The use of the PhonicStick in group training

Can South African children age 5-6 improve their phonological awareness by using the PhonicStick?

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ABSTRACT

Phonological awareness is the ability to recognize, reflect on and manipulate sound structures of a language. This ability has been shown to be crucial when acquiring literacy. The PhonicStick is a speech-generation communication device, which was initially developed for individuals with complex communication needs (CCN) though more recent research has focused on the effects of the device on factors important for literacy acquisition. In the present study the effects on phonological awareness were evaluated after seven group training sessions with the PhonicStick. The participants of the study were 20 typically developing South African 5-6 year old children. All participants were pre and post tested with The Phonological Awareness Test part c) isolation and a PhonicStick test which tested the ability to produce isolated phonemes and combinations of three phonemes with the device. The results of the study showed that training with the PhonicStick did not appear to improve results on The Phonological Awareness Test part c) isolation. However, it was found that the participants of the training group had improved their ability to manoeuvre the PhonicStick and to produce isolated phonemes and combinations of three phonemes.

Keywords: Phonological awareness, literacy acquisition, the PhonicStick, complex communication needs (CCN)

SAMMANFATTNING

Fonologisk medvetenhet är förmågan att känna igen, reflektera över och manipulera ett språks ljudstrukturer. Denna förmåga har visat sig vara betydelsefull vid tillägnandet av läs- och skrivförmåga. The PhonicStick är ett talgenererande kommunikationshjälpmedel som ursprungligen utformades för individer med komplexa kommunikationsbehov. Senare forskning har även fokuserat på hjälpmedlets effekter på faktorer som är viktiga vid tillägnandet av läs- och skrivförmåga. I föreliggande studie utvärderades effekterna på fonologisk medvetenhet hos 20 normalutvecklade sydafrikanska barn i åldrarna 5-6 år efter sju gruppträningstillfällen med the PhonicStick. Alla deltagare i studien pre- och posttestades med två test. Deltest c) från The Phonological Awareness Test rörande förmågan att isolera ljud, samt ett PhonicStick test. Detta testade förmågan att producera isolerade fonem och kombinationer bestående av tre fonem med the PhonicStick. Studiens resultat visade att träning med the PhonicStick inte resulterade i förbättrat resultat på The Phonological Awareness Test del c) isolerade fonem. Däremot tydde resultatet på att deltagarna i testgruppen förbättrade sin förmåga att styra the PhonicStick samt producera isolerade fonem och fonemkombinationer bestående av tre fonem.

Nyckelord: Fonologisk medvetenhet, läs- och skrivinlärning, the PhonicStick, komplexa kommunikationsbehov
1. Introduction

Phonological awareness has been shown to be crucial for individuals acquiring literacy (Ehri et al., 2001). Many augmentative and alternative communication users face an inability to speak. This is due, for instance, to a lack of exposure to literacy experience, which has been shown to have an impact on language development and literacy skills (Alant & Bornman, 1996). The PhonicStick is a speech-generating device prototype, which was developed at the School of Computing, University of Dundee, Scotland. It was initially designed for individuals with complex communication needs (CCN), but recent studies have investigated if the device could be useful in literacy learning (Ager & Sollå, 2009; Kimhag & Lindmark, 2009; Lempke & Lindberg-Wesslert, 2009). The device enables the user to create words by blending sounds together. The prototype was programmed with six phonemes, which are used in the first learning stage of the literacy-teaching programme used in the United Kingdom (Black et al., 2008).

The aim of the current study was to analyse what effect group training with the PhonicStick would have on phonological awareness in a group of typically developing South African 5-6 year olds.

1.1. Phonological awareness

Within the field of linguistics, clearly defined terminology is crucial. The term phonology refers to the area of the linguistic field concerned with the function, behaviour and organization of language sounds and sound systems. Phonetics, on the other hand, is the field concerned with the study of the physical, physiological and anatomical aspects of speech sounds (Yavaş, 1990) Phonemes are the smallest distinctive units of speech sounds and are made up of phones which are variations of speech sounds that do not change the meaning of a word, and therefore are not as significant to the perception of speech as phonemes (Goldstein & Smiley, 1998). The sounds used in the training in the current study will be referred to as phonemes. Phonemic awareness should be separated from the terms phonological awareness and metalinguistics. While phonemic awareness is one aspect of phonological awareness, both phonemic awareness and phonological awareness are components of the metalinguistics. The metalinguistic field is concerned with ones awareness of, reasoning about and control over language in general. The term phonemic awareness refers to the awareness of the fact that the speech stream is built up by a sequence of phonemes and the ability to manipulate those units. Phonemic awareness is one aspect of phonological awareness that refers to one’s awareness of the sound structures of language in general, and puts emphasis on reflecting on an utterance sound structure rather than its meaning. While phonemic awareness is concerned with one’s sensitivity and control of the smallest significant units of speech sounds, phonological awareness is concerned with one’s ability to reflect on and manipulate any size unit of sounds (Yopp & Yopp, 2000).

Phonemic awareness is crucial for readers of an alphabetic orthography in which speech is mapped to print at the phoneme level (Yopp & Yopp, 2000). An individual acquiring literacy needs to have an understanding that words can be segmented into syllables and phonemes, and that symbols in the alphabetic orthography represent phonemes (Ball & Blachman, 1991). Compared to a logographic language where the symbols convey a meaning, the symbols of an alphabetic language only represent sounds and have no meaning in themselves (Snider, 1995). Thus, the symbol system would be arbitrary without phonemic awareness (Yopp & Yopp, 2000).
Phonological awareness is not only an important factor for understanding alphabetic scripts, but has also been proven to have a statistically significant impact on reading acquisition (Ehri et al., 2001). In a quantitative meta-analysis, Ehri et al. (2001) compared the outcomes of 96 cases from a total of 52 studies to analyse the contribution of phonemic awareness instructions to reading and writing acquisition. Analysis of effect sizes revealed that the use of phonemic awareness instructions had a large impact, and was statistically significant in helping children to acquire phonological awareness. Further, phonological awareness instructions were found to have a statistically significant impact on reading and spelling. The training with phonemic awareness instructions showed to be more effective when taught in smaller groups compared to if trained individually or in the classroom. It was also found to have a positive impact on the training to teach a few phonemic awareness skills rather than several. Further, results of the study showed that involving letters in the training had more positive impact on the training than when they were not used.

When assessing phonological awareness, tasks including rhyme knowledge, blending, segmentation and manipulation of syllables, clusters and phonemes are used (Stackhouse & Wells, 1997). Ball and Blachman (1991) reasoned that phonological awareness tasks, for example when asking a child to find an initial, final or medial sound in a word, do not merely require discrimination. When accessing phonemes it is more a matter of abstraction rather than discrimination, due to the fact that the phonemes are not separated in the acoustic stimuli itself, but are rather co-articulated.

Wagner and Torgesen (1994) asserted that the phonological processing skills; phonological awareness, phonological memory and phonological information access rate, are important factors for a positive rate of beginning acquisition of reading skills. Even though research (Liberman et al., 1974) has shown that young children without literacy skills can perform syllabic segmentation tasks and identify initial phonemes in words, orthographic experience sharpens children’s phonological awareness skills and allows them to make finer distinctions (Ball & Blachman, 1991; Wagner & Torgesen, 1994). Ball and Blachman (1991) found that phoneme awareness instructions together with instructions in grapheme-phoneme correspondence had a significant effect on growth of reading and writing skills while “instructions in letter names and letter sounds alone did not significantly improve the segmentation skills, the early reading skills or the spelling skills” (p.49).

The difficulties in achieving a significant improvement in the phonological awareness of at-risk children through phonological awareness training prior to reading instructions have been indicated by Torgesen, Morgan et al. (1992) and Torgesen et al. (1993). A total of 143 kindergarteners participated in an 8-week training program. 51 children were matched into either one of two experimental training conditions or to a language experience training control. One experimental training condition group was trained in phonological awareness tasks including analysis and synthesis, or blending activities, while the participants of the other were only exposed to blending activities. The language experience training control took part in meaning-oriented language experience activities. The majority on the studies participants showed a significant improvement in phonological awareness at the end of the study. Though, approximately 30% of the participants that had been identified as at-risk children in the beginning of the study showed no measurable growth in phonological awareness at the end of the program (Torgesen, Morgan et al., 1992). In a 12-week training study conducted by Torgesen et al. (1993), 60 kindergaten children, who had been screened at risk for reading failure, were trained in analytic and synthetic phonological awareness. The participants were trained in groups of 3-4 children, for 20 minutes, 4 times a week and were given explicit instructions in blending (synthetic) and segmentation (analytic) tasks. During the last 3 weeks of training, they were taught how to use the trained skills to read a few real words. At the end of the program, the phonological skills of a substantial amount of the
participants in the training group remained relatively weak. Wagner and Torgesen (1994) reasoned that variables which predict a successful response to phonological awareness training would be affected by factors like slower access to phonological representations than non-disabled children and difficulties with spelling and reading novel words. Thus, it was reasoned that a large proportion of children with reading disabilities would not profit significantly from phonological awareness training. Stanovich (1986) emphasized the importance of taking reciprocal relationships and organism-environment correlations into account when considering an individual's literacy acquisition. The reciprocal relationship considers “situations where the causal connection between reading ability and the efficiency of a cognitive process is bidirectional”, while organism-environment correlations consider different environmental factors that individuals are exposed to and affected by (Stanovich, 1986, p.360). Stanovich described early reading failure to be affected by so called “Matthew Effects”, or rich-get-richer effects. Poor readers with an inadequate vocabulary tend to be less exposed to print and therefore practice reading skills less, which results in a slower vocabulary development, which affects and limits further fluency and comprehension development.

1.2. Literacy and literacy teaching

1.2.1. Literacy

Literacy—the ability to read and write—is a human right. A definition of functional literacy was adopted by UNESCO’s General Conference in 1978:

“A person is functionally literate who can engage in all those activities in which literacy is required for effective functioning of his group and community and also for enabling him to continue to use reading, writing and calculation for his own and the community’s development.” (EFA Monitoring Report, 2006, p.30).

Literacy is an important means of communication. The ability to read and write gives a person the ability to access written information as well as express himself or herself in written text. In a linguistic perspective, phonological awareness, the ability to identify and manipulate phonemes, is needed to become literate. Decoding is used in the learning process of writing. When decoding, sounds of the spoken language are blended into words and connected with graphemes. Learning how to write is to learn the connections between letter patterns and the sounds they represent. Children learn the letter by its sound not by its name (Rose, 2006).

1.2.2. Literacy in South Africa

Results from the Progress in International Reading Literacy Study (PIRLS) from 2006, which is IEA’s (International Association for the Evaluation of Educational Achievement) assessment of students’ reading achievement in grade four, showed that the average literacy of South African children is low when compared to children in other countries. The study, which was conducted in 40 countries, showed that South African pupils in grade five achieved the lowest score on literacy when compared to children in the other 39 countries. According to the study, aspects considering the participating countries’ demographic, economic and health factors (in which the countries varied widely) should not be overseen when evaluating the results of PIRLS 2006. Of the participating countries, South Africa was the one with the highest primary pupil-teacher ratio (35-1), the highest infant mortality rate per 1,000 live births and the lowest life expectancy at birth. The participating South African children had undergone one more year of formal schooling compared with the
majority of the other participating countries and also had the highest average age at the time of testing (Mullis, Martin, Kennedy & Foy, 2007). The fact that South Africa still has much poverty results in a great extent of learners entering the formal school in the country come from disadvantaged homes. 50 percent of the black and coloured population in South Africa is considered to have an academic delay due to environmental, socio-economic and/or educational deprivation. These learners have not been exposed to literacy resources such as books, newspapers and libraries, and have thereby not the literacy ability which is expected when entering the formal school (du Plessis, 2001). Learners are expected to have learned to read independently after the first three years in the school system. After this you should begin to develop the ability to acquire knowledge through reading. For learners that come from an enriched literacy background, this time will be sufficient, while the learners from a disadvantaged background might need more time to acquire the abilities (Moore & Hart, 2007). The parents in disadvantaged families have often had poor exposure to literacy. Hence, they have a lack of knowledge and ability to provide early literacy stimulation to their child. Absence of an authority figure during homework time may contribute to a difficulty for the child to adjust and accept the teacher as an authority while in school. Disadvantaged children often have to help out at home, which conduces to homework time being interrupted by a task, or that they attend school late or not at all. Other factors that are common in disadvantaged homes and often affect the learning process in a negative way are financial position, alcohol abuse, domestic violence and overcrowded homes. The lack of exposure to writing affects the learners’ cognitive abilities, and poor concentration ability is often shown among these learners. If a learner has not been exposed to writing and ha not gained a basic knowledge about the letters and letter sounds before entering formal schooling, they are likely to develop special communication needs. The chronological age alone does not make sure that a child is ready to enter the formal school. Aspects such as background, cognitive development and social advantage can affect how learners cope in a formal school environment (du Plessis, 2001).

1.2.3. Jolly Phonics

The Jolly phonics was developed in England 1978 by two primary/elementary schoolteachers; Sue Lloyd and Sara Wernham. It is a common teaching approach in the United Kingdom and is based on systematic synthetic phonics. Phonics relates to the correspondence between the sounds and the letters of a language (Ehri et al, 2001). The Jolly Phonics has a multi-sensory approach, where the 42 phonics in the English language are taught to the children in groups of six phonics at a time. Each sound is represented with one or two letters, so called letter sounds. The idea is to learn the letter by its sound and not by its name. One sound is taught each day by using actions. The sound groups are introduced to the children in a specific order, as are presented below. The first sound group was programmed into the speech generating device used in this study. The Jolly Phonics programme was developed to teach children in junior kindergarten to grade two how to read and write. It is mainly used for children who are in the beginning of the learning process of reading and writing. Other domains where the Jolly Phonics is used are among children with reading and writing difficulties, and children who are learning English as their second language.

The five basic skills for learning to read and write according to the Jolly Phonics are: 1) Learning the letter sounds 2) Learning the letter formation 3) Blending 4) Identifying sounds in words 5) Spelling the tricky words (Jolly Phonics Ltd, 2008).
The sound groups 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

1.3. Languages in South Africa

South Africa is known for its diversity in language. There are around thirty languages; the most important are English, Afrikaans, Zulu and Xhosa (Nationalencyklopedin, 2010). Even though some of the indigenous languages today have an official status in South Africa, the two dominant languages are still English and Afrikaans. The country lacks a clearly defined language policy, which makes the linguistic diversity within the country problematic. Research shows that those who speak indigenous languages are, with regard to political, socio-economic and educational matters, considered to be multilingual, while English and Afrikaans first language speakers are considered as bilingual. Before South Africa had a democratic regime the only media of instruction were English and Afrikaans, despite the low competence in the two languages among the majority of the South African population. The former apartheid regime tried to form communities by placing people with the same mother-tongue in the same area. During the regime, racial interactions in residential areas were prohibited. This affected the schools in a negative way and made education a struggle. After apartheid, the compositions of the schools changed. However, today urban schools are attended by learners from all cultural groups, while in the former Model C schools (the former “white-only” schools) there is no diversity shown, neither inside nor outside the schools. In the past, the second language speakers, whom often came from disadvantage backgrounds, were to compete against first language speakers. The second language speakers did often have poor education in English due to ill-trained or unqualified teachers. In some rural schools the problem with ill-trained teachers still remains. For socio-economic reasons, English is used in education institutions in South Africa today. However, there are some institutions that use Afrikaans.

Some African languages such as isiXhosa and IsiZulu are now offered as an optional subject in some Afrikaans-only and English-only schools (Mncwango, 2009). Mncwango (2009) discusses the problems of language diversity in South Africa. His finding is that all schools do not embrace language diversity within the country. The African culture is often not taken into consideration in the schools, e.g. the importance of eye contact is taught, which is something unfamiliar to the African culture. Because of their economic status, many learners from black and coloured families can not afford the former Model C schools. The majority of the African learners in the former Model C schools do not have the ability to read and write in their first language. Mncwango (2009) argues that equal access to English is needed and the functional value of the indigenous languages in South Africa must be spread, to make them a wider communication tool.
1.4. Socio economical status in South Africa

In a study conducted on behalf of the Nelson Mandela Foundation, reflections were made over ten years of basic education in South Africa after the end of apartheid. Various aspects of the basic education were examined, as well as influential factors on these aspects and difficulties that the South African school system faced during the second decade of democracy. Three conclusions were drawn based on the study’s results. Firstly, the effects of apartheid had shown to be more difficult to reverse than expected in 1994. Historical, spatial, economical and other vested interests were found to remain in the school community as well as in the society at large. Secondly, it was concluded that many barriers still remained in the work to reconstruct the educational system. The quality of education was considered to be affected and undermined by a lack, and uneven distribution, of material resources as well as of educators, the slow development of the classroom situation and the educator training, but also “a lack of implementation of sound educational language policy and practice” (Nelson Mandela Foundation, 2004, p.34). Thirdly, the researchers concluded that socio-economic development and education are independent of each other. Not only is education influenced by the economical structure and the access to financial support, but also by factors like health, living standards and employment rates (Nelson Mandela Foundation, 2004).

Schools in the Western Cape region are funded by the Western Cape Education Department (WCED) according to poverty rankings, so called “quintiles”, in their surrounding communities based on the National Norms and Standards for School Funding (NNSF). The schools are assigned a quintile based on three poverty indicators: income level, unemployment rates and education levels of the community (WCED Research notes, 2009). Quintile 1 schools are often situated in poverty-striken areas, whereas quintile 5 schools are often situated in more affluent areas. From 1 January 2007, quintile 1 to 3 schools are exempt from paying school fees (WCED; 17 July, 2007). The National School Nutrition Programme (NSNP) provides a feeding scheme to reach learners in poor communities. The WCED fed 145 596 children in 2004/05 and had an ambition to expand the scheme to feed more than 338 000 children in 2009/10. After expanding the scheme progressively, the WCED fed all learners at quintile 1 to 3 schools and secondary school learners in quintile 1 schools, but also targeted learners in quintile 4 and 5 primary schools and quintile 2 and 3 in 2008/09. Meals were provided in 68.7% of all schools in Western Cape in 2008. The planned budget for the school feeding scheme was in 2009/10 R112.5-million, which is an increase of R75.9-million since 2004/05 (WCED; 21 January, 2009). The participants of this study attended a school classified as a quintile 3 school, i.e., a school in a lower socio-economic status community that is exempt from school fees.

1.5. Communication aids

1.5.1. AAC

Augmentative and Alternative Communication (AAC) is used by people with limited or no verbal expression, with an aim to facilitate communication. This is done through augmenting the verbal output of the individual, or through an alternative method of conveying needs and intentions. The aim of AAC is not to inhibit verbal communication, but to facilitate further verbal output and social interaction (Alant & Bornman, 1994). The inability to speak does not only have an impact on social interaction, but has shown to have an impact on language and the development of literacy skills. This is due to, among other factors, a lack of exposure to literacy experience (Alant & Bornman, 1996).

The results of a survey with the aim “to compare the home literacy experience of physically disabled preschoolers who use augmentative and alternative communication (AAC) systems
to the experience of their non-disabled peers” (Light & Kelford Smith, 1993 p.10), indicated that AAC users are exposed to fewer opportunities to engage in literacy activities when compared to typically developing peers (Light & Kelford Smith). In a study by Sandberg and Hjelmquist (1996), the phonological abilities and literacy competence of eight non-speaking and eight non-disabled preschool children, who had been matched on age and intellectual level, were studied. There was no statistical significance of the results on the phonological tests when comparing both groups. Though the performance on the phonological tests was equal, the comparison group had better results on the reading and writing tests than the disability group. Even though phonological awareness of non-disabled children has been shown to be highly predictive of literacy skills, the researchers reasoned “that even a relatively high level of phonological skill is not enough for the development of literacy skills among non speaking children” (Sandberg & Hjelmquist, 1996, p.148). When comparing both groups, the performances on the reading and spelling tests were on a much lower level in the disability group than in the comparison group.

Even though the results of the study indicated that a non-disabled child should be able to achieve phonological awareness, it is not unusual that they are faced with a difficulty to “form and use the phoneme-grapheme relationship” (Sandberg & Hjelmquist, 1996, p.148).

Further, “mastery of the grapheme-phoneme relationships necessary for successful word recognition and word identification seems even harder to attain” (Sandberg & Hjelmquist, 1996, p.148).

AAC can be divided into two techniques; unaided communication and aided communication. Unaided communication involves the use of gestures, manual signs and pantomimes, which do not require equipment external to the body. Aided communication, on the other hand, incorporates implements external to the users body (e.g. communication boards) and use symbols such as letters and word, picture systems and photographs (Mirenda, 2003). The use of symbol systems can also facilitate an individual’s acquisition of literacy (Alant & Bornman, 1994). It is not unusual to use a multi-modal communication by combining unaided and aided systems with the aim to meet different requirements that can be put on the communication (Alant & Bornman, 1994). Manual signs are, compared to graphical symbol displays without voice output, a communication technique that is more portable, permanent and efficient to use at a distance from the communication partner. The use of manual signing restricts the vocabulary size of an individual only by learner variables, such as fine motor skills and memory, rather than display size and other factors that affect aided communication (Mirenda, 2003). When choosing an aided approach factors such as environmental demands and listener conditions must be taken into account. When communicating with a literate adult there is an advantage for the use of printed words, with or without graphic symbols but also for verbal output communication by using speech-generating devices. This is due to the fact that most adults do not comprehend manual signs. If the communication partner has not acquired literacy skills, the use of graphic symbols with clear visual connection to the referent or a speech-generating device is more efficient (Mirenda, 2003). Michael (1985) argued that manual signing involves an easier discrimination, compared to the use of graphic symbols. While conditional discrimination (i.e. multiple stimuli) is required when using aided symbol systems, there is only a need of unconditional discrimination (i.e. single stimulus) when using a topography-based system, for example manual signing. Due to the fact that manual signing involves a single component rather than a multiple component motor response, it is argued to be an easier aided approach to acquire. In a meta-analytic study by Schlosser and Lee (2000), 50 studies from 20 years of AAC research were reviewed considering the terms of intervention, generalization and maintenance effectiveness. The study aimed to identify strategies that elicit generalization and maintenance, in addition to the effects that the initial learning phase of new communication tools can have. The results, which were consistent
through all age groups and participant populations, showed the unaided AAC approach being significantly more effective when compared to an aided approach when it came to acquisition, but no difference could be seen in the aspects of generalization and maintenance. Although the study’s results suggest that there may be a learning advantage for learning manual signs over aided techniques in an initial phase, it was found that this advantage did not persist over time in shape of generalized communication.

The reliability of an AAC device has been shown to play a crucial role in the initial learning stage of how to use an aided communication technique in an efficient way. Further, a decreased reliability of a device enables further progression in the use of the device but also has an impact on the users’ attitude towards the communication system and with which effect it can be implemented (Rackensperger et al, 2005). In a study by Shephard et al. (2009) the reliability of new speech generating devices was examined. When evaluating the results of the study it was found that the mean time to the first failure of the devices tested in the study was 42.7 weeks. Further, repairs were needed during the first year of use for at least 40% of the devices in the study and more than half (59.2%) of the total amount of the devices failed during the first five years. 66.3% of the devices that failed once in the study, experienced a second break down. When evaluating the most common components that failed, touch screens, wiring, main boards, batteries, memory cards and AC adapters showed to be most prominent. The researchers of the study encouraged for future development of speech generating devices that focus should be put on the reliability of the device, rather than development of new features.

In a study by Light et al. (2007), six non-disabled children were asked to develop an invention to enhance the communication of a child with significant motor and speech impairment. The authors of that study reasoned that “most AAC technologies are designed primarily as a speech prostheses, rather than interactive communication tools” (Light et al., 2007, p.283). The prototypes developed by the study’s participants were multifaceted and integrated aspects such as communication, social interaction and humour, which were shown in features like a “teasing system” and buttons to get attention, which would allow the user to be a part of a social group. Further, the devices integrated functions like telecommunication in the form of a phone and internet access with the possibility to chat and write emails to be able to keep in touch with people in different places. The participants of the study also issued the importance of a play and entertainment function in a communication device of a child and added functions like games, books on tape and movies. The activities could be performed not only by the user on his/her own, but also with a friend or in a bigger social group. They also stressed that communication should be possible during an activity. The devices also incorporated functions to enable art and craft activities and functions allowing the user to participate in motor activities. Further, it incorporated cognitive support which would provide assistance in for example the school. When developing the prototypes, the participants of the study did not only take the user into account by personalizing the devices with functions like change of voice and attitude, but also took the user’s environment and communication partners into account to enable the individual to engage in different social contexts.

1.5.2. The PhonicStick

The PhonicStick is a speech-generating device for people with complex communication needs (CCN). It was developed at the School of Computing at the University of Dundee, Scotland. The inspiration for the PhonicStick came from observations of the ability of children with CCN to navigate their motorized wheelchair by using a joystick. The use of the joystick was to be an initial tool for spoken output, by using the joystick to blend sounds into words. This makes it possible to create words without a visual interface, which does not demand that the user master visual navigation skills or learn to decode visual representations.
A prototype was developed with the six phonemes of the first learning stage in the Jolly Phonics literacy programme. The phonemes programmed into the prototype are: /s/, /a/, /t/, /i/, /p/ and /n/ (Black et. al, 2008). The prototype makes it possible to sound out short words of maximum tree phonemes. By moving the joystick to one of the six positions where a phoneme has been programmed, the device will output the selected sound. The aim of the PhonicStick is to put all the 42 phonemes used in the English language into the PhonicStick. The mapping of the 6 phonemes in the prototype is shown in the picture below.

An initial pilot study was undertaken where seven children of different aetiology participated (including two children with CCN, three children with learning disabilities and two typically developing children). The results indicated that all seven children managed to remember how to use the device to sound out three phoneme words (Black et. al, 2008).

1.5.3. Earlier studies on the PhonicStick

A previously conducted study (Kimhag & Lindmark, 2009) investigated the impact on phonological awareness in a group of 10 typically developing South African 5-6 year old children, after three sessions of training with the PhonicStick, and how they learned to handle the device. The study showed that all participants improved on manoeuvring the PhonicStick and successfully producing words with it. The post-test results on the isolation subtest of The Phonological Awareness Test did not show any significant improvement when compared to the results reached by the study’s participants on the same test when pre tested. Lempke and Lindberg-Wesslert (2009) who studied the effects of the PhonicStick in language play for children with Down’s syndrome, found increased phonological awareness after training with the PhonicStick. Further, some specific tasks concerned with phonological awareness were found to be easier facilitated when performed with The PhonicStick than without the device. In a study with typically developing Swedish preschool children aged 5-6 (Ager & Solli, 2009), no significant improvements in phonological awareness where found when comparing the pre- and post-test results of the test group after three individual training sessions with the PhonicStick and the control group. The participants improved on handling the PhonicStick, remembering the phoneme positions without visual information and producing words with two and three phonemes spontaneously, with picture support and by dictation. All previous studies (Ager & Solli, 2009; Kimhag & Lindmark, 2009 & Lempke & Lindberg-Wesslert, 2009) have investigated the effects of the PhonicStick when trained individually.
2. Aim

The aim of this study, which is to analyse what effect group training with the PhonicStick would have on phonological awareness in a group of 5-6 year old South African children, was tested by The Phonological Awareness Test (PHAT) part c) isolation. Isolation refers to the identification of what sound begins, ends or is in the medial position in a spoken word (Robertson & Salter, 1997). It was considered interesting to see what effects group training with the PhonicStick would have, due to the fact that it has not been investigated previously. To be able to contrast the current study with the previous study by Kimhag & Lindmark (2009), where South African preschool children were trained with the PhonicStick individually, the test part mentioned above was used. The hypothesis of the study was that both the test and the control group would improve their results on the isolation subtest of PHAT due to school training during the period, but that training with the PhonicStick would result in an improvement to a greater extent on both the PhonicStick Test and PHAT when comparing the results of the test and control group. The following questions were raised:

1. Will participants achieve improved results on PHAT part c) isolation (i.e. identifying what sounds begins, ends or is in the medial position of a spoken word) after having engaged in seven sessions of group training with the PhonicStick?
2. Do participants in the test group (those engaged in seven sessions of group training with the PhonicStick) score better than the control group when retested on PHAT part c) isolation (i.e. does the improvement depend on group training)?
3. Can training with the PhonicStick show phonological awareness abilities that cannot be shown by testing with PHAT?
4. Is it functional to use the PhonicStick in group training of phonological awareness?
3. Methodology

3.1. Participants

The study was conducted during a period of 11 weeks in an elementary quintile 3 school in Stellenbosch, Western Cape province, South Africa. The participants of the study were 20 typically developing children who had been recruited from the same Grade R class in which all education was taught in English. Due to time and resource limitations a total number of 20 participants were chosen for the purpose of the current study. The group consisted of 6 girls and 14 boys whose age ranged from 5:6 to 6:4 years. The mean age of all participants of the study was 6:08.

The selection of participants was made by the researcher together with the class teacher. The inclusion criteria were:

1. The participants attend a school class where the medium of instructions is English. The classroom teacher was asked to select participants who were proficient in English.
2. The participants are students in the same class. This was done to control over the phonological awareness training through education.
3. The participant regularly attends school. This information was obtained through the class teacher, as attendance information was not routinely recorded.

3.2. Project design

3.2.1. Questionnaire

The guardians of the study’s participants were given a questionnaire (Information letter parents, see Appendix 2) together with an information letter (Information letter parents, see Appendix 2) before the study begun. The form consisted of questions considering what language was spoken at home and for how long the child had been exposed to English. This was done to give the researchers an overview about the language exposure among the participants of the study. This was relevant when the study was conducted in English in a geographical area where other languages than English are spoken at home. The answers were taken into account when evaluating the results of the study.

3.2.2. The PhonicStick

The PhonicStick is a reconstructed Logitech Attack 3 Joystick with a wooden ball attached to the top of the handle to facilitate manoeuvring of the device. By moving the handle of the PhonicStick to one of the six different positions on the device that have been programmed with speech sounds, a phoneme is chosen and auditory feedback is given by the computer speakers. A phoneme is selected by moving the joystick back to the centre position. A total of three phonemes can be chosen at a time to create words and non-words. Two buttons above the handle were programmed as a “delete button” and two buttons beneath the handle were programmed as a “speech button”. If an incorrect phoneme or combination of phonemes was made, the delete button had to be pressed to make a correction and clear the sounds produced. Due to a bug in the system, this button also had to be pressed before making a new word after the PhonicStick had sounded out a three-phoneme combination. To make the PhonicStick sound out the produced phoneme or combination of phonemes the “speech button” had to be pressed. The prototype used in the study was programmed with the same phonemes as the ones used in the Scottish prototype (/s/, /a/, /t/, /i/, /p/ and /n/), though pronounced in South African English. The phonemes were programmed into six of eight possible compass directions around the circumference of the device. Five of the six phonemes
where produced by pulling the handle to one of the sides around the circumference. The
remaining phoneme (/p/) was produced by pulling the handle first down making the t-sound
and thereafter to the right. The six phonemes and possible words and non-words made out of
two or three-phoneme combinations where recorded with a MBQUART MBK D800 headset
on a HP Pavillion dv6000 computer using the software Audacity. The recordings were made
and programmed into the PhonicStick in August 2010 at the department of Speech-Language
and Hearing Therapy, Stellenbosch University, South Africa by the researchers. Because of
the lack of more advanced technical equipment, some of the sounds did not have the
appropriate quality. It was noted during the study that the /n/-sound often was mistaken for an
/a/ by the participants in the training group. A graduate Speech and Language Therapist
speaking South African English was recorded producing the six phonemes and possible sound
combinations.

3.2.3. The PhonicStick Test
All participants were pre and post-tested with the PhonicStick Test (Instructions pre and post
test, see Appendix 3). This test was designed by the researchers of the current study to
examine the participants’ ability to handle the PhonicStick and produce isolated sounds and
words of three phonemes. The PhonicStick Test consisted of two lists, List A (List AB, see
Appendix 4), and List B (List BA, see Appendix 5). Each list consisted of two parts. The first
part; a) isolated phoneme, tested the ability to produce 12 isolated phonemes that had been
placed in random order. Each of the six phonemes that can be produced with the PhonicStick
was to be produced twice in this test part. The researcher noted if self-corrections were made,
if the researcher had to ask the participant to try again (request) and if the correct target sound
was produced. When an incorrect phoneme was produced, the participant would only be
asked once by the researcher to try again. Even so, the participant was allowed to try finding
the target sound until satisfied with the produced phoneme. All produced sounds were noted
in the test sheet. All directly correct produced answers gave 1 point. If the child produced the
correct target sound after self-correction or after request, this was counted as a correct
response, which gave 1 point. The notes that were made about the participants’ responses
were used in qualitative evaluation of the results. The second part of the test; b) three
phoneme combination, tested the ability to produce six words, three real words and three non-
words, made up by combinations of three phonemes that the participants were asked to
produce. The words that were used during testing had not been practised in the training
sessions. Notes were made in the test sheet considering self-correction, request and if target
word was produced. Each correct word gave 1 point, even if created after self-correction or
request. The participant did not have to press the speech button to make the word count as
correct. If the participant pressed the speech or delete button without being asked, this was
noted on the test sheet. Further notes were, for instance, made by the researcher considering
what sounds were produced by a participant when asked to produce a target word, and if the
speech or delete button was pressed without the researcher asking for it.
The first part of the PhonicStick Test allowed a maximum of 12 points and the second part of
the test a maximum of 6 points, thus a total of 18 points could be reached on the test.

3.2.4. The Phonological Awareness Test (PHAT)
The Phonological Awareness Test (PHAT), was developed by Robertson and Salter, to
diagnose deficits in phonological processing and the phoneme-grapheme correspondence. The
test is recommended for people in the developmental age 5:0 - 9:0 and consists of ten
subtests, which include tasks that correlate with early reading and spelling achievement. The
subtests are arranged in a developmental sequence and include the following; a) rhyming, b)
segmentation, c) isolation, d) deletion, e) substitution, f) blending, g) grapheme, h) decoding
and the optional part i) invented spelling. The whole test, which is an individually administered test, takes about 40 minutes to complete and can be administered in two or more sessions if needed. Each correct response in the subtests gives 1 point while an incorrect response gives 0 (Robertson, Salter. 1997). For the purposes of this study the subtest c) isolation was selected. It consists of three parts: initial, final and medial isolation. A maximum of 10 points could be reached on each part of the isolation subtest. Thus, a maximum of 30 points could be achieved on the isolation subtest. 1 point for each correct response and 0 points for an incorrect response is given by the test administrator. No prompts other than repetition of the stimulus phrase of the task are allowed (Robertson, Salter. 1997).

3.2.5. Additional equipment
The PhonicStick was used with a HP Pavillion dv6000 and a Sony VAIO VGN-S24VWN during the pre and post-testing. PHAT part c) test protocol and the PhonicStick test protocol (List AB, see Appendix 4 & List BA, see Appendix 5) were used during the pre and post-testing of the participants. During the sessions, the PhonicStick was set up to a Sony VAIO VGN-S24VWN. During the sessions a Canon Digital Video Camcorder MVX40 placed on a tripod approximately 2 metres from the participants was used. Fujifilm DVC cassettes à 60 min were used for the recording. During Session 4 through 5, LEGO DUPLO Basic Brick Medium was used as a part of the training. The blocks were used to facilitate understanding of the isolation tasks. A total of six blocks were used during the training: three big and three small in the colours yellow, blue and red.

3.2.6. Observations
Each session was administered by one researcher while the other researcher observed the session. Notes were taken of relevant observations, for example the concentration of the participants or how the participants perform on different tasks during the session. This was done to monitor the development of the participants on an individual level throughout the study. The observations were to be used on a qualitative level at the end of the study.

3.3. Procedure
Each participant was assessed with a pre and a post-test to evaluate their phonological awareness regarding isolation, as well as their ability to handle and produce isolated phonemes and three-phoneme combinations with the PhonicStick. The testing of the test group and control group was done in the same period of time to avoid the school training to have any impact on the test results. Due to the fact that the participants attended the same school class, it was assumed that all participants were exposed to the same phonological awareness training during the education. This could therefore be ruled out as a factor influencing the test results in a misleading way. The results on the pre and post-test of both the test and control group were to be compared at the end of the study to draw conclusions of what effect training with the PhonicStick would have on phonological awareness. The pre and post-test consisted of two individually administered tests; the PhonicStick test and PHAT, together with one of the two researchers. The child would meet one of the researchers at the pre test and the other when the post tested was conducted to avoid examiner bias. The pre and post-test took approximately 15 minutes each to complete. Five of the study’s participants were pre-tested on the same day as the group introduction of the PhonicStick was held. Due to time limits, the remaining fifteen participants were tested one week after being introduced to the PhonicStick. Seven group training sessions with the PhonicStick were conducted between the pre and post test with half of the studies participants that had been divided into one of two
training groups. The time between the pre and post-test was nine weeks due to two weeks of school holiday during the time the study was conducted. Each training session was administered by one of the researcher in groups of five participants, with the other researcher taking notes. The sessions were organized in such a way that the two groups met with one of the researchers every second session to avoid examiner bias. Each session lasted approximately 25 minutes. Both groups were given the same training and instructions during the sessions, which is described in the section “3.3.3. Sessions 1-7”.

3.3.1. Pre-testing
At the start of the study, all (20) participants were randomly divided into one of four groups with four-six participants in each group, in which they were initially introduced to the PhonicStick (Introduction to The PhonicStick, see Appendix 6). After the introduction, all participants were individually pre tested; first with the PhonicStick Test (See Instructions Testing, Appendix 7) and thereafter with PHAT, part c) isolation. Before pre-testing, each child got a short individual repetition of the positions of the sounds in the PhonicStick and how to make words with the device. Half of the participants were randomly assigned to be tested with List A (List AB, See Appendix 4) in the pre-test and with List B (List BA, See Appendix 5) in the post-test while the other half of the participants where pre-tested with List B and post tested with List A. This was done to avoid misleading results.

3.3.2. Grouping of participants
After pre-testing, the (20) participants were matched into one of two groups; one test group, which was trained with the Phonic Stick, and one control group. Aspects that were considered when matching were results on the PHAT-test and results on the PhonicStick Test, which listed the participant’s gender and that the participant was pre-tested. The control group consisted of 2 girls and 8 boys whose age ranged from 5,6-6,3. The mean age of the group was 6.06 years. The test group, into which 10 participants of the study had been matched, consisted of 4 girls and 6 boys whose age ranged from 5,7-6,4. The mean age of the group was 6,1. These participants were thereafter matched into one of two training groups: Test Group Red and Test Group Blue. The groups were given names to facilitate description and distinction making between the two. Each test group consisted of 2 girls and 3 boys. The participants of Test Group Blue had an age range of 6,0-6,4 and a mean age of 6,2 while the participants of Test Group Red had an age range of 5,7-6,25 and mean age of 6,0.

3.3.3. Sessions 1-7
During the 11 weeks under which the study was conducted, the two groups that were trained with The PhonicStick had seven training sessions in groups of five participants together with both researchers, while the control group was only exposed to the PhonicStick when pre- and post-tested. Each session began with a repetition of the positions in the PhonicStick and was thereafter followed by activities in which all children had to participate. All exercises during each session involved the PhonicStick, and each child would use the device at least one time per exercise. When not using the PhonicStick, the participant still actively took part in the exercise. All children were given the same instructions during the sessions, but were allowed to ask as many questions as they liked. The researchers encouraged the children to sound out words with the PhonicStick during the sessions. Each session lasted approximately 25 minutes, and the focus of the training session was on blending, segmentation and isolation on phoneme level. Due to limited resources, all sessions except Session 7 were video recorded. Below follows a short description of each session. For full session plans see Appendix 6.
Session 1
Reintroduction to the PhonicStick:
During the first session the participants of the study were reintroduced to the PhonicStick. They were also introduced to the “speech button” and the ‘boink’ sound was explained to the participants by the researcher. This was done by explaining that there is no sound to produce words in the positions where the ‘boink’ sound is found. The participants were also informed that sounds produced may disappear when a ‘boink’ is made. The reintroduction to The PhonicStick was done by asking one participant at a time to move the PhonicStick in one of the six different directions were phonemes have been programmed. If a child had difficulties with direction words, the researcher made a movement with the hand, like with the PhonicStick in the direction asked for. The participants that were not using the device to produce a phoneme were asked to listen carefully to what sound was made. The participants were asked to guess what sound was made and thereafter the “speech button” was pressed to see if they guessed correctly.

Session 2
Repetition of positions:
The positions of the PhonicStick were repeated by the researcher asking the participants what sounds are made if the device is moved in one direction. The researcher made a movement with the hand, like with the PhonicStick, in the direction asked for at the same time as the question is made. The participants were asked to guess and thereafter the “speech button” was pressed. All six phonemes were repeated with the same procedure.

Using the delete button, making a two phoneme combination and pushing the speech button:
The researcher initially introduced the two delete buttons, explained their functions and when they are used. Thereafter the researcher introduced an activity by making two different sounds with the PhonicStick and thereafter explained that the “speech button” has to be pressed to put them together. This was done by the researcher making /t/ and /a/, explaining how to put sounds together and thereafter pressing the “speech button”. All participants were asked to do the same task with the same sounds.

Making a two phoneme combination and pushing the speech button:
One child at a time was asked to produce two different phonemes and push the “speech button” while the rest of the group listened carefully to what sound was produced and guessed what they heard.

Session 3
Due to a school holiday, two weeks passed between Session 2 and Session 3.

Repetition of positions:
The different positions of the PhonicStick were repeated, which was done by the researcher holding up the device so that it faced the group in the way it needs to be placed on the table when making sounds. The researcher thereafter asked one participant at a time to show, by pointing, were to find one of the six possible phonemes of the device.

Repetition of speech and delete button:
A more thorough review of the speech and delete button was made. This was done by the participants guessing what had to be done before making a sound. Thereafter the researcher pointed at the delete button and explained what would happen if it was not pressed. It was followed by an example of what happens when the delete button is not pressed between two
different phoneme combinations intended to be made. The participants were also informed that only three phonemes can be made at a time, and what happens if more than so are made.

Making two-phoneme combinations, guessing, listening: One child at a time made two sounds of their own choice. The rest of the participants guessed what combination the sounds made and thereafter the speech button was pressed to see if this was correct. If the child did not push delete button the researcher asked what had to be done if an incorrect sound was made.

Making a two-phoneme combination and pushing the speech button: The task from session 2 was repeated (See Session 2: Making a two sound sequence and pushing the speech button). The researcher asked the participants what had to be done before making a new sound. Thereafter the researcher made two phonemes (/t/ and /a/). The participants were asked what has to be done to put the sounds together and were thereafter asked to say what sounds they heard. Each participant did the same task with the same phoneme combination. If the delete button was not pushed, the participants were asked what had to be done when an incorrect sound was produced.

Session 4
Repetition of positions: Each participant was asked to produce one of the six possible phonemes in the PhonicStick. This was done by the researcher placing the PhonicStick in front of one participant at a time, asking them to show where to find a specific phoneme. If the child had difficulties finding the phoneme, the researcher showed with a movement of the hand in which direction to move the device.

Repetition of the delete button and the speech button: The function of the delete button was repeated by the researcher asking the participants what had to be done before making a new sound and which buttons had to be used before a new sound was produced. The function of the speech button was repeated by asking the participant what had to be done when you want to listen to sounds that have been made and what buttons had to be used to do so. The participants were also asked how many sounds could be made with the PhonicStick at a time. While explaining how many phonemes could be produced with the device at a time the researcher put down one block per phoneme to clarify the task.

Making a three phoneme combination, guessing and counting sounds: One participant was asked to produce three different sounds with the device. One block per sound made was put down on the table by the researcher. The participants of the group were thereafter asked what sounds they heard and what the sounds were. The sounds were thereafter counted together with the researcher by using the blocks that had been put down. The researcher summed up how many and which sounds the sequence consisted of. All participants did the same task.

Reintroduction of ‘boink’: The ‘boink’ sound was reintroduced by the researcher explaining that there is no sound to produce words in the positions where you find the ‘boink’ sound. The participants were also informed that sounds made could disappear when a boink was made. This was clarified by the researcher making a two-phoneme combination and thereafter a ‘boink’. One block was put down for each of the two phonemes made. When the ‘boink’ was made the researcher took away the last block put down. The last sound in the two-phoneme sequence was made again
and the block was put down on the table again.

Making a three-phoneme combination:
The participants were thereafter told to make a three-phoneme combination. They were reminded of pressing the delete button before making a new combination and if hearing a ‘boink’. One child at a time made a three-phoneme combination, the participants were asked what they heard and the blocks of the sounds made were counted. The researcher also told what sound each block represented. Each participant was asked to do the same task.

Session 5
Due to a school holiday, two weeks passed between Session 4 and Session 5.

Repetition of positions:
The activity used in session 4 (See Session 4: Repetition of positions) was used to repeat the positions of the phonemes in the PhonicStick.

Repetition of boink:
The participants were asked what a ‘boink’ sound meant and what happened to the sound previously made if a ‘boink’ is made, but also how this could be corrected.

Making a two phoneme combination:
The researcher first showed how to put the two phonemes /s/ and /a/ together. The researcher put down a block per each sound made at the same time as saying each phoneme. The participants were asked what button had to be pressed to make the PhonicStick sound out the sounds made. The participants were asked what they heard and the researcher pointed at one block at a time at the same time as saying /s/, /a/. Each participant did the same task. Thereafter the same task was performed but with /t/, /i/.

Making three phonemes, counting:
Each participant was asked to make three different sounds. One block was put down per sound made. If the incorrect amount of phonemes was made, the participant was asked how many sounds were produced and how many sounds they were asked to make. The participant was asked to try again. The participants were thereafter asked how many sounds were produced and which sound these were.

Session 6
Repetition of positions:
The researcher asked each participant to move the PhonicStick in one of the six different directions where phonemes have been programmed and thereafter asked the participants what sound they heard in that position. Each participant did the same task but with the instruction to move the device in a different direction.

Making three phoneme combination, listen:
The researcher introduced the task by making /tas/ and sounding out each sound. The participants were asked what sound combination was made. The researcher repeated each sound made by saying it. All participants made the same combination.

Making a two-phoneme combination, listen:
The researcher made /pa/ and thereafter asked what the participants heard. Each participant was thereafter asked to make one of five two-phoneme combination (/na/, /in/, /pa/, /it/, /sa/).
The other participants were asked to say what they heard and the researcher said which sounds the combination consisted of.

**Making a three-phoneme combination starting with /t/, listen:**
Each participant was asked to produce a three phoneme combination that starts with /t/. The other participants were asked how many and which sounds were produced.

**Session 7**
**Repetition of positions:**
The same activity used in Session 4 and 5 (See Session 4: Repetition of positions) was used to repeat the positions of the phonemes in the PhonicStick.

**Finding phonemes in initial and final position:**
The researcher produced the sound combination /sat/ and then asked the participants what sound they heard in the beginning of the combination, and thereafter asked what sound they heard at the end of the combination. The participants were asked to produce one of five sound combinations (/isa/, /nap/, /ipa/, /pas/, /ati/) and were thereafter asked about the sounds in the initial and final position of the word.

**Hearing isolated phonemes and putting them together:**
The researcher made two isolated phonemes with the PhonicStick and thereafter asked the participants what is heard if the sounds are put together. The speech button was pressed to see if the guess was correct. Thereafter, each participant was given two isolated phonemes to produce. The other participants were asked what was heard if the sounds are put together. The speech button was pressed and thereafter the researcher said the two isolated phonemes. The sound combinations used were /sa/, /ni/, /ps/, /tn/, /at/.

**Making a three-phoneme combination with a specific initial and final sound:**
Each participant was asked to produce three different sounds. The researcher gave each participant a specific sound that should be in the beginning of the combination and one in the end of the combination. The combinations used were /s-t/, /a-n/, /t-p/, /s-i/, /i-a/.

### 3.3.4. Post-testing

The participants of the study were at the end of the study post-tested with the same two tests used when pre-tested. Each participant was not only given a short individual repetition of the positions and sounds of the PhonicStick, but they were also shown how to make sounds with the device before post-tested.

The participants where first tested with first the PhonicStick Test (Instructions pre and post test, see Appendix 3). To avoid misleading results, the participants where post tested with the list, List A (List AB, see Appendix 4) or List B (List BA, see Appendix 5), which had not been used during the pre-testing. Each participant was, after being tested with the PhonicStick Test, tested with the same PHAT part, c) isolation, as was used in pre-testing.

Out of the 20 children that participated in the study 17 were post-tested two days in a row. The five participants of the study that were pre-tested on the same day as the group introduction of the PhonicStick was held were post-tested on the second day of the post-testing, while the remaining 12 participants were tested on the same day as the repetition to avoid bias. Due to absence two of the participants were post tested six days later. Due to personal reasons, one of the participants did not do the post-test. The participant was not excluded from the study, though results from the post-test of the participants were missing. The participant, who had initially been matched into the test group, underwent the pre-testing
and all 7 group training sessions with the PhonicStick. It was therefore considered interesting to analyze if the training with the PhonicStick have had any effects on the individual’s development during the training period. The notes made during the training sessions with the child were studied descriptively.

3.4. Treatment of data

3.4.1. Questionnaire

The answers given in the questionnaire considering language exposure, which had been given out to the guardians of the participants at the beginning of the study, were to be described and taken into account when discussing the results of the study.

3.4.2. The PhonicStick Test

A total of 18 points could be reached on the PhonicStick Test; a maximum of 12 points on the first part of the test and 6 points on the second part of the test. Notes were taken in the test sheet considering if the participant produced the correct isolated phoneme or phoneme combination 1) directly, 2) after self-correction or 3) after request. If a target phoneme or word was produced correctly after self-correction or request by the researcher it still was counted as a correct response, which gave 1 point. The participant was also allowed to produce sounds until satisfied with the produced phoneme. If the last produced phoneme was correct, this was noted in the test sheet together with the sounds that had been produced before reaching the target sound. All produced sounds that were produced by the participant were noted to observe if the participants used phoneme production strategies when using the device. The comments written by the researchers were to be described when discussing the studies results, evaluating the results of the study.

3.4.3. The Phonological Awareness Test (PHAT)

The scoring of the PHAT, part c) was done in accordance to the test manual. The researcher was allowed to repeat the stimulus phrase of the task, but not give other prompts than that. The participant was given 1 point for each correct response and 0 points for each incorrect response. A maximum of 30 points could be achieved in the subtest used; 10 points on each part. The results of the pre- and post-testing with the PHAT were to be quantitatively analyzed together with the results of the pre and post testing with the PhonicStick Test at the end of the study.

3.5. Data analysis

The pre- and post-test results of the test group which underwent the training sessions and the control group were analysed and presented on a group basis. The results were used for a quantitative analysis. The time and group effect interaction was studied both within and between groups. The time effect is defined as the effect that the length of time during which the training was conducted had on the results of the two tests used in the study. The group effect is defined as the effect that the group constellations had on the results. The interaction of these two effects was also studied.

A variance analysis was conducted where the effect of the dependent variable (seven group training sessions with the PhonicStick) on the independent variables (results on PHAT and the PhonicStick test) were studied. This was done by using a two-way independent ANOVA. To determine significant differences between group means Fishers LSD (Least Significant
Difference Test) post hoc test was used. The number of participants in the test group differed between pre- and post-testing. This did not influence the statistical analysis.

3.6. Ethical considerations

Ethical approval was sought from the Committee of Human Research at Stellenbosch University and a letter of consent was sent out to the participating school and the guardians of the participating children before the researchers arrived in South Africa. The participating children and their guardians were informed that they could withdraw from the study at any time. The researchers sought to ensure that the participation in the study had no negative effects on the participating children’s education. The activities used during the sessions resembled the activities used in the teaching of literacy to reduce the risk of affecting the participants’ literacy achievements in a negative way. Considering the confidentiality aspect, all personal information, questionnaires and audio-visual recording was stored in a locked facility at the department of Speech-Language and Hearing Therapy, Stellenbosch University. All data collected was coded to protect the identity of the participants. To do so each child was given an individual code number.
4. Results

4.1. Questionnaire

Twelve out of twenty questionnaires that were handed out initially in the study were filled out by the parents of the participating children and handed back to the researchers. Even though the numbers of complete submitted questionnaires were quite low, it was found that English was the only language spoken in the majority of the homes (eight) of the participants. All of these children had been exposed to English since birth. Two of the participants of the study spoke only Afrikaans in their home environment. Of these two participants one had been exposed to English for two years and the other for ten months. Two participants had spoken both English and Afrikaans at home. In one of these families the child had been exposed to English since birth while the other child had been exposed since preschool. See Table 1 for language spoken at home in the test group and the control group.

Table 1. Language spoken at home in the test group and the control group.

<table>
<thead>
<tr>
<th>Language</th>
<th>Test group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>English only</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Afrikaans only</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>English and Afrikaans</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Missing data</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

4.2. Statistical analysis

4.2.1. Pre- and post-test results of the PhonicStick Test

The results of the two test parts, a) Isolated phoneme and b) Three phoneme combination for pre- and post-test are presented below, first as raw data in Table 2 and Table 3 and are there after followed by an analysis of the results in the following sections 4.2.1.1 and 4.2.1.2. Note that in the pre-test there are 10 participants in both groups but in the post-test there are 9 participants in the test group and 10 participants in the control group.

Table 2. The sum of the results (raw scores) for part a) Isolated phoneme in pre- and post-tests (n=10) when using the PhonicStick by all children in each group (test and control). In the test group one participant did not do the post-test.

<table>
<thead>
<tr>
<th>Part a) Isolated phoneme</th>
<th>Directly correct</th>
<th>After self correction</th>
<th>After request</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Test group</td>
<td>50/120</td>
<td>73/108</td>
<td>19/120</td>
<td>13/108</td>
</tr>
<tr>
<td>Control group</td>
<td>54/120</td>
<td>55/120</td>
<td>23/120</td>
<td>32/120</td>
</tr>
</tbody>
</table>
Table 3. The sum of the results (raw scores) for part b) Three phoneme combination in pre- and post-tests (n=10) when using the PhonicStick by all children in each group (test and control). In the test group one participant did not do the post-test.

<table>
<thead>
<tr>
<th></th>
<th>Directly correct</th>
<th>After self correction</th>
<th>After request</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Test group</td>
<td>9/60</td>
<td>12/54</td>
<td>4/60</td>
<td>2/54</td>
</tr>
<tr>
<td>Control group</td>
<td>6/60</td>
<td>5/60</td>
<td>2/60</td>
<td>2/60</td>
</tr>
</tbody>
</table>

4.2.1.1  The PhonicStick test part a) isolated phoneme

Directly correct. In the test group there was a significant increase ($p=0.02$) found in directly correct produced isolated phonemes between the pre and post-test, which is displayed in Table 2. As displayed in Table 4, the mean score was notably higher in the test group than in the control group when comparing pre and post-test results. No notable change was found in the results of the control group ($p=0.09$). As displayed in Figure 1 the results show a trend of increase of the test groups’ results between pre- and post-test. However the interaction between time and group ($p=0.09$) is not significant on a 5% level. In the test group a ceiling effect was received by one child in the pre-test and two children in the post-test. The results show that the test group improved their ability to handle the PhonicStick, while no notable change was found in the control group.

Table 4. The mean (M), standard deviation (SD) and p-value of the Directly correct isolated phoneme from a two way independent ANOVA for the two independent groups when using the PhonicStick to complete part a) where n is the number of participants. Level of significance 5%.

<table>
<thead>
<tr>
<th></th>
<th>Directly correct isolated phoneme</th>
<th>n M (SD)</th>
<th>p (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre test</td>
<td>Post test</td>
<td>Pre test</td>
</tr>
<tr>
<td>Test group</td>
<td>10</td>
<td>9</td>
<td>5.0 (4.11)</td>
</tr>
<tr>
<td>Control Group</td>
<td>10</td>
<td>10</td>
<td>5.4 (2.12)</td>
</tr>
</tbody>
</table>

Figure 1. The graph displays the mean and standard deviation of the results for the test and control group in pre and post test of the PhonicStick test part a) directly correct isolated phoneme.
**Total correct.** The notes that had been made regarding if the participants produced the target phoneme 1) directly, 2) after self correction or 3) after request were used when evaluating the result on the PhonicStick Test part a) Isolated phoneme. When considering all these aspects, an increase was found in the test group \((p=0.11)\) though it was not significant, while no changes were found in the control group \((p=1.00)\) between pre- and post-test. The mean score is displayed in Table 5. The time and group interaction is not significant \((p=0.24)\), which can be seen in Figure 2. In the pre-test, four children from the test group and two children from the control group achieved a ceiling effect. In the post-test, six children in the test group and three children in the control group achieved a ceiling effect. The participants in the test group improved their results, due to their improved ability to produce correct isolated phonemes directly.

*Table 5.* The mean (M), standard deviation (SD) and p-value of the Total correct isolated phonemes from a two way independent ANOVA for the two independent groups when using the PhonicStick to complete part a) where \(n\) is the number of participants. Level of significance 5%.

<table>
<thead>
<tr>
<th>Total correct isolated phonemes</th>
<th>Pre test</th>
<th>Post test</th>
<th>Pre test</th>
<th>Post test</th>
<th>p (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test group</td>
<td>10</td>
<td>9</td>
<td>8.4 (3.92)</td>
<td>10.7 (2.00)</td>
<td>ns</td>
</tr>
<tr>
<td>Control Group</td>
<td>10</td>
<td>10</td>
<td>9.6 (2.17)</td>
<td>9.6 (2.99)</td>
<td>ns</td>
</tr>
</tbody>
</table>

*Figure 2.* The graph displays the mean and standard deviation of the results for the test and control group in pre and post test of the PhonicStick test part a) total correct isolated phonemes.

4.2.1.2 **The PhonicStick test part b) three phoneme combination**

**Directly correct.** There is an increase \((p=0.55)\) in directly correct produced three phoneme combinations, between pre- and post-test in the results of the test group while there was a decrease \((p=0.87)\) in the results of the control group as shown in Table 3. The mean of the results are displayed in Table 6 and shows a greater increase in the test group than in the control group when comparing pre- and post-test. The results of the group and time interaction was not significant \((p=0.55)\), as displayed in Figure 3. However, the test group had after training with the PhonicStick improved the ability to produce correct three-phoneme combinations directly.
Table 6. The mean (M), standard deviation (SD) and p-value of the Directly correct three phoneme combination from a two way independent ANOVA for the two independent groups when using the PhonicStick to complete part a) where n is the number of participants. Level of significance 5%.

<table>
<thead>
<tr>
<th>Directly correct three phoneme combination</th>
<th>M (SD)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre test</td>
<td>Post test</td>
<td>Pre test</td>
</tr>
<tr>
<td>Test group</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Control Group</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Figure 3. The graph displays the mean and standard deviation of the results for the test and control group in pre and post test of the PhonicStick test part b) directly correct three phoneme combination.

Total correct.
The scores noted in Total correct consist of a compilation of the scores which are reached after producing the target three phoneme combination 1) directly, 2) after self-correction or 3) after request. These results were used when evaluating the result on the PhonicStick Test part b) Three-phoneme combination. An increase was shown in both groups as displayed in Table 3. Table 7 shows that the increase of the test group was of greater extent than in the control group. The increase was significant in the test group (p=0.0005) but not in the control group (p=0.12). As displayed in Figure 4, there was an increase in time and group interaction, though it is not significant (p=0.07). In the test group a ceiling effect was achieved by three children in the pre-test and one child in the post-test. As displayed in Table 3, both groups had improved their ability to use the help from request between pre- and post-test. However, the test group had made an improvement to a greater extent.

Table 7. The mean (M), standard deviation (SD) and p-value of the Total correct three phoneme combinations from a two way independent ANOVA for the two independent groups when using the PhonicStick to complete part a) where n is the number of participants. Level of significance 5%.
<table>
<thead>
<tr>
<th></th>
<th>Pre test</th>
<th>Post test</th>
<th>Pre test</th>
<th>Post test</th>
<th>p (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test group</td>
<td>10</td>
<td>9</td>
<td>1.9 (2.38)</td>
<td>4.2 (1.99)</td>
<td>p&lt;.05</td>
</tr>
<tr>
<td>Control Group</td>
<td>10</td>
<td>10</td>
<td>1.0 (1.89)</td>
<td>1.8 (2.04)</td>
<td>ns</td>
</tr>
</tbody>
</table>

**Figure 4.** The graph displays the mean and standard deviation of the results for the test and control group in pre and post test of the PhonicStick test part b) Total correct three phoneme combinations.

### 4.2.2. Pre and post test results of The Phonological Awareness Test (PHAT)

In Table 8 each subpart of PHAT part c) isolation in initial, final and medial position is presented separately as well as the total result for both groups at pre and post-test. Note that in the pre test there are 10 participants in both groups but in the post-test there are 9 participants in the test group and 10 participants in the control group.

<table>
<thead>
<tr>
<th>PHAT Total; Initial, Final and Medial position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
</tr>
<tr>
<td>Test group</td>
</tr>
<tr>
<td>Pre</td>
</tr>
<tr>
<td>Test group</td>
</tr>
<tr>
<td>Control group</td>
</tr>
</tbody>
</table>
**PHAT Initial position.** There are changes in the results of both the control and the test group between the pre and post-test. Figure 5 shows a decrease in the test group \((p=0.32)\) and an increase in the control group \((p=0.23)\) when comparing pre- and post-test, which can also be seen in Table 9. Though the test group had a higher score in the pre -est then the control group, the time and group interaction was not significant \((p=0.13)\). In the pre- test six children in the test group and three children in the control group achieved a ceiling effect. In the post-test three children in the test group and six children in the control group received a ceiling effect.

Table 9. The mean (M), standard deviation (SD) and p-value of PHAT Initial position from a two way independent ANOVA for the two independent groups when using the PhonicStick to complete part a) where n is the number of participants. Level of significance 5%.

<table>
<thead>
<tr>
<th>n</th>
<th>PHAT Initial position</th>
<th>M (SD)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre test</td>
<td>Post test</td>
<td></td>
</tr>
<tr>
<td>Test group</td>
<td>10</td>
<td>9</td>
<td>8.8 (1.99)</td>
</tr>
<tr>
<td>Control Group</td>
<td>10</td>
<td>10</td>
<td>8.6 (1.26)</td>
</tr>
</tbody>
</table>

![Figure 5](image)

*Figure 5. The graph displays the mean and standard deviation of the results for the test and control group in pre- and post-test of PHAT Initial position.*

**PHAT Final position.** There is an increase of similar extent in correct results of the both groups. Table 10 shows that is an increase in the mean of both groups between pre- and post-test. There is a significant change over time \((p=0.04)\), but the group effect is not significant \((p=0.70)\). As displayed in Figure 6, the time and group interaction was not significant. In the pre-test, three children in each group achieved a ceiling effect. In the post-test, two children in the test group and three children in the control group achieved a ceiling effect. The participants achieved improved test results after training with the PhonicStick, though the control group also improved their results.
Table 10. The mean (M), standard deviation (SD) and p-value of PHAT Final position from a two way independent ANOVA for the two independent groups when using the PhonicStick to complete part a) where n is the number of participants. Level of significance 5%.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>PHAT Final position</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pre test</td>
<td>Post test</td>
<td>Pre test</td>
<td>Post test</td>
<td>(2-tailed)</td>
</tr>
<tr>
<td>Test group</td>
<td>10</td>
<td>6.2 (3.52)</td>
<td>8.4 (1.51)</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td>10</td>
<td>6.6 (2.84)</td>
<td>8.7 (1.57)</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Vertical bars denote 0.95 confidence intervals

Figure 6. The graph displays the mean and standard deviation of the results for the test and control group in pre- and post-test of PHAT Final position.

**PHAT Medial position.** There is an increase in test scores in both groups from pre- to post-test. Figure 7 shows that the increase is slightly higher in the control group. Table 11 displays that the interaction is not significant (p=0.63). There was a trend for an increase over time in both groups (p=0.06), but no differences between groups (p=0.39). In the pre-test, one child in the test group received a ceiling effect. In the pos-test, one child in each group achieved a ceiling effect. The test group did not improve to a greater extent than the control group on this test part after training with the PhonicStick.

Table 11. The mean (M), standard deviation (SD) and p-value of PHAT Medial position from a two way independent ANOVA for the two independent groups when using the PhonicStick to complete part a) where n is the number of participants. Level of significance 5%.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>PHAT Medial position</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pre test</td>
<td>Post test</td>
<td>Pre test</td>
<td>Post test</td>
<td>(2-tailed)</td>
</tr>
<tr>
<td>Test group</td>
<td>10</td>
<td>4.7 (3.68)</td>
<td>6.2 (2.22)</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td>10</td>
<td>3.3 (3.34)</td>
<td>5.7 (3.09)</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**PHAT Total.** The results of the total PHAT test consist of the results of all the parts above (initial, final and medial position). As displayed in Table 12 the total increase of mean is similar in both the test and the control group when comparing pre- and post-test. A significant difference is shown from pre- to post-test regarding the time effect \((p=0.02)\), which means there is a difference over time for both groups. However, the group effect shows no significant difference \((p=0.99)\). The time and group effect is not significant \((p=0.44)\), which can be seen Figure 8. In the pre-test, one child in the test group achieved a ceiling effect. In the post-test one child in each group achieved a ceiling effect.

Table 12. The mean (M), standard deviation (SD) and p-value of PHAT Total; Initial, Final and Medial position from a two way independent ANOVA for the two independent groups when using the PhonicStick to complete part a) where n is the number of participants. Level of significance 5%.

<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 (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test group</strong></td>
<td>10</td>
<td>10</td>
<td>9</td>
<td>19.7 (8.08)</td>
<td>22.8 (5.14)</td>
<td>ns</td>
</tr>
<tr>
<td><strong>Control Group</strong></td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>18.5 (6.62)</td>
<td>23.8 (3.79)</td>
<td>ns</td>
</tr>
</tbody>
</table>

*Figure 7.* The graph displays the mean and standard deviation of the results for the test and control group in pre- and post-test of PHAT Medial position.
Figure 8. The graph displays the mean and standard deviation of the results for the test and control group in pre- and post-test of PHAT Total; Initial, Final and Medial position.
5. Discussion

The aim of the present study was to analyse what effect seven group training sessions with the PhonicStick would have on phonological awareness in a group of 20 typically developing 5-6 year old South African children.

In the following sections, the results of the study will be discussed in regards to the aim of the study, the chosen method and future research, but will also be related to previously conducted studies.

5.1. Questionnaire

The answers to the questionnaire handed out initially in the study showed that the participants came from diverse language backgrounds and reflected on the multicultural society that many South African children grow up in. The answers showed that several of the studies participants had not been exposed to English for a period longer than two years, which can have affected their understanding of the instructions given during the testing. Efforts were made to rule out this factor in an initial phase of the study by asking the class teacher to choose children proficient in English when selecting participants for the current study.

5.2. The PhonicStick Test

The results of the study showed that the participants of the control group (even though the participants of the study were matched into groups based on age, sex and results on PHAT) showed much better results than the test group when pre-tested with the PhonicStick Test. The three matching factors can therefore be reasoned not to be sufficient enough to predict the participants’ results on the Phonic Stick Test, while the results varied to a large extent between the two matched groups.

After seven training sessions with the PhonicStick, the test group had improved to such great extent that their results on the PhonicStick Test were comparable to the ones of the control group when post-tested. Further, both test and control groups had achieved higher scores of correctly produced isolated phonemes and three-phoneme combinations without self-correction or request when comparing results on pre- and post-test.

Even so, the only significant result was found in the test group on the three-phoneme combination task where the test group had improved their results significantly, while the control group also had improved their scores to some extent, though not significantly. A ceiling effect was seen in test part a), which may have affected the results. However, there was only one participant who reached the ceiling, so if there was an impact by the ceiling effect, the influence would be small. If no ceiling effect would have been reached, a greater increase of the results from pre- to post-test may have been observed. In the pre test part a) Isolated phoneme, the control group self corrected to a greater extent than the test group which resulted in an higher increase of the total pre test score in the control group than in the test group. In the post-test the test group improved their ability to directly produce correct isolated phonemes. This resulted in a higher post-test score on test part a) for the test group than the control group. In part b) Three-phoneme combination, both groups improved their ability to produce the target combination after request between pre and post-test. This improvement led to an increase of the total test score of both groups. However, the increase in the test group was higher. Thus, one can reason that the training with the device improved the test group’s ability to handle the device and create isolated phonemes and phoneme combinations without self-correction or request from the researcher.
When comparing the results to the previously conducted study by Kimhag and Lindmark (2009) in a group of 10 normally developing South African children the results of the current study showed significant results to some extent, while training with the PhonicStick showed no significant results in Kimhag and Lindmark’s study. Participants of both studies did benefit from training with the device and learned to handle it after the training was conducted. It can be reasoned that both studies were limited by the small sample, which could have affected the numbers of significant results.

5.3. The Phonological Awareness Test (PHAT)

There was an improvement in the total result for all test parts for both the test group and the control group when comparing the results from pre- and post-test. When considering the total result on the test both groups did improve. There was a slight improvement in the test group, while there was a great amount of improvement in the control group. This improvement was not found to be significant when comparing the groups, but improvement in the control group over time was found to be significant. In the study by Kimhag & Lindmark (2009), where three training sessions were conducted instead of seven sessions as in the current study, no significant results were found in PHAT part c) isolation. In the current study, the improvement from pre to post test gave significant results over time. Therefore it can be reasoned that the time period in the current study might be a contributing factor to the improvement in comparison to the previous study. The use of the PhonicStick in phonological awareness training shows other phonological awareness abilities that PHAT part c) does not describe. This was showed in the results of the test group where improvements on the PhonicStick test considering production of directly correct phonemes and phoneme combinations was not manifested in the results on the PHAT test. This indicates that training with the PhonicStick improved the ability of the participants of the test group to manoeuvre the device, finding the target sound/sound combination but also producing it without any cues. Thus, it can be reasoned that training with the PhonicStick does not result in an improvement on the PHAT test part used in the study. It can therefore be reasoned that it might not be functional to only use diagnostic tests such as PHAT to evaluate deficits but that these should be complemented with other types of tests to describe a child’s difficulties and abilities in a more comprehensive way. The studies conducted by Torgesen, Morgan et al. (1992) and Torgesen et al. (1993) showed a significant improvement in the participants’ phonological awareness when assessing phonological awareness tasks during eight weeks. This could indicate that the training with the PhonicStick did not practice the abilities to improve on PHAT part c). A ceiling effect was found in all three test parts, which may have influenced the results. If there had been a possibility to get a higher score on the task, a greater increase may have been shown when comparing the pre and post-test results for participants of both groups. More difficult tasks may have prevented the ceiling effect however it could have resulted in very low test scores. When evaluating the results on the test parts, notable changes were found in the part concerned with initial isolation, where the participants did improve their results, while results of the test group on this test part did decrease. In the test part concerned with final isolation, the participants of both groups did improve their results to the same extent. This result can indicate that the sample used in the study was too small, but also that training with the PhonicStick had no effect on the result of PHAT part c) isolation. In the medial isolation test, the biggest improvement in both groups was found, though it is not significant. PHAT contains of a number of subtests in excess of part c) isolation. Due to the time limit, this study did not test all parts. However, the group training with the PhonicStick did also contain segmentation and blending, which also are subtests in PHAT. Before making a word the participants segmented the word they heard by
identifying the isolated phonemes in the word. When hearing two isolated phonemes, the participants could put them together and make two phoneme combinations, which indicate that the participants had the ability of blending. Each task in the training sessions involved isolation, which was tested in PHAT part c). All participants managed to isolate phonemes in the two and three-sound combinations however some participants had some difficulties. To facilitate the task, blocks were used to give the participants visual support together with the auditory input. du Plessis (2001) states that, due to the poverty in South Africa, many children that enter schools come from disadvantaged homes. This often correlates with poor concentration and cognitive ability. Further on, many of these children lack an exposure to writing. The participants in this study came from a quintile 3 school, which may have had impact on their achievements and test results.

5.4. Observations during sessions

It was found during the training session that the participants concentrated better on their tasks when the group was smaller due to e.g. absence. Although the device did create an initial interest in the participants, it did not sustain the participants’ interest over a longer period. One can reason that this could have been affected by the group’s size effect on concentration, the participants’ previous exposure to similar technical equipment and the time needed to convey a message with the PhonicStick. Further, the device might have not been attractive enough for the participants used in the study, which would be in line with the reasoning of Light et al. (2007) that AAC technologies tend to be designed in such a way that they primarily function as “speech prostheses, rather than interactive communication tools” (Light et al., 2007, p.283). Even though group training caused some difficulties in the current study, one benefit was that the participants could help each other to find the positions of the phonemes. However, group training of phonological awareness with the PhonicStick was not functional in this study, and it is preferable to carry out training with the PhonicStick individually or in smaller groups. These findings verify the previous findings from the study by Ehri et al (2001), where training with phonemic awareness instructions was found to be more efficient when taught in smaller groups. Further, it was found during the study that several participants’ had not been exposed to computers or joysticks before the study. The unfamiliarity with the technology could be reasoned to have been affected the participants acquiring of the PhonicStick. A problem that reoccurred during the period of training was a difficulty in remembering to use the delete button before producing a new sound or sound combination. Some of the participants also showed difficulties remembering the positions of the sounds in the device. Notes were made during the training sessions and in the PhonicStick Test sheets regarding what sounds were produced before reaching a target sound. These notes showed that it was usual when having difficulties remembering the position to either produce the sound on the opposite side or to go through all sounds around the circumference one by one. The difficulties that some of the participants were faced with in regards to segmenting the sound structures of three-phoneme combinations were overcome by using blocks during two of the sessions. This supports the idea (Ball & Blachman, 1991) that the access of phonemes does not only require discrimination but is rather a matter of abstraction. Thus, the discrimination should be facilitated by the use of blocks so that the discrimination of phonemes, which are not separated in the acoustic stimuli, would be less abstract.
5.5. Limitations of the study

Few significant results were reached in the study, which can be due to the small sample used in the study. As a result, mainly tendencies could be found when evaluating the test results. Further, the participants of the study had been chosen from the same school class and came from the same geographical area, which makes a generalization for a larger multifaceted population difficult. Regarding the logistic situation during the study, limitations concerning technical resources occurred. The facilities in which the research was conducted did, to some extent, lack desirable material, resources and sound isolation. The recordings and the quality of the sounds programmed in The PhonicStick were also affected, since the recordings were not made in a sound proof studio. This was shown as difficulties for participants to occasionally hear the sounds produced or when one phoneme was mistaken for another. A recurring problem for the participants was to perceive the phoneme /n/, which was often mistaken for being an /a/. This can have affected the participants’ scores on the PhonicStick Test but also the outcome of their training. Beyond the unsatisfactory recordings, the participants training with The PhonicStick could also have been affected by two weeks of school holiday that coincided with the research. Due to this, the sessions were not held each week as planned.

5.5.1. Technical limitations

The sensitivity of the PhonicStick was occasionally found to be a problem. When moving the handle of the device, relatively precise movements towards the correct position around the circumference were needed to produce the goal sounds. If the movement deviated, a boink sound was produced, which resulted in deletion of earlier produced sounds, as a part of a bug in the system. Due to this fact, a longer time was needed to produce a phoneme combination, which was found to be a factor that had an impact on the participants’ sustained interest in the device during group training. It has previously been shown (Shephard et al., 2009; Rackensperger et al., 2005) that, not only is the reliability of an AAC device crucial when acquiring a technology, but so is the impact of which a decrease in the reliability has both on further progression in use of the technology and in the users attitude towards it. In line with these results, the limitation found during the current study should be revised for the future to enable facilitation of more efficient conveying of messages.

5.6. Suggestions for future research

It would be desirable to conduct future research with a larger population individually or in groups smaller than those used in the current study. The findings of the study indicated that the interest for the PhonicStick over time was not sustained in the participants. It was reasoned that this might have been affected by the size of the group, attractiveness of the device, or previous exposure to similar technical items, but also the time that was needed to convey a message with the device. It would therefore not only be interesting to work on further development of the device to suit younger age groups better but also to involve a test panel of children using an AAC technology to receive feedback on the device. Due to this aspect, it would also be desirable to try out the device on an older population to see if the age could have an impact on the acquisition of the technology. Due to the access problematic found during the study it would be interesting to try out the device in other populations. While the device was initially developed for individuals with complex communication needs (Black et. al, 2008), it would be applicable to conduct a study with participants that are users of an aided AAC systems or that uses a wheel chair that is manoeuvred with a joystick to see if the device is functional in these populations. This is due to earlier assumptions that the device would be easier to handle for individuals who use a joystick manoeuvred wheel chair while
they already acquired the techniques necessary to manoeuvre a joystick. To achieve a significant result, larger populations should be used in future studies. The time of training with the PhonicStick should be prolonged to draw conclusions regarding what effect training with the device over a longer period of time would have on acquisition of the technology. Research should be conducted in a communicative situation to see how functional the PhonicStick is when conveying information and intentions. Another suggestion for future development of the device is a word prediction function to facilitate quicker interaction during a conversation. Availability of the sounds when using the device should be reviewed to avoid excessive demands on the fine motor skills of the user and to enable effective communication with the PhonicStick.

5.7. Summary of conclusions

Both the test and control groups improved on their results on the isolation subtest of the PHAT, even though the results were not significant. There is indication that training with the PhonicStick would have little or no impact on the test results in the PHAT Test. In the PhonicStick Test, there was an improvement of greater extent in the test group than in the control group when comparing pre and post-test. This improvement was significant in both test part a) directly correct phoneme and test part b) directly correct three-phoneme combination. All participants easily learned the positions of the sounds and how to manoeuvre the PhonicStick. There were some difficulties with remembering to press the delete button before initiating a phoneme or combination and the positions of the phonemes in the PhonicStick. The size of the training groups and the length of the training sessions contributed to distraction and a rapid loss of concentration among the participants. However, the participants could benefit from each other when doing the tasks during training.
6. Acknowledgements

We would like to thank:

The principal, teachers and students at Ida’s Valley Pre-Primary School, South Africa for their participation in the study and their help throughout the process

Margareta Jennische for her guidance and support

Annalu Waller for helpful advice

Daleen Klopf for enthusiasm and knowledge

Helena Oosthuizen for the help in adapting the materials for the participants of the study

Juan Bornman for the articles

Dr. Martin Kidd and Hans Arinell for the statistical support

The Department of Spraak- Taal en Gehoortherapie at Stellenbosch University, South Africa for their helpfulness and hospitality
7. References


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Appendix

1. Information letter principal
2. Information letter parents/legal guardians
3. Instructions pre- and post test
4. List AB
5. List BA
6. Instruction sessions
Appendix 1: Information letter principal

Dear (principal's name),

We are glad that your school decided to participate in our study. The study will be performed during the fall 2010 and is a cooperation between Uppsala University, Sweden, University of Dundee, Scotland and Stellenbosch University, South Africa.

The aim of the study is to try out a new method for stimulating language development skills in primary school age children. In the future the PhonicStick could be used as an aid when training reading and writing since phonological awareness is important for literacy development. The joystick could also be used as a communication device for children with different types of communication difficulties, for example the ones that occur in children with cerebral palsy or Down syndrome.

The aim of the project that your school will participate in is to see if a group of South African children in grade R can benefit from group training with the PhonicStick to improve on their phonological awareness.

The method that was developed at the University of Dundee in Scotland has the aim to train phonological awareness, which is a skill important for language development. This is done by using a joystick called the PhonicStick, which is programmed with six different speech sounds.

Depending on the direction in which the joystick is moved, different speech sounds can be made. The sounds can thereby be combined into combinations of two or three sounds, which creates existing or nonexistent words. The PhonicStick will be programmed with six sounds, pronounced in South African English. To make this possible, we would like to record the class teacher of the participants while pronouncing the six phonics that are programmed into the PhonicStick. These recordings would be used during the training sessions.

The participants of the study will be divided into two groups. One group is a control group that will meet during two occasions, each time taking about 30 minutes. This group will do a phonological awareness test, which test abilities such as rhyming and distinguishing speech sounds in words. The second half of the participants will do the same kind of tests, but also meet during 7 occasions to have training sessions in a group with the PhonicStick, led by the two researchers. This results in a total of 9 occasions, each taking about 30 minutes. The activities used during the sessions may reassemble the activities used in teaching literacy to minor the risk of affecting the participant’s literacy achievements in a negative way. Attention will also be paid to ensure that the
children's current education does not suffer by their participation. All sessions will be audio and video recorded and the information gathered, which is confidential, will be stored in a locked facility at the department of Speech-Language and Hearing Therapy, Stellenbosch University.
The study will take place over 11 weeks during which the researchers will meet with the children in school once per week or two times during the 11 weeks, depending on which group the children will be assigned to.

The legal guardians of the children have received a letter of consent containing information about the study; that participation is voluntary and that they can withdraw their child at any time.

This study is being undertaken by Anna-Maria Hansson and Caroline Andersz as their Master Thesis project at the final year of the Speech and Language Pathology Program at Uppsala University, Sweden and will be supervised by Margaret Jennische, Senior Lecturer, Uppsala University, Sweden, and Annalu Waller, lecturer, University of Dundee, Scotland.

Yours sincerely,

Caroline Andersz
Caroline.Andersz.9578@student.uu.se

Anna-Maria Hansson
Anna.Hansson.1732@student.uu.se
Appendix 2: Information letter parents/legal guardians

Participant information leaflet and consent form for use by parents/legal guardians

During the fall 2010 a study will be performed in cooperation between Uppsala University, Sweden, University of Dundee, Scotland and Stellenbosch University, South Africa. The aim of the study is to try out a new method for stimulating language development skills in primary school age children.

In the future the PhonicStick could be used as an aid when training reading and writing since phonological awareness is important for literacy development. The joystick could also be used as a communication device for children with different types of communication difficulties, for example the ones that occur in children with cerebral palsy or Down syndrome.

The aim of this project is to see if a group of South African children in grade R can benefit from group training with the PhonicStick to improve on their phonological awareness. We would therefore like to invite your child to take part in this research project.

The method that was developed at the University of Dundee in Scotland has the aim to train phonological awareness, which is a skill important for language development. This is done by using a joystick called the PhonicStick, which is programmed with six different speech sounds.

Depending on in which direction the joystick is moved, different speech sounds can be made. The sounds can thereby be combined into combinations of two or three sounds, which create existing or nonexistent words. The PhonicStick will be programmed with six sounds, pronounced in South African English, which will be used when training with the participants of the study.

The participants of the study will be divided into two groups. One group is a control group that will meet during two occasions, each time taking about 30 minutes. This group will do a phonological awareness test, which test abilities such as rhyming and distinguishing speech sounds in words.
The second half of the participants will do the same kind of tests, but also meet during 7 occasions to have training sessions in a group with the PhonicStick, led by the two researchers. This results in a total of 9 occasions, each taking about 30 minutes. The activities used during the sessions may reassemble the activities used in teaching literacy to minor the risk of affecting the participant’s literacy achievements in a negative way. Attention will also be paid to ensure that the children's current education does not suffer by their participation. All sessions will be audio and video recorded and the information gathered, which is confidential, will be stored in a locked facility at the department of Speech-Language and Hearing Therapy, Stellenbosch University. The study will take place over 11 weeks during which the researchers will meet with the children in school once per week or two times during the 11 weeks, depending on which group the children will be assigned to.

The participation in the study is voluntary and you can withdraw your child from the study at any time.

This study is being undertaken by Anna-Maria Hansson and Caroline Andersz as their Master Thesis project at the final year of the Speech and Language Pathology Program at Uppsala University, Sweden and will be supervised by Margaret Jennische, Senior Lecturer, Uppsala University, Sweden, and Annalu Waller, lecturer, University of Dundee, Scotland.

Yours sincerely,

Caroline Andersz
Caroline.Andersz.9578@student.uu.se

Anna-Maria Hansson
Anna.Hansson.1732@student.uu.se
Declaration by parent/legal guardian

I have taken part of the information in the information letter and I am aware of that the participation in the study is fully voluntary and that I can withdraw my child from the study at any time.

Date:..............................................................................................................................
Name of legal parent/guardian:.....................................................................................
Name of child:.............................................................................................................
Childs date of birth:.....................................................................................................
Language(s) spoken at home:......................................................................................
How long has your child been exposed to English:....................................................

Contact information

Phone number:.............................................................................................................
Email address:.............................................................................................................
We would like to be contacted by
   Phone  □       Email  □       Other:..............................................................

Declaration by parent/legal guardian

By signing below, I (name of parent/legal guardian)
.............................................................. agree to allow my child (name of child)
.............................................................. who is ........ years old, to take part in a research study entitled “The use of the PhonicStick in group training; Can South African children age 5 benefit from group training with the PhonicStick to improve on their phonological awareness?”.
Appendix 3: Instructions pre- and post test

Pre testing

Introduction to the PhonicStick and individual pre-testing

1. PHAT-test
2. PhonicStick test

Comment: All participants will initially be introduced to the PhonicStick and will thereafter be tested with PHAT-test (Phonological Awareness Test by Robertson & Salter part c); Isolation i.e. telling what sound begins, ends or is in the medial position) and the two PhonicStick tests described further down. The participants will be divided into two groups of which one group first will be tested with PHAT and thereafter with the PhonicStick tests, and the other group will first be tested with the PhonicStick and thereafter with PHAT. The introduction to the PhonicStick will be in groups of 4-5 participants together with one researcher.

Instructions for initial introduction to the PhonicStick before pre-testing:
All participants should be encouraged. If one does not understand the instructions, the researcher will show how the specific task is done, for example by making the sounds on the PhonicStick.

Today we are going to play with sounds. We are going to use this (point at the PhonicStick). Have you played with one like this before?
We call it the PhonicStick. When you move it, it makes sounds. Do you know what a sound is? Can you make one with your mouth? Good. With sounds you can also make words. Can you say a word? Good!
To make sounds with the PhonicStick you need to move it, like this. Show /t/,/s/,/a/. Do you want to try to make a sound? (Let the participant make a few sounds). Good!
Now, pull the PhonicStick towards you. What sound do you hear? Yes, it’s a /t/! (If the participants make a mistake/does not answer the researcher asks the participant to try again).
Now, pull it to the side. What do you hear? Yes, it’s a /s/ (or /n/). (If the participants make a mistake/does not answer the researcher asks the participant to try again. The participant is allowed to choose one of the sides to move the stick).
Now, move the PhonicStick to the other side. What do you hear? Yes, it’s a /s/ (or /n/). (If the participants make a mistake/does not answer the researcher asks the participant to try again.)
Pull it forward. What do you hear? Yes, it’s an /a/. (If the participants make a mistake/does not answer the researcher asks the participants to try again).
Now pull the PhonicStick forward to the left (Researcher points to left if needed). What do you hear? Yes, it’s an /i/. (If the participants make a mistake/does not answer the researcher asks the participants to try again).
Now pull the PhonicStick forward to the right (Researcher points to right if needed). What do you hear? (Researcher shows the participant). You hear the sound ‘boink’. It means that there is no sound that you can make words with in that spot.
You can also pull the PhonicStick towards you and to the right. Like this (the researcher shows). What do you hear? Yes, it’s a /p/. Now it’s your turn to try. (If the participant makes a mistake/does not answer the researcher asks the participants to try again).
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 (Researcher points at the delete button). It is called the delete button. This one is the same. (Researcher points at the other delete button).
If you make a mistake and want to start again, you can also push the delete button. When you want the PhonicStick to say the word you made, you have to press this button to make it talk (Researcher points at the speech button). It is called the speech button. This one is the same (Researcher points at the other speaking button). Do you understand?

Now let’s make a word. Start by pressing the delete button. Now try to pull the Phonic Stick to the left side, then forward and then towards you and press the speech button. What do hear? Yes “sat” (If the participant makes a mistake/does not answer the researcher asks the participant to 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 delete button. Now let’s try to make it say “tan” (researcher waits and sees if the participant makes the word by him/her self and in other case the researcher tells the participant how to make each sound, gives space to continue, and does the word together with the participant if needed.

Pre-testing: The participants are randomly assigned into two groups. Further down you find the PhonicStick test which contains of two tests, test 1 (phonics) and test 2 (words/non words). These have been named LIST A and LIST B. One group will be pre-tested with LIST A and the other group with LIST B.

For more information see Test form AB.doc and Test form BA.doc

<table>
<thead>
<tr>
<th>Pre-testing</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group 1</strong></td>
<td><strong>Group 2</strong></td>
</tr>
<tr>
<td>1. Introduction to the PhonicStick</td>
<td>1. Introduction to the PhonicStick</td>
</tr>
<tr>
<td>3. PHAT-test</td>
<td>3. PHAT-test</td>
</tr>
</tbody>
</table>

When the pre-testing is finished the two groups will be matched into one of new two groups; one which will be trained with the PhonicStick during the forthcoming weeks and one control group. Aspects that will be considered when matching are results on the “PHAT”-test, results on the PhonicStick-test, which list the participant was pre-tested with and participant’s gender.
LIST A

Test 1 – phonemes
Now I am 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 with the PhonicStick. Let’s start!

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

Test 2 – words/non words
Now we are going to play with words. There are real words that mean something, for example, “cat” and fake words that don’t mean anything for example “pta”. Now I am going to say some words, some are real words and some are fake words. When I say a word, I want you to make the same word on the PhonicStick. Okay? Let’s start! (Researcher reminds the participant about the speaking and clearing button if needed).

/sit/
/ina/
/pat/
/aia/
/tip/
/nis/

Good job!
LIST B
Test 1 – phonemes
Now I am 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 with the PhonicStick. Let’s start!
/a/
/n/
/i/
/s/
/p/
/t/
/p/
/n/
/a/
/s/
/t/
/i/

Test 2 – words/non words
Now we are going to play with words. There are real words that mean something, for example, “cat” and fake words that don’t mean anything for example “pta”. Now I am going to say some words, some are real words and some are fake words. When I say a word, I want you to make the same word on the PhonicStick. Okay?
Let’s start! (Researcher reminds the participant about the speaking and clearing button if needed).
/sip/
/isa/
/ans/
/nit/
/tap/
/pia/

Good job!
Post testing

Repetition of the PhonicStick and individual post testing.

1. PHAT-test
2. PhonicStick test

Comment: All participants will initially get a short repetition of the PhonicStick in groups of 4-5 participants before tested again with the same tests as used during pre-testing. The group that, during pre-testing, was tested with list A will, during post-testing, be tested with list B and the group that during pre-testing was tested with list B will during post-testing be tested with list A.

Post-testing

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction to the PhonicStick</td>
<td>1. Introduction to the PhonicStick</td>
</tr>
<tr>
<td>3. PHAT-test</td>
<td>3. PHAT-test</td>
</tr>
</tbody>
</table>

Instructions for repetition of the PhonicStick before post-testing:
Do you remember the PhonicStick? When you moved it made a sound. Can you make a sound with it? Good!
Now, pull the PhonicStick down. What sound do you hear? Yes, it’s /t/! (If the participant makes a mistake/does not answer the researcher asks the participant to try again).
Now, pull it to the left side. What do you hear? Yes, it’s /s/. (If the participant makes a mistake/does not answer the researcher asks the participant to try again).
Now, move the PhonicStick to the right side. What do you hear? Yes, it’s /n/. (If the participant makes a mistake/does not answer the researcher asks the participant to try again.)
Pull it up. What do you hear? Yes, it’s /a/. (If the participant makes a mistake/does not answer the researcher asks the participants to try again).
Now pull the PhonicStick up to the left (Researcher points to the left if needed). What do you hear? Yes, it’s /i/. (If the participants make a mistake/does not answer the researcher asks the participants to try again).
Now pull the PhonicStick down to the right (Researcher points to right if needed). What do you hear? Yes, it’s /p/. (If the participant makes a mistake/does not answer the researcher asks the participants to try again). (Researcher makes ‘boink’). Now you hear a ‘boink’. It means that there is no sound that you can make words with there.
Now it’s your turn to try. (If the participant makes a mistake/does not answer the researcher asks the participants to try again).

Now let’s make some short words. When you want to start making a word you always have to press this button to make it ready (Researcher points at the delete button). It is called the delete button. This one is the same. (Researcher points at the other delete button).
If you make a mistake and want to start again, you can also push the delete button. When you want the PhonicStick to say the word you made, you have to press this button to make it talk (Researcher points at the speech button). It is called the speech button. This one is the same (Researcher points at the other speech button). Do you understand?
Do you remember that there are real words that mean something? Like “cat”. And fake words that don’t mean anything like “pta”? Now let’s make a word. Start by pressing the delete button. Now try to pull the Phonic Stick to the left side, then forward and then towards you and press the speech button. What do hear? Yes “sat” (If the participant makes a mistake/does not answer the researcher asks the participants to 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 delete button. Now let’s try to make it say “tan” (researcher waits and sees if the participant makes the word by him/her self and in other case the researcher tells the participant how to make each sound, gives space to continue, and does the word together with the participant if needed).

Good job!

LIST A

Test 1 – phonemes
Now I am 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 with the PhonicStick. Let’s start!

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

Test 2 – words/non words
Now we are going to play with words. There are real words that mean something, for example, “cat” and fake words that don’t mean anything for example “pta”. Now I am going to say some words, some are real words and some are fake words. When I say a word, I want you to make the same word on the PhonicStick. Okay? Let’s start! (Researcher reminds the participant about the speaking and clearing button if needed).

/sit/
/ina/
/pat/
/aia/
/tip/
/nis/

Good job!
LIST B
Test 1 – phonemes
Now I am 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 with the PhonicStick. Let’s start!
/a/
/n/
/i/
/s/
/p/
/t/
/p/
/n/
/a/
/s/
/t/
/i/

Test 2 – words/non words
Now we are going to play with words. There are real words that mean something, for example, “cat” and fake words that don’t mean anything for example “pta”. Now I am going to say some words, some are real words and some are fake words. When I say a word, I want you to make the same word on the PhonicStick. Okay?
Let’s start! (Researcher reminds the participant about the speaking- and clearing button if needed).
/sip/
/isa/
/ans/
/nit/
/tap/
/pia/

Good job!
## Appendix 4: List AB

### PRE-TEST

#### LIST A

<table>
<thead>
<tr>
<th>Target sound</th>
<th>Directly correct</th>
<th>Self-correction</th>
<th>Request</th>
<th>Incorrect</th>
<th>Comments</th>
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Appendix 6: Instruction sessions

**Training Sessions**

*Each session will begin with a repetition of the positions in the PhonicStick. Thereafter, exercises will follow where all children will participate. All exercises will involve the PhonicStick and all children will use the PhonicStick at least one time per exercise. When the child is not using the PhonicStick he/she will still take part actively in the exercise. Each session will take 25 minutes. The focus of the training sessions will be on blending, segmentation and isolation.*

**Week 34: Training session 1**

Hello, nice to see you again! Do you remember what this is? (Point at the PhonicStick)

Yes! This is the PhonicStick. When you move it makes a sound. Today we are going to play with it. Everyone will get to play with it. First I will show you what we will do today.

Now, I am going to pull the PhonicStick towards me. What sound do you hear? (Participants guess the sound). Let’s press this button and listen (press speech button).

Yes, it’s a /t/! Good job!

Now I pull it to the side. What do you hear? (Participants guess the sound). Let’s press this button and listen (press speech button). Yes, it’s a /s/ (or /n/)! (Researcher gives the PhonicStick to one participant.) Now let’s see what happens when you pull it to the other side. (If the participant makes a mistake/does not answer the researcher asks the participant to try again.) What did you hear? (Participants guess the sound). Let’s press this button and listen (press speech button). Yes, it’s a /s/ (or /n/).

Now give the PhonicStick to your friend next to you. Pull it forward. What do you hear? (Participants guess the sound). Let’s press this button and listen (press speech button).

Yes, it’s an /a/. Good!

Ok, give the PhonicStick to the person next to you. Now pull it forward to the left (Researcher points to left if needed). What do you hear? (Participants guess the sound). Let’s press this button and listen (press speech button). Yes, it’s an /i/.

Now pass it to the person next to you. Pull the PhonicStick forward to the right (Researcher points to right if needed). What do you hear? Yes, you hear boink. Do you remember what it meant? (The participants answer). Yes, it means that there is no sound that you can make words with in that spot.

Now pass it on to the next person. Pull the PhonicStick towards you and to the right. What do you hear? (Participants guess the sound). Let’s press this button and listen (press speech button). Yes, it’s an /p/.

Good work everybody! Now we are finished for today. Thank you for coming. I will see you next time!

**Week 35: Training session 2**

Welcome back! Today we will continue to play with the PhonicStick. Let’s go through what happens when you move the PhonicStick.

Do you remember what you hear when I move it towards myself? (Researcher makes a movement with the hand, like with a PhonicStick, in the direction)? (Participants guess).

Let’s see! Let’s press this button. (Yes), it’s a /t/!
Do you remember what you hear when I move it to this side? (Researcher makes a movement with the hand to the left, like with a PhonicStick, in the direction)? (Participants guess). Let’s see! Let’s press this button. (Yes), it’s a /s/! Good!

What do you hear when I move it to the other side instead? (Researcher makes a movement with the hand to the right, like with a PhonicStick, in the direction)? (Participants guess). Let’s press this button. (Yes), it’s a /n/!

What do you hear when I pull it forward? (Researcher makes a movement with the hand, like with a PhonicStick, in the direction)? (Participants guess). Let’s see! Let’s press this button. (Yes), it’s an /a/.

What do you hear when I pull it forward to the left? (Researcher points to the left if needed) (Participants guess). Let’s see! Let’s press this button. (Yes), it’s an /i/.

What do you hear when I pull towards myself and to the right? (Researcher makes a movement with the hand, like with a PhonicStick, in the direction). (Participants guess). Let’s see! Let’s press this button. (Yes), it’s an /p/! Perfect! Good job!

Now let’s do something else! Let’s put two sounds together! Before you start you always have to press one of these buttons, you can choose which one (researcher hold up the PhonicStick and points at the delete buttons). We call them the delete buttons. This buttons you also have to press when you do something wrong with the sounds.

Now I will show you how to put two sounds together, and then it’s your turn to try. First I make one sound and then another one. Like this. (Researcher makes a /t/ and then an /a/). Now we need to put them together! To do so we push one of this buttons, you can choose which one (Researcher points at the speech buttons and then presses one of them). What did you hear? Yes, /ta/. Good job! Now it’s your turn. (Researcher hands the PhonicStick over to the child closest by). Do like I did. Make /ta/. (Researcher helps the child if needed). Good job! (Each child will do the same task with the same sounds).

Good job everyone!

(Researcher hands the PhonicStick over to one child). Now it is your turn to chose two sounds and push the button. The rest of us will guess what sounds you made.

(Child makes two sounds and pushes the speech button. Researcher helps the child if needed). What did we hear? (Children guess). Now let’s push the button again and see if we were right! (Yes) it was /child's chosen sounds/. (All children will do the same task and will be given the same instructions).

**Week 36: School holiday: No training session**

**Week 37: Training session 3**
Hello! Nice to see you again! Today we will continue to play with the PhonicStick.
Let’s go through what happens when you move the PhonicStick. This time let’s do it like this (Researcher holds up the PhonicStick so that it faces the children in the right way). Can you show me where you find /t/?

(Children guess where the sound is by pointing to the position at the PhonicStick. If the children need help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /t/!

Ok, let’s pass it on to the friend next to you.
Can you show me where you find /s/? (Children guess where the sound is by pointing to the position at the PhonicStick. If the children need help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a
PhonicStick, in the direction) (Yes), it’s a /s/! Perfect! Give it on to the friend next to 
you.

Can you show me where you find /n/? (Children guess where the sound is by pointing to 
the position at the PhonicStick. If the children need help, the researcher shows in which 
direction to move the PhonicStick with a movement with the hand, like with a PhonicStick, in the direction) (Yes), it’s a /n/! Ok, let’s pass it on to the friend next to 
you.

Can you show me where you find /a/? (Children guess where the sound is by pointing to 
the position at the PhonicStick. If the children need help, the researcher shows in which 
direction to move the PhonicStick with a movement with the hand, like with a PhonicStick, in the direction) (Yes), it’s a /a/!

Can you show me where you find /i/? (Children guess where the sound is by pointing to 
the position at the PhonicStick. If the children need help, the researcher shows in which 
direction to move the PhonicStick with a movement with the hand, like with a PhonicStick, in the direction) (Yes), it’s a /i/!

Can you show me where you find /p/? (Children guess where the sound is by pointing to 
the position at the PhonicStick. If the children need help, the researcher shows in which 
direction to move the PhonicStick with a movement with the hand, like with a PhonicStick, in the direction) (Yes), it’s a /p/! Good job guys!

Do you remember what you have to do before you make sounds? (Children guess). Yes, 
you need to press this button (points at the delete button). We call it the delete button.

Do you know what happens if you don’t press the delete button before making sounds? 
(Children guess). The sounds that you want to make won’t come out the right way. 

Listen; now I want to make /pat/ (researcher makes /pa/ and does not press speech 
button) and after this I want to make /si/ (researcher makes /si/). Let’s listen what 
happens when I press the speech button. Did it make /si/? No, it only made /i/! That 
happens because you can only make 3 sounds at a time with the PhonicStick. 

(Researcher puts down three blocks). How many sounds do we have in /pat/. (Children 
guess). Yes it’s three. We have /p/, /a/ and /t/ (researcher puts down one block for each 
sound). Yes, that’s three. And how many sounds do we have in /si/? Yes, it’s two. We 
have /s/ and /i/ (researcher puts down one block for each sound). And how many sounds 
could you make with the PhonicStick at a time? Yes three. So it’s two too much! If we 
make five sounds we are not able to hear all of them. So what do we always need to do 
before making a new sound? Yes, press the delete button.

Now, I’m going to make /ta/. Listen! (Researcher makes /tsa/ and puts down one block 
per sound at the time when the sound is made). Let’s listen to what happens when I 
push the speech button (Researcher pushes speech button). Did it make /ta/? No, it made 
/tsa/. So what do we need to do if we make one sound wrong? (Children guess). Yes, we 
have to press the delete button.

(Researcher hands the PhonicStick over to one child). Now it is your turn to choose two 
sounds. Then the rest of us will guess what sound you made and then we will push the 
speech button to see if we were right.

(Child makes two sounds, researcher puts down one block per sound made when it is 
made. If the child adds an extra sound researcher puts down extra block. If the child 
does not push the delete button, the children are asked what you have to do if you make 
the wrong sounds.) What did we hear? (Children guess). Now let’s push the speech 
button and see if we were right! (Yes) it was /child’s chosen sounds/. (All children will 
do the same task and will be given the same instructions).
Now we are going to put two sounds together like you did a few weeks ago! First I will show you. And then it’s your turn. Let’s start.

So what do I need to start with before making a new sound? Yes, I need to push the delete button. Good! First I make one sound and then another one. Like this. (Researcher makes /t/ and then /a/ and puts down one block per sound when the sound is made). Now we need to put them together! What do we need to hear what we made? Yes, we need to press the speech button. Let’s press it. What did you hear? Yes, /ta/. Good job!

Now it’s your turn. (Researcher hands the PhonicStick over to the child closest by). Do like I did. Make /ta/. (Researcher helps the child if needed and puts down one block per sound made. If the child adds an extra sound researcher puts down extra block. If the child does not press the delete button, the children are asked what you have to do if you make the wrong sounds). Good job! (Each child will do the same task with the same sounds). Good job everyone!

**Week 38: Training session 4**

Hello! Nice to see you again! Today we will continue to play with the PhonicStick. Let’s go through what happens when you move the PhonicStick. This time let’s do it like this.

(Researcher hands the PhonicStick over to one child). Can you show me where you find /t/?

(A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /t/! Ok, let’s pass it on to the friend next to you.

Can you show me where you find /s/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /s/! Perfect! Give it on to the friend next to you.

Can you show me where you find /n/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /n/! Ok, let’s pass it on to the friend next to you.

Can you show me where you find /a/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /a/!

Do you remember what you have to do before you make a new sound? (Children guess). Yes you have to press the delete button. Which button is that? And what do you have to do when you want to listen to the sounds you made? (Children guess). Yes, you have to press the speech button. Which button is that? Do you remember how many
sounds you can make at a time with the PhonicStick? (Children guess). You can make one, two or three sounds at a time (researcher puts down one block at a time).
Now let’s make three different sounds (researcher hands over the PhonicStick to one child). Make three different sounds (researcher puts down one block for each sound the child makes). What did you hear? (Children guess). Let’s count together how many sounds “the child’s name” made (researcher and children count the blocks that the researcher put down. E.g. Yes, xxx consists of three sounds /x/, /x/ and /x/). Ok, let’s pass it on to the friend next to you.

Sometimes you hear a ‘boink’ like this (researcher makes a ‘boink’). When you hear a ‘boink’ it means that there is no sound you can use there. It also means that the sound you just made sometimes disappears and then you have to make the sound again straight away, otherwise you have to start over again and then you have to press the delete button. Like this (Researcher makes /ta/+ ‘boink’. A block is put down for each sound and one block is taken away when the ‘boink’ is made and /a/ is made again). Now let’s make three different sounds again, and remember, if you hear a ‘boink’ you have to make the sound again or press the delete button. You start! (Researcher hands over the PhonicStick to one child.) What did you hear? (Children guess). Let’s count together how many sounds “the child’s name” made (researcher and children count the blocks that the researcher puts down. The researcher also says witch sound each block represent). Ok, let’s pass it on to the friend next to you.
That is all for today. Very good job everybody!

Week 39: School holiday: No training session

Week 40: Training session 5
Hello again! Welcome back from holiday. Do you still remember where you can find all the sounds in the PhonicStick? Let’s go through them quickly. (Researcher hands the PhonicStick over to one child). Can you show me where you find /t/?
(A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /t/! Ok, let’s pass it on to the friend next to you.
Can you show me where you find /s/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of hand, like with a PhonicStick, in the direction) (Yes), it’s a /s/! Perfect! Give it on to the friend next to you.
Can you show me where you find /n/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /n/! Ok, let’s pass it on to the friend next to you.
Can you show me where you find /a/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /a/!
Can you show me where you find /i/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /i/!
Can you show me where you find /p/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /p/!
Very good job!

Do you still remember what happens when you hear a ‘boink’? (Children answer) It means that there is no sound that you can use to make words with there. It also means that the sound you just made sometimes disappears and then you have to make the sound again straight away, otherwise you have to start over again and then you have to press the delete button. Okay!

Let’s begin with putting two sounds together. First I will show you. And then it’s your turn. Let’s start. First I will make /sa/, first I make /s/ and then I make /a/. Like this. (Researcher makes /s/ and then /a/ and puts down one block for each sound and says /s/, /a/ at the same time). Now let’s listen to what sounds I made. Which button must I press? Yes, I have to press the Speech button. What did you hear? Yes, /sa/ (researcher points at one block at a time at the same time as saying /s/, /a/, ). Very good!

Now it’s your turn. (Researcher hands the PhonicStick over to the child closest by). Do like I did. Make /sa/. (Researcher puts down one block for each sound the child makes and says /s/, /a/ at the same time. Researcher helps the child if needed). Now we need to listen to what sounds “child's name” made. (Child presses speech button.) What did you hear? Yes, /sa/ (if the child makes the wrong sound combination, researcher asks: was it the same sounds I made? All the children are allowed to answer) Good job! (Each child will do the same task with the same sounds). Good job everyone!

Now I will make /ti/ (Researcher makes /t/ and then /i/ and puts down one block for each sound and says /t/, /i/ at the same time). Now let’s listen to what sounds I made. (Researcher presses speech button) What did you hear? (Children guess) Yes, /ti/ (researcher says /t/, /i/). Very good!

Now it’s your turn. (Researcher hands the PhonicStick over to the child closest by). Do like I did. Make /ti/. (Researcher puts down one block for each sound the child makes and says /t/, /i/ at the same time. Researcher helps the child if needed). Now we need to listen to what sounds “child's name” made. (Child presses speech button) What did you hear? Yes, /ti/ (researcher says /t/, /i/). If the child makes the wrong sound combination, researcher asks: was it the same sounds I made? All the children are allowed to answer) Good job! (Each child will do the same task with the same sounds).

This is the last thing we will do for today. Let’s make three different sounds, and this time you can choose yourself which sounds you want to make. (Researcher puts down one block for each sound the child makes. If the child makes more than three sounds, the researcher asks: how many sounds did you make? And how many sounds did I tell you to make? The child can then start over.) How many sounds and which sounds did you hear?

Ok, so that was all for today. Good job everybody!

**Week 41: Training session 6**

Hi everybody. Before we start putting sounds together lets go through the sounds in the PhonicStick quickly. (Researcher hands the PhonicStick to one child). Pull the PhonicStick down. (If the child needs help the researcher makes a movement with the hand, like with a PhonicStick, in the direction). What sound is there? (Children guess).
Let’s listen. (Yes), it’s /t/! (The PhonicStick is passed on to the next child.)
Now you pull it to the left side? (If the child needs help, the researcher makes a
movement with the hand, like with a PhonicStick, in the direction) What sound is
there? (Children guess). Let’s listen. (Yes), it’s /s/! (The PhonicStick is passed on to the
next child.)
Pull the PhonicStick to the right side (If the child needs help, the researcher makes a
movement with the hand, like with a PhonicStick, in the direction). What sound is
there? (Children guess). Let’s listen. (Yes), it’s /n/! (The PhonicStick is passed on to the
next child.)
Pull the PhonicStick forward? (If the child needs help, the researcher makes a
movement with the hand, like with a PhonicStick, in the direction) What sound is
there? (Children guess). Let’s listen. (Yes), it’s /a/! (The PhonicStick is passed on to the
next child.)
Pull the PhonicStick up to the left? (If the child needs help, the researcher makes a
movement with the hand, like with a PhonicStick, in the direction) What sound is
there? (Children guess). Let’s listen. (Yes), it’s /i/! (The PhonicStick is passed on to the
next child.)
Now you pull the PhonicStick down to the right (If the child needs help, the researcher
makes a movement with the hand, like with a PhonicStick, in the direction). What sound
is there? (Children guess). Let’s listen. (Yes), it’s /p/! (The PhonicStick is passed on to
the next child.)
Perfect! Good job!

Now let’s make the same thing as we did last week but with three sounds instead of two
sounds. I will make /tas/ (Researcher makes /t/, /a/ and /s/ and says /t/, /a/, /s/ at the
same time). Let’s listen to what sounds I made. (Researcher presses speech button)
What did you hear? (Children guess) Yes, /tas/ (researcher says /t/, /a/, /s/). Very good!

Now it’s your turn. (Researcher hands the PhonicStick over to the child closest by). Do
like I did. Make /tas/. (Researcher puts down one block for each sound the child makes
and says /t/, /a/, /s/ at the same time. Researcher helps the child if needed). Now let’s
listen to what sounds “child's name” made. (Child presses speech button) What did you
hear? Yes, /tas/ (Researcher says /t/, /a/, /s/. If the child makes the wrong sound
combination, researcher asks: was it the same sounds as I made? All the children are
allowed to answer.) Good job! (Each child will do the same task with the same sounds).
Good job everyone!

Now I will make /pa/ (Researcher makes /p/ and then /a/). Now let’s listen to what
sounds I made. (Researcher presses speech button.) What did you hear? (Children
guess.) Yes, /pa/. Very good

Now it’s your turn. (Researcher hands the PhonicStick over to the child closest by).
Make /na/. (Researcher says the two sounds the child have been asked to make isolated
and helps the child if needed). Now we need to listen to what sounds “child's name”
made. (Child presses speech button.) What did you hear? Yes, /na/ (Researcher says /x/, /x/. If the child makes the wrong sound combination researcher asks: was it the same
sounds I asked you to make? All the children are allowed to answer. Child may start
over if it's wrong). Good job!
(All children will do the same task and will be given the same instructions, though with different sound combinations to make. Sound combinations that will be used: /na/, /in/, /pa/, /it/, /sa/)

Now, let’s make three different sounds, but the beginning sound must be /t/. If the children don’t understand the researcher says: The first sound must be /t/). How many sounds and which sounds did you hear? (If the child makes more than three sounds, the researcher asks: how many sounds did you make? Did you make as many sounds as I asked you to make? The child can then start over. All children will do the same task and will be given the same instructions.)

Good job everyone, that was all for today!

Week 42: Training session 7
Hi everybody! Before we start putting sounds together let’s go through the sounds in the PhonicStick quickly. (Researcher hand the PhonicStick over to one child).
Can you show me where you find /t/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /t/! Ok, let’s pass it on to the friend next to you.
Can you show me where you find /s/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /s/! Perfect! Give it on to the friend next to you.
Can you show me where you find /n/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /n/! Ok, let’s pass it on to the friend next to you.
Can you show me where you find /a/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /a/! Can you show me where you find /i/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /i/! Can you show me where you find /p/? (A child makes the sound with the PhonicStick. If the child needs help, the researcher shows in which direction to move the PhonicStick with a movement of the hand, like with a PhonicStick, in the direction) (Yes), it’s a /p/! Very good job!

Let’s start with three sounds today. We did it last time, do you remember?
I will make /sat/ (Researcher makes /s/, /a/ and /t/. Lets listen to what sounds I made. (Researcher presses speech button) What did you hear? (Children guess) Yes, /sat/ (researcher says /s/, /a/, /t/, /sat/). What's the beginning sound in /sat/? (Children guess. If the children guess wrong, the researcher may repeat the question). Yes, /s/. And what's the ending sound in /sat/? (Children guess. If the children guess wrong, the researcher may repeat the question) Yes, /t/. Very good!

Now it’s your turn. (Researcher hands the PhonicStick over to the child closest by). Make /isa/. (Researcher says the three sounds the child has been asked to make isolated and helps the child if needed). Now let’s listen to what sounds “child's name” made.
(Child presses speech button) What did you hear? Yes, /isa/ (researcher says /i/, /s/, /a/, /isa/). (If the child makes the wrong sound combination, researcher asks: was it the same sounds as I asked you to make? All the children are allowed to answer, child my start over if it's wrong). What's the beginning sound in /isa/? (If the children guess wrong the researcher may repeat the question). Yes, /i/. And what's the ending sound in /isa/? (Children guess. If the children guess wrong the researcher may repeat the question) Yes, /a/. Good job! (All children will do the same task and will be given the same instructions, though with different sound combinations to make. Sound combinations that will be used: /isa/, /nap/, /ipa/, /pas/, /ati/). Good job everyone!

No let’s do like this I make /t/ and /a/ (researcher says the sounds isolated). If you put them together, what do you hear? (Children guess) Lets press the speech button to hear what we got (researcher presses the speech button), listen! It's /ta/. (Researcher says /t/, /a/).

Now it's your turn (researcher hand over the PhonicStick to on child). Make /s/ and /a/. If you put them together, what do you hear? (Children guess) Let's listen what “the child's name” (the child presses the speech button. If the child doesn’t know how to put the sounds together, researcher says: press the speech button), listen! It's /sa/. (Researcher says /x/, /x/). (All children will do the same task and will be given the same instructions, though with different sound combinations to make. Sound combinations that will be used: /sa/, /ni/, /ps/, /tn/, /at/). Good job!

This is the last thing we will do for today. Let’s make three different sounds, and they have to begin and end with the sounds I tell you. For example, if I have to have /t/ as the beginning sound and /s/ as the ending sound, I do like this. I make /t/, /i/, /s/, /tis/. (Researcher makes /tis/; the beginning sound is /t/ and the ending sound is /s/.) Now it's your turn. (Researcher hands over the PhonicStick to one child). Make a three-sound word, with /s/ as the beginning sound and /t/ as the ending sound. How many sounds and which sounds did you hear? (If the child makes it wrong, the researcher asks: how many sounds did you make? Did you make as many sounds as I asked you to make? Did it start and end with the sounds I told you to make? The child may start over if it's wrong. All children will do the same task and will be given the same instructions, thou with different beginning and ending sounds. The combinations that will be used are: /s-t/, /a-n/, /t-p/, /s-i/, /i-a/).

Very good everyone. This was the last time that we will meet with the group. Next time I see you I will meet you one at a time. Good bye and good job!