# A parental mHealth resource targeting emergent literacy: An experimental study

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Dissertation submitted in fulfilment of the requirements for the degree

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FACULTY OF HUMANITIES

UNIVERSITY OF PRETORIA

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**December 2019**

DECLARATION OF ORIGINALITY

**UNIVERSITY OF PRETORIA**

**FACULTY OF HUMANITIES**

**DEPARTMENT SPEECH-LANGUAGE PATHOLOGY AND AUDIOLOGY**

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**Title of thesis / dissertation / mini-dissertation:**

A parental mHealth resource targeting emergent literacy: An experimental study

I declare that this dissertation is my own original work. Where secondary material is used, this has been carefully acknowledged and referenced in accordance with university requirements.

I understand what plagiarism is and am aware of university policy and implications in this regard.

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**Signature** **Date**

ACKNOWLEDGEMENTS

Firstly, thank you, Jesus, for providing me with the necessary strength, patience, determination, and courage to complete this daunting task. Jesus, thank you for always being by my side and showing me the light when things get tough. I am forever grateful for Your guidance.

Mrs Eccles, Prof. van der Linde, and Ms Abdoola it has been an absolute honour to have you as my supervisors. I am grateful for having had the opportunity to work with such kind-hearted, knowledgeable and hardworking supervisors. Thank you for all your support, guidance, time and effort throughout the process. Thank you for sharing your knowledge and challenging me to reach my full potential.

Thank you to Dr Graham for your patience and assistance with the statistics of this study. Your knowledge and insight were truly valuable.

Wilma, it was a wild rollercoaster ride but also a privilege to have done data collection with you. I am grateful for the laughter; crying and hurdles we were able to share together. I would not have wanted to do this with anyone else. Thank you for your positivity, for carrying me on the bad days and always praying for me. Darike, thank you for always being there and encouraging me. I am grateful for being able to share life with such dear friends. Words cannot describe what you mean to me.

My fellow master speechies, I am grateful for the opportunity to have shared an office and this journey with each one of you. Thank you for the good memories we got to make. You were truly a special group of people that made this year one to remember.

Lastly, but definitely not least, Mamma, Elize, and the rest of my dear family thank you for supporting, encouraging, and believing in me every step of the way. I would not have been able to this without your support. I am forever grateful.

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LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| **CBD** | - | Central business district |
| **CG** | - | Control group |
| **DBE** | - | Department of Basic Education |
| **ECD** | - | Early Childhood Development |
| **EG** | - | Experimental group |
| **EGRS** | - | Early Grade Reading Study |
| **ELLA** | - | Emergent Literacy and Language Assessment |
| **EWC** | - | Every Word Counts |
| **Grade R** | - | Reception year |
| **HLE** | - | Home literacy environment |
| **HPCSA** | - | Health Professions Council of South Africa |
| **LoLT** | - | Language of learning and teaching |
| **LMIC** | - | Lower middle-income countries |
| **mHealth** | - | Mobile health |
| **NCF** | - | Nurturing Care Framework |
| **PA** | - | Phonological awareness |
| **PEDS** | - | Parents' Evaluation of Developmental Status |
| **PEDS: DM** | - | Parents' Evaluation of Developmental Status - Developmental Milestones |
| **PIRLS** | - | Progress in International Reading Literacy Study |
| **SD** | - | Standard deviation |
| **SES** | - | Socio-economic status |
| **SLTs** | - | Speech-language therapists |

| | | |
|---|---|---|
| **SLAM** | - | School-age Language Assessment Measures |
| **SMS** | - | Short message service |
| **SPSS** | - | Statistic Package Social Sciences |
| **TOPEL** | - | Test of Preschool Early Literacy |
| **WHO** | - | World Health Organization |

LIST OF TERMINOLOGY

**Alphabet knowledge:** The term is used to refer to young children's ability to identify letter names and letter sounds, and it is one of the best indicators of reading and spelling achievement (Puranik, Lonigan, & Kim, 2011).

**CareUp:** *CareUp* is a free mobile application designed to improve early literacy through mobile messaging, audio files, activities and resources for ECD practitioners and parents of children aged four to five years (Innovation Edge, 2017).

**Early childhood development (ECD):** The process of emotional, cognitive, sensory, spiritual, moral, physical, social and communication development of children from birth to at least school-going age (Department of Social Development, 2014).

**Electronic health system:** The term describes the application of information and communications technologies across the whole range of functions that affect healthcare, from diagnosis to follow-up. It is the means to deliver responsive healthcare tailored to the needs of citizens (Catwell & Sheikh, 2009).

**Emergent literacy:** Emergent literacy is defined as the developmental process beginning at birth in which children acquire the foundation for reading and writing including language, listening comprehension, concepts of print, alphabetic knowledge, and phonological awareness (Dennis, Lynch, & Stockall, 2012).

**Emergent writing and spelling:** Include name writing, letter writing, and spelling. Children's letter-writing skills may be a better indicator of children's emergent literacy and developing spelling skills than name-writing skills at the end of the preschool year (Puranik et al., 2011).

**Language of learning and teaching (LoLT):** The language medium in which learning and teaching, including assessment, takes place (Department of Basic Education, 2010).

**Lower-middle-income countries (LMIC):** LMIC are defined as lower-middle-income economies with a gross national income (GNI) per capita between $1,026 and $3,995 (The World Bank Group, 2020).

**Mobile health (mHealth):** mHealth is the use of mobile technologies such as mobile phones, software applications, and devices to support the achievement of health objectives (Olla & Shimskey, 2014).

**Phonological awareness (PA):** PA is a key precursor of literacy development and represents the awareness of, and the ability to, manipulate the phonological structure of words (Janssen, Segers, McQueen, & Verhoeven, 2017). PA includes the awareness of syllables, rhyme awareness, and phoneme awareness.

**Print concepts:** Also referred to as print awareness or print knowledge. Print knowledge is an important first step in the acquisition of literacy skills. Children's knowledge of the functions and conventions of print appears to be related to the development of both emergent and conventional literacy skills, including spelling. Children's print knowledge includes understanding the difference between print and pictures, the difference between letters and numbers, and conventions of print, which include knowledge that words are separated by spaces, and that writing is arranged linearly (Puranik et al., 2011).

**Reception year:** Also known as Grade R and refers to the year before primary school entry (le Roux, 2016).

## FORMATTING

In this dissertation, the American Psychological Association (APA), sixth edition, referencing style was utilised.

ABSTRACT

**Introduction:** Emergent literacy abilities of young children are strong predictors of future academic success; however, biological and environmental risks can impact their progress. Insufficient literacy abilities in school-going children are a prominent problem as South Africa ranked the lowest out of 50 countries in the 2006, 2011 and 2016 Progress in International Reading Literacy Study reports. Parental interventions that promote home-based stimulation of preschoolers can enhance literacy development and ensure school readiness. Mobile phone technology worldwide is becoming readily available making mHealth services accessible to parents in a variety of settings providing access to emergent literacy resources.

**Method:** The effect of a parental mHealth resource targeting emergent literacy abilities was investigated through an experimental, pre- and post-test design with preschoolers (four to five years) and their parents. Eighty-two parent-preschooler dyads were randomly assigned to a control or experimental group based on age and gender. The parents (n = 42) of preschoolers in the experimental group received the *CareUp* application for 17 weeks which served as the intervention approach.

**Results and discussion:** At post-test, no significant between-group differences were identified but both groups showed significant within-group differences. Parents' limited use of the parental mHealth resource may have impacted the effect of the resource on preschoolers' emergent literacy abilities. Only eight (19%) of the parents in the experimental group used the *CareUp* application for more than 50% of the active days although most of the feedback provided by parents regarding the application was positive.

**Conclusion:** Parents appear to require additional support when implementing mHealth emergent literacy resources to promote preschool children's emergent literacy development. Further empirically designed studies on the effectiveness and use of parental mHealth applications in LMIC with additional support are warranted.

***Keywords:*** *literacy development, emergent literacy, preschoolers, parental resource, home literacy environment, mHealth, early childhood development*

# 1. INTRODUCTION

**Chapter aim:** Chapter one provides the theoretical overview of emergent literacy and its development as well as the contextual background in terms of South Africa's educational crisis. Furthermore, an argument is formulated for the use of mHealth resources for stimulating emergent literacy abilities in lower-middle-income countries. The rationale for conducting the research study is delineated.

Foundational literacy development starts from birth (le Roux, 2016; Zeece & Wallace, 2009) and a substantial amount of children's literacy development takes place prior to formal schooling (Willenberg, 2007). Children's emergent literacy skills include attending to print, graphemes, and environmental signs or labels (Skebo et al., 2013). The stimulation of these skills should occur during the developing years (zero to five years) when children are more inclined to learn new ideas and concepts as neural plasticity is high (Okeyo, 2015). In response to the stimulation they receive, neural networks associated with language, memory, and higher cognitive functions evolve rapidly (Ebrahim, Seleti, & Dawes, 2013). Research suggests that children's emergent literacy skills can predict their outcomes regarding the development of skilled versus problematic reading in their preschool years (Wilson & Lonigan, 2010). Emergent literacy abilities of children entering formal schooling are strong predictors of future academic success (Chan & Sylva, 2015; Hilbert & Eis, 2014; Xu, Chin, Reed, & Hutchinson, 2014).

Several biological and environmental risk factors may impact children's emergent literacy abilities prior to formal schooling (Olivier, Anthonissen, & Southwood, 2010). Biological risks include a family history of reading deficits, attention difficulties, as well as cognitive, language and hearing impairment (Olivier et al., 2010). A first language that differs from that of the language of learning and teaching (LoLT); low educational achievement of the mother and low socio-economic status (SES) are environmental risk factors that directly influence emergent literacy development (Olivier et al., 2010; Rowe, Denmark, Harden, & Stapleton, 2016). The combination of risk factors has a cumulative negative impact on emergent literacy development and, thus, later academic outcomes (Olivier et al., 2010; Rowe et al., 2016). In lower-middle-income countries (LMIC), such as South Africa, children predominately (65%) receive education, including reception year (Grade R), in English, although only 7%

(Department of Basic Education, 2010) of children and 9,6% of the country speak English as a first language (Statistics South Africa, 2011a). Many children are therefore schooled in English with limited proficiency from Grade R onwards as education in their first language is inaccessible (Sharma, Vallabh, & van der Merwe, 2013). Consequently, children have difficulty acquiring optimal literacy abilities due to language barriers within the educational setting (Rosenman & Madelaine, 2012).

Children's insufficient literacy abilities can also be attributed to the presence of language difficulties. Language development lays the foundation for children's literacy development (Reese, Sparks, & Leyva, 2010). Research emphasises that children's oral language skills during their preschool years strongly predict their later literacy skills and school success (Rowe et al., 2016; Trainin, Wessels, Nelson, & Vadasy, 2017). Additionally, poor early language skills and subsequent limited literacy abilities in young children are consistently related to limited parent education (Rowe et al., 2016; Sharma et al., 2013) which result in the maintenance of intergenerational poverty for families from low SES (Wasik & Hindman, 2011). Children of parents with a high level of education and SES have a broader vocabulary and are on average six months ahead with literacy development compared to children of parents with no formal education and a lower SES (Rowe et al., 2016; Wildschut, Moodley, & Aronstam, 2016). In South Africa, these factors are pertinent as over 30,3 million people live in low socio-economic settings, 66,8% of which are between the ages of zero to 17 years old (Statistics South Africa, 2017b). Furthermore, only 28,4% of persons older than 20 years in South Africa have high school completion as their highest education level (Statistics South Africa, 2011a). A large proportion of the population is therefore at risk of literacy difficulties (Okeyo, 2015) and limited literacy abilities in school-going children have been identified as a significant problem in South Africa (Department of Education, 2017).

South Africa's underperformance in the 2006 *Progress in International Reading Literacy Study* (*PIRLS*) prompted important changes to the education system, resulting in an increased focus on reading literacy (Howie, van Staden, Tshele, Dowse, & Zimmerman, 2012). The *Drop All and Read* campaign, was an initiative implemented in 2007 to improve Grade R and Grade One learners' reading literacy. More than 11 000 primary schools were provided with literacy resources such as storybooks, written

in all 11 official languages (Howie et al., 2012). Another initiative was the *National Reading Strategy* document distributed by the Department of Education in 2008 (Department of Education, 2008). The strategy included activities and approaches to promote and develop the reading skills of Grade R to Six learners (Howie et al., 2012). *Read to Lead* is a more recent initiative that was officially launched in July 2015 and implemented over a period of four years (2015-2019) (Department of Basic Education, 2015). The campaign focused on improving the reading abilities of all South African children. Schools and teachers were provided with clear directives of the Department of Basic Education's (DBE) expectations to achieve expected levels of performance. Thus, ensuring that all learners are able to demonstrate age-appropriate levels of reading by 2019 (Department of Basic Education, 2015).

Ten years after the initial *PIRLS* report in 2006 and numerous intervention programmes, South Africa, however, still ranked the lowest out of 50 countries in the *PIRLS* 2016 report (Howie et al., 2017a). One of the key findings in the recent report was that 78% of learners do not have basic literacy skills by the end of Grade Four, in contrast to only 4% of learners internationally (Howie et al., 2017b). This shows the effect of the cumulative risks while the *PIRLS* 2016 report highlights the impact of environmental risks that influence literacy development. Only 21% of Grade Four children in South Africa who participated in the study spoke the LoLT at home and learners living in remote rural areas had the lowest reading literacy achievements (Howie et al., 2017b). In 2017, 43% of South Africa's children lived in rural households (Statistics South Africa, 2017a). Child poverty remains most prominent in the rural areas of the former homelands, where two-thirds of children in the poorest income quintile live (Hall, Richter, Mokomane, & Lake, 2018). Thus, within the poorest part of the population, it is mainly rural households that care for children which contributes to South African children's inadequate literacy abilities and underperformance in the *PIRLS*. Innovative approaches and resources targeting emergent literacy are therefore needed to promote literacy development in young children and ensure later educational success (Vally, Murray, Tomlinson, & Cooper, 2015). The *PIRLS* 2016 report (Howie et al., 2017a) made various recommendations that emphasise the need for programmes, initiatives, and approaches to stimulate emergent literacy skills before formal schooling. One of the main recommendations made in the *PIRLS* 2016

report was to campaign for greater parental involvement in school and learner activities.

Parents are a vital resource in promoting children's early literacy development prior to formal school entry as they are the primary person in their children's lives (Reese et al., 2010; Trainin et al., 2017). Parents' beliefs about their children's school readiness, family activities and the home literacy environment (HLE) they create are important aspects that contribute to children's ability to read and learn (Jung, 2016; Yeo, Ong, & Ng, 2014). School readiness begins at a very early age, even in infancy, through parent-led activities that cultivate children's positive attitudes about learning (Jung, 2016). Parent-led activities that are effective in improving emergent literacy skills include shared book reading, reciprocal conversations during book reading, and interaction during print awareness (Han & Neuharth-Pritchett, 2015). The quality of child-directed interactions during shared book reading has been found to be more predictive than the frequency of shared book reading in improving children's literacy skills (Yeo et al., 2014). Also, parent-child interactions that stimulate children to tell richer stories improve narrative skills and contribute to the development of children's complex language skills (Reese et al., 2010). The focus of literacy development should, therefore, be on helping parents engage in quality interactions with their children in the home environment.

It is important that parents are encouraged and empowered to create an active HLE early on to support their children's literacy development (Yeo et al., 2014). Developing parental knowledge of supportive literacy, including strategies and activities to implement in the home environment, can increase parental involvement to foster the development of literacy skills (Neumann, Hood, & Neumann, 2009). Access to literacy resources at home is integral to children's literacy development (Jung, 2016) since a positive relationship between HLE and children's future language and literacy skills exists (Baroody & Diamond, 2012). Evidence suggests that families from low SES have a lack of access to literacy and print resources, especially in first languages, thus contributing to less literacy exposure in the home environment (Eslick, 2018; Trainin et al., 2017). Children, however, acquire literacy skills in English faster if they have a strong foundation in their first language, as foundational literacy skills developed in one language often transfer to a second language (Brown, 2014). Parental

interventions that promote home-based stimulation in children's first language, and improve access to literacy resources are needed in LMIC to enhance literacy development and promote school readiness (Okeyo, 2015).

Mobile technology and applications may be an innovative approach to promote literacy development in the HLE by providing information to parents through short message services (SMS) and smartphone-based applications (Folaranmi, 2014; Terry, 2015). Worldwide, mobile health (mHealth), using mobile communication technologies, is rapidly expanding within the electronic health system (Free et al., 2010). Benefits of mHealth services for families and the health care system include reduced costs and increased access to resources (Catwell & Sheikh, 2009). Furthermore, mHealth services are more accessible in all settings due to the increasing availability of mobile phone technology (Surka, Edirippulige, Steyn, Gaziano, Puoane, & Levitt, 2014). Globally, owners of mobile phones have grown from one billion in 2000 to more than seven billion in 2015 (Iribarren, Cato, Falzon, & Stone, 2017). The number of smartphone users in South Africa in 2018 was 20.4 million (35% of the total population), and for 2019 the estimated number of smartphone ownership is 22 million (38% of the total population) (Holst, 2019). Successful smartphone mHealth application services currently being used in South Africa include the Parents' Evaluation of Developmental Status (PEDS) screening tool (Glascoe, 1997; Maleka, van der Linde, Glascoe, & Swanepoel, 2016) as well as the hearScreen application (Swanepoel, Myburgh, Howe, Mahomed, & Eikelboom, 2014). mHealth technology may be a viable approach to offer parents in LMIC access to literacy resources and enhance the HLE.

Several pilot studies implemented in LMIC support the use of mobile technologies to deliver specific health interventions, including mHealth awareness and prevention programmes (Folaranmi, 2014). Awareness and prevention programmes aim to decrease the effect of risk factors on children's development, prevent future problems and promote the necessary conditions for healthy development (American Speech-Language-Hearing Association, 2008). *Read to Kids* is a mHealth awareness and prevention initiative that uses mobile technology to provide books across India and focuses on improving children's literacy development (Pearson, 2018). The goal of the application is to engage parents in the education process as parents often lack

confidence in their own ability to read to their children because of the strength of their language skills (Pearson, 2018). The application was piloted for one year and reached over 203,000 households of which over 57,000 individuals browsed the library and read at least one book (Arkedis, Heinkel, Synowiec, Eberhardt, & Krakoff, 2018). Almost, 7,000 households also changed their reading habits and individuals read from the application at least four times a month, an indicator of reading habit creation and behaviour change (Arkedis et al., 2018). *Read to Kids* gave parents the confidence to be more involved in their children's literacy development. Examples of programmes in Africa include the use of SMS to distribute health information, and prevention messaging to specific target groups (Folaranmi, 2014). *MomConnect* is a South African National Department of Health initiative that supports maternal health through the use of mobile-based technologies (Department of Health, 2019). The initiative sends targeted health promotion messages to pregnant women to improve their prenatal health. Application services are also free to users, and messages are available in South Africa's 11 official languages (Department of Health, 2019).

The *Wordworks* application, a mobile technology developed in South Africa, is designed to equip parents and early childhood development (ECD) practitioners of young children aged birth to five years with ideas and information to support early learning through everyday activities (Innovation Edge, 2018). It extends parental knowledge and provides practical ideas on how to talk, play, sing and share books with children to enable them to realise their developmental potential (Innovation Edge, 2018). The free *Wordworks* application is available in English, isiXhosa, isiZulu, and Afrikaans and users receive activity related messages from Monday to Thursday and an inspirational message on Friday. Similarly, *CareUp* is a South African mobile application designed to stimulate literacy through push notifications, audio files, activities, and resources for parents and ECD practitioners of children aged four to five years (Rudge, 2017). The content of *CareUp* is sourced from *Wordworks' Every Word Counts* (*EWC*) programme (The Reach Trust, 2018). The mHealth application was first piloted in the Western Cape at ten preschool sites with 15 ECD practitioners and 120 parents in a 15-week pilot (Roberts & Spencer-Smith, 2017). After promising results, the study was upscaled to 50 additional sites in 2017. The majority of participating parents found the activities useful and 69% of the parents read stories to their children at least once a week whereas 67% of the parents did not read stories to

their children before using *CareUp* (Innovation Edge, 2017; Roberts & Spencer-Smith, 2017). Given the positive outcome and good potential of *CareUp* on a relatively large sample of parents in the Western Cape, further independent testing is needed in other low SES settings in South Africa. The pilot study however investigated ECD practitioners' and parents' views and not the effect of the application on preschoolers' emergent literacy abilities. Research that investigates the effect of a parental resource (*CareUp*) on preschoolers', aged four to five years, emergent literacy abilities are therefore warranted.

In LMIC, preschoolers' emergent literacy development is at risk due to various risk factors (Howie et al., 2017a). Literacy development could be encouraged by improving parental access to literacy stimulation resources for use in the HLE, which are fundamental for later academic success (Jung, 2016). Speech-language therapists (SLTs) have the responsibility to collaborate with early care, education, and paediatric medical providers, provide information regarding known risk factors and offer in-service training and resource materials (American Speech-Language-Hearing Association, 2008). Participation in prevention and awareness initiatives for young children should, therefore, be prioritised by SLTs and other allied health care professionals. The investigation of targeted mHealth resources and the evaluation of the effectiveness thereof have been recommended (van der Linde, 2015). Thus, the research question of this study was: *What is the effect of a parental mHealth resource targeting emergent literacy (print concepts, alphabet knowledge, and emergent writing and spelling) in preschoolers between the ages of 4.0 and 5.11 years?*

# 2. METHODOLOGY

**Chapter aim:** This chapter describes the methodological aspects followed for the completion of the study. The aim and objective, design of the study, ethical considerations, and setting and participants are described. Furthermore, screening and assessment measures, intervention, the process in which the research was conducted, and the integrity of the measures are explained.

## 2.1 Research aim

To investigate the effect of a parental mHealth resource targeting emergent literacy (print concepts, alphabet knowledge, and emergent writing and spelling) in preschoolers between the ages of 4.0 and 5.11 years.

## 2.2 Research design

The study made use of an experimental, pre-test post-test research design as preschoolers were randomly assigned to research groups (Maxwell & Satake, 2006; Leedy & Omrod, 2013). The parents of preschoolers in the experimental group received the *CareUp* application resource which served as the intervention approach.

## 2.3 Setting

Early childhood development (ECD) centres, in the central business district (CBD) of Tshwane, with English as the language of learning and teaching (LoLT) were approached. Data collection took place at six ECD centres in the Tshwane, CBD, area after permission from principals of the ECD centres was obtained. The City of Tshwane is the capital of South Africa with a total population of 2,921,488 (Statistics South Africa, 2011a) with 23,2% of this population being between zero and fourteen years of age (Statistics South Africa, 2011b). Approximately 24,3% of the population in Tshwane is classified as living in poverty with less than two percent (1,1%) of the population living on US$2 per day (Statistics South Africa, 2011b). Thus, the City of Tshwane is considered a lower-middle-income area. In 2015, 43,5% of children (zero-17 years) in South Africa were living below 50% of the median income per capita (R797 per month) (Statistics South Africa, 2017b).

## 2.4 Participants

*Sampling method*

Parents of preschoolers attending the ECD centres were invited to participate with their preschoolers in the research study. A hundred and thirteen parents provided consent to participate with their preschoolers in the research study. Non-probability purposive convenience sampling was used to identify parents and their preschoolers meeting the inclusion criteria (Etikan, Musa, & Alkassim, 2016).

*Inclusion criteria*

Parents of preschoolers had to meet the following inclusion criteria:

1) Parents had to be between the ages of 18 and 59 years
2) Parents had to be proficient in English (Grade Five level or above)
3) Parents had to own an Android smartphone

Preschoolers had to meet the following inclusion criteria:

1) Male and female preschoolers aged 4.0 to 5.11 years
2) Preschoolers' LoLT had to be English; thus education and instruction to children in the classroom had to be in English
3) English had to be one of the preschoolers' primary languages

*Exclusion criteria*

Preschoolers were excluded based on one of the following criteria:

1) Developmental screening result regarding speech and language indicated a referral for an audiological and speech-language evaluation
2) Hearing screening result indicated a referral for further audiological evaluation

After eligibility screening, the total number of preschoolers was 84 with 82 parents participating in the study during the pre-test. One of the parents had three preschoolers participating in the study.

## 2.5 Participant description

The included preschoolers were randomly assigned to the research groups, control or experimental, based on age and gender. Every second preschooler within each age and gender range were assigned to the experimental group. Language background was not considered in the formation of the research groups as LoLT was part of the inclusion criteria. At the post-test, two preschoolers and their parents were excluded from the sample as one preschooler transferred schools and the other preschooler only had a 12-week intervention period in comparison to the rest of the sample that received 16-20 weeks. The final sample consisted of 82 parent-preschooler dyads participating (Table 2.1). The pre-test age of the experimental group (n = 42) (*mean* = 57.45 months, standard deviation (*SD*) = 5.86) and control group (n = 40) (*mean* = 58,95 months, *SD* = 6.21) ranged from four to five-year-olds. Sixty-four percent of preschoolers (n = 27) were females in the experimental group and 67,5% (n = 27) in the control group.

South Africa is a multilingual country with 11 official languages (Government Gazette, 1996). Information regarding preschoolers' language proficiency and use were gathered from the 81 parent background information questionnaires that were received from the parents. One parent did not complete the parent background information questionnaire. Across the sample, 67% (n = 54) of the preschoolers' most dominant language was English and 54% (n = 44) of the preschoolers spoke more than one language at home including Northern Sotho (29,6%), isiZulu (17,3%), Setswana (16%), Sesotho (11,1%), isiXhosa (7,4%), and other (24,7%) e.g. Tshivenda, Sepedi, IsiNdebele, Tsonga, Shona, Arabic, and Swazi. Thus, English was one of the primary languages of preschoolers although many preschoolers spoke additional languages which is typical in South Africa. The parent background information questionnaire also provided information regarding employment and the highest education level of preschoolers' parents. Ninety-two percent of mothers in the sample and 96,6% of fathers were employed. Most of the parents, more specifically 64,2% of mothers and 60% of fathers that participated in the study, indicated degree or diploma as their highest level of education. Setting, employment and education assisted in identifying SES which predicts literacy outcomes (Rowe et al., 2016; Wildschut et al., 2016). Thus, the majority of parents within the sample received

monthly incomes and were educated predicting better literacy outcomes for their children (Rowe et al., 2016; Wildschut et al., 2016).

**Table 2.1:** Demographic information of participants

| | Percentage | | |
|---|---|---|---|
| | ***Control Group*** | ***Experimental Group*** | ***Total*** |
| **Preschoolers' pre-test ages (n=82)** | **n=40** | **n=42** | **n=82** |
| 4.0-4.11 years | 55% (n=22) | 61,9% (n=26) | 58,5% (n=48) |
| 5.0-5.11 years | 45% (n=18) | 38,1% (n=16) | 41,5% (n=34) |
| **Preschoolers' gender (n=82)** | **n=40** | **n=42** | **n=82** |
| Male | 32,5% (n=13) | 35,7% (n=15) | 34,1% (n=28) |
| Female | 67,5% (n=27) | 64,3% (n=27) | 65,9% (n=54) |
| **Preschoolers' most dominant language (n=81)#** | **n=39** | **n=42** | **n=81** |
| English | 71,8% (n=28) | 61,9% (n=26) | 66,7% (n=54) |
| Northern Sotho | 7,7% (n=3) | 19% (n=8) | 13,6% (n=11) |
| Setswana | 2,6% (n=1) | 7,1% (n=3) | 4,9% (n=4) |
| Sesotho | 7,7% (n=3) | 0% (n=0) | 3,7% (n=3) |
| isiZulu | 2,6% (n=1) | 4,8% (n=2) | 3,7% (n=3) |
| isiXhosa | 2,6% (n=1) | 2,4% (n=1) | 2,5% (n=2) |
| Other | 5,1% (n=2) | 4,8% (n=2) | 4,9% (n=4) |
| **Employment of mother (n=77)#** | **n=36** | **n=41** | **n=77** |
| Employed | 91,7% (n=33) | 92,7% (n=38) | 92,2% (n=71) |
| Unemployed | 8,3% (n=3) | 7,3% (n=3) | 7,8% (n=6) |
| **Employment of father (n=59)#** | **n=25** | **n=33** | **n=59** |
| Employed | 100% (n=25) | 93,9% (n=31) | 96,6% (n=56) |
| Unemployed | 0% (n=0) | 6,1% (n=2) | 3,4% (n=2) |
| **Mother's highest education level (n=81)#** | **n=39** | **n=42** | **n=81** |
| Less than Gr 8 | 2,6% (n=1) | 0% (n=0) | 1,2% (n=1) |
| Gr 9 – 10 | 0% (n=0) | 2,4% (n=1) | 1,2% (n=1) |
| Gr 11 - 12 | 23,1% (n=9) | 11,9% (n=5) | 17,3% (n=14) |
| Degree/Diploma | 64,1% (n=25) | 64,3% (n=27) | 64,2% (n=52) |
| Post-graduate | 10,3% (n=4) | 21,4% (n=9) | 16% (n=13) |
| **Father's highest education level (n=65)#** | **n=30** | **n=35** | **n=65** |
| No formal schooling | 0% (n=0) | 2,9% (n=1) | 1,5% (n=1) |
| Gr 9 – 10 | 0% (n=0) | 2,9% (n=1) | 1,5% (n=1) |
| Gr 11 - 12 | 13,3% (n=3) | 14,3% (n=5) | 13,8% (n=9) |
| Degree/Diploma | 63,3% (n=19) | 57,1% (n=20) | 60% (n=39) |
| Post-graduate | 23,3% (n=8) | 22,9% (n=8) | 23,1% (n=15) |

#Missing data: questionnaire not received and/or incomplete answers to questions

## 2.6 Ethical considerations

Ethical principles should be taken into consideration to protect the rights and well-being of the participants involved in the study (Leedy & Omrod, 2013). The following ethical principles were adhered to in this study:

*Respect:*

Respect participants as persons, and acknowledge their intrinsic worth, dignity, and sense of value (Health Professions Council of South Africa [HPCSA], 2008). The researcher treated each preschooler and his/her parent with respect.

*Confidentiality*:

A researcher should protect participants' right to privacy and confidentiality by treating personal information as strictly confidential (HPCSA, 2008). Personal information and data collected from the application were numerically coded to assure confidentiality of the information and no identifying information will be made public. Parents' profiles on the application were also completed according to assigned alphanumeric codes to maintain confidentiality.

*Risk and benefits:*

The risk of participating in the study should not be greater than the normal risks of day to day living (Leedy & Omrod, 2013). No risks were involved when participating in this research study. Participating parents received information regarding the importance of literacy skills and development during the parent meeting and in the caregiver information leaflet form. The preschoolers were screened for developmental speech and language difficulties based on parental concern and a hearing screening was conducted and necessary referrals were made if needed. After the post-test, parents of the control group were given the opportunity to download the mHealth application. Parents of preschoolers in both groups also received feedback on their preschoolers' literacy and language performance after the post-test.

*Permission:*

Ethical clearance was obtained from the Research Ethics Committee of the Faculty of Humanities of the University of Pretoria (GW20190105HS) (Appendix A). Permission from the principals of six ECD centres was also obtained (Appendix B).

*Informed consent:*

A caregiver information leaflet and informed consent form were provided to all preschoolers' parents before data collection (Appendix C). Data collection commenced once informed consent was obtained. Verbal informed assent was also obtained from each preschooler before assessments commenced (Appendix D). Parents of preschoolers were made aware that participation was voluntary and that they had the right to withdraw at any time if they no longer wished to participate. Participants' right to self-determination or to make their own informed choices should be honoured (HPCSA, 2008).

### 2.7 Materials and Apparatus

The following materials were used during data collection; caregiver information leaflet and informed consent form (Appendix C), verbal informed assent (Appendix D), parent background information questionnaire (Appendix E), Parents' Evaluation of Developmental Status (PEDS) tools (Glascoe, 1997; Maleka et al., 2016), hearScreen application (Swanepoel, 2016), referral letter (Appendix F), and Emergent Literacy and Language Assessment (ELLA) protocol (Appendix G) (Willenberg, 2007).

An interpreter was available but not needed to explain the caregiver information leaflet and informed consent form (Appendix C) and to assist with the parent background information questionnaire (Appendix E) during the parent meeting.

*Parents' Evaluation of Developmental Status (PEDS) tools* (Glascoe, 1997; Maleka et al., 2016)

The PEDS tools, a combination of the PEDS and Parents' Evaluation of Developmental Status: Developmental Milestones (PEDS: DM), were used to identify the presence/absence of domain-specific developmental milestones (van der Linde, 2016). The developmental screening identify parental concerns regarding children's development in the following areas: global/cognitive; expressive language and articulation; receptive language; fine motor; gross motor; behaviour; social-emotional; and self-help skills (van der Linde, 2016). Smartphones (Huawei P Smart and Huawei P10) were used to administer the developmental screening. The PEDS consists of ten open-ended questions that were posed to the parent. The screening measure did not

require the preschooler to be present. The PEDS use a referral algorithm consisting of five paths, namely Path A to E (van der Linde, 2016). Path A indicates a referral for an audiological and speech-language evaluation, when two or more predictive concerns about self-help, social, school, or receptive language skills are present. The PEDS: DM consists of six multiple choice questions posed to parents regarding their child's age-specific developmental milestones (van der Linde, 2016). If one or more milestone has not been reached by the child, the PEDS:DM indicates a fail. The interpretation of the PEDS tools was done using only the PEDS results irrespective of the PEDS: DM result. The Path A referral algorithm (referral for an audiological and speech-language evaluation) was used as an exclusion criterion for this study.

*hearScreen* (Swanepoel et al., 2014)

The hearScreen application (Android OS) was utilised to conduct hearing screening on all potential participants at each of the ECD centres. Minimal training is required to administer the screening as it has a simple, user-friendly interface and onscreen instructions (Swanepoel et al., 2014). A Samsung Galaxy 8 smartphone containing the hearScreen application and Sennheiser HD202 II supra-aural headphones calibrated to ISO/ANSI standards, were used for the hearing screening. The application uses an automated test sequence and interpretation for adults and children according to best practice guidelines (Swanepoel, 2016). Furthermore, the smartphone microphone can evaluate whether test outcomes are influenced by environmental noise. hearScreen is validated for use in schools and in community-based settings (Louw, Swanepoel, Eikelboom, & Myburgh, 2017). The hearing screening indicates a referral when the preschooler is unable to detect the intensity of 20 dB or more at 1000, 2000 or 4000 Hz. Upon failure, the full screening was repeated, thus employing the test-retest method to ensure accurate results.

*Biographical case history*

Parents completed a parent background information questionnaire (Appendix E) compiled by the researcher. The questionnaire included questions to obtain biographic and demographic information of participants to accurately describe the sample and achieve the study objective (Shipley & McAfee, 2016).

*Emergent Literacy and Language Assessment (ELLA) protocol (Willenberg, 2007)*

The ELLA protocol (Appendix G) was administered on all participating preschoolers as there is no formal standardised assessment protocol for emergent literacy skills in South Africa. Willenberg (2007) piloted the ELLA protocol to document the emergent literacy skills of disadvantaged communities in a low SES setting in Cape Town. The ELLA protocol, designed for the South African population, assess specific domains required for the acquisition of emergent literacy skills (Sharma, Vallabh, & van der Merwe, 2013). There are ten subtests included in the ELLA protocol to assess three main domains of emergent literacy; namely, orientation to print skills (environmental print, concepts about print, and writing and spelling); knowledge of speech-print relationships (letter naming, sounds in words, rhyme recognition, and rhyme production), and language (vocabulary, word definitions, and fictional narratives) (Willenberg, 2007). For the current study only the specific emergent literacy domains, orientation to print skills and knowledge of speech-print relationships, were examined (Table 2.2). Fictional narratives, from the language domain, were also assessed because narratives form the bridge from oral language to literacy (Stadler & Ward, 2005). Adaptations to the protocol were made from the recommendations of previous research by Willenberg (2007), Olivier (2009) and Sharma et al. (2013). The ELLA protocol provides results for each subtest across domains and not an overall score for emergent literacy.

Orientation to print was assessed by administering three subtests: environmental print, concepts about print and writing and spelling. The environmental print subtest was used as adapted by Sharma et al. (2013) as the protocol was compiled in 2004 and some of the items are no longer appropriate:

- The Discom chain store logo was excluded as a limited number of these stores are found in the Gauteng area.
- The logo of Shoprite-Checkers was changed to Checkers only as the dual-logo no longer exists.
- The Engen logo replaced the Caltex logo as there is a wider distribution of these service stations in South Africa.

The concepts about print subtest refers to knowledge of print concepts. The subtest was assessed as in the published protocol (Willenberg, 2004). The original concepts about print test (Clay, 1979) was administered using the book, *Follow Me, Moon* (Clay, 2000) as the stimulus.

The writing and spelling subtest assess emergent writing and invented spelling. Invented spelling was assessed as in the original protocol (Willenberg, 2004) by using the first two sections of the Primary Spelling Inventory (Bear, Invernizzi, Templeton, & Johnston, 2000).

The second emergent literacy domain is knowledge of print-speech relationships and includes four subtests: letter naming, sounds in words, rhyme recognition and rhyme production. Letter naming and sounds in words was assessed by utilising the Test of Preschool Early Literacy [TOPEL] (Lonigan, Wagner, Torgesen, & Rashotte, 2007). The TOPEL was used as it is a standardised tool that assesses emergent literacy skills in children three to five years of age (Hilbert & Eis, 2014). The test is norm-referenced; however, it is standardised for the American English-speaking population. The TOPEL has three subtests namely print knowledge, definitional vocabulary, and phonological awareness (PA). Subtest one assesses print knowledge. The TOPEL has been utilised in research studies in both high and low-income countries (Xu et al., 2014).

Rhyme recognition and production are part of children's PA skills (Skibbe, Bindman, Hindman, Aram, & Morrison, 2013). These subtests were assessed using the protocol as adapted by Olivier (2009). In the original rhyme recognition and rhyme production subtests, there were a small number of items (Willenberg, 2004). Therefore, the number of items was increased with five items each, requiring additional participant responses respectively (Olivier et al., 2010).

The third emergent literacy domain is language and include the fictional narratives subtest. Fictional narratives were assessed using more culturally relevant pictures and not as in the published protocol. This subtest determines participants' narrative production ability and required participants to formulate a story when presented with pictures. Six language elicitation cards developed by Crowley and Baigorri for School-age Language Assessment Measures [SLAM] (Appendix H) were used as the stimuli (Crowley & Baigorri, 2015). All narratives were voice-recorded using a voice recorder

application on a smartphone (Huawei P Smart). The voice recording of each preschooler was transcribed and the narrative stage was determined using Applebee's system (Applebee, 1978) for scoring narrative stages. Applebee (1978) proposed a system for studying the development of story organization and presented six developmental levels of narratives that build on the critical elements of centering and chaining (Stadler & Ward, 2005). These levels are thought to be most appropriate for understanding how the stories of children develop from about two to six years of age.

**Table 2.2:** Subtests of the ELLA protocol and the corresponding domains of emergent literacy as used in this study

| ELLA protocol subtests | Construct/s | Assessment tools | Adaptations | Administration procedures | Scoring procedures |
|---|---|---|---|---|---|
| **Orientation to print** | | | | | |
| Environmental print | Awareness of environmental print | Environmental print stimulus *(Sharma et al., 2013)* | - Discom chain store logo was excluded<br>- Logo of Shoprite-Checkers was changed to Checkers<br>- Engen logo was replaced by the Caltex logo | - Preschoolers had to recognise and identify specific signs/ brand names when presented with several locally familiar logos and signs | - Correct response = two points<br>- Incorrect responses belonging to the same generic category = one point<br>- Other incorrect responses = no points |
| Concepts about print | Knowledge of print concepts such as front versus back of the book, print direction, and orientation | *Follow Me, Moon (Clay, 2000)* | | - Preschooler had to answer questions about the book that included concepts such as front versus back of the book, print direction, and orientation, and vocabulary such as page, letter, word and read<br>- Subtest was stopped after three successive errors | - Each correct response was credited with one point |
| Writing and spelling | Emergent writing and invented spelling abilities | Primary Spelling Inventory (*Bear, Invernizzi, Templeton, & Johnston, 2000)* | First two sections of the Primary Spelling Inventory were administered | - Preschoolers were asked to write their name, if they were able to do so they were asked to write the words: *fat, pen, dig, mop,* and *rope*<br>- If they were able to give the correct or invented spelling of the words, they were asked to write the words: *wait, check, slum, stink, shine* | - Subtest was scored by crediting each correct response with one point |
| **Knowledge of print-speech relationships** | | | | | |
| Letter naming | Print and alphabet knowledge, early knowledge of written language conventions and form | TOPEL *(Lonigan, Wagner, Torgesen, & Rashotte, 2007)* | TOPEL subtest one instead of the published | - Preschoolers had to identify letters and written words, point to specific letters, names specific letters, identify letters associated with specific sounds, and say the sounds associated with specific letters | - Raw scores were applied descriptively |

| | | | | | |
|---|---|---|---|---|---|
| Sounds in words | Phonological awareness: sounds in words, word omission, and blending abilities | | TOPEL subtest three | - Preschoolers had to say a word, then say what is left after leaving out specific sounds (elision)<br>- Then preschoolers had to separate sounds and combine them to form a word (blending) | - Raw scores were applied descriptively |
| Rhyme recognition | Phonological awareness: rhyme recognition abilities | Rhyme recognition and production stimulus *(Olivier, 2009)* | Number of items was increased from 10 to 15 | - A set of three pictures were presented and named<br>- Preschoolers had to identify which two words sounded "almost the same"<br>- Two examples were used prior to administration<br>- 15 sets could have been presented but if the subtest was terminated after five consecutive errors | - Each correct response was credited with one point |
| Rhyme production | Phonological awareness: rhyme production abilities | | Five test items were added to the original five items | - Preschoolers had to produce a word that rhymes with the pair of rhyming words presented<br>- 10 pairs could have been presented but the subtest was terminated after five consecutive errors | - Correct responses were credited with one point each. Nonsense words that rhyme was also credited |
| **Language** | | | | | |
| Fictional narratives | Narrative production ability | SLAM cards *(Crowley & Baigorri, 2015)* | Six locally and culturally relevant sequence picture cards were used and not the Bear Story pictures | - Preschoolers had to formulate a narrative based on a set of six sequence cards<br>- A voice recording was made of each narrative | - Narratives were scored by determining the narrative stage according to Applebee's system |

## 2.8 Intervention

*CareUp mobile application*

The *CareUp* mobile application served as the intervention for the experimental group (Rudge, 2017). *CareUp* is a recent South African mobile application that empowers parents to improve literacy development of children aged four to five years through regular push notifications with ECD content linked to activities, instructions, and information (The Reach Trust, 2018). The application is an interactive resource comprising of creative ideas to build language and literacy skills through everyday activities. *CareUp* is accessible as an Android application and mobile website and the content is currently available in isiXhosa, Afrikaans, English, and isiZulu (Rudge, 2017; Wordworks, 2017). The *EWC* programme is evidence-based and supports language and literacy development in young children through the use of responsive parent programmes (Stefano, O'Carroll, & Comrie, 2015). *CareUp* provided parents with quality resources through audio files offering information, and activities (Innovation Edge, 2017). Additionally, parents had access to a selection of culturally relevant stories on the application to read at any time (The Reach Trust, 2018). Parents received motivational messages once a week, three weekly reminder notifications and daily notifications with activities and instructions around a theme that is aligned with the National Curriculum Framework (The Reach Trust, 2018). The use of the application was continually tracked so that uptake, usage and user experiences can be evaluated (Innovation Edge, 2017). The application and content have been designed to use data only when downloading and have no further running costs (Innovation Edge, 2017).

## 2.9 Procedures

*Pilot study*

Pilot studies are conducted to identify possible difficulties that may be encountered during the planned research (Kanjee, 2006). A pilot study was conducted to determine the duration of the protocol, refine procedural aspects and to determine if the *CareUp* application does have an impact on preschoolers' emergent literacy abilities after three months. Two male preschoolers aged four years five months and four years one month

respectively, on the day, were asked to participate in the pilot study. Both preschoolers adhered to the inclusion criteria and were in Grade 000. Informed consent was obtained from both preschoolers' parents, and the parents completed the parent background information questionnaire while the ELLA protocol was administered on the preschoolers. Both preschoolers gave assent before the researcher administered the ELLA protocol.

The parent of the preschooler in the experimental group received the *CareUp* application resource after the pre-test protocol administration. The ELLA protocol was administered within one hour as predicted. After the completion of the pre-test, it was decided to alter the sequence of presentation of the subtests. The subtests that took longer to complete was presented first as preschoolers' concentration deteriorated as the assessment progressed. The letter naming and sounds in words subtests were presented first during the post-test of the pilot study. The post-test took place three months after the pre-test administration of the assessment protocol. During the three months, the parent of the preschooler in the experimental group facilitated literacy stimulation using the *CareUp* mobile application as an intervention resource.

The pilot study provided the researcher with the opportunity to identify limitations and adaptions regarding the protocol that had to be addressed before the planned research commenced. It has been established that the protocol can be administered within one hour and that the sequence of presenting the subtests had to be altered. Furthermore, instructions of subtests were simplified, and the stimulus cards for the fictional narratives were revised. After scoring the pilot's results, it was decided that results should be interpreted using criterion reference as tools used are not standardised for the South African population. Preschoolers' progress in the pre- and post-test should, therefore, be investigated instead of performance on assessment tools. The pilot also concluded that the *CareUp* application had an influence on the development of emergent literacy after three months. Thus, the pilot study provided a good indication of the difficulty of test items and expected results.

*Data collection procedure*

Data collection and analysis was done in collaboration with a fellow Master student investigating the effect of a parental mHealth application on language outcomes in

preschoolers. The same population was assessed and included in both cohort studies, but the objectives and measurements differed. Therefore, combined permission letters, information leaflets, and informed consent forms were used. The same parent background information questionnaire was also utilized. Furthermore, the ELLA protocol was administered as it includes emergent literacy and language subtests. The present study focused on the results of the emergent literacy subtests while the other cohort study examined the language subtests results. Both researchers administered the developmental screening themselves, as well as the hearing screening and literacy and language assessment of preschoolers.

Data collection took place at six ECD centres in the Tshwane, CBD, area once permission was obtained (Appendix B). A parent meeting was held at each ECD centre and the caregiver information leaflet and informed consent letter (Appendix C) was provided to each parent. Preschoolers were not present during the parent meeting. Data collection commenced once the study was explained, parents had read through the information leaflet, and informed consent was obtained. At the parent meeting, the developmental screening of each preschooler's speech and language abilities based on parental concern was conducted. Thirty-one (27%) of the 115 preschoolers that were screened using the PEDS tools received a Path A, referral for an audiological and speech-language evaluation, and were excluded from the study (Appendix F). The parents of the included preschoolers were then asked to complete the parent background information questionnaire (Appendix E) while every second preschooler was assigned to the experimental group based on age and gender. After that, parents in the experimental group were given the mHealth literacy resource (*CareUp*) that served as the intervention. Wi-Fi was provided by the researcher to download the application onto the parents' smartphones. Parents had the option to select the language preference of the application. The majority of parents (n = 38) chose English (90,48%) while two of the parents chose Xhosa (4,76%) and two parents selected Afrikaans (4,76%). The researcher explained the use and content of the application and the parents were orientated on how to use the application. Parents' profiles on the mHealth application were completed according to assigned alphanumeric codes to maintain confidentiality.

After the parent meeting, hearing screening and assessment slots were made with the respective ECD centres during the day. Preschoolers at the ECD centres were divided between the two researchers to administer the hearing screening and ELLA protocol assessments. The included preschoolers' hearing was screened in a quiet room at each ECD centre. None of the preschoolers received a referral for further audiological testing after conducting the hearing screening. If preschoolers had failed the hearing screening they would have been excluded from the study. Subsequently, the pre-test assessments commenced at the ECD centres during school hours using the ELLA protocol (Appendix G). Each preschooler gave verbal informed assent before administering the assessment (Appendix D). Sixteen to 20 weeks (mean = 17 weeks, *SD* = 1.68) after the pre-test, participating preschoolers were reassessed using the same literacy protocol. During the 17 weeks, parents of the preschoolers in the experimental group facilitated literacy stimulation using the *CareUp* mobile application as an intervention resource. The 17-week intervention period correlates with the period of the *CareUp* pilot study done in the Western Cape that showed positive results (Innovation Edge, 2017). The assessment procedures on both occasions did not take longer than an hour per preschooler. Every parent received feedback regarding their preschooler's performance after the post-test assessment.

After completing the post-test early literacy assessments, parents in the control group were then given the opportunity to download the application. Data that tracked the experimental groups' parents' active days (log into the application to open activities or read stories) of *CareUp* usage were downloaded from their phones. Based on the data received from the *CareUp* usage, the researcher contacted 31% (n = 13) of the parents that received the application to obtain feedback about their experience using the application. Parents (n = 13) were randomly selected from three categories based on the use of the application i.e. below average, average and above-average usage during possible active days. Three questions were posed to the parents to gather feedback. Firstly, *Did you use the CareUp application?* If parents replied *Yes* to the first question, the second question was, *What did you enjoy about using the application?* and the third question was then, *What were the challenges in using the application and would you use it in the future?* If the parents responded *No* to the first question they were asked was, *What made it difficult for you to use the application?* and the last question was, *What would have encouraged you to use the application?*

## 2.10 Data analysis

The participants' parent background information questionnaires were recorded in a MS Excel sheet as quantitative data for statistical analysis. The ELLA protocol was used as a criterion measure to track progress from the baseline to post-test assessments. Results from the assessment measures of the ELLA protocol were analysed individually using raw scores and then calculated to percentage out of the possible maximum score for each subtest. The fictional narratives were analysed according to Applebee's system for scoring narrative stages (Applebee, 1978). The scores obtained from the ELLA protocol subtests were interpreted descriptively as the tools used are not standardised for the South Africa population.

In order to test for normality, the Statistic Package Social Sciences (SPSS) v 23 (Chicago, Illinois) gives the Kolmogorov-Smirnov and Shapiro-Wilk test statistics along with their corresponding p-values. These two tests are the same in that they are both testing for normality, however, the Shapiro-Wilk test is known to have more power in detecting differences from normality (Field, 2018). A statistically significant difference is present if the p-value is less than 0.05. The Shapiro-Wilk test indicated no age and gender difference between groups at pre-test and the subtest scores did not follow a normal distribution across the two research groups thus nonparametric tests were used.

The Mann-Whitney test was used to test for between-group differences for continuous data (environmental print, concepts about print, writing and spelling, letter-naming, sounds in words, rhyme recognition and production) while the Chi-Square test was used for categorical data (fictional narratives). The Wilcoxon signed-rank tests for differences within the control and experimental group, respectively, for continuous data. The Cramer's V test evaluated possible within-group differences in categorical data including Fictional narrative: Narrative stage subtest. Data regarding the *CareUp* usage were analysed by calculating the percentage of days parents actively used the *CareUp* application by at least opening the application during the intervention period. Furthermore, a thematic analysis was conducted to analyse a subtest of parent (n = 13) responses about their experience using the application. During thematic analysis patterns or themes are identified within qualitative data to comment on findings (Maguire & Delahunt, 2017).

## 2.11 Validity and reliability

The validity of a measurement instrument is the extent to which the instrument measures what it is supposed to measure, whereas the reliability refers to the consistency of measures (Leedy & Omrod, 2013). Validity and reliability were ensured in the study.

*Internal validity*

A research study demonstrates internal validity if the design and data it yields allow the researcher to derive accurate conclusions about cause-and-effect and other relationships within the data (Leedy & Omrod, 2013). The potential outcome of this study was improved emergent literacy abilities in preschoolers (4.0-5.11 years) through the use of a mHealth parental resource. The ELLA protocol was used to assess preschoolers' emergent literacy abilities and the mHealth parental resource *CareUp* served as intervention to stimulate preschoolers' emergent literacy skills. Thus, investigating the cause and effect relationship between emergent literacy abilities and a parental mHealth application targeting emergent literacy.

The PEDS tools help increase the validity of the results by controlling confounding variables, and the research groups were age and gender matched. A potential threat was that the experimental group did not use the *CareUp* application resource, which served as the intervention approach, as frequently as expected. The use of the application by the parents was however tracked to comment on what influence regular or irregular usage has on the effect of the application on emergent literacy abilities. The possibility of the control group also receiving the application before and not after the post-test was another potential risk. Both groups' participant numbers were screened, during data analysis of the *CareUp* usage, to determine if any of the control group's participants downloaded the application. Furthermore, quantitative and qualitative data were used, which can lead to triangulation of results. The following measures were taken to further ensure the internal validity of this research study.

*Face validity*

Face validity is the extent to which the measurement measures what it is intended to measure (Foxcroft & Roodt, 2009). The ELLA protocol is made up of tools that have

been shown to evaluate the aspects of emergent literacy which the tool is intended to measure (Olivier, 2009; Sharma et al., 2013; Willenberg, 2007).

*Content validity*

Content validity refers to whether the content of a measurement instrument is representative of the area being measured (Leedy & Omrod, 2013). The ELLA protocol is made up of ten subtests each testing a different domain of emergent literacy (Willenberg, 2007). These ten items test the three domains of emergent literacy; orientation to print, knowledge of print-speech relationships, and language (Willenberg, 2007). Thus, the ELLA protocol has content validity.

*Construct validity*

The construct validity of a measure is the extent to which an instrument measures a characteristic that cannot be directly observed (Leedy & Omrod, 2013). Information from the parent background information questionnaire regarding possible developmental, hearing or language difficulties was considered. Furthermore, results from the PEDS tools indicated which participants will be excluded from the study. The exclusion of these participants ensured that additional constructs did not influence the results of the ELLA protocol. The validity is increased by measuring the construct in question, which is emergent literacy (Leedy & Omrod, 2013).

*External validity*

External validity refers to the extent to which the results obtained from a research study can be applied to situations beyond the study itself (Leedy & Omrod, 2013). The results obtained from the research study can be used to describe the emergent literacy abilities of children from preschools in low SES settings in South Africa.

*Reliability*

The reliability of the protocol's application was enhanced by the researcher giving the same instructions to each participant ensuring consistency (Leedy & Omrod, 2013). Furthermore, the protocol is designed for the South African context, and used in at least three previous studies (Olivier, 2009; Sharma et al., 2013; Willenberg, 2007). The current study implemented improvements recommended by the previous studies

to enhance reliability. The two researchers that scored the data of the current study also applied principles of consensus to increase interrater reliability. Scoring of the subtests was done by applying the criterion-reference approach and using a rubric thereby minimising subjective judgements and enhancing reliability (Leedy & Omrod, 2013). The ELLA protocol has a Cronbach's Alfa coefficient of 0.75 suggesting a high level of internal consistency (Willenberg, 2007). The researcher assumed an unbiased, scientific and professional attitude during test administration by not assisting participants in obtaining increased scores (Foxcroft & Roodt, 2009). Furthermore, the researcher is a postgraduate speech-language pathology student familiar with the application of assessment instruments for a paediatric population.

# 3. A PARENTAL mHEALTH RESOURCE TARGETING EMERGENT LITERACY: AN EXPERIMENTAL STUDY

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**Journal:** Early Childhood Education Journal[1]

**Submitted:** 25 November 2019 (Appendix I)

## Abstract

Emergent literacy abilities of young children are strong predictors of future academic success however, biological and environmental risks can impact their progress. Parental interventions that promote home-based stimulation of preschoolers can enhance literacy development and ensure school readiness. mHealth technology may be a viable approach to offer parents increased access to emergent literacy resources. The effect of a parental mHealth resource targeting emergent literacy abilities was investigated. Eighty-two parent-preschooler (four-to five-year-old) dyads were randomly assigned to a control or experimental group based on age and gender. The parents of preschoolers in the experimental group received the mHealth application resource for 17 weeks. At post-test, no significant between-group differences were identified. Both groups showed significant within-group differences at post-test. Only eight of the parents in the experimental group (n = 42) used the mHealth application more than 50% of the active days. Most of the feedback received from parents regarding the application was positive. Parents may require more support when implementing mHealth emergent literacy resources.

***Keywords:*** emergent literacy, preschoolers, parental resource, mHealth

## Introduction

Emergent literacy abilities of children entering school are strong predictors of future academic success (Chan & Sylva, 2015; Hilbert & Eis, 2014; Xu, Chin, Reed, & Hutchinson, 2014). Research suggests that children's emergent literacy skills can predict their outcomes regarding the development of skilled

[1] *This article was edited in accordance with the editorial specifications required by the journal and may differ from the editorial style of the rest of this dissertation.*

versus problematic reading in their early school years (Wilson & Lonigan, 2010). Children's literacy skills develop from birth (Howie et al., 2017a), however, several biological and environmental risk factors can impact development (Olivier, Anthonissen, & Southwood, 2010). Biological risks include a family history of reading deficits, attention difficulties, as well as cognitive, language and hearing impairment (Olivier et al., 2010). Environmental risks that directly influence emergent literacy development are limited proficiency in the language of learning and teaching (LoLT), low maternal education level and/or socio-economic status (SES) (Olivier et al., 2010; Rowe, Denmark, Harden, & Stapleton, 2016).

The combination of risk factors can have a cumulative negative impact on emergent literacy development and, thus, later academic outcomes (Olivier et al., 2010; Rowe et al., 2016). In low and middle-income countries (LMIC), such as South Africa, children predominately receive education, including Reception year (Grade R), in English although only 9,6% of the country speak English as a first language (Statistics South Africa, 2011a). Many children are therefore schooled from Grade R onwards in English with limited proficiency as education in their first language is inaccessible (Sharma et al., 2013). Consequently, children have difficulty acquiring optimal literacy abilities due to language barriers within the educational setting (Rosenman & Madelaine, 2012).

Additionally, poor early language skills and subsequent limited literacy abilities in young children are consistently related to limited parent education (Rowe et al., 2016; Sharma et al., 2013). These factors result in the maintenance of intergenerational poverty for families from low SES (Wasik & Hindman, 2011). Children of parents with a high level of education and SES have a broader vocabulary and are on average six months ahead with literacy development compared to children of parents with no formal education and a lower SES (Rowe et al., 2016; Wildschut et al., 2016). In South Africa, these factors are pertinent as over 30,3 million people live in low socio-economic settings, of which 66,8% are between the ages of zero to 17 years old (Statistics South Africa, 2017b). Furthermore, only 28,4% of the population older than 20 years have high school completion as their highest education level (Statistics South Africa, 2011a). A large proportion of the population is therefore at risk for literacy

difficulties as evidenced by the limited literacy abilities of school-going children in South Africa (Department of Basic Education, 2017).

Since South Africa's underperformance in the 2006 *Progress in International Reading Literacy Study* (PIRLS) important changes to the education system have been implemented, with a particular focus on reading literacy (Howie, van Staden, Tshele, Dowse, & Zimmerman, 2012). Initiatives such as the 'Drop All and Read' campaign and the National Reading Strategy document have been implemented to improve literacy acquisition (Howie, van Staden, Tshele, Dowse, & Zimmerman, 2012). Ten years after the initial PIRLS report, however, South Africa, still ranked the lowest out of 50 countries in the PIRLS 2016 report (Howie et al., 2017b). One of the key findings in the recent report was that 78% of learners do not have basic literacy skills by the end of Grade Four, in contrast to only 4% of learners internationally (Howie et al., 2017b). This shows the effect of the cumulative risks while the PIRLS 2016 report highlights the impact of environmental risks that influence literacy development. Only 21% of Grade Four children in South Africa who participated in the study spoke English, the prominent LoLT, at home and learners living in remote rural areas had the lowest reading literacy achievement (Howie et al., 2017b). Data analysed from a National Education and Evaluation Development Unit of South Africa study also stated that 41% of Grade Five rural English second language learners were 'non-readers of English' (Rule & Land, 2017; Spaull & Draper, 2015). Innovative approaches and resources targeting emergent literacy are therefore needed to promote literacy development in young children and ensure later educational success. The PIRLS 2016 report recommends parental involvement as a vital resource in promoting children's early literacy development prior to school entry as they are the primary person in their children's lives (Reese et al., 2010).

Developing parental knowledge of supportive literacy, including strategies and activities to implement in the home environment, can increase parental involvement to foster the development of literacy skills (Neumann et al., 2009). Access to literacy resources at home is integral to children's literacy development (Jung, 2016) since a positive relationship between the home literacy environment (HLE) and children's future language and literacy skills exists (Baroody & Diamond, 2012). Evidence suggests that families from low SES have a lack of access to literacy and print resources especially in the first

language, thus contributing to less literacy exposure in the home environment (Trainin et al., 2017). Parental interventions that promote home-based stimulation, and improve access to literacy resources are needed in LMIC to enhance literacy development and promote school readiness (Okeyo, 2015).

Mobile technology and applications may be innovative approaches to promote literacy development by providing information to parents through short message services (SMS) and smartphone-based applications. Worldwide, mHealth, mobile communication technologies in health care, is rapidly expanding within the electronic health system (Free et al., 2010). Benefits of mHealth services for families and the health care system include reduced costs and increased access to resources (Catwell & Sheikh, 2009). Furthermore, mHealth services are accessible in all settings due to the increasing availability of mobile phone technology (Surka, Edirippulige, Steyn, Gaziano, Puoane, & Levitt, 2014). Globally, owners of mobile phones have grown from one billion in 2000 to more than seven billion in 2015 (Iribarren et al., 2017). The number of smartphone users in South Africa in 2018 was 20.4 million (35% of the total population), and for 2019 the estimated number of smartphone ownership is 22 million (38% of the total population) (Holst, 2019). mHealth technology may be a viable approach to offer parents in LMIC access to literacy resources and enhance the HLE. Several pilot studies implemented in LMIC support the use of mobile technologies to deliver specific health interventions including mHealth awareness and prevention programmes (Folaranmi, 2014).

*Read to Kids* is an mHealth awareness and prevention initiative that uses mobile technology to provide books across India and focuses on improving children's literacy development (Pearson, 2018). The goal of the application is to engage parents in the education process as parents often lack confidence in their own ability to read to their children because of the strength of their language skills (Pearson, 2018). The application was piloted for one year and reached over 203,000 households of which over 57,000 individuals browsed the library and read at least one book (Arkedis et al., 2018). Almost 7,000 households also changed their reading habits and individuals read from the application at least four times a month, an indicator of reading habit creation and behaviour change (Arkedis et al., 2018). *Read to Kids* gave parents the confidence to be more involved in their children's literacy development.

Examples of mHealth programmes in Africa include the use of SMS to distribute health information, and prevention messaging to specific target groups (Folaranmi, 2014).

The *Wordworks* application, a mobile technology developed in South Africa, is designed to equip parents and early childhood development (ECD) practitioners of young children aged birth to five years with ideas and information to support early learning through everyday activities (Innovation Edge, 2018). It extends parental knowledge and provides practical ideas on how to talk, play, sing and share books with children (Innovation Edge, 2018). The free *Wordworks* application is available in English, isiXhosa, isiZulu, and Afrikaans and users receive activity related messages from Monday to Thursday and an inspirational message on Friday. Similarly, *CareUp* is a South African mobile application designed to stimulate literacy through mobile messaging, audio files, activities and resources for parents and ECD practitioners of children aged four to five years (Rudge, 2017). The content of *CareUp* is sourced from *Wordworks' Every Word Counts* (EWC) programme (The Reach Trust, 2018). The application was first piloted in the Western Cape at ten preschool sites with 15 ECD practitioners and 120 parents in a 15-week pilot (Roberts & Spencer-Smith, 2017). The pilot investigated ECD practitioners' and parents' views and showed promising results. The study was then upscaled to 50 additional sites in 2017. The majority of participating parents found the activities useful and 69% of the parents read stories to their children at least once a week whereas 67% of the parents did not read stories to their children before using the application (Innovation Edge, 2017). Given the positive outcome and good potential of *CareUp* on a relatively large sample of parents in the Western Cape, further independent testing is needed in other low-income areas in South Africa.

In low-income areas, preschoolers' emergent literacy development is at risk due to various risk factors (Howie et al., 2017a). Literacy development could be encouraged by improving parental access to literacy stimulation resources for use in the HLE. The investigation of targeted mHealth resources and the evaluation of the effectiveness thereof have been recommended (van der Linde, 2015). This study aimed to determine the effect of a parental mHealth resource on emergent literacy (print concepts, alphabet knowledge, and emergent writing and spelling) in preschoolers between the ages of 4.0 and 5.11 years.

## Method

### Setting and participants

Data collection took place at six ECD centres, in the central business district (CBD) of Tshwane, with English as the LoLT. The City of Tshwane is the capital of South Africa with a total population of 2,921,488 and 23,2% of the population being between zero and fourteen years of age (Statistics South Africa, 2011b). Approximately 24,3% of this population is classified as living in poverty (a per capita income below €1.72 a day) (Statistics South Africa, 2011b). Thus, the City of Tshwane is considered a lower-middle-income area.

Hundred and thirteen parents provided consent to participate with their preschoolers in the research study. Preschoolers were required to be 4.0 to 5.11 years of age, typically developing regarding speech and language, attend an ECD centre with English as LoLT and English had to be one of the preschoolers' primary languages. Preschoolers had to pass a developmental screening regarding speech and language abilities based on parental concern as well as a hearing screening. Parents of preschoolers had to be between the ages of 18 and 59 years, proficient in English (Grade Five level or above) and own an Android smartphone to be included in the study.

After eligibility screening, the total number of preschoolers was 84 with 82 parents, as one parent had three preschoolers participating in the study. Preschoolers were randomly assigned to the research groups based on age and gender. At the post-test, two preschoolers and their parents were excluded from the sample as one preschooler transferred schools and the other only had a 12-week intervention period in comparison to the rest of the sample that received 16-20 weeks. The final sample consisted of 82 parent-preschooler dyads participating (Table 3.1).

**Table 3.1:** Demographic information of participants

| | **Percentage** | | |
|---|---|---|---|
| | ***Control Group*** | ***Experimental Group*** | ***Total*** |
| **Preschoolers' pre-test ages (n=82)** | **n=40** | **n=42** | **n=82** |
| 4.0-4.11 years | 55% (n=22) | 61,9% (n=26) | 58,5% (n=48) |
| 5.0-5.11 years | 45% (n=18) | 38,1% (n=16) | 41,5% (n=34) |
| **Preschoolers' gender (n=82)** | **n=40** | **n=42** | **n=82** |
| Male | 32,5% (n=13) | 35,7% (n=15) | 34,1% (n=28) |
| Female | 67,5% (n=27) | 64,3% (n=27) | 65,9% (n=54) |

| **Preschoolers' most dominant language (n=81)#** | **n=39** | **n=42** | **n=81** |
|---|---|---|---|
| English | 71,8% (n=28) | 61,9% (n=26) | 66,7% (n=54) |
| Northern Sotho | 7,7% (n=3) | 19% (n=8) | 13,6% (n=11) |
| Setswana | 2,6% (n=1) | 7,1% (n=3) | 4,9% (n=4) |
| Sesotho | 7,7% (n=3) | 0% (n=0) | 3,7% (n=3) |
| isiZulu | 2,6% (n=1) | 4,8% (n=2) | 3,7% (n=3) |
| isiXhosa | 2,6% (n=1) | 2,4% (n=1) | 2,5% (n=2) |
| Other | 5,1% (n=2) | 4,8% (n=2) | 4,9% (n=4) |
| **Employment of mother (n=77)#** | **n=36** | **n=41** | **n=77** |
| Employed | 91,7% (n=33) | 92,7% (n=38) | 92,2% (n=71) |
| Unemployed | 8,3% (n=3) | 7,3% (n=3) | 7,8% (n=6) |
| **Employment of father (n=59)#** | **n=25** | **n=33** | **n=59** |
| Employed | 100% (n=25) | 93,9% (n=31) | 96,6% (n=56) |
| Unemployed | 0% (n=0) | 6,1% (n=2) | 3,4% (n=2) |
| **Mother's highest education level (n=81)#** | **n=39** | **n=42** | **n=81** |
| Less than Gr 8 | 2,6% (n=1) | 0% (n=0) | 1,2% (n=1) |
| Gr 9 – 10 | 0% (n=0) | 2,4% (n=1) | 1,2% (n=1) |
| Gr 11 - 12 | 23,1% (n=9) | 11,9% (n=5) | 17,3% (n=14) |
| Degree/Diploma | 64,1% (n=25) | 64,3% (n=27) | 64,2% (n=52) |
| Post-graduate | 10,3% (n=4) | 21,4% (n=9) | 16% (n=13) |
| **Father's highest education level (n=65)#** | **n=30** | **n=35** | **n=65** |
| No formal schooling | 0% (n=0) | 2,9% (n=1) | 1,5% (n=1) |
| Gr 9 – 10 | 0% (n=0) | 2,9% (n=1) | 1,5% (n=1) |
| Gr 11 - 12 | 13,3% (n=3) | 14,3% (n=5) | 13,8% (n=9) |
| Degree/Diploma | 63,3% (n=19) | 57,1% (n=20) | 60% (n=39) |
| Post-graduate | 23,3% (n=8) | 22,9% (n=8) | 23,1% (n=15) |

# Missing data: questionnaire not returned and/or incomplete answers to questions

**Procedures**

Ethical clearance (GW20190105HS) was obtained from the Research Ethics Committee of the Faculty of Humanities, University of Pretoria. Data collection took place at six ECD centres in the Tshwane area. Permission from principals of the ECD centres was obtained. A parent meeting was held at each ECD centre and preschoolers were not present. Data collection commenced once the study was explained, parents had read through the information leaflet, considered the inclusion criteria and informed consent was obtained. At the parent meeting, a developmental screening of speech and language abilities based on parental concern was conducted. Thirty-one of the 115 preschoolers that were screened obtained a referral for speech-language evaluation and were excluded from the study. The parents of the included preschoolers were then asked to complete the parent background information questionnaire while every second preschooler was assigned to the experimental group based on age and gender. Language background was not considered in the formation of the research

groups as LoLT was part of the inclusion criteria. Parents in the experimental group were then given an mHealth literacy resource (*CareUp*) that served as the intervention. The application and content have been designed to use data only when downloading and have no further running costs (Innovation Edge, 2017). Wi-Fi was provided by the researcher to download the application onto the parents' smartphones. The researcher explained the use and content of the application and the parents were orientated on how to use the application. Parents' profiles on the mHealth application were completed according to assigned alphanumeric codes to maintain confidentiality.

After the parent meeting, the included preschoolers' hearing was screened in a quiet room during the day at their respective ECD centres. None of the preschoolers failed the hearing screening. Subsequently, the pre-test assessments commenced at the ECD centres during school hours using an early literacy protocol. Sixteen to 20 weeks (mean = 17 weeks, *SD* = 1.68) after the pre-test, participating preschoolers were reassessed using the same literacy protocol. During the 17 weeks, parents of the preschoolers in the experimental group facilitated literacy stimulation using the *CareUp* mobile application as an intervention resource. The 17-week intervention period correlates with the period of the *CareUp* pilot study done in the Western Cape that showed positive results (Innovation Edge, 2017). The assessment procedures on both occasions did not take longer than an hour per preschooler. Every parent received feedback regarding their preschoolers' performance after the post-test early literacy assessment.

After completing the post-test early literacy assessments, parents in the control group were given the opportunity to download the *CareUp* application. Data that tracked the experimental groups' parents' active days (log into the application to open activities or read stories) of *CareUp* usage were downloaded. Based on the data received from the *CareUp* usage, the researcher contacted 31% (n = 13) of the parents that received the application to obtain feedback about their experience using the application. Parents (n = 13) were randomly selected from three categories based on the use of the application i.e. below average, average and above-average usage during possible active days. Three questions were posed to the parents to gather feedback. Firstly, *Did you use the CareUp application?* If parents replied Y*es* to the first question, the second question was *What did you enjoy about using the*

*application?* and the third question was then *What were the challenges in using the application and would you use it in the future?* If the parents responded *No* to the first question, they were asked was *What made it difficult for you to use the application?* and the last question was, *What would have encouraged you to use the application?*

**Materials and Apparatus**

*Screening measures for inclusion*

The Parents' Evaluation of Developmental Status (PEDS) tools (Maleka et al., 2016) and hearScreen (Swanepoel, 2016) were conducted on all potential participants. Smartphones (Huawei P Smart and Huawei P10) were used to administer the PEDS developmental screening. The PEDS tools consist of 16 questions (10 open-ended and six multiple choice) that were posed to each parent. The screening identifies parental concerns regarding preschoolers' development in the following areas: global/cognitive; expressive language and articulation; receptive language; fine motor; gross motor; behaviour; social-emotional; and self-help skills (van der Linde, 2016). Participants were excluded if the developmental screening indicated a referral to a speech-language therapist. The hearScreen application was utilised to conduct hearing screening. A Samsung Galaxy 8 smartphone containing the hearScreen application and Sennheiser HD202 II supra-aural headphones (Louw et al., 2017), calibrated to ISO/ANSI standards, were used for the screening. hearScreen is validated for use in schools and community-based settings (Louw et al., 2017). The hearing screening indicated a referral when the preschooler is unable to detect the intensity of 20 dB at 1000, 2000 or 4000 Hz.

*Biographical case history*

Each parent completed a researcher-developed parent background information questionnaire to obtain biographic and demographic information for an accurate description of the population (Shipley & McAfee, 2016).

*Early literacy assessment*

The Emergent Literacy and Language Assessment (ELLA) protocol (Willenberg, 2007) was administered on all participating preschoolers. The ELLA protocol, designed for the South African

population, assesses specific domains required for the acquisition of emergent literacy skills (Sharma, Vallabh, & van der Merwe, 2013). There are ten sub-tests included in the ELLA protocol to assess three main domains of emergent literacy; namely, orientation to print skills (environmental print, concepts about print, and writing and spelling); knowledge of speech-print relationships (letter naming, sounds in words, rhyme recognition, and rhyme production), and language (vocabulary, word definitions, and fictional narratives) (Willenberg, 2007). For the current study only the specific emergent literacy domains, orientation to print skills and knowledge of speech-print relationships, of the ELLA protocol were examined. Fictional narratives, from the language domain, were also assessed because narratives form the bridge from oral language to literacy (Stadler & Ward, 2005). Adaptations to the protocol were made from the recommendations of previous research by Willenberg (2007), Olivier (2009) and Sharma et al. (2013). Assessment measures used to evaluate emergent literacy abilities of the ELLA subtests included the environmental print stimulus, Follow Me, Moon, Primary Spelling Inventory, Test of Preschool Early Literacy [TOPEL], rhyme recognition and production stimulus and School-age Language Assessment Measures [SLAM] (Table 3.2). The TOPEL is not standardised for the South Arica population and results were interpreted using raw scores. A voice recorder application (Huawei P Smart) was used to record the fictional narratives for later analysis. The ELLA protocol provides results for each subtest across domains and not an overall score for emergent literacy.

**Table 3.2:** Subtests of the ELLA protocol and the corresponding assessment measures

| ELLA Protocol Subtests | Assessment measures |
|---|---|
| **Orientation to print** | |
| Environmental print | Environmental print stimulus (Sharma et al., 2013) |
| Concepts about print | Follow Me, Moon (Clay, 2000) |
| Writing and spelling | Primary Spelling Inventory (Bear et al., 2000) |
| **Knowledge of print-speech relationships** | |
| Letter naming | TOPEL (Lonigan et al., 2007) |
| Sounds in words | |
| Rhyme recognition | Rhyme recognition and production stimulus (Olivier, 2009) |
| Rhyme production | |
| **Language** | |
| Fictional narratives | SLAM (Crowley & Baigorri, 2015) |

*Intervention*

*CareUp* is a recent South African mobile application that empowers parents to improve literacy development of children aged four to five years through regular messaging and push notifications with ECD content linked to activities, instructions, and exercises (The Reach Trust, 2018). The content of *CareUp* is available in four languages: isiXhosa, Afrikaans, English, and isiZulu (Rudge, 2017; Wordworks, 2017). The EWC programme from which the content is sourced is evidence-based and supports language and literacy development in very young children through the use of parenting programmes (Stefano et al., 2015). *CareUp* provides parents with quality resources through audio files offering information, activities, stories and inspirational messages (Innovation Edge, 2017). Parents received motivational messages once a week, three weekly reminder notifications and daily messages with activities and instructions around a theme that is aligned with the National Curriculum Framework (The Reach Trust, 2018). Additionally, parents can access a selection of culturally relevant stories on the application to read at any time (The Reach Trust, 2018).

**Data analysis**

The ELLA protocol is used as a criterion measure to track progress from the baseline to post-test assessments. Results from the assessment measures were analysed individually using raw scores and then calculated to percentage out of the possible maximum score for each subtest. The fictional narratives were analysed according to Applebee's system for scoring narrative stages (Applebee, 1978). The data were tested for normality and not all the variables' p-values for the Shapiro-Wilk test were greater than 0.05 indicating the data is not normally distributed thus nonparametric tests were used. The Mann-Whitney test was used to test for between-group differences for continuous data (environmental print, concepts about print, writing and spelling, letter-naming, sounds in words, rhyme recognition and production) while the Chi-Square test was used for categorical data (fictional narratives). The Wilcoxon signed-rank tests for differences within the control and experimental group, respectively, for continuous data. The Cramer's V test evaluated possible within-group differences in categorical data including Fictional narrative: Narrative stage subtest. A statistically significant difference is present if the p-value is less than 0.05.

Data regarding the *CareUp* usage were analysed after a frequency distribution was run to determine the percentage of days parents actively used the *CareUp* application by at least opening the application during the intervention period. Furthermore, a thematic analysis was conducted to analyse a subtest of parent (n = 13) responses about their experience using the application.

**Results**

Baseline assessment results from the ELLA protocol indicated that the experimental group (EG) and control group (CG) were comparable as no significant differences in performance were noted in any subtests; environmental print ($p$ = .721), concepts about print ($p$ = .273), writing and spelling ($p$ = .625), letter-naming ($p$ = .430), sounds in words ($p$ = .820), rhyme recognition ($p$ = .272) and production ($p$ = .588) (Table 3.3). Similarly, no significant between-group differences across subtests were identified at post-test. Post-test within-group comparisons of both the CG and EG showed significant improvement in six out of seven ELLA protocol subtests (environmental print, concepts about print, writing and spelling, letter naming, sounds in words and rhyme recognition). Only the rhyme production subtest did not show significant within-group improvements for either the CG ($p$ = .317) or the EG ($p$ = .157) at post-test. At post-test, 96% (n = 79) of preschoolers were also unable to produce words that rhyme with the test item even after an example was given.

Sounds in words showed the best average performance across the entire sample (n = 82) at the pre-test (CG: 43,81%; EG: 42,07%) and post-test (CG: 56,78%; EG: 55,30%). Preschoolers across the sample (n = 82) performed the poorest in the writing and spelling (CG pre-test: 3,45%, CG post-test: 5,73%; EG pre-test: 2,36%, EG post-test: 5%) and rhyme production (CG pre-test: 0%, CG post-test: 0,3%; EG pre-test: 0%, EG post-test: 0,5%) subtests at pre- and post-test. Preschoolers in both research groups displayed limited evidence of either pretend writing or invented spelling ability. In the post-test, 47,5% (n = 19) of the preschoolers in the CG scribbled or attempted to write the first letter of their name while 50% (n = 23) of the EG preschoolers were able to write their names.

**Table 3.3:** Comparison of ELLA protocol subtests pre- to post-test between- (Mann-Whitney test) and within- (Wilcoxon signed-rank test) groups

| ELLA Protocol Subtest | Max possible score | Control Group (n=40) | | | | | Experimental Group (n=42) | | | | | Between-group post-test |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-test | | Post-test | | Within-group | Pre-test | | Post-test | | Within-group | |
| | | Mean (SD) | Mean as % of max possible score | Mean (SD) | Mean as % of max possible score | p-value | Mean (SD) | Mean as % of max possible score | Mean (SD) | Mean as % of max possible score | p-value | p-value |
| **Environmental print** | 52 | 21.13 (9.55) | 40,63% | 27.00 (10.48) | 51,92% | 0.000* | 21.45 (9.34) | 41,25% | 28.02 (11.17) | 53,88% | 0.000* | 0.721 |
| **Concepts about print** | 24 | 3.88 (3.11) | 16,17% | 5.05 (2.73) | 21,04% | 0.017* | 3.33 (3.33) | 13,88% | 4.38 (2.56) | 18,25% | 0.015* | 0.273 |
| **Writing and spelling** | 11 | 0.38 (0.54) | 3,45% | 0.63 (0.59) | 5,73% | 0.004* | 0.26 (0.45) | 2,36% | 0.55 (0.50) | 5% | 0.001* | 0.625 |
| **Letter naming** | 36 | 11.25 (6.79) | 31,25% | 15.80 (7.15) | 43,89% | 0.000* | 11.29 (8.49) | 31,36% | 15.10 (8.23) | 41,94% | 0.000* | 0.430 |
| **Sounds in words** | 27 | 11.83 (5.49) | 43,81% | 15.33 (5.01) | 56,78% | 0.000* | 11.36 (4.78) | 42,07% | 14.93 (4.83) | 55,30% | 0.000* | 0.820 |
| **Rhyme recognition** | 15 | 2.03 (3.21) | 13,53% | 5.70 (3.28) | 38% | 0.000* | 1.31 (1.97) | 8,73% | 4.83 (3.08) | 32,2% | 0.000* | 0.272 |
| **Rhyme production** | 10 | 0.00 (0.00) | 0% | 0.03 (0.16) | 0,3% | 0.317 | 0.00 (0.00) | 0% | 0.05 (0.22) | 0,5% | 0.157 | 0.588 |

* statistically significant at $p < .05$

The fictional narrative skills of the CG and EG showed no significant between-group differences for the pre-test ($p$ = .238) or post-test responses ($p$ = .452) (Table 3.4). Within-group comparisons identified a significant difference between the pre- and post-test fictional narratives responses of both the CG ($p$ < .001) and EG ($p$ = .001). Preschoolers in the CG progressed from 30% (n = 12) producing sequence stories in the pre-test to 45% (n = 18) presenting chain narratives in the post-test. The EGs' preschoolers improved from 24% (n = 10) heap stories to 43% (n = 18) primitive stories during the post-test. Across the sample, 65% (n = 53) of preschoolers produced heap and sequence stories at pre-test, while at post-test 77% (n = 63) of preschoolers progressed to predominately producing primitive and chain narratives.

**Table 3.4:** Narrative stage raw score crosstabulation for between-group (Chi-Square test) and within-group differences (Cramer's V test)

| **Fictional narratives: Narrative stage** | **Control Group (n=40)** | | | **Experimental Group (n=42)** | | | **Between-group** | |
|---|---|---|---|---|---|---|---|---|
| | **Pre-test** | **Post-test** | **Within-group** | **Pre-test** | **Post-test** | **Within-group** | | |
| | **Frequency (%)** | **Frequency (%)** | **p-value** | **Frequency (%)** | **Frequency (%)** | **p-value** | **Pre-test p-value** | **Post-test p-value** |
| **Heap stories** | 10 (25%) | 1 (2,50%) | 0.000* | 10 (23,80%) | 0 (0%) | 0.001* | 0.238 | 0.452 |
| **Sequence stories** | 12 (30%) | 5 (12,5%) | | 21 (50%) | 13 (30,95%) | | | |
| **Primitive stories** | 10 (25%) | 16 (40%) | | 7 (16,67%) | 18 (42,86%) | | | |
| **Chain stories** | 8 (20%) | 18 (45%) | | 4 (9,52%) | 11 (26,19%) | | | |

* statistically significant at $p$ < .05

Analysis of the *CareUp* usage suggested no association between the active days and the outcomes of preschoolers in the EG as the p-value for each of the subtests was more than 0.05. The *CareUp* usage data showed that the majority (81%) of the parents that received the application used it less than 50% of the active days (Figure 3.1). The frequency distribution indicated that six parents were active for 60% of the days while four parents were active at least 70% of the days. Thus, only ten (23,8%) of the parents actively used the application during the intervention period. The average number of active days (ranging from 1 to 91 days) across the EG for the 17-week intervention period was 24 days ($SD$ =

25.54). Parents (59,5%) predominately used the application at the beginning of the intervention period and less in the last four weeks. Ninety-five percent of parents (n = 40) did not disable the reminder and activity notifications within the application settings. The highest number of activities that were opened by a parent for at least 10 seconds over the 17-week period was 72 (mean = 23.50; *SD* = 27.46). Five of the parents opened 28 stories (mean = 6.83; *SD* = 10.09) for at least 15 seconds during the 17 weeks and 48% of the parents (n = 42) did not open any of the stories available on the application.

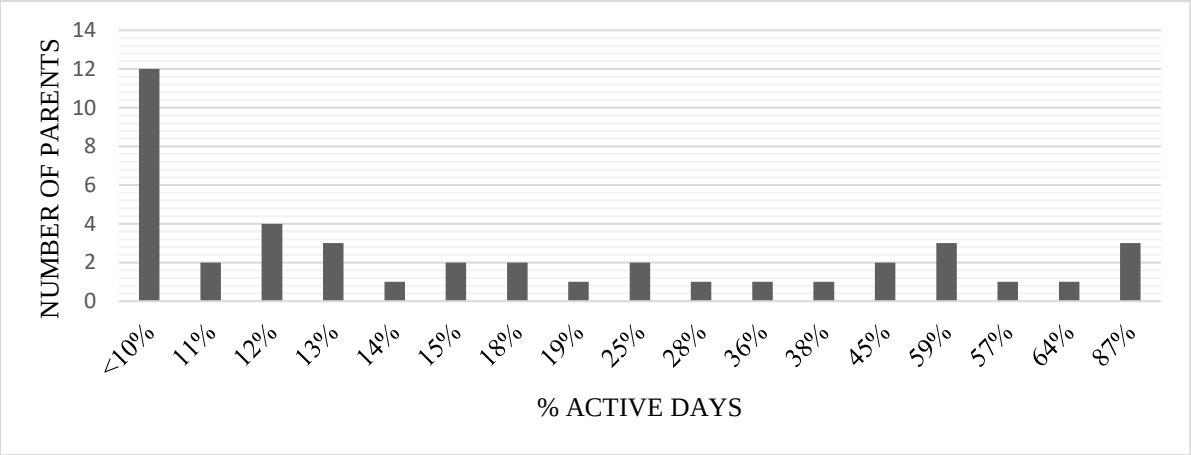


**Figure 3.1:** Percentage of active days parents used the *CareUp* application

To gather parents' perceptions of the application, the parents (n = 11) that used the application were asked what they enjoyed about the application. Responses were grouped and five (45%) of the parents mentioned that they enjoyed the parent-child interaction, while six (55%) commented on the value of the stories and activities - "*The stories and activities showed me how to engage with my children*." Secondly, parents were asked to highlight the challenges they experienced in using the application and to indicate if they would continue to utilise it. Nine of the parents (81%) did not experience any challenges and reported they would use the application in the future. A challenge identified by one of the parents was that their child did not want to concentrate during the activity. Another parent mentioned the application stopped working and took up too much phone storage. The two parents that did not use the application at all were asked: "What made it difficult for you to use the application?" One parent responded she did not have data to use the application, although data was not required to access the resources, and the other parent reported time constraints.

## Discussion

Results indicated that preschoolers in the EG did not perform significantly better than preschoolers in the CG at post-test. *CareUp* usage analysis also suggested no association between the active days and the performances of preschoolers in the EG. Despite what was considered to be a user-friendly and cost-effective mHealth resource that provided access to literacy resources, parents did not consistently utilise the *CareUp* application. A possible contributing factor to the findings of the current study was parents' limited use of the mHealth resource during the 17-week intervention period. Usage data indicated that 81% of the parents that received the application used the resource less than 50% of the active days. These findings are in contrast with several pilot studies implemented in LMIC that support the use of mHealth technology as an innovative approach to stimulate literacy by providing parents with information through mobile applications (Innovation Edge, 2018; Pearson, 2018). Since less than one-third of the parents (n = 10) actively used the application in the current study, the group was too small for a proper statistical analysis to determine whether *CareUp* had an effect on preschoolers' performances. In contrast, the *CareUp* pilot study reported encouraging uptake and usage data for the parents as 67% accessed *CareUp* at least three times per week (Roberts & Spencer-Smith, 2017). Parents' self-report responses after the pilot study suggested increased positive perceptions regarding their own knowledge and more frequent engagement with their children (Roberts & Spencer-Smith, 2017). Similarly, parents in the present study reported improved parent-child engagement when using the stories and activities from the application. The *CareUp* application seemed to be a viable approach to provide parents with information and literacy resources to enhance the HLE. The *CareUp* pilot study, however, differed from the current study in that an initial workshop was held to orientate participants to the mHealth resource and usage was monitored through school and home visits. Parents' usage of mHealth resources is influenced by the lack of knowledge and support to use mobile technology in the home environment (Papadakis, Zaranis, & Kalogiannakis, 2019).

Parental beliefs, opinions, and attitudes directly relate to the use of mobile technology (Papadakis et al., 2019). Eighty-one percent (n = 9) of the parents considered the application as innovative and easy to use. Twenty-seven percent of parents (n = 3) identified some challenges in the current study including

technical problems (n = 2) such as the application stopped working or took up too much phone storage (n = 1) and inconsistent use of the application due to limited time available (n = 1). These factors are similar to those reported in the pilot study, including a lack of interest or confidence in using the service; lack of data to download or update content, challenging home circumstances and receiving reminders and messages at inconvenient times (Roberts & Spencer-Smith, 2017).

Parents that received the *CareUp* application were encouraged and supported through three weekly reminders and daily activity messages send by the application. Parents (59,5%) in the present study predominately used the application at the beginning of the intervention period. Only two of the parents (n =40) disabled the reminder and activity notifications within the application settings thus parents' usage and engagement with the application was facilitated. If the application, however, was not opened regularly the reminder and activity notifications automatically stopped. This may be the reason why parents used *CareUp* less towards the last two months as they were not encouraged to continue using the application. Future recommendations for application developers may be to continue sending notifications regardless of parents' usage of the application or rather using SMS messaging that is not dependent on opening the application regularly.

Within-group comparisons at post-test showed significant differences in the mean scores of the environmental print (CG: 51,92%; EG: 53,88%), concepts about print (CG: 21,04%; EG: 18,25%), writing and spelling (CG: 5,73%; EG: 5%), letter naming (CG: 43,89%; EG: 41,94%), sounds in words (CG: 56,78%; EG: 55,30%) and rhyme recognition (CG: 38%; EG: 32,2%) subtests. These emergent literacy domains typically emerge and/or mature between two to five years of age (Owens, 2014; Paul, 2007; Paul & Norbury, 2012; Shipley & McAfee, 2016). The improved results shown in the within-group comparisons for six of the seven ELLA protocol subtests are most likely attributable to normal maturation and long-term preschool influence. There were also no significant between-group differences for fictional narratives while within-group comparisons identified a significant difference for both the CG ($p < .000$) and EG ($p = .001$).

Narratives are foundational to early literacy development as they form the bridge from oral language to literacy (Stadler & Ward, 2005). Children between the ages of four and five years are expected to produce primitive and chain narratives (Paul, 2007). Preschoolers in both groups predominately produced heap and sequence stories in the pre-test, and more primitive and chain narratives in the post-test. Both groups' preschoolers thus, progressed along the typical continuum of narrative stage development from the pre- to post-test.

The rhyme production subtest was the only subtest that did not show significant within-group improvement and the subtest in which preschoolers across the sample performed the poorest. The rhyme production abilities of the participating preschoolers were a concern as rhyming is integral to later reading development and is an important aspect of children's early literacy experiences (Xu et al., 2014). The developmental sequence of phonological awareness (PA) skills (e.g. letter naming, blending and segmentation, rhyme recognition and rhyme production) observed in English first language speakers might not, however, apply to English second language speakers, the population included in the present study (Raynolds, López-Velásquez, & Olivo Valentín, 2017). The differences in the development of rhyming skills between first and second language English speakers in South Africa may be attributed to the fact that rhyme does not appear in African languages (Vermaak, 2006) and English first language speakers have greater exposure to English nursery rhymes (Raynolds et al., 2017). English second language learners, therefore, find rhyming activities more difficult than other PA tasks, such as blending and segmentation (Vermaak, 2006). This is evident in the present study as preschoolers across the sample achieved better performances in the sounds in words subtest, which involved blending and segmenting words and sounds, than in the rhyme recognition and production subtests. English second language learners, therefore, may not be exposed to rhyme during the period it emerges which may lead to the development of more sophisticated PA skills such as blending and segmentation instead. English second language learners require added exposure to support the acquisition of rhyming skills and as a result future literacy skills.

## Conclusion

Research suggests that mHealth resources are an innovative solution that can support aspects of preschoolers' emergent literacy development, however, in the current study no effect was documented after a 17-week intervention period. Parents inconsistently utilized the application although they identified it as an easy to use and innovative mHealth resource that provided access to literacy resources in the home environment. Parents may require additional support when implementing mHealth emergent literacy resources to improve preschool children's emergent literacy outcomes. Further empirically designed studies on the effectiveness and use of parental mHealth applications in low resourced settings are warranted to clarify the effect on emergent literacy development.

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# 4. DISCUSSION AND CONCLUSION

**Chapter aim:** The aim of this chapter is to describe and conclude the major research findings and report the clinical implications of the current study. Contributions and limitations of the present study are discussed and recommendations for future research are documented.

## 4.1 Discussion of results

The current study aimed to investigate the effect of a parental mHealth resource on emergent literacy (print concepts, alphabet knowledge, and emergent writing and spelling) in preschoolers between the ages of 4.0 and 5.11 years. Between-group comparisons at post-test indicated that preschoolers in the experimental group (EG) did not perform significantly better than preschoolers in the control group (CG). The outcome of the study was that the parental mHealth resource, *CareUp*, did not have an effect on preschoolers' emergent literacy abilities after 17 weeks, however, usage of the mHealth application by parents was limited.

Usage data indicated that 81% of the parents that received the *CareUp* application used the application less than 50% of the active days. Parents (59,5%) predominately used the application at the beginning of the intervention period and less in the last four weeks. Only ten (23,8%) of the parents used the application throughout the intervention period. Thus, the group was too small for a proper statistical analysis to determine whether *CareUp* had an effect on preschoolers' performances.

Parental beliefs, opinions, and attitudes directly relate to the use of mobile applications (Papadakis et al., 2019). Perceptions gathered from the parents' feedback suggested that most (81%) parents in the experimental group considered the application as innovative and easy to use. Factors that may have restricted parents' ability to fully engage and benefit from the mHealth resource included lack of interest or confidence in using the application; lack of data to download or update content, receiving notifications at an inconvenient time and challenging home circumstances (Roberts & Spencer-Smith, 2017). Although *CareUp* was considered to be a user-friendly and cost-effective smartphone resource; parents did not use the mobile application consistently.

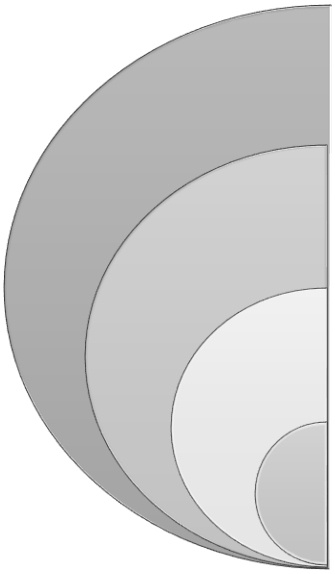
Post-test within-group comparisons showed print concepts, alphabet knowledge, and emergent writing and spelling abilities improved in both groups. Rhyme production was the only subtest that did not show significant within-group differences for both the CG ($p$ = .317) and EG ($p$ = .157). Preschoolers across the sample also achieved the poorest performance in the rhyme production subtest during the pre- and post-test. Ninety-six percent (n = 79) of preschoolers were unable to produce words that rhymed with the test item even after an example was given. The rhyme production results are concerning as rhyming is integral to later reading development and is an important aspect of children's early literacy experiences (Xu et al., 2014). The developmental sequence of phonological awareness (PA) skills (e.g. letter naming, blending and segmentation, rhyme recognition and rhyme production) observed in English first language speakers might not, however, apply to English second language speakers, the population included in the present study (Raynolds, López-Velásquez, & Olivo Valentín, 2017). The differences in the development of rhyming skills between first and second language English speakers in South Africa may be attributed to the fact that rhyme does not appear in African languages (Vermaak, 2006) and English first language speakers have greater exposure to English nursery rhymes (Raynolds et al., 2017).

### 4.2 Clinical implications

Parents require time and resources to provide optimal emergent literacy stimulation to children. In the current study, parents' usage of the application revealed that it was difficult to sustain usage as less than one-third of the parents (n = 10) used the application throughout the 17-week intervention period. These findings contrast several pilot studies, implemented in lower-middle-income countries (LMIC), which support the use of mHealth technology as an innovative approach to stimulate literacy by providing parents with information through mobile applications (Innovation Edge, 2018; Pearson, 2018). The *CareUp* pilot study reported encouraging uptake and usage data for the parents as 67% accessed *CareUp* at least three times per week (Roberts & Spencer-Smith, 2017). The pilot study, however, differed from the current study in that an initial workshop was held to orientate participants to the mHealth resource and usage was monitored through school and home visits. Workshops and

home visits may counter barriers that influence the usage of mHealth resources (Roberts & Spencer-Smith, 2017).

Parents' usage of mHealth resources may be influenced by various barriers hindering parents' capabilities. First, parents may have a lack of knowledge and information regarding which skills children should acquire during preschool years and the importance of those skills for later academic success (York, Loeb, & Doss, 2019). Second, selecting activities that support children's development may be a cognitively complex task as it is not within parents' areas of expertise (York et al., 2019). Third, parenting requires continual involvement in childhood development that is often difficult to sustain due to time demands and lack of support (York et al., 2019). In the current study, a few parents identified barriers that include technical problems such as the application stopped working or took up too much phone storage and inconsistent use of the application due to limited time available. These barriers are similar to those reported in the *CareUp* pilot study, including a lack of interest or confidence in using the service; lack of data to download or update content, challenging home circumstances and receiving reminders and notifications at inconvenient times (Roberts & Spencer-Smith, 2017). The workshop and home visits in the pilot study, however, help form enabling environments and enhance parent's capabilities. Parents, therefore, require more support before and during the implementation of mHealth resources. The use of parental mHealth resources targeting emergent literacy can be facilitated by enabling environments involving parents, communities, services, and policies (Figure 4.1).



**Enabling policies**
- Access to ECD programmes and implementing initiatives
- Policies targeting foundational literacy skills

**Supportive services**
- Policies focusing on quality training programmes for ECD practitioners
- Providing practical strategies to ECD practitioners

**Empowered communities**
- Developing ECD practitioners' knowledge and practices
- Linking ECD programmes to the home environment

**Parents' capabilities**
- Awareness campaigns, text messaging, workshops and home visits
- Providing knowledge and resources to support literacy development

**Figure 4.1:** Enabling environments to facilitate the usage of parental mHealth resources (World Health Organization [WHO], 2018)

For children to develop optimally, caregivers need to have support, time and resources for providing nurturing care which can be achieved through enabling environments (WHO, 2018). The value of supportive and enabling environments is recognised in the Nurturing Care Framework (NCF) (WHO, 2018). These interrelated levels all work together to support parents and therefore improve the stimulation of children and children's outcomes. Several interventions can be introduced to enable environments and counter the barriers that hinder parents' capabilities to use mHealth resources. Enabling environments offer methods to parents to foster children's literacy development in the home environment. Parents who acquire the skills necessary to support literacy development, however, fail to sustain involvement due to various barriers such as limited time available and lack of support (York et al., 2019). This is evident in the present study as most of the parents used the application in the beginning but less toward the end of the intervention period.

Targeted awareness campaigns are used to support parental involvement by assisting parents in understanding and valuing their role in literacy development (O'Carroll & Hickman, 2012). *CareUp* is a targeted awareness campaign that sends regular reminders and activity notifications to facilitate parents' usage and engagement with the application. If the application, however, was not opened regularly the reminder and

activity notifications automatically stop. This may be the reason why parents used *CareUp* less in the last two months. Parents want to use mobile technology to promote learning experiences for their children but often require encouragement and support to use resources as they are intended, in order to receive maximum benefit (Papadakis et al., 2019).

An alternative to the current approach of application notifications is using text messaging. Text messaging provides encouragement, support, and reinforcement to parents over extended periods of time (York et al., 2019). The use of text messaging for communication transcends age and socio-economic status (SES) and is the most widely used smartphone feature in all countries (Nielsen, 2013). Several studies of parent text messaging programmes show positive impacts on children's academic outcomes (Cabell, Zucker, DeCoster, Copp, & Landry, 2019). Text messaging is thus a promising alternative to send reminders and activities instead of application notifications.

Other approaches enhancing parents' capabilities include workshops and home visits which also lead to empowered communities. In the *CareUp* pilot study, the on-boarding workshop was viewed positively as it facilitated engagement with the mHealth application (Roberts & Spencer-Smith, 2017). Home visits support parents as they learn how to effectively engage with their children in the home environment while using mHealth resources. During home visits, families receive in-context guidance and support on how to utilise mHealth resources to increase parents' capabilities to create an effective home learning environment. Workshops and home visits are designed to enable environments and support parent's capabilities by providing parents with knowledge and resources to support literacy development (Hall, Sambu, Berry, Giese, & Almeleh, 2017; O'Carroll & Hickman, 2012).

Empowered early childhood development (ECD) practitioners within communities also provide an opportunity to enable environments and heighten parents' capabilities to stimulate literacy development at home while supporting children directly in the classroom (Connor & Morrison, 2014). The strongest predictor of adequate parental involvement is ECD practitioners that encourage parents to participate in their children's learning and guide them on how to assist their child's literacy development in the home environment (Brand, Marchand, Lilly, & Child, 2014). The current study

did not include ECD practitioners but the *CareUp* pilot study investigated parents' as well as ECD practitioners' engagement, knowledge, and practices using mHealth. Findings of the pilot study indicated 67% of the practitioners used the application at least 13 out of the 15 weeks suggesting sustained engagement with *CareUp* (Roberts & Spencer-Smith, 2017). Practitioners also reported improved knowledge and practice relating to early literacy learning but preschoolers' abilities were not assessed (Roberts & Spencer-Smith, 2017).

For ECD practitioners to support parents, their knowledge and practices of literacy facilitation need to be developed and expanded by policies that focus on quality training programmes. ECD practitioners should also be provided with practical strategies that can support emergent literacy in the home and enhance parents' capabilities (O'Carroll & Hickman, 2012). Practitioners should link early learning programmes to the home environment through parent education initiatives, story-telling groups for parents and children, and/or maternal literacy classes about opportunities for early learning (Borisova, 2013). Empowering ECD practitioners and programmes to support parents' capabilities should receive more attention in future research in order for children to develop optimal literacy abilities prior to formal schooling (O'Carroll & Hickman, 2012).

ECD programmes play a critical role in promoting literacy, preventing reading difficulties, and preparing young children for formal schooling (Brown, 2014). It is important for children, especially those from vulnerable populations, to have access to tuition-free ECD centres and primary education, as environmental factors adversely affect children's learning (WHO, 2018). In South Africa, one of the biggest developmental challenges is the high number of children who present with reading difficulties in the early grades of formal schooling (Department of Basic Education, 2017). Reducing the number of children who enter school with inadequate early literacy experiences is fundamental toward preventing reading difficulties and enabling long-term school success (Department of Basic Education, 2017).

The Department of Basic Education (DBE) initiated the Early Grade Reading Study (EGRS) and aims to build evidence about what works to improve teaching and learning of early grade reading in African languages in the country (Department of Basic Education, 2017). This is a crucial initiative as many children in South Africa receive

education, from the reception year (Grade R) onwards, in English although only 9,6% of the country speak English as a first language (Statistics South Africa, 2011a). In the present study, preschoolers' LoLT was English but only 66,7% (n = 57) of the preschoolers spoke English as their dominant language. English second language learners find rhyming activities more difficult than other PA tasks, such as blending and segmentation (Vermaak, 2006). This is evident in the present study as preschoolers across the sample achieved better performances in the sounds in words subtest, which involved blending and segmenting words and sounds, than in the rhyme recognition and production subtests. The differences in the development of rhyming skills between first and second language English speakers in South Africa may be attributed to the fact that rhyme does not appear in African languages (Vermaak, 2006) and English first language speakers have greater exposure to English nursery rhymes (Raynolds et al., 2017). English second language learners thus require added exposure to support the acquisition of rhyming skills and as a result future literacy skills. The DBE needs to target rhyming skills along with the whole PA continuum by training ECD practitioners on how to manage the development of foundational literacy skills in diverse populations.

Enabling policies around foundational literacy skills have been developed in various countries which led to the development of campaigns targeting parents' capabilities. In South Africa, there is a lack of supportive services and enabling policies that specifically address literacy development in the early years (O'Carroll & Hickman, 2012). The South African government implemented the development of the National Integrated Early Childhood Development Policy (2015) (Hall et al., 2017). The policy aimed at providing a multifactorial enabling framework of ECD services which include formal early learning interventions (e.g. preschool) in communities and parenting programmes (Hall et al., 2017). Through enabling environments, parents' capabilities are enhanced thus the possibility exists of sustaining the usage of parental mHealth resources targeting emergent literacy of preschoolers.

## 4.3 Critical evaluation

A critical evaluation is necessary in order to evaluate the study in terms of its strengths and limitations.

*Strengths of the study*

To the best of the researcher's knowledge, this is the first local study to date to investigate the effect of a parental mHealth resource on preschoolers' (4.0 to 5.11 years) emergent literacy abilities (print concepts, alphabet knowledge, and emergent writing and spelling). The large sample size is another strength of this study. This study provided insight regarding the use of a parental mHealth resource and suggested parents require more support, pre-intervention workshops, and frequent reminders when introducing mHealth resources. Enabling environments involving parents, ECD practitioners and government is suggested to enhance parents' capabilities and stimulate emergent literacy in preschoolers.

*Limitations of the study*

Possible limitations in this study include the absence of a pre-intervention workshop and lengthy protocol duration. Also, the ELLA protocol is described as a South African tool however subtests within the protocol are assessed by using international tools that are not validated for the South African population. Therefore, standardised emergent literacy assessment tools for the South African population are warranted to enable researchers to compare participants' performances.

## 4.4 Future research

For future research, it is recommended that the ELLA protocol should be refined by providing two versions, one suitable for the preschool population and one for the early school grades. This will ensure the abilities that are evaluated are more specific to the different age ranges. More research exploring parent practices, perceptions, parent-child interactions, and usage patterns of mHealth resources with additional support is recommended. Furthermore, future research investigating the effect of an mHealth resource on preschoolers' emergent literacy skills when used by ECD practitioners and parents is suggested. Monitoring uptake and usage of mHealth resources and

providing ECD practitioners and parents with needed scaffolding strategies and support throughout the intervention period is also recommended. Studies investigating the effect of mobile resources versus paper resources targeting emergent literacy when compared to a control group would contribute greatly to this field of research.

### 4.5 Conclusion

This study provided insight regarding the effect of a parental mHealth resource targeting emergent literacy abilities of preschoolers. Research suggests that mHealth resources are an innovative solution that can support aspects of preschoolers' emergent literacy development, however, in the current study no effect was documented after a 17-week intervention period. Parents utilised the application inconsistently although they identified it as an easy to use and innovative mHealth resource that provided access to literacy resources in the home environment. Parents appear to require additional support when implementing mHealth emergent literacy resources to promote preschool children's emergent literacy development. Enabling environments should be mobilised to enhance parents' capabilities to support emergent literacy abilities of young children using mHealth resources. Further empirically designed studies on the effectiveness and use of parental mHealth applications in LMIC with additional support are warranted to clarify the effect on emergent literacy development.

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## 6. APPENDICES

APPENDIX A: Ethical clearance: Faculty of Humanities, University of Pretoria

APPENDIX B: Permission letter to conduct a research project

APPENDIX C: Parent information leaflet & informed consent form

APPENDIX D: Verbal informed assent

APPENDIX E: Parent background information questionnaire

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## Appendix A: Ethical clearance: Faculty of Humanities, University of Pretoria

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Humanities
Research Ethics Committee

6 February 2019

Dear Ms Scheepers

| | |
|---|---|
| **Project:** | **A parental mHealth resource targeting emergent literacy: An experimental study** |
| **Researcher:** | **C Scheepers** |
| **Supervisors:** | **Dr J van der Linder, Ms R Mosca and Ms S Abdoola** |
| **Department:** | **Speech-Language Pathology and Audiology** |
| **Reference number:** | **15009701 (GW20190105HS)** |

Thank you for the application that was submitted for ethical consideration

The resubmitted application was **approved** by the **Research Ethics Committee** on 31 January 2019. Data collection may therefore commence.

Please note that this approval is based on the assumption that the research will be carried out along the lines laid out in the proposal. Should the actual research depart significantly from the proposed research, it will be necessary to apply for a new research approval and ethical clearance.

We wish you success with the project.

Sincerely

**Prof Maxi Schoeman**
**Deputy Dean: Postgraduate and Research Ethics**
**Faculty of Humanities**
**UNIVERSITY OF PRETORIA**
**e-mail: PGHumanities@up.ac.za**

cc: Dr J van der Linde Ms R Mosca and Ms S Abdoola (Supervisors)

Fakulteit Geesteswetenskappe
Lefapha la Bomotho

**Research Ethics Committee Members: Prof MME Schoeman (Deputy Dean);** Prof KL Harris; Mr A Bizos; Dr L Blokland; Dr K Booyens; Dr A-M de Beer; Ms A dos Santos; Dr R Fasselt; Ms KT Govinder Andrew; Dr E Johnson; Dr W Kelleher; Mr A Mohamed; Dr C Puttergill; Dr D Reyburn; Dr M Soer; Prof E Taljard; Prof V Thebe; Ms B Tsebe; Ms D Mokalapa

## Appendix B: Permission letter to conduct a research project

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Humanities
Department of Speech-Language Pathology and Audiology

Date
Street
Suburb
City

**Request to collaborate with ECD centre**

We, Cornelia Scheepers and Wilma le Roux, are Speech-Language Pathology Master's students at the University of Pretoria. We are conducting a combined research project titled: **"A parental mHealth resource targeting language and emergent literacy: An experimental study".** We would like to request permission to conduct the research project at your ECD centre.

Mobile health applications are increasingly accessible in all settings due to the wide availability of mobile phone technology. Furthermore, parents can help improve their children's emergent literacy development and language abilities prior to formal schooling as parents are their children's first teachers. The investigation of targeted awareness campaigns and the effectiveness thereof has been recommended as parental awareness and knowledge of development and literacy may lead to improved development of children.

Caregivers and their preschoolers attending the ECD centre will be invited to participate in the project and informed consent will be attained. Participants will include male and female preschoolers aged four to five years, caregivers that are proficient in English and preschoolers whose language of learning is English as well as one of the preschoolers' primary languages. All participation is voluntary, and should they wish to withdraw from the project, they may do so without any negative consequences. Caregivers should also own an Android smartphone to be part of the study.

The project involves a parent meeting and two contact sessions. Caregivers will be made aware of the nature and procedures of the study and informed consent will be obtained. Participants' development and hearing will be screened and if a referral to a speech-language therapist or audiologist is indicated, the participant will be excluded from the study and receive

a referral. The remaining participants will be randomly assigned to two different groups. Some caregivers will receive the mHealth application resource on their smartphone while other caregivers will only receive the application after the second assessment, four months later. An emergent literacy and language assessment will be administered on both groups during the week at the school. After four months a re-evaluation of emergent literacy and language abilities of both groups will take place. The assessment on both occasions should take no longer than an hour per child.

The assessment results will be shared with the caregivers of participants, researchers, and research supervisors. The results will be made available in a Master's dissertation and scientific article. Although, confidentiality will be maintained as personal and identifying information will be concealed. All research data will be stored in the Department of Speech-Language Pathology and Audiology, University of Pretoria for a period of fifteen years. No costs will be incurred by either the organisation or the participants.

The caregivers and their children will not be exposed to any risks during this project. The benefit of participating in the project is that the children will receive a developmental and hearing screening and increased the stimulation of emergent literacy and language skills which may positively impact later literacy and academic success. The caregivers will also receive information regarding literacy and language development and how they can assist their child/children to develop these skills successfully.

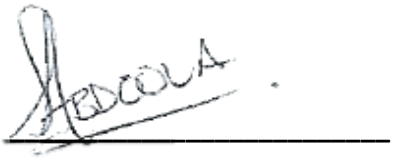
Your approval to conduct this project will be greatly appreciated. We would be happy to answer any questions or concerns that you may have at that time. You may contact us via our email addresses at scheeperscornelia23@gmail.com or wleroux6@gmail.com.

If you agree, kindly sign the letter of permission below.

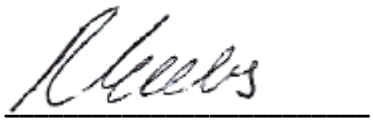
Yours sincerely,

Ms CM Scheepers

Ms W le Roux



Ms S Abdoola (Supervisor)



Mrs R Eccles (Supervisor)

Dr J van der Linde
(Acting HOD: Speech-Language Pathology & Audiology)

I hereby confirm that the researchers, Ms Cornelia Scheepers and Ms Wilma le Roux, have informed me, about the nature, conduct, benefits, and risks of the research project titled: **"A parental mHealth resource targeting language and emergent literacy: An experimental study."** I have also received, read and understood the above-written information (Permission to conduct a project at an organisation/institution) regarding the research project.

Approved by:

_____

Principal

_____ _____

Signature Date

## Appendix C: Parent information leaflet and informed consent form

**Title of the research project:** A parental mHealth resource targeting language and emergent literacy: An experimental study

Introduction

You and your child are invited to participate in a double-sided research project. This information leaflet is to help you decide whether you and your child would like to participate. Before you agree to take part in this project, you should fully understand what is involved. If you have any questions, which are not fully explained in this leaflet, do not hesitate to ask the researchers. Do not agree to take part unless you are completely satisfied with all the procedures involved which include completing a caregiver questionnaire, participate in a survey and hearing screening procedure and administration of an assessment protocol on preschoolers.

What is the purpose of this research project?

Language and early literacy abilities before school are important for later school success. This project aims to investigate a new way of assisting parents in preparing their children to learn at school. Thus, whether increased parental awareness can improve preschoolers' language and early literacy.

Explanation of procedures to be followed

The project involves a parent meeting and two contact sessions. At the parent meeting, you will be made aware of the nature and procedures of the study and informed consent will be obtained. You will also be asked to complete a survey regarding your child's development, and your child will receive a hearing screening. If there are any concerns, we will assist you with the necessary referrals, and unfortunately, you will not be able to participate in the study. If there are no concerns regarding your child's hearing, speech and language development or motor development, you and your child will be part of the study. You will then be asked to complete a background information questionnaire while divisions of the children into two groups commence. Thereafter, some caregivers will receive the mHealth application resource on their smartphone while other caregivers will only receive the application after the second assessment, four months later.

For those who receive the application, it will not cost you any data or airtime as Wi-Fi will be provided by the researchers to download the application onto the smartphones. The application will be explained, and the researchers will train you on how to use the application. The application will send reminder messages three times a week of activities you can do with your child to stimulate his/her language and literacy development.

Your child will undergo a literacy and language assessment if he/she is included in the study during the week at the school. Four months after the first assessment, a re-evaluation of your child's literacy and language abilities will take place. After the second assessment, the remaining caregivers will be able to receive the same application and information as the other caregivers. Both assessment sessions will not take longer than an hour each. A voice recording of one of the sections of the literacy and language assessment will be made. Feedback will be provided to you after the second occasion.

Inclusion criteria

Caregivers of preschoolers should meet the following inclusion criteria:

1) Caregivers between the ages of 18 and 59 years
2) Caregivers should be proficient in English (Grade Five level)
3) Caregivers should own a smartphone (Android not iPhone)

Preschoolers should meet the following inclusion criteria:

1) Male and female preschoolers aged 4.0 to 5.11 years
2) Preschoolers' language of learning should be English; thus education and instruction of children in the classroom should be in English
3) English had to be one of the preschoolers' primary languages

Exclusion criteria

1) Developmental screening indicates a referral for audiological testing and speech-language evaluation on the PEDS tools at pre-test evaluation
2) Hearing screening indicates a referral

What are the risks and benefits involved in this research project?

No risks are involved when participating in the research project. The benefits include that your child will receive a developmental and hearing screening and you will receive information regarding literacy and language development and how you can assist your child to develop these skills.

What are you and your child's rights as a participant in this research project?

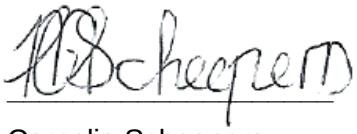
You and your child's participation in this research project are entirely voluntary and you can refuse to participate or withdraw at any time without any consequences.

Confidentiality

All information and voice recordings obtained during this research project are strictly confidential. Data that may be reported in scientific journals will not include any information which identifies you or your child as a participant in this research project. Data will be securely stored, electronically and on hardcopy, at the University of Pretoria.

If you are to allow your child to participate in our research project and provide consent to make use of a voice recording, please sign the attached consent form. If you have any further questions, please feel free to contact us at 084 900 4174 (Cornelia Scheepers) or 079 477 3150 (Wilma le Roux).

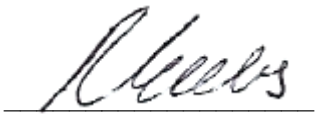
Yours sincerely,



Cornelia Scheepers
Researcher

Wilma le Roux
Researcher

Ms. S. Abdoola
Supervisor



Mrs. R. Eccles
Supervisor

Dr J van der Linde
(HOD: Speech-Language Pathology & Audiology)

**INFORMED CONSENT**

(on behalf of minors under 18 years old)

**Title of the research project:** A parental mHealth resource targeting language and emergent literacy: An experimental study

I hereby confirm that the researchers, Ms Cornelia Scheepers and Ms Wilma le Roux, have informed me about the nature, conduct, benefits, and risks of the research project titled: **"A parental mHealth resource targeting language and emergent literacy: An experimental study."** I have also received, read and understood the above written information (Caregiver information leaflet and informed consent) regarding the research project.

I am aware that the results of the project, including my child's personal details regarding date of birth, initials, and results will be kept confidential. I may, at any stage, without negative implications, withdraw my consent for my child's participation in the research project. I have had sufficient opportunity to ask questions and, of my own free will, declare my child and myself prepared to participate in the project.

Please indicate whether you give permission that the data may be used for further research. Herewith I give consent that the data obtained in the current project may be used for future research as well.

Yes ☐ No ☐ (Please tick the relevant block)

Caregiver/parent's Name _____ (Please print)

Age of caregiver/parent _____

Contact number _____

Smartphone (not iPhone): Yes ☐ No ☐

Signature _____ Date _____

Child's Name and Surname _____ (Please print)

Child's Date of birth _____

Researcher's Name _____

Signature _____ Date _____

## VERBAL PARTICIPANT INFORMED CONSENT

**Title of the research project:** A parental mHealth resource targeting language and emergent literacy: An experimental study

I, the undersigned, Ms Cornelia Scheepers or Ms Wilma le Roux, have read and have explained fully to the caregiver, named _____, the caregiver information leaflet which has indicated the nature and purpose of the research in which I have asked the caregiver and child to participate. The explanation I have given has mentioned both the possible risks and benefits of the research project. The caregiver indicated that he/she understands that he/she and his/her child will be free to withdraw from the research at any time for any reason.

I certify that the caregiver has agreed to participate in this trial.

Caregiver/parent's Name _____ (Please print)

Researcher's Name _____
Signature _____ Date _____

Witness Name _____ (Please print)
Signature _____ Date _____

## Appendix D: Verbal informed assent

## VERBAL INFORMED ASSENT

**Title of the research project:** A parental mHealth resource targeting language and emergent literacy: An experimental study

**Researchers:** Cornelia Scheepers and Wilma le Roux

I want to be involved

I'm not sure yet

I don't want to be involved

## Appendix E: Parent background information questionnaire

# Parent Background Information Questionnaire

**Title of the research project:** A parental mHealth resource targeting language and emergent literacy: An experimental study

Please complete the following background questions. An interpreter will assist if needed.

| | | | |
|---|---|---|---|
| **Child's information** | | | |
| **Name** | **Surname** | **1** | V1 |
| **Date of Birth (dd/mm/yy)** | | **1** | V2 |
| **Age** | | **1** | V3 |
| **Caregiver information** | | | |
| **Mother's name** | | | V4 |
| | | **1** | |
| **Title** | | | V5 |
| Miss | | **1** | |
| Ms | | **2** | |
| Mrs | | **3** | |
| Dr | | **4** | |
| Prof. | | **5** | |
| Other (specify) | | **6** | |
| **Date of birth (dd/mm/yy)** | | | V6 |
| | | **1** | |
| **Highest** educational qualification | | | V7 |
| No formal schooling | | **1** | |
| Less than Grade 8 | | **2** | |
| Grade 9 to Grade 10 | | **3** | |
| Grade 11 to 12 | | **4** | |
| Diploma/Degree | | **5** | |
| Postgraduate | | **6** | |
| **Current occupation** | | **1** | V8 |
| **Cell number** | | **1** | V9 |
| **E-mail** | | **1** | V10 |
| **Marital status** | | | V11 |
| Never married | | **1** | |
| Living together | | **2** | |
| Married | | **3** | |
| Divorced | | **4** | |

| | | |
|---|---|---|
| Separated | **5** | |
| Widowed | **6** | |
| **Father's name** | | V12 |
| | **1** | |
| **Title** | | V13 |
| Mr | **1** | |
| Dr | **2** | |
| Prof. | **3** | |
| Other (specify) | **4** | |
| **Date of birth (dd/mm/yy)** | | V14 |
| | **1** | |
| **Highest** educational qualification | | V15 |
| No formal schooling | **1** | |
| Less than Grade 8 | **2** | |
| Grade 9 to Grade 10 | **3** | |
| Grade 11 to 12 | **4** | |
| Diploma/Degree | **5** | |
| Postgraduate | **6** | |
| **Current occupation** | **1** | V16 |
| **Cell nr** | **1** | V17 |
| **E-mail** | **1** | V18 |
| **Marital status** | | V19 |
| Never married | **1** | |
| Living together | **2** | |
| Married | **3** | |
| Divorced | **4** | |
| Separated | **5** | |
| Widowed | **6** | |
| **General information** | | |
| **Does the child have siblings?** | | V20 |
| No | **1** | |
| Yes | **2** | |
| **Brother/s** | **1** | V21 |
| Age/s (yr.mm) | **1** | V22 |
| **Sister/s** | **1** | V23 |
| Age/s (yr.mm) | **1** | V24 |
| What is your child's **most** dominant language? | | V25 |
| isiZulu | **1** | |
| isiXhosa | **2** | |
| Afrikaans | **3** | |

| | | |
|---|---|---|
| English | **4** | |
| Northern Sotho | **5** | |
| Setswana | **6** | |
| Sesotho | **7** | |
| Other (specify) | **8** | |
| **What languages are spoken at the home?** | | |
| isiZulu | **1** | V26 |
| isiXhosa | **2** | V27 |
| Afrikaans | **3** | V28 |
| English | **4** | V29 |
| Northern Sotho | **5** | V30 |
| Setswana | **6** | V31 |
| Sesotho | **7** | V32 |
| Other (specify) | **8** | V33 |
| With whom does the child spend **most** of his/her time? | | V34 |
| Mother | **1** | |
| Father | **2** | |
| Siblings | **3** | |
| Grandparents | **4** | |
| Friends | **5** | |
| Other relatives | **6** | |
| **Are there any speech, language, or hearing problems in your family? If yes, describe.** | | V35 |
| No | **1** | |
| Yes | **2** | |
| **Describe** | | |
| | | |
| **Has any speech-language therapist seen the child?** | | V36 |
| No | **1** | |
| Yes | **2** | |
| **Have you consulted any other specialists for your child?** If **yes**, indicate the type of specialist, **when** your child was seen, **duration** of treatment and the specialist's **conclusions or suggestions**. | | V37 |
| Yes | **1** | |
| No | **2** | |
| Physician | **1** | V38 |
| Psychologist | **1** | V39 |
| Occupational therapist | **1** | V40 |
| Other (specify) | **1** | V41 |
| **Prenatal and Birth History** | | |

| | | | | |
|---|---|---|---|---|
| **Mother's general health during pregnancy** | | | | V42 |
| | | | **1** | |
| **Length of pregnancy (in weeks)** | | | | V43 |
| | | | **1** | |
| **Birth weight (kg, gr)** | | | | V44 |
| | | | **1** | |
| **Type of delivery** | | | | V45 |
| Head first | | | **1** | |
| Feet first | | | **2** | |
| Breech | | | **3** | |
| Caesarean | | | **4** | |
| **Complications at birth?** | | | | V46 |
| No | | | **1** | |
| Yes | | | **2** | |
| **Comments** | | | | V47 |
| | | | **1** | |
| **Medical History** | | | | |
| **Have there been any other health conditions, illnesses, or surgeries/ hospitalizations? regarding your child? If so, please describe (ear infections, colds, allergies, etc.)** | | | | V48 |
| Yes | | | **1** | |
| No | | | **2** | |
| Description | | | **1** | V49 |
| **Is your child taking any medications?** | | | | V50 |
| No | | | **1** | |
| Yes | | | **2** | |
| **Specify** | | | | |
| | | | **1** | V51 |
| **Hearing** | | | | |
| **Has your child's hearing ever been tested?** | | | | V52 |
| No | | | **1** | |
| Yes | | | **2** | |
| **If yes, please state where and when** | | | | V53 |
| | | | **1** | |
| **Does your child wear a hearing aid?** | | | | V54 |
| Yes | | | **1** | |
| No | | | **2** | |
| **Does your child react to the following sounds?** | | | | |
| | **No** | **Yes** | | |

| | | | | |
|---|---|---|---|---|
| Doorbell | | | **1**<br>**2** | V55 |
| Telephone | | | **1**<br>**2** | V56 |
| Soft music | | | **1**<br>**2** | V57 |
| **Are any environmental sounds experienced as unpleasant, painful or irritating?** | | | | V58 |
| No | | | **1** | |
| Yes | | | **2** | |
| **If yes, describe** | | | | V59 |
| | | | **1** | |
| **Developmental History** | | | | |
| On the line provided, **state the approximate age (yr.mm)** at which your child began to do the following activities | | | | |
| Sitting | | | **1** | V60 |
| Crawling | | | **1** | V61 |
| Standing | | | **1** | V62 |
| Walking | | | **1** | V63 |
| Feed self: | | | **1** | V64 |
| Use toilet: | | | **1** | V65 |
| Use single words (e.g. *no, mom, doggie*): | | | **1** | V66 |
| Combine words (e.g. *me go, daddy shoe*): | | | **1** | V67 |
| Name simple objects (e.g. *dog, car, tree*): | | | **1** | V68 |
| Use simple questions (e.g. *Where's doggie?*): | | | **1** | V69 |
| Engage in a conversation: | | | **1** | V70 |
| **Does your child have difficulty walking, running, or participating in other activities that require small or large muscle coordination?** | | | | V71 |
| No | | | **1** | |
| Yes | | | **2** | |
| **Educational History** | | | | |
| **School** | | | **1** | V72 |
| **Current grade** | | | **1** | V73 |
| **How is his/her academic (or pre-academic) performance?** | Poor | Average | Good **1** | V74 |
| **Special services received** (If yes, describe.) | | | | |

| | | |
|---|---|---|
| Yes | **1** | V75 |
| No | **2** | |
| **Describe** | **1** | V76 |
| | | |

Thank you

_____ _____

Caregiver's signature Date

**Group A** ☐ **Group B** ☐

If you are using the CareUp application the following information will be used to maintain you and your child's confidentiality

| | |
|---|---|
| First name | Participant number: |
| Surname | Participant number: |

## Appendix F: Referral letter

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Humanities
Department of Speech-Language Pathology and Audiology

Date: _____

Dear Parent/caregiver

Thank you for your participation in the research study titled "A parental mHealth resource targeting language and emergent literacy: An experimental study". Ethically, one of the benefits of participation in this study is a therapeutic referral, if deemed necessary, to an allied healthcare professional.

During the developmental and hearing screening, it was noted that your child may need further assessment and/or therapy. We would like to refer your child, _____, to:

| | **Professional Person** | **Reason** |
|---|---|---|
| | Audiologist | Complete hearing evaluation |
| | Occupational Therapist | Gross & fine motor evaluation |
| | Speech-language therapist | Communication assessment and follow-up |
| | Other: | |

We urge you to attend to this as soon as possible at Skinner Clinic, 012 354 1654 or any private practice.

Kind Regards

**Cornelia Scheepers**
**Researcher**

**Wilma le Roux**
**Researcher**

**Ms. S. Abdoola**
**Supervisor**

**Mrs. R. Eccles**
**Supervisor**

**Dr J. van der Linde**
**Head: Department of Speech-Language Pathology & Audiology**

## Appendix G: Emergent Literacy and Language Assessment (ELLA) protocol

## Assessment protocol

Child's name and surname: _____
Child's D.O.B.: _____
Pre-test date: _____ Post-test date: _____
Age Pre-test: _____ Age Post-test: _____

| Emergent literacy/language skills | Assessment area | Score (Pre) | Score (Post) |
|---|---|---|---|
| **1. Environmental print** (Willenberg (2007) adapted by Sharma et al. (2013)) | Recognition of environmental print | | |
| **2. Concepts about print** (Clay (1979)) | Knowledge of print concepts | | |
| **3. Writing and spelling** (Bear,Templeton, Invemizzi, and Johnston (2000) adapted by Willenberg (2004)) | Emergent writing and invented spelling | | |
| **4. Letter naming** (TOPEL) | Alphabet knowledge | | |
| **5. Sounds in words** (TOPEL) | Phonological awareness | | |
| **6. Rhyme recognition** (Willenberg (2004), adapted by Olivier (2009)) | Phonological Awareness, Rhyme recognition ability | | |
| **7. Rhyme production** (Willenberg (2004), adapted by Olivier (2009)) | Phonological awareness, Rhyme production ability | | |
| **8. Vocabulary** (PPVT-4) | Receptive vocabulary | | |
| **9. Word definitions** (TOPEL) | Definitional skill | | |
| **10. Fictional narratives** (*What's Next* sequence cards) | Narrative production ability | | |

**1. Environmental print** (Identify signs- Show me the ...)

| Item | Score 2/1/0 | Score 2/1/0 |
|---|---|---|
| 1.Pick & Pay | | |
| 2.Checkers | | |
| 3.Game | | |
| 4.Edgars | | |
| 5.Clicks | | |
| 6.Ackermans | | |
| 7.Spur Steak Ranches | | |
| 8.M-Net | | |
| 9.Telkom | | |
| 10.Steers | | |
| 11.Wimpy | | |
| 12.Lays | | |
| 13.Coca Cola | | |
| 14.Virgin Active | | |
| 15.Pronutro | | |
| 16.Kellogg's | | |
| 17.Jungle Oats | | |
| 18.Engen | | |
| 19.Shell | | |
| 20.Post Office | | |
| 21.KFC | | |
| 22.McDonalds | | |
| 23.Vodacom | | |
| 24.MTN | | |
| 25.Woolworths | | |
| 26.Oros | | |
| | | |

**2. Concepts about print** (Stop after 3 consecutive errors)

| Question | Score 1/0 | Score 1/0 |
|---|---|---|
| 1. Where is the front of the book? | | |
| 2. Show me where there is something to read? | | |
| 3. Where to start | | |
| 4. Which way to go | | |
| 5. Return sweep to left | | |
| 6. Word by word matching | | |
| 7. First and last concept | | |
| 8. Bottom of picture | | |
| 9. Begin with T or turn book | | |
| 10. Line order altered | | |
| 11. Left page before right | | |
| 12. One change in word order | | |
| 13. One change in letter order | | |
| 14. One change in letter order | | |
| 15. Meaning of question mark | | |
| 16. Meaning of full stop | | |
| 17. Meaning of comma | | |
| 18. Meaning of quotation marks | | |
| 19. Locate pP, mM | | |
| 20. Reversible words was, no | | |
| 21. One letter: two letters | | |
| 22. One word: two words | | |
| 23. First and last letter of a word | | |
| 24. Capital letter | | |
| | | |

**3. Writing and spelling**

| Stimuli | Score 1/0 | Score 1/0 |
|---|---|---|
| 1. Participant's name | | |
| 2. fat<br>pen<br>dig<br>mop<br>rope | | |
| 3. wait<br>check<br>slum<br>stink<br>shine | | |
| | | |

**4. Letter naming**

Directions: Open the Picture book to the first item in the Print Knowledge subtest. As the child looks at the page, read the coloured text. In this subtest, every item has an accompanying illustration in the Picture Book. Read each item to the child and have him or her point to the answer.

ITEM SET A:

| | Response | | Score 1/0 | Score 1/0 |
|---|---|---|---|---|
| 1.Find the picture that has letters in it. | | | | |
| 2.These are pictures of a book. Which one shows the name of the book? | | | | |
| 3.Find the pictures that has a word in it. | | | | |
| 4.Some children wrote stories. Which is the longest story? | | | | |
| 5.Which are letters? | | | | |
| 6.Which is a letter? | | | | |
| 7.Which is a letter? | | | | |
| 8.Which is a letter? | | | | |
| 9. Which can you read? | | | | |
| 10.Which can you read? | | | | |
| 11. Which can you read? | | | | |
| 12. Which can you read? | | | | |
| | | | | |

ITEM SET B:

| | Response | | Score 1/0 | Score 1/0 |
|---|---|---|---|---|
| 13.Which one is "M"? | | | | |
| 14.Which one is "b"? | | | | |
| 15.Which one is "l"? | | | | |
| 16.Which one is "D"? | | | | |
| 17.Which one is "r"? | | | | |
| 18.Which one is "H" | | | | |
| 19.Which one makes the /b/ sound? | | | | |
| 20. Which one makes the /n/ sound? | | | | |
| 21. Which one makes the /t/ sound? | | | | |
| 22. Which one makes the /f/ sound? | | | | |
| | | | | |

ITEM SET C:

Directions: point to the letter and say, "What is the name of this letter?" For Item 23, if the child provides the letter sound, say, That's the sound the letter makes; what is the name of the letter?

| | Response | | Score 1/0 | Score 1/0 |
|---|---|---|---|---|
| 23. D | | | | |
| 24. S | | | | |
| 25. Z | | | | |
| 26. L | | | | |
| 27. k | | | | |
| 28. p | | | | |
| 29. N | | | | |
| 30. Y | | | | |
| 31. V | | | | |
| 32. t | | | | |

Directions: Point to the letter and say, "What sound does this letter make?" Write the child's response. For item 33, if the child provides the letter name, say, That's the name of the letter, what is the sound the letter makes?

| | | | | |
|---|---|---|---|---|
| 33. B/b/ | | | | |
| 34. S/s/ | | | | |
| 35. P/p/ | | | | |
| 36. D/d/ | | | | |
| | | | | |

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |

Subtest 1 Total Raw Score = Set A + Set B + Set C

**5. Sounds in words**

Directions: This subtest begins with two practice items and contains two more pairs of practice items later in the subtest. Only item Set A and C and their accompanying items have illustrations in the Picture Book. Item Sets B and D are presented without illustrations.

**Practice items A and B**

**A:** Say, "Look at these pictures (point to the pictures as you name them)": Table, box, brush, tooth. My word is toothbrush. Say toothbrush. If you take away brush from the word toothbrush, what word would you have? Point to it.

**B:** Say, "Look at these pictures (point to the pictures as you name them)": Ball, mop, man, bat. My word is batman. Say batman. Now point to batman without bat.

ITEM SET A:

| | Response | | Score 1/0 | Score 1/0 |
|---|---|---|---|---|
| 1.Sunflower without flower | | | | |
| 2.Snowshoe without snow | | | | |
| 3.Seesaw without see | | | | |

Stop providing feedback on child's responses.

| | | | | |
|---|---|---|---|---|
| 4.Lamp without /p/ | | | | |
| 5.Shoot without /t/ | | | | |
| 6.Tease without /z/ | | | | |
| | | | | |

**Practice items C and D:**

**C:** Say, "Now we are going to do some without pictures." Listen carefully to what I say and then say the word you hear. My word is doorbell. Say doorbell. If you take away bell, what do you have?
**D:** Say, "Let's do another." My word is mailman. Say mailman. Now say mailman without man.

ITEM SET B:

| | Response | | Score 1/0 | Score 1/0 |
|---|---|---|---|---|
| 7.Shoelace without lace (shoe) | | | | |
| 8.Playground without ground (play) | | | | |
| 9.Driveway without way (drive) | | | | |

Stop providing feedback on children's responses.

| | | | | |
|---|---|---|---|---|
| 10.Heat without /t/ (he) | | | | |
| 11.Raid without /d/ (ray) | | | | |
| 12.Team without /m/ (tea) | | | | |
| | | | | |

**Practice items E and F:**

Directions: Open the picture Book to Practice items E and F. Say, "We are going to play a game with words. I will show you pictures to help you remember the words."
**E:** Say, Look at these two pictures. This is horseshoe, and this is lighthouse. Point to the word you get when you say horse-shoe (1 second pause) together. Is it horseshoe or lighthouse?
**F:** Say, "Now look at these pictures. This is fingernail, this is toothbrush, this is birdhouse, and this is bathtub. Point to the word you get when you say tooth-brush together."

ITEM SET C:

| | Response | | Score 1/0 | Score 1/0 |
|---|---|---|---|---|
| 13.Hot-Dog | | | | |
| 14.Star-Fish | | | | |
| 15.Door-Knob | | | | |

Stop providing feedback on child's responses.

| | | | | |
|---|---|---|---|---|
| 16.Go-t | | | | |
| 17.Ca-t | | | | |
| 18.B-air | | | | |
| | | | | |

**Practice items G and H:**

**G:** Say, "Now we are going to do some pictures. This time listen carefully to what I say and then say the word you hear. What word do these make: pan—cake (1 second pause)?"

**H:** Let's do another. What word do these make: sand—box?

ITEM SET D:

Directions: Say, "Listen carefully to what I say and then say the word you hear. What word do these make?" (Use a 1-second pause between words. Write the child's response).

| | Response | | Score 1/0 | Score 1/0 |
|---|---|---|---|---|
| 19.Air-plane | | | | |
| 20.Rain-coat | | | | |
| 21.Bath-tub | | | | |
| Stop providing feedback on children's responses. | | | | |
| 22.Ca-p | | | | |
| 23.Sew-k (soak) | | | | |
| 24.F-ox | | | | |
| 25.H-at | | | | |
| 26.B-i-ke | | | | |
| 27.F-i-sh | | | | |
| | | | | |

| | | | | |
|---|---|---|---|---|
| | | | | |
| Subtest 3 Total Raw Score = | Set A + | Set B + | Set C + | Set D |

**6. Rhyme recognition** (Stop after 5 consecutive errors)

| | | | Score 1/0 | Score 1/0 |
|---|---|---|---|---|
| cat | hat | ring | | |
| moon | spoon | dog | | |
| cot | cap | tap | | |
| cone | door | bone | | |
| sun | bib | gun | | |
| train | rain | rake | | |
| bat | coat | boat | | |
| clock | sun | sock | | |
| wall | ball | bird | | |
| duck | truck | cup | | |
| pen | sun | hen | | |
| blue | shoe | clock | | |
| hat | bag | flag | | |
| sea | tree | spoon | | |
| bread | clown | crown | | |
| | | | | |

**7. Rhyme production** (Stop after 5 consecutive errors)

| | | Response | | Score 1/0 | Score 1/0 |
|---|---|---|---|---|---|
| cat | hat | | | | |
| pet | wet | | | | |
| sun | gun | | | | |
| glad | mad | | | | |
| map | gap | | | | |
| man | can | | | | |
| red | bed | | | | |

| | | | | | |
|---|---|---|---|---|---|
| snake | rake | | | | |
| car | star | | | | |
| wall | mall | | | | |
| | | | | | |

8. Vocabulary (Training stimulus) (Stop after 8 E in set, but complete set)

| Set 2 | Response | | Score | Score |
|---|---|---|---|---|
| 13.pencil | | | E | E |
| 14.cookie | | | E | E |
| 15.drum | | | E | E |
| 16.turtle | | | E | E |
| 17.red | | | E | E |
| 18.jumping | | | E | E |
| 19.carrot | | | E | E |
| 20.reading | | | E | E |
| 21.toe | | | E | E |
| 22.belt | | | E | E |
| 23.fly | | | E | E |
| 24.painting | | | E | E |
| | | | | |

| Set 3 | Response | | Score | Score |
|---|---|---|---|---|
| 25.dancing | | | E | E |
| 26.whistle | | | E | E |
| 27.kicking | | | E | E |
| 28.lamp | | | E | E |
| 29.square | | | E | E |
| 30.fence | | | E | E |
| 31.empty | | | E | E |
| 32.happy | | | E | E |
| 33.fire | | | E | E |
| 34.castle | | | E | E |
| 35.squirrel | | | E | E |
| 36.throwing | | | E | E |
| | | | | |

| Set 4 | Response | | Score | Score |
|---|---|---|---|---|
| 37.farm | | | E | E |
| 38.penguin | | | E | E |
| 39.gift | | | E | E |
| 40.feather | | | E | E |
| 41.cobweb | | | E | E |
| 42.elbow | | | E | E |
| 43.juggling | | | E | E |
| 44.fountain | | | E | E |
| 45.net | | | E | E |
| 46.shoulder | | | E | E |
| 47.dressing | | | E | E |
| 48.roof | | | E | E |
| | | | | |

| Set 5 | Response | | Score | Score |
|---|---|---|---|---|
| 49. peeking | | | E | E |
| 50. ruler | | | E | E |
| 51. tunnel | | | E | E |
| 52. branch | | | E | E |
| 53. envelope | | | E | E |
| 54. diamond | | | E | E |
| 55. calendar | | | E | E |
| 56. buckle | | | E | E |
| 57. sawing | | | E | E |
| 58. panda | | | E | E |
| 59. vest | | | E | E |
| 60. arrow | | | E | E |
| | | | | |

| Total Raw Score | | |
|---|---|---|

**9. Word definitions**

Practice item: Say, I am going to show you some pictures and I want you to answer the questions I ask you about each picture. (Stop after 3 consecutive errors.)

| **A. Point to Practice B (shoe)** | |
|---|---|
| **PART 1.** Ask what is this? | |
| Correct, say, Yes this is a shoe (or boot) | |
| Incorrect, say, You put it on your foot. | |
| **PART 2.** Ask what do you put on? | |
| Correct, say, Yes, you put it on your foot. | |
| Incorrect, say, You put it on your foot. | |

| Test items | Score 1/0 | Score 1/0 |
|---|---|---|
| 1) Bed<br>What is this? (bed)<br>What is it for? (sleep on, lie on) | | |
| 2) Airplane<br>What is this? (airplane, plane, jet)<br>What does it do? (fly, goes up in the sky) | | |
| 3) Monkey<br>What is this? (Monkey)<br>Where does it live? (in the jungle, zoo, tree, Africa, forest) | | |

| | | |
|---|---|---|
| 4) Door<br>What is this? (door)<br>What does it do? (open, close, shut, keep things out) | | |
| 5) Telephone<br>What is this? (telephone, phone)<br>What is it for? (to call or talk to someone) | | |
| 6) Key<br>What is this? (key)<br>What is it for? (to lock/unlock door, start a car, use for opening lock) | | |
| 7) Turtle<br>What is this? (turtle)<br>Is it fast or slow? (slow) | | |
| 8) Bus<br>What is this? (bus, school bus)<br>What is it for? (to ride on, drive you to school, take you to bus stop, pick up people) | | |
| 9) Boat<br>What is this? (boat or type of boat if accurate)<br>Where does it go? (in the water, river, lake) | | |
| 10) Ladder<br>What is this? (Ladder)<br>What is it for? | | |
| 11) Pig<br>What is this? (pig)<br>Where does it live? (in a pen, on a farm, in mud, in a zoo | | |

| | | |
|---|---|---|
| 12) Teeth<br>What are these? (teeth)<br>What are they for? (To eat, bite, chew with, for talking) | | |
| 13) Shovel<br>What is this? (shovel)<br>What is it for? (to dig with, shovel with, scoop) | | |
| 14) Circle<br>What shape is this? (circle, round, ball)<br>Name another shape. (triangle, square, etc) | | |
| 15) House<br>What is this? (house, home)<br>What is it for? (to live in, sleep in, protect you from the weather) | | |
| 16) Squirrel<br>What is this? (squirrel)<br>What does it like to climb? (tree(s), house, telephone pole) | | |
| 17) Fly<br>What can all of these do? (fly)<br>What do they use to fly? (wings) | | |
| 18) Pancakes<br>What is this? (pancakes)<br>What do you put on it? (syrup, honey, butter) | | |
| 19) Stove<br>What is this? (stove, oven)<br>What is it for? (to cook things, food) | | |

| | | |
|---|---|---|
| 20) Ear<br>What is this? (ear)<br>What is it for? (to hear, to listen) | | |
| 21) Sheep<br>What are these? (sheep, lamb)<br>What sound do they make? (baa) | | |
| 22) Envelope<br>What is this? (envelope, letter, mail)<br>What is inside it? (paper, letter card, mail, invitation, check, bill) | | |
| 23) Pocket<br>What is this (pocket)<br>What is it for? (put hands in, hold something, put stuff in) | | |
| 24) Flower<br>What is this? (flower)<br>Why do people grow them? (they are pretty to look at, they look nice, people like the smell, to pick them, to display) | | |
| 25) Button<br>What is this? (button)<br>What is it for? (to open/close shirt, button up shirt, snapping closed, buttoning) | | |
| 26) Fruit<br>What is a name for all these? (fruit(s) (if food, what kind?)<br>What do you do with them? (eat them) | | |

| | | |
|---|---|---|
| 27) Money<br>What is a name for all of these? (money)<br>What is it for? (to buy things, to spend, paying, buying) | | |
| 28) Feather<br>What is this? (feather)<br>What is it from? (a bird) | | |
| 29) Lock<br>What is this? (lock)<br>Why do we use it? (to close things, lock the door or bike, to protect things, to keep people from taking things, lock things up) | | |
| 30) Clothes<br>What is a name for all of these? (clothes)<br>Why do we wear them? (to keep warm, to go outside, so people can't see you without your clothes on, to be comfortable) | | |
| 31) Farm<br>Where could you find all of these? (on a farm, In the country, in a barn)<br>What is grown there? (corn, vegetables, animals, grass, food, hay) | | |
| 32) Silverware, utensils, cutlery<br>What is a name for all of these?<br>What are they for? (to eat with) | | |

| | | |
|---|---|---|
| 33) Animals<br>What is a name for all of these? (animals)<br>What do they all do? (eat, sleep, bite, live in a zoo, live outdoors) | | |
| 34) Pet<br>What is a name for all of these animals? (pet(s))<br>Why do people have them? (to play with, to keep them company, they like them, for pets) | | |
| 35) Handle<br>What is a name for all of these? (handles, holders)<br>What is it for? (to hold, to lift, to carry) | | |
| | | |

**10. Fictional narratives**

Participants will be asked to formulate a narrative based on a set of three pictures. Voice record.

| | Description | |
|---|---|---|
| Sequence Card 1 | | |
| Sequence Card 2 | | |
| Sequence Card 3 | | |
| Sequence Card 4 | | |
| Sequence Card 5 | | |
| Sequence Card 6 | | |
| | MLU | TTR |
| | MLU | TTR |

## Appendix H: Fictional narratives stimuli (SLAM)



## Appendix I: Submission confirmation

Gmail **Cornelia Scheepers <scheeperscornelia23@gmail.com>**

## ECEJ-D-19-00428 - Submission Confirmation

1 message

**Early Childhood Education Journal (ECEJ)** <em@editorialmanager.com> Mon, Nov 25, 2019 at 12:50 PM
Reply-To: "Early Childhood Education Journal (ECEJ)" <jebamalar.jayapal@springernature.com>
To: Cornelia Magrieta Scheepers <scheeperscornelia23@gmail.com>

Dear Ms Scheepers,

Thank you for submitting your manuscript, A Parental mHealth Resource Targeting Emergent Literacy: An Experimental Study, to Early Childhood Education Journal.

The submission id is: ECEJ-D-19-00428
Please refer to this number in any future correspondence.

During the review process, you can keep track of the status of your manuscript by accessing the Editorial Manager Website.

Your username is: Cornelia
If you forgot your password, you can click the 'Send Login Details' link on the EM Login page at https://www.editorialmanager.com/ecej/

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