonemic segments of spoken language and consciously control these units in different ways (Lundberg, 2006; Lundberg, 1988).

According to Ziegler and Goswami (2005) the process of learning to connect sounds to symbols is called phonological recoding and is the first step in becoming literate. This enables the child to receive literate access to all the words they already can achieve through their spoken lexicons. Once the child realises that phonemes are the units of spoken language that can be represented in graphemes, the alphabetic orthography becomes a logical way to symbolise the language (Ball & Blachman, 1991). Liberman et al. (1974) suggest that learning to connect letters to language sounds is dependent on the ability to reflect on sounds in spoken words. Children who find it difficult to reflect on sounds in words and segment spoken words into separate sounds might have difficulties in learning to read. Stahl and Murray (1994) and Goswami (2006) present research showing that there is a strong correlation between phonological awareness and reading and spelling ability.

According to Lundberg (2006) it is a common view among some researchers that the child needs reading instructions to develop phonemic skills. However, in a training study implemented by Lundberg et al. (1988), they showed that Danish preschool children could develop their phonemic awareness without regular reading instructions. Instead of regular reading instructions they designed a programme with daily exercises during one preschool year, including for example listening games, playing with sentences and words and finally learning to segment words into phonemes. The results showed that these children had made improvements in their phonemic skills and that phonemic skills therefore could be developed among preschool children when using other methods than regular reading instruction with letters. The participating children were followed up through four school years to evaluate their reading and spelling skills, and they showed better skills than children who did not participate in the preschool training programme. In other words, the participating children had a clear advantage in learning to read and spell in school (Lundberg 1988). The study suggested that phonological awareness could be developed before and irrespectively of acquired literacy ability.

Schneider et al. (1997) replicated the Lundberg study and also found positive short-term effects on German preschool children’s phonological awareness, and therefore came to the conclusion that early and intensive training of the phonological awareness had positive effects regardless of language. Their results supports the view that broader phonological skills, e.g. rhyming and syllable segmentation, develops before the child gets in contact with formal reading instructions in school. On the other hand, more narrow skills, e.g. phoneme manipulation, rarely develop spontaneously before entering school and are therefore significantly benefitted from intervention programmes and exercises. Schneider et al. (1997) also stressed the impact of quality and quantity of training. Ball and Blachman (1991) strengthen Lundberg et al.’s (1988) findings with their research indicating that children who receive phonemic awareness intervention show a superior ability in both reading and spelling...
and are more able to match graphemes and phonemes compared to children who do not get the same phonemic awareness training.

Despite the results above, some researchers consider the opposite, that phonological awareness skills do not precede reading and spelling skills. A study implemented by Morais et al. (1986) showed that illiterate adults performed significantly lower on phonemic segmentation tasks, which therefore was assumed to require experience of reading instructions. Morais et al. (1986) argued that the ability to reflect on spoken words develops after rather than before learning to read and is not a naturally developing ability. Their findings that illiterate adults do not develop this phonological skill assume that reading instructions are necessary for achieving phonological awareness.

Another view is that some parts of phonological awareness are learned before literacy and some more complex parts are learned after, and because of, literacy. Stahl and Murray (1994) assumed that some phonological skills predict the ability to develop a sight vocabulary, the ability to unconsciously identify words (Beck & Juel, 1992), and that children become increasingly sensitive to the structure of written words as they learn more and more words. This sensitivity also leads them to a more extensive phonological understanding about the structure of words that may enable them to develop higher decoding skills, e.g. ability to decode words not previously seen. Schneider et al. (1997) suggested that the relationship between phonological awareness and literacy learning is reciprocal. That is, basic phonological skills are essential for learning the alphabetic code, which thereafter improves the level of phonological awareness. Schneider et al. (1997) also found that phonological awareness seems to improve for children after only two months of reading instruction, supporting the view that the relationship between phonological awareness and early stages of literacy is reciprocal.

Despite the different views on this subject, one can establish that phonological awareness in some way is an important part of the early literacy learning. However, since there are different views on what impact literacy learning processes have on phonological awareness, it can be hard to recognise the effect of training phonological awareness when children have already initiated their literacy learning (Schneider et al., 1997).

3. Literacy teaching

3.1. Synthetic Phonics and literacy teaching in United Kingdom

Rose (2006) published, on mission on behalf of the Secretary of State for Education for England, a review about teaching of early reading in British schools, presenting that the British National Curriculum between 1989 and 1998 had too little impact on raising the standard of reading among the pupils. Even though working with phonics in literacy teaching was a stated component, reports from Her Majesty’s Inspectors showed that it often had a weak part in literacy teaching. When redeveloping the National Literacy Strategy in 1998, schools were engaged in performing a structured teaching programme of literacy that did not only describe what should be taught about phonics, but also how to teach it. Rose (2006) recommended all early literacy teaching to include synthetic phonics. A description of synthetic phonics will be presented below.

Before the evaluation of the literacy-teaching curriculum used between 1989 and 1998, the common way of teaching literacy was by using the searchlights model of reading. This model contains four strategies, searchlights, referring to sources of knowledge when decoding
a text: phonic (sounds and spelling) knowledge, grammatical knowledge, word recognition and graphic knowledge, and knowledge of context (Rose, 2006).

3.1.1. Synthetic Phonics

Torgerson et al. (2006) found that systematic literacy instructions based on phonics had a significant positive effect on reading accuracy. Phonics describes the relationships between letters and sounds (Torgerson et al., 2006). One approach using systematic phonics, where you learn letter-sound correspondence in an explicit and organised way, is called synthetic phonics. In this method the phonemes are matched with graphemes, pronounced in isolation and then synthesised/blended together. The pupils learn to segment spoken and written words into its elements, and when coping with unfamiliar words they are able to use their knowledge of phoneme-grapheme correspondence to code the word when both reading and writing. The focus is on connecting phonemes to graphemes and the pupil is not introduced to letter names at the beginning of learning (Torgerson et al 2006; Bowey 2006). According to Bowey (2006), systematic synthetic phonics is the most effective approach in literacy learning.

Contrary to Rose (2006) and Bowey (2006) there are researchers who cannot see the synthetic phonics as a superior approach when teaching early literacy. According to Wyse and Styles (2007) there is no evidence for synthetic phonics to be a preferred method. They consider research evidence showing that early literacy teaching should consist of a variety of instructions in phonics combined with print exercises, and their opinion is that synthetic phonics is not the best approach in literacy teaching. Goswami (2005) discussed that synthetic phonics, as a literacy teaching approach in English, is not working out well since English has an inconsistent letter-sound correspondence. Goswami (2005) considers that literacy teaching in English needs complementary approaches in addition to synthetic phonics.

3.1.2. Jolly Phonics

One common literacy teaching approach based on systematic synthetic phonics used in the United Kingdom is called Jolly Phonics. The pupils are taught all 42 phonics in the English language in intervals and in a certain order to blend sounds into words and eventually reading words. By identifying the sounds in words and connecting sounds to letters they understand the alphabetic code which helps them learn to read and write (Lloyd, 1998). The approach is based on the assumption that knowing letters is superior to a whole-word approach when learning to read and write, and that pupils become fluent readers faster when using the synthetic phonics approach. Pupils who use the synthetic phonics approach also start to write independently and spell accurately earlier than pupils taught with the whole word approach (Lloyd, 1998). Lloyd (1998) assumes that the amount of pupils with reading problems is almost non-existent when a synthetic phonics approach is being used in literacy teaching.

The Jolly Phonics has a multi-sensory approach, involving body movement, hearing, visual ability and speech, that makes it easier to learn the sounds and connect them to letters. One phonic is introduced a day and all 42 phonics are being taught in about 9 weeks. They concentrate on lower case letters and the letters are being introduced by sounds, not by names. The phonics are in groups of six and the order has been carefully selected to support learning. Letters which similarities might confuse the child are not put too close together, for example b and d. Each child has it own Sound Book that can be brought home for the parents to be able to take part in their child’s literacy learning (Lloyd, 1998).
These are the letter sound groups followed in the Jolly Phonics:
1.  s, a, t, i, p, n
2.  ck, e, h, r, m, d
3.  g, o, u, l, f, b
4.  ai, j, oa, ie, ee, or
5.  z, w, ng, v, little oo, long oo
6.  y, x, ch, sh, voiced th, unvoiced th
7.  qu, ou, oi, ue, er, ar

3.2. Literacy teaching in Swedish schools

According to the Swedish national Curriculum for the Compulsory School System, the Pre-School Class and the Leisure-time Centre (Lpo94) (Skolverket, 2006), the school should enable the development of communication skills through reading, writing and communication. This in its turn will enhance the pupils’ belief in their language ability, which is important also for learning and identity development.

Language, learning, and the development of a personal identity are all closely related. By providing a wealth of opportunities for discussion, reading and writing, all pupils should be able to develop their ability to communicate and thus enhance confidence in their own language abilities (p. 5-6).

After nine years in the compulsory school, one aim is that the pupils should be able to master the Swedish language and have the capacity to listen and read and to express their thoughts and ideas in speech and writing (Skolverket, 2006).

The school is responsible for ensuring that all pupils completing compulsory school:
• have a mastery of Swedish and can actively listen and read as well as express ideas and thoughts in the spoken and written language (p. 10).

There are no rules in the curriculum for how to teach language and literacy, but there are guidelines for the teachers, which should be applied in all subjects. Some of the guidelines tell the teachers to give special support for pupils with difficulties, to have the pupils’ individual needs, prerequisites and experiences as starting point and to give the pupils support in their development of language and communication skills (Skolverket, 2006).

The Swedish pre-school class is not part of the compulsory school system, but is still included in the Lpo94 and is also included in the Swedish Education Act (Utbildningsdepartementet, 2009). There are no aims that the pupils should have fulfilled after finishing pre-school class, still the national syllabi for the compulsory school system express the purpose of the different subjects in the education and should be applied in the pre-school class as well. The syllabus for the subject Swedish expresses the aims that the school should create good possibilities for the language development and give opportunities for the pupils to use and develop their ability to for example talk, listen, read and write. The language ability is stated to be of great importance both in school and life in general as well as for the personal identity. It therefore has a central role in the education (Skolverket, 2000).

The syllabus for Swedish (Skolverket, 2000) also lists objectives to aim for in the teaching, which includes helping the pupils to acquire knowledge about the language structure and its history. It also states that language knowledge is built up by using the language, knowledge to use it and by acquiring new knowledge about the language.
According to both the national curriculum and the syllabus for Swedish, the goals to strive for are clear, but there is no established way how to teach language and literacy and it is up to every school to decide what methods to use (Skolverket, 2005).

The methods used for literacy teaching differ among schools, but in a study performed by Arnqvist (2003), all the participating pre-school classes stimulated the language awareness, the consciousness of forms and functions in language (Carter, 2003), although in different ways. Some classes used a systematic way to train the language awareness and some classes did not. The systematic way is explained by starting to train rhyme ability followed by syllables and then phonemes. However, in all the participating pre-school classes, playing with the language was part of the activities, which gave the pupils knowledge about word comprehension and both language structure and language contents. This in its turn prepared the pupils for the literacy teaching in the compulsory school, which they attend after finishing the pre-school class. However, the same study highlights the problems with unsatisfactory individualised education, where pupils who can read already when beginning pre-school class, as well as pupils with difficulties, do not receive the necessary stimulation and help required (Arnqvist, 2003).

Frykholm (2007) described two commonly used ways to teach literacy as the analytic and the synthetic method, where analytic is a top-down method, based on comprehension. This means that the language is being broken down from texts into smaller units as words and phonemes. In this method, the whole word reading, or sight word recognition, is an essential part (Beck & Juel, 1992; Frykholm, 2007). The synthetic method is bottom-up based which indicates that phonemes are being put together into words, sentences and texts, also known as the phonics approach, where phonemes are being related to the corresponding graphemes (Beck & Juel, 1992; Frykholm, 2007). One example of the synthetic method is Bornholmsmodellen (The Bornholm model). It is often mentioned in the literature in this field (see for example Stahl & Murray, 1994, Goswami, 2006) and is based on the study implemented by Lundberg et al. (1988). This method is according to Häggström (2007) a frequently used method in Swedish schools and it trains the phonological awareness by using different language games divided into five steps. Nowadays the method also includes letter knowledge, which was excluded in the initial Bornholm study, published in 1988. The aim with the method is to prepare the children for the latter compulsory literacy learning (Lundberg et al., 1988; Lundberg, 2007). The Swedish language consists of 17 vowels and 18 consonants, in total 35 phonemes (Engstrand, 2004). One example of the analytic method is LTG – Läsning på Talets Grund (Reading with the spoken language as the base). The LTG method was developed by Leimar in the 1970s and although it is an analytic method, it also contains parts of the bottom-up, synthetic method. The aim with this method is to make the pupil aware of the connection between phonemes and graphemes and also between written texts and spoken words (Leimar, 1974).

Although, in most cases, the teachers start with a synthetic method, it is often used in combination with an analytic method and whole word reading (Frykholm, 2007).

4. Communication aids

4.1. Devices used for communication

There are many different devices, developed as aids for literacy learning and speech production. Most of the devices demand visual ability to make them work, such as DynaVox.
Vmax, which is a communication aid that enables both daily communication and literacy development but demands visual ability to handle the use of the dynamic page content (V/Vmax Product Information, DynaVox).

George and Gnanayutham (2009) developed a multimedia interface consisting of both visual and auditory output meant to be used in speech therapy with children having problems with pronunciation. The interface contained sound recordings of both male and female voices, 2D animations to show how each language sound was being used in context and 3D animations that together with the relevant sound showed how each language sound was being pronounced by speech organs in the mouth. The order of sounds and the actions used for 2D animations chosen for the interface were the ones from the Jolly Phonics programme. This interface demanded the user to be able to handle the visual ability required for using it.

When designing devices for augmentative and alternative communication (AAC) the designers need to consider the physical and cognitive demands and abilities of the AAC users and their communication partners. It is of great importance that the users can control their own communication and take part in for example meaningful societal activities (Blackstone et al., 2007). According to Gonzales et al. (2009), many AAC strategies are paper based and consist of for example symbols, which can limit the spontaneity of the conversation. They suggest that electronic AAC devices can improve the quality of communication using for example speech generation devices (SGD) with synthetic speech output produced from combining text, pictures or symbols. According to Blackstone et al. (2007), electronic devices are often programmed with pre-recorded messages. Pre-recorded messages can sometimes limit the variety of communication and dialogues.

AAC users with physical or visual impairments with gaze shifting and joint attention shifting difficulties might find it hard to coordinate their attention between self, the communication partner and their AAC device. A great challenge for these AAC users could be using AAC devices that demand an ability to navigate through systems consisting of multiple pages and screens (Light & Drager, 2007).

### 4.2. The PhonicStick

The PhonicStick is a joystick, developed at the School of Computing, University of Dundee, which can be used for literacy learning and speech production without any demands on visual ability (Black et al., 2008a). This device makes it possible to produce language sounds and blend them together into words without any connections to pictures or letters (Black et al., 2008b), which is mostly the case for other devices, as can be seen above. Another advantage of the PhonicStick is that the users can explore the phonics on their own and that they get immediate auditory feedback, which could have positive effects on the learning process.

The PhonicStick is made as a joystick to make it useable for people with physical disabilities. Many children with physical disabilities can manoeuvre their wheelchair with a joystick, but they show difficulties in using a similar joystick to handle the computer. This might be because a computer demands more cognitive functions and often has a delay in feedback due to second interfaces. The PhonicStick gives direct feedback; a phonic is spoken just by moving the joystick in that direction (Black et al., 2008a).

The prototype of the PhonicStick contains the first six phonics taught in the Jolly Phonics programme. These phonics can be blended together into existing and non-existing words with two or three phonics. To access a phonic, the joystick is being moved in one of six directions (see Figure 1). The users are given auditory feedback as they move the joystick, and when the joystick is moved back to the centre position the phonic is chosen (Black et al., 2008a). The goal is to get all 42 phonics used in the English language into the PhonicStick (Black et al.,
When developing the PhonicStick, the phonics were grouped by their phonemic characteristics (for example fricatives or plosives) and thereafter placed on the 8 main compass rose directions (see Figure 2). The mapping of the phonics is meant to be done in stages where the 6 beginning phonics in the Jolly Phonics programme are the first ones. The phonic positions are not changing when adding further stages (R. Black, personal communication, 2009).

A study has been done within the developing of the PhonicStick, where seven children were testing the PhonicStick. Five of the children had physical and/or learning disabilities and two of them had no disabilities. The results from this study showed that all participating children could use the PhonicStick to blend phonics together into words consisting of three phonics, although two of the children had difficulties in using the joystick because of their severe physical disabilities. An ongoing research is focusing on making the PhonicStick usable for children with Complex Communication Needs (CCN) and physical disabilities (Black et al., 2008a).

Figure 1. The mapping of the first stage of the English PhonicStick.

Figure 2. The future mapping of all 42 phonics in the English PhonicStick.
5. Aim

The aim of this study was to evaluate the impact/effect of the PhonicStick for the phonological awareness in Swedish children age 5 and 6 and to see in what way they were capable to use the PhonicStick. The hypothesis was that use of the PhonicStick would improve parts of the phonological awareness tested in the study. Hence, the PhonicStick could help the child to become aware of phonemes and how to blend them into words, without any connection to graphemes.

In order to do this, the key questions were:
1. Will the PhonicStick result in improvement among Swedish 5 and 6 year-old children in parts of the phonological awareness, including phoneme identification and phoneme segmentation?
2. Will the children be able to remember the positions for the different phonics in the PhonicStick without visual information?
3. Can the children produce words with the PhonicStick by combining phonics?
6. Methodology

6.1. Participants

The study involved 46 children who were recruited from two different schools in Uppsala, in total 5 pre-school classes. Six children from each of three classes and 18 and 10 children from the two other classes participated respectively. The school principals and the teachers in the concerned classes had given their permission for the children to participate (Information letter, see Appendix 1). The parents of all the children in the five pre-school classes received information letters and were asked to give their informed consent if they wanted to let their child/children take part in the study (see Appendix 2). The age of 5 and 6 was chosen because at that age formal literacy teaching has not yet started in Sweden.

All children, whose parents had given their informed consent, were included in the study. The children were divided into two groups: a test group and a control group. The division was made out of alphabetical order with every other child placed in each of the two different groups. The two groups consisted of 23 children each. Two children in the test group and three children in the control group interrupted their participation before the study was finished, which resulted in 21 children in the test group and 20 children in the control group. There were 12 boys and 9 girls in the test group and 9 boys and 11 girls in the control group. All children were between 5 and 7 years old. Mean age of the test group was 6.33 years and mean age of the control group was 6.25 years.

The inclusion criteria were that the children should attend pre-school class and there were no exclusion criteria.

6.2. Project design

6.2.1. Questionnaire

The parents of the participating children were asked to fill in a form with questions about the child’s language and general development. The questionnaire was meant to give the researchers an overview about the variety among the children in the test group and the control group (see Appendix 3).

6.2.2. Test of phonological awareness

The test group and the control group were tested with a set of three tests, and the same tests were used for both pre- and post-test. These tests were: Phoneme identification (fonemidentifiering) and Phoneme segmentation (fonemsegmentering) from Magnusson & Nauclér’s test material Bedömning av språklig medvetenhet hos förskolebarn och skolbarn (Evaluation of language awareness in children in pre- and primary school) (Magnusson & Nauclér, 1993). A third test was taken from Astrid Frylmark’s test material Bedömning av Språklig medvetenhet (Evaluation of language awareness) and tested the ability to separate language sounds in words; Separate sounds (separera språkljud) (Frylmark, 2006). The tests were chosen to evaluate the components of the phonological awareness of interest in relation to the PhonicStick; thus, the ability to identify and segment words into phonemes.

6.2.3. Literacy tasks

The set of tests also included words that the child was asked to read and write. Those were chosen to give an overview of their capacity in reading and writing. In the pre-test the child was asked to write his/her own name and the researchers’ names. The child was also asked to
write four words consisting of one or two syllables. Some of the words consisted of initial and final consonant clusters and vowels that could cause spelling difficulties. The five words that the child was asked to read in the pre-test were one or two syllables words, where some of them included initial and final consonant clusters. Both the reading and the writing words shared a variety of different letters in Swedish (see Appendix 4).

In the post-test, the child was asked to write four different words consisting of one, two or three syllables. Some of the words included initial and final consonant clusters and vowels that could cause spelling difficulties. The child was then asked to read five words consisting of one, two or three syllables and initial and final consonant clusters. As in the pre-test, all these words shared a variety of different letters in Swedish (see Appendix 4).

The difficulty level of the words in the post-test was supposed to be slightly higher than the words in the pre-test in order to see possible improvements.

6.2.4. The PhonicStick

Technical equipment. When designing the Swedish version of the PhonicStick, phonics that when combined generated a large amount of real Swedish words, were chosen. The phonics generated 24 real words consisting of three phonics, and 5 real words consisting of two phonics (see Appendix 5). The chosen phonics were /a/, /o/, /m/, /l/, /t/ and /k/. For the phonics /a/ and /o/ the allophones [a] and [ɔ] were used. Allophones are different versions of a phoneme (Engstrand, 2004). The technical software used for the Swedish PhonicStick was the same as used for the English version (R. Black, personal communication, 2009). Therefore the directions used for the positions of the Swedish phonics followed the English version (see Figure 3). The microphone Samson C01U – USB studio condenser was used for the recording of the phonics and all possible words and non-words, which was performed using the software Audacity. The recordings were made in May 2009 at the School of Computing, University of Dundee, Scotland, by the researchers and three other students from the speech and language pathology programme at Uppsala University.

![Figure 3](image)

*Figure 3. The mappings of the Swedish PhonicStick used in the present study*

The PhonicStick was made out of a computer joystick, by label Logitech, Attack™ 3 Joystick. The stick was removed and replaced by a wooden ball to make it easier for the children to handle the PhonicStick. There were two buttons on the joystick programmed as one “speak button” and one “clear button”. After producing two or three phonics, the “speak button” had to be pressed to generate a word out of the selected phonics. The “clear button” was used to regret or start over when producing an incorrect phonic or after producing a word with two phonics. Due to a bug in the Swedish PhonicStick software, the “clear button” also had to be pressed when the user wanted to start producing a new word after the PhonicStick had spoken out a word consisting of three phonics.
The equipment for the three sessions with the PhonicStick consisted of one laptop, two speaker units and the PhonicStick.

**Additional equipment.** During the games and tests, there were three different picture charts with six pictures on each chart, used to stimulate the production of words. Picture chart 1 was used in session 1 and session 3 for game 2 (see Appendix 6). In session 2, picture chart 2 was used for the same game (see Appendix 7). In Test 2b, picture chart 3 was used in both session 1 and session 3 (see Appendix 8). For Game 3, eight pieces of paper with words were used (see Appendix 9). There were also test protocols for the first and last session with the PhonicStick (see Appendix 10).

6.2.5. **Observations**

During the whole procedure, special observations regarding for example concentration were noted during and directly after the sessions, and in addition the sessions with the PhonicStick were video recorded. A video camera and a tripod were used as observation equipment.

6.3. **Procedure**

Two Speech and Language Pathology students performed the study as a master thesis. Before the start of the actual study a pilot study was performed using the PhonicStick together with two children of the same age as the children participating in the study. The aim for the pilot sessions was to evaluate the choice of tests and games and to get an idea of the amount of time required for the sessions. There were considerable differences between the two children in the pilot study. One of them could handle the PhonicStick without problem from the beginning. The child had no problem remembering the phonic positions and managed to produce words on its own. The games and tests were done easily and quickly. The other child was more insecure about the phonic positions, needed more instructions and had some difficulties playing the games and doing the tests. The pilot sessions gave the researchers an important overview about the variations that could be seen in the study later on.

Both groups were assessed with the set of pre- and post-tests to evaluate parts of their phonological awareness and to give an estimate of the literacy level of the children participating in the study. The testing of the control group was executed in the same period of time as for the test group, to see how much impact the ordinary teaching in preschool had on the phonological awareness. Thereby one could get more information about what role the PhonicStick had on the phonological awareness among the children in the test group. The pre-test and post-test lasted for approximately 15 minutes.

The time interval between the pre-test and the post-test was intended to be 2 weeks. For some children the time interval had to be adjusted if they were not attending preschool class when a session was planned to take place. After the pre-test and before the post-test, three sessions were conducted with the PhonicStick together with the children in the test group, which will be described more closely below. The first and the third session with the PhonicStick lasted for approximately 30 minutes, and the second session with the PhonicStick lasted for approximately 15 minutes.

During the course of the study the researchers met with one half of the total number of participating children each. They were using the same game and test instructions and test forms for every child, although they sometimes had to adjust the instructions depending on the needs for each child.
6.3.1. Session 1 with the PhonicStick

Introduction of the PhonicStick: The researcher introduced the PhonicStick and all the phonic positions and helped the child to find the phonic positions. The researcher told the child to move the PhonicStick in the six different directions and listen to what sound they heard. The “speak button” and the “clear button” were also introduced to the child and the child was told that it was possible to use the PhonicStick to make words with two or three sounds. After introducing the six phonics the child and the researcher produced two words together. After this introduction two games were played with the child.

Game 1: The researcher showed the child a movement for each phonic, for example playing on a drum when pronouncing /t/. The researcher then produced each phonic with the PhonicStick and asked the child to make the movement suitable for each phonic. Furthermore, the researcher produced every sound and movement twice in mixed order and asked the child to produce the phonic with the PhonicStick.

Game 2: A picture chart consisting of six pictures was shown to the child. Four of the pictures represented words that they were able to produce with the PhonicStick and two of the pictures represented words that were not possible to produce with the PhonicStick. The researcher discussed one picture at a time with the child and then encouraged the child to make the word with the PhonicStick. If needed, the child got help from the researcher, either by auditive cues, the phonics’ movements or the positions of the phonics. Picture chart 1 was being used.

During the games, the child got instructions from the researcher if he/she could not remember the phonic positions.

After the two games were played, the test part of session 1 took place. The tests had different sets of sounds/words called list A and list B. Half of the children were tested with list A in session 1 and list B in session 3, and the other half were tested with list B in session 1 and list A in session 3. There were five different tests. The child did not get any feedback from the researcher during the tests regardless of whether he/she made correct phonics/words or not.

Test 1. Position of phonics: The child was asked to produce the different phonics with the PhonicStick from a list in which all phonics came up twice in mixed order.

Test 2a. Production of spontaneous words: The researcher asked the child to produce as many real words as possible during two minutes.

Test 2b. Production of picture-based words: A picture chart consisting of six pictures representing words that could be made with the PhonicStick was introduced to the child. Picture chart 3 was used in this test. The researcher made sure that the child understood which words the pictures were aiming for, and then asked the child to produce the words with the PhonicStick. The child was asked to quit after two minutes even if he/she had words left to produce.

Test 3. Dictation of words and non-words: The researcher had a list of 10 words, both real words and non-words, and the child was asked to produce the words with the PhonicStick. This test had no time limit. If needed, the child got one repetition of the target word.

Test 4. Identification of sounds: The researcher had a list with 9 words, which could not be made with the PhonicStick. The child was asked to produce the first, the last or the middle sounds of the different words with the PhonicStick. This sort of exercise had not been practised with the child before the test took place in session 1. If needed, the child got one repetition of the task.

Self-correction was allowed in all PhonicStick tests, except in Test 1.
6.3.2. *Session 2 with the PhonicStick*

Session 2 started with the researcher asking the child if he/she could remember the positions of some of the phonics from session 1. The child was asked to produce the phonics he/she could remember, after telling the researcher what phonic he/she intended to produce. Thereafter, Game 1 and Game 2 were played just as in session 1. In Game 2, picture chart 2 was used instead of picture chart 1, which was used in session 1. A third game was also played in session 2.

Game 3: In Game 3 the researcher had eight pieces of paper with one word (which could not be produced with the PhonicStick) on each piece. The child was asked to pick one piece of paper at a time without seeing the words written on it, and the researcher then asked the child to make either the first, the last or both the first and the last sounds of the nine different words.

During the games, the child got instructions from the researcher if he/she could not remember the phonic positions.

6.3.3. *Session 3 with the PhonicStick*

Session 3 started with the researcher asking the child if he/she could remember the positions of some of the phonics from session 1 and session 2. The child was asked to produce the phonics he/she could remember, after telling the researcher what phonic he/she intended to produce. Then Game 1, Game 2 and Game 3 were played. Game 1 was played with different length according to how well the child could remember the phonic positions. Picture chart 1 was used in game 2. During the games, the child got instructions from the researcher if he/she could not remember the phonic positions. After playing the games the same tests as in session 1 were used. The children who were tested with list A in session 1 were tested with list B in session 3 and vice versa.

6.4. **Evaluation**

*Questionnaire.* The information from the questionnaire filled in by the parents was analysed using qualitative methods. The parents were asked to estimate their child’s language and overall development. The question concerning the child’s babbling was given a category scale with four categories, where only the lowest one was considered deviant and was noted by the researchers. There were three questions using category scales with five categories each, concerning language development and fine and gross motor ability. Only the lowest category on each scale were considered and noted as deviant. The parents were asked to estimate when the child said his/her first word, and answers where the child was older than 20 months were noted as deviant. If the parents estimated that their child started crawling after 12 months and started walking after 18 months, the researchers noted this in order to observe deviations from the average answers. It was also noted if the child was left- or right-handed. The researchers made notes if the parents reported heredity for delayed language development or literacy difficulties. Furthermore, the parents were asked to assign what languages the child spoke, and if the parents themselves were bi- or multi-lingual. It was noted if the child had attended Swedish pre-school for less than 2 years. The question regarding the child’s hearing was given a category scale with three categories. If the parents estimated their child’s hearing to one of the two lowest categories, this was noted.

*Phonological awareness tests.* The tests of parts of the phonological awareness were corrected and analysed using the reference data.
Writing task. The words written by the child were evaluated on a three-point scale. To get 2 points the child had to be able to spell correctly on his/her own without help from the researcher. The child got 2 points even though he/she did not spell double consonants correct, which is a common mistake when writing. The child who got 1 point needed some help from the researcher in remembering and forming some letters. The written words had some wrong spellings but the meaning of the words could be understood. When the child was not able to write on its own, and when the target word was unreadable, the child got 0 point.

Reading task. The words read by the child were also evaluated on a three-point scale. The child who was given 2 points could read without any help from the researcher. The child got 2 points even if he/she could not handle the double consonants, which is a common mistake when reading. To get 1 point, the child had to be able to read out some letter sounds on his/her own and blend them to some extent. Some help from the researcher to read out letter sounds was allowed. If the child showed great difficulties in reading out letter sounds and could not blend them to words, he/she got 0 point.

The PhonicStick tests. In Test 1, one point was given if the child found the target phonic at the first attempt. He/she got one point for every correct phonic. Even if the child found the right phonic but did not manage to get back to the centre of the joystick faultlessly, for example if he/she produced a /t/ on the way back from producing a /k/, he/she still got one point. Hence, the purpose of finding the position of the phonic was still achieved. No repetition of the phonics was given to the child, and no self-correction was allowed.

When assessing Test 2a, the child got one point for each word he/she made. If the child produced a real word by accident, he/she had to be aware that the word produced was a real word to get a point.

In Test 2b, the child was allowed to do as many attempts as he/she wanted or needed for each word. The child got one point for every correct word produced within 2 minutes. If the child had produced an incorrect word but yet started producing the next word, only the correct words produced were given points. Some children could therefore have produced a larger amount of words than other children, but got fewer points since the number of correct words was lower.

In Test 3, the child got one point for each correct word produced.

When assessing Test 4, one point was given for each correct answer.

6.5. Data analysis

The pre- and post-tests were analysed with paired two-tailed t-tests when comparing the results within the same group. When comparing the test group with the control group according to pre- and post-tests, unpaired two-tailed t-tests was used. For all quantitative tests, the significance level, alpha, was set to 0.05 (two-tailed p). The data from the testing with the PhonicStick was analysed with Wilcoxon’s Signed Ranks Test. The highest number of possible correct answers in the tests with the PhonicStick was twelve (Test 1. Position of phonics) and the answers were on an ordinal scale with no measurable intervals in between; hence the use of a non-parametrical statistic method. The data from the spelling and reading tests are presented for the test group and control group separately. The results are given in table within frequencies. Statistics have been carried out using PASW Statistics 18 and G*Power 3.
6.6. **Ethical considerations**

The parents had to give their informed consent to allow their child/children to participate in the study. The child still had the right to choose not to participate, but one must bear in mind that children might not want to object to their parents or to the researchers. The parents were asked to fill in a questionnaire about their child’s language and overall development, which might offend the parents when sharing personal information. The sessions with the PhonicStick were being video recorded. This might cause inconvenience for the child and the parents, because of the fact that there will be information stored that cannot be easily unidentified. Personal information, questionnaires and video recordings have been collected and stored in a locked closet at the department of Neuroscience, speech and language pathology, Uppsala University. The participating children were given individual code numbers and no names or dates of birth could be identified. The results were analysed and presented on a group level.
7. Results

7.1. Questionnaire

The answers from the questionnaire were put together and deviant results according to the section Assessments (see above) have been shown in Table 1.

Table 1. Children 5 and 6 years old. Deviant results from the questionnaire. Number of total answers (T), mns = months

<table>
<thead>
<tr>
<th>Deviant results according to the questionnaire</th>
<th>Deviant results</th>
<th>Test group</th>
<th>Control group</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babbling</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>41</td>
</tr>
<tr>
<td>First word</td>
<td>&gt; 20 mns</td>
<td>1</td>
<td>3</td>
<td>37</td>
</tr>
<tr>
<td>Language development</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>41</td>
</tr>
<tr>
<td>Heredity, delayed language development</td>
<td>yes</td>
<td>3</td>
<td>3</td>
<td>41</td>
</tr>
<tr>
<td>Heredity, delayed literacy development</td>
<td>yes</td>
<td>4</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>Fine motor abilities</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Gross motor abilities</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Crawling</td>
<td>&gt; 12 mns</td>
<td>0</td>
<td>2</td>
<td>35</td>
</tr>
<tr>
<td>Walking</td>
<td>&gt; 18 mns</td>
<td>0</td>
<td>1</td>
<td>39</td>
</tr>
<tr>
<td>Hearing</td>
<td>≤ 2</td>
<td>1</td>
<td>1</td>
<td>40</td>
</tr>
</tbody>
</table>

According to the parents’ answers about their child’s language and overall development there were two children who did not babble as infants, one in the test group and one in the control group. One of the children in the test group and three of the children in the control group said their first spoken word after 20 months. Two children in the control group were estimated to have a slow language development, compared to none in the test group. The question about heredity within delayed language development generated in reported heredity for three children in the test group and three children in the control group. The question about heredity within delayed literacy development generated in reported heredity for four children in the test group whereas the same result was reported for three children in the control group. The question about the child’s hearing was answered with impaired hearing or impaired hearing to some extent for one child in the test group and one child in the control group.

Apart from the questions presented above, the parents answered questions about first languages, years in pre-school and right-/left-handedness. There were three children in the test group and four children in the control group who did not have Swedish as their first language or had two first languages, one of which was Swedish. The questionnaire also included a question about the parents’ first language. Five parents in each group had other first languages than Swedish or had two first languages, one of which was Swedish. Two children, one in each group, had attended pre-school less than two years. There were 16 right-handed children in the test group and 18 in the control group, whereas one child in the test group and two children in the control group were left-handed. One child in the test group was reported to use both hands.
7.2. Pre- and post-test of parts of the phonological awareness

**Phoneme identification.** In the test of Phoneme identification the maximum possible correct answers were 24. The mean number of correct answers for the test group on the pre-test was 22.05 (SD 2.62) and on the post-test 22.52 (SD 2.25). The mean number of correct answers for the control group on the pre-test and the post-test was 21.25 (SD 2.92) and 21.65 (SD 3.41) respectively. A positive change in mean numbers of correct answers in both test group and control group was received, although the change increase was not significant in neither test or control group, calculated with a paired samples t-test. The mean number of correct answers for 6 year-old children, according to the reference data calculated on the basis of 37 normal language developed children, is 18.8 correct answers. As can be seen above and in Table 2, the mean number of correct answers for the test group and the control group in both pre-test and post-test was higher than in the reference data.

*Table 2.* Children 5 and 6 years old. Results from the test Phoneme identification. Number of participating children (n), mean (M), standard deviation (SD), significance (p) and effect size d.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>p</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phoneme identification</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pre-test</td>
<td>Post-test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test group</td>
<td>21</td>
<td>21</td>
<td>22.05 (2.62)</td>
<td>22.52 (2.25)</td>
<td>ns</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>20</td>
<td>20</td>
<td>21.25 (2.92)</td>
<td>21.65 (3.41)</td>
<td>ns</td>
<td>0.13</td>
<td></td>
</tr>
</tbody>
</table>

The difference between pre- and post-test in the test group was .48 correct answers (SD 1.69). The difference between pre- and post-test in the control group was .40 correct answers (SD 2.09). A two-sample t-test calculating the differences of the results in pre- and post-tests regarding the test group and the control group showed an increase of the results in the test group compared to the control group with .08 correct answers, t(39) = .13. The difference between the two groups was not significant (p > .05), see Table 6.

**Phoneme segmentation.** This test had a possible maximum of 18 correct answers. Data from the test group show a mean number of 11.10 (SD 5.60) correct answers in the pre-test and 12.43 (SD 4.74) in the post-test. The mean number for the control group was 9.70 (SD 5.72) in the pre-test and 11.70 (SD 5.40) in the post-test. According to the reference data calculated on the basis of 37 normal language developed children, the mean number for 6 year-old children is 8.6 correct answers. The mean numbers of correct answers for both groups in the present study in both pre-test and post-test are higher than the results in the reference data, as can be seen above and in Table 3. A paired samples t-test was used to evaluate the difference between the means of the correct answers in the pre-test and in the post-test. The control group showed a significant increase between the pre-test and the post-test. The difference in the test group was also positive, but showed no significant increase.

*Table 3.* Children 5 and 6 years old. Results from the test Phoneme segmentation. Number of participating children (n), mean (M), standard deviation (SD), significance (p) and effect size d.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>p</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phoneme segmentation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pre-test</td>
<td>Post-test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test group</td>
<td>21</td>
<td>21</td>
<td>11.10 (5.60)</td>
<td>12.43 (4.74)</td>
<td>ns</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>20</td>
<td>20</td>
<td>9.70 (5.72)</td>
<td>11.70 (5.40)</td>
<td>$P &lt; .05$</td>
<td>0.36</td>
<td></td>
</tr>
</tbody>
</table>
The difference between pre- and post-test in the test group was 1.33 correct answers \((SD \, 3.45)\). The difference between pre- and post-test in the control group was 2.00 correct answers \((SD \, 3.13)\). A two-sample t-test comparing the test and the control group regarding the differences between pre- and post-test showed a real group difference of .67 correct answers, \(t(39) = .65\), of benefit to the control group. These results were not significant \((p > .05)\), see Table 6.

**Separate sounds.** The maximum of possible correct answers in this test was 16, divided into 8 words and 8 non-words. The mean number of correct answers for the test group was 15.00 \((SD \, 1.76)\) in the pre-test and 14.90 \((SD \, 2.41)\) in the post-test. The mean number of correct answers for the control group on the pre-test and the post-test was 14.75 \((SD \, 2.10)\) and 14.95 \((SD \, 2.20)\), respectively. The data from the pre- and post-test for the test and the control group are shown in Table 4.

**Summary of the tests of phonological awareness.** The comparison between the test group and the control group regarding the difference between pre-test and post-test showed no significant results \((p > .05)\). Only small differences could be seen, in the test Phoneme identification the increase was higher in the test group than in the control group (Mean

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**Table 4.** Children 5 and 6 years old. Results from the test Separate sounds. Number of participating children \((n)\), mean \((M)\), standard deviation \((SD)\), significance \((p)\) and effect size \(d\).

<table>
<thead>
<tr>
<th>Separate sounds, in total</th>
<th>(n)</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>(p) (\text{(2-tailed)})</th>
<th>Effect size (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test group</td>
<td>21</td>
<td>21</td>
<td>15.00 (1.76)</td>
<td>14.90 (2.41)</td>
<td>ns</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>20</td>
<td>20</td>
<td>14.75 (2.10)</td>
<td>14.95 (2.20)</td>
<td>ns</td>
<td>0.09</td>
<td></td>
</tr>
</tbody>
</table>

According to a paired samples t-test, the difference between pre- and post-test in the test group was -0.10 correct answers \((SD \, 2.74)\). The difference between pre- and post-test in the control group was 0.20 correct answers \((SD \, 1.11)\). In other words, the difference in the test group was negative and the difference in the control group on the other hand, was positive. The change was nevertheless not significant in neither test or control group. A two-sample t-test showed a real difference between test and control group on .30 correct answers, \(t(39) = 0.45\), of benefit for the control group. The result was not significant \((p > .05)\), see Table 6.

According to the reference data for monolingual pre-school class children, the mean values were 7.53 for the part with words \((SD \, 1.28)\) and 6.98 for the part with non-words \((SD \, 1.61)\). The data from the study is shown in Table 5, showing words and non-words separate. In both pre-test and post-test, the results showed a higher mean value of correct answers, regarding both test group and control group.

**Table 5.** Children 5 and 6 years old. Results from the test Separate sounds, divided into words and non-words. Number of participating children \((n)\), mean \((M)\), standard deviation \((SD)\).

<table>
<thead>
<tr>
<th>Separate sounds, words and non-words separate</th>
<th>(n)</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test group</td>
<td>21</td>
<td>21</td>
<td>7.71 (.90)</td>
<td>7.67 (1.11)</td>
<td>7.29 (1.01)</td>
<td>7.24 (1.38)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>20</td>
<td>20</td>
<td>7.55 (1.00)</td>
<td>7.60 (1.00)</td>
<td>7.25 (1.21)</td>
<td>7.35 (1.31)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Summary of the tests of phonological awareness.**
difference .08). In the test Phoneme segmentation the increase was higher in the control group than in the test group (Mean difference .67). In the test Separate sounds, the control group showed a positive change whereas the test group showed a negative change. The difference between the two groups were therefore of benefit for the control group (Mean difference .30).

The data is shown in Table 6.

Table 6. Children 5 and 6 years old. Comparison between test group and control group regarding the results from the three phonological tests in the pre-test and in the post-test. t-value (t), degrees of freedom (df) within parenthesis, significance (p) and effect size d.

<table>
<thead>
<tr>
<th>Test/Task</th>
<th>t (39)</th>
<th>Mean difference</th>
<th>p (2-tailed)</th>
<th>Effect size d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phoneme identification</td>
<td>.13</td>
<td>.08</td>
<td>ns</td>
<td>0.04</td>
</tr>
<tr>
<td>Phoneme segmentation</td>
<td>.65</td>
<td>.67</td>
<td>ns</td>
<td>0.20</td>
</tr>
<tr>
<td>Separate sounds</td>
<td>.45</td>
<td>.30</td>
<td>ns</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Due to the low effect size for all three tests, the results cannot be assumed to prove significant with a higher amount of participating children, as could have been the case if the effect size had been higher.

7.3. Literacy tasks

The assessment of the reading and writing tasks were made from a division into a three-point scale, were 0 was the lowest and 2 the highest. The results from the writing tasks are presented in frequencies of the three-point scale, divided in test group and control group, see Table 7. The same results from the reading tasks are presented in Table 8. The results show a higher level of children classified with 1 and 2 points on the writing tasks in the pre-test for the test group (76.2 %) than for the control group (55.0 %). The same relation applies on the post-test where 76.2 % of the test group and 60.0 % of the control group were classified with 1 and 2 points. These results indicate an increase in the control group within 1 and 2 points and a decrease within 0 points between pre- and post-test. The results in the test group did not change regarding 0 points between pre- and post-test. Only small differences within 1 and 2 points appeared within the test group.

Table 7. Children 5 and 6 years old. Results from the writing tasks in the pre- and post-test sessions for test group and control group, expressed in percent (%). 0 points = Needs much help, writings unreadable, 1 point = Needs help or does some errors, 2 points = Writes almost correctly, phonetic spelling ok. Number of participating children (n).

<table>
<thead>
<tr>
<th>Writing tasks</th>
<th>Test group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>0</td>
</tr>
<tr>
<td>Writing pre-test</td>
<td>21</td>
<td>23.8</td>
</tr>
<tr>
<td>Writing post-test</td>
<td>21</td>
<td>23.8</td>
</tr>
</tbody>
</table>

The results from the reading tasks also show a higher level of children classified with 1 and 2 in the pre-test for the test group (76.2 %) than for the control group (50.0 %). Even on the post-test the relation applies, where 61.9 % of the test group and 45.0 % of the control group were classified with 1 and 2 points. These findings indicate a decrease between pre- and post-test in both test group and control group within 1 and 2 points. In both test group and control
group the frequency of children classified with 0 points increased between the pre- and the post-test, see Table 8.

Table 8. Children 5 and 6 years old. Results from the reading tasks in the pre- and post-test sessions for test group and control group, expressed in percent (%). 0 points = Unsure of the letters, does not sound together, 1 point = Needs help with some sounding, 2 points = Reads almost correctly, phonetic reading ok. Number of participating children (n).

<table>
<thead>
<tr>
<th>Reading tasks</th>
<th>Test group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n 0 1 2</td>
<td>n 0 1 2</td>
</tr>
<tr>
<td>Reading pre-test</td>
<td>21 23.8 38.1 38.1</td>
<td>20 50.0 15.0 35.0</td>
</tr>
<tr>
<td>Reading post-test</td>
<td>21 38.1 19.0 42.9</td>
<td>20 55.0 10.0 35.0</td>
</tr>
</tbody>
</table>

7.4. Results of the testing with the PhonicStick

Test 1. Position of phonics. The maximum number of phonics possible to produce in this test was 12. The median number of correct phonics produced in session 1 was 9.50 (min. 1, max. 12) and the median number in session 3 was 11.00 (min. 2, max. 12). According to a Related-Samples Wilcoxon Signed Ranks Test, the increase of the result from session 1 to session 3 was significant ($p < .05$). See Table 9.

Test 2a. Production of spontaneous words. In this test, there was no maximum number of possible words that could be produced, but the time limit was 2 minutes. The median number of words produced during 2 minutes in session 1 was 1.00 (min. 0, max. 2) and the median number in session 3 was also 1.00 (min. 0, max. 5). According to a Related-Samples Wilcoxon Signed Ranks Test, the increase of the result from session 1 to session 3 was significant ($p < .05$). See Table 9.

Test 2b. Production of picture-based words. The maximum number of words possible to produce during the 2 minutes limit in this test was 6, because of the six pictures on the chart. The median number of words produced during 2 minutes in session 1 was 2.50 and (min. 0, max. 6) and in session 3 the median number was 4.00 (min. 0, max. 6). According to a Related-Samples Wilcoxon Signed Ranks Test, the increase of the result from session 1 to session 3 was significant ($p < .01$). See Table 9.

To analyse the impact of the use of pictures in Test 2b in relation to spontaneous produced words in Test 2a, a significance test was carried out using the Related-Samples Wilcoxon Signed Ranks Test. The test showed significant results ($p < 0.001$) when comparing the two tests, both in session 1 and session 3.

Test 3. Dictation of words and non-words. The maximum number of words and non-words possible to produce in this test was 10. The median number of words and non-words produced in session 1 was 6.00 (min. 0, max. 10) and the median number in session 3 was 9.00 (min. 0, max. 10). According to a Related-Samples Wilcoxon Signed Ranks Test, the increase of the result from session 1 to session 3 was significant ($p < .01$). See Table 9.

Test 4. Identification of sounds. The maximum number of initial, medial and final phonics possible to produce in this test was 9. The median number of correct produced phonics in session 1 was 7.00 (min. 1, max. 9) and the median number in session 3 was 8.00 (min. 2,
According to a Related-Samples Wilcoxon Signed Ranks Test, the increase of the result from session 1 to session 3 was not significant ($p > .05$). See Table 9.

**Summary of the PhonicStick tests.** In table 9, the results from the different tests with the PhonicStick are gathered to get an overall view of the findings from the tests.

**Table 9.** Children 5 and 6 years old. Descriptive statistics for five tests with the PhonicStick; Test 1. Position of phonics, Test 2a. Production of spontaneous words, Test 2b. Production of picture-based words, Test 3. Dictation of words and non-words, Test 4. Identification of sounds. Number of participating children ($n$), maximum ($max$), minimum ($min$), median and significance ($p$).

<table>
<thead>
<tr>
<th>Descriptive statistics for tests with the PhonicStick</th>
<th>$n$</th>
<th>$min$</th>
<th>$max$</th>
<th>$median$</th>
<th>$p$ (two-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>min</td>
<td>max</td>
<td>median</td>
<td>$p$</td>
</tr>
<tr>
<td>Test 1</td>
<td>21</td>
<td>1</td>
<td>2</td>
<td>9.50</td>
<td>&lt; .05</td>
</tr>
<tr>
<td>Test 2a</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>1.00</td>
<td>&lt; .05</td>
</tr>
<tr>
<td>Test 2b</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>2.50</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>Test 3</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>6.00</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>Test 4</td>
<td>21</td>
<td>1</td>
<td>2</td>
<td>7.00</td>
<td>ns</td>
</tr>
</tbody>
</table>

The differences between session 1 and session 3 are significant in the first four tests, but not in the last test.

The medians of the five tests performed with the PhonicStick have been illustrated in Figure 4 below, where the results in session 1 and session 3 are being showed in pairs of tests.

**Figure 4.** Children 5 and 6 years old. Showing the test results for session 1 and session 3. Results from session 1 in black and results from session 3 in light grey.
8. Discussion

The aim of the present study was to evaluate the use of the PhonicStick and its possible impact on phonological awareness. The study shows that 5 and 6 year-old children could learn to use the PhonicStick by learning the phonic positions and by producing words. The children could also learn to produce words with the PhonicStick consisting of 2 or 3 phonics; spontaneously, with support from pictures and after dictation. The results show that no visual information is necessary for the user to learn the phonic positions. No improvements of tests of phonological awareness were received. In this chapter the results will be discussed in relation to the aims, chosen method and earlier and future research.

8.1. Questionnaire

Although there were no exclusion criteria, or maybe due to the absence of exclusion criteria, the questionnaire was created to get information about the participating children. The results from the questionnaire show some variation among the children. The questionnaire included a question about the child’s hearing. Because of the sound input in the study it was important to know about the child’s hearing so that the results could be evaluated in relation to this information. The two children who, according to their parents, had impaired hearing or impaired hearing to some extent have results on their pre- and post-tests, which are all in the same variation as for the other children. Therefore, one can assume that their results have not been affected by their possible hearing impairment.

8.2. Phonological awareness

Results compared to aim and key questions. One key question in this study was if the PhonicStick would result in improvements of the phonological awareness among the children in the test group compared with the children in the control group. One possible explanation why the PhonicStick exercises and training did not significantly improve the phonological awareness among the children in the test group might have been the limited number of sessions. If the sessions had been taken place closer to each other, and if there had been more of them, the training with the PhonicStick might have affected and improved the phonological awareness in some way.

Another explanation of the non-significant results could be the level of the test results in the pre-test. Already at this point, the mean values of the results were higher than the reference data for children in the age of the present study. Because of a mean value higher than the average, the possibility to improve the results between pre- and post-test might be limited. A reason could be that the children already in the pre-test have reached such high levels of phonological awareness according to the age that an even higher result would be difficult to achieve during such short time.

A third possible explanation to the results of the phonological awareness could be that the PhonicStick might not have trained the parts of the phonological awareness tested in the pre- and post-tests. The non-significant results along with low effect size in the comparisons between pre- and post-tests mean that no assumptions can be made that a higher number of participating children would show significant results. The tests of phonological awareness used in this study was chosen in the belief that the use of the PhonicStick would improve these parts, but no evidence support these choices. The PhonicStick may train parts of the phonological awareness, but not necessary the parts that were being tested in the pre- and
post-tests. Another explanation could be that the PhonicStick may not train any parts of the phonological awareness whatsoever.

The results of the testing of the phonological awareness could probably be generalised to apply on all 5 and 6 year-old Swedish children if they had achieved the same amount of training with the PhonicStick. No significant results were reached in the study and the effect size was low in all three tests, which means that it might be hard to achieve improvement in the parts of the phonological awareness tested, at least within the time limit of this study.

**Results compared to current research.** In a study performed by Arnqvist (2003) the preschool classes participating were conducting the teaching in different ways with different amount of systematic training. The study showed that methods used for literacy teaching differ between classes but, however, the conclusion of the study was that in all classes, playing with the language existed in some way. This increased the level of language structure and comprehension, which in its turn prepared the children for the literacy learning in school. Since the results from the present study are not significant, they do not support the findings from the Arnqvist study. However, using the PhonicStick can be considered as a form of language play and as assumed before, perhaps a longer training period would enhance the awareness of language structure. The fact that the mean values of the tests in the present study were above the reference average might be related to unsatisfactory individual education. Hence, if the level of phonological awareness is higher than average then the child might need more stimulation and help to enhance the already high level (Arnqvist, 2003). This implies that the tests and the plays used in the present study might have been too easy in order to affect the phonological awareness.

### 8.3. Literacy abilities

The results of the literacy tasks showed a large variation in literacy capacities among the participating children. When evaluating the results from the writing tasks in the pre- and post-test, there was a minor decrease of children who got 0 points within the control group but there was no difference in the test group. In the control group, many children who got 2 points in the pre-test got 1 point in the post-test. These results can be assumed to depend on a more difficult word structure in the post-test compared to the pre-test. Only small variations could be seen in the test group regarding the writing tasks. The results from the reading tasks in the pre- and post-test showed a slight decrease in both test group and control group when evaluating the amount of children who got 1 or 2 points. It can therefore be assumed that the structure of words in the post-test was more difficult than in the pre-test. Since the time interval between the pre- and the post-test was relatively short in this study, there is no reason to believe that the children should have made great progress in their literacy development. The importance of these reading and writing tasks in relation to this study can therefore be discussed.

### 8.4. The PhonicStick

**Results compared to aim and key questions.** In the background section, devices used for communication were discussed. According to Light & Drager (2007), AAC users with physical or visual impairments sometimes find it difficult to navigate through systems consisting of multiple pages and screens and to use devices that demand visual ability. One of the key questions in this study was whether the children could remember the different positions of the phonics without any visual information. When evaluating the results of the
PhonicStick Test 1 (Position of phonics) it can be seen that the children could learn the positions of the different phonics without any visual information, and make significant improvements between session 1 and session 3. Even though the devices discussed in Light & Drager (2007) are meant for users with physical or visual impairments, it could be useful to see if normally developing children are able to use devices without visual demands. This study shows that they can, and knowledge of typically developed user abilities could be of importance when evaluating devices for impaired users. As can be seen, the PhonicStick device does not require visual information for the user to learn the phonic positions. The choice of having movements to learn the phonic positions and pictures to illustrate words in this study is because the children were assumed not to have any impairments that could complicate the use of pictures. Furthermore, normally developing children are thought to be helped when using a multi-sensory way of teaching (Lloyd, 1998).

Another key question in this study was if the children could produce words with the PhonicStick by combining phonics. In Test 2a (Production of spontaneous words), the children did not get any help from pictures when asked to produce real words. The researchers noticed that many children found it hard to produce words on their own. Some of the children produced phonics randomly without a target word, whereas others could neither produce random phonics nor come up with target words. They seemed to get stuck on word mobilisation, which held back the production of words. However, they still showed a significant improvement in the test from session 1 to session 3. In Test 2b (Production of picture-based words) they were shown a picture chart with six pictures of words that could be produced with the PhonicStick. The pictures were introduced to let the child focus on producing words instead of focusing on word mobilisation. Just as in Test 2a, the results from Test 2b showed significant progress from session 1 to session 3. A comparison between Test 2a and Test 2b in both session 1 and session 3 shows that there was a significant improvement of the number of words produced when showing a picture chart. The results indicate that the picture chart facilitates the children’s ability to produce real words with the PhonicStick. Test 3 (Dictation of words and non-words) was also designed to evaluate the question if the children could combine phonics into words with the PhonicStick, and the test included both real words and non-words that were given to the children orally. The results agreed with the results from Test 2a and Test 2b and showed a significant improvement between the two sessions. What is common for these three tests is that they require the ability to remember the positions of the different phonics and the capability to blend them together into words. It can therefore be assumed that the children in this study can combine phonics into words with the PhonicStick after only three sessions. The significant results from the first four tests with the PhonicStick indicate that the children in this study after three sessions are capable to use the PhonicStick in terms of remembering the different phonemes and using them for producing words. The results have been analysed with non-parametrical methods and a power analysis has therefore not been performed although the results from the testing with the PhonicStick show high significance even with only 21 children in the test group. However, the two schools, which the children attended were quite similar and were placed in areas In Uppsala with similar socio-economic background. If the study would have been performed with children from another part of Uppsala or children from other parts of Sweden, the results may have been different. The results from the present study may therefore not be generalised to apply to all Swedish 5 and 6 year-old children.

Test 4 (Identification of sounds) showed no significant difference between session 1 and session 3. This test measures the ability to segment words into phonemes, which concerns the same parts of phonological awareness as the tests Phoneme segmentation and Separate
sounds in the pre- and post-test section. As indicated by the tests of the phonological awareness, the results of Test 4 might imply that the sessions were too few to obtain any significant results.

Method discussion. During the three sessions with the PhonicStick, different games were played with the children to facilitate their handling of the PhonicStick and their learning of the phonic positions. A total of three games were used, including connecting a movement to each phonic, making real words on the basis of a picture chart and producing the first, the last or both the first and the last sound of a word given to the child orally. The results of the PhonicStick tests showing significant improvements in the children’s handling of the PhonicStick, can be supposed to depend on the games mentioned above. According to Jolly Phonics (Lloyd, 1998), a multi-sensory approach supports children’s learning process, which motivates the games in this study consisting of, for example, learning a movement to each phonic. The difference between the three games during the sessions also ensured a variety of activities to avoid the children loosing their interest, motivation and concentration.

In the beginning of the study, a bug was detected in the PhonicStick software for the Swedish version. This bug forced the child to press the clear button after completing a three phonic word. Otherwise the new word, after pressing the speak button, would be said with the first phonic missing. The consequence of the bug did not cause much trouble, because the clear button was already supposed to be introduced as a tool when regretting the production of a phonic or a word or after producing a word consisting of two phonics. The bug even made it more obvious; before starting to produce a new word, the clear button should always be pressed.

During the course of the study the researchers met with one half of the total number of participating children each. Even though the same game and test instructions and the same test form were used for every child, adjustments to each child had to be done dependent on each child’s needs. This might have lead to limitations in the given instructions or judgements of the test results.

During the PhonicStick sessions, and to some extent during the pre- and post-test of the phonological awareness, the researchers made notes about children’s concentration, patience and motivation if necessary. In spite of the variety of games and exercises, some of the children showed a lack of patience and motivation during the sessions and some of the children had difficulties in focusing and concentrating on the games and exercises. The results of these observations might have affected the test results, both regarding the tests of parts of the phonological awareness and the PhonicStick tests. There were children who interrupted some of the tests and children who lost the target tasks because of lack of motivation and concentration.

An external factor that might have affected the results is that all sessions were carried out in the two schools and the premises used depended on availability for the moment. This means that the sessions sometimes took place in an office with many possible distractions or in a room, through which other pupils had to pass during the session. This might have affected the focus and concentration and in turn the test results.

Even though some children found it difficult to keep motivated and focused during the PhonicStick sessions, most of the children seemed to find the games and exercises fun and exciting. Since this was the case for most of the children, it can be assumed that the length and the contents of the sessions were of good balance.
Results compared to current research. According to Blackstone et al (2007) it is of great importance for AAC users to be able to control their own communication. Paper based AAC strategies based on for example symbols can sometimes limit the spontaneity of the conversation (Gonzales et al., 2009), and electronic devices are often programmed with pre-recorded messages which can also limit the variety of communication (Blackstone et al., 2007). As for now, the PhonicStick can only produce words with two or three phonics, but the long-term purpose is to investigate the use of the PhonicStick as a communication device (R. Black, personal communication, 2009). The PhonicStick enables the user to express words, which are not pre-recorded. This function facilitates the chance for users to have control over their own communication and it increases the spontaneity and variation in communication and dialogues. The researchers noticed that most of the children in this study found it very satisfying when they managed to produce real words with the PhonicStick.

8.5. Suggestions for future research

Because of the time limitations of the present study, the training period and the amount of sessions had to be limited. A future study with more training sessions, in a more intense and/or longer training period would be desirable. In that way, the possible impact of training on parts of the phonological awareness could be evaluated in a more longitudinal study, which in turn could have impact on the literacy learning. When the software for the PhonicStick has been developed to include more phonics, it would be necessary to perform more research to evaluate user-friendliness and the capability to use the PhonicStick with more phonics. Another area, which has not been discussed here, is the use of the PhonicStick for people with aphasia who have problems expressing themselves verbally. This might be another field for research in the future.

8.6. Summary of conclusions

The present study evaluated the use of the PhonicStick by children aged 5 and 6 years old and its possible affect on phonological awareness. A test group and a control group with 21 respectively 20 children were used in the study. No improvements in phonological awareness could be seen in the test group in relation to the control group when comparing pre- and post-test. The use of the PhonicStick can therefore not be considered affecting the parts of the phonological awareness tested in this study. This is discussed as being due to the limited time between the pre- and the post-test, consequently too few sessions during a too short time of training with the PhonicStick. Another reason discussed could be that the PhonicStick does not train the tested parts of phonological awareness.

Three sessions with the PhonicStick were conducted between the pre- and the post-test. Session 1 and session 3 included five tests to evaluate the improvement in the use of the PhonicStick between these sessions. Significant improvements in four of the five tests showed that the children in the test group learned to handle the PhonicStick after a short time of use. After only three sessions, the children had improved their ability to remember the phonic positions without any visual information. They had also, after the same number of sessions, improved their capability to produce words with two and three phonics spontaneously, with picture support and by dictation. This shows that the PhonicStick is user-friendly for typically developed children, which could be of importance when evaluating devices for impaired users.
9. Acknowledgement

Thanks to:

All children participating in this study, and the parents given their informed consent.

The principals’ and teachers’ exceptional cooperation, which made it possible to implement this study.

Margareta Jennische for invaluably guidance, support and enthusiasm.

Rolf Black and Annalu Waller for helpful advice and comments, and for great hospitableness in Dundee.

Per Alm for statistical support.

Lovisa Liyanage for correcting us when our language knowledge was insufficient.
10. References


**Other resources**

Appendix

1. Information letter to principals and teachers
2. Information letter to parents
3. Questionnaire
4. Literacy tasks, pre- and post-test
5. Real words possible to produce with the Swedish PhonicStick
6. Picture chart 1
7. Picture chart 2
8. Picture chart 3
9. Words used in Game 3 with the PhonicStick
10. Test protocols, session 1 and session 3 with the PhonicStick
Till rektor

I ett projekt vid Uppsala universitet skall under hösten 2009 en ny metod prövas som har som mål att stimulera fonologisk medvetenhet hos barn i förskoleklass.


The PhonicStick är programmerad med svenska ljud, och vi har som avsikt att låta barn pröva den. Vi vill göra det med hjälp av barn som ännu inte kommit så långt i läs- och skrivutvecklingen och därför har vi valt att söka barn i förskoleklass. Vi behöver träffa cirka 30 barn. Hälften av dem vill vi träffa vid två tillfällen, varje tillfälle tar ca 30 min. Den andra hälften vill vi träffa vid 5 tillfällen, även dessa tillfällen tar ca 30 min var. Den första gruppen är en kontrollgrupp som kommer få genomgå test av fonologisk medvetenhet, till exempel rim-igenkänning och förmågan att urskilja språkljud och stavelser i ord. Även den andra gruppen kommer att få göra samma typer av test, men de kommer även att få använda the PhonicStick tillsammans med oss vid tre tillfällen.

Innan vi träffar barnen kommer deras föräldrar att få ett informationsbrev samt fylla i ett godkännande om att deras barn medverkar i studien.

Studien utgör examensarbete på Logopedprogrammet vid Uppsala universitet. Handledare är Margareta Jennische, universitetslektor, Uppsala universitet och Annalu Waller, universitetslektor, University of Dundee

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Ett steg i barns språkutveckling är att bli medveten om de olika språkljuden och deras betydelse för ordens uppbyggnad och innebörd, vilket kallas fonologisk medvetenhet. Denna förmåga är även en viktig del vid läs- och skrivinvändning.

The PhonicStick
I det här projektet kommer vi att använda en joystick, kallad the PhonicStick, som är utvecklad vid University of Dundee i Skottland. The PhonicStick är programmerad till att göra ljud som sedan kan blandas ihop till existerande och icke-existerande svenska ord. Projektet syftar till att se om the PhonicStick kan användas för att främja utvecklingen av den fonologiska medvetenheten hos barn i 5-6-årsåldern.

Vad innebär deltagande?
Deltagandet är förstås helt frivilligt, och deltagare kan avbryta sin medverkan när som helst utan att skäl behöver anges.

Om Du tackar ja till deltagande kommer Du att som målsman få fylla i ett frågeformulär där Du svarar på frågor om Ditt barns språkutveckling.


Deltagare
Vi söker barn mellan 5 och 6 år.

Personuppgifter
Alla uppgifter och videoinspelningar kommer att hanteras konfidentiellt. Personuppgiftsansvarig är Margareta Jennische, Institutionen för neurovetenskap, Enheten för logopedi, Uppsala universitet.

Intresseanmälan
Om Du ger Ditt samtycke till Ditt barns deltagande i studien är vi tacksamma om Du vill lämna svarsblanketten till Ditt barns lärare senast onsdagen den 30 september. Vid eventuella frågor om projektet är Du välkommen att kontakta oss via nedanstående kontaktuppgifter.

Det här projektet genomförs under hösten 2009 som ett examensarbete på logopedutbildningen vid Institutionen för neurovetenskap, Enheten för logopedi, Uppsala universitet. Handledare för projektet är Margareta Jennische, logoped och Dr.med.vet. margareta.jennische@neuro.uu.se

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**Deltagande i studie**

**Samtycke till Mitt barns deltagande i studien om barns språkutveckling**

Jag har tagit del av informationen i informationsbrevet. Jag är medveten om att deltagandet i studien är helt frivilligt och att jag eller Mitt barn när som helst kan avbryta deltagandet utan att ange skäl.

Datum: ______________________

Underskrift: __________________________________________

Namnförtydligande: ___________________________________

Barnets namn: ________________________________________

Barnets födelsedatum: __________________________________

**Kontaktuppgifter**

Telefonnummer: ________________________________

Emailadress: ________________________________

Vi föredrar att bli kontaktade via □ Email □ telefon
Frågeformulär vid deltagande i studie om fonologisk medvetenhet

För att få mer underlag för denna studie är vi tacksamma om Du som förälder vill fylla i följande frågor angående ditt barns språkliga och allmänna utveckling.

Barnets namn: __________________________________________

Barnets ålder: År: ______ Månad: ______________

Språklig utveckling

Hur mycket jollrade Ditt barn?

☐ Inte alls  ☐ Lite  ☐ Medel  ☐ Mycket

Vid vilken ålder sa barnet sina första ord? _______________________________________

Hur upplevde Du Ditt barns språkutveckling?

<table>
<thead>
<tr>
<th>Långsam</th>
<th>2</th>
<th>Normal</th>
<th>4</th>
<th>Snabb</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td></td>
<td>☐</td>
<td></td>
<td>☐</td>
</tr>
</tbody>
</table>

Plats för ev. kommentar:_______________________________________________________

Har någon i familjen eller nära släkt haft försenad språkutveckling? Ange släktförhållande. __________________________________________________________

Har någon i familjen eller nära släkt läs- och skrivsvårigheter? Ange släktförhållande. __________________________________________________________

Vilket är Ditt barns förstaspråk? __________________________________________

Hur många år har Ditt barn gått i svensk förskola? __________________________

Vilket förstaspråk har Ni som föräldrar? ___________________________________
Allmän utveckling

Hur upplever Du Ditt barns finmotorik (t.ex. hålla penna, klippa, hantera små saker)?

<table>
<thead>
<tr>
<th>Mindre bra</th>
<th>1</th>
<th>2</th>
<th>Bra</th>
<th>3</th>
<th>4</th>
<th>Mycket bra</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Är Ditt barn höger- eller vänsterhänt? ____________________________________________

Hur upplever Du Ditt barns grovmotorik (t.ex. gå, springa, hoppa)?

<table>
<thead>
<tr>
<th>Mindre bra</th>
<th>1</th>
<th>2</th>
<th>Bra</th>
<th>3</th>
<th>4</th>
<th>Mycket bra</th>
<th>5</th>
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</table>

Vid vilken ålder började Ditt barn krypa? __________________________________________

Vid vilken ålder började Ditt barn gå? ____________________________________________

Hur upplever Du Ditt barns hörsel?

☐ Mycket nedsatt ☐ Nedsatt ☐ Normal

Har Ditt barns hörsel blivit testad? I så fall, ange datum och resultat.

___________________________________________________________________________

Ifyllt av: (samt relation till barnet) ____________________________________________

Uppsala den _____/______ 2009
Appendix 4: Literacy tasks, pre- and post-test

**Literacy tasks**

**Pre-test**

*Ask the child to write:*

- His/her name
- Elin
- Emma
- sko
- häst
- tomat
- golv

*Write in capital letters and ask the child to read:*

- fisk
- håret
- stol
- pinne
- mäta

**Post-test**

*Ask the child to write:*

- bror
- vinter
- moln
- snögubbe

*Write in capital letters and ask the child to read:*

- glas
- penna
- svart
- jacka
- kakorna
Real words possible to produce with the Swedish PhonicStick

**Words consisting of three phonics**

Tom
tack
tall
kock
kom
koll
katt
kam
kall
matt
moll
matt
mack
mall
lott
lock
lack
lamm
olla
akt
amma
alla
alt
alm

**Words consisting of two phonics**

och
om
att
ack
all
Appendix 6: Picture chart 1

(not possible to produce because of too many sounds)
äpple
(not possible to produce because of sounds not available on the PhonicStick)

macka
(not possible to produce because of too many sounds)

tack

matt

allt

kall
Appendix 9: Words used in Game 3 with the PhonicStick

Kudde  lurA
Måne  kraM
Orka  vattenfaL
AlM (alm)
OmA
### List A

Child nr: 

Session nr:  

Date: 

Other observations:

### Test 1

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<th>Incorrect</th>
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### Test 2a

Real words produced in 2 minutes

### Test 2b

Real words produced in maximum 2 minutes with support from pictures. Picture chart 3.

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<td>kam</td>
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Dra streck efter 2 min  

Total time
## List A

### Test 3

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### List B

#### Session nr:  
Date:  

Other observations: 

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#### Test 2a

Real words produced in 2 minutes

#### Test 2b

Real words produced in maximum 2 minutes with support from pictures. Picture shart 3.

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Dra streck efter 2 min  

Total time
Appendix 10: Test protocols, session 1 and session 3 with the PhonicStick

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Test 3

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