The PhonicStick

-A South African pilot study about learning how to use a communication device for early literacy training

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Abstract

Literacy is an important part of communication. Phonological awareness, i.e. the ability to recognise the sound units of language and to manipulate them, has been found to be crucial in literacy acquisition.

In 2005 the development of a communication device, a talking joystick called the PhonicStick, started at The School of Computing at the University of Dundee in Scotland. The main focus with the project was to help children with physical disabilities to create spoken words by blending sounds together on the PhonicStick. It was also hypothesized that the PhonicStick could act as a support to literacy learning with typically developing children.

The aim of the present study was to investigate if a group of 10 typically developing South African 5-6 year old children could learn how to use the PhonicStick in three sessions and to see if their phonological awareness improved by using it. The training with the PhonicStick took place over a period of three weeks. The participants’ phonological awareness was screened before and after the sessions with two sub-tests of The Phonological Awareness Test (PHAT). In addition, their ability to produce sounds and words with the PhonicStick was tested.

The results showed that all the participants appeared to be interested in the PhonicStick and that they found it relatively easy to manoeuvre. The participants’ ability to produce sounds and words on the PhonicStick showed a statistically significant improvement from the first session to the third session. The participants’ phonological awareness skills did not appear to improve after three sessions. More time is needed to find out if this training would result in improved phonological awareness skills.

Key words: the PhonicStick, phonological awareness, literacy acquisition, communication devices, Jolly phonics, Synthetic phonics, The Phonological Awareness Test
Sammanfattning

Läs- och skrivkunnighet är en viktig del av vår kommunikation. Fonologisk medvetenhet, det vill säga, förmågan att kunna identifiera ljudenheterna i ett språk och att manipulera dem, har visat sig vara betydelsefullt inom läs- och skrivinlärning.

År 2005 påbörjades utvecklingen av ett kommunikationshjälpmedel i form av en talande joystick, kallad the PhonicStick, på School of Computing vid University of Dundee i Skottland. Projektets huvudfokus var att ge barn med funktionshinder möjligheten att skapa ett talat språk genom att sätta samman ljud med hjälp av the PhonicStick. Man hade även en teori om att the PhonicStick skulle kunna fungera som ett stöd för läs- och skrivinlärning för barn med typisk utveckling.

Syftet med föreliggande studie var att studera om en grupp bestående av 10 sydafrikanska 5-6 åriga barn med typisk utveckling kunde lära sig att använda the PhonicStick under tre tillfällen och att se om deras fonologiska medvetenhet förbättrades genom användandet. Träningen med the PhonicStick pågick under en treveckorsperiod. Deltagarnas fonologiska medvetenhet undersöktes före och efter träningsperioden med två deltest av The Phonological Awareness Test (PHAT). I tillägg till detta, testades deras förmåga att producera ljud och ord med the PhonicStick.

Resultaten visade att deltagarna föreföll uppskatta övningarna och lärde sig att manövrera the PhonicStick. Deras förmåga att producera ljud och ord förbättrades signifikant från testningen i första till tredje tillfället, dock förbättrades inte deras fonologiska medvetenhet efter träningsperioden. Mer tid hade varit önskvärt för att ta reda på om träningen skulle kunna resultera i en förbättrad fonologisk medvetenhet.

Nyckelord: the PhonicStick, fonologisk medvetenhet, läs- och skrivinlärning, kommunikationshjälpmedel, Jolly phonics, Synthetic phonics, The Phonological Awareness Test
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APPENDIX I, II
1. Introduction

Phonemes are the smallest units of spoken language that can differentiate meaning (Rohl, 2008). The term phonics refers to a method of teaching how to combine sounds with letters (Rohl, 2008). Literacy is an important part of communication (Beukelman & Mirenda, 2005). Skills including phonological awareness have been found to be crucial in the literacy acquisition. To support and facilitate learning of these skills, speech generating devices are currently used by speech and language therapists and other practitioners (Schneider et al., 1997).

1.1 The PhonicStick

In 2005 the development of a communication device, a talking joystick called the PhonicStick, started at The School of Computing at the University of Dundee in Scotland. The original plan was to give children with complex communication needs the opportunity to generate phonics directly i.e., to play with sounds and to generate words without being literate. Until now the project has mainly focused on the use of a talking joystick as the initial access point to spoken output for children with physical disabilities. As a joystick is a well established and familiar method for wheelchair control, it was assumed to be relatively easy for children with disabilities to use the device (Black et al., 2008). Today it is also investigated if the PhonicStick could be useful in literacy learning.

In the prototype joystick the Scottish researchers used the first six phonics from the Jolly Phonics literacy programme: /s, a, t, i, p and n/ (for more information see chapter 2.2.1.2). The use of the PhonicStick has been tested in one pilot study with seven children in the UK, of which two were typically developing. All the children learned how to use the PhonicStick, but the typically developing children were found to be more explorative and capable with the PhonicStick in creating their own words (R. Black; Personal communication, 10 June 2009). In order to find out how the PhonicStick could help literacy learning, more studies need to be done, using both typically developing children and children with complex communication needs. The future goal is to use all the 42 phonics from the Jolly Phonics literacy programme (Black et al., 2008).

1.2 South Africa

On the average, the literacy skills of South African children are low compared to children in
the western countries. The PIRLS (Progress in International Reading Literacy Study) study conducted in 40 countries, which was published in 2007, showed that South African pupils in grade four achieved the lowest score on literacy compared to children in the other 39 countries (Mullis et al., 2007). The present study will therefore, as a part of the Scottish pilot study, investigate if a group of typically developing South African children can learn how to use the PhonicStick.
2. Background

2.1 Phonological awareness and literacy

2.1.1 Phonological awareness

An important aspect of written and spoken language is phonological processing, which includes four components: phonological production, which is the ability to produce words correctly; phonological representations, meaning the cognitive manifestations of speech sounds; phonological working memory, which includes the temporary storage of verbal and phonological information and phonological awareness (Ferreira, 2007). Phonological awareness is the ability to recognise the sound units of language and to manipulate them (Rohl & Baratt-Pugh, 2008). As children learn how to read, they develop advanced forms of phonological awareness. That includes the ability to segment words into their units and put them together. It also includes the knowledge of how to isolate and delete sounds from words and recognising syllables and rhymes. For the development of phonological awareness, it is essential to be able to reflect on the sound structure of words apart from their meaning. This helps the children to start developing more advanced levels of literacy (Rohl & Baratt-Pugh, 2008). Liberman et al. (1974) claim that children who find it difficult to reflect on sounds in words and to segment spoken words into separate sounds might have difficulties in learning to read. Some researchers agree that the greatest single predictor that a learner will become a proficient reader is his/her phonological awareness at the beginning of school (Adams, 1990).

Ericson (2007) points out the importance of having correct phonological processing skills to process non words, i.e. words that have the same structure as real words but without meaning. Repetition of non words assesses phonological encoding and decoding of sound patterns (Goldstein, 2004). Children with reading disabilities are often dependent on the semantic form of a word to be able to read it. They commonly find it more difficult processing non words than real words. Since non words have no semantic form the children has to rely on their phonological processing skills only (Ericson, 2007).

2.1.2 Literacy

Phonemes are the smallest units of spoken language that can differentiate meaning. Phonemic awareness is a more narrow term than phonological awareness and means that listeners are
able to identify and manipulate phonemes. The term phonics refers to a method of teaching how to combine sounds with letters (Rohl, 2008). Studies have shown that children, in an early stage, can learn to read at the phoneme level, and that focus on phonics helps children to become more effective independent readers (Johnston & Watson, 2005).

Literacy is an important part of communication. It gives an individual access to language, self-expression, critical thinking and social and cultural attainment. Among others, the home environment plays an important role in the foundation of literacy. It is a continuous process that adults can support by providing models and instructions (Beukelman & Mirenda, 2005). Literacy training to improve phonological awareness skills is, for instance, pursued with listening games using verbal and non-verbal sounds, rhyming, syllable segmentation and phoneme analysis which can be trained with clapping hands, marching in time to the syllable and intonation rhythms. Training to identify the initial phonemes of words can be introduced through isolation tasks. Children can also learn that new words can be made by adding a new initial phoneme to an existing word. The phoneme analysis can proceed to identifying the initial, final and medial phonemes in words and playing games with more complex words (Schneider et al., 1997).

### 2.1.3 Phonological awareness and literacy

In literacy research today there is an ongoing debate of the effect of phonological awareness for literacy development. Some researchers argue that it is the training in phonological awareness that leads to improved literacy skills. Others think that it is the other way around. There have been findings that phonological awareness skills exist in children who are not yet literate (Alcock et al., 2009). Another possibility is that the relationship between phonological awareness and early stages of literacy is reciprocal. This view is for example supported by a study by Schneider et al (1997). Alcock et al. (2009) also found that letter reading has a very close relationship with phonological awareness. Their study using non-literate children from a rural area in eastern Africa suggests that some levels of phonological awareness develop before children learn how to read, but that the literacy acquisition is necessary for further development of phonological awareness (Alcock et al., 2009).

A study conducted by Connor et al. (2009) examined the literacy outcomes for preschool children from socially disadvantaged backgrounds, at risk of having future literacy difficulties, who received phonological awareness and language intervention in whole-class.
The participants’ phonological awareness and language skills were assessed two years after the intervention. The results showed that there was no difference between the children who had received intervention compared to the children who had not received intervention. The gains in literacy directly after the intervention failed to enhance literacy development in a longer perspective. However, a small group of participants improved their phonological awareness and literacy measures to sustain within the normal range of their age-matched peers, which might indicate that this specific group benefited from the intervention (Connor et al., 2009).

2.1.4 Learning and executive functions

Learning is a process that varies for each individual. It can be defined as the way individuals concentrate, process, internalise and remember new information (Boström, 2004). Boström (2004) refers to the Dunn and Dunn Learning Style Model based on 20 factors that affect every learner’s individual learning style. The factors are divided into five groups: environmental, emotional, social, psychological and physiological including perceptual factors. Environmental factors can include the room, temperature, air quality, noise level etc. Emotional factors are for instance attention, motivation and sense of responsibility which affect how the learner profits from training. Social factors involve the variations of how a learner function in groups, pairs or individually. Psychological factors means that a learner has different information processing strategies and ways of thinking. Physiological factors include time of the day, movement, nutrition and the most important component, perception where the learner can be oriented towards different sensory modalities such as either visual, auditory, tactile or a combination (Boström, 2004).

Memory plays an important role in the learning process and can be described as a process that is involved in retaining, retrieving and using information about stimuli (Goldstein, 2005). Working memory in combination with sustained attention allows the child to keep an intention or plan in mind in order to perform goal directed activities and is needed to sustain long chains of organized behaviour (Kerig & Wenar, 2006). The long term memory stores information permanently. To be able to retrieve the information one has to apply strategies, such as recognizing and recalling. Berk refers to Bjorklund's and Douglas' study (1997) that suggests that children with high knowledge in an area, have the ability to categorize their memories according to their experiences (Berk, 2006).
Attention makes us able to focus on specific features of the environment and on certain thoughts or activities. It plays a role in memory, language and problem solving (Goldstein, 2005). Young children’s attention is not fully developed. Due to this, they easily get distracted and spend only a short time involved in one task. As children grow, their attention develops and becomes more selective, adaptable and planned (Berk, 2006).

2.2 Literacy acquisition

2.2.1 Literacy acquisition in the UK

In 2005, Rose composed, on the behalf of the Secretary of State for Education in the UK, an interim report called “The teaching of early reading review”. One of the main focuses of the study was the synthetic phonic method in early settings and primary schools (for more information on synthetic phonics see 2.2.1.1). Rose pointed out that high quality phonic work was one of the most effective ways to prevent reading difficulties and that it should be taught to children systematically. The results of the report showed that the good systematic phonic programmes were the ones where tasks and learning were followed and supported consistently and carefully on a daily basis. The work in these programmes was almost always ”multi-sensory”, for example, involving physical movement to model letter shapes and sounds, and manipulating magnetic or other solid letters to build words (Rose, 2006).

2.2.1.1 Synthetic Phonics

The Synthetic phonic method is an approach using systematic phonic literacy instructions, where children learn letter-sound correspondence in an organised way. Synthetic phonics is taught to children from the age of about five. The method is focusing on the sounds of the letters, not the letter names and how these sounds can be blended together to make words. As soon as the sound is established the child can learn to write the letter. The phonemes are matched with graphemes, first isolated and then blended together. The pupil learns to segment spoken and written words into its smaller units, and then how to use the knowledge of letter-sounds correspondence to code new, unfamiliar words when reading and writing (Bowey 2006, synthetic-phonics.com).

2.2.1.2 The Jolly phonics programme

The Jolly Phonics programme was developed in the UK in 1987. The aim of the programme is to lay a foundation for reading and writing skills. It uses the synthetic phonics method of
teaching the sounds of the letters in a multi-sensory way (Lloyd, 1998). According to the Jolly Phonics programme, the five basic skills for reading and writing are: learning the letter sounds, learning letter formation, blending, identifying sounds in words and spelling tricky words (Lloyd, 1998).

In the Jolly Phonics programme the 42 main phonics of English are taught to the child. The sounds are divided in seven groups as follows:

1. s, a, t, i, p, n
2. c, h, e, r, m, d
3. g, o, u, l, f, b
4. ai, j, oa, ie, ee, or
5. z, w, ng, v, oo, oo
6. y, x, ch, sh, th, th
7. qu, ou, oi, ue, er, ar

The first introduced group of phonemes (s, a, t, i, p, n) can be used to make more simple three-letter words than any other group of six sounds. The programme’s focus on learning the sounds and not the names of the letters will help in blending, the process of saying the individual sounds in a word and then putting them together (Lloyd, 1998).

2.2.2 Literacy acquisition in South Africa

According to UNESCO’s “Literacy for life” report, South Africa is in a close or intermediate position of not achieving the Universal Primary Education (UPE) goal by 2015 (Bernett, 2005). As many as 11 000 000 adults in South Africa are estimated not to have reached functional literacy levels (Penn, 1998).

Prinsloo and Stein (2004) studied the impact of local cultures in South African classrooms through exploration of data collected from the ethnographically based Children’s Early Literacy Learning (CELL) project. The authors argue that the way the teachers applied their literacy pedagogy affected the children’s literacy skills both within and outside of school. Some of the teachers in the project claimed that they did not follow the child-centred pedagogy that they had been trained to use and that corporal punishment was still used in many of the schools and defended as a part of their culture. Prinsloo and Stein states that for children who are struggling with reading and writing, the violence could make the learning
Many South African children also come from cultural backgrounds where they, for example, in order to show adults respect, are not allowed to speak to them. For these children school is challenging in many more ways than just learning how to read, write and count (D. Klop, Personal communication, 26 August 2009). During the apartheid years the white children received quality schooling, while the black children had separate education at a lower level (Byrnes, 1996). After 15 years of democracy the apartheid legacy still remains and the government is working to rectify the imbalance in education, with the greatest challenges being in the poorer rural areas (southafrica.info).

2.3 Augmentative and Alternative Communication

Augmentative and alternative communication is defined by ASHA (The American Speech-Language-Hearing Association) as an area of clinical practice that attempts to compensate (either temporarily or permanently) for the impairment and disability patterns of individuals with severe expressive communication disorders (Beukelman & Mirenda, 2005). An AAC system consists of many components, including symbols, aids, strategies and techniques used by individuals to enhance communication possibilities. Interventions should always be multimodal and use the individual’s full capacity, such as residual speech, vocalization, gestures, signs and aided communication. The symbols used could for example be gestures, photographs, signs, printed words and objects. The term aid refers to an object or device used to transmit or receive messages. It could be a communication book, board, chart, an electronic device or a computer. A strategy is a specific way of using an AAC. The strategy can be taught to the individual or be self-discovered and it facilitates the individual’s communication performance (Beukelman & Mirenda, 2005).

Natural speakers do not need to constantly be aware of how they construct words and arrange their vocabulary. A person using AAC must however, because of physical difficulties be consciously aware of the details in the communication construction. Also the rate of speech output needs to be very high to keep up with a typical conversation. Nevertheless, the access to speech generating devises offers a possibility of a voice and to take part in communication activities for non-speaking people (Alm, 2006).

The PhonicStick is an example of an electronic device used for intervention to enhance
communication possibilities. It was initially intended to function as an access point to spoken output for children with mild to severe physical disabilities, but is now being tested for a larger group of users (Black et al., 2008).
3. Aim and research questions

The aim of this study was to investigate if a group of 10 typically developing South African 5-6 year old children could learn how to use the PhonicStick in three sessions, and to see if their phonological awareness improved by using it. In order to do this, the specific research questions were:

1. Will the children be able to remember, after three individual sessions, the positions of the different sounds on the PhonicStick?
2. Can the children combine sounds to produce short words with the PhonicStick?
3. Will the use of the PhonicStick result in improvements in the phonological awareness skills for the children as measured by The Phonological Awareness Test (PHAT, Robertson & Salter) part c) Isolation i.e. telling the initial, final and/or medial sound of words and part d) Deletion i.e. telling how a word changes if a sound is deleted.

4. Method

4.1 The South African research situation

The research situation in South Africa is in many ways different to the western research climate. In South Africa it can be difficult to get an ethical approval for testing children. For this reason, and also to make sure the study would not be delayed, the researchers were advised not to apply for more than 10 participants and there were limited possibilities to include a control group in the research. For this study, because of the use of an electronic device, it was noticeable that the electricity was sometimes limited.

4.2 Participants

The participants of the study consisted of a group of 10 typically developing children from a South African pre-primary school. The group contained of six girls and four boys. Their ages ranged from 5;11 to 6;10. All participants were from English mother tongue, middle class homes. They were selected from two different classes: seven of the participants were from one class and three from the other one. The selection of participants was made by the principal of the school with help from one teacher. The criteria were:

1) The participant’s mother tongue was English.
2) They were typically developing as judged by their teacher.
3) They were performing well in school and showed a good understanding of words and
sounds as judged by their teacher.

The school was contacted with the help from the South African supervisor. In the first meeting with the principal and one of the teachers, the researchers presented the plan for the research and demonstrated the PhonicStick. During the meeting a problem was pointed out by the teacher, concerning the sounds. The vowels from the Jolly phonics program, used in the PhonicStick are pronounced in a British way /a/ and /I/, which is different from the South African pronunciation. This was something that the teacher regarded as a risk of affecting the children’s literacy learning. However, the researchers and the teacher came to the conclusion that it would have less impact on the children who were performing well in school. Thus the decision to include the above presented third criteria in the selection of participants.

A written consent form, designed by the Committee for Human Research at Stellenbosch University was gathered from the parents of the participants before the study started. No control group was used in the study due to the research limitations in South Africa.

4.3 Material and equipment

4.3.1 The Phonological Awareness Test

The phonological awareness skills were tested using the Phonological Awareness Test (PHAT). The test was first introduced in 1997, by Robertson and Salter, and is designed to diagnose deficits in phonological awareness and phoneme-grapheme correspondence. A number of subtests assess different tasks correlated with early reading and spelling achievement, arranged in a developmental sequence. The subtests are a) rhyming, b) segmentation, c) isolation, d) deletion, e) substitution, f) blending, g) graphemes, h) decoding and the optional part i) invented spelling. The test is performed individually and can be administered in two or more sessions. The test administration time is approximately 40 minutes. Each response receives a 1 for a correct response and a 0 for an incorrect response (Roberson, Salter. 1997). The subtests used in the present study were subtest c) isolation and subtest d) deletion; the phoneme part.

4.3.2 The PhonicStick

The PhonicStick used in the study was a reconstructed Logitech Attack 3 joystick with a wooden ball to make the maneuvering easy. It was connected to a Lenovo ThinkPad laptop
with a set of portable JBL “on Tour” speakers.

![PhonicStick](image)

*Picture 1: The PhonicStick seen from the side. (Private photograph)*

The sounds on the PhonicStick are accessed by moving the joystick in one of the eight major compass rose directions and around the circumference. The PhonicStick gives auditory feedback as the joystick is moved. Each phonic is selected by moving the joystick back to the centre position. In this prototype version the user is able to collect up to three sounds at the time and blend these into short words such as “tap” and “pin” (Black et al., 2008).

![Mappings](image)

*Figure 1: Mappings of the positions of the sounds on the PhonicStick.*

Corrections are made by pushing the so called clearing button. Before producing a word the same button has to be pushed. To make the PhonicStick read the finished word, the so called speaking button has to be pushed.
4.3.3 Video recording

Video recordings of all sessions were made with a Canon Digital Video Camcorder MVX40, and 60 min Sony Mini-DV cassettes. The camera was placed approximately 2 meters in front of the participant.

4.4 Procedure

The study took place over a period of three weeks. The participants met both researchers at their school for three individual sessions to learn how to use the PhonicStick. One of the researchers worked with the participant at a small table and the other one was sitting close by observing and taking notes. Both researchers worked with five participants each during the sessions and testing. The six sounds: /s, a, t, i, p and n/ used in the Scottish pilot study, were used. To evaluate the participants’ phonological awareness skills before and after the training, two additional screening sessions were conducted using above mentioned parts of The Phonological Awareness Test (see chapter 4.3.1).

The testing and sessions took place in a separate room in the back yard of the school. The room was spacious but contained some toys and gym equipment placed along the walls. The researcher tried to keep the training as similar as possible for all the participants. The researchers gave all the participants the same instructions and followed a manual for the testing. Video recordings were made of all three sessions, so that the researchers could verify the results during the analysis of the sessions.
4.4.1 The sessions and testing

Session 1: In the first session, the PhonicStick was introduced to the participant for approximately 5 minutes. After the introduction the participant was allowed some time to try to use the PhonicStick on his/her own. At the end of the first session the participants were asked to perform the following two tests on the PhonicStick:
1: Find 12 sounds on the PhonicStick (see appendix I).
2: Find 10 words on the PhonicStick, containing real words, such as “tap” and “pin” or non words such as “ina” and “tsa” (see appendix I). The duration of the session was between 20 and 35 minutes.

Session 2: The second session was a play session, where no tests were performed and the participant was asked to play games (see appendix I) on the PhonicStick with the researcher. The games were focused on learning how to use the PhonicStick: how to make the sounds, how to produce words with it and how to segment words into sounds. The duration of the session was between 15 and 25 minutes.

Session 3: In the third session each participant once again performed the two tests on the PhonicStick, as described in the first session, but this time using a second set of target sounds and words (see appendix I). The duration of the session was between 10 and 20 minutes.

The tests were administered by the researcher reading the sound/word, one at the time and the participants were asked to make the same sound/word on the PhonicStick. If the participants did not hear the sound/word, they were allowed to ask the researcher to repeat it. At some points the researcher helped the participants to find the sound or to make the word. In particular this happened in the first session when the participants were in the beginning of the learning process. However, this was not noted as a correct answer. If the participants corrected themselves when making a mistake before finishing a word, it was noted as a correct answer. If the participants made several mistakes before finally making the correct word, it was not noted as a correct answer since there was a risk that the participant was not sure enough and was only getting it right by coincidence. Two different lists of sounds and words (see appendix I) were used for the testing during session 1 and 3. This was to avoid the risk of the participants recognizing the words from the testing in session 1 to the testing in session 3.
Each participant’s phonological awareness skills were screened before and after the 3-week training period with part c) and d) from The Phonological Awareness Test (see chapter 4.3.1). The main purpose of the testing was to see if there were any changes in phonological awareness after the three sessions.

The time span for the study was 17 days. The pre testing was performed on day 1. The first training session was on day 6, for participant 1-7 and on day 8 for participant 8-10, due to limited availability of electricity, which led to technical problems and a delay. The second session was on day 8 for participants 1-7 and on day 10 for participants 8-10. The third session took place on day 13 for all participants. The post testing was performed on day 17.

4.5 Data analysis

Descriptive statistics of the test results were used and are presented in text accompanied by tables and figures. In addition, qualitative observations were made to give a broader picture of the participants’ performance during the sessions and testing.

In the data analysis the researchers used the written notes from the qualitative observations and the video recordings. They studied the participants’ ability to remember the positions of the sounds, their ability to produce short words, the possible improvements of phonological awareness and connections between these levels. They also looked at the phonological awareness after the sessions in comparison to improvements in producing words. The difference between real words and non words was also investigated.

A paired two sample t-test (two tailed p) for mean was used for the pre- and post training data of the phonological awareness testing. The same kind of t-test was used for the analysis of the combined and the separate results of the test of sounds and words during session 1 and 3. The results of the t-tests are presented in tables.

4.6 Ethical considerations

Ethical approval for the study was granted by the Stellenbosch University Committee for Human Research. After this the South African supervisor secured verbal permission from the school principal. Each parent/guardian was asked to sign an informed consent form allowing their child to participate in the study. The participants could withdraw from the study at any time.
In planning and performing the activities, attention was paid to ensure that the participants’
education did not suffer by their participation, and that as little time as possible was taken
from normal school activities for the sessions. As all the activities of the research were similar
to normal school activities, potential for risks for the participants were very low.

All information is confidential as the participants are identified by number only. The audio-
visual recordings will be kept in a locked facility at the department of Speech-Language and
Hearing Therapy, Stellenbosch University for the duration of the study and will be destroyed
afterwards.
5. Results

In this chapter the presentation of the results will follow the order of the three research questions of the study. The results on the learning of the positions of the sounds on the PhonicStick will be presented first. The results of the word production in the first and third session will be presented next along with a comparison of these results. Lastly the results of the pre- and post testing of phonological awareness will be presented along with a comparison of these results. The data is presented in graphs and tables, for a detailed description of the tests see appendix I. Additional qualitative observations, including session 2 will be added to the result.

5.1 Learning the positions of the sounds

5.1.1 Session 1

The test material used in the sessions consisted of 12 sounds (see appendix I). The number of sounds learned in the first session, ranged from 6 for participant 10 to 12 for participants 1, 5, 8 and 9 (see figure 2). The mean for the group was 10.1. The maximum score was 12. Overall seven out of ten participants could remember 10 sounds or more of the 12 sounds and the remaining three participants could remember 5 sounds or more.

5.1.2 Session 3

The number of sounds remembered in the third session, ranged from 9 for participant 4 to 11 for participant 2 and 12 for all the remaining participants (see figure 2). The mean for the group was 11.6. Overall the results on the test of sounds were high, as eight out of ten participants gained the maximum score of 12 and even the lowest performing participant gained a score of 9. Participant 10 showed the biggest improvement going from 6 sounds in session 1 to all 12 sounds in session 3.
5.1.3 Observations during learning the positions of the sounds

During the sessions all of the participants showed interest in the PhonicStick. Most of them were eager to come in to the room and work with the researchers. The work with sounds was rewarding and the participants did well already in the test in session 1. Participant 10 was distinguished by working very slowly and giving the impression of losing attention during the test in session 1. The participant performed well on the test in session 3 but was still working slowly and seemed very tired.

Some sounds were harder to find than others and some participants, for example participant 2 and 6 required extra training to find /p/, which was more complicated to find and the movement itself was harder to make since it is produced through /t/ on the PhonicStick.

Participant 4’s result decreased from the first to the second testing. This participant lost focus on and off during the third session and seemed to have a hard time to keep the attention to the task, when tested.
5.2 Word production

5.2.1 Session 1

The test material used in the sessions consisted of 10 words; five real words and five non-words (see appendix I). The results in the first session, ranged from 0 correct words for participants 1 and 7 to 7 correct words for participant 6 (see figure 3). The mean of correct words for the group was 3. The maximum score possible was 10. Overall the results were low as only three participants could produce 5 or more words correctly and the remaining seven only 3 or less. The participants generally showed problems with the vowels in the word production and showed specific problems producing the non-words pta and tsa.

5.2.2 Session 3

The number of correctly produced words in the third session, ranged from 1 word for participant 10 to 9 words for participant 3 (see figure 3). The mean of correct words for the group was 5.9. The maximum score possible was 10. Eight participants produced between 5 and 9 words, and the remaining two participants 4 words or less. Participant 10 was distinguished by performing very low on the test of words.

![Test of words](image-url)

*Figure 3: Results of the test of words after the first and the third session of training with the PhonicStick for ten South African children.*

5.2.3 Observations during word production

The most striking observation during the sessions was how the word production was affected
by the vowel difficulties. Most participants seemed to be confused by the British pronunciation and were constantly searching for the sound they needed to produce the word. Participant 8 performed well during the training, where it was a possibility to reason with the researcher, but during the testing the participant struggled and constantly asked for the vowels. The participant also struggled with remembering the clearing button. The clearing button was an important way for the participants to show their awareness of mistakes they made. Participants 2, 3, 4 and 5 showed good capabilities to correct themselves with the clearing button. The same participants also had high scores on the testing. Participants 2 and 10 were the only ones who scored lower in the test in session 3 that in session 1. During the testing participant 2 lost attention and participant 10 seemed very tired and uncomfortable. Participant 10 sounded the words out loud, for instance when making the word “sit”, the participant would sound “s-i-t” but did not manage to make the word with the PhonicStick.

5.3 Comparison of test results in session 1 and 3

The total group results on the test of sounds improved by 15 points (101 to 116 points) from session 1 to session 3 (see table 1). The results were high and almost reached the ceiling (120 points) already in the test in session 1 and got even higher in session 3. The mean for the test of sounds in the first session was 10.1 and in the third session 11.6.

Table 1: Results of the test of sounds after the first and the third session of training with the PhonicStick for ten South African children.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Session 1</th>
<th>Session 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>11</td>
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<tr>
<td>3</td>
<td>11</td>
<td>12</td>
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<td>4</td>
<td>10</td>
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<td>5</td>
<td>12</td>
<td>12</td>
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<tr>
<td>6</td>
<td>7</td>
<td>12</td>
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<td>7</td>
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<td>12</td>
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<td>12</td>
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<td>9</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>10</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>101</strong></td>
<td><strong>116</strong></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>10.1</strong></td>
<td><strong>11.6</strong></td>
</tr>
<tr>
<td><strong>Variance</strong></td>
<td><strong>5.2</strong></td>
<td><strong>0.9</strong></td>
</tr>
</tbody>
</table>

The total group results on the test of words improved by 29 points (from 30 to 59 points) from
session 1 to session 3 (see table 2). The mean for the test of words in the first session was 3 and in the third session 5.9.

*Table 2*: Results of test of words after the first and the third session of training with the PhonicStick for ten South African children.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Session 1</th>
<th>Session 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
<td><strong>59</strong></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>3</strong></td>
<td><strong>5.9</strong></td>
</tr>
<tr>
<td><strong>Variance</strong></td>
<td><strong>6.4</strong></td>
<td><strong>5.0</strong></td>
</tr>
</tbody>
</table>

In table 3 the combined results of both sounds and words are presented. The results improved by 44 steps (from 131 to 175 points) from session 1 to session 3. The number of sounds and words remembered in the first session ranged from 8 to 18, and in the third session from 13 to 21 (see table 3). The mean for the group was 30.6 (13.1 in the first session plus 17.5 in the third session). The maximum score was 22 (12 for the sounds and 10 for the words).

*Table 3*: Combined results of test of sounds and words after the first and the third session of training with the PhonicStick for ten South African children.
<table>
<thead>
<tr>
<th>Participant</th>
<th>Session 1</th>
<th>Session 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>14</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>13</td>
<td>16</td>
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<tr>
<td>5</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>6</td>
<td>14</td>
<td>19</td>
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<td>7</td>
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<tr>
<td>8</td>
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<td>17</td>
</tr>
<tr>
<td>9</td>
<td>13</td>
<td>19</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>131</strong></td>
<td><strong>175</strong></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>13,1</strong></td>
<td><strong>17,5</strong></td>
</tr>
<tr>
<td><strong>Variance</strong></td>
<td><strong>10,5</strong></td>
<td><strong>5,4</strong></td>
</tr>
</tbody>
</table>

Figure 4 shows individual changes. The differences in test results between session 1 and 3 can be seen in the two kinds of bars. The light bar shows the differences in the test results for sounds and the dark bar shows the differences in the test results for words. For example, participants 3 and 9 scored much higher on the second test of words than on the first (6 points higher). Participant 4 was the only participant who scored lower on the second test of sounds than the first. But the same participant scored 4 points higher on the second test of words. Participants 1, 5, 8 and 9 gained the maximum score already in session 1 in the test of sounds and remained the same in session 3. These participants had varying changes in the test of words. The biggest changes in the test of sounds are seen for participants 6, 7 and 10. In the test of words, the biggest changes occurred for participants 1, 3 and 9. Participants 2 and 10 were the only participants who scored lower on the second test of words than the first (one point lower).
No major difference in difficulty producing real words versus non words was noted. The number of correctly produced real words in session three was 28 and the number of correctly produced non words was 31. The word that the most participants (9 out of 10) could produce correctly was the nonsense word “ntp”.

A t-test shows that the changes for the mean of the combined test results of sounds and words in session 1 and 3 were statistically significant (p=0.0009). Since the participants could produce more sounds and words in the third session than in the first session it suggests that overall the participants’ performance had improved, probably as a result of the training. Further separate analysis shows that the changes in the test of words were statistically significant (p=0.005). A separate analysis of the test of sounds was not used, due to the ceiling effect.

5.4 Phonological awareness skills tested with PHAT

5.4.1 Pre testing

The study began with a screening test of phonological awareness. The maximum score possible was 20. The range of the combined results of the two subtests, (isolation and deletion) in the pre testing, reached from 2 points for participant 10 to 19 points for participant 4. The mean for the group was 13.6. The performance of participant 10 was much
lower than that of the other participants, i.e., 8 points lower than the second lowest participant. Most of the participants scored between 14 and 17.

5.4.2 Post testing

The same screening test of phonological awareness was administered at the end of the study, using different words as stimuli. The maximum score possible was 20. The combined results of the two sub-tests in the post testing, ranged from 6 points for participant 10 to 18 points for participant 2. The mean for the group was 13.2. Participant 10 performed much lower than the other participants, with 5 points less than the second lowest participant. Most of the participants scored between 11 and 18.

5.4.3 Comparison between pre and post testing

A comparison of the combined results of the pre and post testing showed that the results decreased by 4 steps (from 136 to 132 points) from the pre test to the post test.

Table 5: Combined results of pre and post testing of phonological awareness with two subtests of PHAT for ten South African children.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Pre test</th>
<th>Post test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>19</td>
<td>11</td>
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<tr>
<td>5</td>
<td>15</td>
<td>11</td>
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<td>6</td>
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<td>7</td>
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<td>16</td>
<td>15</td>
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<tr>
<td>9</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>136</strong></td>
<td><strong>132</strong></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>13.6</strong></td>
<td><strong>13.2</strong></td>
</tr>
<tr>
<td><strong>Variance</strong></td>
<td><strong>22.9</strong></td>
<td><strong>13.7</strong></td>
</tr>
</tbody>
</table>

The scores for five participants were improved (participant 2, 3, 7, 9 and 10), while the other five participants decreased their scores (see figure 5).
In the Isolation subtest, which assesses the ability to tell the initial, final and medial sounds of words, the biggest improvements were found in telling the medial sounds. The result improved from a group total of 34 in the pre testing to 40 in the post testing. The test for initial sounds showed a slight improvement. The test for final sounds did not show any improvements. In fact, the results deteriorated from a group total of 29 in the pre testing to 20 in the post testing. In the sub-test for deletion, which assesses the ability to tell how a word changes if a sound is deleted, only small changes were found from pre to post testing.

A t-test for the means of the combined pre and post testing results with The Phonological Awareness Test, shows that the changes after the three sessions are not statistically significant (p=0.775).

**5.5 Additional observations**

Session 2 was a play session. During the session most participants seemed relaxed since there was no testing involved. There was also more room for asking questions and reasoning with the researcher. The participants took initiatives during the games and when the researcher made deliberate mistakes the participant corrected it adequately. All participants seemed to enjoy the session. Additional training was given to the participants when needed, this included finding the sounds, making words and maneuvering the PhonicStick in general.
During the last research day at the school, the PhonicStick was presented to all the children in the classroom. The participants of the study were requested to show their classmates how the PhonicStick worked. There was a great deal of interest and the children were standing in line to try the PhonicStick. Some of them had actually picked up the principle of the PhonicStick before it was their turn, so they could already make the sounds and started to make words right away.

5.6 Summary of the results

The relationship between the three levels: sound production, word production and phonological awareness could be seen in some parts and was absent in other parts of the study. The results showed that the sound production was well established in an early stage of the training. The results were high and almost reached the ceiling (120 points) already in session 1 and got even higher in session 3. The word production was for some participants confused by the vowel difficulties. Still significant improvements occurred, as the scores went from a group total of 30 in the first session to 59 in the third session. The phonological awareness as measured in the present study did not improve for the participants and the total results actually showed a slight decrease.

There was an improvement for participants 3 and 7 on all three levels. For participant 9 the scores on the test of sounds were already at the maximum and the words and the phonological awareness improved. Finally for participant 10 there was an improvement on the test of sounds and in phonological awareness, even though the word production slightly decreased.
6. Discussion
The aim of this study was to investigate if a group of 10 typically developing South African 5-6 year olds could learn how to use the PhonicStick in three sessions, and to see if their phonological awareness improved by using it.

The result showed that the children could learn how to use the PhonicStick. The ability to produce sounds and words showed significant improvements in the group. The results of the phonological awareness test varied and it is therefore hard to draw the conclusion that usage of the PhonicStick improves the phonological awareness. However, there were some participants who seemed to benefit from the training and showed improvements on all three levels (sounds, words and phonological awareness).

All participants showed interest and seemed to enjoy working with the PhonicStick. Most participants learned to use the clearing button to correct themselves when they made mistakes, which led to more correct answers in the testing. The ability to correct a mistake while making a word can be interpreted as the participant having the ability to hear and foresee that the word is not going to be correct. Fromkin cited in Forbes et al. (2004) states that self-correction is an important sign of progress in language development and a way in which the child controls his or her learning about spoken language.

6.1 Result discussion
The following discussion will be structured according to how the study answered the three research questions.

All the participants could learn how to find the sounds. The scores nearly reached the ceiling in the testing in both sessions. This result shows that the PhonicStick is relatively easy to manoeuvre and that it is not hard to remember the positions of the sounds. It could also indicate that the way the PhonicStick was presented to the participants was a good method for learning the sounds. On the other hand this group of participants might have performed well because they were good learners and had the ability to concentrate on the task.

The ability to produce words improved from session 1 to session 3. Most participants struggled making the words in the beginning but in session 3 the results had improved
significantly. A result that emerged in the study was that the British pronunciation of the PhonicStick vowels was different from the way they are pronounced in South African English. While making a word, the PhonicStick pronounced isolated vowels in a British way but when the PhonicStick read the finished word it sounded more similar to South African English, which was confusing. Some of the participants showed great difficulties overcoming the difference while others seemed to be able to adjust to it. These vowel difficulties might have had a negative impact on the results of the word production.

Both real words and non words were tested. The reason for including non words in the testing was to see potential differences in the participants’ words production. The researchers wanted to know if non words would be more difficult to produce than real words. When producing non words there are no semantic clues and the children has to rely on their phonological processing skills (Ericson, 2007). No major difference in difficulty producing real words versus non words was noted. The word that the most participants (9 out of 10) could produce correctly was the nonsense word “ntp”, the reason for this could be that the word does not consist of any vowels. The difference between non words and real words was explained to the participants both in the first and the third session. One participant commented on some of the non words saying that they were fake. This could be an indicator of an awareness of the difference between real words and non words. Most participants did not show any reaction to the non words as opposed to the real words.

The results of the phonological awareness test in the pre and post testing did not show any significant improvements. However, five participants scored better on the post testing than on the pre testing. The reason for the improvement could be the training with the PhonicStick which brought attention to sounds and segmentation of sounds. Five participants’ performances decreased. There could be many reasons for this decrease. It is possible that the participants felt more relaxed with the researchers after getting to know them better and thus were playing more and concentrating less. They might also have become tired of being tested, or they just did not understand the task. The participants appeared to be on different levels in their phonological awareness development. As Schneider et al. (1997) claims, it can be difficult to recognise the effect of training phonological awareness of children who have already initiated their literacy learning process. Also due to the short training period it was hard to assign value to its effectiveness. According to Rohl (2008), well developed phonological awareness skills include the ability to segment words into their units and put
them together. To be able to make words on the PhonicStick you have to be able to segment each word into smaller units. If the user has problems with segmentation, making words on the PhonicStick seems to be problematic. Participant 10 was a good example of this. The participant was still sounding the words out loud and had difficulties putting sounds back together to produce a word. Even though the participant scored low on the word production, the phonological awareness improved which indicates that the participant benefited from the training with the PhonicStick. Overall the participants’ ability to produce sounds and words on the PhonicStick showed a statistically significant improvement from the first session to the third session. This suggests that the training overall was successful.

It was expected that the participants who performed well on the test of words in the third session would be the same ones who did well on the post testing of phonological awareness skills, but that was not the case. No clear relationship was found between the results on PHAT and the other testing results, in any direction. Some participants made progress on the tests of sounds and words, while their results on PHAT decreased. The difference could be due to other factors than changes in phonological awareness, maybe it is not even possible to draw the connection between being able to produce words with the PhonicStick and the phonological awareness of the participants. Factors such as the participants’ learning styles, the feeling of security and relaxation, mood, time of the day and so on could also have affected the result. As mentioned earlier, Boström (2004) refers to the Dunn and Dunn Learning Styles Model, where the learning style is claimed to be affected by several different factors within the individual. However, considering the participants who actually did show improvements on all the three levels (sounds, words and phonological awareness), the results indicate that this type of training can be helpful for the development of phonological awareness to some individuals at the same time as it makes no difference to others.

During the first session there was an interruption due to technical problems, caused by a temporary disruption in the availability of electricity, which forced participant 1 to wait and then to move to another room where there were more external disturbances and less space. The following four participants had to continue in that room for the session. This could have affected the participants with a shorter attention span. As Goldstein (2005) claims, attention is very important for the learning process. Some of the participants had problems keeping their attention and became very tired by the end of the training sessions. There is a possibility that the participants were in different stages of their attention development. Participant 8 lost focus
and attention when encountering problems with the vowels in the words production. This could have affected the participant’s results.

6.2 Methodology discussion

This study was performed by two Swedish Speech-and language pathology students. The use of two different researchers did not seem to have any notable impact of the study results, since there were no obvious differences between the performances of the two researchers’ groups of participants. The fact that the researchers were from another country and spoke with a different accent may have had impact of the result, but nothing such was noted.

The researchers did not encounter any major problems or challenges during the training and testing, which suggests that the method used for the study was well suited for the purpose. The number of sessions appeared to be enough for most participants to learn how to use the device. It would have been a risk of the participants being bored or losing interest if too many sessions would have been performed. The time duration between the sessions seemed to be appropriate. During the whole period there were 2-5 days between every meeting with the researchers. The children recognized the PhonicStick when they came to a new session and could recall how to use it. To include a play session was justified since all the participants enjoyed this relaxed way of working. They took the opportunity to reason about sounds, words and the PhonicStick itself with the researcher which possibly could have led to a better understanding. The play session also made it easier for the researcher to get to know the participants.

The researchers used a written manual that worked well as a working frame during the sessions. Though, at several points the researchers had to deviate from it to adapt to each participant’s individual needs. Since the goal was to teach each participant how to use the PhonicStick this was not considered as a problem, even though there was a risk that it could have affected the results. It should be noted that both researchers followed the manual strictly during the testing part.

Two different lists of sounds and words were used for the testing during session 1 and 3. This was to avoid the risk of recognizing the words from the first testing to the second. All participants were tested on the same set of words, as opposed to testing half the group with one part of the list and the other half with the other part of the list. This would have been a
way of avoiding the risk that the lists would be of different severity and thus giving unfair results. However, the researchers judged that the words in the two lists were constructed in a very similar way and that they were of the same degree of difficulty. In the third session a mistake was made during the testing of words. One word from session 1 by accident slipped into the test of words in session 3. The word was excluded from the results.

The sounds used in the study were the sounds from the first stage in the Jolly phonics programme and are the same ones as used in the Scottish pilot study. The fact that only six phonics were used in the study and thereby only a limited number of words could be produced might have been confusing for the participants.

The fact that the pronunciation of the PhonicStick vowels was different from the way they are pronounced in South African English was confusing. Some of the participants showed great difficulties overcoming the difference while others seemed to be able to adjust to it. This was something that the teacher regarded as a risk already before the study started. The reason why the study continued with this material was that the researchers and the teacher came to the conclusion that it would have less impact on the children who were performing well in school. This was also the only material available at this point.

The researchers encountered some of the limitations of the South African research situation and that it is in many ways different from the situation at home. The ethics application was in some parts time consuming and complicated. Despite the fact that only 10 children were recruited for the study, bureaucracy proved to be easier than expected, and the ethics approval was granted rather quickly. Another factor affecting this South African pilot study was the temporary disruption in the availability of electricity that made the study a little bit more complicated than necessary.

No control group was used in the study due to the fact that getting permission to use children for research in public schools required more time than was available and children in a smaller private institution needed be used. It would have been useful to be able to investigate if the PhonicStick improved the participants’ phonological awareness compared to their class mates.

The choice of place for training was important and the researchers tried to find a room with as little disturbance as possible. Though, the room where the sessions took place showed not
always to be optimal. At several occasions it became too warm and it was sometimes noisy when the other children were playing outside. Some portions of the first session had to take place in another room due to technical problems, caused by a temporary disruption in the electricity supply. These aspects might have affected the results. On the other hand, one might suggest that these instances reflected a normal school setting.

Video recordings were made throughout all three sessions and worked as a good complement to the written qualitative observations during the analysis. No video recordings were made during the pre and post testing with PHAT. In the pre testing, it was not a problem not to have any video material, but in counting the scores on the post testing the researchers were unsure at some points. A video recording on the pre and post testing would have been useful as it would have strengthened the reliability of the study. The researchers were however sure enough to establish the scores for each participant. The camera itself was a bit of a problem, since it did not always record the sounds well enough and it was at some points hard to hear what the participants were saying.

For the data analysis of the pre and post phonological awareness tests, a paired two sample t-test (two tailed p) for mean was used. The same kind of t-test was used for the test of sounds and words during session 1 and 3. The t-tests were presented in tables. The researchers chose to use this type of t-test to see changes in both directions. Some of the participants did not improve and even decreased their results after training with the PhonicStick.

Something that the researchers found very pleasing with the study was that the PhonicStick proved to be a fun tool to work with, both for the researchers and for the participants. The participants seemed amused during the training and on the last day they happily showed it to their class mates. It was very inspiring to see the children teach each other and explaining in their own way what the PhonicStick was about. As Boström (2004) argues, motivation is an important factor for a learner to benefit from training.

The study group was very small and all the participants came from the same socio-economical class, from the same area and went to the same school. It was the principal and the teacher and not the researchers who selected the participants from the three criteria mentioned. The researchers considered their judgement the most accurate since they are the ones who have daily contact with the children. Factors such as personality, attitudes and mood of the
participants, hidden agendas or factors the researchers could not detect could have affected the validity. Due to all of these factors one cannot generalize the results to a larger population. The researchers are also aware of the risk that since the children in this selected group are relatively familiar with computers they might not be representative to South African children in general.

6.3 Conclusions

After finishing the study the researchers could draw the conclusion that all the participants appeared to be interested in the PhonicStick and that they found it relatively easy to manoeuvre. The participants’ ability to produce sounds and words on the PhonicStick showed a statistically significant improvement from the first session to the third session. This suggests that the training was successful.

The test results on PHAT did not show any significant improvements after the sessions. This indicates that the training did not have impact in the participants’ phonological awareness skills. However, this might be due to the short time span of the study. The participants improved their ability to produce words on the PhonicStick. This shows that the participants could learn how to use the device, but there was no clear relationship found between the results on PHAT and the other test results, in any direction. It is possible that the skills might not yet have been transferred to other phonological tasks. For the participants who did show improvements on all the three levels (sounds, words and phonological awareness), the results could indicate that this type of training can be helpful for the development of phonological awareness to some individuals. More time is needed to find out if this training would result in improved phonological awareness skills overall.

Since the study group was very small no generalisations can be made to a larger population. However, one can say that it was easy for these 5-6 year old South African children to learn how to use the PhonicStick and that they enjoyed working with it.

6.4 Limitations of the study

The limited size of the study group makes generalizations difficult. In addition, all the children came from the same geographical area and one socio-economic group.

For this study the researchers were advised not to apply for more than 10 participants from a
small private school, as the process of getting permission to use larger groups of children from government schools would have been too time-consuming and the researchers had to make sure there would be enough time to perform the study whilst in South Africa. This is also the major reason for the limited size of the study group and the lack of a control group.

The British pronunciation of the vowels appeared to be confusing for the participants when making words, since it is different from the South African pronunciation.

6.5 Future studies
The researchers of this study would recommend that future studies in this subject should use larger study groups over a longer period of time. This might give the opportunity to see if there is any transfer of the skills with PhonicStick to other phonological tasks. It would also be interesting to see if children, who still have not started to work with phonological awareness in school, can learn how to use the PhonicStick and/or improve their phonological awareness by using it.

Another study could be performed where teachers could be trained, to see how they would work with the PhonicStick in a typical school setting and to study what aspects the PhonicStick would contribute to. How would the training with the PhonicStick be administered and would it be useful in school activities for early literacy training?

Since South Africa is a very diverse country with many socio-economical groups, cultures and languages, a broader study would be needed to generalize the results to its population.

For this study the time duration between the sessions seemed to be appropriate. For a future study it would be interesting to have a longer break after the last session and then make a follow up to see if the knowledge lasted.

If needed new recordings could be made to adjust the pronunciation of the isolated sounds to the pronunciation of the words. It would also be interesting to investigate the need for different versions of the PhonicStick for different English accents, for example British, American, Australian and South African English.
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Jenny & Gabriella
References


**Electronic references**


Session 1

- Introducing the PhonicStick

Encourage the participant. If the participant doesn’t understand what you mean at some point, you may show the participant how it works, for example by making the sound on the PhonicStick.

I’m glad that you wanted to come here today. Today we are going to play with sounds for a while. It’s a little bit like you do in school.

Do you know what this is? Point at the PhonicStick. Sometimes you can use it to play computer games. Have you played with one before?

We call this one a PhonicStick. With the PhonicStick you can make different sounds. Do you know what a sound is? Can you make a sound with your mouth? Good! With sounds you can also make words. Can you say a word? Give the participant an example if he/she does not say one. Good!

To make a sound you pull the PhonicStick like this. Show /t/, /s/, /a/.

Do you want to try to make a sound with it? Let the participant make a few sounds. Good!

Ok! Now I want you to try to pull the PhonicStick towards you. What do hear? Yes good it’s a /t/. Or, if the participant makes a mistake/does not answer: Try again, what do you hear? Yes, it’s a /t/.

Now try to pull the PhonicStick to the side, what do you hear? Yes good it’s a /s/ or /n/. Or, if the participant makes a mistake/does not answer: Try again, what do you hear? Yes, it’s a /s/ or /n/. If the participant asks you which side you mean tell the participant that they can pick a side.

Try to pull the PhonicStick to the other side? What do you hear? Yes good it's a /s/ or /n/. Or, if the participant makes a mistake/does not answer: Try again, what do you hear? Yes, it’s a /s/ or /n/.

Appendix I
Try to pull the PhonicStick forward, what do you hear? Yes good it's a /a/. Or, if the participant makes a mistake/does not answer: Try again, what do you hear? Yes, it's a /a/

Now, try to pull the PhonicStick forward to the left. *Point to the left if needed.* What do you hear? Yes it’s a /i/. Or, if the participant makes a mistake/does not answer: Try again, what do you hear? It’s a /i/.

Now try to pull the PhonicStick forward to the right? What do you hear? *Show the participant.* When you hear that sound, “boink” it means that there is no sound in that spot. You can also pull the PhonicStick like this, towards you and than to the right. What do you hear? Yes it's a /pl. Or show the participant again. Do you want to try?

**Free play:** Now you can try to make sounds with the PhonicStick on your own. *Encourage a lot. If the participant doesn’t do anything, do it together by making a sound and letting the participant make the same one. (Maximum 1 min.)*

With the PhonicStick we can also make short words. When you want to start making a word you always have to press this button to make it ready. *Point at the clearing button.* It is called the clearing-button. This one is the same. *Point at the other clearing button.* If you make a mistake and want to start again, you can also push the clearing button. When you want the PhonicStick to say the word you made, you have to press this button to make it talk. *Point at the speaking button.* It is called the speaking-button. This one is the same. *Point at the other speaking button.* Do you understand?

Now let’s make a word. Start by pressing the clearing button. Now try to pull the PhonicStick to the left side, then forward and then towards you and press the speaking button. What do you hear? Yes “sat”. Or, if the participant makes a mistake/does not answer: Try again. *If the participant needs help with any of the individual phonics try it together for example by making /s-a-t/.

Let’s try to make another word. First we have to press the clearing button. Now, let’s try to make it say ”tan”. *Wait and see if the participant does it by it self, if not tell the participant how to make each sound, give space to continue, if needed do it together.* Good! Shall we try to make ant? *Continue with pan, pin, sit, tap, tin and tip.*

- **Test 1**

Now I’m going to make some sounds and see if you can remember where to find them. When
I make a sound, I want you to make the same sound on the PhonicStick. Ok? Let’s start.

Test 2

Now we are going to do another exercise. There are real words, that means something and then there are fake words that doesn't mean anything. Sometimes the fake words sound like real words even though they're not. I have a list of words, some of them are real words and some of them are fake words. When I say a word, I want you to make the same word on the PhonicStick. Ok? Let’s start. *If needed remind the participant of the speaking- and clearing button.*

sat
aia
tip
ina
pta
pat
sip
tsa
tan
pin

Good work! Thank you for coming, I will see you again next time!

Session 2-Playsession

Nice to see you again! Do you remember the PhonicStick? Let's see if you can remember how to make sounds?

Where’s s
Where’s t
Where’s i
Games

1. I’m going to look away and make some sounds and you are going to try and make the same sound on the PhonicStick. Ok? **Turn your back and ask the participant to make:** /s, t, i, a, p, n, s, i, t, n/.

Now you make sounds on the PhonicStick and I’m going to guess which sound it is. Ok? **The participant makes a sound with the PhonicStick and you say which one it is, say the wrong one now and then to make sure the participant can correct you accurately.**

2. Ok, now we are going to make some words on the PhonicStick. Can you try to make sit? **Continue with sat, tip, tap, pin, pan.**

3. I’m going to say a word and you are going to make the first, middle or last sound of the word. The first sound is the sound the word begins with and the middle sound is in the middle of the word. The last sound is the sound the word ends with. If we take the word “pin”, what is the first sound? **Let the participant answer.** It begins with a /p/. What is the middle sound? The middle sound is /i/. What is the last sound? The last sound in “pin” is /n/. **Let the participant do the sounds on the PhonicStick while doing the exercise.**

Let’s start! Make the first sound in *tan*. Make the first sound in *pat*. Make the middle sound *ian*. Make the middle sound in *nit*. Make the last sound in *pan*. Make the last sound in *ntp*. Make the first sound in *ati*. Make the middle sound in *isa*. Make the last sound in *sit*.

4. Now we are going to do one last exercise. Can you make the word “sit”? **Let the participant make it on the PhonicStick.** If you change /i/ in “sit” to /a/, what word do you get? **Let the participant say it and then make it on the PhonicStick.** “Sat”. Good!

Now we are finished for today. Good work! Thank you and see you next time!
Session 3

Nice to see you again! Do you remember the PhonicStick? Today I’m going to see how much you can remember on the PhonicStick.

- Test 1

I’m going to make some sounds and see if you can remember where to find them. When I make a sound, I want you to make the same sound on the PhonicStick. Ok? Let’s start.

a
n
s
t
i
p
s
a
i
n
t
p

- Test 2

Do you remember that we talked about real words, that means something and fake words that doesn’t mean anything? Sometimes the fake words sound like real words even though they’re not. I have a list of words, some of them are real words and some of them are fake words. When I say a word, I want you to make the word on the PhonicStick. Ok? Let’s start. *If needed remind the participant of the speaking- and clearing button.*

(tan)
	in
	iti
	pan
	pa
	st

nt
	nt
	nt
	pn
	sp

tap
	sna

pit

That’s it for today. Well done! I’ll see you next time!

Appendix I
PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM FOR USE BY PARENTS/LEGAL GUARDIANS

TITLE OF THE RESEARCH PROJECT:
“The PhonicStick - A South African pilot study about learning how to use a communication device for early literacy training”

PRINCIPAL INVESTIGATORS: Jenny Kimhag & Gabriella Lindmark

CONTACT NUMBERS: +27 792 287 353 or +27 767 155 762

Your child is being invited to take part in a research project. Please take some time to read the information presented here, which will explain the details of this project. Please ask the study staff or doctor any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how your child could be involved. Also, your child’s participation is entirely voluntary and you are free to decline to participate. If you say no, this will not affect you or your child negatively in any way whatsoever. You are also free to withdraw him/her from the study at any point, even if you do initially agree to let him/her take part.

This study has been approved by the Committee for Human Research at Stellenbosch University and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?
The aim of this study is to see if a group of 10 South African 5-6 year olds can be taught how to use the PhonicStick in three training sessions without using a visual interface, and to see if their phonological awareness improves by using it.

The participants of the study will consist of a group of 10 typically developing children age 5-6 from one or several South African nursery schools. All children will have English as mother tongue.

The study will take place over a period of 3 weeks. The children will meet the researchers at their school once a week for three individual sessions (one session/week) to work with the PhonicStick. There will also be two additional test sessions for each child to evaluate their pre- and post-training phonological awareness skills. Video or audio recordings will be made.
through all three sessions.

In the first session the PhonicStick will be introduced to the child for approximately 5 minutes. After the introduction the child will be able to play with the PhonicStick on his/her own. In the end of the first session the children will be tested by being asked to find x number of phonics, to produce as many real words as possible in two minutes and finally to produce real words as well as non words.

In the second session no tests will be performed. The children will be asked to play games on the PhonicStick with the researchers.

In the beginning of the third session the researchers will repeat the positions of the sounds while checking if the children can remember them. The children will then play two of the games from the second session with the researcher. After playing with the PhonicStick, each child will once again be tested in the same way as described in the first session, this time with a list of targets.

The phonics in the PhonicStick are accessed by moving the joystick in one of the eight major compass rose directions and around the circumference. The 6 phonics: /s, a, t, i, p and n/ used in the Scottish pilot study will be used in this study as well.

The pre- and post-test of phonological awareness data will be analysed with a t-test. The data from the testing of learning to use the PhonicStick will be presented as descriptive data in text accompanied by graphics.

**Why has your child been invited to participate?**
The selected children have been invited to participate because they are typically developed, in the right age for the study and because they are approaching or are in their pre-literacy
learning phase. Additionally, because of the interest in language development from the children’s nursery school.

**What will your responsibilities be?**
The children can withdraw from the study at any time. All information is confidential as the children will be identified by number only.
As all the activities of the research are similar to normal school activities potential for risks is very low. Attention will also be paid to ensure that the children's current education does not suffer by their participation.
The audio-visual recordings will be kept in a locked facility at the department of Speech-Language and Hearing Therapy, Stellenbosch University.

**Will your child benefit from taking part in this research?**
Participation in this study may result in an improved phonological awareness in the child. Phonological awareness is agreed to be the greatest single predictor that a learner will become a proficient reader is his or her phonemic awareness at the beginning of school (Adams 1990).

**Are there any risks involved in your child taking part in this research?**
There may be a risk that the individual child is affected by the test situation and feels uncomfortable, which may give misleading results.

**Will you or your child be paid to take part in this study and are there any costs involved?**
You or your child will not be paid to take part in the study, but you/your child’s transport and meal costs will be covered for each study visit. There will be no costs involved for you if your child does take part.

**Declaration by parent/legal guardian**
By signing below, I *(name of parent/legal guardian)**************************************** agree to allow my child *(name of child)**************************************** who is ******** to take part in a research study entitled The PhonicStick - A South African pilot study about learning how to use a communication device for early literacy training.
I declare that:

- I have read or had read to me this information and consent form and that it is written in a language with which I am fluent and comfortable.
- If my child is older than 7 years, he/she must agree to take part in the study and his/her ASSENT must be recorded on this form.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is voluntary and I have not been pressurised to let my child take part.
- I may choose to withdraw my child from the study at any time and my child will not be penalised or prejudiced in any way.
- My child may be asked to leave the study before it has finished if the study doctor or researcher feels it is in my child’s best interests, or if my child do not follow the study plan as agreed to.

Signed at (place) ........................................ on (date) ........................................ 2005.

.............................................................. ..............................................................
Signature of parent/legal guardian Signature of witness