LITERACY-RELATED SKILLS AND LITERACY ENVIRONMENTS OF MALTESE CHILDREN AND ADOLESCENTS WITH DOWN SYNDROME

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Dedication

I dedicate this thesis to Jack and Max, who have asked me so many times ...

“Lesta Ma?”

Abstract

This research project was composed of four (4) studies, whereby the performance of young Maltese participants with Down Syndrome (DS) was investigated on different aspects of pre-reading and reading skills was investigated. Home literacy and school literacy environments were also evaluated. A mixed research design was employed using explorative, cross-section, comparative and correlational designs. Throughout the studies, the performance of the participants with DS was compared to that of typically developing (TD) peers matched for abstract reasoning and fluid intelligence abilities. A comparison of mean scores, correlation analysis, and multiple regression analysis was employed to investigate the groups' similarities and differences and identify possible predictors of aspects of reading. This study identified that the participants with DS had several strengths, such as word reading, nonword reading, visual discrimination and phonological awareness tasks with the exception of rhyming abilities. Verbal short-term memory (VSTM) tested through nonword repetition, visual perceptual processing skills and rhyming skills were identified as weaker areas in DS when compared with the control group. Both monoliterate and biliterate readers were identified, and their performance was evaluated in Study 2. Results also indicated that in the DS group, the use of the 'look and say' method of reading is still predominantly used; however, results show that children with DS can also learn to read through a phonological method. Results call educators to expose readers with DS to a phonological approach to reading while also accommodating for difficulties in VSTM. This study yielded preliminary findings within the local context and contributed to the gaps in relevant knowledge. Further research is warranted within the local scene to provide deeper insights into the reading abilities of participants with DS.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ADHD	Attention Deficit Hyperactivity disorder
ANCOVA	Analysis of Covariance
DCM	Dual-route Cascaded Model
DS	Down Syndrome
DV	Dependent Variable
HLE	Home Literacy Environment
IV	Independent Variable
LAMC	Language Assessment for Maltese Children
LD	Learning difficulties
LI	Language impairment
LK	Letter knowledge
LNK	Letter name knowledge
LSK	Letter-sound knowledge
MA	Mental Age
MLU	Mean Length of Utterance
NWR	Nonword repetition
OME	Otitis Media with Effusion
PA	Phonological Awareness
PPVT	Peabody Picture Vocabulary Test
RCPM	Raven's Colored Progressive Matrices
SBR	Shared book reading
SIT	Sentence Imitation Task
TD	Typically Developing
TORPAM	Test of Reading, Phonological Awareness and Memory (Agius, 2012)
TOWRE	Test of Word Reading Efficiency 2nd Edition
TVPS-R	Test of Visual Perception Skills-Revised
VPPS	Visual Perceptual Processing Skills
VSTM	Verbal Short-Term Memory
WS	William's Syndrome

Glossary

Analysis of Covariance ANCOVA. It is a statistical procedure known as a general linear model that combines ANOVA and regression analysis.

Cultural bias The difference in responses dependent on the culture of the specific group

Covariate A variable in statistics that effects a Dependent Variable.

Emergent literacy A term used to state that literacy acquisition is part of the developmental process, whereby a child starts to become skilled in literacy from their early years, rather than when school starts.

Hearing acuity A measure determining the level of hearing of an individual, typically established by a hearing test.

Home Literacy Environment (HLE): refers to literacy activities or the availability of literacy-related resources in a child's home.

Individualised Educational Plan (IEP): An IEP summaries a student's program with diverse learning needs. It involves planning services that students need to progress throughout a school year.

Intellectual Disability In the US, this term describes a Neurodevelopmental Disorder that influences a person's academic, communication, and social abilities. In the UK, this term refers to a significantly impaired ability to understand new or complex information needed to learn new skills. In the UK, it is used interchangeably with the term Learning Disability.

Learning Disability In the US, it refers to a condition that affects specific areas of learning such as reading and writing.

Literacy The ability to read and write.

Look and Say Method A method of teaching children to read by reading whole units or words without breaking down the words into distinct letters and units

Mean Length of Utterance (MLU): a measure of expressive language based on the average length of utterances in spontaneous speech.

Mental Age (MA) The level of mental ability of an individual is typically established by an intelligence test.

Nonwords Often referred to in the literature as nonsense words. These are words formed from a string of letters that resemble a conventional word of a specific language but do not appear in any dictionary.

Orthography The writing system for language

Phonic reading A method of reading by which phonemes are analysed and associated with particular graphemes.

Phonological Awareness: An umbrella term used to describe skills related to sounds or parts of words. This includes recognising and manipulating larger parts of the spoken language such as words, syllables, and rhyme.

Phonological route When reading occurs by sounding out the components of the words

Reading Readiness A point in time in which an individual is ready to learn to read

Shared Book Reading (SBR): An activity between an adult and a child where reading is carried out by the adult and the child is actively involved in the story.

Sight Words Words are recognised immediately without the need to analyse the components of the words.

Students Individuals who attend formal schooling. In this thesis, this term is utilised interchangeably with *participants of the study*.

Visual Route Reading occurs without analysis of phonological components

Chapter 1

Introduction

Chapter overview

This thesis investigated literacy-related skills and literacy environments of Maltese children and young adults with Down Syndrome (DS). It focussed on the performance of Maltese participants with DS on specific reading-related tasks while also exploring the home and school literacy environments. This chapter outlines reading among children with DS, followed by an overview of the local setting, focusing on aspects of the Maltese language and the bilingual context. The chapter then delineates reading development theories in the typically developing (TD) population and individuals with DS. Reading intervention with students with DS is then explored. Finally, the objectives of this thesis are set out.

An outline of reading in individuals with Down Syndrome

Recent decades have unveiled literature that shows that individuals with DS can acquire some reading skills and that these abilities can open new life opportunities (Muscat et al., 2017). Individuals with DS have been reported to have varying degrees of intellectual impairment, and for several years, reading development was not a priority in populations of children with intellectual impairment; however, the situation has changed encouragingly in the past decade (Ratz & Lenhard, 2013). The development of reading and writing can help a child to enhance their oral language skills, such as expression and comprehension, while also helping them advance in other skills, such as memory skills (Abbeduto et al., 2007; Boudreau, 2002). Literacy, particularly reading, also affects a person’s social life; independence is likely to improve due to less reliance on others to perform simple tasks like reading recipes or writing shopping lists. Employability will also be augmented, helping individuals improve their social status (Boudreau, 2002).

Although reading acquisition has been thoroughly studied throughout the years, contentious issues are still emerging in the TD population and individuals with DS. Besides, relevant research data are often non-representative due to the small scale of participants (Ratz, 2013). In contrast to the TD population, individuals with DS portray an irregular pattern of development of pre-reading and reading abilities (Baylis & Snowling, 2012; Byrne et al., 1995; Cupples & Iacono, 2000/2002; Muscat et al., 2017). Variation also arises from the linguistic context of the population being studied, for example, Burgoyne et al. (2016): Russian and English; Vallar and Papagno (1993): French, English and Italian; and, Cossu et al. (1993): Italian. Moreover, a varied number of skills are involved in the complex process of acquiring the ability to read, whereby all these can play a role in the success or lack of success in acquiring reading abilities. The reading and pre-reading abilities of Maltese children with DS have been very sparsely investigated (Muscat, 2017; Pace Balzan, 1997; Wirth, 2008).

Aspects of early literacy exposure are also scarcely investigated, even though this is well acknowledged. Studies investigating these early literacy experiences in children with learning difficulties and, more specifically, in children with DS are limited (Al Otaiba et al., 2009; Loningan & Whitehurst, 1998; Ricci, 2011; Ricci & Osipova, 2012). It has been revealed that children with DS can achieve basic literacy levels and, in particular cases, exceed expectations (Byrne et al., 1995; Byrne et al., 2002; Ricci & Osipova, 2012). Hence, it has been deemed important to investigate all skills that lead to success in this area to identify good practices. Children with disabilities face several barriers to accessing literacy. The disability is a barrier as this might lead to difficulties in language development, hearing and visual difficulties and several other impairments, depending on the individual and the specific condition. Nevertheless, it has also been shown that children with disabilities also have more limited exposure to early literacy experiences (McDonnell et al., 2014).

The Maltese Islands average 11 births a year for babies with DS (Department of Health, Information and Research, 2016). Data and publications on reading development and reading-related skills of Maltese children with DS are very scarce, and what is currently available focuses on a small sample of the population and specific components of reading skills. Only a few studies related to reading skills and DS within the Maltese context. Wirth (2008), in an unpublished undergraduate dissertation, investigated the reading, speech and expressive verbal skills of a small group of children with DS and concluded that the development of reading skills in DS positively affects the participants' *Mean Length of Utterance*. Pace Balzan (1997) evaluated methods of reading instruction in Maltese children with DS and how this affects language development. Muscat (2017) investigated DS's phonological awareness and visual processing skills. Her study revealed that Maltese students with DS showed no significant difference in phonological awareness skills compared to TD peers who were matched for reading abilities.

On the other hand, the latter study showed a significant difference in *Visual Perceptual Processing Skills* (VPPS). Muscat's study indicated that participants with DS performed better than predicted by literature (Cossu et al., 1993) in phonological awareness tasks and poorer in VPPS. In contrast, VPPS has historically been reported to be relatively strong in DS (Næss et al., 2012). Unfortunately, this study was conducted among a small sample of participants with DS, and further investigation is necessary. This calls for a more thorough investigation in reading-related areas regarding the local population of children with DS.

To the author's knowledge, no studies within the local scenario have been dedicated to in-depth investigating the early literacy experiences of children with DS. No local studies investigating reading intervention methods have been identified either.

The Maltese language and context

As an island in the middle of the Mediterranean Sea, the Maltese Islands (mainly Malta and Gozo) have been visited by different peoples and thus were exposed to diverse cultures. The Phoenicians, Romans, Arabs, the Knights – whom themselves hailed from across Europe: from East to West and North to South – the French, the British are just some of those peoples who visited the Islands of Malta. These islands have absorbed a diversity of cultures and beliefs, which helped build their linguistic inheritance (Mifsud, 1995). The Arab rule was predominantly significant for these islands because it contributed to the origin of the Maltese language. The Normans captured the islands in the early 11th century, after Arab dominion, and influenced Romance languages. In more recent history, during the 19th and 20th centuries, Maltese has been used in combination with two main European languages: English and Italian. The role of Italian has phased out during recent decades; however, English has maintained its strength. Malta possesses Maltese as its national language, with English and Maltese as official languages. Mifsud (1995) describes Maltese as Semitic in nature, wherein these Arab routes can be perceived in three linguistic structures; syntactic, morphologic and phonological composition (Mifsud, 1995). Latin, Sicilian, French, and English have affected the semantic and grammatical structures of Maltese throughout the years. At a lexical level, Maltese has and is still being influenced by both the Semitic and the Romance languages (Vella, 2013). Hence, this influence has also impinged on the morphology of the language.

Malta's linguistic scenario makes it almost impossible for a child to grow up in a monolingual environment, although different degrees of Maltese/English use and exposure are apparent. The National Minimum Curriculum emphasises teaching the two official languages and a third and possibly fourth language in middle and secondary school (Sciriha, 2001). The language policy for bilingual education, which complements the National Minimum Curriculum, also offers national strategies for bilingual education. Maltese is still the language mostly used in the home; however, many children with Maltese parents but with English as their first language can also be found (Vella, 2013). In these cases, the parents may speak to each other, mainly in Maltese, yet address their children in English. Camilleri Grima (2013) reported that Maltese is mostly associated with everyday conversations and a sense of national identity, while English is a worldwide means of communication and education. It has also been reported that many children are exposed to both languages at home (Grech & Dodd, 2008). Sciriha (2001) documented a sentiment that English is more important than Maltese in some Maltese individuals. The Maltese feel that they have to be more fluent in a more widely spoken language rather than their own. This feeling also allows multilingualism to be somehow natural in Malta (Sciriha, 2001). The use of Maltese and English within the educational system has been thoroughly investigated. Camilleri Grima (2013) explored the language used across the Maltese islands in different school settings. The author concluded that teachers tend to use a relative amount of code-switching. Some examples where teachers showed the need for code-switching were: to enhance a lesson by adopting content from another language, paraphrasing and using discourse markers. This was irrespective of which school they were teaching in. Translingualism is also often reported and encouraged (Panzavecchia, 2020).

The complexity and distinctiveness of the Maltese language need to be taken into consideration when investigating how reading is acquired. Maltese has a shallow orthography since grapheme to phoneme correspondence is very consistent with only a few exceptions, such as the devoicing in word-final positions and voicing assimilations (Borg & Azzopardi-Alexander, 1997; Agius, 2012). Spanish and Italian can also be described as having a shallow orthography. On the other hand, English is considered to have a deep orthography as it contains many irregularities (Seymour et al., 2009). In languages with deep orthographies, such as English, each letter may or may not have the same pronunciation. The pronunciation differs according to where and next to what other letters are placed in the word (Seymour et al., 2009).

The acquisition of reading can be affected by the depth of orthography. The whole word may need to be considered when reading in deep orthographies such as English (Frith et al., 1998; Seymour & Evans, 1999; Seymour et al., 2009). Readers of shallow orthographies may need to attend to each grapheme in isolation, making reading in shallow orthographies less complex (Cuetos & Suárez-Coalla, 2009; Seymour et al., 2009). In their study of 12 languages with different depths of orthography, Seymour et al. (2009) revealed that decoding takes longer to develop in languages with deep orthographies.

Preliminary studies on the Maltese language support the view that Maltese-speaking children do not rely on larger units in words to acquire reading abilities (Xuereb, 2009). Language-specific characteristics may also predict reading acquisition. In a study involving 50 TD children, Xuereb (2009) concluded that even though *phonological awareness* (PA) abilities may be considered strategic in reading development, the speed of processing and memory are more important in the process of reading acquisition of Maltese. This result reiterates the importance of acknowledging the uniqueness of a language when investigating reading development. The role of the setting in which a language is acquired, in this case, the local bilingual environment, as aforementioned, is also highlighted as being very important.

What is reading? A theoretical perspective

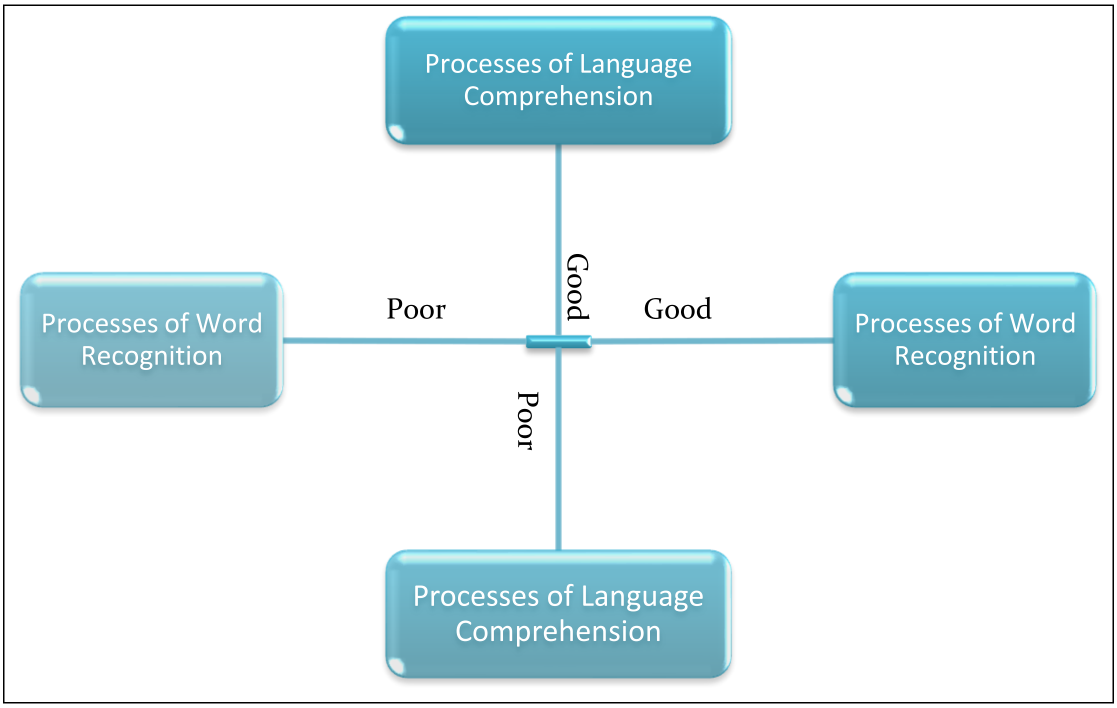
In order to identify the processes that contribute to word recognition in DS, reading models based on TD children need to be evaluated. Reading can be explained as a process in which an individual perceives and derives meaning from the text, also considered part of a language process (Tracey & Morrow, 2012). This complex process appeals to different perceptual and cognitive abilities (Norris, 2013). It has now been widely accepted that reading is a cognitive process that involves many internal mechanisms (Tracey & Morrow, 2012). Visual processing, recognition of the shape of symbols, phonological processing and eye movements are some of the processes involved in the complex task of reading (Norris, 2013). The brain undergoes complex mental activities, and a combination of these leads to succeeding in different activities such as remembering a number, repeating a word or reading a word.

Historically different cognitive processing perspectives have been proposed. Information processing models form part of the cognitive processing perspectives and have brought insight into different learning and reading processes. Atkinson and Shiffrin's (1968) *Information Processing Model* was one of the first accepted models. This model shows how information is processed through different stages. This model will be referred to in more detail in Chapter 2 (p. 68), when working memory will be discussed.

A cognitive processing model applied to explore the workings involved in the reading process is *The Simple View of Reading*. This process depends on two different components; word recognition and reading comprehension (Roch & Levorato, 2009). This model describes how conventional reading is achieved. Conventional reading is also known as the skill to read words correctly, fluently and the ability to derive meaning from these words (Lucas, 2014). In *The Simple View of Reading* (Gough & Tunmer, 1986), an *Information Processing Model* developed from Gough's Model (1972), reading comprehension comprises two components: decoding and language comprehension. The utility of these two components changes across different levels of development (Loveall & Conners, 2016). The usefulness of this model was examined across different languages of alphabetic, non-alphabetic orthographies, second language learners, and bilingual learners (Catts, 2018). *The Simple View of Reading* poses a balance between language learning and learning the alphabetic principle; thus, encouraging language support during the early years can be advantageous (Snow, 2018). A representation of this model can be seen in Figure 1.

Figure 1

Representation of The Simple View of Reading



Another important aspect of literacy, besides conventional literacy, is *emergent literacy*. Emergent literacy refers to a child's abilities related to reading before he/she can decode words (Rohde, 2015). Emergent literacy is a term used to state that literacy acquisition is part of the developmental process, whereby a child starts to become skilled in literacy from their early years, rather than when school starts (Loningan & Whitehurst, 1998). The emergent literacy approach to literacy acquisition moves us away from the *reading readiness* approach, in which a child achieves several milestones before formal literacy instruction is initiated. Hence, emergent literacy acknowledges all skills and behaviours that are precursors to reading and writing and the settings and social situations that support the development of these precursors (Fitzgerald et al., 1995; Loningan & Whitehurst, 1998). In both print and sounds, PA and vocabulary, knowledge of the alphabet are generally agreed to be the precursors to conventional literacy (Loningan & Whitehurst, 1998; van Bysterveldt, 2009).

Models of proficient word recognition

Word recognition has been defined as the method by which a reader makes sense of a series of letters into sounds that make up a word in the context of a specific language which is described as an essential process of reading (Snel et al., 2016). This skill is considered fundamental, especially in the early stages of reading development. It starts with being slow and laborious in the initial stages; however, it develops into an automatic skill as the reader gains more expertise (Snel et al., 2016). Structural and developmental models are two major schools of thought that evaluate word recognition. Structuralist models are at the route of cognitive processing research. The central role of the structuralist approach is to explain the reading process through a biological perspective, whereas developmental research investigates the progress of specific skills across time (Tracey & Morrow, 2012).

From a structuralist perspective, several theoretical models have been proposed to explain how word recognition occurs; however, two main models have been used and referred to more profusely in the literature (Gillon, 2018). The *Dual Route Model* (Coltheart, 1978) and the Connectionist perspective will be described hereunder. Models which stem from these two main perspectives will also be evaluated. From a developmental perspective, Frith's (1985) developmental model has remained predominately popular throughout the years. These will be discussed next.

The Dual Route Model

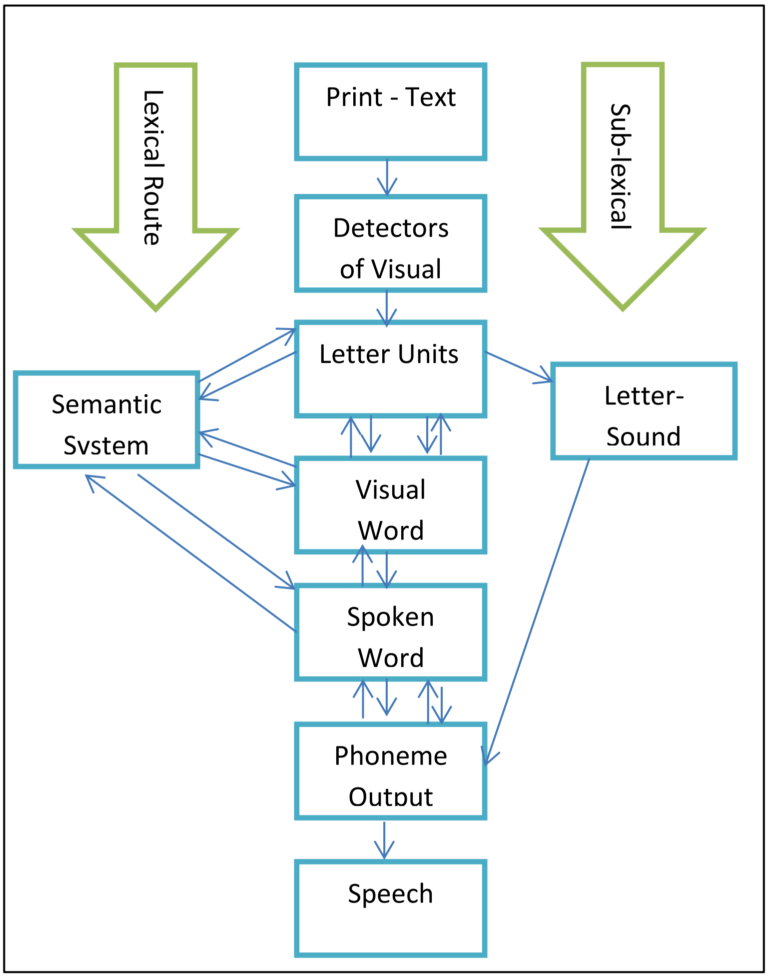
Coltheart originally proposed the *Dual Route Model* (1978), which identified that the meaning of a single printed word could be accessed through two different routes: the visual or phonological route (Gillon, 2018). The phonological route enables a reader to sound out a word and derive its meaning. The sounding out process is explained as being made up of several steps, where the letter-to-sound route procedure is applied. During this procedure letter-to-sound rules of the string of words are examined and the correct pronunciation is identified (Tracey & Morrow, 2012) The visual route has been proposed to come into use in the presence of irregular words, where no regular grapheme to phoneme correspondence was present in a word. This route was proposed to be accessed only when the reader learned words by rote (Gillon, 2018). This model implies that PA is only useful when the phonological route is utilised. The *Dual Route Model* has attracted some criticisms. Dufau et al. (2010) have criticised the model since it does not explain the dynamic acquisition of input and how frequently this is perceived. While Seindenber & Palut (2006) and Perry et al. (2007) maintained that the model does not include an aspect of learning in this mechanism.

Ehri (1992) proposed a variation to the *Dual Route Model.* In this model, a visual-phonological route was introduced, whereby it is proposed that written language is processed through a lexical and a non-lexical route (Rapcsak et al., 2007). Orthographic and phonological representations are examined in the lexical route. The lexical route may or may not utilise the semantic system to retrieve the meaning of a word since this is not considered fundamental for spelling or reading purposes. This route allows for the processing of all regular and irregular words, so long as these are not new words for the reader, thus allowing whole-word retrieval.

On the other hand, the non-lexical route is responsible for acting upon nonwords and words which perfectly follow grapheme to phoneme correspondence (Grainger & Ziegler, 2011; Rapcsak et al., 2007). This model has had a particular influence at an educational level due to the high importance given to phonological processing (Gillon, 2018). Ehri (1992) originally implied that difficulty in phonological awareness would result in difficulty in reading even though sight word reading is used since whole word reading relies on processing phonological information. This model has also proven useful when interpreting reading difficulties such as acquired dyslexia and dysgraphia (Rapscak et al., 2007). A computational model was further developed, and this is one of the most recent information processing models: *The Dual-route Cascaded Model* (DCM) (Tracey & Morrow, 1993). This model is represented in Figure 2. The DCM is a computer-based model where word reading takes place through two different routes: the lexical route, where familiar words are identified and processed as whole words and the non-lexical route, where letter-to-sound rules are involved (Tracey & Morrow, 2012).

Figure 2

Representation of The Dual-route Cascaded Model (DCM) (Ehri, 1993)



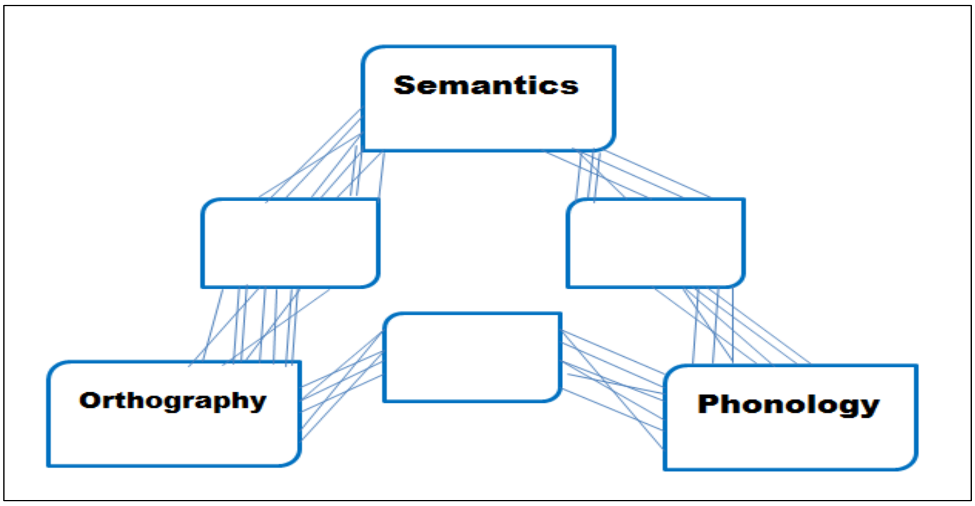
Theories of Analogy. *Theories of Analogy* were introduced to explain how a reader can read words using onset-rime information (Goswami, 1986/1988). These analogy models build on the idea that the Modified Dual-Route proposed by Ehri (1992) allows for an association between words of similar orthographic and phonological patterns. The analogy model proposes that if a reader can recognise the spelling and phonological patterns of a set of words, they might use this information to help them read the word without resorting to phoneme-graphemes correspondence for each word every time (Gillon, 2018; Goswani, 1995). Goswami (1986/1988) maintained that this method of reading could be used by early readers, even by readers who are not proficient in phonologically decoding words. However, it has been reported that the older the reader is, the stronger the use of analogies. Therefore, this type of reading might be more useful once the reader is proficient at reading (Holopainen et al., 2002).

It has also been discussed that analogical reading is highly dependent on the language and the depth in the orthography of each specific language (Goswami, 1995; Holopainen et al., 2015). In languages such as English which has an irregular orthography, analogies have a strong weighting. With the knowledge of 37 rhymes, an English reader can potentially read 500 words (Wylie & Durrell, 1970). In regular orthographies, as is the case for the Maltese language, readers use the alphabetic principle for a longer period. In German, a language with regular orthography, it has been reported that onset-rhyme measures only predict reading development around the ages of 9-10 years. There is more reliance on phonological units in the early years of reading development (Holopainen et al., 2015). In a local Maltese study, Martinelli (1996) concluded that letter-sound knowledge of letter sounds and phoneme segmentation skills are the best predictors of success in early reading of Maltese text. Martinelli (1996) also concluded that rhyming is not useful since Maltese orthography relies greatly on the strong association between graphemes and phonemes. Maltese children do not find rhyme useful to access the phonemic information of words. Hence, Theories of Analogy do not prove useful to interpret reading and reading development in the Maltese language.

Connectionist Models. *Connectionist Models* have mainly developed from the influence of both Dual-route models and Analogy Models (Gillon, 2018). The connectionist perspective has been used to describe typical reading patterns and those which result in errors. The reader processes regular and irregular words through a system of interconnected networks through which the reader acquires semantic, orthographic and phonological knowledge. This process is also known as the *Triangular Model of Reading* (Plaut et al., 1996). Plaut (2004) describes these systems as neuron-like units, where they translate and process information acquired through time and various repetitions. Connectionist models have three main distinctive features. They primarily allow for explaining the learning and development process. Throughout learning, the reader continuously builds on the connections and different units (Plaut, 2004). Secondly, these models show that a learner acquires the ability to generalise, where information learnt about other words can be used for a new word if the latter has common features to the previously trained word. Thirdly, these models explain what happens in the event of brain damage. A slow degradation occurs, where a reader slowly loses connections, hence losing the ability in specific areas rather than a complete loss of the ability to read (Plaut, 2004). Figure 3 shows a representation of how the networks are formed.

Figure 3

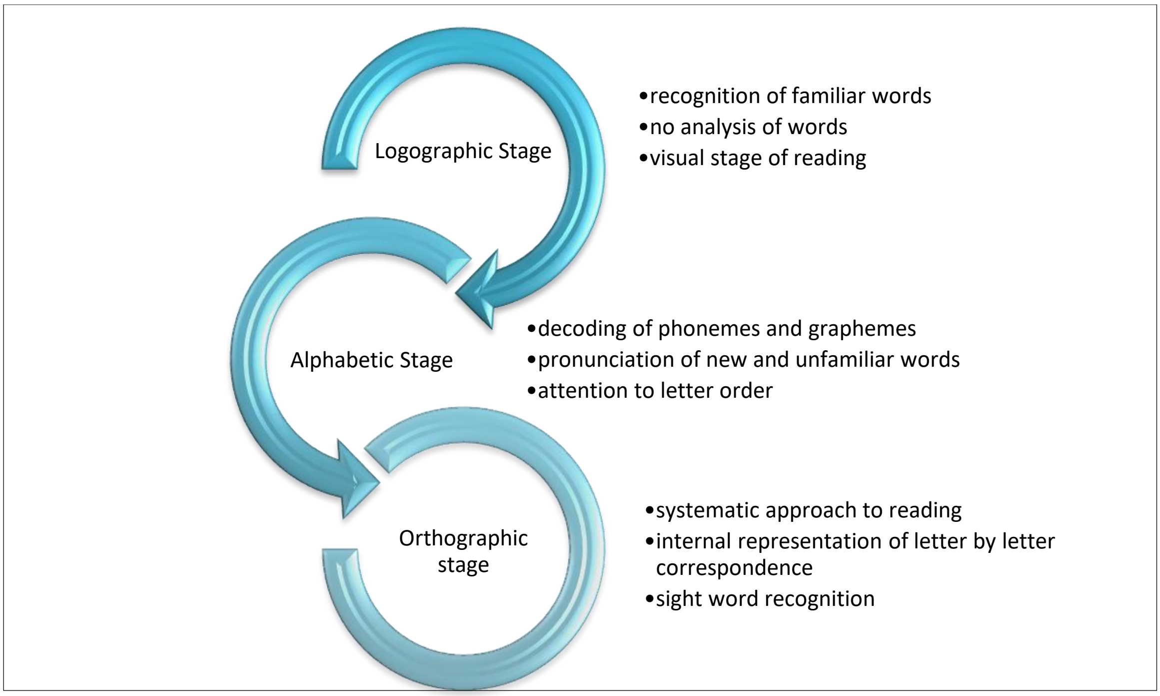
Representation of The triangle framework adapted from Plaut (2004)



A developmental model of reading. The theories mentioned above attempt to provide a framework for word recognition through a biological and physical aspect, whereas developmental researchers have explained how word recognition develops through a developmental process. Stages have often been used to describe the developmental process of word reading acquisition (Frith, 1985; Gough & Hillinger, 1980; Marsh et al., 1980). Stage models assume that children go through stages sequentially to become successful readers and that different cognitive abilities are involved in each different stage (Gillon, 2018). Although these models are important in understanding word reading development, they have also been criticised. The complex processes at each stage are not explained in stage models (Gillon, 2018; Keuing & Vehoeven, 2008; Treiman & Cassar, 1997). Hence, it is implied that stages should be perceived as a particular time in the child's development where the reader selects a particular reading method to be used in preference over the others (Gillon, 2018).

Figure 4

Stages of reading development as proposed by Frith (1985)



The *logographic*, *alphabetic* and *orthographic* stages are the three main reading stages proposed by Frith (1985) which have consistently been referred to in literature. These are represented previously in Figure 4. In the logographic stage, readers identify words by their shape and form. No analysis of the word components is carried out during this stage (Frith, 1985). The reader then starts to analyse and decode the graphemes and the printed letters and associate them with their phonological components, sounding the printed letters. This stage is the alphabetic stage, followed by the orthographic stage. In this final stage of word reading, a reader can recognise words without phonologically decoding each (Frith, 1985). At this final stage, the reader understands morphemic patterns in words and reads these units without grapheme to phoneme correspondence (Gillon, 2018).

Vygotsky's Theory of Home Literacy

Importance of exposure to literacy within the home is integral to all literacy skills. Home literacy learning techniques and ideas took on from Vygotsky's principles. Vygotsky explains that a rich literacy home setting is vital for starting up, promoting, and consolidating children's literacy development. According to Vygotsky, parents play an integral role in the early acquisition of literacy skills by promoting shared teaching and scaffolding (Vygotsky, 1981). Vygotsky's *Theory of Social Development* also promotes literacy exposure at home. This theory promotes the idea that the way individuals interrelate with each other and their cultural setting impinges on their mental development (Vygotsky, 1978). Vygotsky's view of *the zone of proximal development* is key in his theory. In this zone, children need the help of outsiders to help them develop further. Parents and carers can aid children in this zone and *scaffold* their learning through the home environment. This notion has been a stepping stone to promoting and exploring literacy intervention and promotion in the early years (Saracho, 2017).

A model for reading development in Down Syndrome

Attempts have been made to investigate how the reading profile of individuals with DS follows the developmental stages of reading. Ratz (2013) investigated a group of students with DS in Germany. His findings show that in DS, there is a strong prominence on the alphabetic stage. A barrier towards the orthographic stage is also perceived. This has been explained due to the difficulties in short-term memory, which is a characteristic of individuals with DS. Ratz (2013) states that this difficulty in short-term memory hinders progress in literacy. However, it can be argued that these results are due to how literacy was initially taught. There is a tendency for students with DS to be taught to read through sight word reading, and this method does not encourage skills used in the orthographic reading stage; therefore, results might be due to this.

Appleton et al. (2002) evaluated the reading progress of a group of pre-schoolers with DS between 2 – 4 years and compared their performance with TD children of the same age. Both groups of children were being taught through sight words. The authors report that after three years, the groups were re-assessed, and the results identified no significant difference between the performance of both groups on measures of word reading and reading comprehension, hence showing that word identification is a strength in this population. Appleton et al. (2002) argue that children use mostly logographic reading during these early years, which seems to be unimpaired in DS. Moreover, visual discrimination and visual memory help children with DS succeed in this area.

Snowling et al. (2008) agree with the notion that logographic reading is a strength in DS, while difficulties arise when the need for decoding increases. This success in decoding real words could be associated with a stronger tendency to use a *visual route* during reading than a *phonological route* (Roch & Jarrold, 2012). It has been recommended that children with DS learn to read visually without processing letter information (Buckley, 1985; Cossu et al., 1993).

Some researchers claim that reading does not develop uniformly in all areas in the DS population, e.g. Cardoso-Martins et al. (2008); Cupples and Iacono (2000); Roch and Jarrold (2012). Children with DS tend to decode real word reading (Boudreau, 2002) more successfully than nonwords (Roch & Jarrold, 2008). However, studies show that reading nonwords is possible in individuals with DS; therefore, a form of letter-to-sound processing is still involved (Cardoso-Martins & Frith, 2001). Although reading nonwords in DS is possible, difficulty in this task has often been noted. Snowling et al. (2008) state that the difficulty in decoding unfamiliar words and nonwords is specifically tied to difficulties in PA. The relationship between reading and PA will be discussed in detail in the following chapter.

Nevertheless, in their study of 29 English participants with DS, Snowling et al. (2008) identified no difference in word reading between the DS group and the reading age-matched TD group. The authors claim that it is the use of a particular test that helped to achieve these results. Gombert (2002) investigated 12 French-speaking children with DS compared to TD children with comparable reading abilities. Results indicated that a difference between groups could be identified when reading nonwords even though word-reading abilities matched the group. It has been identified that contrasting results are still emerging in the literature, and further investigation is warranted.

Methods of reading instruction in DS are evaluated next, while Chapter 2: Literature Review evaluates different aspects that lead to reading development in DS are evaluated in detail.

Reading Instruction in the local setting

In Malta, children are introduced to schooling between three and four years. Children first attend two years in kindergarten. Although kindergarten is not compulsory, 92.4% of the equivalent age population in 2018 (Eurostat 2021) attended schooling. Children are exposed to pre-literacy and early literacy activities during these two years. The Literacy Strategy for all in Malta and Gozo 2014-2019 highlights that the main literacy goals throughout the early years (4-6yrs) should include;

- The promotion of oracy
- The use of balanced literacy instruction. Here the mechanical aspects of reading and writing are taught in the context of making meaning through text.
- An increase in reading time opportunities in both national languages is promoted across the curriculum.

Church and Independent schools do not always adhere strictly to the national minimum curriculum as curricula are implemented according to the individual school's aims or guided by the Secretariat of Catholic Education. Individual educators often interpret the guidelines, and variations might also occur in different school settings. By the end of kindergarten (KG), children in a public school would have received instructions about letter-sound recognition where the complete Maltese alphabet would have been covered. In Church and Independent schools, the students are first introduced to the English alphabet, while the introduction to Maltese occurs during Year 1. While not specifically prescribed by the national minimum curriculum, it is common practice that children in KG2 (the second year of kindergarten) are exposed both to sight-reading and tasks conducive to sound blending. A joint programme implemented in all Church schools is the READ WRITE INC. Programme (Secretariat of Catholic Education, personal communication). This literacy programme encourages sound blending from the very early years of KG1. Currently, this programme is also introduced in Independent schools. Unfortunately, no efficacy studies are available about this study in the local population, and each school plans its action plan.

In summary, from a very young age, even before formal schooling, children in the Maltese islands are exposed to literacy instruction. To the author's knowledge, no study about literacy practices in KG schools has been conducted. A literature search in the *OAR Database* and information sought through different stakeholders has yielded no results.

Reading Intervention for children with DS

Children with DS in Malta avail themselves of many early intervention services. The Early Childhood Intervention Services (ECIS), the Speech-Language Centre, Occupational therapy Department and Physiotherapy Department are currently offering such services. The ECIS, Speech-language pathologists (SLPs), and Occupational therapists are all actively involved in promoting early literacy and literacy skills and sharing common goals. The Maltese public sector offers all these services for free. Children are also supported by various non-governmental organisations (NGOs) and private practice services. All the different professionals are often involved in delivering services and integrating intervention plans that meet the holistic needs of children and the family's involvement. All services also move on towards implementing their goals in a school setting. During *Individualised Educational Plan* meetings, collective decisions are taken, and future therapeutic plans are drawn up. Each plan is individualised, and different goals are shared between professionals. The ECIS and the SLPS are commonly involved in promoting early literacy skills, while the Teaching staff and Learning Support Educators (LSEs) implement literacy training and instruction in a school setting coordinated by the school Inclusion Coordinator. In Malta, most children with DS are educated in a mainstream setting, in line with international practices (Burgoyne, 2009). However, an evidence-based literacy intervention strategy for children with DS has not been investigated locally to the author's knowledge.

It has been proposed that priority aspects have decided on literacy training methods in DS. Næss et al. (2012) discuss that sight word reading has often been prioritised in DS, influencing language and vocabulary. Such training could include the repeated use of familiar or 'useful' words that could be functional for the individual use daily. Children with DS have predominantly been exposed to a visual method of reading (Lemons & Fuchs, 2010). This trend has been mostly brought about by the acclaimed visual strengths of children with DS, the difficulties in auditory short-term memory, and claims that children with DS find it difficult to develop PA skills (Cossu et al., 1993). The latter is considered an important precursor to reading development. However, a shift in the literature supports other reading instruction methods.

Scaffolded or mixed-method reading instruction has been implemented (Lemons & Fuchs, 2010). Buckley (2003) maintained that pre-schoolers should first be introduced to a visual method of reading. Once the child can recognise around 40 flashcards by sight, they should be introduced to a reading instruction phonic method. Reading methods with an increased phonological component are increasingly being implemented, and these will be reviewed next.

Variation in reading acquisition in DS has been reported extensively (Burgoyne, 2009; Kay-Bird & Chapman, 2011; Robes-Bello et al., 2020). Variability can depend on the children's characteristics and the method and frequency of reading instruction (Goetz et al., 2008; Robes-Bello et al., 2020; King et al., 2020). Several adapted approaches to reading and literacy training have been proposed for children with learning difficulties. Browder et al. (2009) proposed a conceptual framework for literacy instruction for children with severe learning difficulties*; Road to the Code* (RTC). The framework has two primary aims. The first is to increase access to literature through reading time, the adaptation of books, and technology. While the second is to enhance independence as a reader through reading instruction methods and providing opportunities for generalisation (Browder et al., 2009).

The efficacy of this reading intervention method has been investigated in children with DS. Lemons et al. (2012) and Lemons et al. (2015) evaluated this program's effectiveness. In the first evaluation (2012), the authors concluded that the RTC program was ineffective on blending, segmentation and sound identification abilities. However, no modifications were applied to the program during the first evaluation. In the second evaluation (Lemons et al., 2015), the authors aimed at providing modifications that were specific for children with DS. When the program was administered in an adapted modality, the authors identified that the modifications correlated to PA improvement. Several adaptations to the RTC were further proposed by accommodating short-term memory and speech-language measures (Lemons et al., 2017, 2018).

King et al. (2020) built on Lemons et al.'s 2015, 2017 and 2018 studies. The authors investigated whether children with DS benefitted from a reading instruction method specifically adapted to DS behavioural characteristics and how this affects curriculum measures. Four children between the ages of 7 and 8 years were enrolled in the study. The participants were exposed to the RTC curriculum together in addition to their daily curriculum. According to Bowder et al. (2009), this curriculum focussed on phonemic awareness, the alphabetic principle conveyed in an adapted one-to-one instructional method. The instructors aided the students with visual cues, reduced the demand for expressive language, and catered to memory difficulties (King et al., 2020). The students were provided with an average of 19 intervention sessions. Results showed an inconsistent response to the adapted intervention method. The intervention sessions improved letter-sound fluency; however, results on other measures were inconsistent.

Goetz et al. (2008) evaluated the performance of 15 participants over 16 weeks of training for 1 group and eight weeks for the 2nd group. Their results showed that the participants made remarkable progress in letter-sound knowledge and word recognition. Progress was also noted on word and nonword reading. However, this was to a lesser extent. The authors argue that a holistic Intervention method, which includes teaching word recognition and decoding abilities and training PA, is very useful for this population (Goetz et al., 2008).

Bayliss and Snowling (2011) also evaluated the performance of children with DS on a phonologically based program over ten weeks. The children were between 9 years, ten months and 14 years ten months. The training program involved alphabet instruction, letter-sound activities, word and shared book reading and comprehension skills. Post-intervention data indicated that the participants improved on letter knowledge. However, no improvement was noted in rhyming skills. This might suggest an intrinsic difficulty in rhyming abilities. Four out of 10 children improved on nonword reading skills; however, progress in spelling abilities was limited. This is a common finding with Goetz et al. (2008). Unfortunately, the authors do not look into the participants' language, verbal short-term memory, behaviour, and attention; these factors could have impinged on the results.

Burgoyne et al. (2012) also evaluated the effects of implementing a program that involves both language and literacy intervention in a randomised control trial (RCT). The authors implemented a program for 57 participants with DS between the ages of 5;02, and 10 years. The program included a reading component where the participants were exposed to an approach that taught reading and phonics and a language component where vocabulary and expressive skills training were incorporated (Burgoyne et al., 2012). After a 20-week program, the authors reported that progress could be noted in word reading, letter-sound knowledge, blending abilities, and expressive knowledge when the intervention was compared with teaching as usual in the RCT part of the study. However, no significant improvement was found in nonword reading, spelling abilities and receptive vocabulary. The control group made similar gains in 20 weeks when they went on the program. The authors showed that further improvement was noted in the participants who received the 40-week program. This study indicated that the participants benefitted from such an approach; however, some individual variability could be identified. The study also showed that receptive vocabulary, younger age at start (5–6-year-olds) and number of teaching sessions influenced reading progress. This will be discussed in detail further on in the review of the literature.

In summary, research about reading intervention studies identifies that children with DS benefit from PA training (Lemons et al., 2017, 2018; Næss, 2015) and that PA progresses as reading increases. Some studies also identified that letter knowledge predicts reading (Steele et al., 2013), while most studies identified the importance of a mixed modality and holistic approach to reading instruction (Burgoyne, 2009, Burgoyne et al., 2012). Intervention methods with easy to follow instructions, high on visual elements, and less reliance on verbal expressive skills could positively impact literacy development (Loveall et al., 2021). However, inconsistency and variation between groups have also been noted, possibly due to the individual variability of participants. An evaluation in the local Maltese community is missing, and the need is highly felt, particularly with Maltese having a shallow orthography. The role of orthography and the role of PA are discussed further on p. 58 to complement the evaluation. An investigation of the Maltese scenario will also shed light on intervention methods within a bilingual setting. A gap in the literature is existent in this area; to the author's knowledge, no studies investigating bilingual literacy intervention with individuals with DS in Malta have been published.

Aims and objectives

The study investigates aspects of reading and pre-reading skills in young individuals with DS. It also aims to investigate the home literacy environments, school literacy environments, and literacy teaching. Different components which are involved in the process of reading development are considered. This study aims to provide a clearer picture of how different components are involved in reading acquisition in the Maltese context. Particular attention is given to the local linguistic context, whereby children are exposed to more than one language early on, and the *National Minimum Curriculum* and *Language Policy for Bilingual Education in the Early Years* (2016) highlight the promotion of bilingualism.

The Home Literacy Environment of individuals with DS has been sparsely investigated in the literature (see p. 87). Hence investigation in the area is warranted both in a local and international scenario. To date, no studies investigating the school literacy environments and practices in the local Maltese setting have been put forward; moreover, literature outside the Maltese islands is unavailable, leaving room for much-needed investigation in the area. On the other hand, the role of different components such as PA and VSTM has been thoroughly investigated from an international perspective; these abilities in individuals with DS in a Maltese and bilingual setting have sparsely been investigated. This study will shed more light on how these abilities interplay in a bilingual setting. VPPS have been prominently showcased as an area of strength in DS. Preliminary local studies have shown that this area is not as strong in the local DS population; therefore, further investigation is needed.

While word reading has also been portrayed as a strength in DS, nonword reading has not. However, a thorough investigation in languages with a shallow orthography is still lacking in the DS population. Hence the need to investigate the performance of individuals with DS on these skills. Finally, the word and nonword reading in DS have been studied from an international perspective; however, the abilities of bilingual reading are lacking; moreover, in the local scenario, no studies are available to date hence showing the significant need to investigate. Such investigations will allow the researcher to contribute to building a portfolio of abilities of individuals with DS. Such a portfolio will contribute to a better understanding of the research population and enhance therapeutic and educational services for individuals with DS.

The data needed to contribute to this investigation was subdivided into four studies. The studies were carried out at different time points (see p. 112), and the results and evaluation of Study 1 led the researcher to the conceptualisation and implementation of Study 2.

Study 1: An investigation of the Phonological Awareness skills, Verbal Short-Term Memory, Visual Perceptual Processing Skills and Nonword reading abilities of individuals with DS compared to TD peers.

Study 2: An investigation of Word and Nonword reading in DS.

Study 3: An investigation of the Home Literacy Environments of individuals with DS and compared to TD peers

Study 4: An exploration of the school literacy environments and literacy practices of Maltese students with DS.

Following are the objectives of the thesis, which will be investigated throughout the four studies.

Objectives

Objective 1: To evaluate the phonological awareness abilities of students with DS and TD controls.

Objective 2: To investigate the verbal short-term memory of students with DS and TD controls.

Objective 3: To evaluate the visual perceptual processing abilities of students with DS and TD students.

Objective 4: To investigate the word reading abilities of students with DS and compare them to TD controls.

Objective 5: To investigate nonword reading skills in students with DS and TD controls.

Objective 6: To explore bilingual reading in the Maltese population of individuals with DS.

Objective 7: To evaluate the contribution of PA, VPPS and receptive vocabulary to word and nonword reading.

Objective 8: To evaluate the home literacy experiences of students with DS compared to a TD group using a questionnaire to parents.

Objective 9: To investigate the school literacy environment and literacy practices used with Maltese students with DS.

Chapter Conclusion

Chapter 1 introduced this research study. The chapter presented the research area, the local bilingual context, the educational context and an overview of reading abilities within the DS population. A theoretical perspective was then put forward. The objectives of the study were consequently stated. In conclusion, an overview of the following chapters is presented next.

Chapter 2 provides a detailed review of the relevant literature. The review explores relevant literature relating to different factors involved in reading development. Literature about both the TD and the DS population is evaluated. The study's research questions are also presented. Chapter 3 provides detail of the method and methodological issues of the study. Chapter 4 presents Study 1, where the PA, VSTM, VPPS and Nonword reading investigation compared to TD peers is presented. Chapter 5 presents Study 2; this study investigates word and nonword reading while also investigating PA, VPPS and Receptive vocabulary as contributors to Word and Nonword reading. Bilingual reading is also evaluated in this study. Chapter 6 portrays Study 3, where an investigation of the Home Literacy Environment of participants with DS compared to a TD developing control group is presented. Chapter 7 presents Study 4; this chapter provides the investigation, results, and discussion of the School Literacy Environment and literacy practices for students with DS. Finally, Chapter 8 provides a conclusion to the thesis.

Chapter 2

Literature Review

Chapter Overview

Areas of development such as language abilities, hearing skills and cognitive skills may develop differently in Down Syndrome (DS) from those in the typically developing (TD) population. Together with other characteristics discussed in this chapter, these might alter reading development in the DS population compared to the TD population. This chapter initially reviews language skills, cognitive skills and hearing abilities in DS. The early literacy skills and components of emergent literacy are then discussed in the DS population and compared to the TD population. The chapter then explores Verbal Short-Term Memory and how this affects reading development in DS. Next, the Visual Perceptual Processing Skills involved in reading and how these develop in DS are discussed. Consequently, the chapter considers and elaborates on the environments and experiences that could nourish reading development in TD and DS populations. Finally, the research questions and the research framework are presented.

The researcher presents a *traditional literature review* format. The latest research is reviewed, identifying gaps and acknowledging discrepancies (Arshed & Danson, 2015). The literature review includes searches in APA *PsycInfo, ProQuest, Scopus, Education Resources Information Center (ERIC), OAR@UM* - Open Access Repository University of Malta and *Google Scholar*.

Language development in individuals with Down Syndrome

The language skills of children and adults with DS have been extensively studied throughout the years, and language profiles in the DS population have often been described to develop unevenly (Laws & Hall, 2014; Couzens & Cuskelly, 2014) with specific domains being stronger when compared to others. Language development also progresses more slowly in comparison to other skills (Mundy & Kasari, 1995). The language profile of individuals with DS has also been compared to that of children with SLI (now referred to as *Developmental Language Disorder*) (Næss et al., 2015), and hence a similar therapeutic path to that of SLI has also been suggested.

Næss et al. (2011), in a meta-analysis review, reported overall difficulties in language abilities when matched to TD on nonverbal mental age. However, the difficulties of the DS group in receptive vocabulary were not so prominent compared to other language skills such as grammar and expressive abilities (Næss et al., 2015). Receptive language skills have been reported to exceed nonverbal cognitive abilities, and expressive skills to be generally delayed in infancy (Mason Apps et al. 2020). A brief overview of the language abilities of individuals with DS is now presented.

Early language and pre-language skills in Down Syndrome

Early language and pre-language abilities comprise a spectrum of abilities often associated with difficulties in verbal expressive language abilities in this population (Mundy & Kasari, 1995). Gesturing, vocalisations, behaviour, attention and social interaction all contribute to the building blocks of communication (Jenkins & Ramruttan, 1998; Romano et al., 2019).

Gesturing has been described as a strength in young children with DS and a predictor of expressive vocabulary (Romano et al., 2019). Gesturing is reported to be used more than TD peers and maintained for longer during childhood, possibly a way to compensate for weaker expressive skills (Iverson et al., 2003; Romano et al., 2019; Vandereet et al., 2011).

Babbling is an important stage of vocalisation and is considered a predictor of speech development (Nymar & Lohmander, 2017). However, findings with regards to individuals with DS are still inconsistent. Some studies in the area show no difference compared to TD groups (Smith & Stoel-Gammon, 1996), while others, such as Lynch et al., 1995, report a delay in onset of babbling in DS compared to TD. However, it has also been discussed that babbling is only marginally delayed compared to other skills that develop at that age (Oller, 2000; Kent & Vorperian, 2013). In a study investigating eight children with DS aged between 12-18 months, Nymar and Lohmander (2017) report no difference between DS and TD groups on canonical babbling and plosives, yet, TD children used more consonants.

Joint attention has been reported to contribute to language and social skills (Hahn et al., 2018). In a longitudinal study evaluating the early language skills of infants with DS, Mason-Apps et al. (2018) found that in DS, the response to joint attention is the major predictor of later language development. It has also been reported that the ability of young children with DS to use joint engagement is dependent on their verbal skills (Hahn et al., 2018). In a systematic literature review, Hahn et al. (2018) identified that joint attention is comparable to TD peers matched by Mental Age (MA). They also identified that individuals with DS show better joint attention abilities when compared to individuals with other developmental difficulties and ASD. However, studies concerning other developmental difficulties are still sporadic, and further research is needed.

The early social skills of young children with DS have been reported to be less delayed than in other areas (Guralnick et al., 2011). Abilities related to emotional recognition (Kasari et al. 2001) and spared imitation abilities (Heimann et al. 1998) are reported to develop at par with those of TD children (Moore et al., 2008). The children's environments are also commensurate with positive early social interaction, where active participation in early social activities is positively reported (Guarnick, 2002). Nonetheless, social competence issues have also been reported. Difficulties in regulating emotions during challenging situations have been reported (Guaralnick et al., 2011).

Receptive Language Abilities

Studies exploring the language comprehension of individuals with DS have shown mixed results. Although individuals with DS often show an advantage in receptive abilities compared to expressive abilities, individual variability is also often reported (Martin et al., 2009; Mason-Apps et al., 2020). However, the literature has shown an agreement that individuals with DS do not perform at par compared to TD children with similar intellectual abilities, yet this performance was not observed throughout all studies (Finestack et al., 2013).

Price et al. (2007) studied the performance of 45 boys with ages ranging from 5;04 years to 16 years on *The Test for Auditory Comprehension of Language* (Carrow-Woolfolk, 1999). Results showed a weaker performance when compared to non-verbal intellectual abilities matched peers, supported by other studies (Chapman et al., 2003; Finestack et al., 2013). However, contrasting findings are also found in the literature.

In contrast, Miller (1999), Vicari et al. (2000) and Laws and Bishop (2003) reported that language comprehension develops closely to non-verbal intellectual abilities in DS. Meanwhile, the comprehension of syntactic structures is particularly impaired in the DS population (Abbeduto et al., 2003; Laws & Bishop, 2003; Finestack et al., 2013).

Longitudinal studies in the area report that the progress in receptive vocabulary skills in children with DS is slower in the early stages of acquisition compared to TD peers, and this also correlates with nonverbal cognitive abilities (Cuskelly et al., 2016; Te Kaat van-den Os et al., 2017; Mason-Apps, 2020). The contrast in findings and individual variation enhances the importance of a thorough assessment in the clinical and educational setting to ascertain receptive language level prior to setting the language and other academic goals (Burgoyne, 2009; Laws, 2016).

Does receptive vocabulary predict reading in DS? Receptive vocabulary has been identified as a predictor of academic achievement and reading development (Laws & Gunn, 2002; Hulme et al., 2012; Burgoyne et al., 2012; Mengoni et al., 2014; Lim et al., 2014; Cuskelly et al., 2016). Hulme et al. (2012) maintain that receptive vocabulary is a stronger predictor of reading in DS than in TD children. In a 2-year longitudinal study, Hulme et al. (2012) identified that vocabulary knowledge was a predictor of reading in the initial stages of reading. However, this predictive value was not maintained once progress in reading was achieved. The correlation between vocabulary knowledge and reading in DS was also confirmed by Næss et al. (2021) in a 3-year longitudinal study. The authors evaluated the performance of a group of Norwegian 6-year olds with DS. The researchers followed the participants' reading development and progress across variables intrinsic to reading development over three years. Thus early vocabulary knowledge, as assessed on the Norwegian version of the *British Picture Vocabulary Scales (*Dunn & Dunn, 1992)*,* contributes to decoding abilities.

The predictive value of vocabulary on spelling in DS has also been evaluated (Cardoso et al., 1999, Hulme et al., 2012; Lim et al., 2014; Næss et al.,2021). Cardoso et al. (1999) show a correlation between receptive vocabulary and spelling in DS when using the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997).

Lim et al. (2014) investigated predictors of spelling abilities in DS. The Singapore Bilingual Vocabulary Test (SBVT; Rickard Liow & Tng, 2003) was used to measure receptive vocabulary, which is a test based on the British Picture Vocabulary Scale (Dunn & Dunn, 1992). Phonological short-term memory and receptive vocabulary were identified as the best predictors of spelling ability in DS, whereas nonverbal cognitive ability was not identified as a predictor. The authors used assessment tools that did not have standardized data on the specific research population; this issue often comes up when working with diverse communities, in this case, students from Singapore. Therefore the authors could not use psychometric data for the measure. Also, the sample size could be considered rather small for regression analysis (Jenkins & Quintana-Ascencio, 2020). Nonetheless, research in the area of disability often uses similar sample sizes in regression analysis.

Increasing literature has confirmed that receptive vocabulary plays an important role in acquiring reading abilities. To the author's knowledge, no study was carried out to investigate the effect of this variable on bilingual readers with DS, particularly concerning the Maltese population; therefore, further research is warranted.

Verbal Expressive Vocabulary

Verbal expressive vocabulary development in DS has been described as delayed (Berglund et al., 2001). It has been stated that children with DS have uttered their first words between the ages of 12 to 24 months; however, reports of later emergence of first words can also be found (Berglund et al., 2001). Nonetheless, it is generally agreed that in DS, the development of spoken words is slow compared to TD children, and individual disparity exists (Berglund et al., 2001; Gillham, 1990; Martin et al., 2009). This individual variation can be attributed to the methodology of studies and the different hearing levels of participants (Martin et al., 2009). Language exposure, bilingual context and intellectual potential are other factors that could contribute to the variation.

In a large-scale study of 330 Swedish children with DS, Berglund et al. (2001) evaluated the vocabulary items that children produced as reported by the parents. Results indicated that in about 10% of the children, the first words appeared during their first year, and after two years, 80% of the sample started to talk. The authors, therefore, maintain that although the level of lexical acquisition is slower than that of TD peers, the onset is not. This study also revealed that the average vocabulary at age three was 36 words. Berglund et al. (2001) also confirm previous studies by Mundy et al. (1988); Smith et al. (1988); Bates et al. (1995) – and that the DS group showed similar patterns of vocabulary acquisition as TD groups; however, exhibiting a significant delay. Interestingly enough, this study also reveals important information about gender disparity, with girls showing a stronger vocabulary acquisition performance than boys. In a local small-scale study investigating early lexical production in Maltese children with DS, Coppini and Gatt (2015) report that the average age of lexical onset was 2;3 years.

Children with DS also exhibit a delayed emergence of two-word utterances, and this production of shorter sentences carries on into adulthood (Boudreau & Chapman, 2000; Chapman et al., 1998; Price et al., 2008). In an in-depth study of the production of syntactic structure in DS, Price et al. (2008) investigated the performance of 31 boys with DS; they compared the performance to that of boys with Fragile X Syndrome and TD matched by non-verbal cognitive abilities and maternal education. Results indicated that the DS group had a weaker performance than the Fragile X Syndrome and TD groups. Boys with DS appeared to have lower-level overall syntactic abilities and produced fewer complex questions and negations when compared to both control groups. In this study, only boys were included, and the authors give no justification as to why girls were excluded from the study.

Morphosyntactic structures are also impaired in the DS population (Moraleda Sepulveda et al., 2013; Polisenská´ & Kapalková, 2014). Studies involving the analysis of the Mean Length of Utterance (MLU) of children with DS reveal fewer verb tenses and inflexions, articles, prepositions, and subordinate clauses in this population (Chapman et al., 1998; Rondal & Perera, 2006). However, some studies have shown no statistical difference between participants with DS and younger mental-age matched groups. No difference in clausal density could be identified in Keller-Bell and Abbeduto's (2007) study.

As previously discussed, receptive skills are considered to be stronger when compared to expressive abilities in DS (Abbeduto et al., 2007; Polisenská´ & Kapalková, 2014). The discrepancy between receptive and expressive abilities has often been attributed to poor speech intelligibility, commonly reported in DS. It has been reported that individuals with DS might resort to simpler sentences to get their message across more clearly (Polisenská & Kapalková, 2014). A combination of anatomical or physiological characteristics, such as hypoplasia, low muscle tone, and hearing impairment, can decrease speech intelligibility. Motor skills and oral-motor planning abilities are also involved in the development of intelligibility (Kumin, 2006) and children with DS exhibit difficulties on all these levels.

The effect that reading abilities have on expressive abilities has also been investigated. Laws (2010), in a review of literature that looked into intervention methods for speech development in DS, did not identify a clear causal link that supports the notion that reading abilities increase speech intelligibility. Knight et al. (2015) tested this notion further. They investigated if 8 participants with DS were more accurate, intelligible, and consistent if words were read out rather than named or imitated. Their results showed that speech production was less inconsistent upon reading out. Although a small scale study shows that reading does provide an advantage to speech production, further investigation with bigger samples for generalisation and longitudinal data is surely needed.

A recent study by Næss et al. (2021b) investigated the predictors of expressive vocabulary in DS over three years. Their study showed that the home literacy environment, receptive vocabulary and verbal memory predicted expressive vocabulary in the DS. The same predictors were identified in the TD nonverbal mental age-matched control group. However, receptive vocabulary and verbal memory had a stronger prediction value in the DS group. On further evaluation of the trajectory of expressive vocabulary development, the DS group progressed more slowly on expressive vocabulary than the cohort group. The authors maintain that this could indicate that difficulties in other language areas all interplay and also hinder successful and progressive development.

How do expressive skills affect reading development in DS?

Difficulties in Rapid Automized Naming (RAN) have often been associated with reading difficulties in TD populations (Botelho da Silva et al., 2020). RAN tasks entail naming familiar visually presented items, hence involving both expressive and processing abilities (Botelho da Silva et al., 2020). Næss et al. (2021) investigated whether RAN could be identified as a predictor of reading development in DS. This skill was not a significant predictor of reading in their 3-year longitudinal study (p=.27). The prediction was also not identified when the sample was controlled for nonverbal cognitive ability (p=.14).

Colozzo et al. (2016), in a 1-year longitudinal study, investigated the progress made in reading abilities by 15 participants with DS after the implementation of a hybrid literacy program, where both a whole word approach and a phonic approach to literacy were used. Their findings suggest that as literacy increased, so did the participants' language abilities. However, no account is given of additional language intervention methods and the literacy program; therefore, the increase in expressive skills could also be attributed to therapy, home environment and other extrinsic factors. Also, the authors fail to provide an account of the nonverbal cognitive abilities of the students; therefore, progress could also be attributed to individual differences.

Bilingualism in Down Syndrome

Learning a language is considered laborious for individuals with DS as they are likely to encounter difficulties. Therefore, parents and professionals often limit a child with DS to being exposed to a single language (Edgin et al., 2011; Kay-raining Bird et al., 2005). However, many factors constantly challenge this notion since bilingualism presents all children with several benefits. Research regarding bilingualism in intellectual challenges is still growing. Pertinent literature so far shows that the use of two languages does not negatively influence language development (Kay-Raining Bird et al., 2005; Feltmate & Kay-Raining Bird, 2008; Cleave et al., 2014; Ward & Sanoudaki, 2020). However, the trend to use one language when living in a bilingual community is still present, where the home language is generally left behind (Ward & Sanoudaki, 2020); however, this depends on the country and the social context. This is known as forced monolingualism (Uljarević et al., 2016). This could also have negative social and emotional repercussions.

The earliest reports of bilingual research in DS base their investigations on case studies (Vallar & Papagno, 1993; Woll & Grove, 1996). Kay-Raining Bird et al. (2005) was the first reported study with a larger (*N*=20) sample exploring the area. The authors explored the early stages of language development of monolingual and bilingual (English and French) children with DS. Their abilities were then compared to those of TD children matched by cognitive abilities. The participants were assessed using a language sample, a parent questionnaire, and a cognitive abilities test. This study revealed several interesting results. An important finding was that monolingual and bilingual children with DS had a similar performance on the English measure, showing that being bilingual does not hinder the development of the other language. In this case, exposing the children to French did not hinder their development in English, which was the primary language. This was observed both in DS and TD participants. Results also show that even though DS and TD groups were exposed to similar bilingual environments, the DS groups were not as successful as the TD group in developing the second language. This study highlights that even though proficiency in the second language might not be as successful as in the first language, a bilingual environment could be considered beneficial to enhancing social experiences and avoiding restrictions to one language (Kay-Raining Bird et al., 2005).

Edgin et al. (2011) also explored bilingualism in DS. The authors studied 41 participants between the ages of 7 and 18. The participants were given language tasks involving an expressive and receptive component, prefrontal tasks which comprised a task assessing rule and reversal learning, an assessment of inhibitory control and working memory, a questionnaire for caregivers investigating everyday skills concerning the executive domain, and a measure of executive abilities. Hippocampal tasks, which included a measure of spatial paired associates and spatial memory, were also included in the assessment battery. Their results complemented the previous study by Kay-Raining Bird et al. (2005), as results showed that there was no difference between the group of monolingual particiapnts and the bilingual groupon any measure. Thus, introducing a second language is not detrimental, yet it is beneficial from a social aspect.

To date, no local studies about the use of Maltese as opposed to English or the other way round in children with DS could be identified. Local studies about bilingual exposure both in the home or at school focussing on the local DS population could not be identified. Nonetheless, the topic was investigated with other groups of children with disabilities. Sant (2018) investigated the language preference of Maltese children with autism. Her results indicated that even though the home language was Maltese, the preferred language was predominantly English. Sant (2018) maintains that the choice of English over Maltese is determined by the opportunities of exposure to one language and not the other and the social setting. This identifies a gap in the literature, and therefore further studies in the area are necessary both locally and at an international level.

Bilingual Reading in DS

While the reading abilities of individuals with DS are increasingly being reported in the literature, research about bilingual reading, also referred to as biliteracy in DS, is sparsely available. The researcher's database search only identified two studies that have delved into this notion, and both studies presented single case studies.

Nelson et al. (2008) reported the bilingual abilities of a 10-year old Spanish-English girl residing in a North Mexican city. The aim of the study was specifically intended to look into the eye and head movements present during reading, and no information was presented about reading-related skills such as PA, language abilities and nonverbal cognitive abilities. The study shows that the student does not differ in eye-tracking movements when reading in different languages.

Burgoyne et al. (2016) also presented a single-case study of an English-Russian speaking girl with DS; however, a complete picture of language and cognitive abilities was presented in this scenario. The abilities of the participant were also compared to those of TD peers. The English and Russian languages have two different orthographies, with English possessing a deep orthography and Russian a shallow orthography (Burgoyne et al., 2016). This pattern poses similarities with the Maltese scenario, where Maltese presents a shallow orthography. However, the difference is that the participant in the study resided in the UK, acquired Russian as L1 (first language) and was introduced to English as L2 (second language) upon school entry. In the local Maltese scenario, both Maltese and English are used interchangeably in most situations. The participant in Burgoyne et al. (2016)'s study possessed comparable language abilities in L1 and L2. The participants showed good word reading abilities in both languages. However, this was not transferred to nonword reading. The authors discuss whether the good bilingual reading abilities of the student could be attributed to her cognitive profile. Good PA, auditory memory and a positive HLE could have contributed to this success. While yielding very interesting and novel results in the area, this study is rather limited as it focuses solely on the performance of one participant.

Further investigation in the area is highly warranted. The need for investigation is particularly felt in the local Maltese scenario. From professional experience, the researcher is aware that bilingual reading in students with DS is present in Malta. Unfortunately, no investigation has been carried out to date. This leaves an evident gap in the literature.

Hearing skills of individuals with Down Syndrome

Hearing impairment is commonly associated with DS. Hearing difficulties are reported in 40% to 80% of children with DS. A conductive loss, a sensorineural loss or both have been identified (Laws & Hall, 2014; Martin et al., 2009; Muscat et al., 2017). Nightengale et al. (2017) report an incidence of 33.3% conductive loss and 29.8% sensorineural loss.

Otitis Media with Effusion (OME) is the primary cause of conductive hearing loss in young children (Laws & Hall, 2014). *Language impairment* is associated with OME since language learning typically occurs before the age of 7. This could mean that children with DS might carry the consequences of former OME occurrences, which are common in this population (Laws & Hall, 2014; Muscat et al., 2017).

OME in early adulthood has also been reported (Nightengale et al., 2017). This reoccurrence can also permanently impair the middle ear's appropriate functioning in DS (Sacks & Wood, 2003). If untreated, reduced mobility in the eardrum is reported in 40% of young adults (Marcell, 1995). Sensorineural loss can also be identified and reported from adolescence in DS (Laws, 2004). Marcell (1995) suggests this is due to a probability of early onset of presbycusis. This highlights the importance of periodic audiological testing from early to late childhood (Nightengale et al., 2017).

Nonetheless, the correlation between hearing impairment and speech and language development is not as straightforward when research on language development in DS is evaluated. Laws and Hall (2014) report that pre-school hearing loss might affect speech and language outcomes in schools. They also maintain that incosistency in results might probably be due to excluding severely hearing-impaired individuals from research studies, hence excluding a good percentage of children with DS and thus not presenting a true picture of the syndrome.

Cognitive skills of individuals with Down Syndrome

Individuals with DS are predominantly described as having a mild to moderate cognitive impairment level, yet Intelligence Quotient (IQ) scores within the average range have also been reported (Lanfranchi et al., 2009; Martin et al., 2009). It is also suggested that general intelligence is the strongest predictor of successful literacy and other academic activities (Boudreau, 2002; Carr, 1995). Cognitive skills, mostly underdeveloped in individuals with DS, include reasoning skills and *Theory of Mind* (Abbeduto et al., 2007; Turner & Alborz, 2003). These abilities also influence reading development, predominantly in the reading comprehension aspect. Nevertheless, although several difficulties are apparent, phonological memory is the most cognitive skill that influences reading acquisition (Abbeduto et al., 2007).

The notion of fluid and crystallised intelligence, first proposed by Horn and Cattell (1967), has also been explored in the DS population. Fluid intelligence refers to the skills that an individual uses to reason and think, yet these are not formed through educational or life experiences, for example, working memory; while crystallised intelligence is formed through experience and forms of tuition or education; for example, development of vocabulary (Pak & Price, 2008). Fluid intelligence has been reported to predict performance in academic subjects (Bergman Nutley et al., 2011). Laws and Gunn (2002) reported that readers achieve better scores on measures of fluid intelligence such as nonverbal cognitive abilities compared to non-readers. Training in fluid intelligence, such as working memory, has also been reported to benefit the development of crystallised intelligence among individuals with learning difficulties (Perrig et al., 2009).

Lifshit et al. (2020) explored fluid and crystallised intelligence trajectories in adolescents and adults with DS. Their study involved 80 participants between the ages of 16 and 61. They found that fluid intelligence is more sensitive to deterioration by age when compared to crystallised intelligence. However, their study also revealed that daily stimulation through games and activities positively contributes to crystallised and fluid intelligence.

Thus, it can be summarised that a reciprocal relationship exists between a group of skills: hearing, language and cognitive skills, wherein an improvement in one area will help develop another area (Frenkel & Boudrin, 2009). These skills tend to vary between one individual with DS and another. Hence, even though specific phenotype characteristics generally tie individuals with DS, diversity lies between one individual and another. Characteristics can change and are not necessarily fixed at birth, and several experiences influence progress. Therefore, there must be close monitoring of an individual's hearing and other abilities, particularly in the early years of education. Additionally, hearing acuity would need to be checked and possibly controlled when individuals with DS are involved in research studies.

In the next section, the different abilities involved in the process of reading development will be discussed. These abilities have been identified as important building blocks in the acquisition of word reading abilities, as portrayed in the theoretical framework discussed in the Introduction chapter.

Early Literacy Experiences and components of Emergent literacy

Early literacy experiences sustain reading development (Al Otaiba et al., 2009). These activities may comprise a supportive home literacy environment and shared book reading practises. Studies have shown that language abilities, conceptual skills, phonological awareness (PA), letter awareness, print awareness, and reading strategies are emergent literacy skills associated with a rich literacy environment and enhance the reading experience (Ricci & Osipova, 2012). As soon as children experience literacy at a young age, they recognise letters and the relationships between letters and sounds. Children who acquire these skills are more successful by the time they are in kindergarten (Miller & Warschauer, 2013).

Knowledge of Print & Letters

Letter knowledge is considered a strong predictor of reading and spelling in alphabetic languages (Drouin et al., 2012; Ecalle et al., 2008). This skill refers to the child's familiarity with the letters, names, and corresponding sounds (Piasta & Wagner, 2010; Whitehurst & Loninghan, 1998). Letter knowledge was initially thought to be only an aid to the visual recognition of a word (Foulin, 2005). Nevertheless, later studies have shown that letter naming and letter-sound correlations develop interchangeably and predict other pre-literacy skills such as PA (Piasta & Wagner, 2010).

These skills are also considered a prerequisite to formal schooling, where according to the Maltese Early Years National Minimum Curriculum Framework (2012), the following objectives should be achieved: linking sounds to some letter sounds; recognition of a few familiar words and awareness that print conveys meaning.

Letter knowledge offers a foundation for understanding the alphabetic concept (Leppänen et al., 2007; Silva et al., 2010). *Letter name knowledge* (LNK) has been one of the strongest predictors of pre-school learning (Paige et al., 2018) and a predictor of spelling and higher reading skills (Blachford & Plewis, 1990; Catts et al., 2001; Pennington & Lefty, 2001). LNK also correlates with letter-sound knowledge (LSK)(Evans et al., 2006). It has been deduced that this association helps further the reading process, as readers tend to quickly process letters they know the name (Evans et al., 2006; Treiman et al., 1998). It has been discussed that LNK needs specific instruction to develop; hence children coming from a less literacy-rich environment might take longer to develop this skill (Paige et al., 2018). This is why the importance of teaching this skill in early schooling is often stressed.

A distinction needs to be made between LNK and LSK. Letter to phoneme correspondence is a type of LSK. Both are important precursors to reading, yet acquiring information about both skills provides a better understanding of the child's general knowledge of letters (Foulin, 2005). By the end of the pre-school years, LNK is more developed than LSK, and when LNK is mastered, LSK continues to develop as it is considered the next strongest predictor of reading. LNK does not merely contribute to the visual identification of words yet supports the emergence of a phonological approach to reading (Foulin, 2005). Phonemic sensitivity and LNK have been reported to develop in parallel. Burgess and Loningan (1998) maintain that LNK contributed to the development of phoneme deletion and phoneme isolation in five-year-olds, whereas LSK was named a predictor of phonemic analysis and phonemic synthesis (Wagner et al., 1997). More prominence and detail will be given to the development of PA in the subsequent sections. Meanwhile, in the following section, research in letter knowledge with a specific focus on children with DS is evaluated.

Letter knowledge in students with DS

Steele et al. (2013) carried out a study to evaluate the PA, *Letter knowledge* (LK) and vocabulary skills of 26 children with DS. Comparison groups were cast between TD participants, DS participants and participants with William's Syndrome (WS). Although the sample size is small, this study provides important insights into LK in DS. The groups were assessed at two points in time. The DS group was matched to a TD group matched by non verbal MA and also to a TD group matched by reading abilities. Results from Time 1 show that DS participants had higher reading abilities and stronger LK when compared to the TD who were matched by non-verbal MA. Vocabulary, phoneme matching and rhyme were equivalent to the other groups. This could most likely be associated with the older ages of the participants with DS, whereas the TD group was still not exposed to formal literacy due to the younger age. Time 2 results showed TD progressed in all areas; vocabulary, phoneme matching, rhyme and LK, yet the DS group performed similarly to TD only on LK. The authors suggest that LK could be the only predictor for reading progression in DS. This supports earlier claims from other studies that LK is a predictor of reading in DS (Lemons, 2008; van Bysterveldt, 2009). This result could be tentatively explained by the fact that LK is one of the earliest skills children are trained in, which is not particularly cognitively challenging as it does not need the support of other skills such as memory or complex language comprehension (Steele et al., 2013). It also highlights the delayed progress that children with DS experience, where progress in vocabulary, phoneme matching and rhyme were particularly slow.

Phonological Awareness

PA skills form part of a group of abilities identified as metalinguistic abilities. These skills require a learner to reason, think about and use different parts of word structures while also using the knowledge of the sounds of these structures (Farrar et al., 2005). PA skills have been defined as different skills that break down words into smaller components (Gillon, 2004). Syllable awareness, rhyming skills, rhyming identification, and phonemic awareness skills comprise the umbrella term

PA. Syllable awareness requires the individual to know that a word can be divided into syllables, where each syllable contains a vowel or a vowel sound and that the stress pattern denotes syllable division (Gillon, 2004). Onset-rime awareness demonstrates that each word or syllable has an onset, which is a beginning sound, and a rhyme which is the sound that forms the rest of the word or syllable. For example,/*tap*/ where *t* is the onset and *ap* is the rhyme (Gillon, 2004). Finally, phoneme awareness refers to the notion that words are formed with different phonemes. Every phoneme can change a word's meaning (Gillon, 2004; Wood & Terrell, 1998).

PA has been defined as the main significant predictor of reading (Cardoso-Martins & Frith, 2001; Farrar et al., 2005; Pufpaff, 2009) and can be attributed to different languages such as; English (Bryant et al., 1989; Bryant et al., 1990), Spanish (Carrilo, 1994), Greek (Aidinis & Nunes, 2001; Porpodas et al., 1990), Korean (Cho et al., 2011) and Mandarin (Yeong & Rickard Liow, 2012). Nevertheless, this prediction strength does not apply to all languages, as some PA aspects might be stronger predictors in one language than another (Gillon, 2007). Ziegler et al. (2010) evaluated PA in five languages; Finnish, Hungarian, Dutch, Portuguese, and French, and they concluded that PA is instrumental in the acquisition of reading; however, the impact might not be strong in languages with transparent orthographies. The relevance of this in the Maltese language will ensue.

With particular reference to the Maltese language, the few studies that evaluated PA in Maltese have agreed on the importance of this skill as a predictor, yet not all PA elements were considered to be particularly relevant to the language. No association between rhyme awareness and literacy has been found in the Maltese language (Gellel, 1999; Martinelli, 1996). The lack of association has been mainly attributed to two factors: the limited number of nursery rhymes available in the Maltese language and the availability of only a few monosyllabic words in Maltese (Pace Gellel, 2004). In his longitudinal study of 132 children, Martinelli (1996) maintains that until the age of 5, Maltese children do not develop rhyme awareness, yet this does not hinder reading development. Pace Gellel (2004) confirmed this difficulty in developing rhyme awareness. These results are in contrast with studies on the English language. Going back to the reading theories in

Chapter 1, p. 24, this might indicate that early Maltese readers do not use Theories of Analogy to develop reading.

Xuereb (2009) also studied PA within the Maltese bilingual scenario. In an initial study involving 50 students, Xuereb looked into the performance of bilingual Maltese-English students on PA tasks. This study highlights that younger (8-year-olds) bilingual readers performed better than the older ones (10-year-olds) on the Maltese elision tests. The author suggests that PA might not be a strong predictor of reading in regular orthographies such as Maltese. Xuereb maintained that in transparent languages, PA is successfully acquired by the age of six years; therefore, further investigation with a younger Maltese group is warranted.

The development of PA skills generally follows a developmental sequence starting from the development of large units such as awareness of rhyme to smaller units such as phoneme identification. A general universal pattern is observed across languages; however, differences may occur in the rate of progress from one skill to another or across levels of proficiency in particular skills and the sequence of development (Anthony & Francis, 2005). Since PA develops before literacy instruction, the building blocks for these skills are laid by a child's proficiency in a specific language. Therefore, the linguistic complexity of a specific language might play a role in the developmental sequence of PA skills (Anthony & Francis, 2005).

Children exposed to languages with prominent syllabic structures develop syllable awareness before children with simple syllabic structures in their languages (Anthony & Francis, 2005). Turkish, Greek, and Italian are languages with simpler syllables when compared to French and English. Children of the latter language take longer to master their syllabification skills (Anthony & Francis, 2005). For instance, Denton et al. (2000), in their review of the development of PA in Spanish, maintain that syllabification, rhyme and alliteration are the skills that develop initially, whereas phoneme segmentation only emerges after the acquisition of reading. They also maintain that a cross-language transfer of skills is evident since the student would have learnt how language works and is processed, and therefore these skills can be transferred across different languages. The effect of bilingualism on PA whilst considering our rich local bilingual context will be discussed next.

Bilingualism and Phonological Awareness

The National Minimum Curriculum in Malta strives to develop literacy abilities in both Maltese and English from the first years of schooling. This has also been highlighted previously in the Introduction Chapter. Bilingual acquisition of literacy skills has also become very frequent in several countries (Wren et al., 2013). In the USA, it has been reported that bilingual programmes have increased by 25% during the past decade, and East Asian countries have English as part of the curriculum from kindergarten (Kuo et al. 2016). This increased practice has led researchers to investigate how bilingualism affects the development of pre-literacy skills. As formerly discussed, PA is an important predictor of literacy skills, and this result has also been proven in bilingual contexts.

The cross-language transfer has been reported to occur when PA occurs in a bilingual context (Kuo et al., 2016). The authors argue that learning about the components of one language facilitates the learning of another language. This theory, also known as the *Classical theory of Transfer*, was originally proposed by Osgood (1949). However, other theories have also been proposed. Cummins (1978) builds on the theory of transfer by proposing the *Interdependence Hypothesis*. This hypothesis states that knowledge from L1 (the mother tongue) can be positively transferred during L2 (second language) acquisition. Kuo and Anderson (2012) also build on this by proposing the *Structural Sensitivity Theory*. This theory states that children with consistent exposure to more languages may have better abilities when using linguistic information and manipulating linguistic structures (Kuo & Anderson, 2012).

Research results in the area are dependent on the languages being used. Wren et al. (2013) reviewed literature where they identified research studies that investigated the influence of bilingualism on the development of phonemic awareness. Their review identified 13 studies that investigated this area. In summary, their review concluded that bilingual children showed similar or better phonemic awareness than monolingual children. Bilingual children performed better when the two languages showed similar characteristics. This supports Dodd et al.'s (2008) views, where they maintain that this bilingual advantage is only noted when orthographies are similar, and it is maintained only throughout the first year of schooling. Reder et al. (2013), in a study of 52 French monolinguals compared to 43 French-German bilinguals, show that the bilingual group achieved better results than the monolingual group on some aspects of syntactic and morphological awareness; however, they performed similarly on PA tasks. Thus showing that bilingual advantage is not clear throughout.

Unlike as described by Wren et al. (2013) and Dodd et al. (2008), the strength of PA in the bilingual group could also be identified when the languages being spoken did not have similar characteristics. Kuo et al. (2016) explain that Japanese and English vary in syllable structure, phoneme inventory and consonant clusters. The researchers studied the performance of 129 monolingual and bilingual children. Results showed that the bilingual group performed better than the monolingual group on PA tasks with shared elements between the two languages. The authors argue that this might not be due to the *Classical Theory of Transfer*. This bilingual group had less exposure to English than Japanese, where English is the language that could have contributed to increased PA development. Therefore according to the *Classical Theory of Transfer*, the bilingual group should have performed worse, not better, than the monolingual group. Kuo et al. (2016) attribute this positive performance to the Structural Sensitivity Theory. While yielding fruitful results, a limitation in this study could be observed. The authors do not look into the home background of the participants. While common academic exposure is noted, the use of languages and parents' perception of bilingualism is not looked into.

Phonological Awareness in Down Syndrome

The role of PA as a predictor of reading in DS has been portrayed differently in the literature. Over the past 40 years, a significant amount of international research has been carried out in this area. Lemons and Fuchs (2010) conducted a comprehensive literature search dating from 1970 until 2008. Their search identified 20 studies that yielded information about PA development in DS and drew comparisons to PA skills in participants with DS and TD children. Sixteen studies focused on the relationship between reading development and PA, while the other four studies implemented an intervention programme. Although research in PA in DS is rich yet, varied conclusions are still being drawn. Several studies will be reviewed; next, a summary of the findings will be provided.

Cossu and Marshal (1990) claimed that PA did not develop in DS. They presented a case study of a boy who was 8;11 years old, and spoke Italian. The boy was considered a good reader of both real and nonwords; however, he performed poorly on PA. This result led to the assumption that in DS, PA is not essential to acquiring reading. Cossu et al. (1993), built on the Cossu and Marshal (1990) study, investigated PA in DS further. This study compared 11 Italian students with DS to younger TD children with similar reading abilities. The students with DS could read both words and nonwords; however, the DS students performed poorly on PA tasks compared to the TD group. Due to these results, Cossu et al. (1993) claimed that children with DS could not use PA and do not utilise it to help them acquire reading skills. Two significant limitations could be identified in this latter study which could have impinged on the results. The participants' language in this study was Italian, a very transparent language. It is argued that these results were achieved since, in the Italian language, decoding abilities are not crucial for the reading process (Snowling et al., 2002). Moreover, there was a discrepancy between the cognitive ages of the participants. The TD group had higher cognitive abilities than the DS group. This difference could have led the DS group to have a limited understanding of what was expected from them in particular tasks (Snowling et al., 2002). However, these were not the only studies that showed poor performance on PA tasks in DS.

Evans (1994) investigated the PA abilities of a small group of participants with DS. PA tasks were similar to those used by Cossu et al. (1993). Results indicated that this group of children with DS could not read nonwords and had very poor PA abilities. All children used the whole-word approach as their reading method. Unfortunately, the author gives no information about the children's backgrounds. Years and type of schooling would have given a better picture of the method of instruction used throughout the year and if some form of PA training was carried out.

Snowling et al. (2002) assessed PA in DS to verify the relationship between PA and reading in DS. This study was comprised of three different studies. In all three studies, 29 children with DS (aged 6;11 -17;6 years) were compared to 31 TD students (aged 4;6 – 6;5 years). The groups were matched by reading age. In their first study, results indicated a correlation between PA and reading in both groups. This first study also indicated surprising information for the authors about the poor performance on rhyming tasks in the DS group. In their subsequent studies, Study 2 and Study 3, the authors attempted to adjust the cognitive demand needed for specific rhyming tasks to ascertain that the performance was not due to the high level of difficulty of the specific task. Even though some adjustments were made, the DS group continued performing significantly poorly on rhyming tasks.

Kumar Misrah (2007) studied the performance of 10 participants with DS and compared them to 15 younger TD children. The groups were matched by reading abilities. Participants used the Oriya language, which is highly regular in phoneme-to-grapheme correspondence. This study showed that participants with DS develop PA skills; however, a significantly lower form of competence in PA was achieved. They also maintain that the DS group was stronger on syllable manipulation tasks when compared to phoneme manipulation tasks, while they performed strongly on rhyming tasks. Particular limitations could be identified in this study. The major limitation is that the groups came from two different educational systems. All students with DS attend special schools, where a focus was placed on *whole word* reading, and they had received intensive training through this method of reading, whereas the TD attended mainstream local schools. This must have played a role in both groups' performance since different training methods surely lead to different strengths and abilities. Moreover, a further limitation of this study is that participants with DS with sensory and medical problems were excluded from this study. This shows that the sample does not show the real picture of the DS population since children with DS are particularly characterised by one or a combination of these difficulties. In addition, a small sample size is presented.

Other studies show that the limitation occurs only on specific skills rather than all PA skills (Cardoso-Martin & Firth, 2001). Cardoso-Martin and Firth (2001) conducted a study on Brazilian-Portuguese-speaking individuals with DS, as in Cossu et al.'s (1993) study reported that readers must rely on the logographic principle rather than the alphabetic principle of reading. Portuguese is a language with a transparent orthography, like Italian. Thirty-three individuals with DS aged 10 to 49 participated in the first study. They were compared to a TD group of 33 children aged 6 to 9. Groups were matched on their ability of word and nonword reading. Results indicated that the DS group showed a stronger performance on phoneme detection tasks and found phoneme deletion tasks difficult to complete. This shows that a reader may not need to manipulate phonemes to access the alphabetic principle; however, this does not mean that PA is not needed in DS, as Cossu et al. (1993) suggested. A strong performance on phoneme detection tasks was noted. The authors maintain that the poor performance on manipulation tasks was due to the cognitive demands.

Steele et al. (2013) also researched PA in DS. Their study investigated the performance of students with DS and students with William Syndrome (WS). Twenty-six students with DS were compared to a group of TD children. The groups were matched by reading ability. All participants were English speaking. Students with DS presented significantly lower rhyme and phoneme matching results. However, the DS group performed better on letter knowledge skills. Letter knowledge was strong across all three groups. The authors maintain that this might be due to the strong relationship between early educational activities and letter knowledge tasks. On the other hand, PA skills are taught more indirectly. Therefore, children with learning difficulties find it more difficult to learn this indirectly unless it is heavily taught formally. Unfortunately, the authors fail to provide information about the participants' hearing abilities. This information is important as it would help interpret results more accurately and represent the realities of DS populations. In addition, participants in this study are from diverse educational settings. The difference in school setting between the students and the controls could have impinged on the study results due to the different educational practices that are not discussed.

Zahra (2010) studied the PA abilities of Maltese speaking students with DS. Ten students with DS were compared to 10 TD children. The groups were matched by word reading abilities. All tests were administered in the Maltese language; however, as indicated earlier, Maltese children are exposed to Maltese and English at different levels from their early years (Xuereb et al., 2011). The students were subdivided into two groups: reading age six years; reading age nine years. The participants were assessed on 13 tasks. The students with DS in the age-6 group performed significantly lower on only three tasks: medial phoneme identification, sound counting and sound blending. An explanation for this might be that the students were required to manipulate the phonemes; thus, counting and memory skills were essential for these tasks. This imposed a higher cognitive demand on the students (Byrne, 1993; Firth, 1993; Zahra, 2010). In the nine-year-old reading group, children with DS obtained lower scores than the TD children. However, there was no significant difference between DS and TD, indicating only a mild delay in developing PA. This study was a first of its kind within the Maltese context; however, limitations could be observed: the sample size was small, students were not screened for hearing abilities, and tests were not standardised on the local population.

Fletcher and Buckley (2002) explored the PA abilities of children with DS by using assessment tools that were more appropriate for children who found difficulties in expressing themselves verbally and who had auditory short-term memory difficulties. Seventeen students took part in this study. All students attended mainstream schools and had benefitted from early intervention. Varying yet quantifiable levels of PA could be identified in all children, thus contesting claims by Cossu et al. (1993) and Evans (1994). PA was positively correlated to reading and spelling; however, PA was not significantly correlated to nonword reading. The authors conclude that phoneme awareness is necessary but not sufficient to master decoding abilities. It may suggest that some children have not had experience with nonword reading, which needs to be taught. This study particularly highlighted the idea that assessment tools should be chosen specifically to cater to and overcome specific difficulties presented by the students.

PA in DS was also studied when participants were matched according to cognitive age. Boudreau (2002) studied the performance of 20 participants with DS when compared to 20 TD children. The groups were matched on a measure of non-verbal MA. The participants were all monolingual English speakers. Participants with DS performed similarly to MA-matched peers on letter naming tasks, letter knowledge and print concepts. Besides, no significant difference could be observed in blending and segmentation skills, whereas DS participants performed significantly lower on tasks depicting rhyme and alliteration. The author suggests that TD peers had an advantage in some tasks (rhyme and alliteration) despite MA-matching, yet they did not show an advantage on reading measures. This suggests that reading performance could be more dependent on language skills than MA since TD children have equivalent language and cognitive measures, whereas participants with DS have poorer language abilities when compared to MA (Lim et al., 2014). Steele et al. (2013) also investigated PA in DS compared to non-verbal MA matched peers with Williams Syndrome (WS). Results indicated that children with DS performed on par with the non-verbal mental age-matched group in rhyme and phoneme matching while scoring lower scores on the same tasks compared to MA matched participants with WS. The weaker performance of the DS group, when compared to that of the participants with WS, can be attributed to a higher level of vocabulary skills intrinsic in WS. Hence, reiterating that vocabulary and language skills play a big role as precursors to PA (Lim et al., 2014; Næss et al., 2012; Steele et al., 2013).

It has been stressed that PA is highly dependent on vocabulary skills in TD populations (McDowell et al., 2013), yet this dependence might not only be because students need a specific amount of vocabulary skills to develop their PA. Poor vocabulary skills could also impinge on the level of language comprehension achieved by students with DS (Burgoyne, 2009; Næss et al., 2012). The students need a certain level of language comprehension to understand the instructions of the

PA tests. Thus a low score might be due to the lack of comprehension of the task rather than the inability to perform the task (Næss et al., 2012).

In summary, it can be concluded that the majority of studies have shown that even though PA development may be delayed, these skills are very important for reading acquisition in DS (Lemons & Fuchs, 2010). It has also been shown that individuals with DS respond to targeted PA training (Næss, 2015). Furthermore, other studies specify that PA is not necessarily a precursor to reading; however, it grows and progresses as the students advance further in their reading abilities (Hulme et al., 2012). To date, to the author's knowledge, only one study has investigated PA in DS locally; therefore, such an investigation would highly contribute to knowledge in the area. Investigation in the local bilingual scenario is extremely limited, so research in this area is also highly warranted.

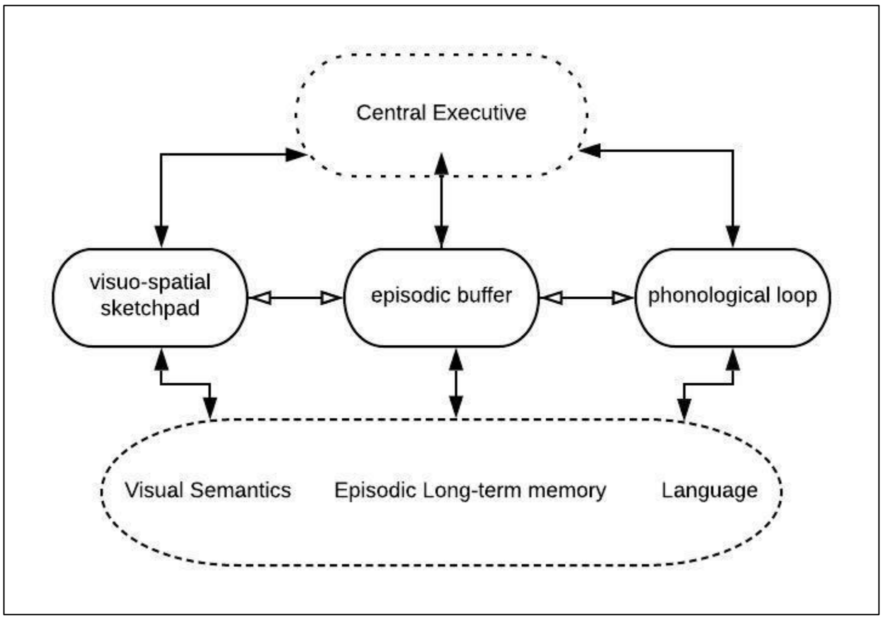
Verbal Short-Term Memory

Verbal short-term memory (VSTM) is associated with language acquisition, and difficulties in language development are often attributed to it (Gathercole & Baddeley, 1990). A correlation between grammar and vocabulary and VSTM has been identified. The development of phonological representations is also affected by VSTM, also described as influencing reading development (Verhagen & Leseman, 2016).

The Multicomponent Model has proved to be a valuable framework to explain the processing of information (Baddeley, 2010). Atkinson and Shiffrin (1968) initially proposed a working memory model where information moves from the outside of the body into temporary buffers. Information is then passed on temporarily to short-term memory, ultimately feeding the long-term memory. This model was known as *The Multi-store model*. Baddeley and Hitch (1974) developed this model further by involving three components that interact with each other. In the 1974 model, the visuospatial sketchpad and the phonological loop processes hold incoming information. The central executive then directs attention to the incoming information, supports processing and relates it to long-term memory. The central executive also acts as a selector to prioritise the most important information (Baddeley, 2010). Baddeley maintains that although this model was resilient and used widely in literature, it needed an additional component. The episodic buffer was introduced as a fourth component. It is thought to integrate different modes of sensory input (visual, auditory and maybe taste and smell) and interface with long term memory. Baddeley (2010) continues that the buffer serves as a passive component, where information is not processed but merely stored. Figure 5 is a representation of the model being proposed

Figure 5

A modified version of The Multicomponent Model as proposed by Baddeley (2010)



The phonological loop plays a crucial part in verbal auditory processing. The role of the phonological loop is bi-fold, and it acts as a temporary store for auditory information. Baddeley (2010) maintains that this store is active for approximately 2 seconds; moreover, it also allows for sub-vocal rehearsal (Baddeley, 2010), also known as the articulatory loop (Dehn, 2008). This rehearsal practice is also used to rehearse information that is not phonological. Gathercole and Baddeley (1993) maintain that non-phonological information such as pictures and text are processed in the phonological loop, and phonological information is then accessed and stored in the phonological store. In distinction to this, speech information is directly stored in the phonological store without being rehearsed (Gathercole & Baddeley, 1993). Words or other auditory units are *recorded* in the same sequence as perceived. These will decay after a short time unless rehearsed in the same phonological loop (Dehn, 2008). These phonological representations are then matched with codes available in the long-term memory (Dehn, 2008).

VSTM has been measured mainly using digit span tasks involving repeating numbers (Verhagen & Leseman, 2015). This has been described as a less sensitive measure of working memory (Abdelhameed & Porter, 2010). *Nonword repetition* (NWR) tasks might be simpler to understand by the participants as they might be more familiar with digit repetition (Jarrold & Baddeley, 2001; Laws, 1998). Some words in NWR tasks might have a high phonotactic probability (Jarrold & Braddely, 2001); therefore, it might sound more common to the participants, making the task easier, which could be positive to use with individuals with DS. However, the performance can be affected by hearing skills and speech production abilities. Therefore, difficulty in NWR might not necessarily mean difficulty in phonological memory (Cairns & Jarrold, 2005). Besides, performance on NWR tasks can also be influenced by the learner's knowledge of the specific language (Chiat, 2015; Messer et al., 2015). Performance on NWR has been associated with vocabulary growth. Rispens and Baker (2012) describe this task as mimicking the process of learning a new word in young TD children.

An association between vocabulary size, phonological knowledge, and NWR could explain why children with language difficulties perform poorly on NWR tasks (Rispens & Baker, 2012). Rispens and Baker (2012), from a comparative study involving children with language impairment, reading difficulties, and TD children, concluded that phonological short-term memory and phonological representations significantly correlate to NWR. Children with language impairment have been reported to find difficulty perceiving the phonemic variations of nonwords (Maillart et al., 2004). PA difficulties, together with NWR difficulties, have also been reported in children with a reading impairment (Boada & Pennington, 2006; Rispens & Baker, 2012)

In contrast to a monolingual environment, a bilingual environment can also play a role in NWR tasks' performance. Messer et al. (2015) investigated 69 bilingual Turkish-Dutch and 72 Dutch-speaking children. They carried out a developmental investigation concerning the growth of VSTM between the ages of 4 and 6. Two NWR tests were used; one test consisted of words with high phonotactic probability, while the other had low phonotactic probability. A digit recall test was also administered. Results indicated a better score on recalling high phonotactic words when compared to the low phonotactic words.

Agius (2012) developed a literacy assessment battery for Maltese children. The battery included the assessment task in both Maltese and English. This battery also included a test that evaluated NWR. As part of the validation and standardisation process, Agius administered the test to 549 students aged 8 to 12. At the assessment time, the students were in 3 class levels: Year 4, Year 5 and Year 6. Her results indicated that students from different school settings performed similarly in public, church or independent schools. Thus, maintaining that schooling does not affect the performance of these tasks. An interesting result yielded by Agius is that bilingual children were less accurate in their performance than monolingual children on Maltese Nonword repetition tasks. The author suggests that repetition might be more laborious for the bilingual child dealing with the Maltese-/English dichotomy since they have to go through two different mental representations. However, this does not occur with the English repetition task with the bilingual group.

Tabone et al. (2016) investigated the phonological working memory of TD Maltese children and children with *literacy difficulties* (LD), language impairment (LI) and *Attention Deficit Hyperactivity Disorder* (ADHD). The participants were assessed through a NWR task. The students were also assessed on a language processing task where they were expected to repeat sentences. The *Sentence Imitation Task* (SIT) was used for these purposes (Grech et al., 2011). Results indicated that the LI group performed the weakest on both tasks. No difference was identified between the TD and ADHD group on the NWR task. However, the ADHD group performed better on the SIT. The LD group’s performance was lower than the TD and ADHD group. Although having a small sample size, the authors indicate that the linguistic component impinged mostly on the results.

Verbal Short-term memory in Down Syndrome

Individuals with DS find difficulty processing verbal language (Gathercole & Baddeley, 1990; Laws, 1998; Purser & Jarrold, 2013; Seung & Chapman, 2000; Næss et al., 2015). This difficulty allegedly makes the acquisition of language and language-related abilities more laborious. This impairment also affects the development of cognitive skills (Kanno & Ikeda, 2002). VSTM has been reported to be shorter in individuals with DS than in TD peers or MA-matched peers (Abdelhameed & Porter, 2010; Jarrold et al., 2000; Kanno & Ikeda, 2002; Næss et al., 2015). These difficulties have also been reported in different languages (Abdelhameed & Porter, 2010; Næss et al., 2015). Differences in performance have also been identified amongst individuals with DS. These differences have also been attributed to both intrinsic characteristics in DS and the home and school environment (Abdelhameed & Porter, 2010). The poor performance on VSTM tasks reportedly affects reading since phonological representations are impaired (Verhagen & Leseman, 2016).

The hearing acuity in DS could potentially impair VSTM, and this claim has been investigated. Seung and Chapman (2004) assessed two groups of students with DS. Group 1 included participants who failed three frequencies at 20db, and Group 2 passed at least one frequency at 20db and all frequencies at 40db. The participants were assessed on sentence memory tasks. Results indicated that no statistical significance was found between the groups on the VSTM task, hence confirming that hearing does not play a crucial role in VSTM, complementing other studies (Jarrold et al.,2002; Varnhagen et al., 1987)

The origin of VSTM difficulties has often been attributed to weakness in the phonological loop in the DS population. This is also known as the phonological storage hypothesis, where VSTM is considered fundamental in forming phonological representations to form words (Næss et al., 2015). According to Baddeley's working memory model, a slower articulation of words could also bring about VSTM difficulties, mainly due to poorer subvocal rehearsal (Seung & Chapman, 2004). Sentence recall tasks can aid in the identification of these difficulties. Tests on sentence imitation correlate with expressive language abilities and indicate the children's linguistic knowledge (Seef-Gabriel et al., 2010). Seef-Gabriel and colleagues claim that sentence imitation tasks could yield information about the participants' receptive and phonological memory skills. Seung and Chapman (2000) also investigated the origins of VSTM difficulties in DS. They aimed at studying whether difficulties could be attributed to difficulties in the articulatory rehearsal mechanism or *the passive store*. They studied the performance of 35 individuals with DS and compared them to 35 mental age-matched peers and 35 language-age matched peers. Results indicated that the DS group had a shorter recall duration. The authors maintain that this is due to a deficit in the *phonological store*. In this study, it has also been concluded that the performance of the DS group was closer to the language-age matched group than the mental-age matched group. Hence, performance on VSTM tasks could be more closely related to language rather than cognitive abilities.

Jarrold et al. (2000) also investigated the rehearsal mechanisms of individuals with DS compared to language age-matched peers. The participants in the comparison group presented moderate learning difficulties as reported and measured by the *British Picture Vocabulary Scale* (Dunn & Dunn, 1982). In this investigation, the participants were asked to repeat a list of words. The authors maintain that both groups had similar speech and articulatory abilities. Unfortunately, no information about the participants’ hearing abilities is given. Results indicated that the DS group had a weaker performance on repetition tasks, confirming that children with DS tend to perform worse than the control group on Verbal Short-Term Memory assessments. The authors also maintain that difficulties in VSTM are not correlated to poor rehearsal mechanisms. They uphold that poor rehearsal would be attributed to articulatory difficulties; however, these groups had similar articulatory abilities. Therefore, it was concluded that the difficulties in VSTM do not pertain to poor rehearsal abilities. In the second part of their study, Jarrold and colleagues compared the DS group to a new control group, TD children. The TD participants were younger but matched the DS group by verbal and mental age, similarly to the participants in experiment 1. In this second experiment, the authors sought to remove the word length effect by employing a probe recall method. This probing in the second experiment did not significantly reduce the deficit. The DS group did not perform as well as the other groups.

Moreover, all groups have been reported to not rely on rehearsal. Therefore, any difficulties in VSTM are not caused by poor subvocal rehearsal. Therefore, the authors maintain that difficulties in VSTM could be attributed to either the phonological store component or difficulties in deciphering verbal information.

It has also been argued that the deficiency in phonological representations could cause poor VSTM (Metsala, 1999). Brock and Jarrold (2004) investigated 21 individuals with DS compared to 19 TD students. Participants were matched on measures of MA. The DS group had a significantly higher chronological age when compared to the TD group. No information about the participants' hearing abilities or speech intelligibility was mentioned in the study. The students were assessed on item discrimination, where the participants had to identify if a repeated word was identical to the test word. The participants did not have to repeat words themselves —additionally, a second task involved an item memory task. The participants had to identify if a list of nonwords was repeated accurately. In the third task – order memory tasks, the participants had to identify whether a list was repeated in the correct order or not. Results indicate that both groups performed close to the ceiling on item discrimination tasks. Participants with DS performed better on order memory tasks when compared to item memory tasks. Hence the authors conclude that language abilities are contributors to poorer VSTM. Brock and Jarrold (2004) maintain that these results indicate a deficiency in phonological discrimination abilities. If the participants’ hearing abilities were ascertained, it could have been identified whether some of the discrimination difficulties were due to poor hearing abilities.

Purser and Jarrold (2013) also investigated whether phonemic discrimination contributes to VSTM difficulties. Fourteen individuals with DS were matched to 19 TD MA matched peers and 19 verbal-age matched peers. The DS group had a significantly higher chronological age than the other two groups. The participants were reported to have good hearing abilities. However, no information was given about how these were assessed or their educational background. The participants performed both a discrimination task and a VSTM task. The DS group performed better on discrimination tasks when compared to the non-verbal age-matched group; however, the performance was poorer on memory tasks. The authors conclude that these results indicate that phonemic discrimination does not contribute to poor VSTM.

Næss et al. (2015), through a longitudinal study, investigated the relationship between vocabulary, grammar and VSTM in a group of 43 6-years with DS. They were compared to TD by nonverbal cognitive abilities. Results indicated no evidence of a predictive relationship between VSTM and receptive vocabulary was perceived from the data collected throughout the two years of study. Hence, VSTM is not the foundation for phonological representations, and vocabulary skills do not hold back the development of VSTM, in disagreement with Metsala (1999) and Seung and Chapman (2000).

The effect of word length on recall has often been investigated in the DS population. The Word length effect is also considered a clinical indicator of poor rehearsal (Jarrold et al., 2003). Hulme and McKenzie (1992) maintain that individuals with DS do not show the word-length effect, and they argue that this shows that they do not engage in any rehearsal. However, this notion was not supported (Comblain, 1996; Laws, 1998; Laws et al., 1995). Comblain (1999), in an investigation on the number of errors according to syllable length, maintained that the longer the words, the higher the probability of percentage errors of nonwords repeated from the DS group. This supports the *phonological short-term hypothesis* described by the author, where participants use the short-term memory depictions of words to shape lexical representations of the phonological structure. It was found that a difference could be identified between 1 to 2 syllable words; however, no difference was noted between 3 to 4 syllable words. The author discusses that the participants performed equally poorly beyond the three-syllable length. It is concluded that the length of words is the major influencer on the participants' performance.

From the literature presented, it can be established that even though VSTM in DS has been extensively studied in the past years, a consensus about what specifically causes these difficulties is yet to be reached. The differences in methodologies and sample participants could contribute to the diverging results. Although an agreement is perceived on the notion that individuals with DS find VSTM tasks difficult, this skill takes longer to develop when compared to TD peers who are matched both through nonverbal cognitive skills and language abilities. More studies, especially longitudinal studies, could help to explore this area further. Studies on VSTM in the local Maltese population of children with DS are unavailable. Studies investigating the relationship between VSTM and DS are also unavailable, and therefore the need for such studies is high within the local scenario.

Visual Perceptual Processing Skills and reading

Reading is a psychological process of interpreting and understanding language through text (Venezky, 1993). Throughout this process, the eyes are required to shift and extract information distributed in the text. Moreover, this movement accommodates print recognition and print comprehension (Schuett et al., 2008). The eyes scan text according to the direction depicted by the language. Words are then fixated upon during scanning. Fixation of words can take place more than once, while some of the words are skipped. These eye movements are also influenced by the characteristics of the text, which is being analysed. Visual acuity and visual perceptual processing affect the extraction of information from the text. Thus, both the optical and neurological systems constantly interplay to transform characters into meaningful information (Venezky, 1993).

The interplay between physical and psychological processes makes the reading process complex. Thus identifying or excluding a difficulty in the visual areas related to reading can be extremely complex. Difficulty at several levels can occur when the visual stimulus gets to the eye through the retina and is processed in the visual cortex (Willows et al., 1993). Thus, visual perception should be attended to once the eye's physical health is ascertained. This largely includes the details of shapes and colours primarily, yet it also entails spatial orientation, visual memory, visual discrimination, visual sequential memory and location recognition (Baluoti et al., 2012). Through visual perception, individuals can identify, interpret, and discriminate visual stimuli concerning previous experiences, on which many daily experiences rest (Ahmetoğlu et al., 2008; Chedzey, 2016; Martin, 2006). Visual perception and individual attempts to understand and make sense of visual information. Spelling, reading, writing, and arithmetic skills are influenced by how visual information is perceived and processed (Ahmetoğlu et al., 2008). Moreover, Kielhofner (2009) explains that visual perception also has a reciprocal relationship with cognition, where perception is responsible for evaluating data from a sensory source, while cognition processes and formulates a response.

Although reading involves a visual act, research about the visual processing aspects concerning reading difficulties has been rather scarce (Muscat et al., 2017). Willows et al. (1993) describe research in visual processing as dispersed, stating that visual processing has not been studied sufficiently; therefore, theories are still controversial and still emerging. Vellutino et al. (2004) reviewed literature that evaluated the visual component involved in reading disability. They explain that early theories such as *Orton's Theory* (1925), also known as the *optical reversibility theory*, where letters and print are perceived in a reversed form and the *Hermann spatial confusion theory* (1959) have been heavily challenged. Vellutino et al. (2004) maintain that several studies (Vellutino, 1979; Vellutino & Scanlon, 1982) comparing normal to poor readers on visual perceptual processing tasks revealed few significant differences. Vellutino et al. (1994) found that visual processing abilities were poor predictors of several reading tasks: nonword reading, spelling, and reading comprehension. This result could be observed within a wide age group, from 7-year-olds to 13-year-olds. Vellutino et al. (2004) maintain that these results prove that reading is predominantly a linguistic ability.

Kavale and Forness (2000) have analysed auditory and visual perceptual processing skills' predictive qualities for reading abilities. A meta-analysis of 267 studies identified a big divergence in the relationship between visual processing skills and their predictive ability towards reading development in visual perception. Kavale and Forness (2000) maintain that *Figure-Ground Discrimination* has the least effect on predictability, while Visual Memory was the strongest predictor. Unlike Vellutino et al. (2004), Kavele and Froness (2000) recognise a relationship between visual perceptual processing and reading; however, they also uphold that other factors, such as processing speed, may play a stronger role in reading development.

Baluoti et al. (2012) attempted to identify a relationship between visual processing difficulties and reading. Their study was set in Ahwaz city among a population of 50 students. Students' visual-motor skills, figure-ground discrimination, shape constancy and spatial relation perception, were evaluated. Their study yielded that difficulty in several VPPS is correlated with reading difficulties. However, visual motor skills do not affect reading abilities. Moreover, they also maintain that correcting visual processing deficits helps improve performance even within different levels of the learning disability.

A correlation between visual processing and reading was also identified in an older study by Amoriell (1979) in his study of 105 students with reading difficulties. Amoriell (1979) concludes that visual sequential memory is a skill that is highly related to reading difficulties. Unfortunately, the results of this study are dated and unclear as the author fails to provide any statistical data to support his claims; therefore, it is difficult to attribute significance to his findings. Bellochi et al. (2017) also investigated the claim of a relationship between visual processing and reading. Their study of 36 French first-graders identified that visual perceptual skills predict reading outcomes one year later.

Giovagnoli et al. (2016) explore the visual-spatial abilities and visual-motor abilities of 63 Italian children diagnosed with Developmental Dyslexia as referred by the authors. They were compared to a group of chronological age-matched normal readers. The authors subdivided their participants into younger (attending primary school) and older (attending secondary school) groups. Their results indicated that the children attending primary school presented a significant deficit in visual-spatial abilities. However, these difficulties were not found in the older group. Difficulties in visual attention have been reported in the older group. The authors maintain that this difficulty is related to reading since, with such an impairment, the readers have a limited 'visual-attention window' to overview a complete word. Thus, also inhibiting rapid word identification. Giovagnoli et al. (2016) reported that both visual-motor and visual-spatial tasks predicted both word and non-word reading in the younger group. Whereas in the older group, only visual-spatial tasks predicted reading.

It has been specified that the relationship between visual processing skills and reading is not reportedly consistent both in the TD population and in children with reading difficulties. It needs to be questioned why a visual method of reading intervention is primarily used within the DS population. However, prior to progressing further with the discussion of VPPS, it is important to note the different skills mentioned in the literature.

The Visual Perceptual Processing Skills

Visual Perceptual Processing Skills (VPPS) include many different skills. VPPS involved in the reading process will be discussed next.

Visual Memory. Two types of visual memory are identified within the visual processing continuum: *visual-spatial memory* and *visual sequential memory*. Visual sequential memory is described as the capability of distinguishing and remembering a sequence of symbols, being letters, numbers or pictures (Chedzey, 2016; Scheiman & Rouse, 2006). The researchers maintain that this type of memory is associated with verbal mediation. Verbal mediation is also known as private speech or inner speech (Lindstone et al., 2012). During verbal mediation, a reader needs to organise, practise and remember information (Scheiman & Rouse, 2006). It has been reported that students who demonstrate good performance at verbal mediation also show a positive performance in other cognitive tasks (Lindstone et al., 2012; Scheiman & Rouse, 2006). Visual-spatial memory includes another aspect of memory, which involves remembering objects and symbols in their location. It is used for the temporary storage of information. It is also known as the visual-spatial sketchpad or visual short-term memory (Buckley, 2001).

Visual Closure. *Visual closure* is the skill of recognising a visual object or symbol from an unfinished visual illustration and hence allowing the perception of a symbol as a whole even though specific parts are missing (Williams-Medlow, 2008). Visual closure aids the reader both at the beginning stages of reading, where identification of letters is needed and during more complex reading activities where a reader needs to conclude the text to understand a story. Without visual closure, deductive reasoning, such as completing puzzles or building blocks by copying a picture, can also be impaired (Williams-Medlow, 2008). Skimming through text and identifying words whose print is not completely legible is all possible due to the development of visual closure (Kurtz, 2006)

Visual Discrimination. *Visual discrimination* is the skill of detecting an object or symbol's details, including the shape, size, and colour (Kurtz, 2006). This skill allows the development of fluent reading as the reader finds difficulty differentiating fine details, and thus reading gets more laborious. A reader with poor discrimination also finds it difficult to stick to one line when reading (Williams-Medlow, 2008). Woodrome and Johnson (2009) maintain that visual discrimination supports letter knowledge learning since early learners first need to differentiate between letters: /b/ vs /d/ and /p/ vs /q/; and then learn the particular letter symbol. Hence, they imply that this skill allows a smoother shift to a phonetic method of reading. Their study of 73 4 to 5-year-old children indicated a correlation between letter identification and visual discrimination, and the highest correlation could be observed on lower case letters.

Form Constancy. *Form constancy* is the ability to understand that symbols remain the same even though their size, background or position might change (Kurtz, 2006; Williams-Medlow, 2008). A reader with form constancy difficulties might struggle to recognise a specific letter in a different font or find a lower case and upper-case letter misleading. Difficulty in form constancy might lead a reader to recognise words on a specific book whilst not reading the same words on another book or a wall-mounted board (Williams-Medlow, 2008).

Figure-Ground Discrimination. *Figure-Ground discrimination* is the ability to differentiate between background and foreground and identify what is needed and not needed to read a word. This skill also allows a reader to identify the spacing between words and focus specifically on the words which need to be read (Kurtz, 2006; Williams-Medlow, 2008). Boon (2010) claims that this skill is particularly important since an impairment in this skill would not allow a reader to identify information from far away, such as a classroom board and therefore miss whole pieces of information.

Different aspects of the visual processing continuum have been explained concerning the reading process. It can be concluded that the relationship between reading and VPPS is not linear and may result in a discrepancy in different skills, which may affect reading development. Following is an evaluation of how individuals with DS perform on visual perceptual processing tasks.

Visual Perceptual Processing in Down Syndrome

Reading involves vision, and the visual abilities concerning reading have been explored in the DS population. Nandakumar and Leat (2010) maintain that 100% of DS participants whom they studied had abnormal visual accommodation. They also maintain that bifocal correction is best to improve accommodation difficulties. Nandakumar and Leat (2010) also maintain that bifocals play a positive role in the reading process in DS. In a study with 14 participants with DS, Nandakumar and Leat (2010) prescribed bifocals to improve close visual acuity. The participants were then assessed on aspects of visual perceptual processing. Results indicate that participants responded positively to the change, and enhanced performance on VPPS tasks could be observed. This indicates that the physical visual factor can play a role in perceptual processing skills. Along with the visual difficulties, individuals with intellectual difficulties secondary to congenital disorders such as DS also experience difficulties developing several mental processes: cognition, language, motor, and social skills. A global developmental delay has also been observed when individuals with intellectual difficulties are compared to chronological age-matched peers (Ikeda et al., 2013).

Nevertheless, studies have found that visual perceptual processing in TD and participants with intellectual difficulties develop at par once MA is matched. Ikeda et al. (2013) also claim that individuals with intellectual difficulties can perform better on some tasks. This good performance is especially noticeable in the early years. Following is a review of relevant literature investigating different aspects of VPPS in DS.

In DS, VPPS have been considered a relative strength (Fidler, 2005; Klein & Mervis, 1999), with some types of visual processing skills being described as stronger than others. Fidler (2005) identifies visual memory, imitation, and visual-motor integration as stronger than visuo-constructive tasks and spatial memory. These skills have also been identified as correlates to word identification (Fidler, 2005). Laws (2002) maintains that visual working memory skills are particularly strong in DS, with no significant difference noted when TD peers by receptive language abilities are matched. However, the author states that DS participants outperformed TD peers on spatial memory tasks. Literature in this area is rather inconsistent.

Moreover, it is also debatable whether VPPS is truly an area of strength or whether this area is stronger than other abilities, such as those with weak expressive skills (Muscat, 2017; Yang et al., 2014). The assumption that VPPS are strong in DS has influenced educational practices, where children were exposed to educational methods that heavily relied on these visual abilities. Intervention on these skills rarely occurs in children with DS, and research in this area is very limited since other areas might have taken priority throughout the years. A review of the literature about visual processing within the DS population was carried out by Yang et al. (2014). This review comprised 49 comparative studies between DS and TD participants matched by measures of cognitive abilities. Overall, a varied performance by the DS group could be identified with specific differences found in particular visual processing skills.

Several studies have compared DS's abilities and other learning disabilities, especially Williams Syndrome (WS). Klein and Mervis (2010) conducted a comparative study between two groups of 9 to 10-year-old children with DS and WS. This study aimed to identify the strengths and weaknesses of each specific syndrome. The children were assessed on several visuospatial skills. Results indicated that the DS group outperformed the WS group on three tasks: *Block Building*, *Draw-a-Child*, *and Draw-a-Design* subtests from the Mental Scales of the McCarthy Scales of Children's Abilities (McCarthy, 1972). However, it needs to be stated that in this study, the participants were grouped and compared according to chronological age, and in fact, the authors state that it was difficult to match the two groups according to their cognitive abilities. Hence, it would have been interesting to have cognitive-age matched participants.

Vicari et al. (2006) also studied DS in comparison to WS. An investigation of the visual memory of particip+ants with DS compared to participants with WS and TD participants was carried out. Comparison groups were set up both based on chronological age and mental age. Results indicate that DS participants showed poor results on visual-spatial and visual-object tasks. Participants with DS performed worse than TD mental-age-matched peers on perceptual and imagery tasks. However, a significant difference could not be identified between the TD and the DS group on spatial tasks.

In comparison, participants with WS performed at par on visual processing and spatial tasks with TD mental-age-matched peers. Vicari et al. (2006) maintain that the discrepancies between the participants may be due to the different anatomical brain structures due to the different syndromes. The authors imply that differences are not due to learning difficulties per se. They continue by stating that the poor performance in DS may be due to the decline in volume in both ventral and temporal areas of the brain (Jarrold et al., 2007a).

Jarrold et al. (2007b) further explored the similarities and differences between DS and WS regarding visual characteristics. Jarrold et al. (2007b) compared 20 individuals with DS to 15 individuals with WS on visual and verbal long-term memory tasks. With specific reference to the performance on visual tasks, both WS and DS groups showed impaired performance on long term memory visual tasks. Difficulties in visual object association in long-term memory could also be identified.

Wan et al. (2014) investigated the VPPS of participants with DS compared to TD peers and peers with intellectual difficulties (ID). TD peers were matched both on chronological age, and participants with ID were matched to the DS group by mental age. Their first result indicated that the TD group performed better than the DS group on all subtests, which assessed visual processing. However, this result comes with no surprise since matching was only done by chronological age, and nowhere in the literature was it stated that the DS group did not have difficulties in visual processing. It was merely stated that visual processing was a relative strength compared to other skills (Fidler, 2005; Klein & Mervis, 1999). Their second result indicated that when the DS group and ID group were compared, no significant difference could be identified. Hence the DS group performed similarly to other participants with disabilities and had comparable MA scores. This result contradicts Vicari et al. (2006), as was discussed that VPPS vary according to specific aetiologies. Wan et al. (2014) fail to describe the ID participants who could have provided a stronger counter-argument to the Vicari et al. (2006) study. Also, Wan et al. (2014) maintain that participants with deafness were excluded. Unfortunately, they fail to define deafness; given that a percentage of individuals with DS tend to have some degree of hearing loss, it is unclear whether these were excluded from the study.

Lanfranchi et al. (2009) investigated the performance of DS participants on visual-spatial working memory. Working memory is central to all aspects of learning; however, the authors distinguish between visual and spatial skills. Thirty-four children and adolescents with DS were matched by receptive age and mental age to 34 TD children. An interesting initial result in this study shows that the DS group drew equivalent age scores in both receptive and visual-spatial skills, whereas literature usually states that visual-spatial skills are usually more advanced when compared to verbal comprehension skills (Bower & Hayes, 1994; Kay-Raining Bird & Chapman, 1994). The authors discuss that this could have been because the receptive language was investigated, one of DS's strongest language components. Lanfrachi et al. (2009) identified areas of strength within the visual-spatial skills, where DS performed better than TD peers on spatial-sequential memory tasks, while poor performance is identified on the spatial-simultaneous memory task. The authors maintain that this is due to the difficulty individuals with DS face when required to process information simultaneously. Lanfranchi and colleagues claim that there is a dissociation between simultaneous and sequential tasks and that this is mainly due to biological structures in the brain. However, this theory is still relatively unexplored and needs further support (Pinter et al., 2001).

The visual-spatial memory construct was also investigated by Visu-Petra et al. (2007). Twenty-five participants with DS matched to MA TD peers were administered five visual-spatial tasks. All tasks were administered through computers, and participants responded through touch screens. Their results indicated that visual-spatial short-term memory is unimpaired on simple spatial span tasks compared to this comparison group. This lack of impairment could be due to the positive preservation of parietal lobe grey matter (Visu-Petra et al., 2007). However, the authors also discuss that this similarity in results could be due to the chronological age of TD peers and that these visual-spatial short-term memory skills have not fully developed. On the contrary, a severe impairment was observed on the *Paired Associates Learning task*. This task investigates medial temporal lobe functioning involving long-term memory mechanisms. This impairment is expected since hippocampal lesions have been reported in DS (Visu-Petra et al., 2007).

Fidler et al. (2005) investigated the performance of 29 children and teenagers with DS compared to 20 participants with developmental disabilities. The participants were matched on a nonverbal IQ, gender and chronological age. The authors aimed to identify any differences between groups due to a specific aetiology. Fidler et al. (2005) compared the groups' performance on measures of visual processing (*Motor Free Visual Perceptual Test-Revised*) and word identification. The authors also investigated number recall and receptive vocabulary. No differences between groups were identified on reading decoding tasks and VPPS; however, the DS group's performance was poorer than that of the control group. On further investigation, the authors identified a correlation between word identification and VPPS when the sample was controlled for age, thus implying that the participants' age and VPPS influence word identification performance. This association was stronger than the one identified in the control group. In this sample, the authors suggested that the DS group could be using different neuropsychological abilities from the ones used by the control group. It was also suggested that the learners with DS might rely more on processing words visually and rely more on visual memory than the other participants with developmental disabilities. The results showed that a visual method of reading was beneficial. The authors argued that this method helps overcome difficulties in VSTM and recurrent hearing difficulties.

Only one study investigating VPPS in DS within the local scenario could be identified. Muscat (2017) investigated the VPPS of 10 students with DS compared to 10 TD children. The groups were matched by reading age. The study aimed to identify any implications which could affect reading intervention practices. In this study, the PA abilities of both groups were also assessed. Results indicated that the DS group performed more poorly than the comparison group on VPPS. The author suggests that the visual method of reading training should not be used as a single method of reading instruction for students with DS. Both a phonological and a visual method of instruction were suggested to develop their reading abilities. This was particularly suggested since no significant difference was identified between the DS and TD groups (Muscat, 2017). This study has some limitations since the participants were not screened for hearing and visual abilities, the sample size was small, and no measures of cognitive abilities were reported. However, this study provides important insights into an area that has been unexplored in the local setting.

In summary, it has been identified that individuals with DS present an uneven profile of visual perceptual processing. VPPS are still considered a strength, but not uniformly throughout the research. Literature is still debating whether visual processing skills are an essential component of reading development in the TD population, and it is less available concerning the DS population. Therefore a literature gap is identified. Thus, it has also been identified that more research is needed in this area as studies are uncommon and rather fragmented, tackling different aspects of visual processing. In the next section, the environment and experiences involved in developing emergent literacy skills will be explored.

Environment and Experiences which promote Emergent Literacy

Emergent literacy can be enhanced through several environmental aspects and different adult interactions. The home environment is one of the most influential settings for emergent literacy in the child's early years (McDonnell et al., 2014). The *Home Literacy Environment* (HLE) of both typically developing children and children with disabilities will be discussed.

Home literacy Environment

The home environment characteristically provides the first setting for literacy to emerge. This is done by providing children with and exposing them to various materials and activities which promote print and reading material, and these may include games, computer activities, and adult reading material such as newspapers and recipes (McGinty & Justice, 2009). Studies have shown that a rich HLE is fundamental for a child to develop emergent literacy and language skills (Ricci, 2011). A rich HLE is where parents frequently read to their children and where books and other reading material such as magazines, flashcards, and letter games are easily available to the child. A positive approach to reading materials, for example, is when children see adults engage in reading activities, which also enhances the HLE (Al Otaiba et al., 2009; Ricci, 2011; Spedding et al., 2007; van der Schuit et al., 2009). An environment that promotes early literacy is also considered a prevention strategy for later reading difficulties (McDonnell et al., 2014).

Language abilities and early literacy skills develop primarily in the home environment, and several different aspects are interrelated and play a central part in developing these very important skills (van der Schuit et al., 2009). Moreover, enhanced exposure to early literacy has been associated with higher IQ scores (Stevenson & Fredman, 1990). Niklas and Schneider (2013) identify cognitive abilities as the main precursor to success in literacy acquisition, hence imposing more importance on the building block of HLE since this also promotes cognitive development among the other skills.

Fallon and Day (2009) investigated the HLE of children with language impairment (LI). Eighty-one families participated in this study, 49 LI and 32 TD children. The ages ranged from two years, two months to five years 11 months. 6.1% of the LI consisted of children with DS. A questionnaire was used as a method of data collection. Results showed no difference between the frequency of joint reading and duration of reading; however, difficulties could be identified in the behaviours exposed during reading. Children with LI showed fewer language abilities. The type of behaviour also differed from that of the TD cohort. Children with LI used more concrete behaviours such as pointing when compared to the TD group, who used more inferential behaviours. Differences were also observed in the parents' actions. Parents from the LI group tended to give less input during reading. Hence, this study suggests that although the environments are similar, reading practices differ qualitatively and quantitatively.

To the author's knowledge, only one study concerning the HLE has been identified in the local scenario. Vella (2018) investigated the effect of HLEs on reading comprehension. Vella studied the performance of 129 eight to nine-year-olds who attended Grade 4. This study identified no correlation between home reading and English reading comprehension; however, a correlation was identified between home reading and Maltese reading comprehension. The frequency of shared book reading was also not correlated with reading comprehension.

Bilingualism and the Home Literacy Environment

The language heard by children in the home enhances their development of both languages and is vital as it makes up that which is often defined as 'homescape' (Boivin 2020). The socio-economic background and the educational level of the parents affect home literacy. This is attributed to financial expenses toward literacy material and the importance that the parents attribute to literacy (Said, 2021). Studies investigating bilingualism and HLE are in both the typology and the context. A difficulty in generalising results is apparent. Studies investigating the HLE of Spanish-English children attending US schools have often reported a risk of literacy difficulties and are highly attributed to a poor socioeconomic status (SES) (Hammer et al., 2003). Hammer et al. (2003) report that parents' education and frequency of reading correlated to reading difficulties in Hispanic communities. Literature shows that differences in the HLEs of mainstream American Caucasian families can be identified (Philips & Lonigan, 2009); however, great variability lies within Latino communities (Davis et al., 2015).

Research about HLE and bilingualism can also be identified in Arabic communities. Said (2021) investigated the literacy practices and challenges that three families speaking Arabic, English and one family also German. It has been reported that multilingual families support good home literacy practices. Parents are reported to buy books and use technology in all languages. The use of technology has been increasingly reported due to the COVID-19 pandemic (Said, 2021). The parents have also reported a lack of resources. This situation is analogous to the Maltese context; while the availability of literacy material in Maltese is increasing, literacy games and especially digital literacy activities are more abundant in the English language.

Research supporting the connection between children's literacy progress and the settings in which they grow up highlights the need to investigate these early experiences and the settings in which these take place (Davis et al., 2015). The author was unable to identify research that investigated differences in the HLE within the local context, and the research identified on an international level is hardly comparable due to the differences in social, linguistic, and economic backgrounds. Research within a population of children with disabilities is further restricted. Studies of the HLE of children with DS are discussed next.

Home Literacy Environment of children with Down Syndrome

The relationship between the importance of a rich HLE and later reading success has been established, yet research is still limited, specifically including children with DS. Fitzgerald et al. (1995) explored the HLE of 3 pre-schoolers with DS. Findings showed that the homes had extensive print material. However, literacy exposure was limited to the same tasks. The exposure to literacy occurred mostly solely through shared book reading. In a more comprehensive survey, Al Otaiba et al. (2009) found that most cases portrayed a home environment that promotes literacy. 75% of the families in the study maintained that they had more than 50 children's books in the house; 60% of the families also stated that they used flashcards or other toys that promoted literacy daily. Thus, parents/carers promoted a positive approach to literacy from the early years in the home.

In an exploratory survey of 224 Canadian participants, Trenholm and Mirenda (2006) found that children with DS were offered occasions for literacy practises, yet the interactions were reported to be more one-directional. Only 20-30% of the cases reported that story re-telling occurred. The richness of the HLE could also be identified in the study of 85 children with DS from New Zealand (van Bysterveldt et al., 2010). This study showed a prevalence of literacy practises, which focussed on shared book reading, to be discussed further hereunder. Nevertheless, little importance was given to drawing or writing activities, where only 35% of the participants attempted to write words and writing skills were mostly associated with school activities and homework rather than an additional activity at home. This shows that parents and carers could benefit from being provided with support services and exposure to good activities and ideas, enhancing the HLE.

Parental beliefs about the children's literacy abilities have also been considered a contributor to the HLE. Ricci (2011), in a study of 31 participants with DS, found that the richness of the HLE does not correlate to the emergence of early literacy skills, yet it does contribute to the children's attitude towards reading. The higher the occurrence of literacy activities carried out in the home, the more this increases the child's interest in reading (Ricci, 2011). It is also maintained that, in contrast to the TD group, the HLE is not a direct predictor of early literacy skills. The primary predictor of the development of early literacy abilities is MA. Two major conclusions come out of this study. Firstly, success in reading development depends primarily on cognitive abilities, and secondly that children with DS can perform better than predicted by their MA on some literacy tasks. Therefore, encouraging exposure to literacy experiences beyond the children's cognitive age should be promoted to expand the children's opportunities for literacy learning.

In this section, it has been highlighted that a difference can arise in shared book reading, availability of reading and writing material, children's experiences with literacy material, activities associated with literacy, and attitudes and expectations of parents towards literacy development. *Shared book reading* (SBR) and its importance in the emergent literacy continuum have attracted many researchers and will be discussed more specifically.

Shared book reading. Shared book reading (SBR) is an activity that has been notably featured in studies highlighting its importance for both language and literacy development. (Hindman et al., 2008; Kaderavek & Justice, 2004; Kaderavek et al. 2014). This can be described as an activity between an adult and a child where reading is carried out by the adult and the child is involved in the story by discussing or referring to the text (Hindman et al., 2008). Vocabulary growth, morpho-syntactic skills, conversational abilities, social interactions, pre-language skills, and early literacy understanding have been positively affected by the experience of shared book reading (Justice & Kaderavek, 2004). Through this early literacy experience, children also develop print awareness and phonological awareness (Johnston et al., 2008). SBR has been described as a very powerful vector to facilitate linguistic development. Besides being an important tool used in the home, SBR is also important for intervention in a clinical setting (Justice & Kaderavek, 2004).

Children with developmental and communication difficulties are at risk of later literacy difficulties (Johnston et al., 2008; Schuele, 2004; Snow et al., 2005). Therefore, parents and early educators are encouraged to engage children with developmental and communication difficulties in more activities that promote shared reading to lessen long term negative results concerning literacy (Johnston et al., 2008; Schuele, 2004). However, the mere increase in shared book reading is insufficient to justify linguistic development; the quality of these reading interactions is also particularly important (Kaderavek et al., 2014).

Several factors play a role in the quality of shared book reading experiences. Kaderavek et al. (2013) maintain that cultural beliefs and expectations, adult level of training, and adult literacy abilities are the primary factors that influence shared book reading quality. Whitehurst et al. (1994)

initiated a project to teach techniques to mothers from low socio-economic backgrounds during shared book reading. They focussed on *dialogic reading*. They defined it as a style of shared reading which involves the whole family reading with the child rather than to the child. Dialogic reading also avoids instances of correcting the child during the reading process. Dialogue and expanded conversations are encouraged during this style of reading, and due to the holistic approach, vocabulary, syntax, semantics and social skill also seem to benefit (Hay et al., 2007). Brannon and Dauksas (2012) also maintain that dialogic reading instils confidence in both parents and children and promotes positive social-emotional functioning between parents and children.

Studies about the behavioural qualities of children with DS indicate that they are motivated by social exchanges (Fidler, 2006), benefit from planned activities and structure, but tend to avoid challenging tasks and struggle to develop goal-oriented behaviours (Jordan et al., 2011). Hence, dialogic reading can create an environment of verbal or non-verbal exchange between parent and child while also indirectly adapting to the child's needs, for example, by choice of books or specific questions throughout the reading. The closeness in proximity between adult and child during this reading style also promotes appropriate modelling of words, especially for children with articulation difficulties (Jordan et al., 2011).

Shared book reading has also been used as a therapeutic technique to enhance receptive and expressive language abilities in a clinical setting. (Davie & Kemp, 2002). Children tend to engage more in conversation during storytime, and adults model language and use feedback automatically as the story progresses (Davie & Kemp, 2002). Nevertheless, this has also been met with criticism. Justice and Kaderavek (2002) evaluate possible drawbacks of using shared book reading as part of therapeutic practice. A primary limitation is that children with language impairment might lack interest in books and more interest in non-literacy activities. This claim is supported by a comparative study of ten students with specific language impairment (SLI) and ten with no language difficulties (Kaderavek & Sulzby, 1998). It was concluded that children with SLI showed a 40% lower interest in shared book reading. This could have been due to the parents' didactic reading strategies during the reading process. However, further research in this area should support this first potential pitfall. Justice and Kaderavek's (2002) second drawback suggests that the dialogic reading style, which is considered an optimal method of shared book reading, might not be ideal for children with language impairment (Crain-Thoreson & Dale, 1999). It is also discussed that shared reading could hinder the generalisation of skills. Hewitt (2000) suggests that by using this method as an intervention strategy, the speech-language pathologist might be disturbing a natural process, and thus the child might start viewing the moment of shared book reading merely as a teaching situation. However, the benefits of SBR are widely acknowledged, as will be discussed next.

Davie and Kemp (2002) conducted a study involving 22 children with mild to moderate language difficulties. The study aimed to observe expressive language opportunities during shared book reading compared to facilitated play. In particular, a higher number of initiations to conversations were recorded. They concluded that shared book reading provided more conversational interactions with adults rather than facilitated play. Hence, they suggested that shared book reading could be used as an assessment method through which a language sample can be elicited, especially with children with learning difficulties. However, the children's history of play activities or shared book reading experiences could also influence such results. It could be the case that this group of students are accustomed to shared book reading. This would make them more comfortable communicating or knowing the rules of shared book reading and initiate more conversations. Thus, a history of the children's early literacy experiences would have cleared out this variable.

Shared Book Reading with children with Down Syndrome. Only a few studies have been specifically dedicated to exploring SBR with children with DS. Fitzgerald et al. (1995) have conducted a study to explore the type of literacy experiences carried out in the home. Their study revealed that children with DS were exposed to a limited variety of literacy activities which the authors described as negligible, and where the majority of such activities focussed on storybook reading. Nevertheless, this study was only conducted on three pre-schoolers with Down Syndrome; therefore, results only give a minute sample perspective and cannot be generalised to the DS population.

Al Otaiba et al. (2009) conducted a web-based survey in which 107 parents of children with DS between three months and six years participated. Of the respondents, 30% claimed to own more than 50 reading books, while more than half stated that they have more than 100 books. Moreover, the parents of practically all the participants reported that the children were being read to from 10 to 30 minutes a day. In addition to parent-child reading, this study revealed that half of the children looked and played with books independently for at least 10 minutes a day. It would have been interesting if the researchers compared their results with TD children, as it would have given a clearer indication of where children with DS stand compared to age-related peers. Moreover, the researchers fail to give information about the participants' language or cognitive skills. This information would have been valuable to explore whether SBR differs from children with different language and cognitive abilities.

van Bysterveldt et al. (2010) administered a questionnaire to 85 parents of children with DS from New Zealand. The study showed that parents are actively involved in acquiring their children's literacy skills, with 90% of the participants claiming that they engage in shared reading practices, 48% doing so daily and 10% stating they engaged in reading several times a day. This study portrayed a very positive picture of what is taking place in the homes of children with DS, yet, the inclusion of a control group would have given room for comparison with typically developing peers.

Ricci (2011) investigated the home-literacy environment, focusing on the SBR of children with DS compared to both chronologically matched and mental age-matched peers. The study included three groups of participants: pre-school children with DS, school-age children with DS, and school-age TD children. When the preschool children with DS were initially compared to the older group of children with DS, results showed that the older group could engage in longer shared reading sessions than the younger group. This could have been due to the older group's longer attention spans (Ricci, 2011). In a second comparison, Ricci (2011) evaluated the level of attention during shared reading among the three groups. The older school-aged groups showed a higher level of attention and interest in shared reading than the preschool group, yet the TD group of school-aged children still showed an increased interest compared to the age-matched DS group. This could be associated with a characteristic of children with DS who may tend to avoid prolonged challenging tasks (Jordan et al., 2011). Although it is an innovative study with apparent importance, it has limitations. It is based on parents' reports that might yield incorrect responses since parents may give answers they consider more socially appropriate. Moreover, it does not consider the type of reading practices, as the form of shared reading could affect the quality of the reading experience and shift the child's enjoyment and engagement.

A recent study by Lusby and Heinz (2020) focussed specifically on SBR. They investigated the engagement, motivation, methods employed during reading, level of participation and parents' perceptions of SBR. The researchers administered an online questionnaire to 191 parents of Irish children with Down Syndrome. The ages of the respondents' children varied between 1 to 6 years. Their study revealed that many parents reported engaging in SBR regularly (76.7%). They also maintained that 17% of children under two years had not commenced SBR. The authors reflect that this is a worrying statistic considering the importance of early exposure to literacy. Lusby and Heinz (2020) report that the length of the reading sessions was highly dependent on the attention span, and, at most, this lasted for 10 minutes. An important finding reported by the authors is that parents stated that they had not been given any educational advice about SBR. It highlighted the importance of disseminating information within the area of early literacy. Parents also reported two main strategies used during SBR; oral language strategies and commenting on pictures. This showed that parents were unaware of the different strategies used during SBR.

Moreover, 71.4% of the parents reported pointing at words during reading. The authors maintain that this stems from the idea that children with DS should be exposed to a sight word reading approach. This study provides very good insight into SBR in DS; however, a few limitations could be identified. The study does not address the respondents' socioeconomic status, and like other questionnaires, parents might not have reported the full truth in their responses.

Burgoyne and Cain (2020) maintain that the type and quality of interactions during reading lead to growth in language abilities. They also indicated that books give a visual backing that helps cope with VSTM difficulties, which is a characteristic of children with DS. Eight parents and their children participated in this study. Burgoyne and Cain (2020) investigated how prompts can affect parents' interactions with their children with DS. The ages ranged from 4;07 years to 6;09 years. The parents were presented with two books, one adapted to include question prompts. The parents were asked to use these prompts to question their children. The authors also used a questionnaire to investigate the HLE. Results indicated that the parents and children engaged more in conversation to support the book when prompts were given. Participation from the children's end also increased. The authors reported that the language used was more varied when the books with prompts were used. It was also reported that the prompted books did not affect the children's MLU. This study shows that manipulation of reading material can aid to improve the quality of SBR. The questionnaire's responses revealed that parents engaged in SBR frequently with their children and considered this a pleasant activity. It was also reported that during SBR, parents focussed mainly on delivering the concept of the story and reading new words and less to teach new vocabulary. The study also highlighted the need for parents to be trained to scaffold learning for their children. Unfortunately, this study had a small sample size, leading to significant individual variability. The effect on language gains from the prompted SBR was also not explored. The literature review will shift from the traditional method of reading and literacy to the role of technology and literacy. This role will be explored in the next section.

Technology in reading. Technology has taken an increasingly predominant role in the home literacy environment and general literacy development (Spedding et al., 2007). Children are exposed to electronic books and other literacy materials through computers and other devices. The role of technology in the pre-reading phase will be discussed hereunder.

The exercise of reading is rapidly stirring from print to screen, and this also occurs with children, where tablet devices and mobile phones have become a primary source of literacy experiences (Miller & Warschauer, 2013). Technology can promote early literacy development; however, although it is a constant feature across the emergent literacy scenario, a gap between theory and practice in this field still exists (Liang & Johnson, 2008). Most existing research concentrates on technology's role in electronic reading (e-reading). The importance of e-reading regarding students with learning disabilities has also been investigated; however, this research is still limited. McClanahan et al. (2012) maintain that readers are more engaged and exhibit deeper comprehension when using a tablet device. The fact that the reader is more in control of their reading material; for example, text size can be modified, audio features can be used, or different positioning helps improve the reading experience. Hence electronic reading can be an important aid to students with physical disabilities, where a simple tap can turn pages on the screen or a vocal command.

Technology offers other benefits in both the pre-reading and reading stage. Technology offers pre-readers and readers a multitude of opportunities to explore this medium. Computer software, the internet, and different computers and tablets have expanded children's options (Miller & Warschauer, 2013). It has also been shown that technology can be particularly motivating during the reading process, thus enhancing the learning experience. Vernadakis et al. (2005) maintain that technology can be predominantly useful for young children since they are more prone to learn through pictures and sounds, and this is easily provided through different software materials. Most studies regarding technology and reading focus on school-age and early school-age children; however, some studies investigating technology in the home literacy environment could also be identified. Touchscreen tablets have become increasingly popular throughout all generations. Their simple operating features have made them easily accessible even to the youngest children, and recently interaction with digital devices commences earlier in children's lives (Orrin & Olcese, 2011).

Children with learning difficulties and disabilities are more prone to experience a difficult path toward literacy acquisition. Hence, early intervention in these areas is essential to help the child encourage the child to achieve their personal best. Research has shown that training early literacy skills improve reading acquisition both within short-term and long-term scenarios for children with learning disabilities (Mioduser et al., 2000).

Assistive technologies can be a fundamental tool to enhance early literacy development (Burne et al., 2011). Assistive technology is described as an apparatus used to increase functionality in individuals with a disability (Boyd, 2008). This technology can be both low tech – for example, switches or keyboards – and high tech– for example, specific software. Speech recognition programs can be a form of early literacy exposure since the child can visualise how speech is portrayed in writing. Mioduser et al. (2000) have shown that early literacy training through computer devices can be more successful for children with learning difficulties than traditional instruction methods.

Following is a literature review specifically focusing on how technology enhances literacy in Down Syndrome.

Technology for literacy for students with Down Syndrome. Children with DS have been extensively studied in psychology and education, yet studies of technology and other computer usages concerning literacy are limited (Hu et al., 2011). Only a few studies specific to DS could be identified, and none were specific to early literacy skills. Feng et al. (2010) surveyed 561 individuals with DS, where the use of computers was investigated. Their investigation showed that most participants used computers for educational (80%) and leisure (95%) activities, and the most commonly used applications were educational software, games, and browsing the Internet. It would have been interesting to compare these results to TD children to see whether the same trends occur. This result was also confirmed by Fritz (2017). Fritz (2017) investigated the impact of technology on children and adolescents with DS. The author investigated technology in DS through a questionnaire distributed to parents, totalling 107 participants. The study found that 78% of participants use technology in school. Unfortunately, the study does not look into how it is used in the school setting.

Another study specific to individuals with DS was conducted by Hu et al. (2011), where three different input methods: keyboard and mouse, word prediction software, and voice-based input, were investigated. However, this study does not have direct implications for literacy acquisition, and it merely identifies preferred methods of inputting data in a Microsoft Word document. Kirijian et al. (2007) provide further insight into how individuals with DS access computers. The authors devised a website specifically designed for individuals with DS, with the sole purpose of helping them learn and practise the use of simple internet functions and thus improving the internet experience. It is claimed that the participants using this website have gained considerable knowledge, and their ability to use computers has improved. However, further research on the success of these practises is called for to obtain objective data about the use of this website.

In this part of the literature review, it can be observed that studies related to the use of reading-related technology in individuals with DS are particularly limited. A gap in the literature is evident, as even though research is available regarding other learning difficulties or disabilities, findings cannot be generalised due to the diversity of the different impairments. Hence, the need for further investigations in this area is emphasized.

Gender differences in the Home Literacy Environment

Differences in attainment have been attributed to gender (Mensha & Kiernan, 2010). Studies have mainly focussed on the differences between the girl and boy gender roles. Unfortunately, little research is available on other genders. In this study, the researcher aims at identifying differences and similarities between the boy and girl genders. Research does not always distinguish the difference between gender and sex. Some of the literature will be discussed.

Girls have been reported to attain better achievements in literacy, and, in the 2018 PISA study, Malta was reported to have the largest gender gap among the participating countries in reading performance in favour of girls. However, this study specifically focussed on a cohort of 15 to 16-year-olds. The SES has been identified as a primary contributor to the gender difference in the educational setting. Families with higher SES support boys and girls more equally (Connolly, 2006; Entwisle et al., 2007; Mensha & Kiernan, 2010). Barron et al. (2006) investigated the gender differences of 152 participants in early literacy skills and literacy perceptions of teachers and parents in the early school years. The investigation was conducted using a questionnaire and a diagnostic reading assessment: *Indicators for Reading Development Continuum*. Results showed that girls outperformed the boys in early literacy abilities; however, this advantage was only marginal. Teachers', parents' and students' attitudes showed gender-based differences. Then again, these results are not uniform at an international level. Krijnen et al. (2020) investigated the home literacy activities of 179 children from the Netherlands through a questionnaire. Their results indicated no difference in the type and use of home language activities between genders. Niklas and Schneider (2013), in a study investigating the HLE of 921 German children, results show that there was no significant interrelation between gender and the HLE.

From a local context, Gatt (2017) investigated the bilingual vocabularies of Maltese children between 23 and 34 months. The study also looked into the factors that influence vocabulary development. Her study indicated that girls performed better than boys; however, this difference was not statistically significant. Vella (2018), in another local study, also looked into the differences in gender concerning the HLE. The author found no association between the frequency of home reading and the enjoyment of reading to gender. However, it was reported that girls read more willingly.

The role of gender in studies focussing on the HLE of children with DS is rather limited. Studies on the HLE are available, as discussed previously, but only a few complete further investigations towards the role of gender. Ricci (2011), in her study of the HLE of 20 pre-school and school-aged children, reported no differences in results between genders. This result was also reported by Lusby and Heinz (2020), whose study has been discussed in a previous section.

International literature states that difference between genders is not perceived. However, local research does identify a difference in attainment between gender. Therefore this will be investigated due to the divergent findings.

Summary of Findings in the Literature

The literature review identified specific salient areas relevant to the DS population's successful development of literacy abilities. This literature review also shows that research in these areas is highly needed as it is scarce in local and international scenarios. Following is a summary of the findings;

- Literature on bilingualism in DS is still emerging. To date, findings suggest that although L1 and L2 do not develop at par, developing a second language is not detrimental to the primary language in DS. Moreover, the use of LI and L2 gives individuals with DS an important social advantage in a bilingual setting.
- Bilingual reading has been reported. However, the literature is very sparse; hence further investigation is warranted.
- Receptive vocabulary has been identified as a predictor of reading in DS
- Letter Knowledge is considered to be a predictor of reading in DS
- PA in DS has been reported to be delayed in studies, while other studies have reported that individuals with DS do not rely on this skill to develop reading. Strengths and weaknesses across different PA skills have also been reported. The PA skills of bilingual individuals with DS have sparsely been reported.
- Individuals with DS have been reported to have difficulties in VSTM. Locally no studies in this population have been identified.
- In DS, VPPS have been considered a relative strength; however, contrasting findings in the latest literature are emerging, where this strength in VPPS is not perceived.

- The HLE has been sparsely investigated within the DS population. Literature emphasised that while individuals with DS are exposed to appropriate home literacy experiences, a difference in shared book reading, availability of reading and writing material, children's experiences with literacy material, activities associated with literacy, and attitudes and expectations of parents towards literacy development when compared to TD peers.
- According to international literature, gender does not affect literacy attainment; however, local literature differs in studies with TD and DS individuals.

The research framework for this study

The research framework for this study was drawn by the amalgamation of Chapter 1, The Introduction and the review of pertinent literature, which was presented in this chapter. The researcher used her professional perspective, the current clinical and educational situation and theories and literature to identify areas that needed investigation. These allowed the researcher to identify the objectives (see p. 41), the research questions (see p. 105), formulate the hypothesis and plan the study Method. The choice of variables was also influenced by the availability of tools specific for examination in our local bilingual setting. An evaluation of tools is available in Appendix A, p. 360. Figure 6 shows the conceptualisation of this research project.

Individuals with DS show strong word identification capabilities (Mengoni et al., 2014); however, poor phonological decoding abilities and limited reading comprehension have been reported (Cupples & Iacono, 2000). Literature states that reading is impaired in the DS population; however, degrees of success and impairment vary. Research about reading and the different aspects involved in successfully developing reading in DS within the local scene is limited. Therefore, the researcher was not predicting to identify enough skilled readers with DS to investigate both components of word identification and reading comprehension components in-depth. Thus, a choice was made to focus mainly on aspects involved in word identification. Hence, in this study, the word identification domain of the Simple View of Reading previously explained will be used to explore the reading abilities of participants with DS. Additionally, a tool to assess reading comprehension in the bilingual Maltese context is unavailable locally, and the construction of such a tool went beyond the scope of this research.

In Study 1, the researcher aimed at exploring the different sub-skills that may be involved in reading. The Dual-route Cascaded Model (1993) was used to identify the different sub-components of word identification. The visual aspects of print were investigated as although DS were reported to have predominantly strong VPPS, inconsistency from the literature was identified (refer to p. 79). An inconsistency in results regarding PA was identified, where varying abilities were reported depending on the skills being measured. Moreover, the PA of bilingual individuals with DS is sparsely reported in the literature (refer to p. 62); hence this was included as an initial variable to be investigated. Aspects of VSTM were also investigated in the initial phase of the study. The literature reported that individuals with DS often find VSTM tasks challenging (refer to p. 72). VSTM results will be analysed according to *The Multicomponent Model* as proposed by Baddeley (2010). In Study 1 an investigation of nonword reading is carried out. The *Dual-route Cascaded Model* (1993) allows for the investigation of pseudowords or nonword reading. The development of these abilities in DS has been laborious in DS (refer to p. 19); moreover, the researcher wanted to evaluate these abilities within a bilingual setting and their relationship with other reading-related abilities.

In Study 2, the researcher evaluated the participants' Word and Nonword reading abilities while elaborating on biliteracy. Studies involving biliteracy in DS are sparse locally and internationally (p. 52). Hence the research incorporated a strong element of bilingualism and biliteracy throughout all the studies. Considering that the area has never been explored locally, some areas are sporadically explored in the literature. Here, *cross-language transfer* theories (refer to p. 61) are investigated. The results are also evaluated according to the *Stages of reading development* proposed by Frith (1985).

In Study 2, the researcher also introduced an assessment of receptive vocabulary in both languages to the assessment battery in addition to the SIT language measure used in Study 1.

Although a tool specific to the local population was not available, after evaluating initial results, the researcher deemed it necessary to explore these skills in this population due to the strong importance perceived from the literature (refer to p. 45).

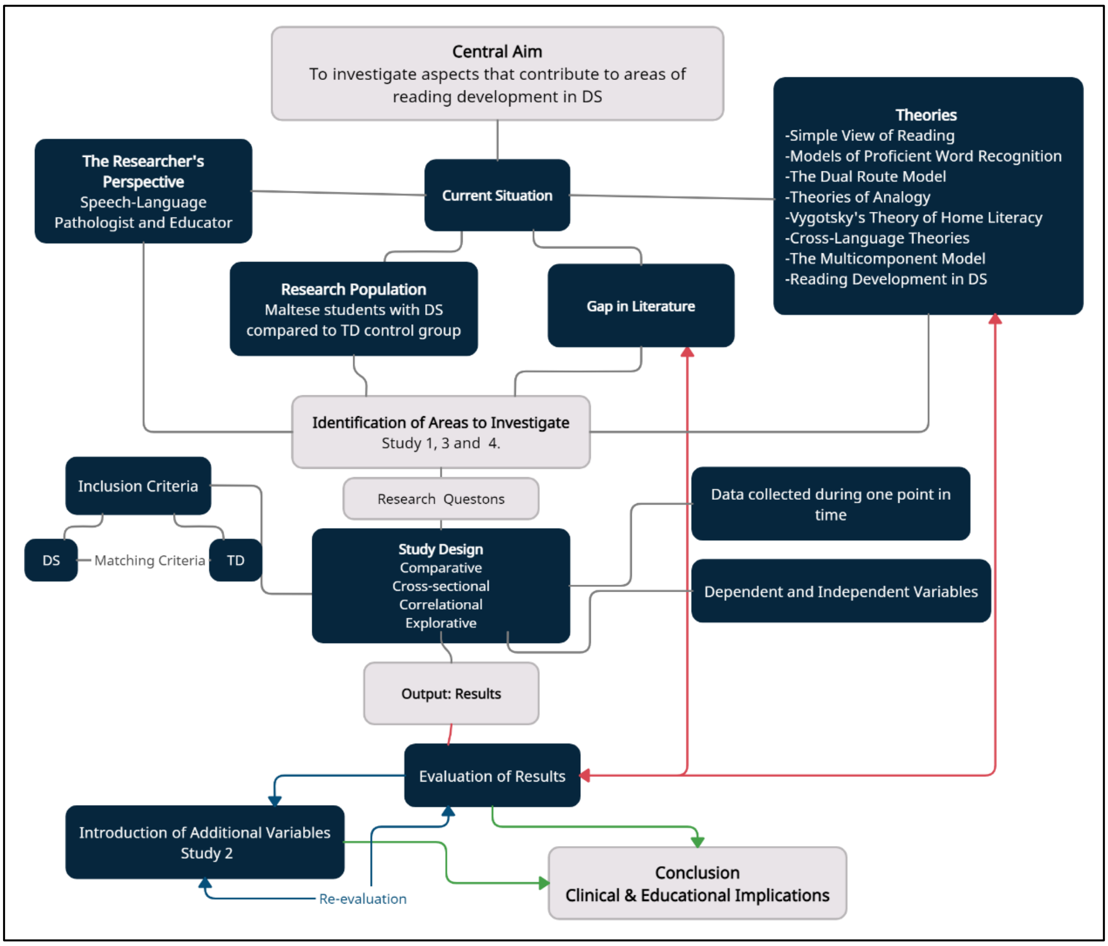
Throughout Study 3, the researcher looked into the HLE of individuals with DS. Research pertaining to the literacy environments in DS is unavailable locally; hence the need for studies to evaluate the home and school environments was greatly felt. As discussed in Chapter 1 (see p.32), Vygotsky's theories have helped educators shape aspects of emergent literacy theory. These theories also form the conceptual framework of this study.

Study 4 evaluated the school literacy environments. It has been discussed that different reading intervention methods are being proposed in the literature (refer to p. 35); however, to date, no knowledge of the type of literacy instruction being imparted is available about the local population (refer to p. 34). Hence Study 4 aimed at exploring this scenario.

The researcher took an explorative approach in the initial stages of the thesis (Study 1) refer to Figure 6). Inductive reasoning was used to identify the research population and the dependent and independent variables to be explored. After evaluating the results, the researcher introduced new variables that needed further evaluation (Study 2). The full results were evaluated, and clinical and educational implications were discussed. Figure 6 depicts the research framework. Following are the research question for each study.

Figure 6

The *Research Framework for the study*



Research Questions

In order to address the objectives of the study as revealed in the Introduction chapter and the gaps in the literature as identified both in the Introduction and Literature Review chapters, the researcher subdivided the complete study into four different studies. The separate studies and the relevant research questions are outlined below.

Study 1: An investigation of PA, VSTM, VPPS and nonword reading of Maltese individuals with DS when compared to TD participants.

- **Research Question 1:** How do Maltese participants with DS perform on phonological awareness, verbal short-term memory, VPPS and Nonword reading tasks compared to TD peers

- **Research Question 2:** What are the predictors of nonword reading in the Maltese group of participants with DS when compared to the TD group?

Study 2: An investigation of word and nonword reading in DS

- **Research Question 1:** Do monoliterate individuals with DS perform similarly to the TD participants on Word reading and Nonword reading tasks?
- **Research Question 2** How do Maltese biliterate participants with DS perform on Word and Nonword reading tasks?
- **Research Question 3:** Do PA, VPPS, Receptive Vocabulary, and RCPM predict Word and Nonword reading attainment in Maltese monoliterate and biliterate readers with DS?

Study 3: An investigation of the HLE of Maltese individuals with DS

- **Research Question 1:** How does the home literacy environment of Maltese children and adolescents with DS compare to that of typically developing peers?
- **Research Question 2**: *Do the gender and the age of students affect the Home Literacy Environment?*
- **Research Question 3:** How does the bilingual environment of Maltese children and adolescents with DS affect HLE?

Study 4: An evaluation of the Maltese school literacy environments and practices with students with DS

- **Research question 1:** What are the literacy practices used with children and adolescents with Down Syndrome in a Maltese school setting?
- **Research Question 2:** Can a difference in practices be identified between different school settings and school levels?
- **Research Question 3**: How does the bilingual context affect the school literacy environment and literacy practices when working with Maltese children and adolescents with Down Syndrome?

Conclusion of chapter

Chapter 2 has highlighted salient aspects in the literature and has provided an outline of the studies that will be investigated, and the research questions have been portrayed. The following chapter gives the method by which the research questions will be addressed. Chapter 3 describes the study's design and provides details about the implementation of the investigation.

Chapter 3
Method

Chapter Overview

This chapter describes the methods used to explore different aspects of reading both in the DS population and a control group composed of typically developing (TD) children. The research design and selection of participants will be discussed first. Information about the participants will follow. A description of the assessment tools, data collection procedures, including measurement of reliability and validity of tools and methods used in analysing the data, will follow. Finally, ethical considerations and data protection measures will be described.

Research Design

This study examines the competence of students with DS in reading and reading-related skills. The literacy environments of participants with DS are also investigated. As discussed in the Literature Review chapter, several studies have tried to describe the characteristics of the reading development of DS. To see whether differences are related to the specific DS phenotype or other characteristics, it was deemed necessary to introduce a control group in the study. The control group was composed of TD students. The group matching characteristics are discussed on p. 114. The investigation of reading and reading-related abilities was conducted using various tools for collecting data in different stages across four studies. A control group was not introduced in Study 4 as this study followed a different design as explained hereunder.

This research study followed a non-experimental approach. The non-experimental or observational approach can be either longitudinal or cross-sectional in design. This study follows an amalgamation of three designs described hereunder.

The thesis primarily follows a cross-sectional design, in which data was collected from a single occasion rather than multiple occasions. The cross-sectional design allows the researcher to study a whole population or a segment of it at a particular time, and such data enables the answering of research questions from a specific population (Olsen & George, 2004). DeVaus (2001) maintains that this design allows a researcher to compensate for time constraints. The cross-sectional design also provides a means of comparison between groups (Machin & Campbell, 2005). Part of this study followed, more specifically, a comparative cross-sectional design. Øvretveit (1998) describes this as an intrinsic study of two or more populations. In this circumstance, the investigation of factors contributing to reading development was studied in a sample population of Maltese students with DS and a matched sample population of Maltese TD students. Machin and Campbell (2005) explain that this type of framework in health research is used to study a sample population with a specific condition or disease compared to a sample population without that condition or disease. However, the limitation with such a framework could be identifying the 'healthy' population as these may have underlying conditions that may bias the results. Hence rigorous inclusion and exclusion criteria were enforced for both sample populations being tested (Machin & Campbell, 2005). Moreover, any other influential factors needed to be controlled to study the effect of the variables.

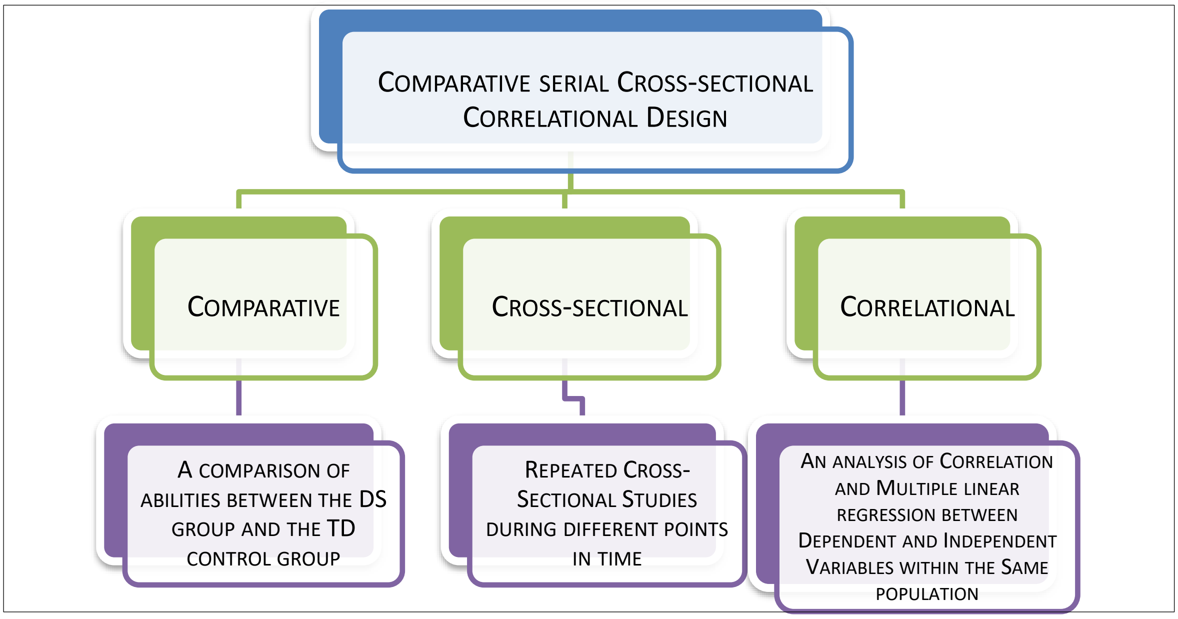
According to Machin and Campbell (2005), a comparative cross-sectional research design has the following characteristics:

- can contribute to both quantitative and qualitative data;
- can describe two or more groups;
- data is collected from one point in time;
- several methods of sampling can be employed – random sampling, convenience sampling, complete sampling;
- The study can be repeated at a different time to measure change; however, a different sample population needs to be used.

Nevertheless, a comparative cross-sectional design does not describe this study in its entirety. The element of a *Correlation Design* also needed to be included to explain the study. A correlational design allows for evaluating and establishing a relationship between variables. The relationship can be examined within one or more populations (Curtis et al., 2015). Simon and Goes (2011) maintain that correlational investigations study variables in their natural settings and do not include actions or treatments enforced by the researcher. Correlational research aims to test the associations between variables and, if such an association is present, build a regression model that could be generalised and make predictions in a specific population (Simon & Goes, 2011). Hence this study follows a *Comparative cross-sectional correlational design*. Figure 7 summarises how the amalgamated design represents this study.

Figure 7

A representation of the Cross-sectional Comparative Correlational Design



The researcher implemented repeated cross-sectional studies throughout the investigation, however the comparative aspect was only included in studies where a TD group was included. Study 2: Analysis of biliteracy and Study 4: An investigation of literacy pracitises followed an exploratory cross-sectional design. This is discussed on p. 111. Moreover refer to Figure 8 about details of data collection. Repeated cross-sectional studies can also be described as serial cross-sectional studies, where data is collected from the same target population at different points in time (Wang & Cheng, 2020). The researcher used a different sample from the target population (Wang & Cheng, 2020).

This study's comparative serial cross-sectional correlational research design generated mostly quantitative data to explain, evaluate, and quantify any occurrence in the real world (Engel & Schutt, 2005). This information was collected through specific tests to ascertain the individual and group performance of the participants (Robson, 2002). According to Verma and Mallik (1999) and Robson (2002), quantitative data have the following characteristics:

- results show apparent precision;
- the data gathered can be measured, counted and statistically analysed;
- results depend on the assessments used rather than on the researcher;
- regards the world as being made of observable and measurable facts;
- supports a conceptual framework.

Some data were analysed qualitatively. However, this was substantially minimal. In the *Home Literacy Questionnaire*, the researcher had one open-ended question, where the respondents could list their child's preferences related to the use of technology. The *School Experiences Questionnaire* had ten open-ended questions; the participants were asked to list activities carried out in the school according to different skills.

An investigation of the reliability and validity of some of the assessment tools was conducted. For these purposes, 10.75% of the research population were engaged, including 3 participants with DS and 7 TD participants. Data collected from this cohort were tested for measures of reliability and validity. These methods and measures are presented on p. 145, whereas detailed results are presented in Appendix B on p. 369.

Study 4 aimed to investigate the literacy practices of students with DS in the local Maltese schools setting. The research design for this study was an *exploratory cross-sectional survey design*. This allowed the researcher to examine the differences in the ways Maltese educators employ several literacy practices in the classroom. A cross-sectional design approach was suitable for this study as the researcher planned to identify the practices and hypotheses about literacy training with students with DS at one point in time (Creswell, 2013). An exploratory study was suitable due to the absence of any research in the area (Stake, 1995). This design allowed the researcher to explore new ideas and novel concepts.

Limitations of the Design

A cross-sectional design has its limitations. From a cross-sectional study, the researcher cannot look at the individual changes of the sample population. The limitations also include the difficulty to measure the incidence and make a causal implication; moreover, cross-sectional studies frequently choose a sample of participants from a large and heterogeneous study population, which can lead to a bias in the sampling (Wang & Cheng, 2020).

The Sample Population and Collection of Data

Data collection was carried out in 5 phases: Phase 1 collection of data from students with DS (Study 1 and Study 3); Phase 2 collection of data from the control group (Study 1 and Study 3); and, Phase 3 involved only participants from the DS cohort who could read and respective TD controls (Study 2). Data from Phase 4 was utilised to evaluate the validity and reliability of the assessment tools. Phase 5; a collection of Data for Study 2 and Study 4. Figure 8 illustrates the data collection throughout all phases of the study. The timeline of this research has also been summarised in Table 1.

Figure 8

The participants and the data collected throughout Phase 1, Phase 2, Phase 3, Phase 4 and Phase 5

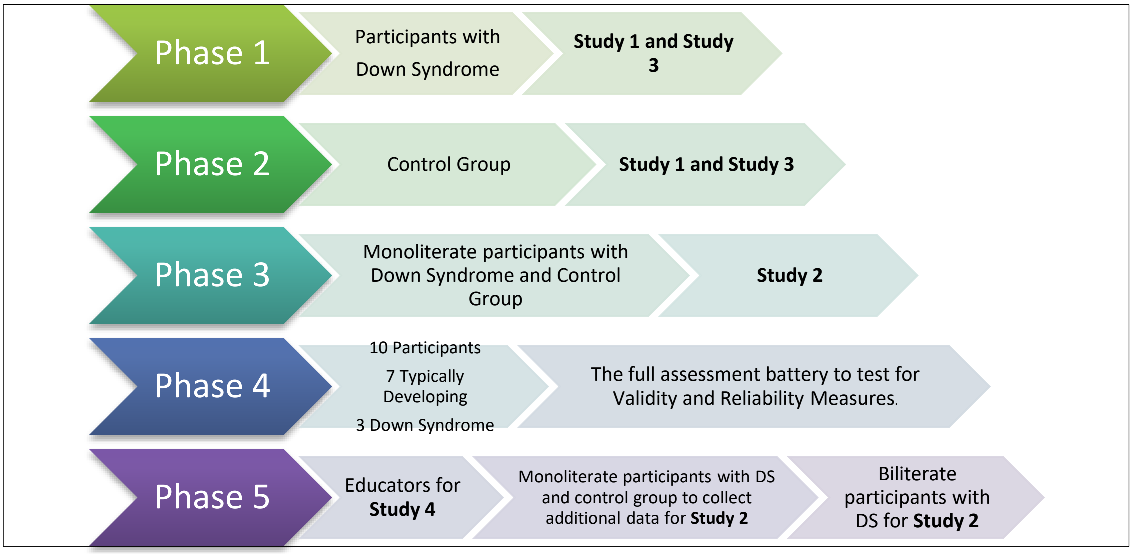


Table 1

Timeline of study

Date	Stage	Description
February to April 2014	Phase 1 Request for ethical approval	Processing of application for Ethics Research Committee for Phase 1. (Study 1 and Study 3)
April 2014 to January 2015	Identification and preparation of Assessment tools Selection of Participants	Distribution of Information Letters to participants Piloting of Home Literacy Questionnaire
January to September 2015	Data Collection Phase 1	Collecting data for participants with DS (**Study 1 and Study 3**)
October/November 2015	Phase 2 Request for ethical approval	Processing of application for Ethics Research Committee for Phase 2.
November 2015 to June 2016	Data Collection Phase 2	Recruitment and assessment of TD students (**Study 1 and Study 3**)
March to June 2018	Data Collection Phase 3	Recruitment and assessment of DS and TD students for additional assessments (**Study 2**)
June to September 2018	Data Collection for Reliability and Validity Testing: Phase 4	Data collection from 10 participants. For test-retest reliability of assessment tools.
May to June 2021	Phase 5 Request for Ethical Approval	Processing of application for Ethics Research Committee for Phase 5
September to November 2021	Data Collection Phase 5	Recruitment and Assessment of Educators for **Study 4**. Recruitment and Assessment of participants with DS and control group for the monoliterate group in **Study 2**.
February 2022	Data Collection Phase 5	Biliterate DS group in **Study 2**.[1]

Note: [1]The analysis of biliteracy in Study 2 only included a group of DS participants. A TD could not be included as the TD were too young and did not have literacy training in both languages at the time of assessment. This section is to be considered as following a *Explorative Cross-sectional Design*.

In the subsequent sections, the selection of the participants is discussed. A description of the administration methods throughout all five phases then follows.

The Participants

During Phase 1, the researcher aimed to collect data from the total population of children and young adults with DS while acknowledging the inclusion and exclusion criteria below. The control group was formed from TD children. Both groups were administered the same screening and assessment tools. Purposive sampling was used to identify participants for both groups. The TD control group was matched with the DS group by:

- **Scores of Fluid Intelligence:** This was established by administering The Raven's Colored Progressive Matrices (Raven et al., 1990). This is a tool that assesses fluid intelligence. (refer to p. 367 for the review of the assessment tool)
- **Maternal level of education**: This is considered a significant determinant of the child's learning environment as the higher the maternal education, the more constructive changes are expected to be in the child's developmental experiences (Magnuson, 2007). Better maternal education has been linked with more complex speech and language development (Fewell & Deutscher, 2003; Rice et al., 1999). The maternal level of education has often been used as an indirect measure of socioeconomic status (Gatt et al., 2020).
- **Language exposure:** Each student with DS was matched with a TD student with a similar language exposure in the home, English, Maltese or both.
- **School attended**: Students were matched according to the school they attended in their primary years of education. Therefore, each pair of TD and DS students attended the same school but not the same class. It was impossible to find students from the same class due to differences in chronological age. Students with DS were older than the respective TD match, given that they were matched for a measure of fluid intelligence. The age difference is portrayed and discussed in Figure 10, p. 123.

A set of inclusion and exclusion criteria were set for both groups. Table 2 and Table 3 list the inclusion and exclusion criteria.

Table 2

Inclusion and exclusion criteria for participants with DS

Inclusion Criteria	Exclusion Criteria
• Maltese citizens with Maltese and/or English as their first language. • Attends formal schooling between Kinder 1 and Post-Secondary • Can complete part of the RCPM (Raven et al., • 1990) • Having normal hearing acuity of mild/moderate hearing loss • Having moderate/mild visual difficulties, which were corrected • Possess alphabetic reading abilities (For studies 1 and 2)	• Having severe/profound hearing loss[1] • Having severe visual difficulties • Unable to complete part of the RCPM (Raven et al., 1990)

Note: [1]*The participants responded above the 60 dBA in sound field.*

Table 3

Inclusion and exclusion criteria for participants in the control group

Inclusion Criteria	Exclusion Criteria
• Maltese citizen with Maltese and/or English as their first language as matched to a DS participant • Attends formal schooling between Kinder 1 and Post-Secondary as matched to a DS participant • Obtaining a score on the RCPM (Raven et al., 1990) comparable to that of a participant with DS • Having no history of learning or reading difficulties. • Having normal hearing acuity and normal/corrected vision as reported by the parents/carers • Possess [1]alphabetic reading abilities (For studies 1 and 2)	• Having moderate/severe/profound hearing loss • Having severe visual difficulties • Unable to complete part of The RCPM (Raven et al., 1990)

Note: [1]Alphabetic reading is the stage where the reader can make connections between the written and the spoken forms of letters (Gillon, 2004). This has been ascertained by the parents/carers prior to the assessment.

For Study 2, the same matching criteria for DS and TD participants were utilised; however, not all participants were matched on the School Attended. A sample of participants was assessed during the COVID-19 pandemic; hence, the researcher could not obtain permission to visit different schools.

Group Matching Design

Group-match design is one of the commonest designs in research involving investigations related to intellectual disabilities. In such a design, pre-existing groups are matched according to explicit variables. Chronological age, mental age and IQ are the most commonly utilised (Phillips et al., 2014).

When matching a group with ID to a TD group on a measure of MA, researchers reject the anticipated developmental delays caused by lower cognitive abilities. This allows the researchers to determine participants' performance and identify strengths and weaknesses after considering a possible general delay (Phillips et al., 2014). However, this method also has some limitations. Groups often differ significantly in chronological age, and hence elements of maturation, life experiences, and different interests need to be accounted for. However, matching by MA is usually preferred rather than matching by chronological age (Phillips et al., 2014). Phillips et al. (2014) add that a researcher should also consider the population’s strengths and weaknesses. Children and adolescents with DS are described as prone to having difficulties in expression; therefore, a nonverbal means of matching criteria is considered more appropriate. The researcher also had the option of matching the participants by reading abilities. This measure was utilised by the same researcher in a previous study (Muscat, 2010). However, the researcher was interested in reading and pre-reading cognitive abilities in this study. Matching participants by their reading abilities would have led to sample attrition as students who only developed pre-reading skills would have been excluded.

The researcher’s decision to match by a measure of cognitive ability was also reinforced by the fact that several previous studies in the area utilised this as a matching criterion (Boudreau, 2002; Steele et al., 2013; Seung & Chapman, 2000; Jarrold et al., 2000; Brock & Jarrold, 2004; Purser

& Jarrold, 2013; Ikeda et al., 2013; Vicari et al. 2006; Visu-Petra et al. 2007). This also allowed the researcher to compare and evaluate findings with previous literature.

Screening measures for Hearing acuity and Visual skills

Hearing is a primary contributor or inhibitor to language development in DS (Laws & Hall, 2014). Considering that children with DS are at high risk of hearing difficulties, particularly conductive hearing loss, a study on language and literacy development must consider that participants may have some degree of hearing loss. However, it is of the greatest importance that the participants' hearing abilities on the day of assessment are noted as this may affect the performance in particular tests. A portable hearing screening method is ideal, particularly when data is not collected in a clinical setting. A handheld Paediatric Audiometer (PA5) allowed the researcher to gain sufficient information about the participants' hearing abilities (Muscat et al., 2017). The intensity of the sound stimuli was checked with a sound level meter (Kamplex KM-6) every time a hearing screen was conducted for each frequency tested since the venue for testing participants was not consistent. The parents of the participants who responded above the normal threshold level were informed that their children needed to be followed up by an audiologist. Portable means of assessment also prevent sample attrition since this avoids unnecessary visits to an audiology clinic on the day the researcher carries out the other tests

Given that changing or compromised health status is predominant in children with DS, as indicated in the Literature Review chapter p. 54, informants were not excluded based on significant ongoing medical concerns, mild hearing, visual impairment or a diagnosis of additional difficulties. Considering that children with DS are at high risk of hearing difficulties, particularly conductive hearing loss, a study on aspects of reading development must consider that participants may have some degree of hearing loss. Only one participant was excluded from the study as severe hearing difficulties were identified during the screening. The participant responded above 60dBA in sound field. Such exclusion was made since the results would be skewed due to possible significant sensory difficulties rather than the characteristics specific to DS. Fifty-one participants responded between 31-60 dBA in sound field at an average intensity level for frequencies 0.5, 1.0, 2.0 and 4.0 kHz. After a personal communication with an Audiologist, it was deemed appropriate to include the participants as long as the assessments were administered in a quiet background and in very close proximity to the participants. The same screening procedure was carried out during Study 1 and Study 2.

The researcher also collected information about visual skills in the initial meeting with the parents/carers as per the parent report. When this information was unavailable, the participants were referred for a visual assessment by a specialist ophthalmologist. Participants with moderate/mild difficulties and with corrected visual skills were included. Most participants provided documentation of appropriate corrected vision by an ophthalmologist or *The Down Syndrome Clinic*. Two participants were excluded from the study as they did not provide the appropriate documentation.

Sampling and recruitment of participants

Eligibility to participate in this study included all children and young adults with DS who are Maltese citizens and attended formal schooling in Malta and Gozo, between kindergarten School 1 and post-secondary school. For this reason, the terms *participants* and *students* will be used interchangeably throughout this thesis. According to the Public Health Register of births, 138 individuals with DS between the ages of 4 and 20 could participate in the study. When contacting specific post-secondary schools, it was highlighted to the researcher that students over the age of 20 were still attending formal schooling. Therefore the age range of participants was extended to 23 years. This meant that the total population within the age parameters was 156 individuals. This number included individuals born between 1993 and 2009. No official data is available about births with DS for the year 1992. Therefore, the actual number of births could not be obtained. However, students born in 1992 were still included in the sampling process of the study.

The students with DS were identified with assistance from the local Down Syndrome Association, other NGOs and educational institutions, or service providers. Participants were invited via an information letter to participate in the study (see Appendix C, p. 379). These letters were given to the institutional Heads for distribution to caregivers of potential participants. Two hundred fifty copies of the letter of information were distributed among the associations, and 71 signed consent forms were returned.

The information letters were given to the head of the institutions to forward to respective caregivers. The Heads of schools and other institutions were the intermediaries for the sake of confidentiality. The nature of the study and the involvement of the students were clearly outlined in this letter. The parents/carers who consented to their participation returned the signed letter to the Head of the school or institution. Each head of the institution returned the signed consent forms to the researcher, who then proceeded with data collection. The letter of information and consent forms can be referred to in Appendix C, p.379.

The sampling of participants varied according to the different phases of the study. During Phase 1 of the study, which involved collecting data from participants with DS, was conducted in their respective homes. At the end of Phase 1, the researcher had a list of students with specific characteristics: a fluid intelligence score on the RCPM; the school the participants attended during their primary education years; maternal education and language exposure at home. Hence, after completing Phase 1, Phase 2, which involved the recruitment of the control group, could commence.

During Phase 2, the researcher first attended a school that fitted the profile of at least one of the participants with DS from Phase 1, and several TD students were initially assessed using the RCPM. Once a student with the same raw score on this test as that of the student with DS was identified, they were matched with a participant from Phase 1. Both students had to have a corresponding maternal education level and similar language exposure in the home. Hence, some TD students were assessed on the RCPM, yet they were not included in the study since they did not match a student with DS on the other criteria.

Data from Phase 2 were collected at the participants' schools. School authorities provided the approval to collect data, College Principals and Heads of Schools. All assessments were carried out by the researcher, who is a Speech-Language Pathologist and is qualified to administer the respective test battery.

In Phase 3, participants with DS were recruited from the original sample of participants. Information letters were sent to 36 participants. This data was used for Study 2. The primary aim of Phase 3 was to collect data about the participants' word reading abilities; therefore, only participants who had shown good reading abilities as reported by the parents in the HLE questionnaire during Phase 1 of data collection were contacted. Eighteen parents/carers responded to the third call of participants; however, only 15 of the 18 participants identified with at least basic reading skills completed the reading test, and therefore only data from these 15 participants were utilised.

As with the original sample, the same inclusion and exclusion criteria were used for this group in Phase 3. Participants were matched according to their raw score on the RCPM, level of maternal education and language exposure. A re-assessment on all measures was needed as some time had elapsed since the collection of data from Phase 1. Therefore, this could have led to some changes in the students' abilities.

Phase 4: This phase aimed to collect reliability and validity measures of the assessment tools. Ten participants were involved in this study. These participants were recruited from the sample population of Phase 1 and Phase 2. All reliability and validity measures are discussed in detail on p. 145.

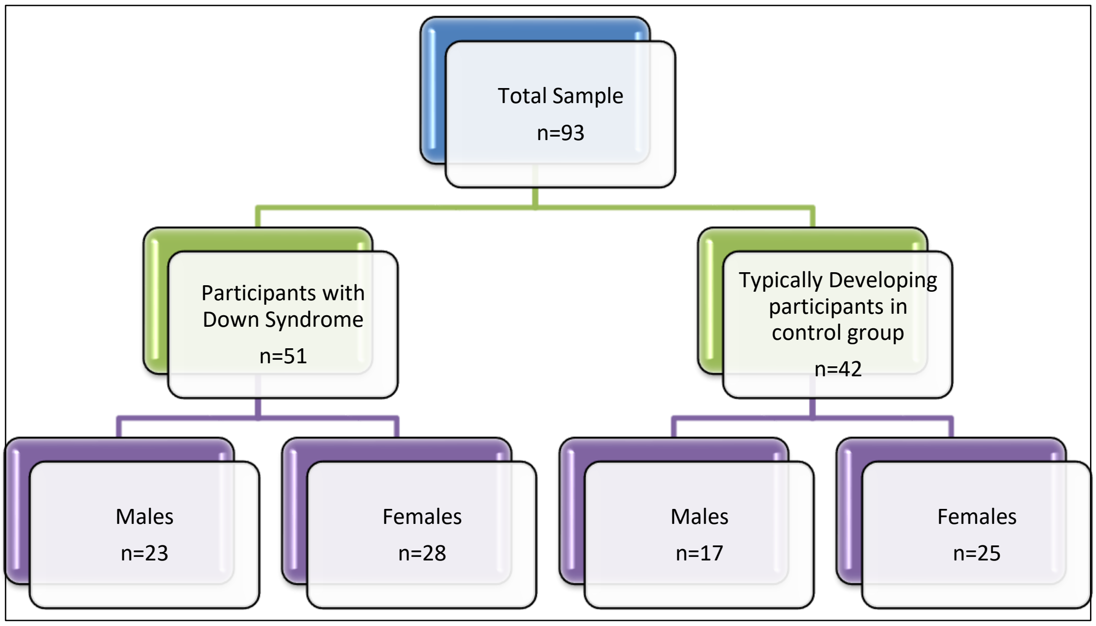
Phase 5: This phase aimed to collect data for Study 2 and Study 4. For Study 2, the researcher contacted all the participants from the original sample (Phase 1). 13 participants were no longer attending school. Therefore these were removed from the sample. 2 parents reported that the children had been diagnosed with a comorbid diagnosis of ASD. These 2 participants were also removed from the sampling pool. The researcher also removed participants who could not read, as reported by the parents. 31 consented to take part in Study 2. Data from Phase 3 and Phase 4 were combined and investigated in Study 2. 15 participants were included in a monoliterate group to whom a TD comparison group was assigned. 16 were included in a biliterate group. No comparison group was assigned as the TD participants were too young to be able to read in two languages. Further details are provided in the Chapter 5.

For study 4, the researcher aimed at investigating the literacy practices utilised with students with DS. The sample population consisted of teachers and learning support educators who work with students with DS. The researcher distributed information letters to all Heads of Schools of State, Independent and Church schools. The Head of Schools, at their discretion, distributed the anonymous online questionnaire. The researcher received 68 responses.

Sample size. In Phase 1, 71 participants with DS agreed to participate through their parents/carers; however, only 51 were eventually selected since the rest did not fulfil the stipulated criteria of inclusion/exclusion. This is 32.9% of the total population which gave the researcher a margin of error of 11.29% with a confidence interval of 95%. The control group was made up of 42 participants of TD peers. Matching peers on all selection criteria was particularly challenging, and only 42 participants matched exactly with their DS corresponding participants. Therefore 93 was the total number of participants in this study. Figure 9 shows the distribution of the total number of participants.

Figure 9

The number of participants in the study for Phase 1 and Phase 2: Study 1 and 2

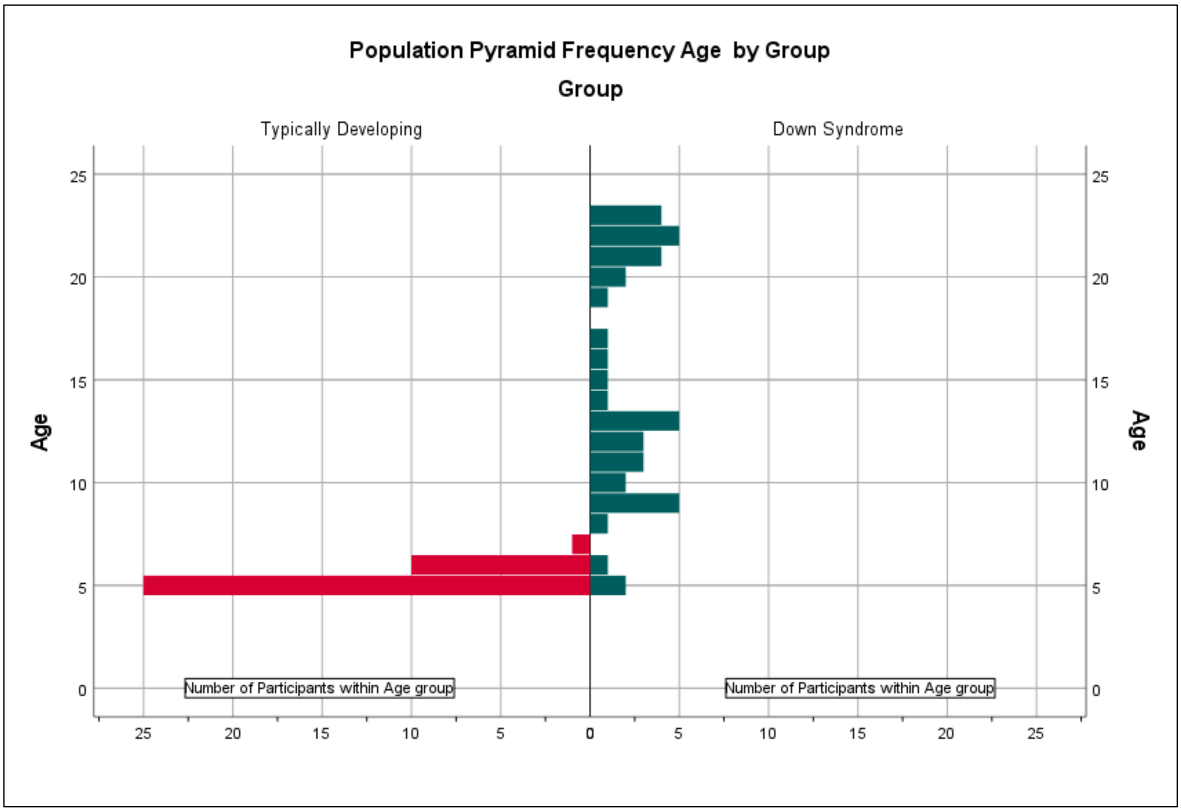


Many participants were able to complete all assessments measures. However, due to the differences in abilities, not all participants with DS completed all tests. The distribution of participants according to each skill measured will be discussed specifically in the relevant chapters. The researcher used the population of Phase 1 as a population pool for Study 2.

Age Distribution of Participants. Figure 10 illustrates the age distribution of participants. There is a significant disparity between the ages of both groups. The group of DS participants was older than the TD participants. The mean age in the DS group was 15 years, with the youngest participant being five years old and the oldest 23 years old. The mean age of the TD group was 5;3 years, with the youngest participant being five years old and the oldest being seven years old. The DS and TD groups were matched according to scores from RCPM, which is an indicator of fluid intelligence, diminishing the disparity between chronological ages between groups. The age distribution for each specific study will be portrayed in the relevant chapters. The researcher used statistical measures on several computations to statistically control for the disparity of ages between the participants. The ages of the participants are evaluated in each study, respectively.

Figure 10

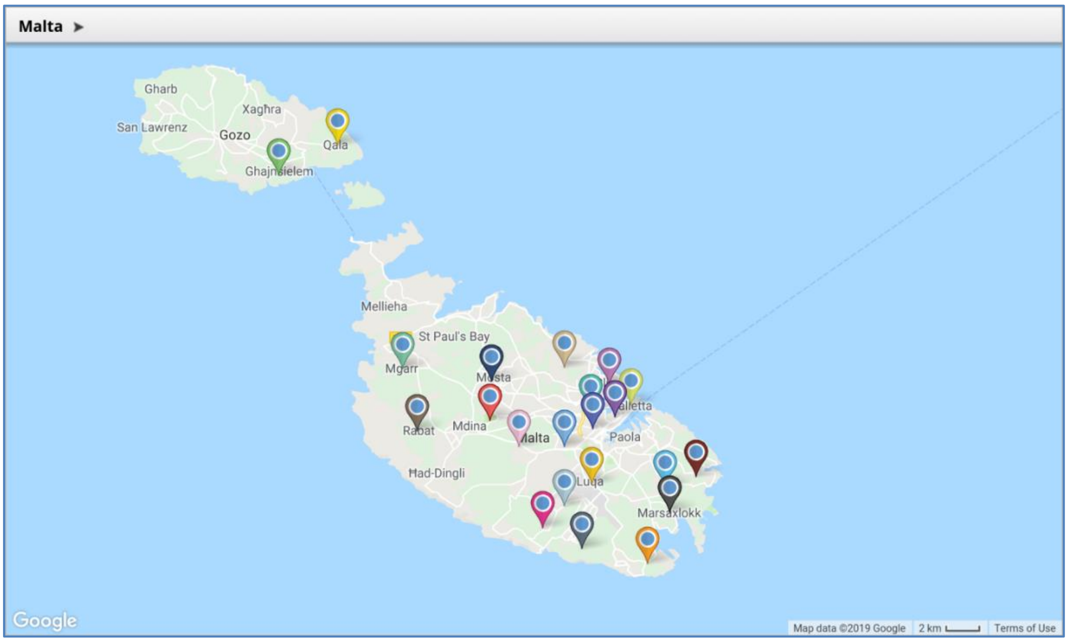
Age distribution of the participants within both DS and TD groups



Geographical distribution of participants. The geographical distribution of participants covered the North, South and Central parts of Malta. Figure 11 illustrates the distribution of participants across the Maltese Islands.

Figure 11

Distribution of participants with DS across the Maltese Islands. Adapted from: Google (2019) [Google map of Malta] January 21, 2019

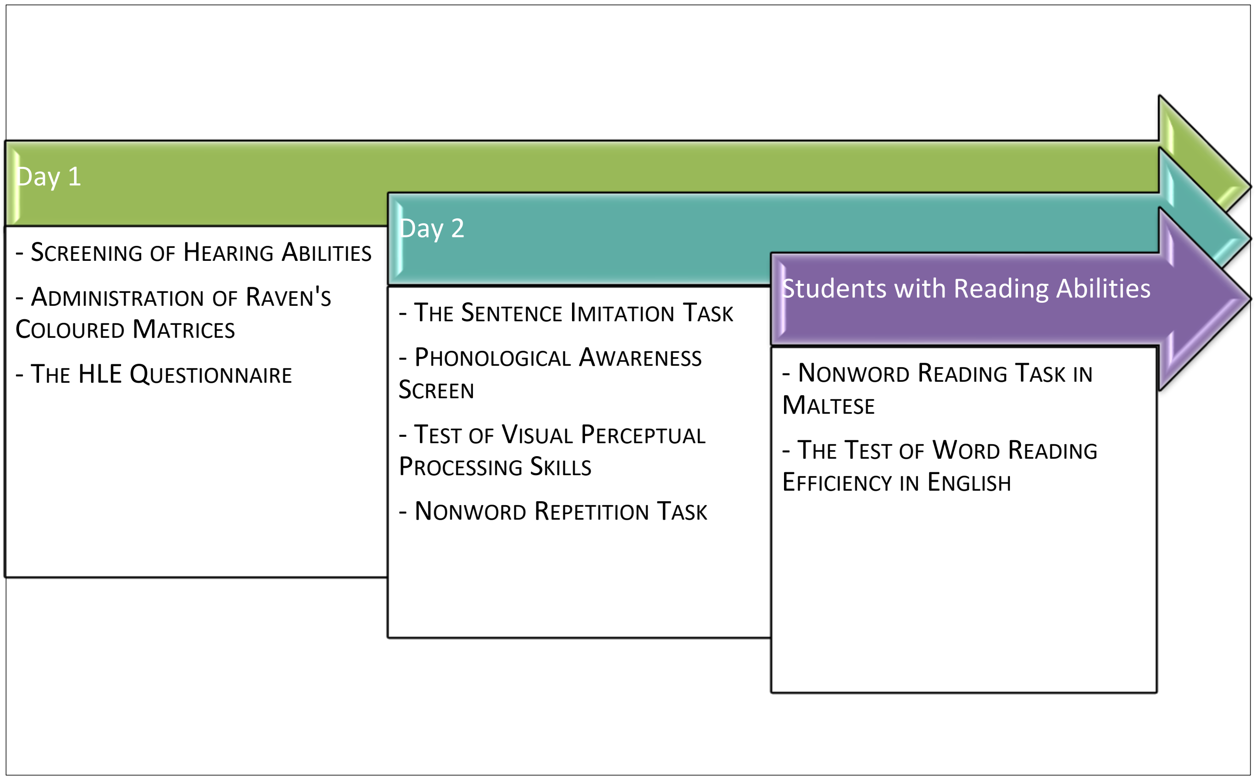


Administration Procedures

The researcher carried out all the collection of data for all Phases. The researcher initially started by administering a screening test for hearing abilities on the first day of data collection. This was the initial step in data collection, as this was one important exclusion criterion. The researcher then assessed the students' non-verbal cognitive skills by using the RCPM. Since the RCPM had a lengthy administration, the researcher set up another appointment with the participants and their carers, and the remaining assessments were administered on a second visit. Figure 12 illustrates the procedure of administration. The assessments sequence was randomised per participant on the second day to minimise the fatigue effect (Lavrakas, 2008). Each visit did not take longer than one hour, and the researcher gave short breaks between assessments. During Phase 1, Phase 3 (DS group), Phase 4 and Phase 5 (Study 2), the researcher visited the participants' homes and asked parents and carers whether she could administer the tests in the quietest room in the house. For Phase 2 and Phase 3 (control group), the researcher was allocated a room by the head of schools to carry out the assessments within the school. A quiet room was always requested to collect the data.

Figure 12

Administration procedure for Phase 1



Ethical Considerations

This project involved data collection from human subjects; therefore, the researcher submitted the proposed study for vetting by the University Research Ethics Committee. Ethical approval was sought in two phases. Phase 1: Approval to recruit and research students with Down Syndrome (Reference no. 177/2014). Phase 2: Approval to recruit and research typically developing students who matched DS (Reference no. 001/2016). Approval for Phase 1 was received on the 8th of October, 2014. Whereas approval for Phase 2 was received on the 6th of November 2015. Approval for Phase 1 and Phase 2 can be found in Appendices D, p. 389 and E, p.400. An additional request for approval for Phase 3 and 4 was addressed to the University Research Ethics Committee (see Appendix F, p. 409). Phase 5 was covered by ethical approval (Reference no. 15062020 9100, see Appendix G, p. 410).

All personal information of the participants was solely available to the researcher and the supervisors. The participants were assigned a reference number during the first data collection stage. This number throughout the study identified them. All data was password-protected to ensure added security.

The participants' physical and emotional well-being was considered throughout the data collection. It was ascertained that all participants were comfortable throughout the assessment sessions and that the sessions were enjoyable. The researcher ensured that the students showed no signs of fatigue or stress during data collection. Short breaks were given, or the sessions were discontinued if this was noted.

The Assessment Battery

The researcher needed to consider that each tool was appropriate to be administered to individuals with learning and possibly other sensory difficulties, catering for the unique linguistic situation and catering for language proficiency. An initial parental interview is usually recommended; this provides the assessor with a background of the student's abilities (Elleseff, 2015). Moreover, the researcher had to make concessions. The concessions were given to both groups. Concessions included using larger font when reading was required, removing a timing element from the reading tasks, and sitting close to the students to ascertain that the assessor was clearly heard. During the assessment sessions, frequent breaks were provided, and sessions were discontinued when fatigue was noted (Abbasian & Ebrahimi, 2020). The different tools used for data collection will be discussed in the following section. A detailed description of the tools will then follow. Table 4 gives a summary of the assessments used.

Table 4

Assessment tools used for data collection

Skills Assessed	Assessment Tools
Fluid Intelligence	The *Raven's Colored Progressive Matrices Test* (RCPM) (Raven et al. 1990)
Sentence Imitation	The Sentence Imitation Task (Maltese and English version) (Grech et al., 2011)
Early Literacy Experiences	An adaptation of the Home Literacy Environment Questionnaire (Boudreau, 2005)
Nonword Reading	The Test of Word Reading Efficiency 2nd Edition TOWRE (Torgensen et al., 2012) for the English language; Non-Word Reading Test (Agius, 2012). for the Maltese language.
Verbal Short-Term Memory	Nonword Repetition -Maltese and English version (Calleja et al., 2018)
Phonological Awareness	The Phonological Awareness Screen (Maltese and English Version) (Grech et al., 2011)
Visual Perceptual Processing	Test of Visual Perception Skills-Revised (TVPS-R) (Martin, 2006)
Word Reading	Word Reading Test (Agius, 2012) for the Maltese language; The Test of Word Reading Efficiency 2nd Edition TOWRE (Torgensen et al., 2012) for the English language
Receptive Vocabulary	*The Peabody Picture Vocabulary Test 4th Edition* (Dunn & Dunn, 2007) No Maltese version is available. The researcher informally translated a Maltese version for the purpose of this research.
School Literacy Experiences	The researcher developed a questionnaire.

The Raven's Colored Progressive Matrices Test (Raven et al. 1990)

The *Raven's Colored Progressive Matrices Test* (RCPM) (Raven et al. 1990) has been identified as a tool to test nonverbal cognitive abilities. This tool provides a measure of fluid intelligence. A review and evaluation of other assessment tools are available in Appendix A, p.367. The RCPM allows the researcher to measure non-verbal cognitive ability in individuals between 5 and 11 years. However, the authors also maintain that the RCPM can be administered to older individuals with learning difficulties. Research involving participants with learning disabilities often uses the raw score to compare to other peer groups (Muscat et al., 2017; Van Herwegen et al., 2011), and the RCPM consents to this. The tool is not language bound as the participants only need to point to shapes and patterns. Hence, it can be easily used cross-linguistically. It has been described as being impartial at an international cultural level (Bass, 2000; Muscat et al., 2017). The RCPM has also been used extensively in comparative studies involving TD and DS groups (Facon & Nuchadee, 2009; Fagis et al., 2011; Muscat et al., 2017). Lanfranchi and Carretti (2012) identified 33 studies of this type.

This tool was used as a matching criterion between DS and TD participants. It is also considered the best tool for this research, given that the researcher is not a psychologist and that this is needed as a screening measure for non-verbal cognitive abilities. While being a very useful assessment measure, it also has its shortcomings. The norms provided by the authors cannot be utilised since no formal attempt has been made to obtain local norms so far, and no local results of individuals with learning disabilities are available to compare results to (Muscat et al., 2017).

The Sentence Imitation Task (Grech et al., 2011)

Tests on sentence imitation correlate with verbal language abilities and indicate linguistic knowledge (Seef-Gabriel et al., 2010; Grech, in press). Results of sentence imitation tasks have also been reported as clinical markers of SLI, now referred to as *Developmental Language Disorder* (Conti-Ramsden et al., 2001). The Sentence Imitation Task (Grech et al., 2011) collects information about the participants' sentence imitation skills. This tool has been identified as the only standardised tool of its kind for the local population. Besides being the only tool available, this test allows for data collection of its type within a bilingual environment since both Maltese and English versions can be administered. This test was found to be a predictor of receptive language (Grech et al., 2011), hence also providing the researcher with an indication of the receptive skills of participants. Normative data for the Maltese population for developmental ages 2;0 - 6;0 years are available. This test has also been utilised locally (Calleja et al., 2013; Xuereb et al., 2011), where correlation scores are also available with older children.

The test consists of 10 sentences. Sentences are available both in Maltese and in English. In Study 1, participants were asked to indicate the language they were most comfortable conversing in, and the corresponding list of sentences was used. In Study 2, biliterate participants were encouraged to complete the test in both Maltese and English. The participants were then asked to repeat the ten sentences. The participants obtained a score of '2' if the repeated sentence was repeated clearly with no errors. A score of '1' was given if half of the sentence was correct. A score of '0' was given if less than 50% was repeated correctly. The test was discontinued if the participant said nothing after three consecutive tries.

This assessment allows the researcher to assess the ability of the child to imitate sentences of increasing difficulty, both in length and grammar. The SIT was used in Correlation and Regression analysis with different assessments. These results will be discussed in their relevant chapters.

Nonword Reading

An assessment of nonword reading or naming is considered an important tool as it provides insight into underlying processes that are not apparent at face value. According to Ellis (1985), nonword reading involves three very important underlying abilities; the ability to segment graphemes visually, identify the correspondence between graphemes and phonemes, and the third ability to blend corresponding phonemes. This shows that performance on nonword reading tasks is closely associated with phonological awareness abilities.

The Maltese bilingual context requires tests in both Maltese and English. This method provides the participants with the freedom to choose their preferred language. During data collection for Study 1, it was evident that some participants could complete both the Maltese and the English versions. However, it was decided to administer the test in only one language for two reasons; to avoid fatigue and repetition on the part of the students and due to limited time constraints. In Study 2, the researcher encouraged biliterate participants to complete the tasks in both languages. Following is a description of the two tests used to evaluate Nonword Reading.

Nonword Reading Test (Agius, 2012). Locally, only one standardised assessment that can assess Maltese nonword reading is available. The *Nonword Naming Test* forms part of the assessment battery TORPAM (Agius, 2012). It consists of 60 items. This list includes a variety of syllabic structures, from one-syllable words to four-syllable words. This test assesses the ability of a reader to decode nonwords in the Maltese language. This tool has been developed following the phonotactic structure of Maltese (Xuereb et al., 2011).

This test had no time constraints, and it was explained to the students that all words were invented; however, some of them might resemble real words, and they had to read as many words as they could. The participants were shown a list of nonwords; they were asked to go through the list and read the words at their own pace. The researcher discontinued the test after three incorrect responses. A correct response was scored by a 1, while a score of 0 was given on an incorrect response. The total number of correct responses was consequently compiled.

TOWRE Subtest 2: Phonemic Decoding Efficiency. The TOWRE Phoneme Decoding Efficiency (Torgensen et al., 2012) was used with students who had English as their first language or preferred to read in English. This test was chosen since Agius (2012) validated the *Test of Word Reading Efficiency 2nd Edition* (TOWRE) (Torgensen et al., 2012) on a sample of the Maltese population. Hence this tool has been considered adequate to assess Maltese students using English.

According to the authors’ administration procedure, the students should be allocated 45 seconds to read as many nonwords as possible from the list provided. However, for this study, the researcher did not allocate any time limit, and the same procedure as for the Maltese test was used. The researcher started by explaining to the participants that she would present a list of made-up words, and they had to read as many words as possible. Before the actual test, students were asked to read a 'practice list' to familiarise themselves with the test. Once the 'practice list' was read, the researcher administered the 'Test list'. Form A was used with all participants who chose to read in

English. Prompts were given to some students if they hesitated to read a word after 3 seconds. Prompts involved: "Continue" and "Move on". The assessment was discontinued after three incorrect responses. A correct response was scored by a 1, while a score of 0 was given on an incorrect response. The total number of correct responses was consequently compiled.

Word Reading

Considering the bilingual environment, as formerly discussed in p. 21, it was deemed pertinent to identify assessment tools that evaluated word reading abilities in Maltese and English. An evaluation of commercially available tools can be found in Appendix A, p. 365.

Word reading was evaluated in Study 2. Monoliterate participants chose the preferred language, while biliterate participants were encouraged to complete the assessment in both languages. Participants who opted for the Maltese language were administered the *Maltese Word Reading test*, which formed part of the assessment battery Test of Reading, Phonological Awareness and Memory (TORPAM). Students who opted for the English language were administered the *Sight Word Efficiency Test*, forming part of the Test of Word Reading Efficiency 2nd Edition (TOWRE).

Maltese Word Reading Test. *The Maltese Word Reading Test* (Agius, 2012) consisted of 60 items with syllabic combinations ranging from one-syllable to four-syllable words. The participants were first required to read through eight practice items. If they successfully read five of these, the participants could move on to the main test: the 60 items (Xuereb et al., 2011). No time limit was given. However, the total time to complete the test was recorded. The researcher discontinued the test after three incorrect responses. A correct response was scored by a 1, while a score of 0 was given on an incorrect response. The total number of correct responses was consequently compiled.

Sight Word Efficiency Test. The *TOWRE Sight Word Efficiency Test* (Torgensen et al., 2012) was used with students who had English as their first language or preferred to read in English. The test is composed of 108 words of varying syllabic structures. Similarly to the *Phonemic Decoding Efficiency Subtest*, as previously explained, the participants were not allocated a time limit to follow the same testing procedure as the Maltese word reading test. Instead, the researcher discontinued the test after three incorrect responses.

Before the test, participants were asked to read a 'practice list' to know what the test consisted of. Once this list was read, the researcher administered the 'test list'. Form A was used with all participants who chose to read in English. During the test, prompts were given to the students if they hesitated to read a word after three seconds. Prompts included "Continue" and "Move on". A correct response was scored by a 1, while a score of 0 was given on an incorrect response. The total number of correct responses was consequently compiled. The total number of correct responses was recorded, and the raw scores were used. Scales and norms presented by the TOWRE could not be utilised for this study, as no standards and norms were available for the Maltese population.

Nonword Repetition (Tabone, 2018)

The Nonword repetition test (Tabone, 2018) has been identified as ideal to evaluate nonword repetition in the Maltese population of individuals with DS. This tool required the participants to repeat a list of nonsense words built on the phonology of a particular language, in this case, either Maltese or English. This task investigates phonemic and auditory processing (Tabone, 2018). A detailed evaluation of tools available to assess nonword repetition locally and details about the construction of the tool is provided in Appendix A, p. 367.

The test consists of 24 nonwords in Maltese and 24 nonwords in English. The participants determined the choice of language used. The researcher asked the participants to repeat all the words she was saying. The researcher marked the word as correct with a score of 1 and wrong with 0. The number of errors per word was also marked. The percentage of errors was analysed separately. The test could be administered both in noise or in quiet. The tool was only administered in quiet in this study since all assessments were administered at the participants' homes or schools.

The quietest room of the house or school was chosen. A sound-level meter was used to ascertain the background noise level of each room and ascertain a minimum background noise in all situations.

The Phonological Awareness Screen (Grech et al. 2011)

The *Phonological Awareness Screen* was the only published standardised assessment tool available to screen PA in the Maltese bilingual population. This is a sub-test of the *Language Assessment for Maltese Children* (LAMC) battery (Grech et al., 2011). The tool assesses five PA skills: syllabification, rhyme awareness, identification of initial sounds in words, phoneme segmentation and sound-to-letter conversion. This test was constructed as part of a language assessment battery for children from a Maltese/English bilingual environment. The *LAMC* allows the assessment to be carried out in Maltese or English while supporting the sociolinguistic Maltese setting.

Syllabification, rhyme awareness, identification of first sound, phoneme segmentation and letter to sound conversion were assessed. In Study 1, the participants chose the preferred language of administration. In Study 2, biliterate participants were encouraged to complete the task in both languages. The researcher addressed the participant in their preferred language. Each child could score a maximum of 5 per subtest and a maximum of 25 scores for the complete PA screen. The researcher computed a composite PA score for specific sections throughout the analysis.

Syllabification. Throughout this task, the participants were expected to count the number of syllables present in a word. The tester introduced the task in the following manner: "I am going to say a word, and I want you to clap the number of syllables in this word". The tester then gave an example either in Maltese "*qattus*" or in English "cat", depending on the student's language preference. Once the first test item was completed, the tester proceeded to the other five words. The tester scored 1 for a correct response or 0 for an incorrect response.

Rhyme awareness. In this task, the student was expected to find the word which does not rhyme out of 3 words. The following words were used with each student to show them what is expected of them: "I am going to say three words, and you will have to find the word which does not rhyme". At times the tester had to add, "...you have to find the word which does not sound the same as the others". One test item was used to practise, and five other sets were utilised to score the performance.

Identification of first sound. Throughout this task, the student was expected to identify the first sound of the words presented. The tester informed the students using the following script: "I will say a word, and you will have to tell me what sound the word starts with", and an example was given in either Maltese or English. The students were expected to give a verbal response to 5 words.

Phoneme segmentation. In this task, the student was asked to segment a word into individual sounds using the following wording: "I will now say a word, and you will have to split it up into different sounds, for example...". The tester gave an example herself and then gave the student a word as practice. The student needed to give five verbal responses.

Letter to sound conversion. Throughout this task, the student was presented with printed letters. These consisted of five upper case letters. The student was asked to name the sound of the grapheme. The student often had to be reminded that they had to produce the sound of the letter and not name the letter. Five verbal responses were required from each student.

Test of Visual Perception Skills-Revised (TVPS-R) (Martin, 2006)

The latest version of the TVPS-R investigates seven visual processing areas: visual discrimination, visual memory, spatial relationships, form constancy, sequential memory, visual figure-ground, and visual closure. Although having several subtests, the test is easy and rapid to administer and complete. Multiple-choice answers are provided, and students are required to point to large print (Muscat et al., 2017). Thus, it is considered ideal for participants with expressive language difficulties or fine motor difficulties. This test is considered an ideal tool for this study since it includes a wide age range and can be completed in one session. An evaluation of assessment tools used to assess visual processing skills can be found in Appendix A, p. 363.

Moreover, the tool is not language-based and can be used in our local setting without adaptation (Muscat et al., 2017). The TVPS-R allows the researcher to compare the results obtained with standardisation data from 2008 students from the initial validation of the tool. Unfortunately, data collection was completed in North America, and currently, no Maltese data is available related to this test. However, this test has been used in international research studies. Therefore, data collected from the Maltese population could be compared to these results with caution (Bower & Hayes, 1994; Nandakumar & Leat, 2010; Wan et al., 2014). Furthermore, this tool was also used locally for another research study (Borg, 2017), allowing the comparison of results to local research

Participants were asked to answer through a multiple-choice modality by pointing at different symbols during administration. The researcher administered all seven subtests in one session. Each subtest required different instructions, yet the same response booklet was used throughout the administration. Two practice and 16 test plates are used for each subtest. The tester moved from one test plate to another and only discontinued the test and changed the subtest if the child produced three incorrect responses in a row. The total number of correct responses per sub-skill was added. The subtests were administered in the order suggested by the author, ranging from skills of lower difficulty to more complex tasks (Martin, 2006). The researcher computed a composite VPPS score for specific sections throughout the analysis.

Visual Discrimination. The students were shown a symbol; they were then asked to identify the symbol the same out of a choice of 5. All designs were presented on the same page.

Visual Memory. This subtest was tied with a time constraint. The tester showed a design to students for 5 seconds. After these 5 seconds, the tester turned the page and asked the student to identify the previous design.

Spatial Relationships. The students were shown a design set; they were then asked to identify the one design that differed from the others from the set presented. The tester, at times, had to explain to the students that this task resembled the 'odd one out' game and that they had to find out the design which does not match the others in some form.

Form Constancy. The students were shown a design. They were then asked to identify the design out of the set provided, which had the same shape as the originally presented design; however, this could be larger or smaller or facing a different direction. All designs were on the same page; therefore, the students had the opportunity to look back and forth at the original design.

Sequential Memory. This subtest had a time element. The students were given a set of designs, and after 5 seconds, the page was turned. The students were then asked to identify the design that matched the previously shown one.

Visual Figure-Ground. Throughout this task, students were shown a simple design. It was then explained to them that this design was hidden somewhere among the provided complex backgrounds. The students had to identify which background out of the four, and the original design was hidden.

Visual Closure. The students were shown a design. They were then asked to look at four other designs; however, these were not complete, as they had missing ink. The students had to find the incomplete design which matched the complete one.

Receptive Vocabulary

In Study 2 a test for receptive vocabulary was used. *The Peabody Picture Vocabulary Test 4th Edition* (Dunn & Dunn, 2007) was used to measure the receptive vocabulary of the participants. Form A was utilised. An assessment tool specifically adapted for the local population is currently unavailable. The researcher informally adapted a Maltese version for this study. The researcher directly translated the assessment tool and no validation of the tool was implemented. The original version is extensively used to test receptive vocabulary. During the administration, the assessor presents a word orally, and the participant is encouraged to point to a picture out of four that shows the correct meaning. This tool is straightforward to administer and use in research studies involving students with DS and other learning difficulties (Loveall et al., 2016).

The researcher compiled raw scores for each student according to the administration procedure suggested by the manual. Due to the lack of normative data for the local population, the researcher could not use normative scores; however, the growth scale value (GSV) was derived as suggested by the Test Manual. The GSV transforms the raw score and allows for statistical comparisons.

An adaptation of the Home Literacy Environment Questionnaire (Boudreau, 2005)

A Home Literacy Questionnaire was utilised for Study 3. An evaluation of available tools was first carried out, and three tools were identified as suitable to assess the local population. This evaluation is available in Appendix A, p. 360. The tools were: The Stony Brook Family Reading Survey (Whitehurst, 1993); Home Observation for Measurement of the Environment (Caldwell & Bradley, 1978); and the Home Literacy Environment Questionnaire (Boudreau, 2005). The Home Literacy Environment Questionnaire (Boudreau, 2005) was ultimately chosen to obtain information about the participants' early literacy experiences. It provided a comprehensive yet efficient method of investigating the HLE, posed no culture-sensitive questions and has already been utilised in studies investigating participants with DS.

Thirty questions were asked in total, of which 53.3% were partially open-ended questions. In these questions, participants were provided with a choice; however, if the choice was not appropriate for the participant, they had the option to give a brief explanation (Jackson, 2012). Parents/carers had to provide information about their personal experiences through these partially open-ended questions, for example, "*What language do you prefer when you watch TV?"* and *"Does your child have additional support at school? If yes, what support do they have?"* 33.3% had summated ratings (Likert, 1932), for example, *"How often do you read to your child?"* These questions make the questionnaire look appealing to the respondent (Robson, 2002) and aid the researcher in providing a numerical score to rate the respondents' attitudes (Kothari, 2004). Of the questions, 13.3 % were closed-ended, whereby respondents needed to provide only a Yes/No response; for example, "*Can your child read the letters of the alphabet?" S*uch a variety of question types was used to make the questionnaire structured while obtaining a complete picture of the respondents' attitudes (Kothari, 2004).

The adapted version of the Home Literacy Environment Questionnaire (Boudreau, 2005) included additional questions to investigate the school environment, support received at home, and how reading was introduced. For a questionnaire to yield the most accurate data, this must be unbiased. Bias is defined as a deviation of results from the truth. The researcher ensured that the questions were unbiased, short, not complex, unambiguous, and did not contain technical jargon. Forced choice questions and sensitive questions were also avoided. The researcher also ensured that the questionnaire did not have too many open-ended questions and that these were not long, thus reducing questionnaire design bias and response fatigue (Choi & Pak, 2005). Finally, administration bias was kept to the minimum by ensuring that the interviewer took an objective stance during interviews. The researcher collected all data; therefore, there was no difference in how the responses were scored. *Cultural bias*, which refers to the difference in responses dependent on the culture of the sample group (van Hemert et al., 2001), was also taken into consideration. This questionnaire was chosen over others as no culture-imposed questions were included, and therefore the participants found no cultural ambiguity in responding.

Translation of the modified Questionnaire. Due to the bilingual context in Malta, the questionnaire had to be presented both in Maltese and English. The original version of the questionnaire was in English; therefore, a translated version in Maltese was prepared following permission from the author (see Appendix H, p. 411). A literal translation is far from enough when translating an assessment tool, as this does not consider cross-cultural and linguistic complexities (Jain et al., 2016). Translation by committee is considered the best approach towards translation on the assessment tool. There are two ways this can be achieved; either by having two translators working independently on the translation and then agreeing on a final version, or by using back-translation (Jain et al., 2016). Back translation was used for this research. Two qualified bilingual

Maltese/English translators were used for this process. One translator first translated the questionnaire. This translated version of the questionnaire was then back-translated by a second translator who was blind to the first version of the questionnaire. This translation method has been considered the best method in translation by committee (Jain, Dubey & Jain, 2016). The questionnaire can be found in Appendix I, p. 413.

Administration of the Questionnaire. This questionnaire was completed during a face-to-face interview with the parents or carers. This method is known as the *Investigator-Administered Questionnaire* (Mitchell & Jolley, 2012). Such a method was used as it enabled the researcher to explain any unclear questions to the respondents. The in-person interview also encouraged the respondents to answer as many questions as possible (Mitchell & Jolley, 2012). The questionnaire was administered either in Maltese or English, depending on the respondent's preference. The respondents took between 10 to 12 minutes to complete all replies.

School Literary Experiences Questionnaire

The researcher designed the School Literacy Experiences Questionnaire to be utilised in Study 4. This questionnaire aimed to yield information about literacy practices in a school setting. The questionnaire was completed online by the participants due to COVID-19 restrictions. The questions and design of the questionnaire were approved by the University of Malta Board of Ethics. The tool was face-validated by three professionals. The questionnaire was only developed in English. The Ethics committee indicated that this questionnaire did not need a translation to Maltese since it was addressed to teaching professionals. The questionnaire comprised 5 Sections:

- **Section A:** Setting and Student Information. This section provided information about the school setting, the role of the educator, the student's age and class setting, the student's language skills, and information about different services that the student uses.

- **Section B:** Reading and Writing Abilities. This section explored the reading and writing abilities of the student, the services concerning reading and writing provided in the school, the perceptions of the educators and details about literacy intervention methods.
- **Section C:** Writing Instruction. This section explores the writing abilities of the student and the writing instructions that are being offered at the school.
- **Section D:** Technology. The use of technology in literacy instruction was evaluated.
- **Section E**: Conclusion. The educators are invited to share additional ideas and comments.

The questionnaire was distributed to the educators of the participants recruited during Phase 1. Moreover, the questionnaire was distributed further to schools and Resource centres. The Heads of Schools were invited to disseminate the online questionnaire to educators working with students with DS. 280 schools were contacted. 32 schools responded that they had studens with DS and that they would distribute the questionnaire to their educators. This gave the researcher a response rate of 11.4% from the total schools in Malta. However, a national statistic about the distribution of students with DS within the Maltese schools is unavailable to date. (NSO, personal communication, 2022) The questionnaire was voluntary and anonymously completed by the educators. This tool is available in Appendix J, p. 419.

Method for Analysis of Data

The data collected was analysed using the *IBM SPSS Statistics 25 software*. SPSS was chosen since it is a statistical package readily available for all researchers. It is referenced throughout many textbooks and online tutorials, and therefore, its use for research practices is highly facilitated (Pring, 2005).

Before evaluating data, it is important to ascertain that results are analysed to test a specific hypothesis. In this research, both summary statistics and inferential statistics will be presented. A summary, also known as descriptive statistics, describes the basic data information in a study, for example, presenting the mean and standard deviation (Mishra et al., 2019). Inference statistics provide conclusions about a population's situation compared to a sample of scores obtained (Robson 2002). The researcher evaluated differences between groups, correlations, and regression analysis based on the basic assumption that the data tested follows a normal distribution (Das & Imon, 2016). The method involved in *Normality testing* will first be explained in the next section. The methods for comparing groups, correlation analysis, *multiple regression analysis* and reliability and validity measures will be discussed.

Testing for Normality

Testing for normality involves investigating whether the data collected is of a normal distribution or not. The *Null Hypothesis* specifies that the score distribution is normal and accepted if the *p-value* exceeds the .05 level of significance. The *Alternative Hypothesis* specifies that the score distribution is skewed or not normal and is accepted if the *p*-value is less than .05. If data follows a normal distribution, parametric tests can be used; if not, non-parametric tests should be used for data analysis (Ghasemi & Zahediasl, 2012; Mishra et al., 2019). In some cases, data sets had both normally and non-normally distributed data, as will be discussed in the relevant chapters. In such cases, non-parametric tests are suggested since the assumption of normality was not honoured (Nahm, 2016). Therefore, this hypothesis needs to be ascertained and tested. The testing can be done through plots or specific analytical testing; for example, a histogram is the easiest and most widely used. However, graphical plots can be subjective; therefore, statistical testing is highly suggested (Das & Imon, 2016). The *Kolmogorov-Smirnov test* and the *Shapiro-Wilk test* are two main tests that can be used to check for normality (Ghasemi & Zahediasl, 2012). The *Shapiro-Wilk test* was used since it is considered more suitable when the sample size is small, especially since the sample is less than 50 (Mishra et al., 2019).

Skewness and *kurtosis* can also be used to measure the normality of data distribution. Skewness refers to the asymmetry of the distribution. The normal distribution has a skew value of zero (Kim, 2013). Kurtosis shows the “peakedness of a distribution” (Kim, 2013; Misrah et al., 2019).

Data with skewness and kurtosis scores between -1 and +1 is considered to be normally distributed (Misrah et al., 2019). However, it has been argued that this method might not be reliable with smaller samples. Hence, a *z score* should be obtained. For smaller samples with less than N=50, a *z score* of ±1.96 is satisfactory to ascertain normality (Misrah et al., 2019). Results of *Normality Testing* can be found in Appendix K, p. 438.

In addition, ceiling or floor effects (CFE) are common causes of the non-normal distribution of data. If CFE is present in the data, extreme items are probably absent in the lower or upper end of the scale, indicating reduced content validity. Seeking a nonparametric test is a primary reason for a researcher to avoid conditions where one or more groups may be experiencing CFE (Rorden, 2007).

Following normality testing, a choice between parametric and nonparametric tests was implemented. The choice was implemented on the tests used to compare groups and for tests for correlation analysis. The choice of the test according to the corresponding distribution of the data is portrayed in the respective results chapters.

Comparing the groups

The researcher used the comparison of means and ranks to investigate the similarities and differences between groups. The comparison of means indicates the evaluation of the average of one or more continuous variables. This comparison can occur over one or more categorical variables (Salkind, 2010). Different types of comparisons of means are possible; however, in this study, the comparison of two means achieved through paired data was applied (Whitley & Ball, 2002). This type of comparison is possible since case-matched control data has been collected. Comparison of means is principally carried out through the *independent-samples T-Test*. However, for the *T-Test* to be performed, an assumption of normality needs to be ascertained. If data is not normally distributed, the research has two options; to transform the data or utilise non-parametric tests (Whitley & Ball, 2002). Non-parametric approaches offer an alternative to the parametric tests and need no or little assumptions about the data (Whitley & Ball, 2002). The *Mann-Whitney U test* is a non-parametric test used to compare data with a non-normal distribution.

Data was also collected from the Home Literacy Environment Questionnaire and the Educators' Questionnaire. The questionnaires generated both quantitative and qualitative data. The quantitative data was analysed by using the *Chi-Square Test* and descriptive statistics. The *Chi-Square Test* is a non-parametric test to analyse group differences (McHugh, 2013). This test investigates the association between two categorical variables (Pring, 2005). The *Chi-square* (χ^2) provides information about the performance of each group and allows for comparisons (McHugh, 2013). These results from the HLE Questionnaire are evaluated in Chapter 6, while data from the Educators' Questionnaire are evaluated in Chapter 7.

Effect Size

The sample effect size is an additional finding in quantitative research, allowing the reader to interpret the findings further. The *p*-value allows the reader to identify a difference between the groups. However, the effect size allows for the interpretation of substantive significance, achieved by effect size and statistical significance, achieved by the *p*-value (Sullivan & Feinn, 2012). Cohen's *d* Index reports the sample size effect between groups. The effect is classified as small ($d = 0.2$), medium ($d = 0.5$), or large ($d \geq 0.8$) (Sullivan & Feinn, 2012). *Partial Eta Squared* is reported as a measure of effect size in ANCOVA. Correlation Coefficients also express sample effect size. This is represented by the strength of correlation (Lakens, 2013). In *Chi-Square*, the effect size is reported by *Phi (φ)* or *Cramer's V statistic,* where a value of .1 is considered a small effect, .3 a medium effect and .5 a large effect (Kim, 2017). Each index is reported in the relevant result sections.

Correlation Analysis

Correlation analysis allows for investigating the strength of the relationship between variables (Akoglu, 2018; Bewick et al., 2003). A key aspect of correlation is that it does not show causation between variables. *Correlation analysis* relies on the assumption of normal distribution. In a data set with normal distribution, correlation is measured using *Pearson's r*. However, *Spearman's rho (rs)* is a non-parametric alternative (Akoglu, 2018). A correlation analysis allows the researcher to identify whether a relationship is present and how strong this relationship is. When both normal and non-normal distribution occurs in the data set, non-parametric tests were used. In a review of literature, Bishara and Hittner (2012) maintained that this is the most common recommendation put forward by statisticians. The correlation coefficient ranges from -1 to 1, where a correlation close to 1 indicates a strong positive relationship, while a correlation close to -1 indicates a strong negative relationship, and a correlation close to 0 indicates no relationship. The correlation results and the variables assessed for correlation for each study are portrayed in the corresponding chapters.

Regression Analysis

Regression analysis aims to estimate the contributions of all the explanatory variables collectively. Regression analysis controls the association of an independent variable; for example, RCPM, on a dependent variable, for example, nonword reading, with the statistical assumption that all other variables remain unchanged (Hamilton et al., 2015; Uyanık & Güler, 2013). This relationship is stated through an equation (Bewick et al., 2003):

$$Y = \beta_0 + \beta_1 X$$

The regression equation can be utilised to predict a single variable, and many variables (independent) can contribute to a single outcome (dependent variable) (Hamilton et al., 2015). Thus multiple regression analysis gives the research the whole picture of how different variables may contribute to the outcome variable. Multiple or multivariate regression analysis relies on the assumptions that the data are normally distributed, linearity is present, no outliers are present, and the multiple ties between independent variables are not present (Uyanık & Güler, 2013). All these assumptions are tested and discussed in the relevant chapters.

For the final regression model to be robust, it must contain independent variables that explain a big part of the variance in Y. Thus; the variable selection is an important step to assure that only these variables are included (Schneider et al., 2010). Forward selection/elimination, Backward selection/elimination, Stepwise Selection and Block inclusion are the four selection methods for variables. Schneider et al. (2010) suggest that the results from both forward and backward selection methods should be computed. The regression model will be considered robust if both methods provide the same variables. A backwards-elimination model is initiated when all explanatory variables are included; the least significant variables are discarded. The elimination stops when each variable remaining is statistically significant (Smith, 2018). The *Backward elimination* process for each study will be portrayed in the forthcoming chapters. The researcher also computed *Forward Selection* to confirm the analysis, although the *Backward elimination* process is only reported in writing. Both selection methods identified the same final predictors. The list of Dependent and Independent variables and the choice is also portrayed in each chapter accordingly.

Measures of Reliability

Reliability refers to the stability or uniformity of an assessment (Robson, 2002). Different factors can cause limited reliability; an example is participant error (Robson, 2002). An error may be caused by fatigue or illness. For this study, these factors were kept to a minimum by the researcher. The researcher ascertained that the participants were not ill on the assessment day. This could also have affected the participants' hearing abilities on the day if any colds were present. Hence, the researcher checked with the parents and or carers if the participants had any colds or difficulty hearing during that week. The researcher also ensured that the students did not get tired throughout the assessments. Movement breaks between one task and others were provided to the participants. Observer error and bias are also another cause of unreliability. Observer error is commonly observed when the *assessor* is fatigued. On the other hand, observer bias occurs when the assessor is influenced by their ideas of what should or should the results not be (Robson, 2002). In this study, the researcher carried out all assessments; therefore, no discrepancy in the marking scheme should exist as the researcher held only one assessment criteria.

The *correlation coefficient* is the most common technique used to measure reliability. This measures the correlation between two or more variables (Drost, 2011). Kimberlin and Winterstein (2008) suggest three measures that minimise measurement error and thus increase the reliability of an assessment tool and results:

- Test-retest Reliability
- Internal Consistency
- Inter-rater Reliability

The reader is invited to refer to Appendix B, p. 369, for the investigations of *Test-retest reliability* and *Internal Consistency*. A second rater was not involved due to time constraints and the availability of a rater. Trochim et al. (2015) maintain that research can do without inter-rater reliability; however, test-retest reliability needs to be implemented.

Measures of Validity

Validity is defined as the degree to which a tool assesses what it implies to assess (Harris, 2017). Validity necessitates that tool is reliable, but a tool can be reliable without being valid (Kimberlin & Winterstein, 2008). Researchers consider four main measures that assess the validity of an instrument; statistical conclusion validity, internal validity, construct validity, and external validity (Drost, 2011).

Statistical Conclusion Validity. This type of validity investigates whether there is a relationship between two variables (Drost, 2011).

Internal Validity. *Internal validity* investigates the reason for a particular test or study (Roberts & Priest, 2006). Content validity, criterion-related validity and construct validity are all internal validity measures. This is a qualitative manner of confirming that pointers investigate a concept's significance as defined by the researcher (Drost, 2011). Content validity is generally achieved through a literature review where the researcher looks out for the opinion of experts in the field about the specific tool. For this study, the researcher looked into the content validity of the assessment tools by critically evaluating the literature concerning these tools. This can be referred to in Appendix A, p. 376.

Criterion-related validity. This type of validity confirms how well scores on the new tool correlate with other tools that measure similar skills or external criteria theoretically related (Kimberlin & Winterstein, 2008). Correlation measures usually measure this.

Construct validity. *Construct validity* involves indicating associations between the concepts under investigation and the theory relevant to them (Roberts & Priest, 2006). Drost (2011) maintains that face validity, content validity, concurrent and predictive validity, and convergent and discriminant validity form part of construct validity. Face validity was ascertained for both Questionnaires.

External validity. *External validity* looks into the ability to generalise with confidence the findings of the research to other situations (Roberts & Priest, 2006). The sample population plays an important part in good external validity as it needs to represent the whole population. In this study, the total population of school-aged students with DS was contacted. Although not the total students responded to the call for participants, a substantive number of students within the DS population participated.

The main scope of this research moves away from investigating the validity of each assessment tool. However, different aspects have been integrated into the study's design to ascertain Validity measures. The researcher carried out a literature search and identified any measures of validity undertaken by the respective authors of the assessment tools. These measures are summarised in Table 5.

Table 5

The validity of assessment tools as investigated by the authors of the tools

Assessment Tool	Validity Measure
An adaptation of the Home Literacy Environment Questionnaire	The authors provide no information about Validity Testing.
The Test of Word Reading Efficiency and Phonemic Decoding Efficiency 2nd Edition TOWRE	Content Validity, Criterion-Prediction Validity, Construct Validity
Word Reading Test and Nonword Reading Test	Content Validity, Criterion Validity, Construct Validity, Internal Validity, External Validity
Nonword Repetition	Content Validity, Convergent and Concurrent Validity, Statistical Conclusion and Internal Validity
The Sentence Imitation Task	Criterion Related Validity
The Phonological Awareness Screen	Criterion Related Validity
Test of Visual Perception Skills-Revised (TVPS-R)	Content Validity, Criterion Related Validity, Construct Validity

The reader is referred to specific tests' citations for more details about the measurement scores of these tests.

Factor Analysis for the adaptation of The Home Literacy Questionnaire

An adaptation of the Home Literacy Questionnaire was used in this study to explore the home literacy environment of participants. As explained in previous sections, the researcher included additional questions in the questionnaire that pertain to the local scenario. Although not the main aim of this study, the researcher investigates the reliability and the validity of this assessment tool since it was a novel adapted tool. The researcher first carried out Factor Analysis. Fricker et al. (2012) maintain that factor analysis is intended to look at the relationship between variables. In this research study, *Exploratory factor analysis* was conducted, where the researcher explored the data to commonalities between a set of factors since this is a newly adapted questionnaire. Data from 60 typically developing participants were collected for this factor analysis. The participants were Maltese citizens and had a mean age of 5;6 years. Within the parameters of

Factor Analysis, 60 is considered a small sample. However, the main aim of the research study was not to validate the questionnaire but rather to use this investigation as an additional measure to review the reliability and validity of the results. This analysis aided the researcher in identifying questions that could not have been determinant in investigating the HLE. The results of this analysis are portrayed in detail in Appendix L, p. 463.

Chapter conclusion

This chapter has provided a review of the design used throughout this research project. The description of the participants and the recruitment process were portrayed. An explanatory description of the data collection methods was outlined, and a report of the assessment tools used was also provided. The ethical considerations and approvals in the study were described. Subsequently, the methods by which data was analysed and statistical procedures were explained. Following is Chapter 4, where Study 1 is presented. Study 1 investigates PA, VSTM, VPPS and Nonword reading of Maltese individuals with DS compared to TD participants.

Chapter 4

Study 1: An investigation of Phonological Awareness, Verbal Short-Term Memory, Visual Perceptual Processing and Nonword reading in Down Syndrome

Chapter Overview

Throughout this chapter, the performance of participants with DS compared to a TD control group is investigated. In Study 1, the researcher aimed to investigate the gaps in knowledge in the Maltese population of individuals with DS. Although the abilities of individuals with DS on word identification are known and documented in the Maltese population (Zahra, 2010), there is a lack of knowledge about their abilities in different subskills and decoding abilities once reaching the alphabetic stage.

Data for Study 1 were collected during Phase 1 of data collection (refer to p. 112 for the detailed explanation of data collection). In this chapter, the participants' performance on each separate subskill is first evaluated. The descriptive statistics are presented first. The comparison between groups then follows these. Subsequently, an analysis of correlation and regression for specific skills are presented. An investigation into the relationships based on the correlations and the *ANCOVA* models between different subskills is then presented. The investigation aimed at answering the following research questions:

Research Question 1: How do Maltese participants with DS perform on phonological awareness, verbal short-term memory, visual perceptual processing and nonword reading tasks compared to TD peers matched on a measure of fluid intelligence?

Research Question 2: What are the predictors of nonword reading in the Maltese group of participants with DS when compared to the TD group?

The following hypotheses were tested:

Hypothesis 1: Maltese participants with DS perform differently from the TD control group on PA, VSTM, and VPPS tasks.

Hypothesis 2: The Maltese participants with DS perform significantly lower on nonword reading Tasks when compared to a TD control group.

Hypothesis 3: A relationship between PA and Nonword reading can be identified in both DS and TD groups.

Hypothesis 4: Nonword reading is not correlated to VPPS and VSTM.

Participants

Forty-two participants with DS took part in this study. The participants were compared to a group of TD participants (N=36). The participants were matched on scores of fluid intelligence assessed on the Raven's Colored Matrices (Raven et al. 1990), Level of Maternal Education, Language exposure in the home, and school attended in the primary years. Although the participants were matched for the language at home, they did not always choose the same language for each assessment. Some participants alternated between Maltese and English. Scores on Sentence Imitation Task (SIT) (Grech et al., 2011) were also collected, as explained on p. 128.

The DS group was composed of 20 males and 22 females with a *mean* chronological age of 15 years SD 5.78. The *mean* score on the RCPM was 13.07 SD = 3.9. The parents reported all 42 participants to have achieved an initial level of alphabetic reading. The group of TD students that formed part of the control group consisted of 15 males and 21 females with a *mean* age of 5.3yrs SD = .53. The TD group obtained a mean of 14; SD = 4.2 on RCPM. All TD students attended Year 1 in primary school. Teachers reported that students in the TD group were able to achieve a level of alphabetic reading.

The independent samples T-test was used to compare the chronological ages. The control group significantly differed on chronological age from the DS group $t(76) = 9.981$, *p-value* < 0.001. A large effect size also needs to be noted between comparison of groups on the variable of age (D=2.36). The groups also differed on measures of sentence imitation as assessed by the Sentence Imitation Tasks when the task was administered in Maltese (*p-value* < 0.001); however, a difference was not identified when the tasks were administered in English (*p*=.066), however the sample size on the English subgroup was small when compared to the Maltese subgroup A large effect size is noted on SIT scores between the two groups. The reader is reminded that SIT is used as an indirect measure of receptive language since a measure of receptive language for the Maltese population is unavailable. Refer to Table 7 for the descriptive statistics of the participants and the results of the assessment battery.

Assessment Measures

The researcher assessed the participants on multiple measures to evaluate sub-skills involved in word reading and a measure of nonword reading. Table 6 summarises the assessment tools. A full description, administration and marking of the assessment measures can be found in Chapter 3, p. 126. Due to the local unique language environment, the researcher ascertained that the assessment tools were available in Maltese and English. The students were given the choice of the language of administration. The researcher wanted to ascertain that the participants chose the language that they felt most comfortable in reading.

Table 6

Assessment Battery for Study 1.

Skills Assessed	Assessment Tools
Fluid Intelligence	The Raven's Colored Progressive Matrices (Raven et al., 1990)
Sentence Imitation	The Sentence Imitation Task – Maltese and English version (Grech et al., 2011)
Nonword Reading	The Test of Word Reading Efficiency 2nd Edition TOWRE (Torgensen et al., 2012) for the English Language; Non-Word Reading Test (Agius, 2012). for the Maltese Language.
Visual Perceptual Processing	Test of Visual Perception Skills-Revised (TVPS-R) (Martin, 2006)
Phonological Awareness	The Phonological Awareness Screen – Maltese and English version(Grech et al. 2011)
Verbal Short-Term Memory	The Nonword repetition test – Maltese and English version(Tabone, 2018)

Note: The participants chose 1 language of administration.

Results

The results are presented in three sections. The comparison between groups is first presented, where the participants' performance on PA, VPPS and VSTM results is presented first. An analysis of Nonword reading then follows. Finally, an analysis of relationships between subskills and also nonword reading is portrayed. A summary of findings is provided after each section.

Section 1: PA, VPPS and VSTM of participants with DS when compared to a TD control group

The descriptive statistics and the comparison between the DS and TD groups are presented in Table 7. *The independent samples T-test* was used to compare means where data was normally distributed, while, The *Mann Whitney U test* was used to test the difference in non-normally distributed tasks (refer to Appendix K, p. 438 for Normality testing). The *effect size* is also presented through *Cohen's d statistic.*

Table 7

Descriptive Statistics and results on the assessment battery of participants with DS and TD groups

Variable	DS			TD						
Gender	M =20	F = 22		M=15	F=21					
Language at Home	21 (Mal) 6 (E) 15 (B)			19 (Mal) 6 (E) 11 (B)						
Maternal Education	1 (P) 10 (S) 19 (PS) 12 (T)			9(S) 17 (PS) 10(T)						
Age	Mean =15	SD= 5.78		Mean= 5.33	SD = .53			$t(76) = 9.981$ p=.00		D = 2.3***
Assessment Task	**N**	**M**	**SD**	**N**	**M**	**SD**	***Mann-Whitney-u***	***T-Test***	***p*-value**	***D***
RCPM	42	13.1	3.9	36	14	4.2		-.994	.323	.226*
SIT English	13	7.5	3.05	9	9.76	2.87		-1.92	.066	.774***
SIT Maltese	29	6.5	2.88	27	9.64	2.41		-4.052	.00	1.17***
Syllable Counting Maltese	36	3.47	1.767	32	3.75	1.67	557.5		.527	.152*
Rhyme Awareness Maltese	36	1.21	1.679	32	2	1.52	400.5		.011	.636***
Identification of First Sound Maltese	36	3.97	1.325	32	4.62	.751	467.5		.052	.483**
Phoneme Segmentation Maltese	36	3.16	1.925	32	3.22	1.84	605.0		.971	.009*
Letter to sound Identification Maltese	36	4.03	1.479	32	4.28	1.25	545.5		.394	.205*
Composite PA Maltese	36	15.84	6.377	32	17.88	5.81	491.5		.168	.334**
Syllable Counting English	4	4.25	.500	4	4.75	.500	4.0		.343	1.05***
Rhyme Awareness English	4	1.5	1.915	4	2	1.41	6.0		.686	.428**
Identification of First Sound English	4	5	.00	4	4.75	.500	6.0		.686	.756***
Phoneme Segmentation English	4	4	1.41	4	4.75	.500	5.5		.486	.616***
Letter to sound Identification English	4	5	.00	4	4.75	.500	6.0		.686	.756***
Composite PA English	4	19.75	.957	4	21	2.16	5.0		.486	.670***
Nonword Repetition Maltese	32	14.34	7.76	27	22.41	1.98	94.5		.00	1.6***
Nonword Repetition English	10	12.40	10.18	9	23.22	.667	8.0		.001	1.7***
Visual Discrimination	42	2.81	1.687	36	3.42	2.407	669.5		.369	.293**
Visual Memory	42	3.24	2.228	36	4.0	1.707	543.5		.031	.383**
Spatial Relations	42	1.83	1.687	36	4.42	2.644	313.0		.000	1.16***
Form Constancy	42	2.90	1.8	36	3.47	1.298	546.0		.031	.363**
Sequential Memory	42	2.36	1.529	36	3.22	1.533	511.0		.011	.562**
Figure Ground Discrimination	42	2.67	1.422	36	3.36	1.533	525.0		.018	.467**
Visual Closure	42	2.50	1.306	36	3.75	1.991	460.5		.003	.742***
Composite VPPS	42	2.62	1.09	36	3.66	1.3	406.5		.000	.876**

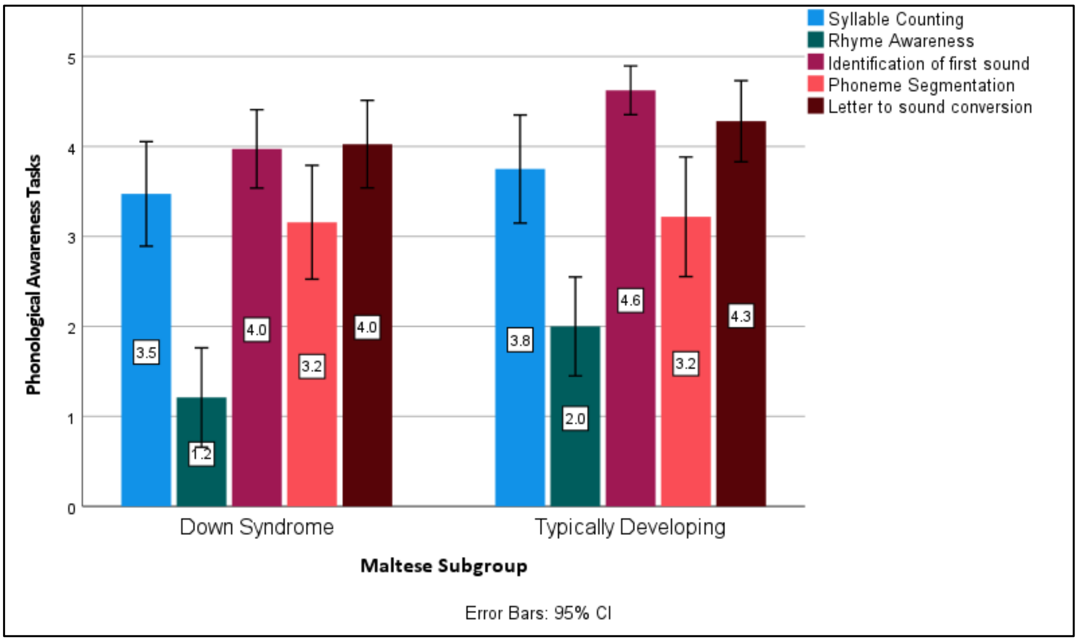
Note: Language at Home: Mal= Predominantly Maltese, E=Predominantly English, B =Equal use of both languages; Maternal Education: P=Primary, S=Secondary, PS=Post-Secondary, T=Tertiary. Effect size: *small sample size effect, **medium sample size effect, ***large sample size effect as *interpreted according to Lenhard & Lenhard (2016).*

The Sentence Imitation Task. An investigation of means was first carried out with samples from the respondents of both languages. Results for the DS group showed poorer performance on SIT in Maltese (*M*=6.5, *SD*=2.8) than participants in the TD group (*M*=9.64, *SD*=2.41). An *independent samples T-test* established this difference between groups to be significant (*p* = .00). No significant difference was identified on the English test; DS (M =7.5, SD=3.05), TD (M = 9.76, DS= 2.87), p= .066. These results suggest that the control group performed significantly better than the participants with DS only in the Maltese language. A large effect size has been identified on both Maltese and English tests.

Phonological Awareness. *Non-parametric* tests were used to analyse PA results since all the scores in both DS and TD groups were non-normally distributed. The *Mann Whitney test* compared the performance of DS and TD groups on PA scores. The performance of the Maltese subtest is first illustrated. Thirty-eight participants with DS completed the task with DS; the group was compared to 32 TD participants. Participants with DS performed similarly to TD participants on most tasks except for Rhyme Awareness when administered in Maltese (refer to Table 7). Figure 13 shows the distribution of the results.

Figure 13

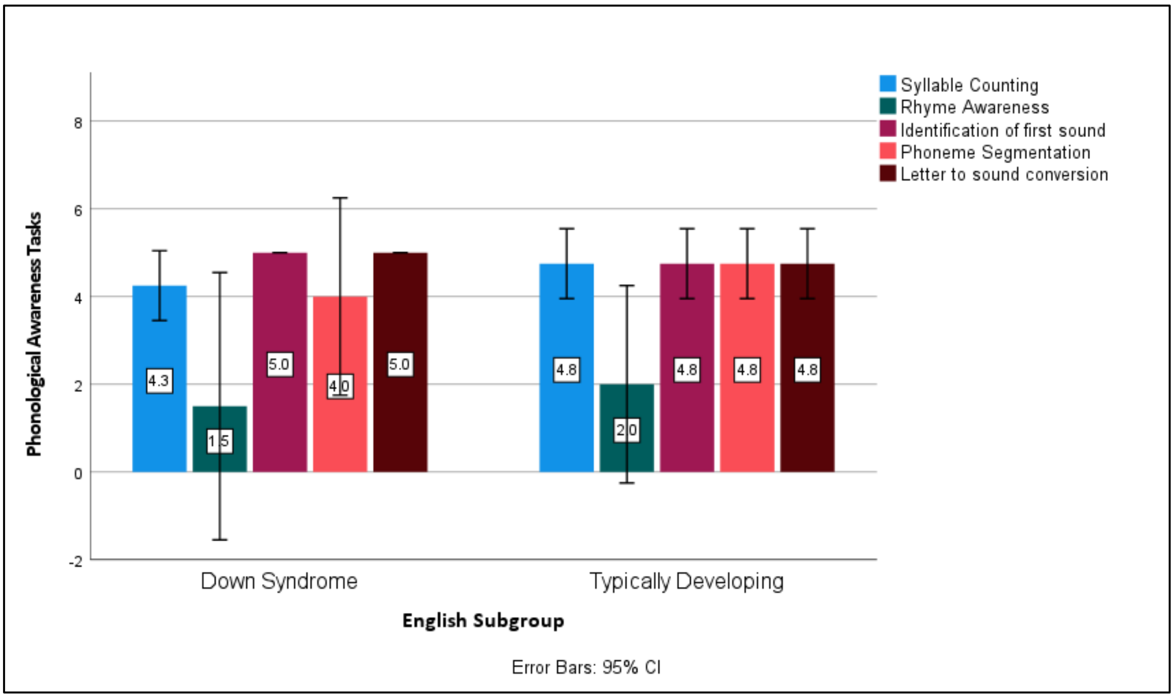
Comparison between groups on Phonological Awareness tasks in Maltese



Four participants in the DS group chose for the test to be administered in English, while 38 were administered the test in Maltese. The 4 DS English respondents were matched to 4 TD English respondents. Results from the English subgroup showed that participants performed similarly on PA tasks (refer toTable 7). The results are further illustrated in the error bar graph in Figure 14.

Figure 14

Comparison between groups on Phonological Awareness tasks in English



The *Effect Size* was also computed. The Cohen's d statistic, which can be found in Table 7, shows the effect size.

Comparison of Means controlling for SIT and Age. As presented in Table 7, the group was not matched on SIT; hence an *ANCOVA* model was used to check for the difference in means of PA task due to group while controlling for SIT and Age. In the Maltese Sample (refer to Table 7), it can be identified that both Age and SIT are covariates that influence the participants' performance. After controlling for age, a significant difference between DS and TD can be identified in Syllable Counting, Rhyme Awareness, Identification of First Sound and Letter to Sound conversion, showing a better performance for the TD group. When the sample was controlled for SIT, a significant difference between DS and TD was identified in Rhyme Awareness, Identification of First sound and Phoneme Segmentation, showing a better performance for the TD group.

Table 8

Analysis of Covariance on PA skills with SIT as a covariate in the Maltese Sample

Dependent Variable	Covariate	F	Sig.	Partial Eta Squared	R Squared
Syllable Counting					
	SIT	3.006	.088	.043*	.320
	Age	11.719	.004	.120*	.154
Rhyme Awareness					
	SIT	28.295	.000	.297*	.338
	Age	13.199	.001	.165*	.166
Identification of First Sound					
	SIT	22.22	.000	.249*	.311
	Age	21.431	.000	.242*	.245
Phoneme Segmentation					
	SIT	5.171	.026	.072*	.309
	Age	1.914	.171	.028*	.044
Letter to sound conversion					
	SIT	1.124	.293	.016*	.211
	Age	4.708	.034	.066*	.076

Note: N= DS: 38 TD: 32; **Partial Eta^2** indicates the effect size *small effect, **moderate effect, ***large effect.

No significant difference was identified between the DS and TD groups when the sample was controlled for SIT and Age on PA when administered in English, showing a similar performance on the English PA. A small sample size needs to be highlighted. Table 9 summarises the results**.**

Table 9

Analysis of Covariance on PA skills with SIT as a covariate in the English Sample

Dependent Variable	Covariate	F	Sig.	Partial Eta Squared	R Squared
Syllable Counting					
	SIT	.151	.714	.029*	.414
	Age	1.875	.229	.273*	.455
Rhyme Awareness					
	SIT	.342	.584	.064*	.329
	Age	1.158	.331	.188*	.288
Identification of First Sound					
	SIT	.816	.408	.140*	.158
	Age	.009	.927	.002*	.156
Phoneme Segmentation					
	SIT	.167	.700	.032*	.185
	Age	.189	.682	.036	.144
Letter to sound conversion					
	SIT	.816	.408	.140	.158
	Age	.009	.927	.002	.156

Note: N= DS: 4 TD: 4; **Partial Eta^2** indicates the effect size *small effect, **moderate effect, ***large effect.

Verbal Short-Term Memory. An aspect of verbal short-term memory (VSTM) was measured using a Nonword repetition task. The *Nonword repetition Test* (Tabone, 2018) was chosen to evaluate nonword repetition. More details about this assessment can be found in the Method Chapter, p. 129. Table 7 shows the descriptive information of the participants. The majority of participants with DS chose to complete the test in the Maltese language (32 Maltese; 10 English). The results are analysed according to the language of administration.

Non-parametric tests were used to analyse nonword repetition results since all the scores in both DS and TD groups were non-normally distributed. The *Mann Whitney test* compared the performance of DS and TD groups on nonword repetition scores. The results from the Maltese version showed that participants with DS had lower nonword repetition scores (M = 14.34, SD = 7.76) than those in the comparison group (M = 22.41, SD = 1.98). The *Mann-Whitney U test* showed a significant difference (U = 94.5, *p-value* < 0.001). The results from the English version also showed that participants with DS had lower nonword repetition scores (M = 12.40, SD = 10.18) than those in the comparison group (M = 23.22, SD = .667). The *Mann-Whitney U test* showed a significant difference (U = 8, p = .001). These results suggested that the comparison group performed significantly better than the participants with DS. The effect size was also calculated. *Cohen's d* shows that the effect size was large on both Maltese and English versions (refer to Table 7).

An *ANCOVA* model was used to check for the difference in means of nonword repetition due to group while controlling for SIT; Table M1 in Appendix M p. 469 summarises the results. The analysis shows that a significant difference (*p-value* < 0.001) between groups was confirmed whilst controlling for SIT. A significant difference between groups was also confirmed when the sample was controlled for Age (p= .00). The same results were achieved for the Maltese and the English versions.

Syllable length error analysis. An analysis of the number of errors produced on different syllable lengths was conducted. An examination was put forward to evaluate whether the errors were distributed according to the length of the nonwords. The participants attempted all words. The analysis was spread across four groups: Group 1 participants with DS responding in Maltese (N = 32);

Group 2 participants in the control group responding in Maltese (*N* =27); Group 3 participants with DS responding in English (*N* = 10); and, Group 4 participants in the control group responding in English (*N* =9). Figure *15* and Figure 16 display the means of the percentage errors on each syllable length in the four groups. Figure 15 shows that the participants with DS in the Maltese sample produced more errors on 2 and 3 syllable words, while errors on 4-syllable words were less.

On the other hand, the performance of the TD group showed that the errors increased as the syllable length increased. A different pattern was observed in the group of English respondents, where errors in the DS group were found more on 3 and 4 syllable words, while in the TD group, errors were observed mostly on 3-syllable words. However, the small sample size of the English participants needs to be taken into account.

Figure 15

The distribution of percentage errors on 2-syllable, 3-syllable and 4-syllable words on NWRT when administered in Maltese

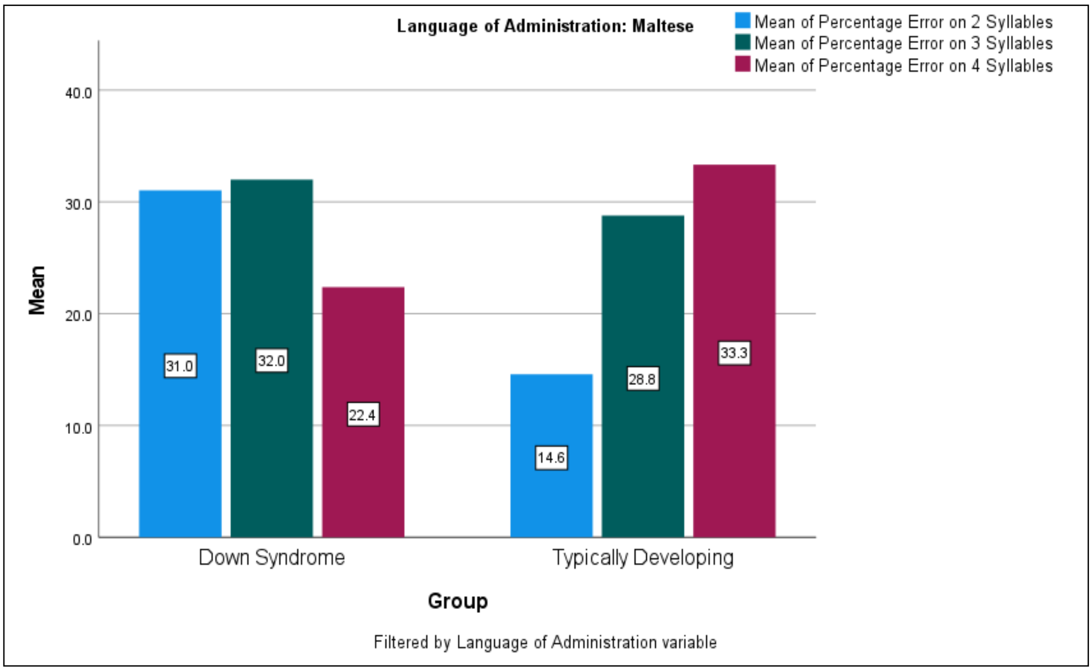
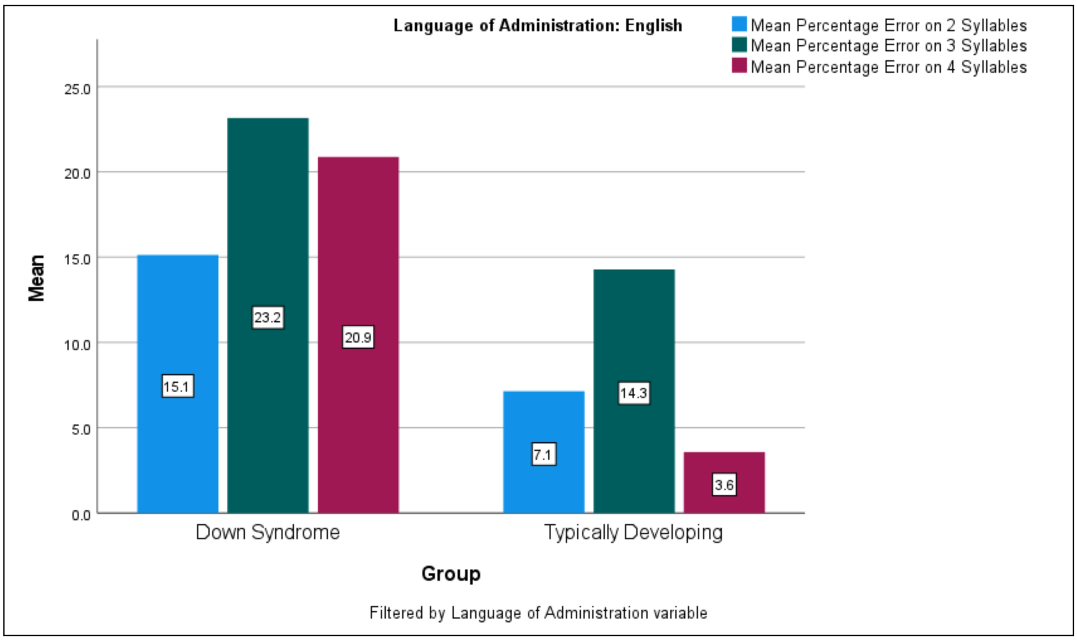


Figure 16

The distribution of percentage errors on 2-syllable, 3-syllable and 4-syllable words on NWRT when administered in English



A comparison between the performance of the DS group and the TD group was carried out. A non-parametric test was used as data was non-normally distributed. The Mann-Whitney U test was calculated, and the results can be referred to in Table 10. This test compared the mean percentage error results on each syllable length between groups. The first analysis compared the difference between participants responding in Maltese and the second between the English respondents. Results from the Maltese sample showed that a difference between groups could be identified in two-syllable words and three-syllable words. However, no statistical significance was found in percentage errors of 4 syllable words between both groups. A non-significant difference could be identified among the English respondents between DS and TD groups. This result shows that DS and TD produced errors on similar syllable lengths. (Refer to Appendix N, p. 470 for additional data)

Table 10

Comparison of Means of Percentage Errors on 2, 3 and 4 syllable words between participants with DS and the control group

	Percentage Errors 2-Syllables	Percentage Errors 3-Syllables	Percentage Errors 4-Syllables
Maltese			
Mann-Whitney U	224.00	300.00	348.50
P	.001	.039	.949
English			
Mann-Whitney U	29.50	37.50	17.00
P	.211	.549	.088

Note: N = DS: 42 (Maltese =32, English = 10) TD: 36 (Maltese =27, English =9)

Visual Perceptual Processing Skills. The Test of Visual Perception Skills-Revised (TVPS-R) investigated seven perceptual areas. The administration details can be found on p. 134. The test included seven subtests; these were administered all in one session. The results of each subtest are presented in Table 7. The comparison between groups is also presented.

Normality testing (refer to p. 452) identified that VPPS scores were non-normally distributed. Therefore, non-parametric tests were used. The *Mann-Whitney U Test* tested the differences in the performance of the two groups on VPPS tasks. Results indicated that the DS group performed significantly lower on all tasks, except for Visual Discrimination. Refer to Table 7.

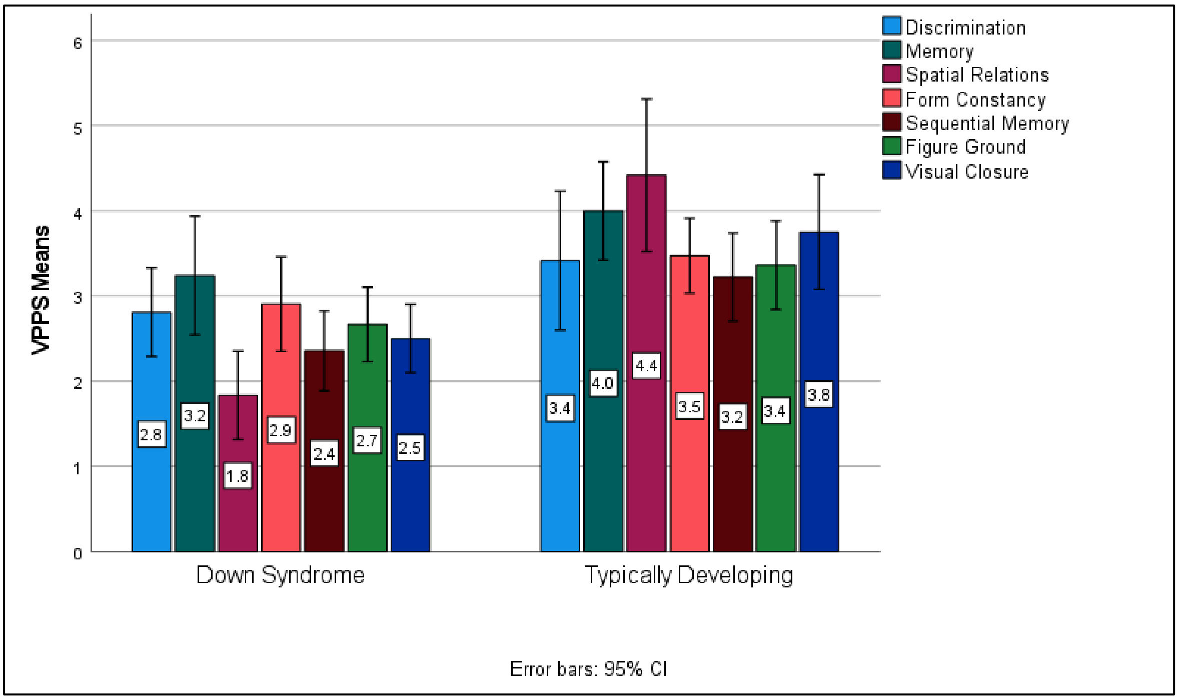
The sample effect size can be observed in Table 7 through *Cohen's d* statistic. Results indicate that Visual Discrimination had a small effect size, Visual Memory, Form Constancy, Sequential Memory, Figure-Ground Discrimination, and Visual Closure had a medium effect size. However, a large effect size was observed on scores from Spatial relations.

The error bar graph (see Figure 17) further illustrated the difference between the two groups on VPPS. Figure 17 displays the 95% confidence intervals for the actual VPPS score if the sample included the whole population of school-aged children within the same age range as the participants in this study. When two confidence intervals overlap considerably, this indicated that their mean VPPS scores differed marginally. This difference only occurred in the case of Visual Discrimination. When two confidence intervals are disjointed or slightly overlapping, this indicates that their mean VPPS scores vary significantly, and in fact, this was evident in all other VPPS tasks besides Visual Discrimination.

ANCOVA analysis allowed for comparing means between groups on VPPS while controlling for the Age variable. *ANCOVA* results indicated that the difference between groups was significant on all VPPS. A table of results and a bar chart can be found in Appendix O, p. 472.

Figure 17

Comparison of Means on Visual Perceptual Processing tasks for Down Syndrome and Typically Developing groups



Results summary of Section 1

- Students with Down Syndrome and the comparison groups performed similarly on PA tasks, where a significant difference was identified on *rhyme awareness* tasks when compared to other subscales. A large effect size was also noted on rhyme awareness. However, when the sample was controlled for age as a covariate, the DS group achieved significant different results when compared to the TD group in the Maltese language sample, showing a better performance by the TD group. The original differences were maintained in the English language sample even when the sample was controlled for Age.

- Although the English group was very small, the Maltese PA and English PA tasks yielded similar results.
- The participants with DS performed significantly worse than the comparison group on the Nonword repetition task in both Maltese and English versions.
- Participants with DS produced more errors on 2 and 3 syllable words in the Maltese sample while producing more errors on 3 and 4 syllable words in the English sample.
- The group of participants with DS performed significantly lower than the control group on an analysis of comparison of means on all VPPS except for Visual Discrimination.

Hypothesis 1 stated that *Maltese participants with DS perform differently to the TD control group on PA, VSTM, and VPPS tasks.* Results indicate that *Hypothesis 1* has been accepted on Verbal-Short-Term Memory, Visual Perceptual Processing Skills measures (with the exception of Visual Discrimination). .

Hypothesis 1 was rejected for PA tasks in Maltese and , with the only exception of Rhyme Awareness when administered in Maltese

Section 2: Nonword Reading in participants with Down Syndrome

The data presented in the following section was collected during Phase 1 (participants with DS) and Phase 2 (control group). The reader is reminded about the assessment tool; details about the participants are also given. Following is a comparison between groups. Data from this section investigates ***Hypothesis 2****: The Maltese participants with DS perform significantly lower on nonword reading tasks when compared to a TD control group.*

Assessment Measures. The Test of Word Reading Efficiency 2nd Edition (phonemic decoding efficiency section) TOWRE (Torgensen et al., 2012) was utilised as an assessment measure for students who chose the English language for assessment, while the Non-Word Reading Test (Agius,

2012) was chosen for the Maltese language. Refer to Chapter 3 Method chapter p. 129 for further details about the assessment tools. The subgroups consisted of; the DS group Maltese Test, DS group English Test, TD group Maltese Test, and TD group English Test.

Participants. A total of 42 participants with DS completed the nonword reading tasks with a minimum of score 0. Thirty-two participants achieved a minimum score above 1. Participants who obtained a score of 0 were included in the analysis. Twenty-nine participants with DS attempted the test in Maltese, while 13 attempted the test in English. The participants who read in Maltese were matched by RCPM, while those who read in English matched the TD on the RCPM and SIT. Table 11 provides the descriptive statistics and comparison between groups of Maltese readers, whereas Table 12 provides information about the English readers.

Comparison between groups. The analysis identified no significant differences in nonword reading tasks between DS and TD groups in both languages (refer to Table 11 for Maltese and Table 12 for English). Maltese Nonword Reading (Mann Whitney U = 196, p= .924), English Nonword Reading (Mann Whitney U = 82.0, p= .979). Since the groups were not matched by Age, an ANCOVA analysis allowed comparing groups by controlling for age as a covariate. The analysis showed that Maltese Nonword reading ($F(1,37)=1.839$, $p=.277$) and English Nonword Reading ($F(1,23)=2.262$, $p=.399$) do not differ between groups when controlled for age.

Table 11

Descriptive information for participants reading the Nonword Reading Task in Maltese

Variable	DS			TD						
Language at Home	15 (M) 5 (E)9 (B)			14 (M) 5 (E) 8 (B)						
Maternal Education	1 (P) 7 (S) 14 (PS) 7(T)			5 (S) 13 (PS) 7(T)						
Age	Mean =15.4	SD= 5.61		Mean= 5.38	SD = .554		$t(38) = 9.958$ p=.00			
Assessment Task	N	M	SD	N	M	SD	*Mann-Whitney-u*	*T-Test*	*p*-value	*D*
RCPM	29	14.45	3.76	27	14.82	.984		-.035	.972	.009*
SIT Maltese	29	6.5	2.88	27	9.76	2.8		-4.052	.000	-1.12**
Nonword Reading Maltese	29	10.55	14.05	27	12.7	12.8	314		.202	.345**

Note: Nonword Reading Maltese: Max Possible Score 60. DS Range of Scores 0-51. TD Range of Scores 1-42.

Table 12

Descriptive information for participants reading the Nonword Reading Task in English

Variable	DS			TD						
Language at Home	6 (M) 1 (E) 6 (B)			5 (M) 1 (E) 3 (B)						
Maternal Education	3(S) 5 (PS) 5 (T)			4(S) 4(PS) 3 (T)						
Age	Mean =16.5	SD= 6.34		Mean= 5.5	SD = .688		$t(64) = 10.09$ p=.00			
Assessment Task	N	M	SD	N	M	SD	*Mann-Whitney-u*	*T-Test*	*p*-value	*D*
RCPM	13	12.4	3.95	9	14.25	1.98		-1.058	.305	.459**
SIT English	13	7.5	3.05	9	9.76	2.87		-1.926	.066	.835***
Nonword Reading English	13	17.9	16.88	9	12.44	10.67	52.		.663	.186*

Note. Nonword Reading English: Max Possible Score 63. DS Range of Scores= 0 - 58. TD Range of Scores = 1 - 38

Summary of results from Section 2: Nonword Reading Scores

The results represented in this section provide information about the performance of a group of participants with DS on Nonword reading. A comparison between participants with DS and the control group is given. The following results can be summarised;

- Students with Down Syndrome and the control group performed similarly on Nonword reading. A statistically significant difference between groups could not be identified.

In summary, it can be stated that ***Hypothesis 2****: The Maltese participants with DS perform significantly lower on nonword reading Tasks when compared to a TD control group,* is rejected as the participants from both groups have performed similarly on measures of Nonword Reading. Maltese results and English results were analysed separately. Participants with DS obtained lower scores on the Maltese subtest but scored better on the English subtest.

Section 3: An analysis of relationships between reading subskills and nonword reading.

In this section, the researcher seeks to answer the second research question: ***Research Question 2:*** *What are the predictors of nonword reading in the Maltese group of participants with DS compared to the TD group?*

The following hypotheses were tested:

Hypothesis 3*: A relationship between PA and Nonword reading can be identified.*

Hypothesis 4: *Nonword reading is not correlated to VPPS, VSTM and RCPM.*

Correlation analysis initially assessed the relationship between variables. However, the major limitation of correlation analysis is that it investigates the relationship between a dependent variable and a single explanatory variable. However, this research study aims to collectively estimate the contributions of all the explanatory variables upon the dependent variable they influence. It is well known that a single explanatory variable could be rendered a very important predictor in explaining variations in the dependent variable scores but would be rendered insignificant in the presence of other explanatory variables (Myers, 1990). Hence, *Multiple Regression* follows *Correlation analysis* to test whether the relationships identified could potentially be significant predictors.

***Analysis investigating Hypothesis 3:* A relationship between PA and Nonword reading can be identified.**

The researcher conducted several correlation analyses. First, the correlation analysis related to PA, SIT, RCPM and Nonword reading is presented. A Multiple Regression Analysis follows this a*nalysis*.

Correlation Analysis in Phonological Awareness. Two investigations of correlation were implemented. A first correlation analysis was implemented between RCPM, each PA subscale score, and SIT. Data from nonword reading scores were also included in the analysis. Results can be found in Table P1 in Appendix P, p. 474. A second correlation analysis was implemented where PA skills were analysed in a group in a *composite score*. The first analysis identified that Maltese SIT correlates significantly to all Maltese PA tasks. The correlation patterns were maintained when the sample was controlled for age through partial correlation (refer to Appendix P, p. 474). English SIT only correlated significantly with syllable counting when the sample was controlled for Age in the English analysis. RCPM was not correlated with PA tasks and with Nonword reading. In the second analysis, Maltese nonword reading and English nonword reading positively correlated with Composite PA when samples are controlled for age (refer to Table 13 andTable 14, respectively).

In the TD group, the correlation analysis identified that all PA tasks were intercorrelated. The correlations were maintained when the analysis was controlled for Age (refer to Table P2 in Appendix P, p. 474). This result mirrors the performance of the DS group. RCPM was not correlated with PA, SIT, or Nonword Reading tasks. This result also mirrored the result of the DS group. In this sample, a correlation between rhyme awareness and nonword reading Maltese and Nonword reading English was identified. This correlation was different from the pattern observed in the DS group. The table of correlations for the TD group can be found in Appendix P. From the first correlation analysis presented, it was identified that all PAs were highly correlated (refer to pg. 474).

Table 13

Correlation Analysis with PA Composite score in the DS group completing the nonword reading task and SIT in Maltese

Control Variable	Variables		*N*	*M*	*SD*	1	2	3
	1	RCPM	29	14.45	3.76			
	2	SIT Maltese	29	6.5	2.88	.326		
	3	Nonword Reading Maltese	29	10.55	14.05	.371	.493*	
	4	Maltese Composite PA Scores	29	16.3	6.26	.284	.771**	.544**
Age	1	RCPM						
	2	SIT Maltese				.394		
	3	Nonword Reading Maltese				.281	.485**	
	4	Maltese Composite PA Scores				.353	.726**	.532**

Note: *p= .05, ** p=<.01

Table 14

Correlation Analysis with PA Composite score in the DS group completing the nonword reading task and SIT in English

Control Variable	Variables		*N*	*M*	*SD*	1	2	3
	1	RCPM	13	12.4	3.95			
	2	SIT English	13	7.5	3.05	.025		
	3	Nonword Reading English	13	17.9	16.88	-.222	.259	
	4	English Composite PA Scores[1]	4	16.56	6.01	-.134	.292	.510
Age	1	RCPM						
	2	SIT English				.235		
	3	Nonword Reading English				-.416	.361	
	4	English Composite PA Scores				-.117	.621*	.476

Note: *p= .05, ** p=<.01; [1] Results from English PA need to be interpreted with caution since the sample size is not equal.

Analysis for Hypothesis 4: Nonword reading is not correlated to VPPS, VSTM and RCPM.

The researcher presents two sets of correlation analyses. The results are then summarised to respond to Hypothesis 4.

Correlation Analysis of Verbal Short-Term Memory. The literature (refer to p. 72) identified that VSTM could contribute to reading abilities. Results from an analysis of correlation in the DS group show no correlation between VSTM and Nonword reading in both languages (refer to Table 15 and Table 16). The correlation was also not identified in the TD group. The results were maintained when the sample was controlled for age. A correlation between SIT in both languages and Nonword repetition was identified. A similar performance was observed in the TD group. No correlation between Nonword Repetition and Nonword reading tasks was identified (Refer to Appendix Q, p. 478)

Table 15

Correlation Analysis for VSTM in the DS group reading in Maltese

Control Variable	Variables		*N*	*M*	*SD*	1	2	3
	1	RCPM	*29*	14.45	3.76			
	2	SIT Maltese	29	6.5	2.88	.326		
	3	Nonword Reading Maltese	29	10.55	14.05	.371	.441*	.
	4	Nonword Repetition Maltese	29	13.8	8.3	.386*	.361*	.095
Age	1	RCPM						
	2	SIT Maltese				.394		
	3	Nonword Reading Maltese				.281	.485*	.292
	4	Nonword Repetition Maltese				.576*	.565*	.412

Table 16

Correlation Analysis for VSTM in the DS group reading in English

Control Variable	Variables		*N*	*M*	*SD*	1	2	3
	1	RCPM	*13*	12.4	3.95			
	2	SIT English	13	7.5	3.05	-.025		
	3	Nonword Reading English	13	17.9	16.88	-.306	.646**	.
	4	Nonword Repetition English	10	12.4	3.95	.068	.852**	.393
Age	1	RCPM						
	2	SIT English				.235	.	
	3	Nonword Reading English				-.416	361*	-
	4	Nonword Repetition English				.209	.732**	.037

Correlation Analysis for Visual Perceptual Processing Skills. The researcher first implemented a correlation analysis where all VPPS tasks were included individually. This analysis can be referred to in Appendix R, p. 480. Research in TD children indicates that there is a possibility that VPPS affects nonword reading because each grapheme needs to be attended to separately, and therefore, greater visual analysis is required (Cestnick & Coltheart,1999; Bosse & Valdois, 2009; Kibby et al. 2015; Borg, 2017). This relationship was hence investigated. The correlation indicated that all VPPS tasks are inter-correlated. Therefore the researcher proceeded to compute a Composite VPPS score for all VPPS to be analysed as a group. The correlation analysis in Table 17 and Table 18 identified a correlation between VPPS and Nonword reading in both languages. Composite VPPS scores were also correlated to Nonword reading in the TD group; Maltese Nonword rs(25)=.719, p=.00, English Nonword rs(7) = .635, p=.036. Hence a similar correlation was identified in DS and TD groups.

Table 17

Correlation Analysis on VPPS tasks in the DS group for participants reading in Maltese

Control Variable		Variables	*M*	*SD*	*N*	1	2	3
	1	RCPM	14.45	3.76	29			
	2	SIT Maltese	6.5	2.88	29	.326		
	3	Nonword Reading Maltese	10.55	14.05	29	.371	.441*	.
	4	Composite VPPS	2.56	.822	29	.012	.577*	.463**
Age	1	RCPM						
	2	SIT Maltese				.394*		
	3	Nonword Reading Maltese				.281	.485*	.
	4	Composite VPPS				.136	.567**	.626**

Table 18

Correlation Analysis of VPPS tasks in the DS group for participants reading in English

Control Variable		Variables	*M*	*SD*	*N*	1	2	3
	1	RCPM	12.4	3.95	13			
	2	SIT English	7.5	3.05	13	-.025		
	3	Nonword Reading English	17.9	16.88	13	-.306	.646**	.
	4	Composite VPPS	2.67	1.46	13	-.103	.421	.520*
Age	1	RCPM						
	2	SIT English				.235		
	3	Nonword Reading English				-.416	.361*	.
	4	Composite VPPS				-.040	.300	.510*

Following the correlation analysis, the researcher identified that nonword repetition was not correlated to nonword reading; however, VPPS were correlated to nonword reading abilities in both languages. The strength of prediction of VPPS was subsequently tested in multiple regression analysis.. The implications of the results from the correlation analysis and the multiple regression analysis which follows are evaluated in the discussion.

Multiple Regression Analysis. A multiple linear regression model was fitted to the data obtained by the DS and TD groups to test whether there was a relationship between Nonword reading, SIT, RCPM and PA. The analysis was implemented for both Maltese and English subtests. SIT has been identified as a clinical marker of SLI and an indicator of language abilities (Seef-Gabriel et al., 2010), and a strong and positive correlation with nonword reading has been identified. In DS literature, PA has not necessarily been identified as a precursor to reading; however, it grows and progresses as the students advance further in their reading abilities (Hulme et al., 2012). This relationship has not been tested in the local population, especially with the local shallow orthographic language.

Moreover, a positive correlation was identified in the correlation analysis (refer to p. 168); hence, PA was included as a variable in the analysis. RCPM is a measure of fluid intelligence, and in studies, it has been reported that readers have better nonverbal cognitive abilities when compared to non-readers (Laws & Gunn, 2002). A correlation with VPPS was also identified (refer to p. 170); hence Composite VPPS was also included in the Models. Thus, these four variables were investigated in relation to nonword reading. The researcher implemented separate analyses for participants responding in Maltese and English.

Model 1: DV: Nonword reading Maltese; IV: RCPM, Maltese PA, VPPS, and SIT Maltese. Assumptions of linear regression were primarily tested from data of students with DS who completed the nonword reading task and SIT in Maltese. All assumptions have been met, but the normality of residuals. The P-P plot suggests that the assumption of normality of the residuals may have been violated and needs to be considered.

The regression model identifies Maltese Composite PA as a statistically significant predictor of Maltese Nonword reading in Down Syndrome. Backward elimination removed RCPM and Maltese SIT from the final predictive model (refer to Table 19). The coefficient of determination R^2 resulted to be R^2 = .292, showing Maltese Composite PA explains 29% of the total variation of Maltese nonword reading scores. Due to the coefficient's low value, the model needs to be interpreted with caution. The results indicated that the model was a significant predictor of Nonword reading, $F(1,21)$ = 8.678, p = .008. It was established that Maltese Composite PA significantly predicted Maltese nonword reading (β1 = -1.178, p = .008) in the DS group. Refer to Table 20 for results. The final predicted model was:

$$Y = \beta_0 + \beta_1 X$$

Nonword reading = -8.183 + (1.178* Composite PA)

Table 19

Variables Entered and Removed for Nonword Reading as DV and Maltese SIT, RCPM and Maltese PA as IV in the DS group

Model	Variables Entered	Variables Removed	Method
1	Maltese Composite PA, RCPM, Maltese SIT, VPPS	.	Enter
2	.	RCPM	Backward (criterion: Probability of F-to-remove >= .100).
3		Maltese SIT, VPPS	Backward (criterion: Probability of F-to-remove >= .100).

Note; Group = Down Syndrome, Dependent Variable: Maltese Nonword Reading

Table 20

Regression Analysis with Nonword reading as a DV and Maltese Composite PA as a final predictor in DS Group

Model	*B*	*SE*	Β	T	*P*
Constant	-8.183	6.749		-1.212	.239
Maltese Composite PA	1.178	.400	.541	2.946	.008

Note. R^2 = .292; Durbin-Watson = 2.201.

An analysis of multiple regression was also computed for the TD group. The same model was used. The regression analysis in the TD group identified RCPM as a predictor of Nonword reading.

It was established that RCPM significantly predicted Maltese nonword reading (β1 = 1.911, p = .002) in the TD group. The results indicated that the model was a significant predictor of Nonword reading, F(1,18) = 13.818, p = .002.

Model 2: DV: Nonword reading English; IV: RCPM, PA English, and SIT English. Model 2 tested predictions for the group who completed nonword reading and SIT in English. Assumptions of linear regression were primarily tested from data of students with DS. All assumptions have been met, but the distribution of residuals. The P-P plot suggests that the assumption of normality of the residuals may have been violated and needs to be considered when tested.

The regression model identifies RCPM as a statistically significant predictor of English Nonword reading in Down Syndrome. Backward elimination removed English Composite PA and English SIT from the final predictive model (Table 21). The coefficient of determination R^2 resulted to be R^2 = .511, showing RCPM explains 51% of the total variation of English nonword reading scores. The results indicated that the model was a significant predictor of Nonword reading, $F(1,8) = 8.359$, $p = .020$. It was established that RCPM significantly predicted English Nonword reading (β1 = -3.171, $p = .02$) in the DS group. Refer to Table 22 for results. The implications of this result are discussed in the discussion section. The final predicted model was:

$$Y = \beta_0 + \beta_1 X$$

$$\text{English Nonword reading} = 60.17 + (-3.171 * \text{RCPM})$$

Table 21

Variables Entered and Removed for Nonword Reading as DV and English SIT, RCPM and PA as IV in the DS group

Model	Variables Entered	Variables Removed	Method
1	English Composite PA, RCPM, English SIT, VPPS	.	Enter
2	.	English SIT, VPPS	Backward (criterion: Probability of F-to-remove >= .100).
3		English Composite PA	Backward (criterion: Probability of F-to-remove >= .100).

Note; Group = Down Syndrome, Dependent Variable: Nonword Reading; a. All requested variables entered. RCPM was identified as a predictor.

Table 22

Regression Analysis with Nonword reading as a DV and English SIT as a final predictor in DS Group

Model	*B*	*SE*	Β	T	*P*
Constant	60.146	15.012		4.006	.004
RCPM	-3.171	1.097	-.715	-2.891	.020

Note. R^2 = .511; Durbin-Watson = 2.248.

A limitation of this model is that the sample size was small since fewer participants attempted the assessment in English. In the TD group, the regression model could not be computed since the fit was perfect for the TD group.

Summary of Results for Section 3

- The analysis in Section 3 identified that a correlation between Nonword Reading in Maltese and SIT is identified in correlation analysis in the DS group.
- Maltese PA was correlated to Maltese Nonword reading, but no correlation between English PA and English Nonword reading in DS.
- RCPM has been identified as a significant predictor of nonword reading in English in DS.
- There was no significant relationship between VSTM and nonword reading in both languages in DS, however correlations were high.
- A correlation between VPPS and Nonword Reading tasks in both languages was identified in DS.
- *Hypothesis 3*: A relationship between PA and Nonword reading can be identified. Hypothesis 3 has been accepted for the Maltese subgroup but rejected for the English DS subgroup. However, it needs to be noted that the English subgroup had a small sample size hence this hypothesis needs further testing.
- *Hypothesis 4:* The hypothesis that nonword reading is not correlated to VPPS, VSTM and RCPM in DS, is rejected in relation to VPPS but accepted for VSTM and RCPM.

The implications of the results are discussed next.

Discussion

Study 1 is a first of its kind study for the local scenario. At the beginning stages of this investigation, the skills and abilities of Maltese individuals with Down Syndrome were assumed to be similar to the skills of participants of other languages; hence the primary aim of the researcher was to ascertain these abilities and also investigate how the Maltese linguistic environment contributed to these abilities. The researcher also aimed to gain detailed insight into the participants' skills to add to the international literature. The researcher evaluated phonological awareness skills in detail and meticulously assessed Visual Perceptual Processing skills. Detailed investigations about VPPS are limited in the DS population, which is a study's strength. Following is the discussion of the results of the specific research questions.

Research Question 1: How do participants with DS perform on phonological awareness, verbal short-term memory, VPPS and Nonword reading tasks compared to TD peers

Phonological Awareness

As discussed in the literature review chapter (Section: *Phonological Awareness in Down Syndrome* see p. 62), the role of phonological awareness (PA) in DS is controversial. Some studies have suggested that children with DS do not develop PA (Cossu et al., 1993), while others mention that a lower PA level is developed (Kumar, 2007). In other studies, it is suggested that PA develops later when reading is already developing (Hulme et al., 2012). In this study, the performance of 42 participants with DS and 36 TD participants was compared. It was observed that participants with DS could unquestionably develop PA skills. Results indicate that the DS group performed similarly to a TD group matched by the language used in the home and a measure of fluid intelligence, except for Rhyme Awareness in Maltese (see Table 7 p. 154, for results). However, a difference between groups was identified when the sample was controlled for age and SIT when the tasks were administered in Maltese (refer to Table 8 p. 157). The relationship did not change in English (refer to Table 9, p. 157). Each skill is discussed separately hereunder. Due to the varying chronological ages of the groups, the

DS group could have developed PA later; therefore, showing that the age of the participants could have impacted the results. It needs to be noted that the English sample was small, and therefore caution is needed when interpreting the results.

In response to Research Question 1, students with DS assessed in Maltese, and the comparison group performed similarly on all PA when not controlled for age. Boudreau (2002) obtained similar results, where results showed that the DS group performed differently only on rhyme and alliteration tasks. van Bysterveldt (2009) also confirmed similar results, where participants with DS performed poorly on a rhyme oddity task. Kennedy and Flynn (2002) also reported difficulty in rhyme in DS. However, the age of the participants needs to be taken into consideration.

Similarly to what was observed by van Bysterveldt (2009), in the present study, participants with DS seemed to find it challenging to understand the concept of rhyme or what was expected of them during this task. Buckley and Fletcher (2002) suggested that tasks should be modified to accommodate difficulties in understanding the task. Difficulties in rhyme tasks were also identified by Evans (1994), Gombert (2002), Snowling et al. (2002) and Steele et al. (2013). However, this difference in rhyming abilities could not be identified by Kumar Misrah (2007), where it was maintained that the DS group performed particularly well on rhyming tasks. Similarly, this was reported in the English sample. Poor progress on rhyming skills was also reported in intervention studies (Bayliss & Snowling, 2011)

A difficulty to acquire rhyming skills has also been reported in the literature concerning TD children in Maltese children (Pace Gellel, 2004; Martinelli, 1996; Xuereb, 2009). The participants in Martinelli's (1996) study had a mean age of 4;6 years; whereas in Pace Gellel's (2004) study were between 3-4 years; while Xuereb's (2009) students were between 8-10 years old. Maltese children tend to develop rhyming skills later and do not depend on them to build their reading abilities. This study could indicate that even Maltese students with DS do not rely on rhyming to develop their reading.

This result is also supported by correlation analysis as no correlation is identified between Nonword reading and rhyming in both TD and DS groups in both languages (refer to Appendix P, p. 474). To verify whether this difference in performance was language-dependent, the researcher investigated the participants' responses who chose Maltese as a language of administration separately. Results confirmed that when only the Maltese respondents' sample was analysed, a significant difference between DS and TD groups was only present on Rhyming tasks (p = .01) but not on the other PA tasks (see Table 7, p. 154). This result also supports the notion that the participants with DS in Maltese do not seem to follow the Theories of Analogy (see p. 29) for reading development since there is no reliance on rhyming tasks.

The letter-sound-knowledge (LSK) investigation through the letter-to-sound conversion task in this study shows that the DS group performed very similarly to the TD group, thus showing that the DS group performed strongly on this task; however, the performance was not maintained when the sample was controlled for SIT and age (see Table 7 p. 154). A similar pattern was observed in both languages. This result agrees with Steele et al. (2013) 's findings, in which they show that Letter knowledge is particularly strong in DS. Moreover, this task was highly correlated to the task: Identification of first sounds; and Syllable Counting. In literature, the relationship between LSK and reading was not established in DS (Snowling et al., 2002). In TD Maltese children, letter-sound knowledge and phoneme segmentation have been described as the best predictor of success in early reading in this study (Martinelli, 1996). No significant correlation between nonword reading and letter-to-sound conversion could be identified in this study (see Appendix P, p. 474*)*.

The phonological approach to reading relies on the analysis of phonological units, also known as phonological awareness abilities. This study carried out a correlation analysis between PA and Nonword reading in both languages. Results in Maltese identify a correlation between PA and nonword reading (refer to Table 13 p. 168), but no correlation was identified between PA and nonword reading in English in DS (refer to Table 14 p. 168). Fletcher and Buckley (2002) reported a similar result to the English sample on correlation analysis. In DS, PA grows and progresses as the students advance further in their reading abilities (Hulme et al., 2012). The sample of participants in this study showed a good level of nonword reading; hence the good performance on PA could be due to this sample's nonword reading abilities. The role of PA seems to be different for the Maltese respondents, possible due to the orthography of the language, and in fact, PA has been identified as a predictor of nonword reading in Maltese but not in English (refer to Tables 19 and 21, p.172).

In summary, it has been established that the group of participants with DS performed close to their TD peers on PA tasks when not controlled for age, with the exception of rhyme awareness and a large effect size on discrimination tasks. Thus, it can be stated that students with DS can develop levels of PA skills, unlike what was noted in some early literature findings (Cossu & Marshal, 1990; Evans, 1994; Kumar Misrah, 2007; Rossini & Marshal, 1993). This study agrees with research that identifies a variation in the development of different PA skills (Boudreau, 2002; Fletcher & Buckley, 2002; Steele et al., 2013). The relationship between PA and nonword reading will be discussed further in Research Question 2. Moreover, a further investigation between PA and Word reading is provided in Study 2.

Verbal Short-Term Memory

In the Literature Review chapter, p. 72, it has been highlighted that verbal short-term memory (VSTM) is particularly impaired in the DS population. Nevertheless, although the level of impairment is known, the cause of the difficulties is still debatable. Forty-two participants with DS and 36 TD participants took part in this evaluation.

In response to Research Question 1, the investigation of the performance of participants with DS on Nonword repetition tasks indicates that this group's performance was significantly poorer than that of the control group (DS M = 13.88, TD M = 22.6, p =.002) (see Table 7, p. 154). The difference was confirmed when the sample was controlled for age. These results support previous international literature stating that DS participants do not perform at par with their cognitively matched or mental age-matched peers in this task (Abdelhameed & Porter, 2010; Godfrey & Raitano Lee, 2018; Jarrold et al., 2000; Kanno & Ikeda; 2002).

The literature has often questioned whether the weaker performance in VSTM could be associated with poor phonemic discrimination or other phonological difficulties (Brock & Jarrold, 2004; Metsala, 1999). In this study, the participants were also assessed on PA tasks, of which phonemic discrimination skills were also included. This study analysis reported no significant differences between groups on phonemic discrimination tasks. Nevertheless, the difficulty in nonword repetition is present, and the performance is significantly different from that of the TD group ($p < .000$). These results agree with Purser and Jarrold (2013), where even though a very good performance on phonemic discrimination was observed, nonword repetition was still impaired.

Literature has revealed that sentence recall tasks can also help identify VSTM difficulties while providing information about receptive abilities (Seef-Gabriel et al., 2010). An investigation of correlation within this study revealed that the relationship between Nonword repetition and SIT was strong, positive and statistically significant in both languages. This reflects findings in literature both in a bilingual population (Thordardottir & Brandker, 2013) and in a monolingual population (Conti-Ramsden et al., 2001), as discussed on p. 68. A medium correlation is also identified with RCPM (a measure of fluid intelligence) in the Maltese subgroup (refer to p. 169). This supports results from Seung and Chapman (2000). Thus, it can be reiterated that in this population, verbal short-term memory tasks are closely related to both language abilities and non-verbal cognitive abilities.

It has often been discussed that the performance of poor repetition could be attributed to inadequate subvocal rehearsal. During the data collection, it was visible that some participants engaged in internal repetition before the repetition of the nonword. In contrast, other participants either were very quick at responding, or a non-response was achieved. Comblain (1995) had reported similar behaviours during the study in participants with DS. Therefore, it is difficult to suggest that poor performance was associated with subvocal rehearsal solely by observing the participants' behaviour.

It has been discussed that sub-vocal rehearsal develops around the age of 7 (Buckley & Bird, 2001; Jarrold & Tam, 2011). In this study, all participants with DS achieved low scores on the RCPM, and the TD participants who had comparable RCPM scores were much younger; hence, children from the control group could still be developing these skills. Buckley and Bird (2001) also reported that expressive skills are more associated with STM skills than comprehension abilities. Regrettably, this study did not explore expressive skills; therefore, this notion cannot be thoroughly investigated.

As discussed in Chapter 2, p. 74, word length, specifically the number of syllables in a word, has been considered a clinical marker for subvocal rehearsal. In this study, the participants' performance on the Nonword Repetition task was analysed according to the number of errors produced according to different syllable lengths. The analysis was subdivided according to the language of administration; Maltese or English. In the Maltese sample (see Table 10, p. 161), it could be identified that the group of participants with DS produced the most errors on two-syllable and three-syllable words. Errors were produced on four-syllable words; however, these results did not significantly differ from the TD group. The DS group produced more errors in 3-syllable words in the English sample (p. 158). When interpreting the results, it needs to be noted that the English respondents consisted only of 4 participants.

These results show that in this sample, no word-length effect was identified. This finding supports Hulme and McKenzie's (1992) claims and contrasts with Comblain's (1999). Results also contrast with local studies on nonword repetition. Tabone (2018) had identified a higher percentage of errors on three and four-syllable tests. Tabone also achieved similar results to Comblain (1999) with TD participants and the clinical group, consisting of 30 students with ADHD, literacy difficulties, and a history of developmental language difficulties. This group had an age range between 7 and 9;11 years; therefore, it could be argued that the rehearsal had developed by this age.

In summary, this study identifies that nonword repetition is not as strong in the Maltese population of participants with DS as that of TD peers when administered in either languages. It has also been shown that these VSTM difficulties do not seem to impinge on this group's nonword reading abilities, which is in contrast to Ratz (2015), who stated that verbal short-term memory difficulties are the main cause of reading difficulties. Finally, this study has provided novel contributions to the area of word length effect within the local population. This sample exhibited no word length effect. This study in this area was the first of its kind in the local population, and it has date VSTM in Maltese individuals with DS was not investigated.

Visual Perceptual Processing Skills

Visual Perceptual Processing Skills (VPPS) have been considered a relative strength in the DS population (Fidler, 2005; Klein & Mervis, 1999); however, more recent results are also showing contrasting views (Muscat, 2017; Yang et al., 2014). Refer to p. 81 in the Literature Review chapter for the literature analysis. In this study, this strength in VPPS is not demonstrated. Forty-two participants with DS and 36 TD participants were compared on their performance on the *TVPS*. Results showed that the DS group scored significantly lower on all tasks than the TD group. However, the group had similar results on Visual Discrimination (p = .369) when matched by a measure of fluid intelligence (see Table 7, p. 154). This result contrasts with studies such as Lanfranchi et al. (2009), where the DS group outperformed the TD on particular VPPS. In Lanfranchi et al.'s study, it has been reported that in the DS group, better performance on spatial, sequential memory was observed compared to the TD group. In Lanfranchi et al.'s (2009) study, participants were matched by cognitive and language abilities. In response to the research question: *How do participants with DS perform on phonological awareness, verbal short-term memory, Visual perceptual processing skills and nonword reading tasks compared to typically developing peers?* The performance of each visual perceptual skill is now discussed separately.

Visual Discrimination.

Visual Discrimination is the only visual perceptual processing skill assessed, where no significant difference was identified between the DS and TD groups. The DS group obtained a mean score of 2.8, while the TD group obtained a mean score of 3.42. with a p-value of .369. The DS group performed slightly lower. This was identified as an area of particular strength in the domain of visual processing in DS. These results contrast a local study (Zahra, 2010), where it was reported that the DS group performed significantly lower than the TD group compared to reading age-matched peers. However, Zahra (2010) had a small sample size, and grouping was according to reading age rather than a non-verbal measure of reasoning. Miranda and Fantz (1973) also evaluated visual discrimination in DS, where a delay in visual discrimination was observed in the DS group. This result also contrasts with the results from this present study. Wan et al. (2015) evaluated visual discrimination in DS, and their DS group performed worse than the TD group, which was matched by chronological age. However, results were comparable to students with intellectual disabilities with matching cognitive age. These findings could reflect this study's results since performance is similar to a group matched by cognitive skills. Further analysis also identified Visual Discrimination as a correlate of nonword reading. This will be discussed further hereunder.

Visual Memory

The TVPS subtest in this study evaluated visual memory where immediate recall was needed. The DS group performed significantly lower than the comparison group (*p*-value .031, see p. 154). This finding is similar to Laws (2002), where visual-spatial memory was investigated. Nevertheless, this result contrasts Visu-Petra et al.'s (2007) claim, who maintain that visual short-term memory is unimpaired compared to TD mental age (MA) matched peers. No significant difference could be identified when the MA matched group presented with intellectual impairment (Wan et al., 2015). An uneven pattern of results could be due to the different methodologies of the studies.

Visual Sequential Memory

This subtest shows that the DS performed significantly lower (*p*-value .011; see p. 154) than the TD group on the sequential memory task, similar to other studies investigating the same skills (Bower & Hayes, 1994; Vicari, 2006; Wan et al., 2015). Nevertheless, contrasting results are portrayed by Lanfranchi et al. (2009), where the DS group performed better than the TD comparison group. A particular deficit in this area has been hypothesised due to the difficulty in remembering an object's place in the form of a matrix (Wan et al., 2015).

Spatial Relations

The DS group scored significantly lower (*p* < .00; see p. 154) in this subtest compared to the TD group. This DS group performed the weakest on spatial relations among the perceptual skills assessed. This result contrasts with Wan et al.'s (2015) study, wherein the participants achieved one of the best results on spatial relations. Other studies in the area of spatial abilities in DS also confirm weakness in these skills. In the literature, visual-spatial relations have often been evaluated through block design (Yang et al., 2014). Research findings on when block design was used as an assessment method were inconsistent. When the DS group was compared to MA matched TD peers, results showed that the DS group performed similarly to the TD group with no significant difference reported (Vicari et al., 2004), while they performed better than the TD MA matched group in Lanfranchi et al. (2012). When groups were compared by receptive language abilities, results were also inconsistent. Lee et al. (2010) maintain that no difference between the groups could be identified on the *Differential Ability Scale Pattern Construction* subtest (Elliott, 1990), while lower performance was reported by Cornish et al. (1999) using the *Wechsler Intelligence Scale for Children: Block Design* (2003). More research is needed in the area, results are still uneven, and it is sometimes difficult to compare results due to the different methodologies.

Form Constancy

The DS group performed significantly lower on the Form Constancy task than the TD control group (*p* = .031; see p. 154). This reflected results from other studies (Nandakumar and Leat, 2010; Wan et al., 2015). However, in contrast to Wan et al. (2015), this was not the weakest area of the visual processing skills assessed. Although the difference is significant, confidence intervals overlap, thus showing that the difference is not that big. Muscat (2017) also identified a significant difference between DS and TD participants when groups were matched according to reading age.

Figure-Ground Discrimination

Weak performance from the DS group was identified on Figure-Ground Discrimination compared to the TD group. The difference was statistically significant with a p = .018 (see p. 154). This performance is similar to that observed in other studies (Muscat, 2017; Wan et al., 2017) when assessed on the same task.

Visual Closure

The Visual Closure subtest measured a significant difference between the DS and TD groups. The DS group performed lower than the control group (p = .003, see p. 154). A very limited number of studies have been identified in the area. However, all confirm that DS participants perform lower in visual closure tasks when compared to MA control groups (Wan et al., 2017), reading age control groups (Muscat, 2017) and receptive language age control groups (Cornish et al., 1999).

Bartlett (2018) investigated whether fluid reasoning, such as visual processing measures, correlated to sentence imitation tasks. Her results indicated that a relationship between these skills was not found. This analysis was carried out on a TD group; therefore, the researcher wanted to test this correlation or lack of correlation in a group of participants with DS. An analysis of correlation , including all VPPS for the DS group can be referred to in Tables 17 and 18, p. 170. The study showed a correlation between the VPPS and SIT in this sample. The correlation was maintained when the sample was controlled for Age. Comparable results were achieved in the TD group. Thus, it is in contrast with Bartlett (2018).

In summary, it has been recognised that Visual Processing is not a strength in this sample population of participants with DS. The literature explains that as children mature, VPPS evolves (Santi et al., 2015); however, this has not been observed in the DS sample group. Even though their chronological age is greater than that of the comparison group, their performance was significantly lower than the latter. Also, when the sample was controlled for Age, the same differences were reported. In the analysis of research question 2, the implications of VPPS on aspects of reading will be discussed.

Nonword Reading

An investigation of Nonword reading investigated the differences and similarities between 42 participants with DS and 36 TD participants. This analysis allowed the researcher to investigate ***Hypothesis 2****: The Maltese participants with DS perform significantly lower on nonword reading Tasks when compared to a TD control group.* The group of participants with DS appear to have developed good alphabetic reading abilities and could utilise grapheme-phoneme correspondence. Results indicate that Hypothesis 2 was rejected. The analysis of nonword reading was subdivided according to the language of administration. The study of results yielded from the nonword reading assessment shows that the DS group performed similarly to the TD control group (English nonword reading $p = .663$; Maltese nonword reading $p= .202$; see p. 165 for results). This result shows that in DS, Nonword reading can develop, complying to (Cardoso-Martins & Frith, 2001; Gombert, 2002; Snowling et al., 2008). It also comes with a surprise, as Nonword reading has often been described as impaired in the DS population (Roch & Jarrold, 2008; Snowling et al., 2008; Gombert, 2002). In this sample, the participants were compared to participants with similar nonverbal cognitive abilities, which led to a discrepancy in the chronological ages. The DS group was older than the TD group could have contributed to their better performance. However, when this was tested through an *ANCOVA*, results were unchanged, and no significant difference was found between the groups. The researcher could potentially attribute the effects on the Maltese sample to the depth of orthography. Readers of shallow orthographies practice and attend to each grapheme in isolation, making reading in shallow orthographies less complex (Cuetos & Suárez -Coalla, 2009; Seymour et al., 2009) while possibly also making them more proficient in decoding skills. However, a relatively good performance was observed from this sample on both the Maltese and English subtests. Yet it also need to be noted that some participants scored a 0 on this test. The reader is reminded that all participants possessed a level of alphabetic reading. A score of 0 could also be attributed to the degree of difficulty of the test itself, where a simpler subscale could be needed so as to assess the abilities of students at lower levels. A difference in language performance could not be computed since the participants completed the task in one language. This is investigated further in Study 2 in Chapter 5.

The relationships between different subskills and Nonword reading are discussed next.

Research Question 2: What are the predictors of nonword reading in the Maltese group of participants with DS when compared to the TD group?

The analysis to investigate this research question was two-fold. Primarily an analysis of *correlation* was implemented; a multiple regression analysis followed th*is*. Results from Section 3 (refer to p. 166) identified that nonword reading in Maltese is correlated to Composite PA. When this analysis was tested further, it was identified that Composite PA also significantly predicts nonword reading ($\beta1$ = -1.178, p = .008) in the DS group. However, this differed from the TD group results, as RCPM was identified as a significant predictor of English Nonword ($\beta1$ = 1.911, p = .002). A similar relationship has been documented in DS literature (Snowling et al.,2002; Wise et al., 2010; Næss et al., 2012). Roch and Jarrold (2008) have reported a strong relationship between PA and nonword reading in DS; however, as participants grew older, the strength of the relationship decreased (Roch & Jarrold, 2011). From the findings of this study, the researcher is unable to compare the literature on participants with DS by Fletcher and Buckley (2002) and Hulme et al. (2011), who reported that although the importance of PA is identified, the strength of the relationship is not maintained as reading abilities increase. Therefore, it is not perceived as a direct precursor to reading at all levels. It has often been discussed that PA skills develop alongside reading abilities (Hulme et al., 2012). It is also reported that variability in DS is highly common, where some children's PA skills may allow them build up a strong system of orthography–phonology connections, while on the other hand, learns with DS rely more on creating 'coarse-grained' mappings between graphemes and phonemes (Hulem et al., 2012). Unfortunately, longitudinal data is unavailable in this study; hence this needs further testing.

This investigation identified an additional relationship between PA and another sub-skill. A significant correlation between PA and SIT was identified in the sample of Maltese readers. Grech et al. (2011) identified similar correlation patterns in a TD group, where SIT was strongly and significantly correlated to a PA score and chronological age. The clinical implications of sentence imitation tasks for assessing language skills are well-established. Sentence imitation tasks have been identified as a good clinical marker for language impairment (Theodorou et al., 2017). A correlation between sentence imitation and nonword reading has been identified in TD populations (Kim, 2011). However, the correlation between sentence imitation and nonword reading in DS is relatively unexplored in literature, and therefore this result is novel in respect of this population. In the TD population, Maltese children's PA skills are strategic in the development of reading abilities (Xuereb, 2009), particularly because of the characteristics of the shallow orthography of the language. Since results from this study indicate that the DS group followed similar patterns to the TD group, this could suggest that PA skills are also influential in developing reading abilities in the population of Maltese children and young adults with DS.

A separate analysis for English Nonword reading was computed. Multiple regression analysis identified that English Nonword reading in the DS sample was predicted by RCPM. The literature reported that non-verbal cognitive abilities could positively predict performance in academic subjects in the TD population (Bergman Nutley et al., 2011). Laws and Gunn (2002) also reported that individuals with better non-verbal cognitive abilities present better reading abilities. However, Boudreau (2002) reported that non-verbal cognitive ability did not predict decoding skills used for nonword reading. In this study, the sample of participants reading in English is particularly small; hence, further investigation is needed to further explore the predictions on English Nonword reading.

In summary, it can be concluded that *Hypothesis 3*: A relationship between PA and Nonword reading can be identified, is accepted for Maltese readers but needs to be investigated further for English readers. Such a result invites the researcher to investigate further the different characteristics of the languages and how such characteristics could impinge on the readers' abilities.

The researcher introduced Hypothesis 4, stating that *Nonword reading is not correlated to VPPS and VSTM.* The investigation of VPPS in Maltese participants with DS identified a correlation between VPPS and nonword reading in both languages. Hence aspects of visual processing have been identified as contributors to nonword reading. Bosse and Valdois (2009) maintain that VPPS predict both Word and Nonword reading development in TD first-graders, while Shapiro et al. (2013) found no relationship between visual attention and reading and nonword reading in TD children. Kibby et al. (2015) and locally Borg (2017) demonstrated that reading difficulties correlate to the performance on VPPS; however, this correlation investigation was only available for TD participants. Giovagnoli et al. (2016) reported that visual-spatial skills predicted word and nonword reading performance in TD children with developmental dyslexia.

Fidler et al. (2005) identified a correlation between word identification and VPPS in DS, thus suggesting that the participants' age and VPPS influence word identification performance. Research on VPPS and their relationship to reading abilities is sparse in DS. Hence the researcher identifies the need for further investigation. Moreover, this study is missing an inquiry into whether the VPPS affects orthographic processing and word reading. Such an investigation could expose the relationship between VPPS and reading in DS better. Therefore this is investigated further in Study 2.

The association between nonword repetition and nonword reading in literature is not straightforward. An analysis of the correlation between Nonword repetition and Nonword reading does not identify a positive correlation in the DS group in both languages. This contrasts with Degasperi (2010), who identified a positive correlation between DS reading abilities and nonword repetition. However, supports Tattersall (2010), who found no significant correlation between nonword repetition and nonword reading in groups of students with TD language abilities and older children with reading difficulties. However, Tattersall (2010) identified a positive and significant relationship with younger participants with reading difficulties. The links between nonword repetition and nonword reading are not clearly delineated, hence the need for further research.

Therefore, it can be concluded that *Hypothesis 4*, is accepted for VSTM and rejected for VPPS in the DS group.

Conclusion

Study 1 was a first of its kind in the local scenario and contributed to the knowledge of the skills of students with DS within the local population compared to the international literature. This study provides an original contribution to the area of reading development in the Maltese population. This first study in this thesis served as a stepping stone for investigating different aspects that contribute to reading in DS while also identifying areas for further investigation. The findings have important clinical and educational implications, which are discussed in the final chapter of this thesis. Following are the most significant findings from Study 1;

- Students with Down Syndrome and a TD MA matched comparison groups performed similarly on PA tasks, where a significant difference was identified on *rhyme awareness* tasks and *identification of first sound* for both groups
- A strength in VPPS was not perceived in the participants with DS. The group performed significantly lower than the comparison group on an analysis of comparison of means.
- Participants with DS performed similarly to TD participants on nonword reading when matched on non-verbal cognitive abilities.
- PA skills predict nonword reading in Maltese readers with DS.
- A measure of fluid intelligence predicts nonword reading in English readers with DS.
- VSTM is not correlated to nonword reading in the DS group.
- VPPS is correlated to nonword reading. However, this has not been identified as a significant predictor in the DS group.

Limitations of the study

The researcher acknowledges that some limitations are identified in this study. Particular limitations assisted the research in the implementation of Study 2.

- The group of participants was matched on a measure of nonverbal cognitive ability; this led to a disparity in chronological ages.
- A measure of word reading was not included in the assessment battery as the main aim of this investigation was to investigate sub-skills; however, a word-reading measure could have added to the evaluation of abilities. The researcher responds to this limitation in Study 2.
- The researcher used SIT to measure language abilities; however additional measures such as receptive vocabulary were not accounted for. This limitation is attended to in Study 2.
- The cross-sectional design limited the researcher from identifying longitudinal predictors.
- The researcher acknowledges that the subdivision of groups according to the language of administration was not always straightforward. In the case of PA, only 4 participants carried out the task in English, yet on the other hand, 13 participants read in the English language. This limited the researcher to evaluate the results with specificity to the language. Stricter administration guidelines could have been implemented to overcome this limitation. This limitation is attended to in Study 2, where participants were encouraged to respond in both languages.

Chapter 5 is presented next. Throughout Chapter 5, the researcher presents Study 2.

Chapter 5

Study 2: An investigation of Word and Nonword reading in DS

Chapter Overview

Study 2, presented in this chapter, exhibits data collected during Phase 3 and Phase 5 of the study. During Phase 1, the researcher identified students with DS. The researcher invited participants with reading abilities to participate in an additional part of the study (Study 2). In Phase 3, 15 participants responded to the call. The researcher initiated an additional call for participants. For Phase 5, 16 participants responded. The process of data collection is explained in detail on p. 112. This allowed the researcher to increase the number of participants for this study while also allowing the researcher to introduce additional variables, i.e. Word Reading and a measure for receptive vocabulary. Hence, the total number of participants for this study, Study 2, was N=31. 15 participants with DS were monoliterate while 16 participants with DS were biliterate. Data from the two data sets were combined and analysed concurrently as the same variables were used.

Due to the nature of the linguistic situation in Malta, the researcher needed to subdivide the analysis according to the competencies and language preferences of the participants. The researcher primarily distinguishes between readers in 1 language, who will be referred to as the monoliterate group and readers in 2 languages. This group is referred to as the biliterate group.

Assessment Measures

The researcher assessed the participants on multiple measures to investigate Word and Nonword reading levels and possible contributors to Word and Nonword reading. Table 23 summarises the assessment tools. A full description, administration and marking of the assessment measures can be found in Chapter 3, p. 126. Due to the local unique language environment, the researcher ascertained that the language-dependent assessment tools were available in Maltese and English. The students were given the choice of the language of administration. Fifteen participants completed the assessments in only one language; 16 completed all the tests, including the Maltese and the English version for language-dependent assessments in both languages.

Table 23

Assessment Battery for Study 2.

Skills Assessed	Assessment Tools
Fluid Intelligence	The Raven's Colored Progressive Matrices (Raven et al., 1990)
Sentence Imitation	The Sentence Imitation Task (Grech et al., 2011) – Maltese and English Versions
Word Reading	Word Reading Test (Agius, 2012) for the Maltese Language;
	The Test of Word Reading Efficiency 2nd Edition TOWRE (Torgensen et al., 2012) for the English Language
Nonword Reading	The Test of Word Reading Efficiency 2nd Edition TOWRE (Torgensen et al., 2012) for the English Language; Non-Word Reading Test (Agius, 2012). for the Maltese Language.
Visual Perceptual Processing	Test of Visual Perception Skills-Revised (TVPS-R) (Martin, 2006)
Receptive Vocabulary	Peabody Picture Vocabulary Test (4th Edition PPVT) (Dunn. 2007). An informal translation of the test was used for respondents who chose Maltese as a Language of administration.
Phonological Awareness	The Phonological Awareness Screen (Crech et al., 2011) -Maltesea and English Versions

In this chapter, the study is presented in 2 sections; Section 1: Monoliterate participants, Section 2: Biliterate participants. Three research questions are investigated.

- **Research Question 1:** Do monoliterate individuals with DS perform similarly to the TD participants on Word and Nonword reading tasks?
- **Research Question 2** How do Maltese biliterate participants with DS perform on Word and Nonword reading tasks?
- **Research Question 3:** Do PA, VPPS, Receptive Vocabulary, and RCPM predict Word and Nonword reading attainment in Maltese monoliterate and biliterate readers with DS?

The following Hypotheses were tested:

Hypothesis 1: The performance of the DS group is similar to the TD group on Word and Nonword reading tasks when matched by RCPM scores.

Hypothesis 2: No difference in performance in either Maltese or English is observed in the attainment of biliterate participants with DS.

Hypothesis 3: SIT, and PA predict Word and Nonword Reading in DS

Hypothesis 4: Receptive Vocabulary predicts Word and Nonword reading in DS.

Hypothesis 5: RCPM and VPPS do not predict Word and Nonword reading in DS.

Participants

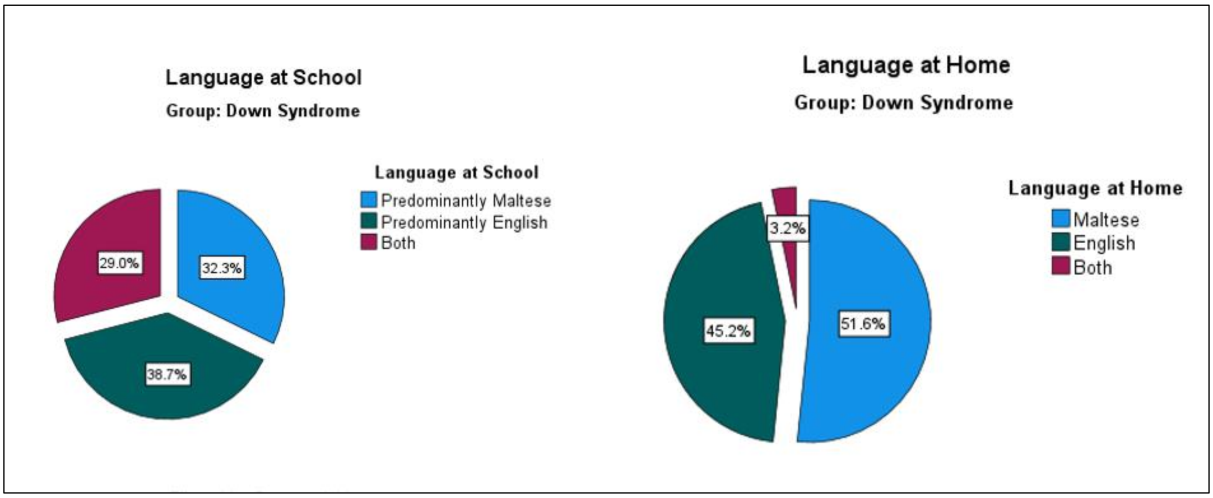
Thirty-one students with DS participated in Study 2. The monoliterate participants with DS and the biliterate participants with DS are analysed separately. No TD comparison group was identified for the biliterate group as the TD could not read in two languages. In the monoliterate group, the participants were matched by performance on RCPM (*Mann Whitney U* = 474, *p*= .929), which measures fluid intelligence. Many were also matched for the language used at home. Not all students with DS were attending primary school at the time of assessment, and they also attended secondary and post-secondary school. Therefore, the researcher matched by the type of school they had attended during their primary years, such as state, church, or independent school. The full matching, inclusion and exclusion criteria can be referred to in Chapter 3, p. 115.

The participants with DS consisted of 15 males and 16 females with a *Mean* age of 13.7 yrs, SD = 2.72. The youngest student was seven years old and attended primary school, while the oldest was 19 and was attending post-secondary school at the time of assessment. All students in the primary and secondary schools attended mainstream schooling, while participants in a post-secondary school attended a specialised programme to learn office skills. Only participants who had reached a level of alphabetic reading were included in the study. This was ascertained through an initial meeting with the caregivers. The students with DS came from different language backgrounds. For matching purposes, the parents/caregivers were asked to identify the language used predominantly in the home; however, many reported that both languages are often used interchangeably in different settings. For example, although Maltese is predominantly used at home, both Maltese and English are used in school. For matching purposes, the researcher used the language that is predominantly used in the home. The researcher encouraged participants who read only in 1 language to complete the other tasks in the same language. The participants in Study 2 did not take part in Study 1.

In Figure 18, the use of the language of the participants is depicted. It can be noted that a variation exists between the language used in the home and a language used at school. While a monolingual context is mostly reported in the homes, increased use of bilingualism is reported at school. The implications are discussed in the discussion.

Figure 18

Language use at home and school by participants with DS.



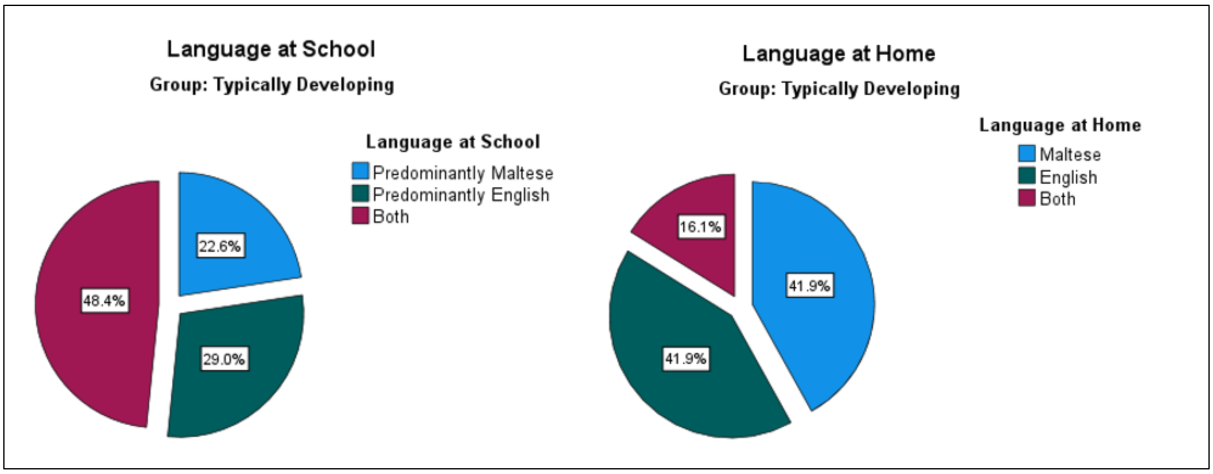
TD students that formed part of the control group consisted of 13 males and 6 females with a *Mean* age of 5.6yrs, SD = .627. All students attended Year 1 in primary school. As discussed in the Introduction chapter p. 21, students would have had between 1 to 2 years of formal literacy training at this age. Formal literacy training in church and independent schools starts in KG2, while in state schools, this starts at Year 1. The control group significantly differed in chronological age from the DS group: $t(32.2) = 13.8$ $p < .00$. The independent samples T-test was used to test the difference between groups. Refer to Table 25 for the full descriptives. The groups also differed on the Sentence

Imitation Task measures when administered in English, but not when this task was administered in Maltese for the monoliterate group.

Figure 19 depicts the language use of the TD group. A similar pattern to the DS group is reported, where at home, the use of 1 language is favoured over the use of both Maltese and English; however, this is noted in a smaller proportion. The TD group uses both languages at home more (16.1%) than the DS group (3.2%).

Figure 19

Language use at school and at home in the control group



Section 1: Reading abilities of the Monoliterate group

The descriptive statistics and the comparison between the DS and TD groups are presented in Table 25. The *Mann Whitney U test* was used to test the difference between groups on tasks from the assessment battery. This test was used since assessments of *Normality* identified that the data were non-normally distributed. Hence, a non-parametric test was utilised. The *effect size* is also presented. A descriptive table for monoliterate readers is first presented. Fifteen participants with DS completed the reading tasks in 1 language. Ten participants completed the tasks in English, while 5 completed the tasks in Maltese. As portrayed in Table 25, the choice of language for administration was not always dependent on the language used at home.

The Maltese subtests were standardized by Agius (2012). The standardization of the assessment tool identified the percentile scores of participants between 8 and 12 years. Results from the DS group on the Maltese Word and Nonword reading task identify that the DS group performed between the .01 and .25 percentile rank for this age group on Word reading and between .0 and .28 percentile on Nonword reading. The TD group performed between the .0 and the .02 percentile on Word reading while on the .01 percentile on Nonword reading Tasks. This result was expected as the tool was standardized on an older cohort.

The scores were interpreted according to the TOWRE Age Equivalent scores. It needs to be noted that these norms are not standardized on the Maltese population. The age equivalent scores for both Word and Nonword reading tasks are summarized in Table 24. It can be noted that some students managed to achieve close to age equivalent scores.

Table 24

Age Equivalent Scores for English Word and Nonword reading tasks.

	English Word		English Nonword	
Group	Raw Score	Age Equivalent	Raw Score	Age Equivalent
DS N =16	2[1], 5[2], 7[3], 12[4]	<5 yrs	6[a]	6 yrs
	20[5], 22[6], 23[7]	6.3 yrs	8[b], 10[c]	6.3 yrs
	62[8]	8.9 yrs	11[d], 12[e]	6.6 yrs
	78[9]	12.6 yrs	14[f]	6.9 yrs
	94[10]	>17.9	20[g], 21[h]	7.6yrs
			23[i], 24	7.9 yrs
TD N=19	0 – 9	<5 yrs	0-3	6 yrs
			7-9	6.3 yrs

Note: **The students' chronological ages *English Word Reading***: [1]13 yrs & 12 yrs, [2]= 11yrs, 14,yrs, 15 yrs & 19 yrs,[3]10 yrs [4]10 yrs, [5]10 yrs, [6]12 yrs & 11 yrs, [7]12yrs, [8]13 yrs & 16 yrs, [9]10 yrs, [10]19 yrs.

The students' chronological ages *English Nonword Reading*: [a]12 yrs, 13yrs & 11 yrs, [b]10 yrs & 19yrs, [c]14 yrs & 15 yrs, [d]13yrs & 10 yrs, [e]11 yrs, [f]10 yrs, [g] 16yrs, [h] 10 yrs, [i] 12yrs & 12 yrs, [j]19 yrs.

Maximum score on Word Reading = 104; **Maximum possible score on Nonword Reading** = 63.

Table 25

Descriptive Statistics and results of monoliterate readers with DS and TD groups

Variable	DS			TD					
Language at Home	M = 6	E = 8	B = 1	M=8	E=8	B=3			
Gender	M =8	F = 7		M=13	F=6				
Age	Min = 10 Max = 19	Mean =13.6	SD= 2.72	Min = 5 Max = 7	Mean= 5.7	SD = .627	*p*=.00		
Assessment Task	N	M	SD	N	M	SD	*Mann-Whitney-u*	*p*-value	*D*
RCPM	15	13.6	3.29	19	13.8	3.0	182.5	.890	.49**
SIT English	10	5.4	2.95	19	6.47	2.98	77.0	.405	.846***
SIT Maltese	5	7	2.34	19	7.79	2.39	39.0	.541	1.5***
Word Reading English	10	31.18	35.13	13	15.5	6.57	72.0	.784	.182*
Word Reading Maltese	5	23.75	24.54	6	10	2.72	20.5	.843	.635**
Nonword Reading English	10	18.9	20.01	13	6.73	2.76	44.5	.454	.55**
Nonword Reading Maltese	5	18.75	27.54	6	5.07	4.39	22.0	.574	.835***

Note: Language at Home: M= Predominantly Maltese, E=Predominantly English, B =Equal use of both languages; Effect size: *small sample effect size,

**medium sample effect size, ***large sample effect size as *interpreted according to Lenhard & Lenhard (2016).*

***Comparison between groups*.** To investigate the first research question: *Do monoliterate individuals with DS perform similarly to the TD participants on Word and Nonword reading tasks?* The researcher compared the performance of the DS group with the TD group on Word Reading and Nonword reading in the monoliterate group. Each language was analysed separately. From Table 25, a significant difference between Ages was observed. Thus the sample was controlled for these variables through *ANCOVA.* The analysis with controlled variables can be found in Table 27.

Reading Tasks. The *Mann-Whitney-U Test* was used to compare the performance of both groups since data were *non-normally* distributed. This test was used as a non-parametric alternative. Refer to p. 462 for Normality testing. An *ANCOVA* analysis was used to test the effect of the covariate. The homogeneity assumption was not met for both word and nonword reading; hence, the models were adjusted with *Robust Standard Errors*. The *effect size* between groups varied (refer to Table 25). The TD group was during the initial months of formal literacy training; hence, most participants had only received training in one language and could not read in both. The DS group were older (refer to Table 25); hence literacy training and exposure to both language was more extensive. The researcher subdivided the groups according to the language of administration. This posed difficulties to maintain an equal sample between DS and TD groups. In such cases, the results need to be interpreted with caution. Agius (2012) provided standardization of scores on both Word and Nonword reading tasks in Maltese. The standardization ranged from ages 8 to 12. Therefore it needs to be noted that the TD participants in this study were younger than the group used to standardise this tool. A standardized test for this age group (6 years) is currently unavailable locally. Results from the DS group show individual variability. The lower end of scores showed that participants performed around the .01 percentile, while the higher end of scores shows that participants scored around the .85 percentile. The 1. percentile was not reached by any participants; therefore, no participant scored above the 12 years of age top threshold.

Word Reading. The analysis was subdivided according to the language of administration. Non-parametric comparison of means shows no significant difference between groups on reading tasks in both languages. No significant difference is identified between groups in English Word Reading (*Mann Whitney U* = 72, *p*= .785) and Maltese Word Reading (*Mann Whitney U* = 20.5, *p*= .843). Large effect size was reported on both tasks. The difference is maintained when the sample is controlled for age. The *ANCOVA* measure was used to test the effect of the covariate English Word Reading: F(1,22)=.366, p=.729, Maltese Word Reading: F(1,9)=-412, p=.843.

Nonword Reading. The analysis identified no significant differences in Nonword reading tasks between DS and TD groups in both languages. English Nonword Reading (*Mann Whitney U* = 44.5, *p*= .454), Maltese Nonword Reading (*Mann Whitney U* = 23.5, *p*= .631). A *non-parametric* comparison between groups while controlling for age shows that Maltese Nonword reading F(1,9)=.010, p=.974, English Nonword Reading F(1,18)=.603, *p*=.732 do not differ between groups when controlled for age.

The researcher compared the performance of the monoliterate participants of each group on Word and Nonword reading tasks in each language to investigate whether a difference in performance is identified between Word and Nonword reading abilities. The *Min-Max Technique* first normalised the data from all four reading tasks. The technique gives a linear transformation of the original range of data (Krishna Patro & Kumar Sahu, 2015). *The Wilcoxon Signed Rank Test* was used to compare the performance of the same group of participants on the two different measures. This test was used since the data were non-normally distributed.

A *Wilcoxon signed-rank test* presented a significant difference (Z = -2.589, p= .010) between scores on Maltese word reading and Maltese Nonword reading in the DS group. This result shows that the Maltese readers with DS performed better on word reading when compared to nonword rading. *Cohen's d* statistic shows a large effect size (*d*= 1.12).

The *Wilcoxon SR test* was also computed to examine the DS group's similarity or difference in performance on the English Word and Nonword reading tasks. A significant difference was identified (z=-2.853, p=.004), showing that Word and Nonword reading is not uniform in the English Language. Also identifying that a significantly better performance was obtained on word reading when compared to nonword reading. *A large effect size* was reported at (d=1.011).

In the TD group, the *Wilcoxon signed-rank test* presented no significant difference (Z = -1.841, p= .066, N=6) between Maltese word reading and Maltese Nonword reading scores in the TD group. This shows that the group performed similarly on both measures. However, it needs to be noted that this group was made of a small sample of participants (N=6). *Cohen's d* statistic shows a large effect size (d=1.7). The *Wilcoxon SR test* was also computed to examine the TD group's similarity or difference in performance on the English Word and Nonword reading tasks. A significant difference was identified (z=-2.667, p=.008, N=13). Indicating a similar performance to the DS group. *A large effect size* was reported at 1.38.

Analysis of association between reading and sub-skills in the monoliterate participants.

In Section 2, the performance of the participants who completed the full assessment battery is presented. Data for this section was collected during Phase 3 and 5 of data collection (refer to p. 112). In this analysis, the researcher presents the associations between reading tasks and sub-skills. As in Section 1, the researcher subdivided the group according to the language of administration. In order to minimise any ambiguity with regards to the language used, the participants who completed the full assessment battery in the same language were only evaluated. In some instances, participants completed the SIT and Vocabulary Task in a different language than the choice of language for reading, however they were encouraged to complete this in the same language This subdivision reduced the sample size in each subgroup. Statistical computations were still implemented; however, these need to be interpreted cautiously due to the small sample size (R. Sammut, personal communication, March 4, 2022).

The descriptive statistics of the participants with DS are presented in Table 26 and Table 27. A composite score of the 5 PA tasks was computed. In Chapter 4, it was ascertained that a high correlation is present between PA skills; hence, throughout this chapter, a composite score was utilised through this chapter. A high correlation between VPPS was also identified. Hence a composite score was also computed for VPPS. The clustering allowed the researcher to evaluate multidimensional data in one score (Song et al., 2013).

Table 26

Descriptive Statistics and results on the assessment battery of participants with DS in the English Language

Variable	DS		
Language at Home	M = 2	E = 7	B = 1
Gender	M = 7	F = 3	
Age	Min = 10 Max = 17	Mean =13.5	SD= 2.29
Assessment Task	N	M	SD
RCPM	10	13.8	3.2
SIT English	10	5.6	2.96
PPVT English	10	59.8	23.32
Word Reading English	10	38.5	31.2
Nonword Reading English	10	17.06	22.3
Composite PA English	10	2.5	1.38
Composite VPPS	10	2.6	1.16

Note: Language at Home: M = Predominantly Maltese, E = Predominantly English, B = Equal use of both languages

Table 27

Descriptive Statistics and results on the assessment battery of participants with DS in the Maltese Language

Variable	DS		
Language at Home	M = 4	E = 0	B = 0
Gender	M = 1	F = 3	
Age	Min = 10 Max = 19	Mean =13.75	SD= 4.11
Assessment Task	N	M	SD
RCPM	4	12.75	1.25
SIT Maltese	4	7.25	2.63
PPVT Maltese	4	83.75	17.02
Word Reading Maltese	4	23.75	24.541
Nonword Reading Maltese	4	18.75	27.548
Composite PA Maltese	4	3.41	.85
Composite VPPS	4	3.02	.603

Note: Language at Home: M = Predominantly Maltese, E = Predominantly English, B = Equal use of both languages

Correlation Analysis

Correlation analysis was implemented to answer the third research question: *Do RCPM, PA, VPPS, SIT, and Receptive Vocabulary predict Word and Nonword reading attainment in Maltese participants with DS?* Different analyses were computed for assessments completed in Maltese and English. Hence correlations for the English and Maltese respondents were separated for the monoliterate group. The variables entered in the correlation analysis for the English sample included: RCPM, English Word Reading, English Nonword reading, English PA, RCPM, English PPVT, English SIT and VPPS, whereas for the Maltese sample, the following variables were entered in the analysis: RCPM, Maltese Word Reading, Maltese Nonword reading, RCPM, Maltese PA, Maltese PPVT, Maltese SIT and VPPS. Due to the separation of the sample, *N* in each subgroup was reduced; hence each correlation needs to be interpreted with caution. The number of respondents in each correlation is represented in each separate equation. The correlations were partially controlled for age. Table 28 represents the correlations and partial correlations for the participants who responded in English, while Table 29 represents the Maltese respondents.

When responding in Maltese, a correlation between Word Reading and Nonword reading was only identified ($rs(2) = 1.$, $p=.001$). However, this group has a very small sample size, and the researcher feels that further investigation with increased sample size is needed to have enough information to achieve reliable conclusions.

When responding in English, a correlation between Word Reading and Nonword reading was was identified ($rs(8) = .957$, $p = .003$). A correlation between English word reading and VPPS ($rs(8) = .824$, $p = .04$) has also been identified. This sample also shows that PPVT scores are correlated to English PA ($rs(8) = .819$, $p = .04$).

Table 28

Correlation and Partial Correlations in predictor variables in the group of monoliterate participants with Down Syndrome who responded in Maltese

Control Variable	Variables		*N*	*M*	*SD*	1	2	3	4	5	6
None	1	RCPM	4	12.75	1.25						
	2	SIT Maltese	4	7.25	2.63	.316					
	3	PPVT Maltese	4	83.75	17.02	.632	.800				
	4	Word Reading Maltese	4	23.75	24.541	.632	.800	1.0**			
	5	Nonword Reading Maltese	4	18.75	27.54	.632	.800	1.0**	.989		
	6	Composite PA Maltese	4	3.41	.85	.949	.400	.800	.800	.80	
	7	Composite VPPS	4	3.02	.603	.316	-.200	-400	-.400	-.400	.00
Age	1	RCPM									
	2	SIT Maltese				.999*					
	3	PPVT Maltese				.697	.732				
	4	Word Reading Maltese				.966	.978	.858			
	5	Nonword Reading Maltese				.999*	.996	.672	.957		
	6	Composite PA Maltese				.970	.981	.850	1.0**	.962	
	7	Composite VPPS				.305	.257	-.470	-.050	.338	.067

Note: *p= .05, ** p=<.01

Table 29

Correlation and Partial Correlations in predictor variables in the group of participants with Down Syndrome who responded in English

Control Variable	Variables		*N*	*M*	*SD*	1	2	3	4	5	6
None	1	RCPM	10	13.8	3.2						
	2	SIT English	10	5.6	2.96	.597*					
	3	PPVT English	10	59.8	23.32	.200	.390				
	4	English Word Reading	10	3.41	.85	-.073	.261	-.017			
	5	English Nonword reading	10	3.18	1.05	-.051	.337	.078	.961**		
	6	Composite PA English	10	2.5	1.38	.327	.578	.655	.550	.692	
	7	Composite VPPS	10	2.6	1.16	-.167	.230	-.238	.778*	.685	.382
Age	1	RCPM									
	2	SIT English				.303					
	3	PPVT English				.506	.819*				
	4	English Word Reading				.100	.533	.635			
	5	English Nonword Reading				-143	.546	.512	.957*		
	6	Composite PA English				.600	.590	.762	.754	.579	
	7	Composite VPPS				-.163	.294	.412	.824*	.800	.676

Note: *p= .05, ** p=<.01

Multiple Regression Analysis

A multiple linear regression model was fitted to the data obtained by the DS and TD groups to test whether there was a relationship between PPVT, PA, SIT, VPPS, RCPM and reading measures. The analysis assessed whether the previously identified correlations could be identified as significant predictors of a DV. This analysis aided in answering the third research question. The independent variables (IV) were also chosen following preliminary results obtained in Chapter 4 and since predictors have been identified in the literature (refer to p. 45 for Receptive Vocabulary, p. 62 PA, p. 73 SIT, VPPS p. 81 and RCPM p. 54). Additionally, the IV were also chosen following results from Study 1. Due to the small sample sizes, groups were analysed separately to maintain sufficient power in each model and ascertain that the number of variables entered in each model was not greater than the number of respondents. The researcher planned to complete a multiple regression analysis for both the Maltese and the English sample in the monoliterate group; however, due to the small sample sizes, the assumptions for multiple regression were not ascertained for both subgroups; hence the analysis was not completed.

Section 2: Analysis of the Biliterate Group

The researcher combined participants from Phase 3 and Phase 5 of data collection. The participants' performance who were able to read in both Maltese and English was evaluated. Sixteen participants completed the reading tasks in both languages. Fifteen participants completed the full assessment battery. However, 1 participant did not complete the PA and VPPS tasks as a second appointment could not be made. The performance of this participant was not included in the correlation and multiple regression analysis. The reader is reminded that TD could not complete reading tasks in both languages. Therefore the performance of the DS group only is presented hereunder. Table 30 illustrates the descriptive statistics of the participants on each assessment task.

Table 30

Descriptive Statistics of the Biliterate group

Variable	DS					
Language at Home	M = 10	E = 6	B = 0			
Language at School	M= 4	E= 4	B= 8			
Gender	M =8	F = 8				
Age	Min = 7	Max = 19	Mean =13.8	SD= 3.69		
Assessment Task	N	M	SD	Wilcoxon Signed-Rank Test	*p*-value	Effect size *d*
RCPM	16	14.31	3.55			
SIT English	16	5.37	3.64	-.233	.816	.082
SIT Maltese	16	5.69	4.54			
PPVT English	16	57.88	26.24	-1.112	.266	.402
PPVT Maltese	16	68.38	31.95			
Word Reading English	16	49.44	30.52	-2.689	.007	1.081
Word Reading Maltese	16	21.19	17.11			
Nonword Reading English	16	17	23.0	-.170	.865	.006
Nonword Reading Maltese	16	14.19	18.27			
Composite PA Maltese	15	3.34	.89	-1.669	.095	.618
Composite PA English	15	2.72	1.33			
Composite VPPS	15	2.73	1.08			

Note: Language at Home: M= Predominantly Maltese, E=Predominantly English, B =Equal use of both languages

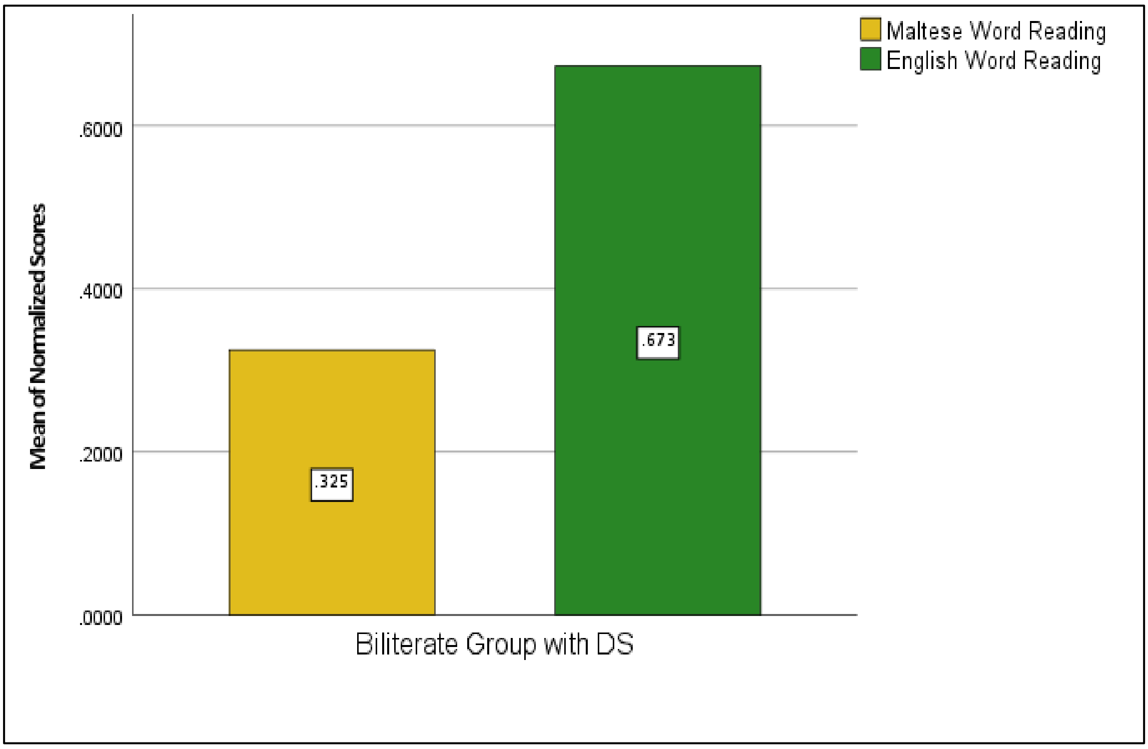
The researcher investigated the participants' performance and tested whether the participants performed better in a language compared to the other on reading tasks. This analysis was computed by using the *Wilcoxon Signed-Rank Test*. Secondly, the researcher tested whether the group of participants with DS performed better on Word Reading Tasks when compared to nonword reading tasks. For the researcher to compare this group's performance on both tests, the *Min-Max Technique* was used to normalise the raw scores. This allowed the researcher to compare data collected from different distributions, in this case, two assessment tools with different scales.

The researcher investigated whether the group performed differently when tasks were administered in Maltese or English. The participants performed similarly on SIT, PPVT, Nonword Reading, and PA from this sample. However, a significant difference was identified between Maltese

Word reading and English Word reading (z=-2.689, p=.007, *d*=1.081). The biliterate group achieved better results on English Word reading. The distribution of the scores is illustrated in Figure 20

Figure 20

Distribution of Normalized scores of Maltese Word and English Word Reading in the biliterate group



The difference between Word and Nonword reading was tested as a second analysis. A difference between Word and Nonword Reading was identified. The participants with DS performed better on word Reading tasks in Maltese (z=-2.480, p=.013, *d*=.908) with a large effect size (refer to Figure 21) and English (z=-2.726, p=.006, *d*=1.02) with large effect size when compared to nonword reading (refer to Figure 22).

Figure 21

Distribution of Normalized scores of Maltese Word and Maltese Nonword Reading in the biliterate group

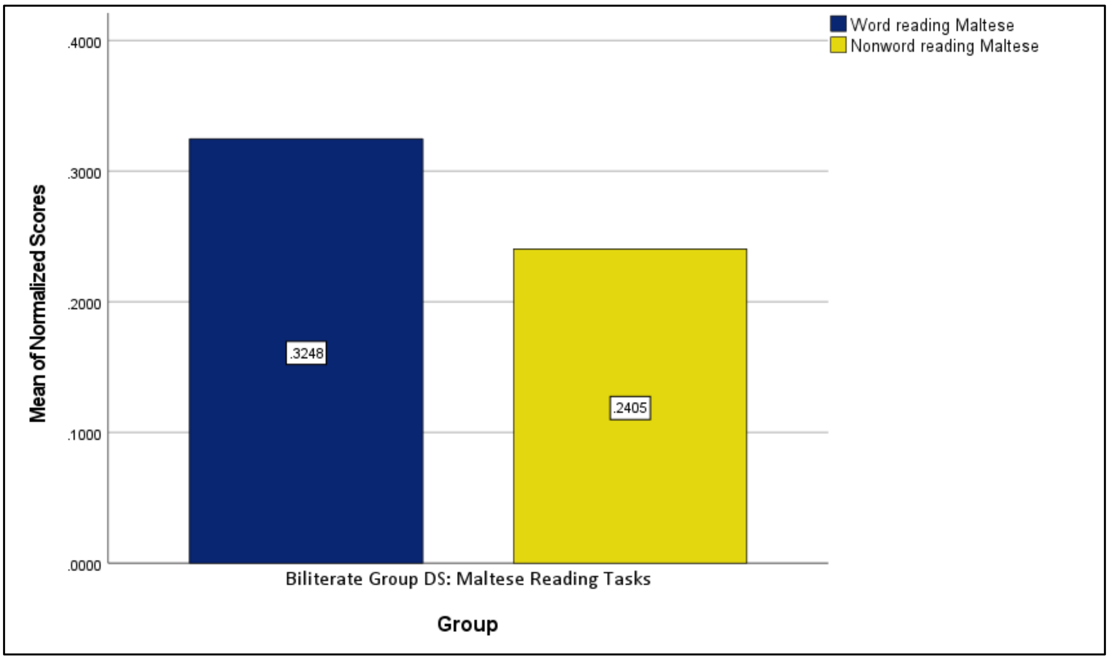
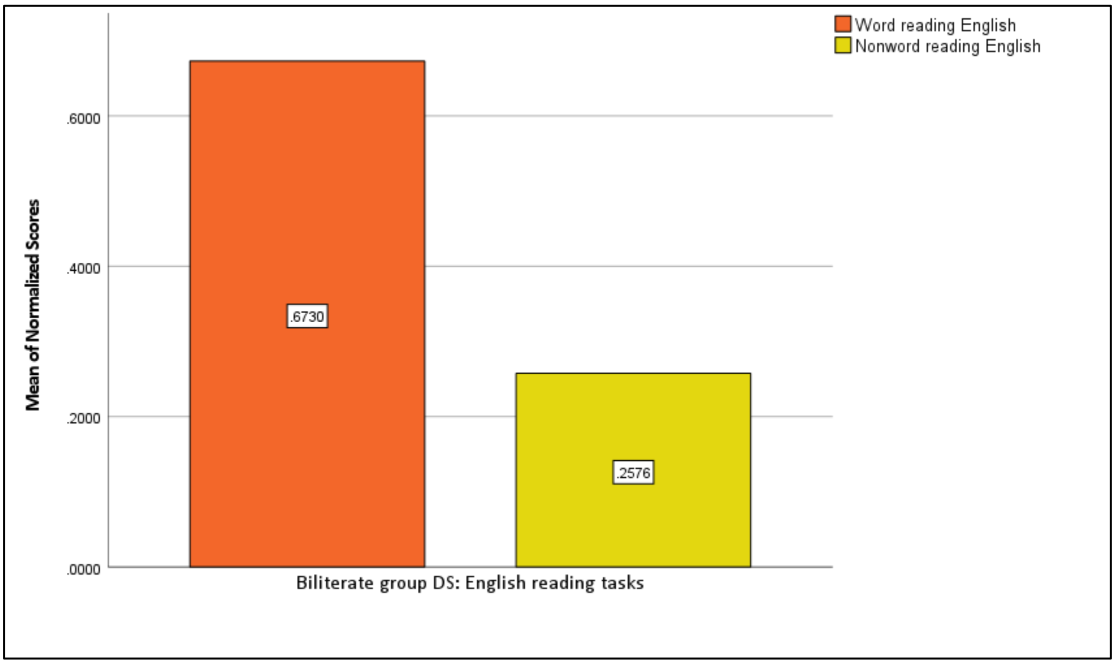


Figure 22

Distribution of Normalized scores of English Word and English Nonword Reading in the biliterate group.



Correlation Analysis in Biliteracy. A correlation analysis was conducted to investigate the relationship between the different reading tasks, Maltese and English PPVT, Maltese and English SIT, Maltese and English PA and VPPS. A partial correlation for the variable Age is also presented (refer to Table 32); however, no change in the correlations has been identified. The analysis identified significant correlations that are summarised in Table 31.

Table 31

Summary of Correlation Equations for the Biliterate group of participants with DS

Correlated Variables	Correlation Equation
English PPVT with English SIT	($rs(14)$ =.557, p = .025)
Maltese PPVT with Maltese SIT	($rs(14)$ =.729, p = .001)
PA English with English SIT	($rs(14)$ =.614, p = .015)
PA English with Maltese VPPS	(rs(14 = .526, p =.044)
Nonword reading English with PA Maltese	($rs(14)$ =.811, p = .000)
Nonword reading Maltese with Word reading Maltese	($rs(14)$ =.665, p = .005)

Table 32

Correlation Analysis in the Biliterate group of participants with DS

Control Variable		Variables	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11
None	1	RCPM	14.31	3.55											
	2	SIT English	5.37	3.64	.249										
	3	SIT Maltese	5.69	4.54	.241	.047									
	4	PPVT English	57.88	26.24	.060	.557*	-.278								
	5	PPVT Maltese	68.38	31.95	.400	.056	.729**	-.120							
	6	Composite PA English	3.34	.89	.035	.614*	.243	.135	.526*						
	7	Composite PA Maltese	2.72	1.33	.425	.363	-.144	.213	.271	.323					
	8	Composite VPPS	2.73	1.08	.273	.163	.317	.139	.060	-.218	-.063				
	9	Word Reading English	49.44	30.52	.263	.179	.082	.018	.016	.092	.291	.188			
	10	Word Reading Maltese	21.19	17.11	.495	-.083	.329	-.222	.140	-.223	.021	-.004	.373		
	11	Nonword Reading English	17	23.0	.409	.405	.060	.016	.206	.243	.811**	.107	.151	.115	
	12	Nonword Reading Maltese	14.19	18.27	.249	-.049	.398	-.366	.229	.102	-.266	-.250	.337	.665*	-.331
Age	1	RCPM													
	2	SIT English			.180										
	3	SIT Maltese			.404	.034									
	4	PPVT English			.105	.449*	-.237								
	5	PPVT Maltese			.362	.126	.809**	-.096							
	6	Composite PA English			-.134	.588*	.278	-.050	.413*						
	7	Composite PA Maltese			.224	.354	-.209	.049	.156	.372					
	8	Composite VPPS			.143	.354	.195	.309	.067	.008	-.117				
	9	Word Reading English			.495	.122	.063	.023	-.067	.121	.330	.076			
	10	Word Reading Maltese			.474	-.052	.447	-.291	.216	.036	-.074	-.256	.409		
	11	Nonword Reading English			.446	.426	.032	.061	.264	.274	.724*	.231	.253	.261	
	12	Nonword Reading Maltese			.314	.077	.394	-.256	.134	.312	-.044	-.315	.472	.909**	-.184

Note: *p= .05, ** p=<.01; N =16.

Multiple Regression Analysis. A multiple linear regression model was fitted to the data obtained by the biliterate DS group to test the predictors of Word and Nonword reading tasks. Due to the small sample size, the researcher needed to ascertain that only a restricted number of variables were entered in each model. The researcher used results from Study 1, correlation analysis and the review of the relevant literature to decide whether an independent variable was to be included in the analysis. Backward elimination was used to remove variables; refer to p. 144 for details about the elimination method. The researcher is aware of the small sample size, however it needs to be noted that the population is examination is rather small. In the analysis the R^2 will also be presented, this allows the reader to interpret the goodness of fit of each model. Yet the sample size is still considered as a limitation and does not allow generalisabilty.

Correlation analysis (refer to Table 32) indicated that VPPS did not share a relationship between Word and Nonword reading tasks in this population. Hence VPPS was not included as an IV. On the other hand, PA tasks, PPVT and SIT showed to be correlated with reading tasks. Hence these were included as IV in each model. RCPM was not identified as correlated to reading abilities in the correlation analysis. However, in Study 1, it was identified as a predictor of Nonword reading. Hence it has been included as an IV. The models are summarised in Table 33.

Table 33

Dependent and Independent variables for Multiple Regression Analysis in the biliterate group

Model	Dependent Variable	Independent Variables
1	English Word Reading	English PA, Maltese PA, English PPVT, Maltese PPVT, English SIT, Maltese SIT, RCPM.
2	Maltese Word Reading	English PA, Maltese PA, English PPVT, Maltese PPVT, English SIT, Maltese SIT, RCPM.
3	English Nonword Reading	English PA, Maltese PA, English PPVT, Maltese PPVT, English SIT, Maltese SIT, RCPM.
4	Maltese Nonword Reading	English PA, Maltese PA, English PPVT, Maltese PPVT, English SIT, Maltese SIT, RCPM.

Model 1: DV: English Word Reading. The assumptions for multiple regression were first tested and ascertained. Table 34 indicates the variables entered and removed in Model 1. The final model identified Maltese Composite PA, Maltese PPVT and Maltese SIT as predictors of English Word reading; however, the model is not statistically significant. $F(3,11) = 2.055$, $p = .165$. This shows that not enough data is available to confirm the model.

Table 34

Variables Entered and Removed for English Word Reading as DV

Model	Variables Entered	Variables Removed	Method
1	PPVT English, PPVT Maltese, RCPM, SIT English, SIT Maltese, Composite PA Maltese, Composite PA English. [a]	.	Enter
2	.	PPVT English	Backward (criterion: Probability of F-to-remove >= .100).
3	.	SIT English	Backward (criterion: Probability of F-to-remove >= .100).
4	.	Composite PA English	Backward (criterion: Probability of F-to-remove >= .100).
5	.	RCPM	Backward (criterion: Probability of F-to-remove >= .100).

Note; Group = Down Syndrome, Dependent Variable: English Word Reading; [a]ll requested variables entered in the model; N=16.

Model 2: DV: Maltese Word Reading. The assumptions for multiple regression were first tested and ascertained. Table 35 indicates the variables entered and removed in Model 2. The final model identified Maltese SIT as a predictor of Maltese Word reading; however, the model was not statistically significant, $F(1,16) = 4.013$, $p = .066$. This shows that insufficient data is available to confirm the model, and further investigation is needed.

Table 35

Variables Entered and Removed for Maltese Word Reading as DV

Model	Variables Entered	Variables Removed	Method
1	PPVT English, PPVT Maltese, RCPM, SIT English, SIT Maltese, Composite PA Maltese, Composite PA English. [a]	.	Enter
2	.	Composite PA English	Backward (criterion: Probability of F-to-remove >= .100).
3	.	SIT English	Backward (criterion: Probability of F-to-remove >= .100).
4	.	Composite PA Maltese	Backward (criterion: Probability of F-to-remove >= .100).
5	.	PPVT English	Backward (criterion: Probability of F-to-remove >= .100).
6		RCPM	Backward (criterion: Probability of F-to-remove >= .100).
7		PPVT Maltese	Backward (criterion: Probability of F-to-remove >= .100).

Note; Group = Down Syndrome, Dependent Variable: Maltese Word Reading; [a]. All requested variables entered in Model 2; N=16.

Model 3: DV: English Nonword Reading. The assumptions for multiple regression were first tested and ascertained. Table 36 indicates the variables entered and removed in Model 3. The final model identified Composite Maltese PA as a predictor of English Nonword reading. The model was statistically significant, $F(1,13) = 14.301$, $p = .002$ (refer to Table 37). The coefficient of determination R^2 resulted in $R^2 = .524$, showing Maltese PA explains 53% of the total variation of English Nonword reading scores. The final predicted model was:

$$Y = \beta_0 + \beta_1 X$$

$$\text{English Nonword reading} = -44.766 + (18.795 * \text{Maltese PA})$$

Table 36

Variables Entered and Removed for English Nonword Reading as DV

Model	Variables Entered	Variables Removed	Method
1	Composite PA Maltese, PPVT English, PPVT Maltese, RCPM, SIT English, Composite PA English, SIT	.	Enter
2	.	SIT	Backward (criterion: Probability of F-to-remove >= .100).
3	.	PPVT Maltese	Backward (criterion: Probability of F-to-remove >= .100).
4	.	Composite PA English	Backward (criterion: Probability of F-to-remove >= .100).
5	.	PPVT English	Backward (criterion: Probability of F-to-remove >= .100).
6	.	SIT English	Backward (criterion: Probability of F-to-remove >= .100).
7	.	RCPM	Backward (criterion: Probability of F-to-remove >= .100).

Note; Group = Down Syndrome, Dependent Variable: English Nonword Reading; [a]. All requested variables entered in Model 3; N=16.

Table 37

Regression Analysis with English Nonword reading as a DV in DS Group

Model	*B*	*SE*	Β	T	*P*
Constant	-44.766	17.184		-2.605	.022
Maltese PA	18.795	4.970	.724	3.782	.002

Note. R^2 = .524; Adjusted R^2= *.487* Durbin-Watson = 1.824.

Model 4: DV: Maltese Nonword Reading. The assumptions for multiple regression were first tested and ascertained. Table 38 indicates the variables entered and removed from Model 4. The final model identified Maltese SIT and Maltese PPVT as predictors of Maltese Nonword reading; however, the model was not statistically significant, *F*(2,12) = 3.640, *p* = .058. However, the significance value is not far from the .05 criterion. This shows that insufficient data is available to confirm the model, and further investigation is needed.

Table 38

Variables Entered and Removed for Maltese Word Reading as DV

Model	Variables Entered	Variables Removed	Method
1	Composite PA Maltese, PPVT English, PPVT Maltese, Composite PA English, SIT English, Maltese SIT	.	Enter
2	.	PPVT English	Backward (criterion: Probability of F-to-remove >= .100).
3	.	SIT English	Backward (criterion: Probability of F-to-remove >= .100).
4	.	Composite PA English	Backward (criterion: Probability of F-to-remove >= .100).
5	.	Composite PA Maltese	Backward (criterion: Probability of F-to-remove >= .100).

Note; Group = Down Syndrome, Dependent Variable: Maltese Nonword Reading; [a.] All requested variables entered and removed in Model 4; N=16.

In summary, it can be identified that SIT and PA were considered major contributors to Word and Nonword reading in the biliterate group of individuals with DS. However, correlations amongst subskills were also identified, such as SIT and PPVT. The implications of these results follow.

Summary of results

The results represented in this chapter provided information about a group of participants with DS. The group was assessed on an assessment battery, including reading and reading-related skills assessments. This data was collected during Phases 3 and 5. Some participants completed the tasks in both Maltese and English, hence providing useful data about bilingualism and biliteracy. A comparison between the participants with DS and the control group was also provided. An investigation of correlation was also consequently given. Following is a summary of the results, after a discussion of the results will be presented.

Monoliterate Group

- In the monoliterate group, the DS group performed similarly to the control group on all reading measures in both languages when matched on a measure of fluid intelligence.
- In the DS group, a significant difference was found between Word and Nonword reading scores in both Maltese and English. The group obtained better results on Word reading.
- Maltese Word reading significantly correlated with Maltese Nonword reading, while no association between reading and PA, VPPS and PPVT has been identified.
- English Word reading correlated with VPPS.
- PPVT and SIT were correlated in English respondents.

Biliterate Group of Participants with DS

- There was a similar performance on PPVT, SIT, Nonword reading, and PA in Maltese and English subtests.
- Better Word reading abilities on the English subtest compared to the Maltese subtest were identified.
- Better Word reading abilities compared to Nonword reading abilities were observed in both languages.
- Maltese Word reading was solely correlated with nonword reading.
- English Nonword reading correlated with Maltese PA
- A correlation between PPVT and SIT in the English language was identified.
- Maltese PA predicted English Nonword reading. However, no statistically significant predictor was identified for English Word reading, Maltese Word reading, and Maltese Nonword reading.

Discussion

The investigation results in Study 2 have been presented, and a discussion of the results now follows. The research questions are then answered. The investigation of reading abilities in Maltese students with Down Syndrome population provided information about the local linguistic context.

Thirty-one participants participated in this study; 16 participants were able to read in Maltese and English, showing that a substantial proportion of Maltese students with DS are successful bilingual readers (52%). Monoliterate participants favoured reading in English (32%) compared to Maltese (16%). Such distribution in the choice of reading language led to sample dispersion in the analysis. The researcher could not analyse the group together as language differences impinge on reading characteristics. This posed a limitation in the analysis as the sample sizes were reduced once they were sub-divided.

The aspect of bilingualism also needs to be reflected on. Although some participants have been identified as monoliterate, this does not mean that the participants are monolingual. This was clearly identified in the TD group, where most participants were bilingual; however, they could only read in one language due to the lack of training in the other language. This was similarly noted in the DS group of monoliterate participants. During data collection, it was noted that a number of DS participants could effectively communicate in both languages at varying levels but could only read in one. An evaluation of the Maltese linguistic environment identifies that it is difficult to identify 'pure' monolinguals (Martinelli & Brincat, 2020). Hence there is still the possibility of cross-language transfer also in monoliterate participants. Cross-language transfer is discussed further on p. 222.

The discussion of the research questions is now presented.

Research Question 1: Do monoliterate individuals with DS perform similarly to the TD participants on Word and Nonword reading tasks?

In Hypothesis 1, The researcher maintained that the performance of the DS group is similar to the TD group on Word and Nonword reading tasks when matched by RCPM scores. The hypothesis is accepted as no difference between the DS and TD groups was identified on Maltese and English measures. The abilities of the DS group are discussed in detail.

DS readers have often been described as strong alphabetic readers (Ratz, 2013); however, they find difficulty at an orthographic stage of reading (Cupples & Iacono, 2000; Cardoso-Martins et al., 2008; Snowling et al., 2008; Roch & Jarrold, 2012). Nevertheless, it has also been reported that successful nonword reading development occurs in DS (Burgoyne et al., 2014; Hulme et al., 2012; Næss et al., 2012; Roch & Jarrold, 2012). Many of the participants in this study were capable of analysing the words, reading by sight and decoding words as needed. When analysed through the stages of reading development proposed by Frith (1985), results show that the DS group performed successfully throughout the Logographic and Alphabetic stages. Ratz (2013) maintained that DS participants remain in the alphabetic stage. Orthographic reading implies that readers access the meaning of words automatically (Frith, 1985). Unfortunately, this has not been tested in this study, so orthographic reading can not be ascertained, and hence it is a recommendation for further research.

In the literature, it has also been argued that in DS, reading real words is more successful than reading nonwords (Burgoyne et al., 2014; Hulme et al., 2012; Næss et al., 2012; Roch & Jarrold, 2012, Loveall et al. 2021), findings from this study showed that the DS group was able to read both words and nonwords. However, the participants were more successful in Word reading. This was reported in monoliterate readers in Maltese and English. This finding supports the current literature. Data from the TD group shows the groups performed similarly to the DS group on the English tasks, where a better performance on word reading was identified; however, the performance was different on the Maltese reading tasks. No difference between word and nonword reading was identified in the TD group reading in Maltese (*p*=.066). This could possibly be attributed to the language's characteristics and the young age of the TD group. Maltese possess a very regular orthography, and hence early readers tend to decode both words and nonwords alike due to the high phoneme-to-grapheme correspondence (Agius, 2012; Hasenäcker & Schroeder, 2022). The results presented in this study also indicate a large effect size between DS and TD groups. This could also have influenced the significance of the results.

Maltese is a language with a shallow orthography and has a more transparent mapping between phonology and spelling when compared to English. English is considered to have an opaque orthography; on the other hand, this has been described as being more difficult to acquire (Borleffs et al., 2019). This concept is sustained by the *Orthographic Depth Hypothesis,* as discussed on p. 23. Xuereb (2009) maintained that a non-lexical route to reading is sufficient for all regular, irregular and nonwords when both Maltese and English were evaluated. In this sample, the DS group who could read in 2 languages did not differ between Maltese and English nonword reading. Hence Xuereb's claim is supported.

An analysis of the results through *The Dual Cascade Model* (1993) shows that DS participants can successfully utilise both lexical and sub-lexical routes. The nature of the Maltese Language does not indicate to have impinged on the development of reading abilities and the success in phonological decoding. This is because results from both languages had a similar outcome. Moreover, Snowling et al. (2008) state that in DS, a difficulty in decoding unfamiliar words, or nonwords, is present and associated with PA difficulties. Results from this study are in contrast with Snowling et al. (2008). An analysis of PA abilities was implemented in this study. Results indicated that PA developed at par with the control group in both languages when the sample was controlled for age in the group of monoliterate participants. The relationship between sub-skills and reading abilities is further discussed in Research Question 3, p. 222.

At the beginning of the investigation, the researcher hypothesized (Hypothesis 1) that the performance of the DS group is similar to the TD group on word and nonword reading tasks when matched by RCPM scores. Hypothesis 1 has been accepted in Study 2.

Research Question 2: How do Maltese biliterate participants with DS perform on Word and Nonword reading tasks?

In the literature review it has been identified that research in biliteracy in DS is very limited. Results from this study provide novel insight into aspects of biliteracy in DS. The Maltese linguistic context is unique and varying levels of bilingualism and translingualism are reported both in the home and in the school setting; it is important to keep this context in perspective when interpreting the results. Camilleri Grima (2016) reports that Maltese TD children are constantly exposed to both languages and, at times, also a third. Translingualism is often reported and encouraged in the classroom in all school settings (Panzavecchia, 2020). In addition, Camilleri Grima (2016) adds that the use of languages has important social implications where a constant interplay between languages supports the social structures. Book reading and the internet are extensively carried out in English, while conversations with parents (Grech & Dodd, 2008) and teachers are mostly conducted in Maltese (Camilleri Grima, 2016). However, the school setting also has its influences. This relationship has not been specifically studied in Study 2; however, it is investigated further in Chapters 6 (p. 228) and 7 (p. 271). Such a strong bilingual environment could have positively contributed to the successful bilingual abilities of this group of participants.

From this study, 16 participants with DS could read in both Maltese and English. However, the level of orthographic reading could not be ascertained. This is comparable to Burgoyne et al. (2016), where the ability to read words in two languages does not necessarily transfer to also reading nonwords in two languages. The Wilcoxon SR test indicated that in the biliterate group, word reading is better than nonword reading.

Moreover, this study also ascertained whether a difference in proficiency between Maltese and English reading was present in the biliterate group. Results indicated no difference between languages on the vocabulary task, the Sentence Imitation Task, Nonword reading, and PA skills. However, better Word reading abilities on the English subtest were recognised compared to the Maltese subtest. On the other hand, the biliterate group performed similarly on nonword reading tasks in Maltese and English. In **Hypothesis 2,** the researcher maintained that no difference between languages was observed in the attainment of biliterate participants with DS. This hypothesis has been partially accepted for nonword reading abilities.

Local research on TD children shows that Maltese children found it easier to read in the Maltese Language, and the author attributes this to the regular orthography of the Language (Xuereb, 2009). This has also been reported on an international level (Chao, 2011), where readers of a shallow orthography reportedly outperform those of a deeper orthography. Results from this study contrast findings within the TD population. Such a result also shows that the depth of orthography and the differences between the languages did not impinge on the performance of the biliterate group on nonword reading tasks.

The researcher hypothesises that the strength in English word reading, compared to Maltese word reading, could possibly be attributed to methods of reading instruction. Individuals with DS have predominantly been exposed to reading through flashcards, and in the majority of cases, this type of reading instruction is carried out mostly in English. In fact, as will be discussed further in Chapter 6 and Chapter 7, English is predominantly used more during home reading and school literacy instruction.

The results of this study identified that a form of cross-language transfer could possibly be occurring in this sample, where learning about the components of one language could have facilitated the knowledge of another language since similar results were reported on sub-skills. Multiple regression analysis identified Maltese PA as a significant predictor of English nonword reading in this DS population. These results potentially support the *Structural Sensitivity Theory*, where the consistent exposure to more languages may have positively affected the use of linguistic information and manipulation of linguistic structures (Kuo & Anderson, 2012). Cross-language correlations were also reported in studies of Maltese TD students (Agius 2012). Agius reports that PA has been reported as a significant predictor of reading abilities in the other language (Maltese-English). It is important to note that the small sample size limits the researcher to ascertain these claims, so further investigation is warranted. Studies investigating language transfer in DS are currently unavailable to the author's knowledge; hence further research to support the above claims is needed.

In this investigation, the researcher tested whether the reading abilities of the participants with DS were correlated. Xuereb (2009) maintained that reading skills in L1 and L2 are correlated in a TD population. Results from this study do not support Xuereb's (2009) finding, potentially indicating that the participants with DS follow a different pattern of biliteracy acquisition. Maltese word reading was only correlated with Maltese nonword reading, and no correlation between L1 and L2 was identified. However, as previously mentioned, the number of participants is particularly small, and further investigation is needed.

In summary, it can be noted that the linguistic situation of the Maltese readers with DS is not a straightforward one, and theories hypothesised for the TD population might not fit the pattern of abilities of the local DS population. Nonetheless, strong results from this study reinforce the notion that reading in two languages is not detrimental to the individual's development (Burgoyne et al., 2016, Ward & Sanoudaki, 2021). Moreover, in a bilingual society such as the one in the Maltese Islands, it is paramount that individuals with learning difficulties are exposed to both languages so as not to be limited or excluded from social situations, academic achievements, and vocational prospects. Therefore limit the pool of opportunities in a bilingual society.

Following is an investigation of the relationship between different sub-skills and reading abilities. This investigation aims to answer Research Question 2.

Research Question 3: Do PA, VPPS, Receptive Vocabulary, and RCPM predict Word and Nonword reading attainment in Maltese monoliterate and biliterate readers with DS?

The researcher used correlation analysis and multiple regression analysis to answer research question 3. As previously highlighted, results need to be interpreted with caution due to the reduced sample size in each subgroup. The role of PA is first discussed, followed by VPPS and receptive Vocabulary as measured on the PPVT. The role of fluid intelligence measured by the RCPM is then discussed. The analysis identified a correlation between word and nonword reading in Maltese and English. There was a difference in relationships between sub-skills and reading abilities between Maltese and English. The relationships in the biliterate group are also discussed.

Phonological Awareness

In the investigation of monoliterate readers, no association between PA and reading abilities in Maltese or English were identified; these result contrast findings in the literature where a correlation between PA and reading tasks was established (Snowling et al., 2002; Fletcher & Buckley, 2002). Thus findings from Study 1 are not replicated in Study 2.

When the relationship in the biliterate group was tested through regression analysis, Maltese PA skills were identified as significant predictors of nonword reading in English. The relationship between PA and nonword reading has been supported in the literature (Snowling et al.,2002; Wise et al., 2010; Næss et al., 2012), and it has also been documented in Study 1 in this thesis. However, this relationship has not been identified in both languages. This result shows that PA may contribute positively to decoding in DS while also supporting cross-language transfer theories. This has also been reported in Maltese TD literature (Agius, 2012; Martinelli & Brincat, 2020). In studies involving Maltese TD participants, Maltese PA has been identified as a predictor of English PA and English reading abilities, while also English PA predicted Maltese abilities (Martinelli & Brincat, 2020). This study identified that the DS biliterate group performed similarly on Maltese and English PA tasks. Hence, this reinforces the idea that the group has comparable bilingual abilities on different measures (SIT, PPVT, PA; refer to Table 30 p. 205). In TD, it has been reported that such a balanced performance between languages could indicate a high probability of cross-language transfer (Martinelli & Brincat, 2020). Cross-language transfer could also be supported by the Maltese and the English alphabet similarities. The Maltese alphabet consists of 30 letters, 6 of which are unique to the language [ċ, ġ, ħ, għ, ż]; the remaining letters are pronounced like the English counterparts, except for only [z] (Xuereb et al., 2011). Therefore training and exposure to one language could have been easily transferred to the other. Results from DS participants in this study favour this idea; however, further research is needed due to the small sample group.

Findings concerning PA skills also support local literature in TD populations, where Maltese PA skills of Maltese children are considered to be strategic in developing reading abilities (Martinelli, 1996; Pace Gellel, 2004; Xuereb, 2009). It has been suggested that an awareness of phonemes might not be considered the sole contributor to developing successful decoding abilities (Fletcher & Buckley, 2002). In the case of the Maltese language, aspects such as the type of language's orthography could be better contributors. This notion of depth of orthography is sparsely investigated in DS reading research, and further evaluation is needed.

Visual Perceptual Processing Skills

The role of VPPS as contributors to successful reading in DS has been given prominent exposure in the literature, with individuals with DS being described as having strength in these abilities (Fidler, 2005; Klein & Mervis, 1999). The relationship between VPPS and Word Reading has been discussed in the literature; Fidler et al. (2005) showed that a visual method of reading was beneficial. The authors argued that this method helps overcome VSTM and fluctuating hearing difficulties. In Study 3 (refer to p. 237), the researcher found that participants with DS could read more flashcards. Additionally, in Study 1, it was also identified that a correlation between VPPS and Maltese nonword reading was identified.

Further investigation in this study (Study 2) shows that VPPS were associated with word reading abilities. This association was identified in the group of monoliterate participants reading in English. This result supports Appleton et al. (2002) and Fidler et al. (2005).

However, the prediction value of VPPS could not be tested due to the small sample size. Such a result could indicate that the participants could rely on these skills for reading in a language with deep orthography, such as English, but not in a language with shallow orthography, such as Maltese. In Maltese, deciphering the written words is a more regular process. Therefore, visual knowledge of the word is not essential. However, the argument is different for the English language as this language has a deeper orthography. The students' literacy training could have also influenced such a result. Participants in this study all attended mainstream schools. According to the *National Minimum Curriculum Framework*, children within a mainstream setting are introduced to literacy training through a phonic teaching method. Hence, participants in this group could have relied less on the visual aspects of the words when words could be deciphered easily also because they were not being trained to read by solely visual processing. In the past, visual reading methods were mostly used with students with DS (Loveall et al., 2021), which could have influenced and strengthened their visual processing skills and influenced the relationship between English Word reading and VPPS. Results about the participants from this sample pool also confirmed that flashcards were extensively used from the early years. This is discussed in further detail in Chapter 6. The type of literacy training methods currently being implemented in the local school setting is further investigated in Chapter 7.

In the biliterate group, the researcher identified no association between VPPS and reading abilities in any language. This could indicate that biliterate readers have strong abilities to use a non-lexical route for reading; therefore, they could possibly analyse word units due to their ability to read different orthographies, hence not solely relying on the visual components of the word.

Receptive Vocabulary

Receptive vocabulary has been recognised as a predictor of academic progress and a positive contributor to reading development (Laws & Gunn, 2002; Hulme et al., 2012; Burgoyne et al., 2012; Mengoni et al., 2014; Lim et al., 2014; Cuskelly et al., 2016). This study assessed this area using the PPVT-4 in the English language and an informal version of the Maltese PPVT for evaluating participants in the Maltese language.

The *correlation analysis* in both the monoliterate and biliterate groups did not identify that scores on the PPVT-4 in either language were correlated to reading measures. This was also confirmed through *multiple regression analysis,* where PPVT was not recognised as a predictor of word and nonword reading abilities. This result contrast literature (Laws & Gunn, 2002; Hulme et al., 2012; Burgoyne et al., 2012; Mengoni et al., 2014; Lim et al., 2014; Cuskelly et al., 2016). The researcher considers that the choice of the assessment measure could have impinged on these results. The selection of vocabulary items could have influenced the participants' performance. The *English PPVT-4* is not culturally appropriate for the Maltese population. Moreover, the Maltese version of the test was not standardised for the Maltese population since the researcher informally translated this tool for the purpose of this study. Therefore this could have added to the bias of the results. Agius (2012) reported similarly when she identified that the Maltese version of the PPVT was considered an unreliable predictor of language ability, possibly due to cultural bias.

This study identifies that scores on PPVT-4 are correlated to SIT, supporting similar research in TD populations (Agius, 2012). In this investigation, SIT and PPVT were not identified as significant predictors of reading; however, this result could have important clinical implications and support an important finding related to language development. The Sentence Imitation Task has been identified as a predictor of receptive vocabulary in the international literature (Seef-Gabriel et al., 2010) and in the Maltese population (Xuereb, 2009; Grech et al., 2011; Grech in press). Although on a small scale, the result from this study identifies novel literature in populations with DS. Results were achieved across both languages. In the Maltese context, the availability of a standardised tool for the local population is limited. Hence, using SIT as an indicator of receptive language abilities could be particularly helpful in a clinical setting when other tools such as a vocabulary task are unavailable.

Fluid Intelligence

The RCPM measured fluid intelligence in this study. In the literature, it has been reported that fluid intelligence predicts academic success (Bergman Nutley et al., 2011). It has also been reported that DS readers obtain better results on fluid intelligence measures when compared to nonreaders (Laws & Gunn, (2002). In Study 1, it has been identified that RCPM was a significant predictor of English Nonword reading in DS. The results are not supported in Study 2. No correlation has been identified between RCPM and reading measures in both Maltese and English tests.

Hence, it can be summarised that in study 2, a general predictor for the reading tasks has not been identified. Visual perceptual processing skills have been identified as correlates of English Word reading, and Maltese PA has been identified as the predictor of English Nonword reading. Individual variability, as often associated with DS (Karmiloff-Smith, 2016), methodological issues, small sample size, and unique linguistic characteristics could have contributed to these results. The researcher had identified three hypotheses:

Hypothesis 3: SIT, and PA predict Word and Nonword Reading in DS. This hypothesis has been partially accepted. Maltese PA has been identified as a significant predictor of English Nonword reading in the biliterate group.

Hypothesis 4: Receptive Vocabulary predicts Word and Nonword reading in DS. This hypothesis has been rejected as PPVT has not been identified as a significant predictor.

Hypothesis 5: RCPM and VPPS do not predict Word and Nonword reading in DS. This hypothesis has been rejected concerning RCPM; however, accepted with regards to VPPS. VPPS have been identified as predictors of English word reading in the group of English monoliterate individuals.

Conclusion and significant findings

Study 2 was presented in this chapter. Throughout this chapter, the researcher evaluated Word and Nonword reading in participants with DS. Predictors of reading abilities were identified, and biliteracy in DS was also evaluated. The study contributed to the field of reading in DS by showing that different relationships between sub-skills and reading abilities could be identified for Maltese and English, respectively. The abilities of monoliterate and biliterate readers additionally contributed to the results. Hence it is suggested that throughout an evaluation process of students' abilities and planning of intervention services, educators are encouraged to take into account the linguistic background and the intricacies of the language being attended to. Cross-linguistic transfer has also been reported. A relationship between receptive vocabulary and SIT was identified, which offers a useful, practical clinical finding. Therefore, it is suggested that these elements should be included during the planning process of a reading intervention programme. VPPS were identified as significant contributors to English word but not to Maltese word reading in this population.

DS readers from this study have been identified to develop functional levels of Word and Nonword reading abilities. Hence, educators are encouraged to use lexical and non-lexical reading intervention methods. Successful reading in Maltese and English has been identified; therefore, training in biliteracy is further encouraged.

Limitations of the Study

- In section 1, the researcher subdivided the groups according to the language of administration. This type of analysis resulted in fragmentation of the sample size, particularly in the comparison group. An increased number of participants in the comparison group could have contributed to a better distribution of numbers in the specific groups.

- Aspects of reading comprehension were not evaluated; unfortunately, an adequate assessment tool for the Maltese language is unavailable. The inclusion of such a measure could have provided a more complete picture of reading in Down Syndrome and would have allowed the researcher to evaluate the abilities according to The Simple View of Reading.
- The assessment battery did not include a measure of assessing orthographic reading abilties.
- A standardised measure of receptive vocabulary is unavailable for the Maltese population. Hence results from the assessment tool used for this research should be interpreted with care.

Following is Chapter 6, where an investigation of the Home Literacy Environment is presented.

Chapter 6

Study 3: An Investigation of the Home Literacy Environment (HLE)

Chapter Overview

This chapter will provide the results from the investigation of the HLE of participants with DS and TD participants. The participants' caregivers were asked to complete a questionnaire related to the home literacy environment. The questionnaire can be referred to in Appendix I, p.413. The data collected from this questionnaire aimed to answer the following research questions:

Research Question 1: How does the home literacy environment of Maltese children and adolescents with DS compare to that of typically developing peers?

Research Question 2: Do the gender and the age of students affect the Home Literacy Environment?

Research Question 3: How does the bilingual environment of Maltese children and adolescents with DS affect HLE?

The following hypotheses were tested;

Hypothesis 1: The HLE of participants with DS differs from the HLE of TD students.

Hypothesis 2: The HLE of participants in both groups differs according to age.

Hypothesis 3: The gender of both groups affects the participants' attainment in home literacy activities.

Hypothesis 4: Participants exposed to Maltese and English at home engage in increased home and environmental literacy experiences c

Participants

Ninety-three caregivers (51 DS and 42 TD) participated in a structured interview. Table 39 provides more information about the participants. The DS participants came from 22 different localities, and the TD group was composed of students from the same localities. The localities were distributed all over the Maltese islands, including participants from Malta's sister island of Gozo (refer to Figure 11, p. 124). The majority of participants with DS attended additional educational or health services: 70% attended Speech-Language Intervention; 58% attended Physiotherapy; 30% Occupational Therapy; 35% Early Intervention Services. TD participants did not attend any additional services outside of school.

Questions 7 and 19 gave information about the reading abilities of the participants, as reported by the parents/carers. Question 7 asked the parents/carers if their children could read. The ability to read flashcards was quantified. This is discussed further in the study. Forty-two readers were reported in the DS group, while 27 were reported in the TD group. Question 19 asked the parents/carers to quantify the number of flashcards that their children could read at the time of the questionnaire.

Table 39

Descriptive information about the participants taking part in the HLE Questionnaire

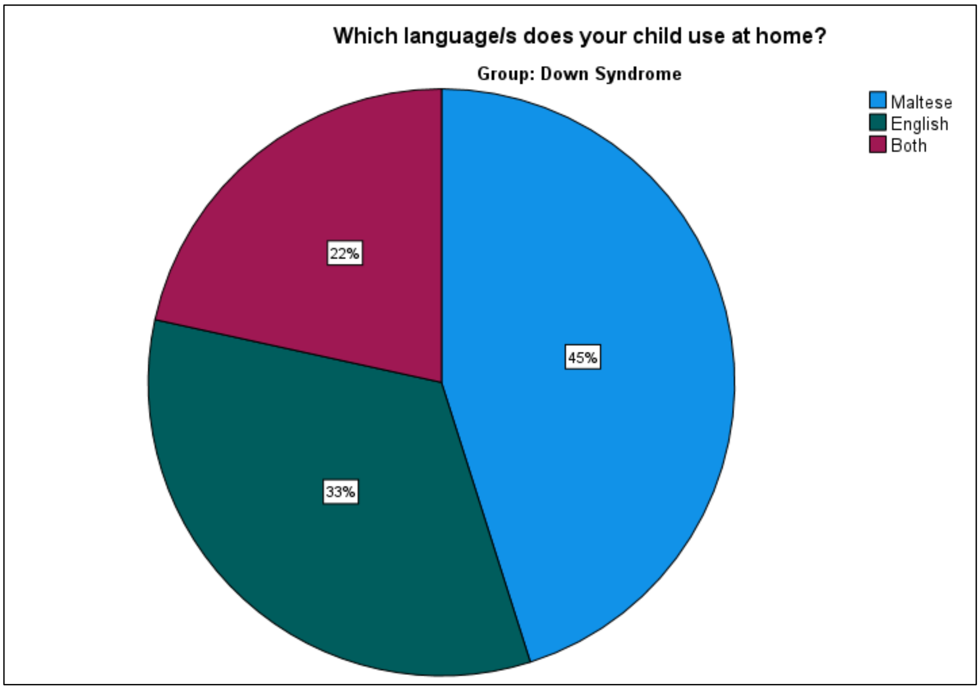
Group	*N*	Gender		*M* Age	Age	*Reported*	*%Home Language*			
		M	F		*Range*	*Readers*	*Mal*	*E*	*B*	*p-value*
DS	51	23	28	15.00	18	42	45%	22%	33%	.97
TD	42	17	25	5.33	2	27	36%	19%	45%	

Note: Mal= Maltese, E=English, B=Both

The participants were also matched by the language used in the home. Figure 23 shows that from the DS group, 33% spoke English, 45% spoke Maltese, while 22% used both Maltese and English. Table 39 shows the distribution of language use in the home between groups. No difference between groups was identified (p=.97).

Figure 23

Distribution of Language used at home by participants with DS



Assessment Measure

The Home Literacy Environment Questionnaire (Boudreau, 2005) was adapted to collect the data. Details about the assessment tool were provided in Chapter 3, p. 137. The researcher administered all questionnaires in person. The researcher interviewed the parents/carers and read all questions to the parents/carers. The parents/carers of students with DS were interviewed during the home visits. The researcher set an appointment with the parents/carers at school for the TD group. Unfortunately, this method led to sampling attrition, as not all parents/carers could attend for the short interview. For some participants, an appointment at their home was given instead.

Results

The *Chi-Square test* was used to analyse the quantitative data. The *Chi-square (χ^2)* provides information about each group's performance and allows for comparisons (McHugh, 2013). One variable describes the group composition, either the DS group or TD group, while the other describes the specific home literacy experiences. Hypothesis 1: *The HLE of participants with DS differs from the HLE of TD students* was first tested.

The null hypothesis (H_0) and the *alternative hypothesis* investigated the discrepancy between the two groups. The null hypothesis states that there is no significant difference between the groups. Conversely, the alternative hypothesis (H_1) states a significant difference between groups in home literacy experiences.

Moreover, the questionnaire included open-ended questions, which were analysed qualitatively. The results were grouped into five themes to ease discussion purposes: The language used during reading, reading books; response to print; interest in letters; and technology at home. The effect size for each computation will be presented for each computation through the *Cramer's V* statistic and the *df* (Kim, 2017).

The language used during reading*.* Three questions investigated the language used during reading. All three questions investigating the language used during reading showed a significant difference between the DS and TD groups, and the alternative hypothesis is accepted on all two questions. Moreover, the preferred language chosen for reading is not always the home's language since the groups were originally matched by the preferred language used in the home. On all three questions of language use, the DS group favoured the use of English. These responses show that parents chose to read to their children predominantly in English and that reading materials are more available and more readily accessible to participants in English rather than in Maltese. In the TD group, a balance between the languages could be observed on all three questions. The TD group expressed that reading occurs in both languages, that: good reading abilities were observed in both languages, and reading books are read in both languages at home. Besides indicating a difference between groups, these results also provide insight into aspects of bilingualism. Bilingual reading is observed in both groups (32.2%); however, the TD group showed a preference for reading in both languages (50%) when compared to the DS group (17.6%). Nevertheless, the participants in the DS group showed a capability to read in both languages (35.5%), as reported by the caregivers. Tables 40, 41 and 42 portray these results.

Table 40

Percentage results for question: If they read, which language do they read in?

Answer	Group		Total
	TD	DS	
Maltese	2.4%	25.5%	15.1%
English	11.9%	43.1%	29.0%
Both	50.0%	17.6%	32.3%
None	35.7%	13.7%	23.7%

Note. N = DS: 51, TD: 42; $\chi^2(1) = 28.091$; $p = .00$; H_1 is accepted. *Cramer's V* = .550 – *large effect size*.

Table 41

Percentage results for question: In which language are they better at reading?

Answer		Group		Total
		TD	DS	
Maltese	% within Group	28.6%	17.6%	22.6%
English	% within Group	35.7%	47.1%	41.9%
Both	% within Group	35.7%	25.5%	30.1%
None	% within Group	0.0%	9.8%	5.4%

Note. *N* = DS: 51, TD: 42; $\chi^2(1) = 28.091$; $p = .00$; H_1 is accepted. *Cramer's V = .271 -medium effect size.*

Table 42

Percentage results for question: When reading to your child, are most books in Maltese of English?

Answer		Group		Total
		TD	DS	
Maltese	% within Group	11.9%	19.6%	16.1%
English	% within Group	47.6%	62.7%	55.9%
Both	% within Group	40.5%	13.7%	25.8%
None	% within Group	0.0%	3.9%	2.2%

Note. N = DS: 51, TD: 42; $\chi^2(1) = 9.824$; $p = .02$; H_1 is accepted. *Cramer's V* = .325 – medium effect size

Book reading at home. Four questions explored the quality and quantity of book reading during the day. A significant difference between DS and TD groups could be observed in the results investigating: *Does your child ask you to read to them?* Therefore, the alternative hypothesis is accepted. The TD group showed more initiative and regularly requested that their parents/carers read to them. Caregivers from the TD group reported a high request (38.1%), indicating that children asked to be read daily, and 14.3% requested to be read several times a day. In contrast, caregivers from the DS group reported that most participants asked to be read to only occasionally (47.1%), followed by a lower percentage who asked to be read to weekly (23.7%). These results are portrayed in Table 43.

Table 43

Percentage results for question: Does your child ask you to read to them?

Answer		Group		Total
		TD	DS	
Never/Rarely	% within Group	4.8%	17.6%	11.8%
Occasionally	% within Group	16.7%	47.1%	33.3%
Weekly	% within Group	26.2%	21.6%	23.7%
Daily	% within Group	38.1%	11.8%	23.7%
Several times a day	% within Group	14.3%	2.0%	7.5%

Note. N = DS: 51, TD: 42; χ^2 (1) = 21.222; *p* = .00; H_1 is accepted. *Cramer's V* = .478 – large effect size.

On the question: *How often do you read to your child?* – results indicate a discrepancy between the two groups (Table 44). This discrepancy is found to be statistically significant. The parents/carers of TD participants read more to their children when compared to the parents of participants with DS, of whom 47.6% indicated that they read with or to their children daily, while 16.7% reported that they read to their child several times a day. This result is contrary to the DS group, where most participants only occasionally read (45.1%) or weekly (31.4%). Therefore for this question, the alternative hypothesis is accepted.

Table 44

Percentage results for question: How often do you read to your child?

Answer		Group		Total
		TD	DS	
Never/Rarely	% within Group	0.0%	9.8%	5.4%
Occasionally	% within Group	7.1%	45.1%	28.0%
Weekly	% within Group	28.6%	31.4%	30.1%
Daily	% within Group	47.6%	13.7%	29.0%
Several times a day	% within Group	16.7%	0.0%	7.5%

Note. N = DS: 51, TD: 42; $\chi^2(1) = 33.66$; $p = .00$; H_1 is accepted. *Cramer's V* = .602 – large effect size.

When parents/carers were asked questions about the students' quality of interaction and involvement during shared reading, a significant difference could be identified between the groups on the first question: *Does your child point independently to or talk about pictures when you read stories?* However, no difference in answers was found on the second question: *Do you point out signs and words such as restaurant names or street signs to your child?*

Table 45 shows that answers were more evenly distributed within the DS group. A discrepancy in the answers could be attributed to the different chronological ages. The DS group had a higher mean chronological age, and parents/carers of the DS group commented that when the students were younger, they used to engage more in such behaviours, but now they do not engage as often in pointing to books and objects, since they are more independent.

Table 45

Percentage results for question: Does your child point independently to or talk about pictures when you read stories?

Answer		Group		Total
		TD	DS	
Not Currently	% within Group	7.1%	5.9%	6.5%
Has but rarely	% within Group	0.0%	17.6%	9.7%
Occasionally	% within Group	7.1%	17.6%	12.9%
A few times per story	% within Group	26.2%	23.5%	24.7%
Very frequently	% within Group	59.5%	35.3%	46.2%

Note. N = DS: 51, TD: 42; χ^2 (1) = 55.776; *p* = .00; H_1 is accepted. *Cramer's V* = .366 – large effect size

On the question: *Do you point out signs and words such as restaurant names or street signs to your child?* – no significant difference between groups could be identified. Therefore, the null hypothesis has been accepted. Results for this question are found in Table 46.

This response shows that even though the age groups were different, the parents/carers were still actively engaging their children in literacy exposure from their surrounding environment.

Table 46

Percentage results for question: Do you point out signs and words such as restaurant names or street signs to your child?

Answer		Group		Total
		TD	DS	
Not Currently	% within Group	19.0%	13.7%	16.1%
Has but rarely	% within Group	4.8%	13.7%	9.7%
Occasionally	% within Group	19.0%	43.1%	32.3%
Weekly	% within Group	19.0%	5.9%	11.8%
Daily	% within Group	38.1%	23.5%	30.1%

Note. *N* = DS: 51, TD: 42; χ^2 (1) = 11.458; *p* = .22; H_0 is accepted. *Cramer's V* = .351 – large effect size.

Response to print. The next questions investigated how the students responded to print in their surroundings. When parents/carers were asked about the interest in adult reading material and the ability of their children to identify words in their surroundings, no difference between groups could be identified. A very similar distribution of responses was particularly identified in the second question of this section. See Table 47 and Table 48. For both questions, the null hypothesis was accepted.

Table 47

Percentage results for question: Does your child show interest in adult reading material?

Answer		Group		Total
		TD	DS	
Never/Rarely	% within Group	26.2%	15.7%	20.4%
Occasionally	% within Group	33.3%	43.1%	38.7%
Weekly	% within Group	11.9%	3.9%	7.5%
Daily	% within Group	11.9%	9.8%	10.8%
Several times a day	% within Group	16.7%	27.5%	22.6%

Note. N = DS: 51, TD: 42; χ^2 (1) = 5.047; p = .283; H_0 is accepted. *Cramer's V* =.233 – medium effect size

Table 48

Percentage results for question: Does your child identify words in the environment?

Answer		Group		Total
		TD	DS	
Never/Rarely	% within Group	11.9%	15.7%	14.0%
Occasionally	% within Group	31.0%	31.4%	31.2%
Weekly	% within Group	9.5%	3.9%	6.5%
Daily	% within Group	21.4%	15.7%	18.3%
Several times a day	% within Group	26.2%	33.3%	30.1%

Note. N = DS: 51, TD: 42; χ^2 (1) = 2.163; p = .706; H_0 is accepted. *Cramer's V* =.153 – medium effect size

Another set of questions looked into flashcards and sight word reading. Responses to these questions are summarised in Table 49.

Table 49

Flashcards and sight word reading questions

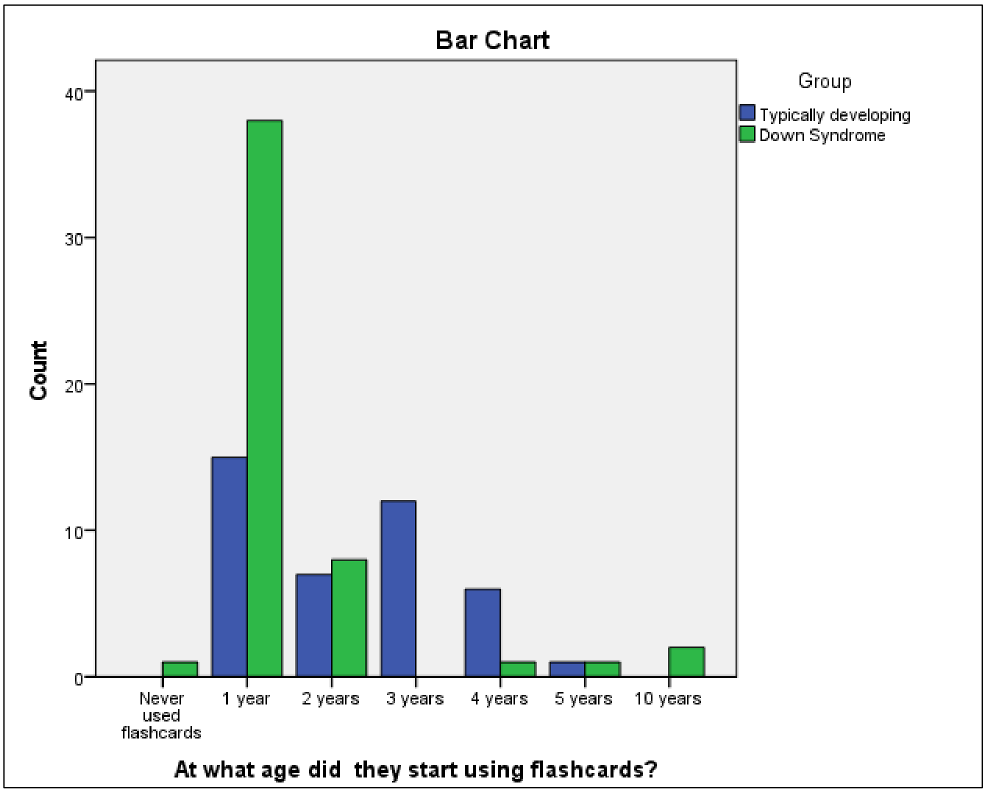
Question	*p*	Accepted hypothesis	*Cramer's V*
Does your child read any words by sight?	.067	H_1	.307**
Did your child start reading through the use of flashcards?	.000	H_0	.639**
How many flashcards can your child read?	.000	H_0	.459**
At what age did they start using flashcards if they used any?	.000	H_0	.550**
Are flashcards still being used?	.918	H_1	.043*

Note. *N* = DS: 51, TD: 42; H_0 = Null Hypothesis; H_1 = Alternative Hypothesis. * small effect size, ** medium effect size.

Respondents from both the DS and TD groups maintained that sight-reading is present and that flashcards are still being used, and there was no difference between groups. Conversely, a difference in responses could be identified in the other questions that looked into flashcards' use. Figure 24 clearly illustrates that most students with DS were introduced to reading through the use of flashcards. This result significantly differs from the TD group. Moreover, results also show that the group of students with DS was introduced to flashcards at a very young age, at 1-year-old (74.5%) in fact; while only 36.6% of the TD were introduced to flashcards at one year old.

Figure 24

Bar chart: At what age did they start using flashcards?



The number of flashcards students in the DS group could read significantly differed from that of the TD group. Most students with DS (70.6%) are reported to read more than 51 flashcards, while most TD participants (35.7%) can only read between 0 to 5 flashcards. Results are depicted in Table 50.

Table 50

Percentage results for question: How many flashcards can your child read?

Answer		Group		Total
		TD	DS	
0-5	% within Group	35.7%	9.8%	21.5%
6-10	% within Group	19.0%	3.9%	10.8%
11-20	% within Group	9.5%	7.8%	8.6%
21-50	% within Group	11.9%	7.8%	9.7%
51 or more	% within Group	23.8%	70.6%	49.5%

Note. N = DS: 51, TD: 42; χ^2 (1) = 22.749; p = .00; H_0 is accepted. *Cramer's V* = .495 – large effect size.

Interest in letters. Four questions targeted the participants' interest in letters. Results for these questions are summarised in Table 55. All participants were reported to have similar abilities in reading the letters of the alphabet, as reported by the parents/carers (Table 52), putting letters together to sound out the words (Table 53), and writing words and letters (Table 54). On the other hand, a discrepancy in results could be noted on the question investigating when participants were introduced to the alphabet (Table 51). The TD group was introduced to the alphabet during preschool (69%) or kinder years (31%), while for the DS group, this was introduced in preschool to beyond the third year of schooling. This result shows that the DS group was introduced to reading instruction very early but through a different reading instruction method than the TD group.

Table 51

Percentage results for question: At what age did they start being exposed to the alphabet?

Answer		Group		Total
		TD	DS	
Pre-schooling	% within Group	69.0%	32.7%	49.5%
Kinder	% within Group	31.0%	26.5%	28.6%
Year 1	% within Group	0.0%	26.5%	14.3%
Year 2	% within Group	0.0%	2.0%	1.1%
Year 3 or later	% within Group	0.0%	12.2%	6.6%

Note. N = DS: 51, TD: 42; χ^2 (1) = 23.355; *p* = .00; H_0 is accepted. *Cramer's V* = .507 – large effect size

Table 52

Percentage results for question: Can your child read the letters of the alphabet?

Answer		Group		Total
		TD	DS	
Yes	% within Group	66.7%	78.4%	73.1%
No	% within Group	23.8%	7.8%	15.1%
Not all	% within Group	9.5%	13.7%	11.8%

Note. *N* = DS: 51, TD: 42; χ^2 (1) = 4.680; *p* = .096; H_1 is accepted. *Cramer's V* = .224 – medium effect size.

Table 53

Percentage results for question: Can your child put letters together to sound out words?

Answer		Group		Total
		TD	DS	
Yes	% within Group	52.4%	47.1%	49.5%
No	% within Group	35.7%	37.3%	36.6%
Not all	% within Group	11.9%	15.7%	14%

Note. *N* = DS: 51, TD: 42; χ^2 (1) = .382, *p* = .826; H_1 is accepted. *Cramer's V* = .064 – small effect size.

Table 54

Percentage results for question: Does your child write letters and/or words?

Answer		Group		Total
		TD	DS	
Yes	% within Group	52.4%	47.1%	49.5%
No	% within Group	35.7%	37.3%	36.6%
Some letters	% within Group	11.9%	15.7%	14.0%

Note. *N* = DS: 51, TD: 42; χ^2 (1) = .765; *p* = .682; H_1 is accepted. *Cramer's V* = .091 – small effect size.

Table 55

Interest in letters questions

Question	*p*-value	Accepted hypothesis	*Cramer's V*
At what age did they start being exposed to the alphabet?	.00	H_0	.507***
Can your child read the letters of the alphabet?	.096	H_1	.224**
Can your child put letters together to sound out words?	.826	H_1	.064*
Does your child write letters and/or words?	.682	H_1	.091*

Note. H_0 = Null Hypothesis; H_1 = Alternative Hypothesis. *small effect size **medium effect size ***large effect size

Technology at home. The last set of questions in the questionnaire investigated the use of technology in the home. Results showed no difference between the groups could be identified (see Table 56). An additional question also investigated the type of electronic devices or applications used. Similar answers were provided between the groups. The percentage of results can be found in Appendix S, p. 469, Table S1 and Table S2.

Table 56

Technology in the home

Question	*p*	Accepted hypothesis	Cramer's V
Do you have a computer or any other electronic device such as a tablet at home?	.362	H_1	.095*
Does your child use the device independently?	.693	H_1	.041*

Note. H_0 = Null Hypothesis; H_1 = Alternative Hypothesis. *small effect size

The effect of Gender on HLE

The second research question in this study sought to find answers regarding the effect of gender on the HLE. The *Chi-Square Test* was utilised for investigation by using a Three-Way Cross-Tab.

The following hypothesis was tested;

Gender affects the participants' attainment of home literacy activities. This is known as the *Alternative Hypothesis* and is accepted if there is a significant difference and the *p*-value is less than the .05 criterion. If the *p*-value exceeds the .05 level of significance, the Alternative Hypothesis is rejected, and the null hypothesis is accepted. The null hypothesis stipulates that no difference can be identified due to gender.

The initial investigation with gender as a dependent variable indicated that gender did not affect the DS or TD results. Table 57 indicates that the p-value is below the .05 level of significance on no question. Therefore, no significant difference between males and females could be identified. Hence the Alternative hypothesis is rejected, and the null hypothesis is accepted.

Table 57

Gender Difference in Questions from the Home Literacy Questionnaire

Question	Group	*p*	Difference	*Cramer's V*
1. Which language/s does your child use at home?	TD	.974	No	.035*
	DS	.686	No	.122**
2. Which language/s does your child use at school?	TD	.301	No	.295**
	DS	.708	No	.165**
3. Which language do they prefer to watch TV or videos in?	TD	.779	No	.043*
	DS	.264	No	.228**
4. If they read, which language/s do they read in?	TD	.224	No	.322**
	DS	.470	No	.223**
5. In which language are they better at reading?	TD	.329	No	.230**
	DS	.703	No	.166*
6. When reading to your child, are most books in Maltese or English?	TD	.593	No	.158*
	DS	.350	No	.254**
7. Does your child ask you to read to them?	TD	.206	No	.375***
	DS	.457	No	.267**
8. How often do you read to your child?	TD	.567	No	.220**
	DS	.906	No	.054*
9. Does your child point independently to or talk about the picture when you read stories?	TD	.970	No	.076*
	DS	.355	No	.362***
10. Do you attempt to teach the names of the letters in the alphabet and/or alphabet sounds when reading?	TD	.958	No	.124*
	DS	.499	No	.257**
11. Do you point out signs and words such as restaurant names or street signs to your child?	TD	.866	No	.174**
	DS	.233	No	.331**
12. Does your child show interest in adult reading material?	TD	.058	No	.466***
	DS	.564	No	.241**
13. Does your child identify words in the environment?	TD	.989	No	.086*
	DS	.168	No	.356***
14. Does your child read any words by sight?	TD	.524	No	.276***
	DS	.687	No	.211**
15. Did your child start reading through the use of flashcards?	TD	.949	No	.092*
	DS	.730	No	.111*

16. How many flashcards can your child read?	TD	.227	No	.367***
	DS	.704	No	.207**
17. At what age did they start using flashcards, if they used any?	TD	.471	No	.294**
	DS	.207	No	.375***
18. Are flashcards still being used? If no, why have these been stopped?	TD	.188	No	.282**
	DS	.658	No	.128*
19. At what age did they start being exposed to the alphabet?	TD	.859	No	.027*
	DS	.605	No	.236**
20. Can your child read the letters of the alphabet?	TD	.673	No	.137*
	DS	.974	No	.032*
21. Can your child put letters together to sound out words?	TD	.821	No	.097*
	DS	.367	No	.198*
22. Does your child write letter and/or words?	TD	.766	No	.113*
	DS	.788	No	.097*
23. Do you have a computer or any other electronic devise such as a tablet at home?	TD	constant	No	-
	DS	.360	No	.128*
24. Does your child use the devise independently?	TD	constant	No	-
	DS	constant	No	-

Note: *small effect size, **medium effect size, *** large effect size

The effect of age on the HLE

The *Chi-Square Test* was also used to investigate the effect of age on the HLE in both groups. Students were grouped into four groups: 1-5 years (DS *N* = 7, TD *N* = 21); 6-10 years (DS *N* = 10, TD *N*= 21); 11-15 years (DS *N* = 21, TD *N*= 0); and, 16 and older (DS *N*= 13, TD *N* = 0). Results from a *Three-Way Cross Tab* can be found in Table 58.

The following Hypothesis was tested:

The HLE of participants differs according to the age of the participants. The *Alternative Hypothesis* is accepted if there is a significant difference and the *p*-value is less than the .05 criterion. If the *p*-value exceeds the .05 level of significance, the Alternative Hypothesis is rejected, and the null hypothesis is accepted. The null hypothesis stipulates that no difference can be identified due to age differences.

Results indicated that age affects several responses. Therefore the Alternative Hypothesis was accepted. Out of the 24 questions investigated, nine questions demonstrated an effect of the age variable in the DS group. These questions are highlighted, and the results will be individually shown and evaluated (Table 58).

Table 58

Age group on Questions from the Home Literacy Questionnaire

Question	Group	*P*	Age Difference	Cramer's V
1. Which language/s does your child use at home?	TD	.079	No	.348**
	DS	.590	No	.213**
2. Which language/s does your child use at school?	TD	.007	Yes*	.539***
	DS	.081	No	.317**
3. Which language do they prefer to watch tv or videos in?	TD	1.000	No	.0
	DS	.088	No	.324**
4. If they read, which language/s do they read in?	TD	.006	Yes*	.548***
	DS	.050	No	.333**
5. In which language are they better at reading?	TD	.011	Yes*	.463***
	DS	.037	Yes*	.342**
6. When reading to your child, are most books in Maltese or English?	TD	.039	Yes*	.393***
	DS	.611	No	.218**
7. Does your child ask you to read to them?	TD	.255	No	.356***
	DS	.449	No	.280**
8. How often do you read to your child?	TD	.799	No	.155*

	DS	.513	No	.232**
9. Does your child point independently to or talk about pictures when you read stories?	TD	.219	No	.325**
	DS	.027	Yes*	.388***
10. Do you attempt to teach the names of the letters in the alphabet and/or alphabet sounds when reading?	TD	.149	No	.401***
	DS	.069	No	.361***
11. Do you point out signs and words such as restaurant names or street signs to your child?	TD	.406	No	.309**
	DS	.001	Yes*	.475***
12. Does your child show interest in adult reading material?	TD	.160	No	.396***
	DS	.148	No	.334**
13. Does your child identify words in the environment?	TD	.433	No	.301**
	DS	.001	Yes*	.457***
14. Does your child read any words by sight?	TD	.011	Yes*	.557***
	DS	.658	No	.249**
15. Did your child start reading through the use of flashcards?	TD	.145	No	.358***
	DS	.436	No	.240**
16. How many flashcards can your child read?	TD	.109	No	.424***
	DS	.407	No	.286**
17. At what age did they start using flashcards, if they used any?	TD	.117	No	.425***
	DS	.477	No	.309**
18. Are flashcards still being used? If no, why have these been stopped?	TD	.035	Yes*	.399***
	DS	.001	Yes*	.467***
19. At what age did they start being exposed to the alphabet?	TD	.317	No	.155*
	DS	.039	Yes*	.389***
20. Can your child read the letters of the alphabet?	TD	.013	Yes*	.455***
	DS	.223	No	.284**
21. Can your child put letters together to sound out words?	TD	.006	Yes*	.491***
	DS	.000	Yes*	.507***
22. Does your child write a letter and/or words?	TD	.015	Yes*	.448***
	DS	.000	Yes*	.549***
23. Do you have a computer or any other electronic device such as a tablet at home?	TD	constant	No	-
	DS	0.692	No	.169*
24. Does your child use the device independently?	TD	0.038	Yes*	.319**
	DS	0.002	Yes*	.542***

Note. *N* = DS: 51, TD: 42; *Questions affected by the Age Variable; *small effect size, **medium effect size, *** large effect size.

Question 5: In which language are they better at reading? In the DS group, Maltese as the only language was never mentioned in the younger age groups, and it only started gaining responses within the 11-15 age group. Among the younger age groups, it was only mentioned together with English. Use of the Maltese language started being reported as being predominantly better later on. Refer to Figure 25 hereunder and Table 59 for Chi-Square results and percentages.

On the contrary, in case of the TD group most participants responded that their proficiency in English increased as the child grew older. This result can be observed in Figure 26.

Figure 25

Clustered Bar Graph of responses by age group to question: In which language are they better at reading? for the DS group

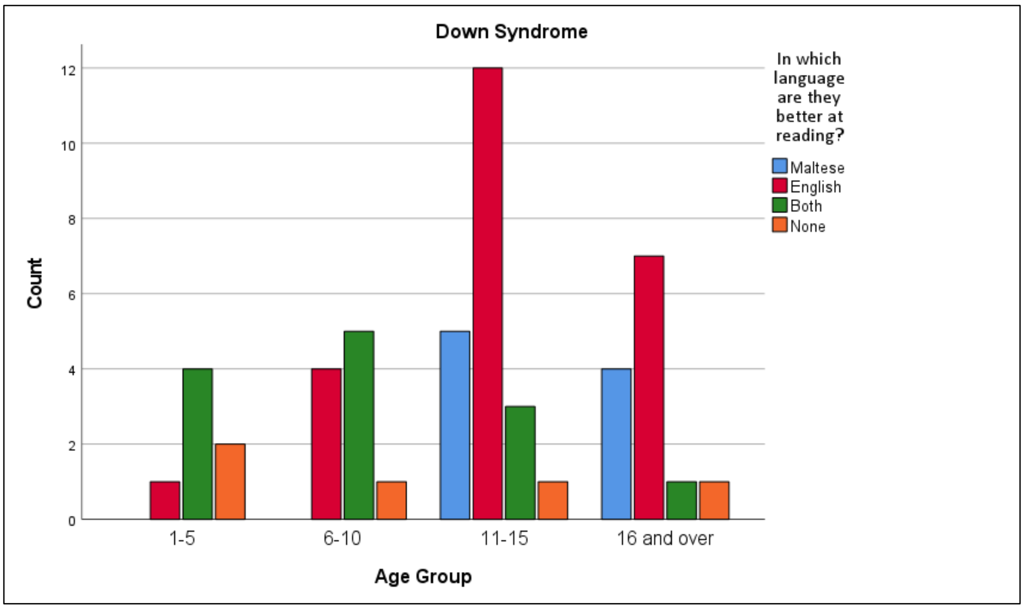


Table 59

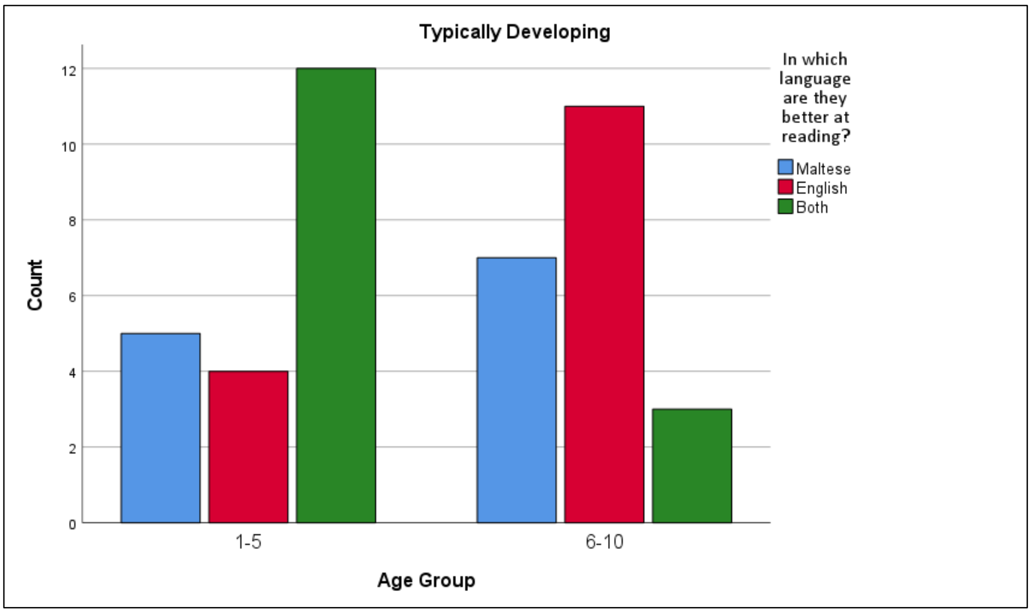
Chi-Square and Percentage responses for Question 5: In which language are they better at reading?

Group			Maltese	English	Both	None	Total
TD	Age Group 1-5	% within Age Group	23.8%	19.0%	57.1%		100.0%
	6-10	% within Age Group	33.3%	52.4%	14.3%		100.0%
DS	Age Group 1-5	% within Age Group	0.0%	14.3%	57.1%	28.6%	100.0%
	6-10	% within Age Group	0.0%	40.0%	50.0%	10.0%	100.0%
	11-15	% within Age Group	23.8%	57.1%	14.3%	4.8%	100.0%
	16 and over	% within Age Group	30.8%	53.8%	7.7%	7.7%	100.0%

Note: TD group: $X^2(1)= 9.00$; $p = 0.011$; DS group: $X^2(1) = 17.882$; $p = 0.037$. *N* = DS: 51, TD: 42.

Figure 26

Clustered Bar Graph of responses by age group to question: In which language are they better at reading? for the TD group



Question 9: Does your child point independently to or talk about pictures when you read stories? This question looked into the use of books independently, and therefore the frequency of independently pointing at pictures increased as the age increased. This age effect was not observed in the TD group as no significant difference in the responses was found between the age groups (p = .219), where the frequency was constant in both age groups. The difference between age groups was significant within the DS group (p = .027). Refer to Figure 27 and Table 60 for Chi-Square results and percentages.

Figure 27

Clustered Bar Graph of responses by age group to question: Does your child point independently to or talk about pictures when you read stories? for the DS group

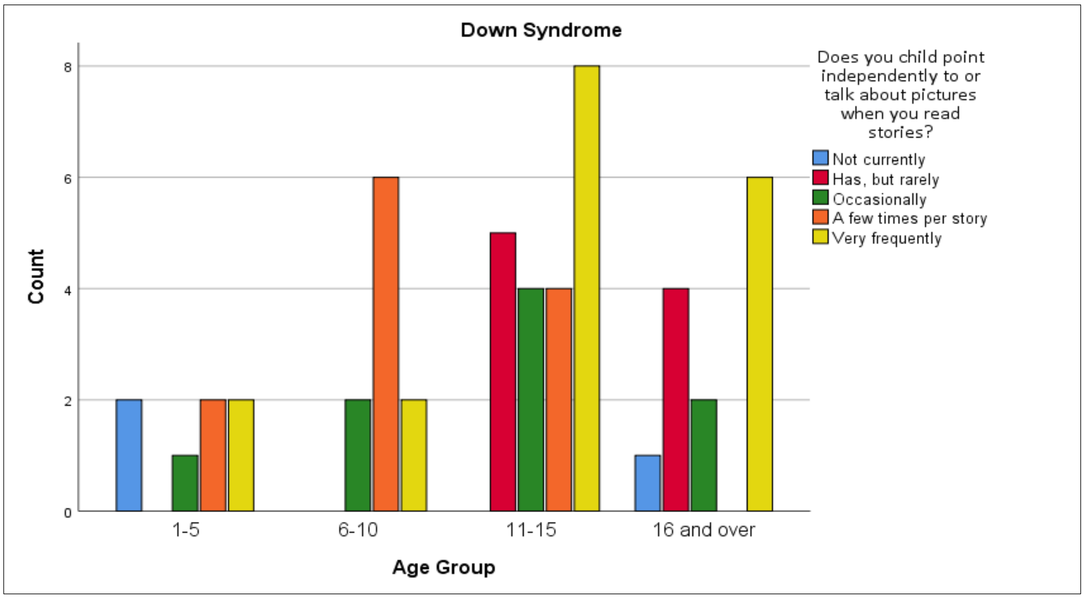


Table 60

Chi-Square and *percentage* responses for Question 9: Does your child point independently to or talk about pictures when you read stories?

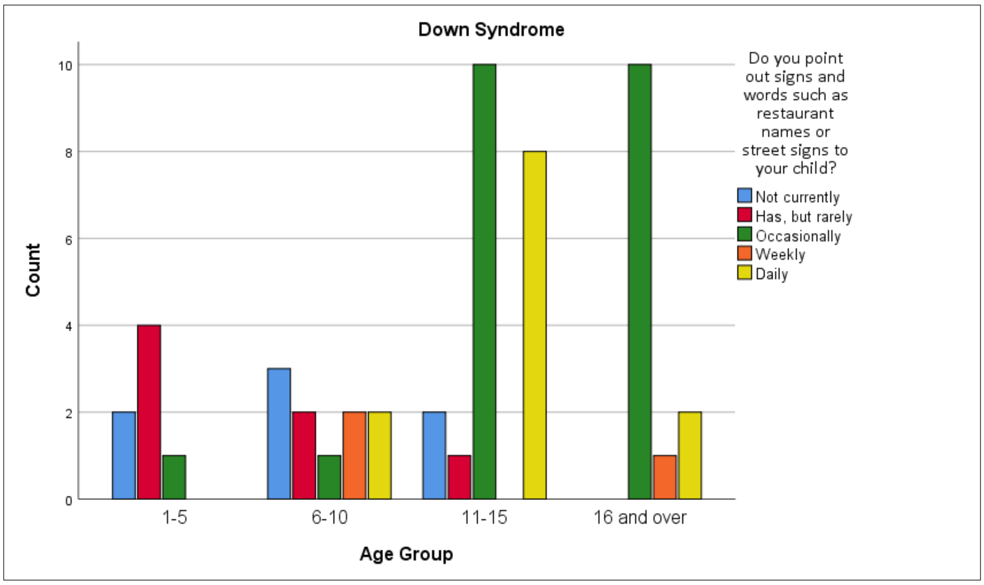
Group			Not currently	Has, but rarely	Occasionally	A few times per story	Very frequently
TD	Age Group	1-5	14.3%	0.0%	9.5%	28.6%	47.6%
		6-10	0.0%	0.0%	4.8%	23.8%	71.4%
DS	Age Group	1-5	28.6%	0.0%	14.3%	28.6%	28.6%
		6-10	0.0%	0.0%	20.0%	60.0%	20.0%
		11-15	0.0%	23.8%	19.0%	19.0%	38.1%
		16 and over	7.7%	30.8%	15.4%	0.0%	46.2%

Note. TD group: $X^2(1) = 4.424$; $p = .219$; DS group: $X^2(1) = 23.080$; $p = .027$.

Question 11: Do you point out signs and words such as restaurant names or street signs to your child? Respondents from the DS group showed an increase in pointing out signs and words as their age increased. The marked increase could be mostly felt in the 11-15 years cohort. In contrast, the increase was notable in the TD group, with a daily occurrence of 47.6% from 28.6% for 'a few times per story'. However, this growth was not statistically significant. The responses are summarized in Figure 28. Refer to Table S3 in Appendix S p. 481 for the full results.

Figure 28

Clustered Bar Graph of responses by age group to question: Do you point out signs and words such as restaurant names or street signs to your child? for the DS group



Question 13: Does your child identify words in the environment? Age played significant importance in these questions, with answers being affected by the age group being significant as the *p*-value was .001. As Figure 29 and Table 61 illustrate, the older the participants, the more the word identification reports. Reports of 'Never' or 'Rarely' identifying words in the environment were attributed to the younger age groups, while the response: 'Several times a day' was attributed mostly to the older age groups.

Figure 29

Clustered Bar Graph of responses by age group to question: Does your child identify words in the environment? for the DS group

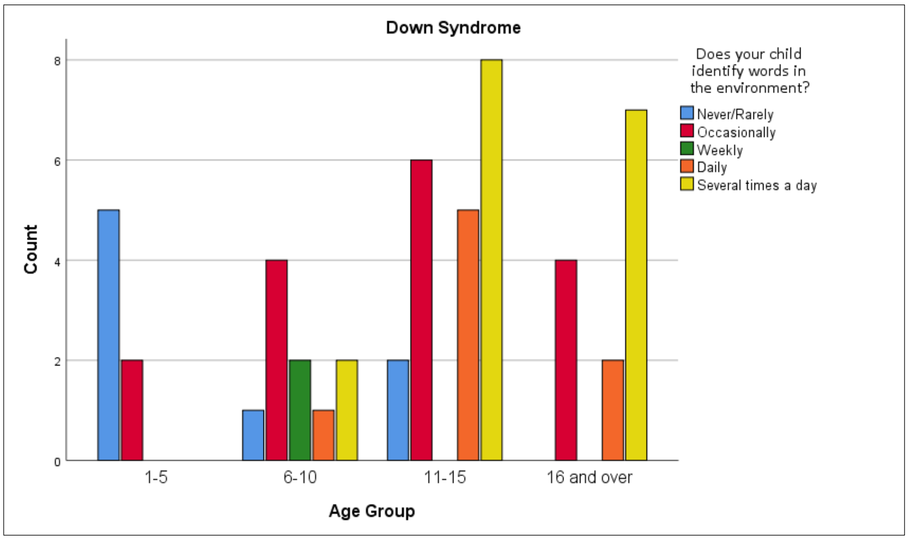


Table 61

Question 13: Does your child identify words in the environment?

Group			Never /Rarely	Occasionally	Weekly	Daily	Several times a day
TD	Age Group	1-5	19.0%	28.6%	14.3%	19.0%	19.0%
		6-10	4.8%	33.3%	4.8%	23.8%	33.3%
DS	Age Group	1-5	71.4%	28.6%	0.0%	0.0%	0.0%
		6-10	10.0%	40.0%	20.0%	10.0%	20.0%
		11-15	9.5%	28.6%	0.0%	23.8%	38.1%
		16 and over	0.0%	30.8%	0.0%	15.4%	53.8%

Note. *N* = DS: 51, TD: 42; TD group: $X^2(1)$= 3.806; *p* = .433; DS Group: $X^2(1)$ = 31.967; *p* = .001.

Of the questions investigating the use of flashcards, only one question resulted in being affected by the age variable. For question 18: *Are flashcards still being used? If no, why have these been stopped?* – Flashcards were reported to be used in most cases within the younger age groups; however, the frequency decreased as the age increased. (Refer to Table 62 and Figure 30).

Table 62

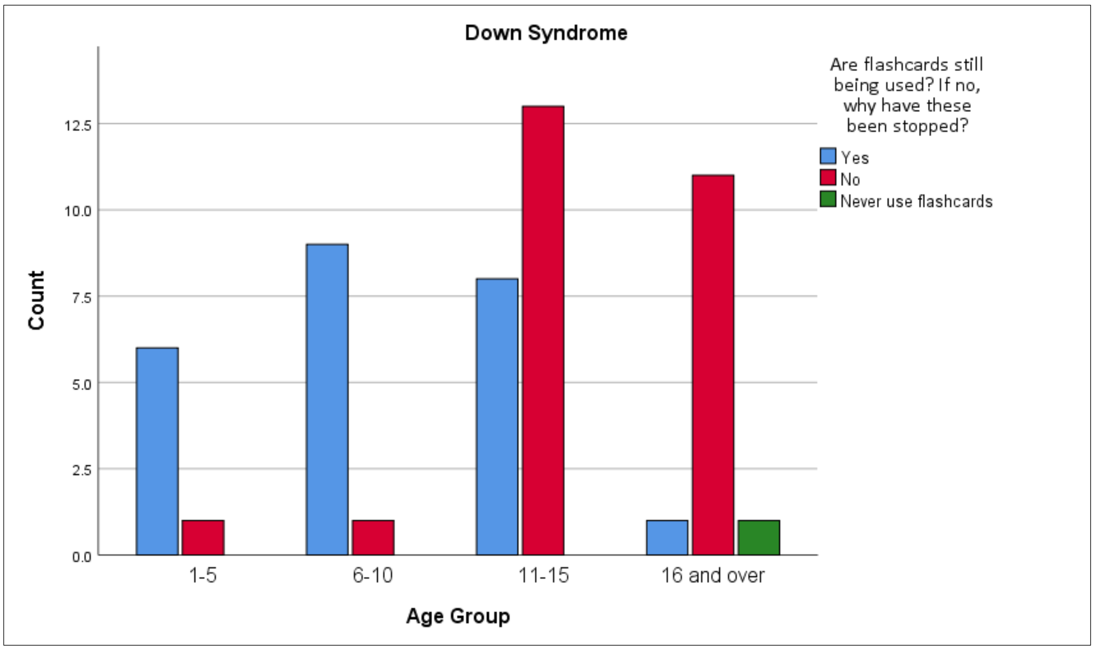
Chi-Square and Percentage results of differences between age groups on Question 18: Are flashcards still being used? If no, why have these been stopped?

Group				Yes	No	Never used flashcards	Total
TD	Age Group	1-5	% within Age Group	61.9%	38.1%	0.0%	100.0%
		6-10	% within Age Group	23.8%	71.4%	4.8%	100.0%
DS	Age Group	1-5	% within Age Group	85.7%	14.3%	0.0%	100.0%
		6-10	% within Age Group	90.0%	10.0%	0.0%	100.0%
		11-15	% within Age Group	38.1%	61.9%	0.0%	100.0%
		16 and over	% within Age Group	7.7%	84.6%	7.7%	100.0%

Note. *N* = DS: 51, TD: 42; TD group: $X^2(1) = 6.686$; $p = .035$; DS Group: $X^2(1) = 22.223$; $p = .001$.

Figure 30

Clustered Bar Graph of responses by age group to question: Are flashcards still being used? If no, why have these been stopped? for the DS group



Three questions investigated the interest in letters displays affected by the age variable. Results are discussed in the following sections.

Question 19: At what age did they start being exposed to the alphabet? This question provides interesting insight. As depicted in Table 63 and Figure 31, the answers show that within the younger age groups, children with DS were being exposed to the alphabet at a young age and at par with TD developing peers, at times even before their peers. This result could be attributed to the importance that is being put on early intervention. However, responses from the older groups show otherwise. Respondents have reported that students were exposed to the alphabet later than their TD peers, suggesting an internally motivating reading-readiness approach.

Table 63

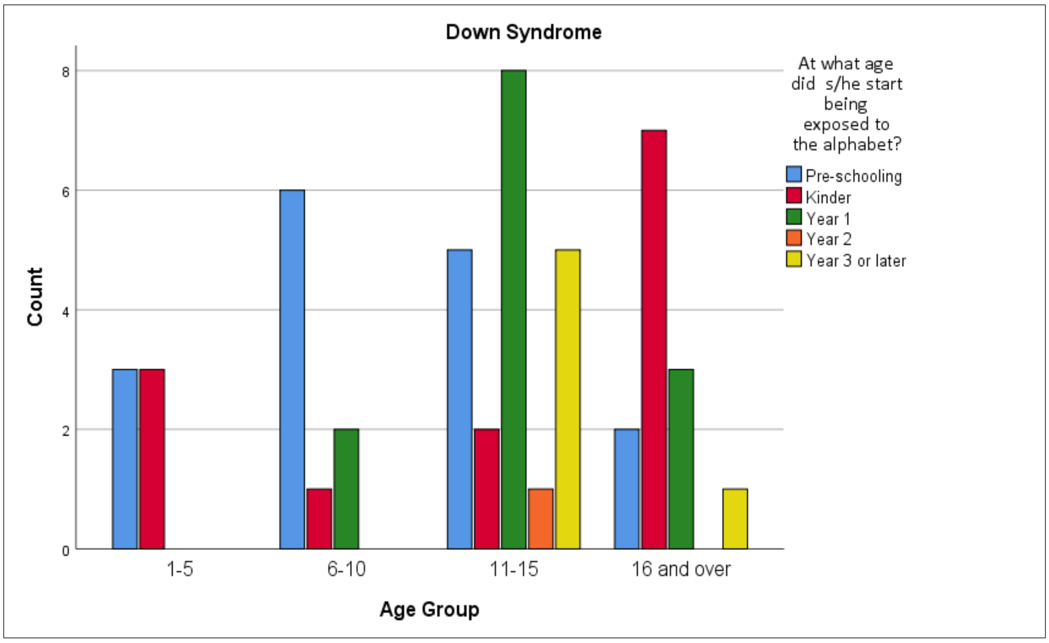
Chi-Square and Percentage results of differences between age groups on Question 19: At what age did they start being exposed to the alphabet?

Group			Pre-schooling	Kinder	Year 1	Year 2	Year 3or later
TD	Age Group	1-5	23.8%	0%	0%	0%	0%
		6-10	38.1%	0%	0%	0%	0%
DS	Age Group	1-5	50.%	50.%	0%	0%	0%
		6-10	66.7%	11.1%	22.2%	0%	0%
		11-15	23.8%	9.5%	38.1%	4.8%	23.8%
		16 and over	15.4%	53.8%	23.1%	0.0%	7.7%

Note. *N* = DS: 51, TD: 42; TD group: $X^2(1) = 1.003$; *p* = .317; DS Group: $X^2(1) = 21.885$; *p* = .039.

Figure 31

Clustered Bar Graph of responses by age group to question: At what age did they start being exposed to the alphabet? for the DS group



Questions 21 Can your child put letters together to sound out words? and 22 Does your child write letters and/or words? Question 21 and 22 also indicate an impact on the age variable. This effect was found both in the DS and the TD groups. Independent blending of sounds was reported as age increased. This was significantly evident within the ages of 11-15 and 16+ ages. These responses also indicate the late development of blending skills in the DS population. Answers from Question 22 mirror those of Question 21, where respondents indicated that the students could write more as they increased in age. These results are represented in Figure 32, Table 64 and Figure 33 (refer to Appendix S, Table S4 p. 481 for full results for Question 22). The TD group also had similar responses.

Figure 32

Clustered Bar Graph of responses by age group to question: Can your child put letters together to sound out words? for the DS group

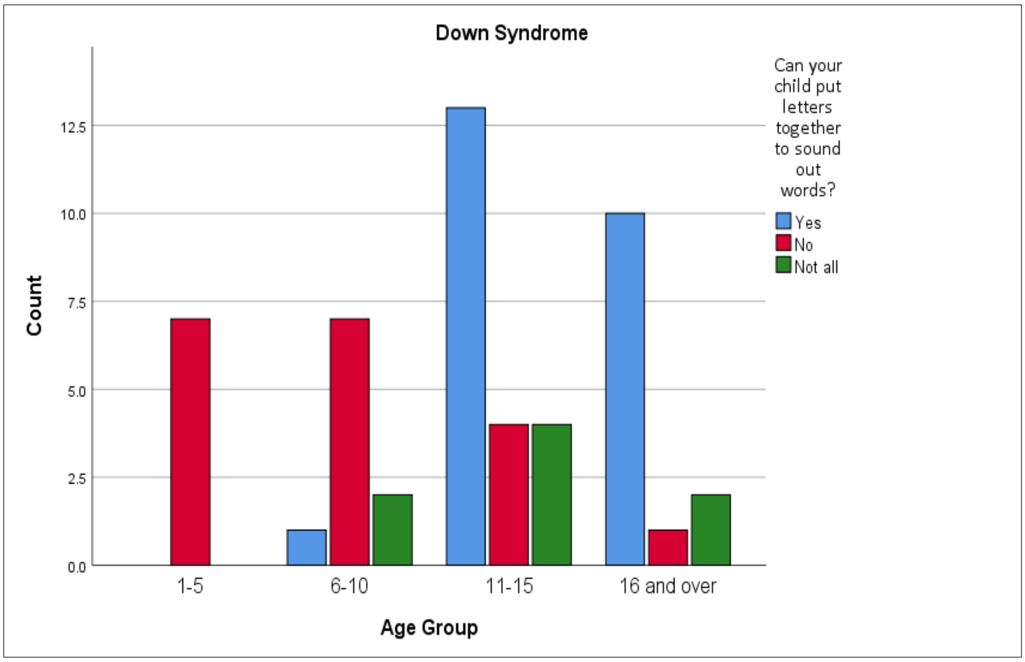


Table 64

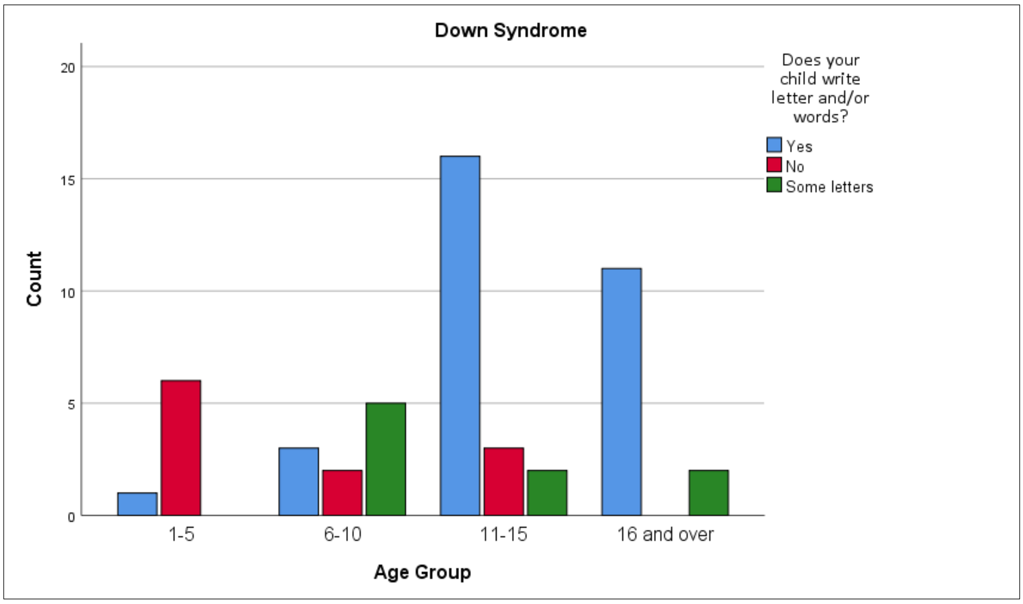
Chi-Square results and Percentages for Question 21: Can your child put letters together to sound out words?

Group			Yes	No	Not all	Total
	Age Group	1-5	28.6%	57.1%	14.3%	100%
		6-10	76.2%	14.3%	9.5%	100%
DS	Age Group	1-5	0%	100%	0%	100%
		6-10	10%	70%	20%	100%
		11-15	61.9%	19%	19%	100%
		16 and over	76.9%	7.7%	15.4%	100%

Note. *N* = DS: 51, TD: 42; TD group: $X^2(1) = 10.145$; $p = .006$; DS Group: $X^2(1) = 26.222$; $p = .000$.

Figure 33

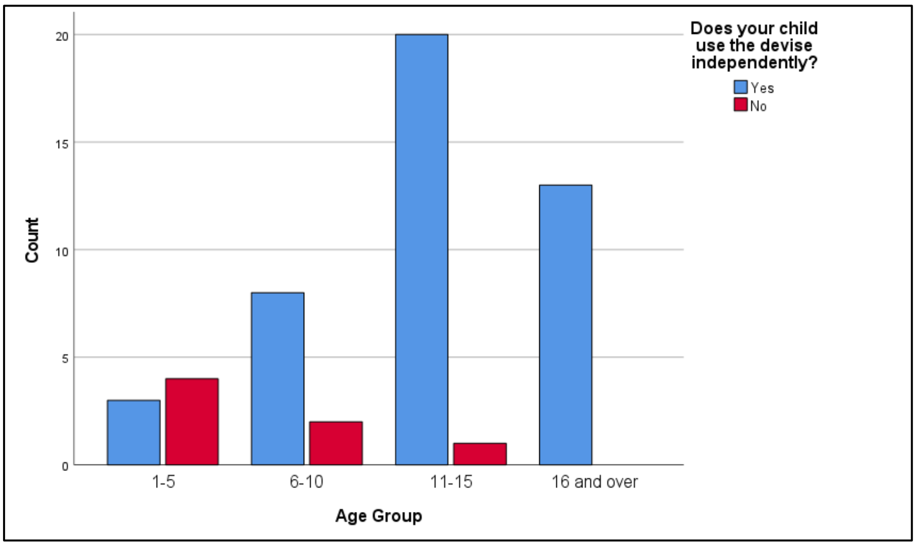
Clustered Bar Graph of responses by age group to question: Does your child write letters and/or words? for the DS group



Question 24: Does your child use the device independently? This question investigated the use of technology. Results show that the older the age groups, the more independent the children used technology. This could be observed both in the DS and the TD group. See Figure 34. Refer to Table S5 in Appendix S p.483 for full results.

Figure 34

Clustered Bar Graph of responses by age group to question: Does your child use the device independently? for the DS group



The effect of a Bilingual Environment on the HLE

A third research question in this study sought to investigate the effect of the bilingual environment on the HLE. The question asked: How does the bilingual environment of Maltese children and adolescents with DS affect HLE? The following hypothesis was tested: *Participants exposed to Maltese and English at home engage in increased home and environmental literacy experiences.*

The *Chi-Square Test* was also used to investigate the effect of the bilingual environment on the HLE in both groups. Results from a *Three-Way Cross Tab* can be found in Table 65.

The following Hypothesis was tested:

The HLE of participants differs according to the language environment of the participants. This is known as the *Alternative Hypothesis* and is accepted if there is a significant difference and the *p*-value is less than the .05 criterion. If the *p*-value exceeds the .05 level of significance, the Alternative Hypothesis is rejected, and the null hypothesis is accepted. The null hypothesis stipulates that no difference can be identified in the language environment.

Results indicated that the bilingual environment does not affect responses. Therefore the Alternative Hypothesis was rejected, and the Null hypothesis was accepted. Results are summarized in Table 65. Results indicate that no significant difference could be identified in HLE between monolingual and bilingual participants in DS and TD groups. Only two questions showed to be affected by the aspect language use at home. The post-hoc analysis for Question 16 and Question 23 is presented next to investigate this result further.

It can therefore be stated that the Alternative hypothesis is rejected, and the Null hypothesis is accepted on the majority of the questions. It needs to be noted that the effect size on the different computations varied and is highlighted in Table 65. This allows the researcher to add another layer of interpretaion to each separate questionnaire question.

Table 65

Chi-square test results investigating the effect of the bilingual environment on Home Literacy Experiences

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Question	Group	*P*	*Cramer's V*
7. Does your child ask you to read to them?	TD	.521	.290**
	DS	.619	.306**
8. How often do you read to your child?	TD	.888	.440***
	DS	.713	.165*
9. Does your child point independently to or talk about pictures when you read stories?	TD	.369	.243**
	DS	.652	.374***
10. Do you attempt to teach the names of the letters in the alphabet and/or alphabet sounds when reading?	TD	.053	.255**
	DS	.540	.167*
11. Do you point out signs and words such as restaurant names or street signs to your child?	TD	.118	.591***
	DS	.612	.363***
12. Does your child show interest in adult reading material?	TD	.151	.333**
	DS	.657	.492***
13. Does your child identify words in the environment?	TD	.709	.306**
	DS	.228	.585***
14. Does your child read any words by sight?	TD	.393	.395***
	DS	.498	.256**
15. Did your child start reading through the use of flashcards?	TD	.461	.322**
	DS	.573	.091*
16. How many flashcards can your child read?	TD	.011*	.322**
	DS	.766	.423***
17. At what age did they start using flashcards if they used any?	TD	.535	.242**
	DS	.065	.329**
18. Are flashcards still being used? If no, why have these been stopped?	TD	.083	.418***
	DS	.827	.637***
19. At what age did they start being exposed to the alphabet?	TD	.353	.044*
	DS	.658	.312**
20. Can your child read the letters of the alphabet?	TD	.077	.333**
	DS	.518	.262**
21. Can your child put letters together to sound out words?	TD	.806	.318**
	DS	.758	.304**
22. Does your child write a letter and/or words?	TD	.081	.359***
	DS	.664	.205**
23. Do you have a computer or any other electronic device such as a tablet at home?	TD	.01*	-
	DS	.537	-
24. Does your child use the device independently?	TD	.664	.180*
	DS	.807	.110*

Note. *N* = DS: 51, TD: 42; *Questions which were affected by the Bilingual Variable; *small effect size, **medium effect size, *** large effect size.

Post-Hoc Analysis.

A post-hoc analyisis for questions 16 and 23 was implemented. As identified in Table 65. Questions 16 and 23 showed an affect by the choice of language in the Home.

Post-Hoc Analysis Question 16. The Chi-Square Test of independence identified that the distribution was not equal among all responses. However, on further analysis allowing for Type 1 Error correction (Bonferroni corrected, p=.0033) identified that on question 16: How many flashcards can your child read? No response achieved a level of significance. Hence, post-hoc analysis concluded that the type of language used in the home did not effect the responses.

Post Hoc Analysis Question 23. The *Chi-Square Test* of independence identified that the distribution was not equal among all responses. A post-hoc analysis allowing for Type 1 Error correction (Bonferroni corrected) identified that on the question 23: *Does your child use the devise independently? in the TD group, an 85.7% was reported in* the group of TD students with Maltese mainly used at home. This result was statistically significantly smaller (Bonferroni corrected p=.0083) when compared to the group of participants who either used English at home or both languages. No variation was identified in the DS group.

The results from this study are evaluated and discussed next

Discussion

The forthcoming section will discuss the results obtained in Study 1 according to the pertinent research questions.

Research Question 1: How does the Home Literacy Environment of participants with DS differ from TD children?

Chapter 2, p. 87, discussed that the home environment typically offers the first setting for literacy to develop. Inherent characteristics of the DS phenotype, individual characteristics, or caregivers' influences can impact reading development. In this study, the Home Literacy Environment (HLE) of students with DS was compared to the HLE of TD peers. Information about the

HLE was collected through a questionnaire. The data was collected through structured interviews to assist caregivers to complete the questionnaire. Ninety-three caregivers of participants (51 DS and 42 TD) responded to the questionnaire. The TD had a mean age of 5;33 years (Median = 5), while the DS group had a mean age of 15 years (Median = 13). This comparison aimed to identify whether differences exist between the two groups. The literature review identified that HLE is relatively unexplored in the DS population. Even though research is available regarding other learning difficulties or disabilities, findings cannot always be generalised due to the diversity of the different impairments. Moreover, the researcher could not identify any analogous literature within the local Maltese scenario. The limited research available locally involves TD children (Vella, 2018).

The differences and similarities between the DS and TD groups will be discussed by grouping the questionnaire questions into different sections, also mirroring the approach used in the Results chapter. The four sections in the Questionnaire are Reading Books, Response to Print, Interest in Letters, and, Technology in the Home.

Reading books

The first part of the questionnaire investigated what language was used during home-reading. Although the participants were matched for the language used at home, results from the DS group showed that a higher preference was given to the English language (43.1%) during reading when compared to Maltese (25.5%). This result was not observed in the TD group, where a balance between Maltese and English was reported, with 50% choosing both languages. Refer to Table 40, p. 232.

This result provides useful insight into our local situation. Increasingly it was noted that English is favoured as a language of instruction in populations of children with learning difficulties (Sant, 2018). Unfortunately, no local studies are found in particular reference to DS. However, Camilleri Grima (2013) reported that in Malta, Maltese is reportedly used at an informal level in many families; however, English is used for educational purposes in a TD population. This study's results mirror this finding; however, only within the DS group, since most of the participants were

Maltese-speaking at home, they chose to engage in English during shared book reading (SBR). The TD showed a balance between the languages. Parents/carers might choose English during SBR as this language is associated more with formal education. Hence, parents/carers might feel that they expose their children to English to help more their children's educational level. This preference was present throughout all the age groups in the DS groups. Therefore, it can be observed that this preference is shown from early reading to reading during the teenage years. Lewis et al. (2016) investigated the language used during SBR in Spanish-English bilingual children's homes. They found that the children spoke more English during shared reading than Spanish, even though Spanish was their native language. Children participating in Lewis et al.’s study were typically developing students. Unfortunately, no similar studies have been identified for the DS population.

In this study, parents/carers reported that in DS, reading was better in the English language (47.1%) (see p. 232). It was also found that participants were read to more in English, and at home, books were more readily available in the English language (62.7%) rather than in the Maltese language (19.6%; see Table 42, p. 232). This result contrasts findings from the TD group, where exposure to books, availability of books and reading competence were balanced between Maltese and English. Gonzalez-Barrero (2020) investigated the HLE of sixty-six 5-year old TD French-English participants. The participants' parents reported that children have more books in the non-dominant language than in the dominant language. Most of the study participants were predominantly Maltese-speaking; however, results show that books' availability was favoured the English language. Hence, the results are similar to Gonzales-Barrero's (2020).

Although a specific investigation towards bilingual proficiency was not carried out, these results demonstrate an understanding of bilingualism exposure aspects. *The Language Policy for the Early Years in Malta and Gozo* urges the facilitation of both languages from the early years of schooling. Bilingual reading was observed in the DS group (17.6% refer to Table 40, p. 232), and parents also reported that their children had good reading levels in both languages (25.5%, refer to Table 41, p. 232). DS's bilingual reading ability was also reported in other studies with DS participants (Burgoyne et al., 2016). Although bilingual reading has been reported, this study did not investigate comprehension of bilingual texts, which may not reflect both languages' reading comprehension. Thus, even though bilingual decoding is reportedly present, a full understanding of bilingual comprehension is unavailable. This factor warrants further investigation.

A difference between DS and TD groups was observed in the results investigating whether children ask their parents/carers to read to them, where less initiative was observed in the DS group since 47.1% asked to be read to occasionally, while a high percentage from the TD group asked to be read to daily (38.1%). Refer to Table 42, p. 233. In this study, the participants with DS were older, as reported in the previous chapter. This meant that more teenagers were present in this group. The DS group's older age could have led to less willingness to ask parents/carers to read to them. This is also reported in the literature in DS (Jordan et al., 2011; Ricci, 2011).

Notwithstanding, when these questions (Question 7 and 8) were analysed across different age groups, similar responses were identified across the ages (refer to p. 244). Moreover, the participants with DS had a lower mean score on the SIT (as reported in Study 1 Table 7) This result indicates that verbal comprehension is lower in the group of participants with DS than in the matched control participants; this could contribute to the findings. This difference was also found when parents/carers were asked how often they read to their children. This finding shows that even though reading material was available, behaviours towards shared book reading are still not at par with TD peers, in compliance with some of the literature reviewed (Fallon & Day, 2009). Yet it needs to be noted that an important age difference between DS and TD groups was evident in this study and this could have impinged on this result.

Response to print

Despite being of a younger mean chronological age, the TD group showed more interest in print than the DS group. The frequency of shared book reading differed between the two groups ($\chi^2(1) = 33.66$; $p = .00$; see Table 44 on p. 234). TD parents/carers reported reading more frequently to their children. This could be partially due to the age gap between the two groups. Younger children might enjoy engaging in SBR as an activity more when compared to older children. However, this might not necessarily be the case, as Ricci (2011) reported that the older the students, the higher the interest in shared reading. Al Otaiba et al. (2009) also reported that children with DS, between three months and six years of age, spend on average 10-30 minutes playing with books a day.

Parents were requested to provide feedback on the level of interest in adult reading material. Results showed that there was no difference between groups (χ^2 (1) = 5.047; p = .283; see Table 47 on p. 236). Similar findings were also reported for the question, which investigated the identification of words in the environment (χ^2 (1) = 2.163; p = .706; see Table 48, p. 236). Aspects of reading will be evaluated further later in this chapter.

A set of questions investigated the use of flashcards and sight-word reading. Results, summarized in Table 49, p. 237, show that the groups are different in their responses to most questions. Forty-two readers were reported in the DS group, while 27 were reported in the TD group. Results showed that for the DS group, flashcards have been dominant in their reading experience. Unlike the TD group, the DS group was introduced to flashcards at a very young age. They started reading through flashcards, thus showing that the *look-and-say* method was dominant as a literacy intervention method, in contrast to the TD group. The majority of parents/carers of the TD group reported that their children were introduced to reading through a phonological approach since flashcards were not used in the introductory stages of reading but alphabet instruction was used (refer to Table 49). This result is in line with the Maltese national minimum curriculum framework. Such results also show that a different reading instruction method may have been used for the DS population, which brings forth the query of who is responsible for literacy training for DS children.

During the data collection meetings, many parents from the DS group informally reported that their children did not follow all lessons along with the mainstream class of their school-year peers in school. In the Maltese context, most students with DS are assigned a Learning Support

Educator (LSE) on the first days of school. It is common practice that the LSE is mostly responsible for adapting the class curriculum. However, it is the teachers' responsibility to set the lesson and involve all students in the class. Parents have remarked that in most cases, it was up to the LSE or other professionals, such as Speech-Language Pathologists and Early Intervention specialists, to decide which reading intervention method to introduce (this is discussed further in Study 4). This is usually decided during an Individualised Evaluation Plan meeting, where all professionals are invited to attend and plan the students' goals for each scholastic year. In Malta, sight-word reading has been heavily favoured within the DS population (Muscat, 2017). This common practice is also confirmed in this current study. Study 4 further in this thesis sheds more light on the current practices. Unfortunately, the efficacy of this intervention method has not been researched locally; therefore, not all students may have used or benefitted (or not) from this approach. Several parents remarked that it was a uniform model. These comments did not surprise the researcher, as even though no intervention studies have been carried out locally, this was often observed in clinical and educational practice. The literacy practices employed in Maltese schools with students with DS will be investigated in Study 4 to fill the gap in the literature.

Technology in the home.

The use of technology at home concerning literacy was explored through three questions; Questions 23-25 (refer to Table 56, p. 241). Results indicated that the DS and TD groups had similar exposure to technological devices and could use devices independently. The use of tablets was reported to be very common, more common than laptops. This shows a preference for using more portable devices and supports findings in the literature (Orrin & Olcese, 2011), a finding identified in both groups. Parents reported that devices were used mainly for leisure and entertainment. This was similarly reported by Fritz (2017). The primary source of entertainment through technology was the use of YouTube videos. Educational activities varied from eBooks, literacy applications and language applications. Although this subject was explored briefly in this study, it highlights essential educational resources. Technology is readily available to both the TD population and the DS population. It confirms that literacy through technology is a constant feature in emergent literacy (Liang & Johnson, 2008). Thus, there should be a push towards encouraging literacy activities to be carried out or reinforced through this medium, making literacy exposure fun and interactive in the process.

Research Question 2: Do the gender and the age of students affect the Home Literacy Environment?

A second research question investigated whether gender and age played a part in affecting participants' responses. Results indicate that the null hypothesis was accepted when gender was investigated since no difference was identified between males and females in both the DS and the control group (see Table 57, p. 242). This result is consistent with international research (Lusby & Heinz, 2020; Ricci, 2011), where a relationship between gender and HLE was not found. This result adds to the local scenario where an investigation of the effect of gender in the DS population on the HLE is novel.

In contrast, age affected several responses. The findings affected by the age of the participants will be discussed. The results of this investigation can be found in Table 58, p. 244. Regarding Question 5: In which language are they better at reading? – the parental reports indicated that during the early years (1-5 years), no better reading abilities in one language over the other were identified. This was reported in the DS and TD groups, with 57.1% reporting a similar reading competence in both languages. Some parents reported better use of English (14.3%) in the DS group. However, no parents reported better use of Maltese (0%) in DS. This contrasts with the TD group. It could indicate that the DS group is predominantly exposed to English text within the early years rather than Maltese, while the TD group is exposed to both. According to The Language Policy for Bilingual Education, children in mainstream schooling should be exposed to equal literacy training in both languages. However, regarding the DS group, parents/carers, therapists or other professionals could have favoured English, and therefore the national minimum curriculum recommendations were not adhered to. As previously discussed, parents maintained that most children with DS attended literacy lessons outside the mainstream classroom.

Within the 6-10 age group, a balance between Maltese and English was reported in DS and TD groups. The DS groups' respondents reported that the DS participants were reading in both languages (50%), while the TD group reported being good at reading in both (14.3%). None of the parents within the DS group of this age group reported that the participants were better at reading in Maltese; however, this was reported in the TD group. This adds to the notion that Maltese is introduced later, and consequently, competence in reading this language takes longer to develop. With an increase in age, the parents started reporting that reading in Maltese was predominantly better in DS. 23.8% of the parents of DS participants from the 11-15 age group reported that reading in Maltese was better. Of the 16 and over age group, 30.8% reported that reading in Maltese was better. However, even though the competence in Maltese was reported to increase, the competence in English was consistently better throughout all age groups (see Table 59, p. 246, for results). In Maltese schools, many subjects are taught in English, which could have contributed to this result since English is practised across subjects and not limited to a few academic subjects.

Independent reading was also affected by the increase in age in the DS group. The older students with DS reportedly pointed at pictures more independently than the younger participants. Of the participants with DS within the 16 and over age group, 46.2% pointed very frequently, while a lesser frequency was reported within the younger age groups (see Table 60, p. 248, for results).

Parents/carers were also asked about participants' ability to identify words in the environment, where an increased ability to identify a word in the environment increased as age increased. The difference in age groups was significant within the DS group ($p = .001$) but was not significant within the TD group ($p = .433$) (see Table 61, p. 250). However, it needs to be reminded that the TD participants were closer in age, while the DS age groups varied more. This finding shows that the DS group may have needed more maturation to develop literacy skills yet managed to achieve the same abilities as the comparison group with time.

Question 19 investigated at what age the alphabet was introduced. The respondents' answers also showed an age effect (see Table 63, p. 252 for results). The results showed that the older cohort was introduced to the alphabet much later than the younger DS group. This result confirms that the younger cohort was now being exposed to early literacy practices and was moving away from the reading readiness approach, which was found to have been the more common approach for the older cohort. Hence shows that in more recent years, DS are more exposed to early literacy practices. It is encouraging to observe such early literacy practises, as this was not always observed in the literature (Lusby & Heinz, 2020). In comparison, in the TD group, no age effect was perceived as all respondents from the TD group reported that the participants were introduced to the alphabet at the same young age.

The age effect also applied to questions relating to the blending of letter sounds and the writing of letters. Question 21 asked if the participants could put letters together to sound out words. Both DS and TD groups were reported to have better blending abilities as they got older. The difference between age groups was significant in DS ($p = .006$) and TD ($p < .000$). The DS reportedly needed more time to develop blending skills when compared to the TD group. By 6-10 years, most TD participants were reported to be able to blend letter sounds (76.2%), while within the same age group, only 10% of the DS participants were reported to blend (see p. 254). Zahra (2010) reported a difference in blending abilities between TD and DS participants; however, Boudreau (2002) did not find this difference.

In summary, and response to research question 2, gender does not affect the HLE; however, age affects responses in some areas of the HLE.

Research Question 3: How does the bilingual environment of Maltese children and adolescents with DS affect HLE?

Throughout this investigation, the researcher attempted to identify whether the HLE of participants with DS differed in their language use in the home. The researcher categorised the participants according to the language spoken at home. A combination of only Maltese, only English and both languages could be identified. This initial finding first draws novel information about the area of bilingualism in DS. The local Maltese context is rich in bilingualism; however, not all Maltese individuals with DS engage in Maltese and English. The literature shows that the use of two languages does occur in DS; however, reports are not so common (Ward & Sanoudaki, 2020). It has been reported that bilingualism does not hinder language development in the two languages (Feltmate & Kay-Raining Bird, 2008; Cleave et al., 2014; Ward & Sanoudaki, 2020). An important finding in the study comes primarily from the sample. Of the sample population of 51 participants with DS, 33% use both languages in the home. This contributes to the literature confirming that bilingualism is possible in DS, and such a statistic identifies that a substantive number of participants with DS from this sample can communicate in both languages.

The research evaluated further whether being bilingual played an effect on the HLE. Results indicate no differences between the monolingual and bilingual groups; hence it can be hypothesised that the HLE is not affected by bilingualism. The researcher identified only 1 question which was effected by the language use in the home and this was in the TD group. It was identified that TD children who used Maltese only at home were less likely to be independ usesrs of technological devices. The fact that most of the technology is in English could have contributed to this result. Although further investigation is warranted especially looking into the different types of bilingualism, this result provides novel information about the area as this has been seldomly explored.

Conclusion and summary of results investigating the Home Literacy Environment

The investigation, previously illustrated, gives a clearer idea of the HLE of participants with DS compared to TD peers matched according to cognitive abilities. The participants in this questionnaire included 42 readers with DS and 27 readers from the TD group, as reported by the parents/carers. Findings from this chapter are summarised hereunder;

- Participants with DS favoured English book reading, whereas participants in the TD group did not show a preferred language.

- The DS group showed less initiative towards SBR when compared to the TD group, and parents of participants with DS reportedly read less to their children.
- In the DS group, interest in reading increased with age. A similar performance was noted in both groups regarding interest in print.
- Both DS and TD groups were exposed to flashcards; however, the DS group were introduced to flashcards at an earlier age. The DS participants can read a bigger number of flashcards; however, it needs to be noted that the DS group were older.
- Children with DS were introduced to the alphabet later than their TD peers.
- Similar competencies in reading single letters, blending letter sounds and the writing of letters and words were reported in both groups.
- No difference between groups was found in the use and type of technology related to reading.
- Gender did not affect the response to questions investigating the HLE in both groups.
- Several responses were affected by the age of the participants in both groups. The TD group had a small age range. Therefore the effect of age could not be investigated similarly to the DS group as only two age brackets were included for the TD participants.
- The Home Literacy Experiences of participants who use Maltese and English at home are not different from the HLE of participants who use only one language at home.

Limitations of the Study

- The researcher carried out a Factor analysis for the Home Literacy Questionnaire (refer to p. 463). This was included since this was an adapted version of the Home Literacy Questionnaire (Boudreau, 2005), and no reliability and validity measures were available. The analysis identified that the internal consistency of the questions within the questionnaire was not strong. Further reliability and validity measures are warranted for this assessment tool.

- The researcher collected information about the language used in the home. Further investigation into bilingualism could have provided additional informative data to the study.
- The difference in chronological ages between groups impinged on some of the responses. An investigation with groups matched on chronological age is warranted.

Chapter 7 now follows, where Study 4 is represented throughout this chapter. Study 4 evaluates the Maltese school literacy environments and practices with students with DS.

Chapter 7

Study 4: An Evaluation of the Maltese school literacy environments and practices with students with DS

Chapter Overview

This chapter investigates the literacy practices utilised with Maltese students with Down Syndrome. This exploratory study provides novice information about the widespread practices within the local Maltese situation. This study is the fourth investigation forming part of this thesis, and the investigation was carried out throughout different age groups and school settings. This study aims to answer the following research questions:

- **Research question 1:** What are the literacy practices used with children and adolescents with Down Syndrome in a Maltese school setting?
- **Research Question 2:** Can a difference in practices be identified between different school settings and school levels?
- **Research Question 3**: How does the bilingual context affect the school literacy environment and literacy practices when working with Maltese children and adolescents with Down Syndrome?

The following hypotheses were tested:

Hypothesis 1:

- Alternative Hypothesis: The literacy practices are individualised according to the student's needs.
- Null Hypothesis: The literacy practices are not individualised according to the student's needs.

Hypothesis 2:

- Alternative Hypothesis: The Learning Support Educators are the primary educators with regard to literacy instruction for students with DS.
- Null Hypothesis: The Learning Support Educators are not the primary educators with regard to literacy instruction for students with DS

Hypothesis 3:

- Alternative Hypothesis: A difference in literacy practices and students' abilities is identified between school settings.
- Null Hypothesis: A difference in literacy practices and students' abilities is not identified between school settings.

Hypothesis 4:

- Alternative Hypothesis: A difference in literacy practices and students' abilities is identified between school levels.
- Null Hypothesis: A difference in literacy practices and students' abilities is not identified between school levels.

Hypothesis 5:

- Alternative Hypothesis: Literacy intervention is predominantly carried out in the English language.
- Null Hypothesis: Literacy intervention is not predominantly carried out in the English language.

Participants

Fifty-eight (58) educators participated in this study. The 58 educators represented 58 different students. The researcher invited educators, which were both teachers and Learning Support Educators (LSEs), to participate in the study. The data was collected through an online questionnaire distributed to all schools in Malta. Refer to Appendix H p. 419 for the questionnaire. As represented in Figure 35, the majority of participants were LSEs. Figure 36 illustrates the distribution of the participants across the different school settings. This figure shows that 95% of the participants attended mainstream education while 5% attended a resource centre. The researcher approached all 280 registered schools in Malta and asked for the Head of Schools to distribute the questionnaires to their school staff if they had a student with DS within their school. The educators were asked to respond to the questionnaire according to the student they were following at the time. A resource centre is not considered as mainstream as it allows for the students to have specialised educational experiences. A national statistic about the distribution of students with DS within the different schooling systems is unavailable to date. (NSO, personal communication, 2022). Table 66 represents information about the students.

Figure 35

Number of Participants

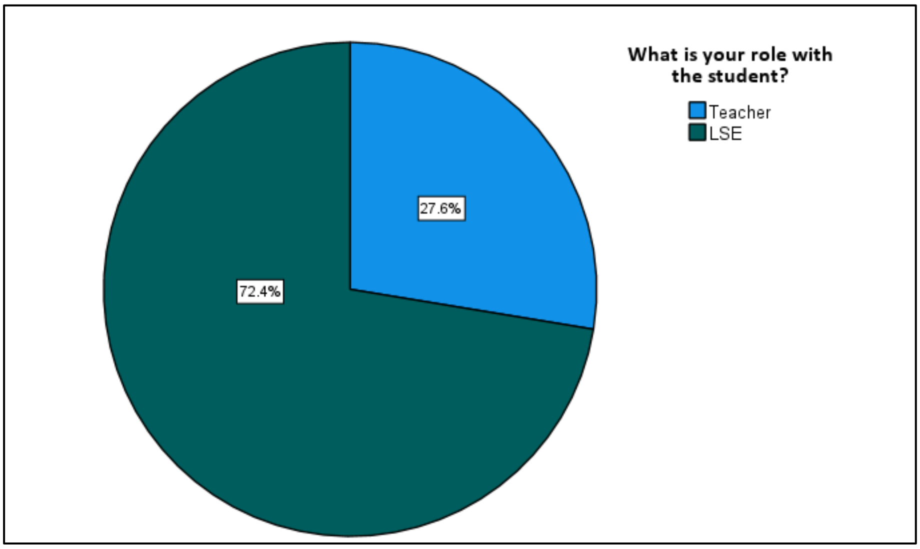


Figure 36

Distribution of the participants across the school settings

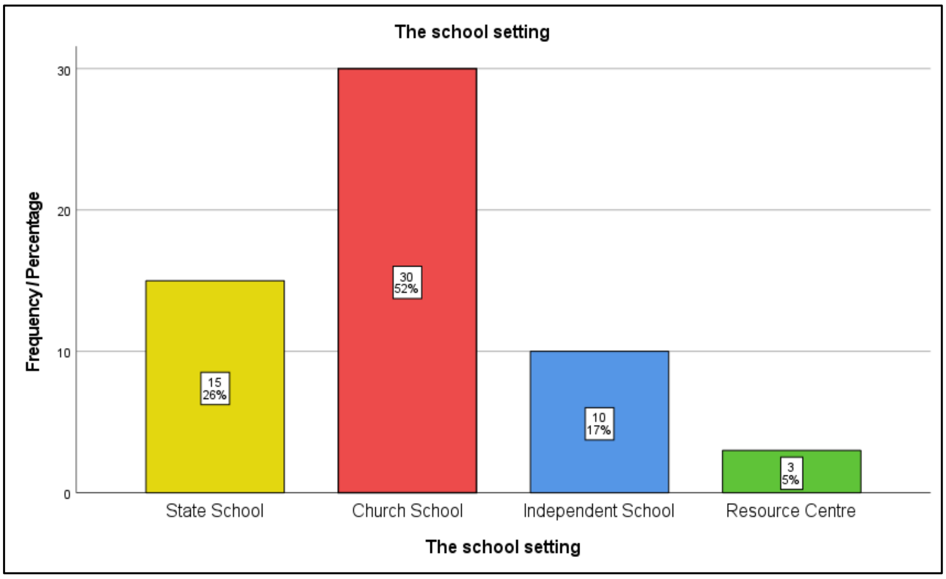


Table 66

Information about the students with DS

School Level of Student			Age of Student		
	N	Percentage		*N*	Percentage
Early Years (KG2- Year1)	8	13.8%	*3 years - 5 years*	9	15.5%
Primary Years (Year 2- Year 6)	21	36.2%	*6 years - 8 years*	8	13.8%
Middle School (Year 7-8)	5	8.6%	*9 years - 11 years*	15	25.9%
Senior School (Year 9-11)	19	32.8%	*12 years - 14 years*	10	17.2%
Resource Centre: Secondary Years	5	8.6%	*14 years +*	16	27.6%

Responses indicate that most participants were actively involved in a school mainstream setting (81%). However, 9% reported not participating in a mainstream setting despite attending mainstream schooling. The level of involvement in the mainstream classroom is varied, where only 12% of the students were reported to be 100% involved in the mainstream setting. Results are summarised in Table 67.

Table 67

Mainstream Setting of Students with Down Syndrome

Does the student participate in a mainstream setting?			The proportion of school hours in mainstream		
	N	Percentage		*N*	Percentage
Yes	47	81%	Less than 20%	11	19%
No	9	15.5%	20 %	10	17.2%
Mainstream in a Resource Centre	2	3.4%	40 %	10	17.2%
			60 %	9	15.5%
			80 %	11	19%
			100%	7	12.1%

The *Chi-Square Test* was used to investigate the effect of the school year the students were in on the proportion of participants in the mainstream setting. Students were grouped into four groups; Early Primary Years, Primary Years, Middle School, Senior School and Resource Centre Secondary School. Results indicated that no difference could be identified between the groups. Therefore, the researcher could not identify a year group where mainstream involvement was more or less prevalent. The results of the crosstabulation are found in Table 68 and represented in Figure 37.

Table 68

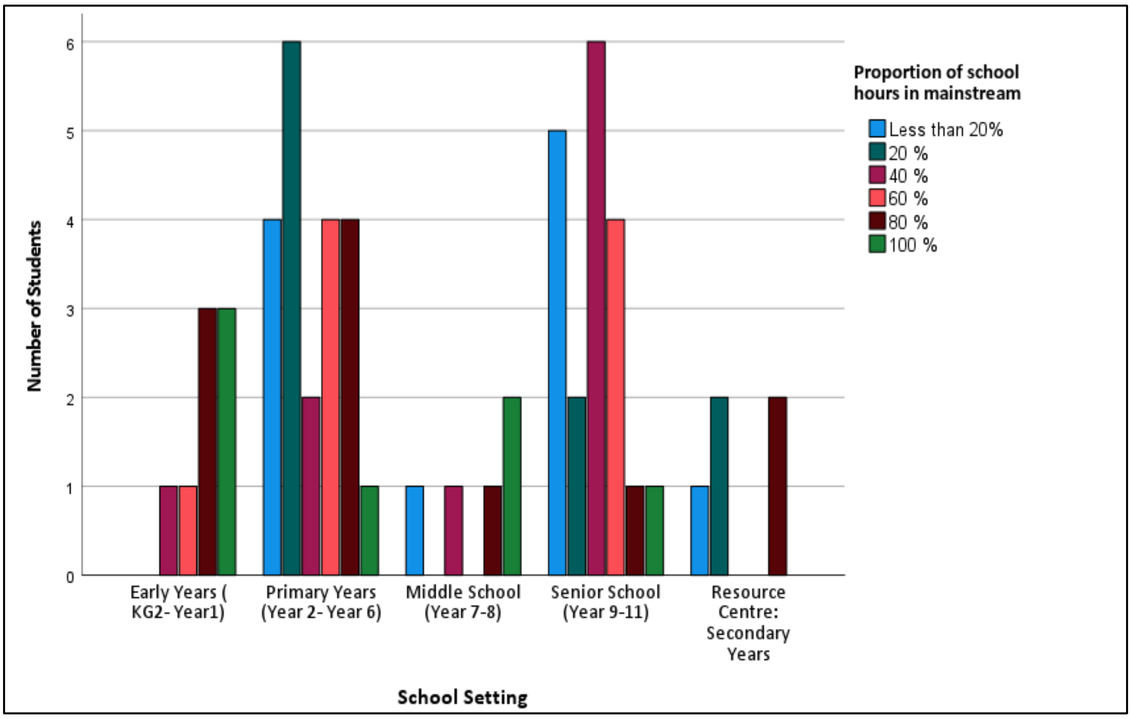
Crosstabulation and Chi-Square result investigating any difference in the proportion of mainstream between school settings.

	The proportion of school hours in mainstream					
	Less than 20%	20 %	40 %	60 %	80 %	100 %
Early Years (KG2- Year1)	0	0	1	1	3	3
Primary Years (Year 2- Year 6)	4	6	2	4	4	1
Middle School (Year 7-8)	1	0	1	0	1	2
Senior School (Year 9-11)	5	2	6	4	1	1
Resource Centre: Secondary Years	1	2	0	0	2	0

Note. χ^2 (1) = 28.27; *p* = .103.

Figure 37

Distribution of Mainstream Involvement according to the school setting.



Results

The results hereunder are presented in 4 different sections; Language Abilities, Reading and Writing Skills, Reading and Writing Instruction; Technology.

Language Abilities. The 58 educators contributed to the students' diverse abilities, showed the educators' awareness of the students' language and language-related abilities, and explored the bilingual aspect of students with DS in the Maltese school setting.

The students were reported to use the English language (40%) more predominantly in the school setting when compared to Maltese (28%). However, a substantial proportion of students used both languages (33%). However, different proportions were reported for the home language, and Maltese is reportedly used more than English in the home setting. Many educators also reported that they were not aware of the language used at home. These results are summarised in Table 69. Educators were also asked about the students' hearing abilities. 10.3% reported that the student had hearing difficulties, 75.9% reported no hearing difficulties, and 13.8% reported that they were not aware of the hearing abilities of the student.

Table 69

The language used by the students

Predominant Language at School			Predominant Language at Home		
	N	Percentage		*N*	Percentage
Maltese	16	28%	*Maltese*	27	47%
English	23	40%	*English*	21	37%
Both	19	33%	*Both*	6	10%
			I don't know	4	7%

All educators reported a level of bilingualism. The educators reported different levels of language use between Maltese and English among the bilingual participants, with a greater proportion of English use being reported. These results are reported in Table 70. The difference between the language used at school was tested across school types. The crosstabulation revealed no difference in language use between school types; this is shown in Table 71.

Table 70

Language use in bilingual students

Question: If both languages are used at school, can you give an estimate of the use of each language?		
	N	%
50% Maltese 50% English	11	19.0%
60% Maltese 40% English	8	13.8%
60% English 40% Maltese	6	10.3%
70% Maltese 30% English	4	6.9%
70% English 30% Maltese	4	6.9%
80% Maltese 20% English	10	17.2%
80% English 20% Maltese	15	25.9%

Table 71

Crosstabulation and Chi-Square result investigating any difference in the proportion of Language usage across different school types.

If both languages are used at school, can you give an estimate of the use of each language?							
School Setting	50% Maltese 50% English	60% Maltese 40% English	60% English 40% Maltese	70% Maltese 30% English	70% English 30% Maltese	80% Maltese 20% English	80% English 20% Maltese
State School	2	4	2	1	0	1	5
Church School	6	3	2	1	4	7	7
Independent School	3	1	0	2	0	2	2
Resource Centre	0	0	2	0	0	0	1

Note. χ^2 (1) = 24.63; *p* = .136.

Two additional questions investigated the language use of the participants at school. Results indicate that the majority of the students use Maltese (47%) at home (refer to Table 69). However, literacy instruction is mostly given either in English (41.4%) or in both languages (41.4%). Respondents maintained that the language of literacy instruction was either chosen during the Individualised Education Plan (IEP) meeting (48.3%) or else by the parents (39.7%). These results are summarised in Table 72. A crosstabulation and an analysis using the *Chi-square test* indicated no difference in the responses according to the type of school (*p* = .131, *p* = .721).

Table 72

Language use at school

The language during Literacy Instruction[1]			Choice of Language of Literacy Instruction[2]		
	N	Percentage		*N*	Percentage
Maltese	10	17.2%	During an IEP	28	48.3%
English	24	41.4%	By the Teacher	5	8.6%
Both	24	41.4%	By the Parents/Guardians	23	39.7%
			Missing responses	2	3.4%

Note: [1] χ^2 (1) = 9.86; p = .131; [2] χ^2 (1) = 3.67; p = .721.

Reading and Writing Skills. A set of questions investigated the students' reading attainment levels as reported by the educators. The educators were primarily asked whether their students were assessed specifically for reading abilities by an Educational Psychologist or Literacy Specialist. 50% of the educators reported that an assessment was available, 19% responded negatively, while 31% were unaware of an assessment.

Questions consequently investigated the students’ level of letter recognition, and results indicated that most of the participants’ usually always’ can recognise letters. This positive response was given for both Maltese (41.4%) and English (67.2%). The further analysis investigated whether this response differed according to the students' school year. A *Chi-square* analysis revealed that no difference between school years was denied. Results are presented in Table 73. Letter-to-sound correspondence was next investigated. The educators reported that 41.4% of the students could perform this task in both languages, 5.2% in Maltese, 44.8% in English and 8.6% could not complete such a task.

Table 73

Letter Recognition

Letter Recognition in Maltese[1]			Letter Recognition in English[2]		
	N	Percentage		*N*	Percentage
Not yet	12	20.7%	Not yet	4	6.9%
Has Sometimes	6	10.3%	Has Sometimes	0	0
Occasionally	6	10.3%	Occasionally	7	12.1%
Often	10	17.2%	Often	8	13.8%
Usually always	24	41.4%	Usually always	39	67.2%

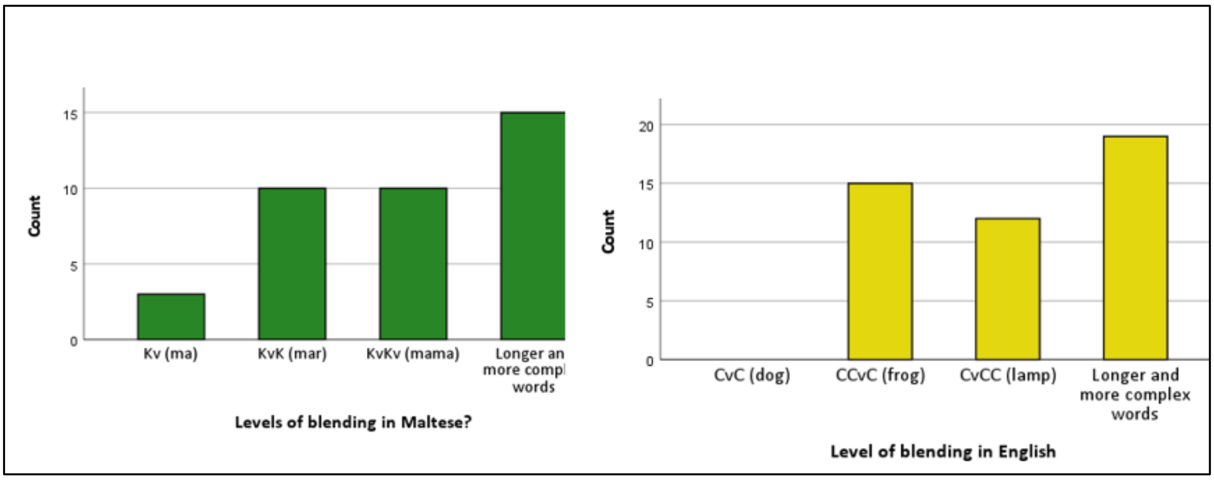
Note: [1] χ^2 (1) = 21.43; p = .162; [2] χ^2 (1) = 10.44; p = .577.

The levels of blending were investigated in both languages. Varied levels of blending were reported by the educators, with a substantial number of students with DS reported to be able to blend complex words in both languages. These are represented in Figure 38. A crosstabulation was computed to investigate whether is a difference in responses according to the school level. The Chi-Square test did not reveal any difference between school levels on blending in English χ^2 (1) = 7.875; p = .446. A difference in responses between school levels was found in the Maltese sample χ^2 (1) = 23.45; p = .005. This difference was tested through a post-hoc analysis.

Post-hoc Analysis: Level of Blending in Maltese. The *Chi-Square Test* of independence identified that the distribution was not equal among all responses. A post-hoc analysis allowing for Type 1 Error correction (Bonferroni corrected) identified that on the question: *Level of Blending in Maltese, a 0% was reported in* the group of students within the Primarily level of education on blending KvKV words. This result was statistically significantly smaller (Bonferroni corrected p=.0019) when compared to other group years. Students within this group either performed at a lower or a higher level. Throughout other school levels, the distribution was more even.

Figure 38

Levels of Blending in Maltese and English



Sentence and paragraph reading was investigated in both Maltese and English. Responses are summarised in Table 74. Students were reported to achieve more sentence reading in English (72.4%) than Maltese (36.2%). A similar pattern was confirmed in paragraph reading, with competence in English (48.3%) being reported to be better than Maltese (25.9%). A *Chi-square* investigation reveals no difference between school settings in these responses.

Table 74

Reported Reading Levels

	Reading Level							
	Sentences in English[1]		Sentences in Maltese[2]		Paragraphs in English[3]		Paragraphs in Maltese[4]	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Yes	42	72.4%	21	36.2%	28	48.3%	15	25.9%
No	16	27.6%	37	63.8%	30	51.7%	43	74.1%

Note: [1] χ^2 (1) = 598; *p* = .897; [2] χ^2 (1) = 2.005; *p* = .571, [3] χ^2 (1) = 2.194 *p* = .533, [4] χ^2 (1) = 2,005; *p* = .571

An investigation of the responses related to the students' reading comprehension level reveals a large variability between the students. Most educators responded that the students could comprehend short phrases in both languages. A higher proportion of educators reported that the students found it difficult to comprehend the meaning of words in Maltese (27.6%) compared to English (8.6%). Several educators also mentioned that they were not aware of the level of reading comprehension of their students, and this was most evident in Maltese (12.1%) compared to English (3.4%). Results are presented in Table 75.

Table 75

The reported level of Reading Comprehension

What level of Reading Comprehension does the student have?	Maltese		English	
	N	%	N	%
Difficulty in understanding the meaning of written words.	16	27.6%	5	8.6%
Understands the meaning of single words	8	13.8%	9	15.5%
Understands the meaning of short phrases	12	20.7%	18	31.0%
Understands the meaning of short paragraphs	9	15.5%	16	27.6%
Understands the meaning of a long text	6	10.3%	8	13.8%
I do not know the level of reading comprehension	7	12.1%	2	3.4%

Independent book reading was next explored. The educators reported difficulty in the area where most students could not read books independently in both Maltese and English. Poor engagement in pretend reading was also reported. Results are summarised in Table 76. A *Chi-square test* tested whether there was a difference in responses dependent on the school setting, and no difference was identified. (refer to Note on Table 76).

Table 76

Independent reading and Pretend reading

	Independent Reading Maltese[1]		Independent Reading English[2]		Pretend Reading[3]	
	N	%	N	%	*N*	%
Yes	12	20.7%	18	31%	18	31%
No	46	79.3%	40	69%	40	69%

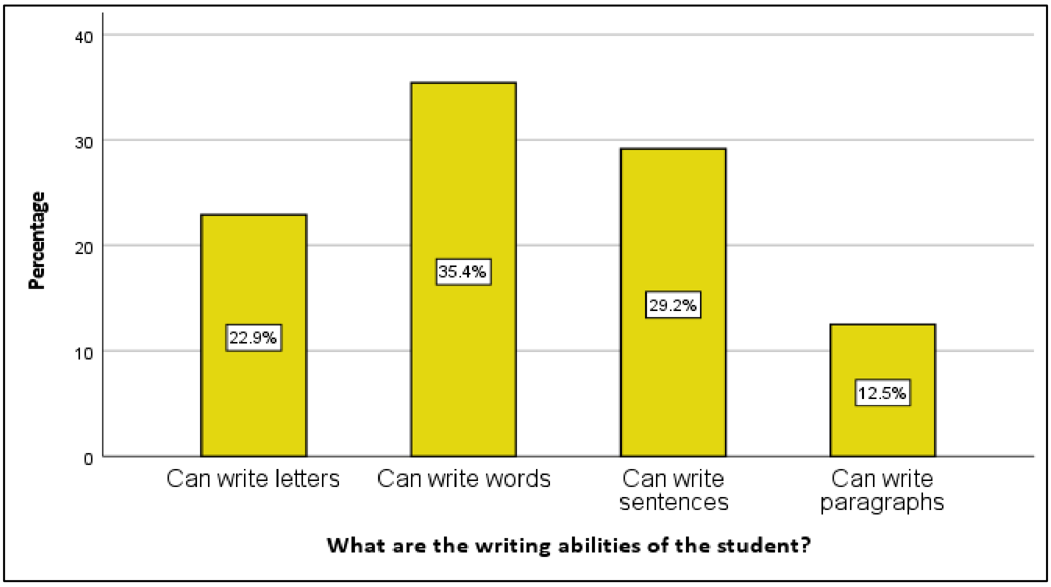
Note: [1] χ^2 (1) = .918; *p* = .821; [2] χ^2 (1) = 1.933; *p* = .586, [3] χ^2 (1) = 5.204; *p* = .157

Three questions investigated the writing abilities of students. Students were reported to possess different levels of writing abilities. 36.2% of the students were reported to be able to write

Independently. 43.1% were also reported to write yet using several writing aids such as flashcards, computers, and tablets. 20.7% were reported to be unable to write. 8.6% of the students were reported to write in Maltese, 63.8% in English and 13.8% in both languages. The different levels of writing abilities are reported in Figure 39. Cross-tabulation and *Chi-square* analysis demonstrated that the results on the three questions did not differ according to the school setting or the school level.

Figure 39

Writing levels of students with DS



Note: School Setting χ^2 (1) = 11.96; *p* = .216; School Level χ^2 (1) = 11.48; *p*= .488.

Reading Instruction and Writing Instruction. A set of questions investigated reading and writing instruction with students with DS. Educators reported that 56.9% of the students received additional help during reading exercises and 43.1% of the time provided by the LSE. The majority of the educators reported that challenges are evident during reading instruction (72.4%). Results of questions investigating the frequency of participation in literacy lessons indicate that many educators reported that the students Never or Rarely Participated in literacy lessons (43.1%). In contrast, most students have between 1-and 2 hours of literacy training a week (39.7%). Results are summarised in Table 77.

Table 77

Participation in Literacy Activities

Frequency of participation in activities relating to reading instruction in the classroom?			How much time per week is dedicated to literacy activities?		
	N	Percentage		*N*	Percentage
Never/rarely participates	25	43.1%	Less than 30 minutes a week	13	22.4%
Occasionally participates	16	27.6%	Between 1-2 hrs a week	23	39.7%
Participates sometimes	6	10.3%	3 -4 hrs a week	12	20.7%
Participates often	10	17.2%	More than 4 hrs a week	9	15.5%
Missing	1	1.7%	*Missing*	1	1.7%

It is common practice in Maltese schools to assign books for home reading, educators in this study report that 48.3% of the students with DS were rarely given reading books at home. Educators reported that 48.3% of the students did not follow an alternative reading programme when investigating the type of reading instruction, and however, 43.1% did. Results are presented in Table 78.

Table 78

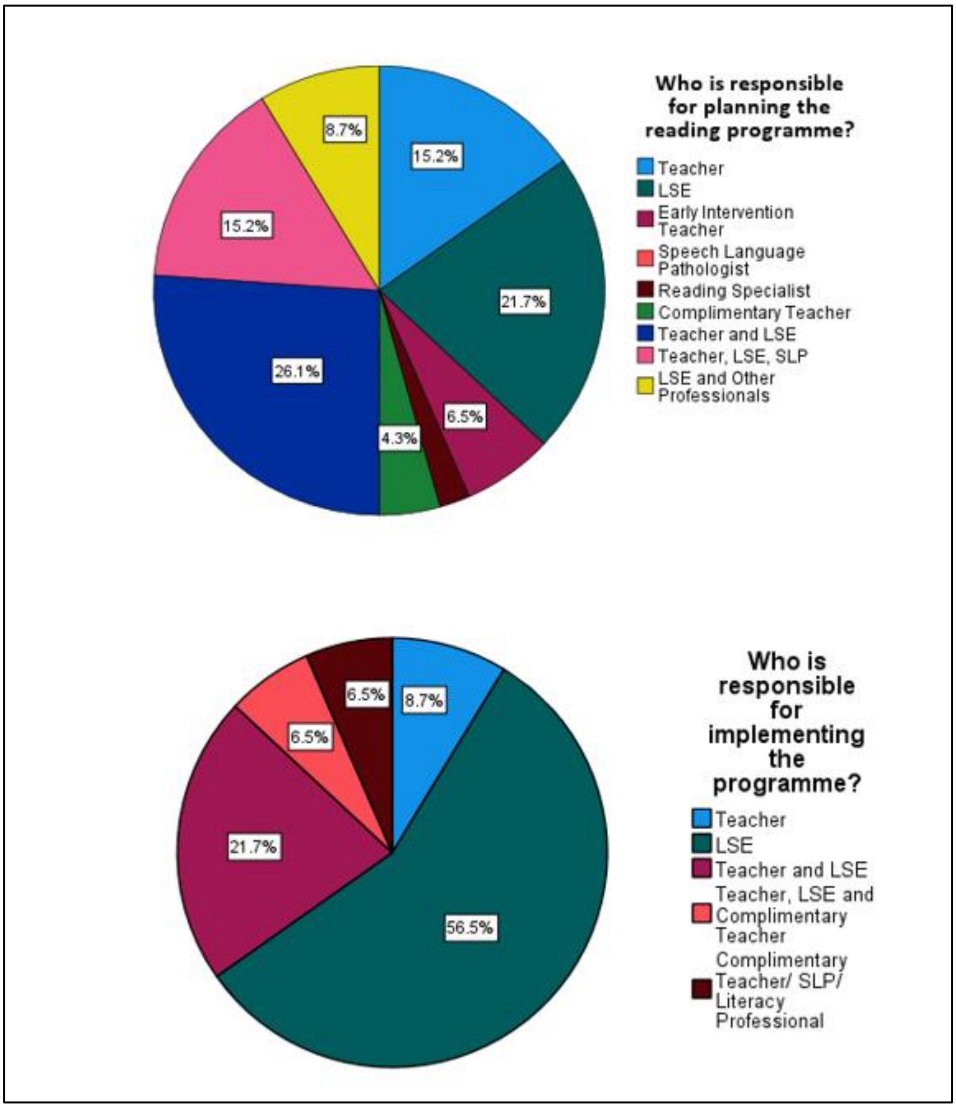
Home Reading and Alternative Reading Programme results.

Does your student take reading books home from school for home practice?			Does the student follow an alternative reading programme?		
	N	Percentage		*N*	Percentage
Never/rarely	28	48.3%	Yes	25	43.1%
Occasionally	12	20.7%	No	28	48.3%
Once a week	8	13.8%	Total	53	91.4%
Several times a week	5	8.6%	*Missing*	5	8.6%
Missing	5	8.6%			

Results investigating the planning and implementation of reading instruction identify that the teachers and LSEs cooperate mostly and are responsible for planning reading instruction. Other professionals such as Speech-Language Pathologists are also actively involved in the planning process. On the other hand, the implementation of reading instruction was primarily the responsibility of the students' LSEs. Figure 40 represents these results.

Figure 40

Professional who are responsible for the planning and the implementation of the reading programme



The type of reading methods was also investigated. Educators reported that most students are exposed to both a *phonic* and a *visual* method of reading instruction (50%). However, a large proportion solely follows a visual method (20.7%). When asked about their opinion about the best method of reading instruction, 56.9% reported that a mixed-method should be used compared to a phonic method (10.3%) or *look and say* method (25.9%) only. Results are represented in Table 79.

Table 79

Educators' responses on the methods of reading instruction

What method of reading instruction is used with the student?	*N*	%	In your opinion, what is the best method for reading instruction for students with Down Syndrome?	*N*	%
Phonic Method	10	17.2%	Phonic Method	6	10.3%
Look and Say (using flashcards)	12	20.7%	Look and Say (using flashcards)	15	25.9%
Both Methods	29	50.0%	Both Methods	33	56.9%
Missing	7	12%	*Missing*	4	6.9%

Questions related to writing instruction identified that the biggest proportion (29.3%) of students Never or Rarely participated in writing activities, and between 1 to 2 hrs per week (37.9%) is mostly spent on writing instruction. The majority of the educators also reported that students do not participate actively in writing activities (53.4%). Results are summarised in Table 80.

Table 80

Educators' responses on Writing Instruction

Does your student participate in activities relating to writing activities in the classroom?	*N*	%	How much time is spent on writing activities?	*N*	%
Never/rarely	17	29.3%	Less than 30 min a week	13	22.4%
Occasionally	10	17.2%	Between 1-2 hrs a week	22	37.9%
Weekly	9	15.5%	3-4 hrs a week	11	19.0%
Several times a week	6	10.3%	More than 4 hrs a week	6	10.3%
Daily / Several times a day	10	17.2%	*Missing*	6	10.3%
Missing	6	10.33%			

A crosstabulation and a Chi-Square test analysis tested whether the responses on questions within the section Reading and Writing Instruction were influenced by either the school setting or the school level. Results showed that there was no effect on the responses by the school setting.

Results can be found in Table T1 in Appendix T, p. 484. The analysis testing the effect of the school year identified that an effect was found on three questions. The three questions are presented in Table 81, and a post-hoc analysis is applied.

Table 81

Questions identifying a significant Effect of School year variable on Reading and Writing instruction.

Question	Chi-Square Value	p-value
How much time per week is dedicated to literacy activities?	25.087	.014
Are there activities related to reading instruction your student does not participate in?	10.975	.027
In your opinion, what is the best method for reading instruction for students with Down Syndrome?	21.674	.006

Post-hoc analysis: How much time per week is dedicated to literacy activities? The Chi-Square Test of independence identified that distribution was not equal among all responses. A post-hoc analysis allowing for Type 1 Error correction (Bonferroni corrected) identified that on the question: *How much time per week is dedicated to literacy activities,* the group of students within a primary level of education were exposed to a significantly larger number of literacy hours (Bonferroni Corrected *p= .0002*) when compared to other group years.

Post-hoc analysis: Are there activities related to reading instruction your student does not participate in? The Chi-Square Test of independence identified that distribution was not equal among all responses. A post-hoc analysis of the responses was computed to allow for Type 1 Error Correction. Following a Bonferroni adjustment *(p=.005*), no answer was identified to be significantly significant. Hence no difference is identified between responses.

Post-hoc analysis: In your opinion, what is the best method for reading instruction for students with Down Syndrome? The *Chi-Square Test* of independence identified that the distribution was not equal among all responses. A post-hoc analysis allowing for Type 1 Error correction (Bonferroni corrected) identified that on the question: *In your opinion, what is the best method for reading instruction for students with DS?* the group of educators within the Early years level of education maintained that the Phonics Method was the best in their opinion. This response was significantly larger (Bonferroni Corrected p=.0001) when compared to other group years.

Technology. The use of technology in reading and writing was examined. The educators reported that 62% of the students have a computer in the classroom, while 36.2% do not. The educators maintained that only 44.8% of the students use the computer for literacy training; however, 65.5% of the educators reported using the device for other educational activities. 36.2% of the students reported having a tablet in the classroom, while 62.1% did not. Results are summarised in Table 82. A crosstabulation and a Chi-Square test analysis tested whether the responses to the question within the section Technology were influenced by either the school setting or the school level. Results showed no effect on the responses by either the school setting or school level. Results are reported in the note section in Table 82.

Table 82

Educators' responses on the use of technology in the classroom.

	Does the student have a computer in class?[1]		Does the student use the computer for literacy training?[2]		Does the student use a tablet in class?[3]		Is the computer used for other educational activities?[4]	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Yes	36	62.1%	26	44.8%	21	36.2%	38	65.5%
No	21	36.2%	29	50%	36	62.1%	15	25.9%
Missing	1	1.7%	3	5.2%	1	1.7%	5	8.6%

Note: ***Chi-Square Evaluation School Setting*** [1] χ^2 (1) = 1.442; p = .696; [2] χ^2 (1) = 2.993; p = .393, [3] χ^2 (1) = 2.588; p = .460, [4] χ^2 (1) = .580; p = .901
Chi-Square Evaluation School Level [1] χ^2 (1) = .572; p = .966; [2] χ^2 (1) = 1.670; p = .796, [3] χ^2 (1) = 5.836; p = .212, [4] χ^2 (1) = 3.162; p = .531

Discussion

The forthcoming section will discuss the results obtained in Study 4 according to the pertinent research questions. The data in discussion has been collected through a questionnaire, and 58 educators completed the questionnaire. The educators worked with students with DS in a Maltese classroom environment at the completion time.

The initial questions in the questionnaire allowed the researcher to obtain a better understanding of the levels of literacy achieved by students with DS. An investigation of the students' reading abilities showed that students with DS could complete various reading skills. A large proportion of the students recognise letters, blend complex words, read words, and read sentences. The ability of students to read paragraphs is also reported; however, a decline in the proportion can be observed. This shows that great variability is present and agrees with the literature (Burgoyne, 2009, Kay-Bird and Chapman, 2011, Robes-Bello et al., 2020). It has been reported that variability can vary according to intrinsic student characteristics and the method and frequency of reading instruction (Goetz et al., 2008, Robes-Bello et al., 2020, King et al., 2020). Albeit the complexity involved in independent book reading, students with DS were also reported to engage in this type of reading. This shows that many students with DS can develop complex reading abilities.

Large variability was also reported concerning reading comprehension. Most educators reported that students could comprehend the meaning of single words. However, comprehension abilities declined as the complexity of the texts increased, which supports previous research (Couples & Iacovo, 2000). Refer to Table 75. An interpretation from the perspective of the Simple View of Reading allows the researcher to assert that a proportion of the population of students have appropriate abilities in the two main components of the framework, where students can develop both word recognition and reading comprehension.

Research Question 1: What are the literacy practices used with children and adolescents with Down Syndrome in a Maltese school setting?

The researcher put forward a first hypothesis to investigate research question 1;

Alternative Hypothesis 1: The literacy practices are individualised according to the student's needs. For an educator to ensure that a student is provided with an individualised literacy experience, the educator must be aware of the student's abilities. This investigation, unfortunately, revealed that not all educators are aware of the students' skills. 7% are unaware of the language used in the student's home, 13.8% do not know the student's hearing abilities, 31% were not aware whether a literacy professional had formally assessed the student, and 12.1% do not know the level of reading comprehension. While it has been reported that several educators are aware of the students' abilities, it is worrying that such a proportion of educators does not. This is not conducive to preparing an individualised literacy programme for the student. The lack of knowledge about the abilities of students with additional needs has often been reported in the literature, with teachers reporting to be frustrated as this lack of knowledge does not help them to support the students successfully (McFadden, 2014; Giel-Romo, 2014; Fannan, 2017) 56.9% of the students were reported to be given additional help during literacy activities. However, only 43.1% are provided with an alternative literacy programme. This could be because many students can cope well with the mainstream literacy curriculum. However, only 12.1% are reported to follow a full mainstream curriculum. Variability between students was observed again; hence the importance of individualised educational services for students with DS is extremely important. On an international level, it has been reported that the inclusion of students with DS in a mainstream setting is increasingly standard practice in middle and high-income countries (Faragher & Clarke, 2014). This is concurrently reported in the Maltese school setting. The majority of students with DS attend mainstream education. However, a move to Resource Centres by some individuals is reported in the secondary years of schooling. Secondary schools in Malta are highly geared towards academic subjects, and students with learning difficulties often find it difficult to cope and have their needs adequately addressed.

This study indicates that most students attend mainstream education, done to varying degrees (see Table 67). This is mostly dependent on the students' abilities. Local research is still sporadic as the researcher could only identify one case study where the inclusion of a student with DS in a secondary school setting was evaluated. This study identified that the student balanced in-class and out of class lessons with the LSE (Tabone-Valetta, 2014). Most educators in this study maintained a similar pattern while maintaining that the LSE constantly guides the student throughout this process.

Educators were asked what type of literacy instruction was mostly used with the students (see Table 79, p. 284). The *look and say* method was still favoured by by a substantial number of educators, however this was not the majority. Most educators reported that a balance between a *visual approach* to reading and *a phonic approach* is mostly implemented. Such a finding complements suggested practices, where a mixed modality approach is favoured over one specific approach (Burgoyne, 2009, Burgoyne et al., 2012). This study shows the importance of training to educators, where such training can help educators identify each student's strengths and work around the student's abilities.

In response to the first hypothesis, it can therefore be concluded that the Alternative Hypothesis 1 can be accepted for some individuals but not generalised throughout the whole sample. Educators are unaware of the students' abilities, making it difficult to individualise an educational program.

The researcher put forward a second hypothesis;

Alternative Hypothesis 2: The Learning Support Educators are the primary educators with regard to literacy instruction for students with DS. The teacher should be the primary educator responsible for a student's educational journey and be assisted by a Learning Support Educator (National Minimum Curriculum Framework, 2016; Faragher et al., 2020). This study is the first local study to evaluate the role of the LSE concerning literacy in students with DS. Throughout the result, it was highlighted numerous times that the LSE was the primary educator for students with DS. It has been reported that the Teacher and LSE work together for both the planning and implementation of a reading programme (21%) (refer to p. 283). However, since most of the students spend a proportion of time outside the mainstream setting (refer to Table 77, p. 282), it is the responsibility of the LSE to implement any individualised intervention outside the classroom. This has been similarly reported in the literature (Lorenz, 1998; Faragher et al., 2020). It has also been reported that this practice might lead students with learning difficulties to receive training and explanations more from an LSE than from a teacher (Faragher et al., 2020).

The overt reliance on additional adult support apart from the teacher can also have social ramifications. This has been reported as an increased barrier between students with DS and peers due to the increased removal from peer groups (McFadden, 2014). The proximity of the adult can prevent peers from integrating the student within a peer group relationship while also preventing the student with difficulties to rely on the peers her/himself (McFadden, 2014).

The researcher moves forward to ask what happens when the LSE is not present during the day. Do the students perform to the best of their abilities? The amplified reliance on the LSE takes away the student from the classroom experience, promoting increased reliance, even when this is not needed. This has been associated with a decline in a willingness to engage in problem-solving activities (Wishart, 2004).

Hence it can be summarised that the Alternative Hypothesis 2 is accepted. A step further from this research would be to look into the training provided to LSE. The researcher asks, if LSEs are being given a big part of the educational responsibilities, are they being trained adequately to deliver these services? Unfortunately, the answer to this question goes beyond the scope of this research.

Research Question 2: Can a difference in practices be identified between different school settings and school levels?

A crosstabulation analysis utilising Chi-square identified that no questions were affected by the school setting. Hence, the ***Alternative Hypothesis 3: A difference in literacy practices and students' abilities is identified between school settings,*** has been rejected, and the Null Hypothesis accepted. Agius (2012) maintained that the school setting does not affect the literacy attainment of Maltese TD students. The current study adds to Agius (2012) by maintaining that the school setting does not affect literacy attainment and literacy practices with Maltese students with DS. These results also imply that uniform services are offered to students across different settings. The national School Support Services provide the same services to all students with LD across Malta, irrespective of the school setting. This ensures that all students are provided with the same support opportunities. Such services could have contributed to the uniformity across school settings.

An investigation was also conducted to investigate whether responses varied across school levels. ***Alternative Hypothesis 4: A difference in literacy practices and students' abilities is identified between school levels***, was tested. Two significant findings were identified. Students with DS within a primary school setting have spent significantly more time on literacy training. During the early years of schooling, educators collaborate with other professionals to support the students in developing the building blocks of language, motor development, and other fundamental skills. Hence, as identified through this questionnaire, the focus is not on literacy in most cases. The importance of literacy training is then felt more during primary years. Such a decision might be taken as a matter of priority, where educators and other professionals might decide that literacy training is not a priority during the early years or due to the students' abilities. Martin et al. (2009) also support this by maintaining that educators need to prioritise intervention services; for example, early communication skills should be prioritised over word-identification skills. However, one might indirectly strengthen the other.

The National Literacy Strategy (2014) encompasses that students with learning difficulties should be provided with multi-sensory learning strategies and that educators should be encouraged to follow continuous professional development to support students with learning difficulties. Unfortunately, the national strategy offers very broad guidelines, and hence it is finally dependent on the Heads of Schools and Educators themselves to follow the recommended training. The importance of professional development has been a recurrent point of importance put forward by educators themselves to help them implement better teaching strategies (McFadden, 2014). In summary, Null Hypothesis 4 has been accepted on two questions but rejected on the remaining questions of the questionnaire.

Research Question 3: How does the bilingual context affect the school literacy environment and literacy practices when working with Maltese children and adolescents with Down Syndrome? It has often been reported that individuals with DS have been limited and encouraged to use a single language by parents and professionals (Edgin et al., 2011; Kay-raining Bird et al., 2005). The uniqueness of the language scenario in Malta lends itself to a needed investigation of the ways the bilingual aspect affects literacy training and literacy acquisition of students with DS. The researcher's personal experience and results from all studies of this research show that Maltese individuals with DS can use two languages at varying degrees both in the home and achieve a level of biliteracy.

Alternative Hypothesis 5: Literacy intervention is predominantly carried out in the English language. A sizeable proportion of students has been reported to use both Maltese and English during school hours (33%); however, the majority were reported to use the English language (40%) more predominantly in the school setting when compared to Maltese (28%). The language proportion of the language used at school does not match the language used at home. 47% of the students are reported to have Maltese as a home language, 37% English, and 10% use both. Such a finding supports Vella (2013), where a similar pattern of language use was reported in TD children. On the other hand, when the language used during literacy instruction was investigated, educators reported that 41% of the students were exposed to predominantly English literacy training, while 41% were exposed to Maltese and English. Such a finding confirms that although different degrees of Maltese/English use and exposure is apparent both at home and at school, the National Minimum Curriculum, which emphasises teaching the two official languages, is being implemented for many students with DS.

This leads to the rejection of the Alternative Hypothesis and acceptance of the Null Hypothesis. Although a big shift towards literacy training in the English language is observed, this is not greater than literacy training in both Maltese and English. Research about the language use in bilingual communities of individuals with DS lacks both locally and internationally. Scriha (2001) reported a sentiment that English is more important than Maltese within the educational system was reported among TD children and is similarly reported here within the Maltese community of students with DS. However, the value of bilingualism is still as strong. Camilleri Grima (2013) reports that educators use a substantial amount of code-switching in the classroom, and this is also confirmed in this study as different degrees of both Maltese and English are used with students with DS. No distinction between the school setting was reported by Camilleri Grima (2013) and confirmed in this study.

A second important finding is that all educators reported that all students were bilingual at school. Varying degrees were reported (see Table 72, p. 277), with a greater proportion of English use being reported among the students.

Limitations of the study

- Both Teachers and LSE were invited to respond to the questionnaire, and LSE responded in greater proportion. This response could have contributed to an imbalance as the teachers' perspectives and LSEs were not proportional.
- Few respondents from Resource Centres were identified. An in-depth study within this setting could provide the researcher with additional novel findings as a Resource centre as the educational interventions within resources centres are relatively unexplored.
- In-depth case studies could have yielded more detailed information about specific practices that are currently taking place in schools.
- The educators' level of education has not been explored, and such a finding could have contributed to a better evaluation of the results.

Conclusion and significant findings

Study 4 revealed significant findings about the school literacy environment of Maltese students with DS. The study identified salient findings.

- It has been reported that Maltese students with DS are predominantly educated within a mainstream setting. The LSE primarily meets the needs of students with DS, and the implications of such a finding have been discussed.
- No difference in responses was identified between different school settings; however, the school level affected individual responses.
- Maltese students with DS are exposed to Maltese and English within the school setting. This result indicated that students with DS follow the National Minimum Curriculum recommendations.
- Biliteracy has been reported within the population of Maltese students with DS. Varying levels according to the individuals' abilities have been shown; this finding has also been confirmed in Study 2.
- A preference for Maltese in the home has been reported; however, English is favoured during school hours.
- A substantial proportion of students use a visual method of literacy training. However, a large proportion uses both a visual and phonic method concurrently.

This study provides novel literature about bilingualism and biliteracy in Down Syndrome. This study is also the first to investigate literacy training with students with Down Syndrome within the Maltese educational system.

The final chapter of this thesis; Conclusion is next presented.

Chapter 8

Conclusion

Chapter overview

In this final chapter, a summary of the salient findings of this study is provided. Next, the limitations of the study will be brought forth. Subsequently, the clinical and educational implications of the findings will be portrayed. Finally, future research topics will be discussed.

Summary of salient findings

The scope of this research study was to investigate aspects of pre-reading, reading-related skills and reading abilities in a population of Maltese individuals with Down Syndrome. The home and school reading environments of the same population were also investigated. This study is the first of its kind in the local bilingual context, and it helped to explore aspects of the development of reading while identifying gaps in knowledge that contribute to the international perspective in this domain. This study highlighted an array of strengths and weaknesses within this population. It also highlighted similarities with TD participants of similar non-verbal cognitive abilities. Moreover, results also show valuable information about the home literacy environment of children with DS and how these contribute to further developing reading skills. It also sheds light on the literacy practices of educators, which are commonly used in this population compared to the TD population. The thesis was subdivided into 4 Studies. Study 1 and Study 2 presented an evaluation and discussion of skills and abilities related to reading, while Study 3 and Study 4 investigated literacy environments.

Study 1 was an initial investigation that helped build a profile of characteristics of Maltese individuals with DS. Study 1 was a first of its kind investigation of the local scenario; it helped the researcher explore the local scenario and initiate an in-depth investigation of the abilities of local participants. Study 1 further helped with the conceptualisation of Study 2, where additional variables for investigation were included. Throughout the two studies, the researcher identified that individuals with DS could reach an alphabetic stage of reading, where many participants showed to be able to read through a non-lexical route to reading. Participants with DS were reported to successfully read words and nonwords in Maltese and English. The DS participants showed the ability to read at a comparable level to the control group when matched on a measure of fluid intelligence.

Study 1 and Study 2 revealed that participants with DS could develop comparable levels to the control group on PA tasks; however, significant difficulties were identified in Rhyme Awareness. The difficulty in developing rhyming tasks could possibly be attributed to two contributing factors. The cognitive demand that the task imposed could have acted on the results. Participants with DS found it difficult to understand what was expected in the task. Also, this result could be related to the fact that very few nursery rhymes are available in Maltese, so the exposure is limited. PA skills were also significant predictors of Maltese nonword reading in DS. However, a different predictor of English nonword reading was identified. The RCPM measure was identified as a significant predictor of English nonword reading. The results highlighted that participants with DS could develop PA skills, which has implications on which reading instruction methods should be used. The results support the idea that students with DS should also be exposed to a *phonic approach* to reading intervention as their good performance on PA tasks supports this.

Study 1 offered a thorough investigation of VPPS in DS. This is considered a strength in the investigation as few studies have investigated this area. Results revealed that the DS group did not show significant strengths in VPPS. These skills have been acclaimed to be a significant strength in the literature. However, a different performance was obtained in this study. A correlation between VPPS and nonword reading was identified. However, VPPS were not identified as significant predictors of reading abilities.

An investigation of Verbal Short Term Memory skills showed that the performance of the group with DS was significantly lower on Nonword repetition tasks compared to the TD control group. This result is in line with research that portrays difficulties in Verbal Short-term Memory. This result implies that even though a *phonic approach* to reading would be beneficial, this needs to support and cater for VSTM difficulties. Moreover, no word length effect was identified among the DS participants on Nonword repetition tasks. These results could indicate that the individuals with DS do not engage in subvocal rehearsal when investigating participants' developmental age in this study.

Study 2 helped build a complete picture of the abilities of local participants with DS. An investigation of a monoliterate group and a biliterate group was presented. Results from the monoliterate group mirror results from Study 1, where participants showed comparable PA skills. Results also indicated that the DS group performed similarly to the control group on all reading measures in both languages when matched on a measure of fluid intelligence. However, better word reading was reported when compared to nonword reading. Such a finding is in line with the current literature. Correlations vary according to the language of administration.

The investigation in Study 2 identified 16 biliterate participants. This is a significant finding as few studies in the literature have reported the abilities of biliterate individuals with DS. The unique linguistic aspect built a profile of abilities in this population of DS participants. Results from the biliterate group indicate that the participants showed similar competencies on SIT and PPVT measures in both languages. This highlights the idea that participants with DS are capable of developing appropriate bilingual linguistic abilities. The rich bilingual linguistic environment could have helped the participants achieve these abilities due to the constant exposure to both languages. When the biliterate reading abilities were investigated, it could be noted that English reading was favoured, and the DS participants were better in English. This ties in with findings from Studies 3 and 4, where English literacy experiences are shown to be favoured both at home and in a school setting.

Reading predictors have not been clearly delineated; this could be attributed to the number of participants and individual characteristics, as often reported in DS research. The subgrouping according to the language of administration and language used by the participants impinged on the number of participants in the subgroups. Nevertheless, this was necessary to provide an unambiguous picture of the abilities in different languages. In this sample, it could be identified that VPPS play a role in reading abilities. However, the relationship was more prominent in English reading rather than Maltese. This result has been identified in both Study 1 and Study 2. The history of reading intervention methods could have impinged on strengthening reading through a visual aspect. In Study 3 and Study 4, it has been reported that the *Look and Say method* is still being used in a large proportion in the DS population in our local setting, although . Additionally, English is predominantly favoured as a language of reading instruction, possibly contributing to such a finding.

Results from Study 1 and Study 2 show that the depth of orthography could play a role in developing sub-skills and reading abilities. Cross-language transfer has also been reported. A relationship between Maltese PA and English nonword reading was identified. Hence, the researcher stresses the importance of assessing participants in all the languages that they are exposed to and using language-appropriate assessment tools. Standardized language-appropriate measures are not always readily available for the local population. Hence the need for further research in the area is highly needed.

The chapters investigating the literacy environments contributed to novel literature in the area. The Home Literacy Environment and School Literacy Environments were never investigated for the local population of DS participants; hence this study contributed to building a better picture of the local literacy scenarios. Individuals with DS are part of a bilingual environment and have also shown reading skills in both official languages of the country, Maltese and English. However, reading in English is reportedly favoured. Reading material is more readily available in English rather than Maltese at home, contributing to the increased choice of English rather than Maltese when reading.

The home literacy questionnaire identified that individuals with DS are read to less often than their TD peers, and they show less interest in adult reading material. These findings could depend on the participants' age since the DS group were older than the TD participants, who were matched on scores from the RCPM. The HL questionnaire also highlighted that flashcards are predominantly used in the DS population to stimulate reading development. This teaching method dates back to deep-rooted practices within the Maltese community, which had been introduced decades ago and are still highly practised (Muscat, 2017). The usefulness of this method as the only method of reading instruction, particularly in the later stages of reading development, is questioned since it has been found that individuals with DS can acquire reading abilities through a phonic approach. The DS group's parents maintained that their children were introduced to literacy through a *look and say* method. However, most TD respondents maintained that a phonological approach to reading was used in the initial reading stages. It has also been observed that VPPS positively correlated to reading measures in this population.

The investigation of the school literacy environment highlighted that Maltese students with DS are predominantly educated within a mainstream setting, and the Learning Support Educator meets their primary educational, social and physical needs. Maltese students with DS are exposed to Maltese and English within the school setting, with varying biliteracy environments. A preference for Maltese in the home has been reported; however, English is favoured during school hours. An analysis of competence in Maltese and English reading tasks showed that the participants performed similarly in both languages. In agreement with the result of the Home Literacy investigation, many students use a visual method of literacy training. However, a large proportion uses both a visual and phonic method concurrently. Studies 1 and 2 reveal that VPPS could possibly predict word reading in English. However, this has not been reported in Maltese. Hence, a mixed method of reading instruction is encouraged for this population.

Results from the investigations in Study 1 and Study 2 highlighted the clinical importance of The Sentence Imitation Task. The SIT resulted in being an important correlate to reading abilities and also to other sub-skills such as receptive vocabulary. This has important clinical implications, particularly due to the lack of standardized assessment measures available for the Maltese population.

Limitations of the Study

The limitations of each particular study have been put forward in each corresponding chapter; however, further generic limitations have also been identified.

- In studies 1 and 2, the researcher aimed to collect data from the total population (N = 156) of individuals with Down Syndrome who attended formal schooling.
- For the researcher to have a margin of error of 5% with a confidence interval of 95%, 112 respondents were needed. The researcher recruited 71 respondents, which was below the required sample size. Moreover, the sample needed to be reduced for the participants to abide by the inclusion and exclusion criteria. Therefore, this study's results have a margin of error of 11.29% with a confidence interval of 95%. This sample also includes participants who took part in Phase 3 of the study.
- Inter-rater reliability was not included as a measure of reliability as it was difficult to recruit an additional rater.
- Due to time constraints, an assessment of reliability and validity is unavailable for the School Environments Questionnaire and The Peabody Picture Vocabulary Test 4th Edition (Dunn & Dunn, 2007).
- In the initial stages of the study, the researcher did not plan to collect data about the participants' Word Reading abilities. The HLE questionnaire included questions that could give information about the number of flashcards that students could read. However, throughout the data collection, the researcher identified that many participants had reading abilities to varying degrees, and therefore a word reading measure was introduced later in Phase 3 and Phase 5. Since data was collected after some time, this reduced the sample size as not all the participants who had agreed initially showed their interest in participating again. Not all the eligible participants responded to the additional call for data collection. Consequently, the sample size was reduced to 31.

- In the Analysis of Multiple Regression, not all assumptions for Multiple Regression were met. These have been highlighted in specific sections. Moreover, multiple regression analysis was not always feasible due to the reduced sample size.
- The researcher used various assessment tools for data collection; however, not all tools were validated and standardised on the Maltese population. These included: The Raven's Coloured Progressive Matrices Test (Raven et al., 1990); the adaptation of the Home Literacy Environment Questionnaire (Boudreau, 2005); The Test of Word Reading Efficiency 2nd Edition TOWRE (Torgensen et al., 2012); the Test of Visual Perception Skills-Revised (TVPS-R) (Martin, 2006); The Test of Word Reading Efficiency 2nd Edition TOWRE (Torgensen et al., 2012), The Peabody Picture Vocabulary Test 4th Edition (Dunn & Dunn, 2007).
- An assessment of reading comprehension was not included in the assessment battery. The researcher concluded that a local tool to assess reading comprehension in the bilingual Maltese context is unavailable. The inclusion of such a tool would have allowed the researcher to obtain a complete picture of individuals' reading abilities with DS and interpret the results according to The Simple View of reading. After several personal communications with local scholars, it was deemed that no tool was considered adequate to be included in the assessment battery.

Clinical and Educational Implications

The findings of this research study have several clinical and educational implications, which are outlined below.

- Results indicate that participants with DS performed very well on PA tasks in this population. This invites clinicians and educators to headline these strengths, utilise the phonological abilities and provide the appropriate training for reading to develop successfully. Reading through a phonological approach would equip the participants with DS with the necessary tools to decipher the reading code rather than solely memorising single words.

- Word reading is particularly strong in this sample population. Clinicians and educators should capitalise on this strength as good reading abilities can be used as a key to access other aspects of education such as information technology, the sciences, mathematics and other subjects. It could also be used as an aid to develop life skills, promote independent living skills, and enhance higher language and reasoning abilities.
- Nonword reading has been identified as a strength in this population. This calls educators to expose readers with DS to a phonological approach to reading. This strength in Nonword reading indicates that readers with DS can use excess both lexical and sub-lexical routes. This should be considered during the planning of a reading intervention programme.
- Verbal Short-Term memory is significantly impaired; therefore, intervention on aspects of verbal short-term memory is needed in this population. Moreover, a reading intervention method should cater for these difficulties.
- VPPS have been extensively studied in this research, making it a significant highlight of the study. Results concerning Visual Perceptual Processing Skills indicate that strength in these skills was not perceived in comparison with the control group. This shows that a thorough assessment of the VPPS must be included in the clinical setting. The introduction to reading through a visual method, such as the *look and say* method, should not be a straightforward choice since DS students might have significant difficulties in the area. Intervention in these specific skills is also suggested because results confirm the difficulty experienced by the DS group.
- The Sentence Imitation Task is a clinical tool that predicts language abilities. Clinicians should use this tool as part of an assessment battery to within the local DS population, especially considering the absence of other language-related assessment tools.
- PA, VPPS and Receptive Vocabulary contribute to word and nonword reading in the local Maltese DS population. Hence clinicians and educators are encouraged to help strengthen these literacy building blocks in clinical and educational settings.

- To date, very limited research on biliteracy in DS is available. This research revealed that individuals with DS could read in both Maltese and English; hence they should be exposed to both languages during literacy acquisition. Such a result sheds light on the importance of bilingual exposure.
- Students with DS can successfully develop both Word and Nonword reading; therefore, individuals with DS should be offered the appropriate support and training to develop reading visually and phonetically to help them decipher the phonetic codes.
- Shared book reading could be used as an intervention strategy. Results show that shared book reading is very popular in this population, and therefore this could be channelled towards promoting language and literacy development. Parents/carers should be trained and encouraged to use shared book reading more efficiently so that this could help in the development of other skills.
- This study highlights that compared to the carers of TD children, DS carers tend to use the *reading readiness* approach. Once again, more training and guidance should be directed toward parents and carers about the benefits of early literacy exposure.
- The predominant use of flashcards was apparent in this study. The *look and say* approach is still highly used with the local DS population. However, results show that children with DS can also learn to read through a phonological method of reading. Parents and educational professionals should be trained to help their children acquire reading abilities through other methods and not solely through the predominant use of flashcards.
- Results indicate that technology is a dominant part of the participants' lives. Students with DS are exposed to technology as much as their TD peers. This suggests that literacy training and acquisition should be supported by technology as the use of digital devices is constantly increasing, and the DS population is keeping up with this advance in technology.
- Students with DS are primarily educated in a mainstream setting. This calls for educators to be adequately trained in literacy development for students with DS to ensure that the most appropriate teaching methods are implemented.

Future Research

This study explored pre-reading and reading development aspects in the Maltese population of students with Down Syndrome. The Phonological Awareness skills, Verbal Short-Term Memory, Visual Perceptual Processing Skills, Receptive Vocabulary, Word reading and Nonword reading abilities and inter-relationships were investigated. The Home Literacy, the School Literacy environments and Biliteracy were also explored. This study yielded preliminary findings within the local context and contributed to the gaps in relevant knowledge. Aspects of reading comprehension were not explored as no suitable measure exists in both languages. Such an investigation would have given a global picture of the abilities of the Maltese students with DS.

This study's findings and literature review indicate that longitudinal studies are necessary for this area. These would allow for the investigation of educational and clinical procedures from early childhood and throughout the years of schooling. Such studies are scarce both from an international and a local perspective.

Efficacy studies on reading intervention methods are currently unavailable within the Maltese population of students with DS. Such studies are needed to provide better evidence-based practice in reading development.

The relationship between Sentence Imitation Skills and aspects of reading should be further explored in the DS population. Research at both a local and an international level is needed to explore the correlations between clinical and educational implications.

Finally, an investment in constructing and validating assessment tools within the local bilingual scenario is urgently needed. Validation for both typically developing and students developing atypically would provide clinicians and educators with an adequate assessment protocol and, therefore, more robust diagnostic tools.

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Appendices

Appendix A

Evaluation of Assessment Tools

An evaluation of commercially available assessment tools pertaining to variables investigated throughout this thesis will be presented in the following Appendix.

According to the American Speech-Language and Hearing Association (n.d.), an assessment of reading abilities should be linguistically suitable, culturally appropriate, and practical. It should include input from different stakeholders such as the families, educational team and other professionals. An assessment that looks into different aspects of reading should holistically consider the child and investigate aspects that impact the final results of reading abilities. Although an array of assessments is available for each skill, only tools which are considered to be most appropriate for this research and the local population, were shortlisted and discussed. Finally, the best tools for this research were identified. Different assessment tools that look into the skills mentioned in the previous section will be evaluated in the following sections.

Assessing the Home Literacy Environment

There is a weak relationship between home literacy backgrounds and progress in early literacy skills; this has been discussed previously in this chapter. However, this poor relationship can be mainly attributed to characteristics of measures being used to evaluate the home environment rather than the environmental factors in themselves, since some tests might not ask the best questions to filter out information from the child's background (Curry, 2012). The aim of this section is two-fold:

- To identify the best possible assessments to investigate the home literacy environment;
- To identify the best instruments to use for the population of Maltese participants with Down Syndrome.

Evaluation of tools available was carried out, and three assessments were identified. The tools are Th*e Stony Brook Family Reading Survey* (Whitehurst, 1993), *Home Observation for Measurement of the Environment* (Caldwell & Bradley, 1978), and the *Home Literacy Environment Questionnaire* (Boudreau, 2005). The Stony Brook Family Reading Survey (Whitehurst, 1993) is a 42-item based questionnaire whereby all questions are on a Likert scale. This is a valuable tool as it provides information about the frequency of visits to the library, frequency of book reading, availability of books in the home, and how often literacy modelling takes place, which are all very valid aspects to investigate. However, the survey also addresses questions about schooling with specific reference to the schooling system of the USA, and it has been thought that this might be misleading for the population for the Maltese population since this would have to be adapted to local circumstances by re-wording or modifying questions to make them culturally appropriate for the local population.

The *Home Observation for Measurement of the Environment* (Caldwell & Bradley, 1978) is a tool considered appropriate for this study since it collects information about different environmental experiences, materials and parental involvement. However, this tool is split according to age groups. The fact that different versions are available for different age groups might yield different data and therefore not serve the purpose of comparing two groups (DS and TD) matched by a measure of cognitive abilities, as was planned for this study.

The Home Literacy Environment Questionnaire (Boudreau, 2005) has been considered a preferred tool for data collection for this study for several reasons. Primarily, it was identified because the questionnaire yields a variety of data. The tool allows the researcher to select quantitative and qualitative data to investigate (Muscat et al., 2017). This questionnaire was also utilised by other researchers investigating literacy and DS, although not within the Maltese context; instead, it was used in New Zealand (van Bysterveldt et al., 2010). Therefore, it promotes aspects of comparison to other studies. This tool is not standardised on the local population, and permission would be required to adapt it for specific populations such as the DS population in Malta.

The Home Literacy Environment Questionnaire has five sections. It investigates the educational context, the participants' language; the shared book reading practises; the participants' response to print; the participants' interest in letters; and a final section that includes questions related to the use of technology. Thirty questions are asked in total, of which 53.3% are partially open-ended questions, where participants are provided with a choice. However, if the choice is not appropriate for the participant, they can give a brief explanation (Jackson, 2012). Parents/carers have to provide information about their personal experiences by responding to these partially open-ended questions. 33.3% of the total questions have summated ratings (Likert, 1932). These questions make the questionnaire look appealing to the respondent (Robson, 2002) and aid the researcher to analyse quantitatively by providing a numerical score to rate the respondents' attitudes (Kothari, 2004). Of these questions, 13.3 % are closed-ended, where respondents need to provide only a Yes/No response. *S*uch a variety of question types is used to make the questionnaire structured, yet it allows the researcher to obtain a comprehensive picture of the respondents' attitudes (Kothari, 2004). The administration procedure is explained further on p. 137.

Assessing Verbal Short-term Memory

Studies in this area have been conducted mainly using digit span tasks, which involve repeating numbers. This method has been described as a less sensitive measure of working memory (Abdelhameed & Porter, 2010). Nonword repetition tasks are considered to be good clinical indicators of VSTM. Nonword repetition tasks might also be simpler to understand by the participants as such a task might be more familiar than digit repetition (Jarrold & Baddeley, 2001; Laws, 1998). Some words in non-word repetition tasks might have a high phonotactic probability (Jarrold & Baddely, 2001). Therefore, it may sound more common to the participants, making the task easier. However, performance can be affected by hearing skills and speech production abilities. Therefore, a difficulty in nonword repetition tasks might not necessarily mean difficulty in phonological memory (Cairns & Jarrold, 2005). Besides, performance on Nonword repetition tasks can also be influenced by the learner's knowledge of the specific language (Chiat, 2015). It has also been noted that Nonword repetition tasks are clinical markers for SLI (Conti-Ramsden et al., 2001), now also referred to as Developmental Language Disorder.

Tests of Nonword Repetition. Currently, two tests to evaluate Nonword repetition are available for Maltese children: *The Maltese Nonword Repetition Test,* which forms part of the assessment battery *Test of Reading, Phonological Awareness and Memory* (TORPAM) (Agius, 2012); and the *Nonword Repetition* (Calleja et al., 2013). The Maltese Nonword Repetition test by Agius (2012) has been based on the Maltese phonotactic and syllabic structures. This test has also been validated on the local population. An English version is also available in the TORPAM, which has been validated within the local context. However, this was not developed locally. The *Comprehensive Test of Phonological Processing* (Wagner, Torgesen & Rashotte, 1999) is utilised in the TORPAM.

The Nonword repetition (Calleja et al., 2013) has been considered a more appropriate tool to evaluate nonword repetition in the Maltese population of individuals with DS. This test was chosen primarily since all nonwords have been chosen according to Cost Action ISO804 standards (COST 264/08). These include nonwords developed specifically for the language. These nonwords differ in the length of syllables, have different segmental complexity, and are available in both high and low word-likeness (Muscat et al., 2017). Since the tool was part of a Cost Action, this assures that it has passed rigorous methods during its development. Also, this tool was validated, and both a Maltese and English version has been specifically developed. In the Method chapter, details about the tool and its administration can be found on p. 132.

Assessing Visual Perceptual Processing Skills

A selection of tests that measure visual processing is available, with the following being the most used in a clinical setting: *Developmental Test of Visual-Motor Integration* (VPI) (Beery et al., 2010); *Test of Visual Perception Skills-Revised* (TVPS-R) (Martin, 2006); *Motor Free Visual Perception Test-Revised* (MVPT) (Colarusso & Hammill, 2003); *Developmental Test of Visual Perception-2* (DTVP-

2) (Hammill et al., 1993; Brown et al., 2003). However, studies specifically administered to the British population show that two main tests are frequently used by occupational therapists, as reported by Brown et al. (2003). These tests allow for the testing of visual processing without assessing motor abilities. Occupational therapists mainly chose the MVPT to screen the students, while on the other hand, the TVPS proved to be useful for confirmation of diagnosis; reviewing progress; and was also considered helpful to plan therapy (Brown et al., 2003). Both tests have similar administration methods and help the researcher obtain similar information.

The latest version of the TVPS-R investigates seven visual processing areas: visual discrimination, visual memory, spatial relationships, form constancy, sequential memory, visual figure-ground, and visual closure rather than the five areas investigated by the MVPT. Although having several subtests, the test is easy and rapid to administer and complete. Multiple-choice answers are provided, and students are required to point to large print (Muscat et al., 2017). Thus, it is considered ideal for participants with expressive language difficulties or fine motor difficulties. This test is considered an ideal tool for this study since it includes a wide age range and can be completed in one session.

Moreover, the tool is not language-based and can be used in our local setting without adaptation (Muscat et al., 2017). The TVPS-R allows the researcher to compare the results obtained with standardisation data from 2008 students from the initial validation of the tool. Unfortunately, data collection was completed in North America, and currently, no Maltese data is available related to this test. However, this test has been used in international research studies. Therefore, data collected from the Maltese population could be compared to these results (Bower & Hayes, 1994; Nandakumar & Leat, 2010; Wan et al., 2014). Furthermore, this tool was also used locally for another research study (Borg, 2017), allowing the comparison of results to local research. Details about the administration procedure can be found on p. 134.

Assessing Word Reading Abilities

Considering the bilingual environment, as formerly discussed, it was deemed pertinent to identify assessment tools that evaluated word reading abilities in both the Maltese and the English language.

Assessing Word Reading in the Maltese language. Three assessments of word reading in the Maltese language have been identified: *Maltese group reading test in Maltese and English* (Falzon, 1972); *Word Reading Test* (Bartolo, 1988); and *Word Reading Test,* which forms part of the Test of Reading, Phonological Awareness and Memory (TORPAM) (Agius, 2012).

Maltese group reading test (Falzon, 1972) is sparsely used within the local educational setting, and it is seldom utilised for research practices; therefore, it was deemed more fruitful if an alternative to this assessment was sought.

The Word Reading Test (Bartolo, 1988) is extensively used in the local setting. It is a diagnostic tool for word reading difficulties and is standardised on the local population. Its usefulness has been proven throughout the years, and it is the tool that is majorly used throughout all educational settings, from early reading assessments to later reading assessments. This test is also used as a benchmark for granting access arrangements for secondary and post-secondary examinations in Malta. Although acknowledging the utility of such a tool, it is also considered relatively dated. Words and standardisation date back to 1988; thus, changes within the population might alter the reliability of the results.

Word Reading Test, which forms part of the Test of Reading, Phonological Awareness and Memory (TORPAM) (Agius, 2012), has been constructed. This tool builds on the 1988 *Maltese Word Reading Test* by Bartolo; however, it is enhanced in some aspects. The author maintains that word features, including frequency, imageability and concreteness, were looked into during this assessment's construction (Xuereb et al., 2011). The final version consisted of 60-word items (Agius, 2012). This tool has been validated and standardised by 549 participants. This assessment tool has not been published; however, the author granted a research version. Refer to p. 131 for administration details.

Assessing Word Reading in the English language. An array of assessments of word reading are available in the English language; however, access to assessments standardised for the Maltese context is not available, causing many challenges. All word reading tests currently being used in the local setting are imported are assessment tools standardized on other populations. Thus, when identifying an assessment tool to sample word reading abilities of children, the results need to be interpreted with caution. Although the tools are in the English language, these have not been standardised on the local population. The *Suffolk Reading Scale* (Hagley, 2002) is an assessment tool used locally and accepted by the University of Malta Board for Access arrangements. This board provides access arrangements to students for MATSEC Examinations. The test can be administered both online and on paper. The test is made up of multiple-choice and sentence-completion questions. On reviewing the test material, it has been observed that a big part of the test impinges on language comprehension. Therefore it was not deemed ideal for this research because the aim is to tap solely into single-word reading.

Although an English assessment tool has not been specifically created for the Maltese scenario, attempts at validating tools on our local population have been made. Agius (2012) worked on the validation of The Sight Word Efficiency test, which is part of the *Test of Word Recognition* (TOWRE) Torgesen, Wagner and Rashotte's (1999) assessment battery. The tool is very efficient to administer. In the original version, the children are given 45 seconds to read as many words as they can. However, during the validation process, Agius removed this timing aspect. Agius gave the students 5 minutes to complete the test. Agius (2012) aimed to provide similar conditions to the Maltese reading test, which did not have a timing component. This tool has been considered ideal for this research since it has been validated locally, and data are already available. Administration details can be found on p. 131.

Assessing Nonword Reading Abilities

An assessment of nonword reading or naming is considered an important tool as it provides insight into underlying processes that are not apparent at face value. According to Ellis (1985), the process of nonword reading involves three very important underlying abilities; the ability to segment graphemes visually, the ability to identify the correspondence between graphemes and phonemes, and the third ability to blend corresponding phonemes. This shows that performance on nonword reading tasks is closely associated with the development of phonological awareness abilities. Locally, only one standardised assessment which can assess nonword reading in Maltese is available. The *Nonword Naming Test* forms part of the assessment battery TORPAM (Agius, 2012). This test assesses the ability of a reader to decode nonwords in the Maltese language. This tool has been developed following the phonotactic structure of Maltese. Refer to p. 129 for the administration procedure.

Assessing Non-verbal Cognitive Skills

Three different tests have been identified as useful tools to measure cognitive functioning for research purposes. The *Kaufmann Brief Intelligence Test 2nd Edition* (2004) is used to screen for intellectual difficulties. This assessment provides measures of both verbal and non-verbal aspects, and it allows for the provision of an IQ score. However, both measures must be computed for a total score (Bains & Jespers, 2010). Hence, this might not be ideal for the Maltese population since the test's verbal section cannot be utilised due to the absence of a Maltese language component in the test. Moreover, this test can be administered by both psychologists and other educators. However, interpretation should only be carried out by persons with formal training. This makes it difficult to use for research purposes, as not all researchers have formal training on this assessment.

The *Wide Range Intelligence Test* (WRIT) (2004) is another useful tool. Shields et al. (2004) describe it as a compact measure of ability, and it can be administered in 30 minutes. It is considered ideal for research purposes since it yields results that are as valid and useful in predicting achievement as other longer tests. The WRIT provides measures for both verbal and non-verbal abilities. Although a very useful clinical tool, the researcher was looking for a measure of cognitive abilities that did not rely on the verbal domain for the same language issue described in The Kaufmann Brief Intelligence Test 2nd Edition (2004). Therefore, this tool was not utilised as a screening measure for this research.

Appendix B

Reliability and Validity

Throughout Appendix B, the aspects of Reliability and validity incorporated in the study are explained.

Test-retest Reliability

Test-retest reliability is also known as stability of measurement (Kimberlin & Winterstein, 2008). This technique measures stability over time (Drost, 2011). This result is achieved by administering the same assessment to the same individual at two points in time. The correlation of strength between the two results is then determined. Although being a strong measure of reliability, this can have shortcomings, and these mainly depend on the time of administration between the two. If the administration date is too close, the participants' responses might be affected by their memory from the previous administration. If the administration date is too far between test and retest, other factors might impinge on the results, such as maturation, education or the influence of health factors (Drost, 2011; Kimberlin & Winterstein, 2008). The assessment tools in this research study were all assessed for reliability through test-retest reliability measures. The same data from 10 participants (7 TD and 3 DS), which make up 10.75% of the sample population, were collected at two points in time and measured for test-retest reliability. The small sample size needs to be accounted for when interpreting the results. The time gap between the two assessment procedures was ten days. The assessment tools produced data on a metric scale, nominal scale and ordinal scale. These data required the use of different measures to verify test-retest reliability. The different data will be discussed separately.

Test-retest reliability of assessment tools on a metric scale. The intra-class correlation coefficient measures the test-retest reliability of continuous measures with a metric scale. The intra-class correlation coefficient ranges from 0-1, where the closer the coefficient is to 1, the higher the test-retest reliability. The null hypothesis specifies poor test-retest reliability and is accepted if the *p*-value exceeds the .05 level of significance. The alternative hypothesis specifies satisfactory test-retest reliability and is accepted if the *p*-value is less than the .05 criterion. Table B1 portrays the result. Results indicate that all measures were strongly reliable on test-retest measures since the correlation coefficient was always close to 1 with a 95% confidence interval. Moreover, the alternative hypothesis was accepted for all measures since the *p*-value was consistently below the .05 level of significance.

Table B1

Intraclass Correlation Coefficient of assessment measures

Assessment Measures	Intraclass Correlation	95% *CI*		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	*p*
Sentence Imitation	0.975	0.904	0.994	39.333	9	9	0.00
RCPM's coloured matrices	0.980	0.919	0.995	55.250	9	9	0.00
		A					
Nonword Reading Tasks							
Nonword reading English	0.999	0.996	1.000	1079.634	9	9	0.00
Nonword reading Maltese	1.000	0.999	1.000	4447.200	9	9	.00
Word Reading Tasks							
Word reading Maltese	0.996	0.985	0.999	246.000	9	9	.00
Word reading English	1.000	0.999	1.000	3904.309	9	9	.00
Nonword repetition	0.968	0.880	0.992	32.607	9	9	.00
Visual Perceptual Processing Skills							
Visual Discrimination	0.975	0.882	0.994	50.905	9	9	.00
Visual Memory	0.980	0.918	0.995	44.800	9	9	.00
Spatial relations	0.988	0.953	0.997	78.200	9	9	.00
Form constancy	0.945	0.752	0.987	23.095	9	9	.00

Visual Sequential Memory	0.970	0.882	0.993	37.750	9	9	.00
Figure-Ground Discrimination	0.955	0.822	0.989	24.750	9	9	.00
Visual Closure	0.990	0.952	0.998	129.000	9	9	.00
Phonological Awareness							
Syllable Counting	0.972	0.894	0.993	35.667	9	9	.00
Rhyme Awareness	0.983	0.932	0.996	66.000	9	9	.00
Identification of First Sound	0.919	0.664	0.980	11.200	9	9	.001
Phoneme Identification	0.985	0.940	0.996	61.200	9	9	.00
Letter to Sound Conversion	0.920	0.697	0.980	13.683	9	9	.00

Confidence Interval

Test-retest reliability for tasks with an ordinal and a nominal scale. The Home Literacy Environment Questionnaire (Boudreau, 2005) had a series of questions that provided results of both a nominal and an ordinal nature. This called for the assessment of test-retest reliability of the questions using two different measures. The *Kappa test* was used to measure test-retest reliability for questions on a nominal scale, for example: In which language are they better at reading? The Kendal Tau test was used to measure the test-retest reliability of questions on an ordinal scale, for example: How often do you read to your child? The null hypothesis stipulates poor test-retest reliability for both tests and is accepted if the *p*-value exceeds the .05 level of significance. The alternative hypothesis specifies good test-retest reliability and is accepted if the result is less than .05. Table B2 illustrates test re-test reliability results for Questionnaire questions on a nominal scale, while Table B3 shows test-retest reliability results for Questionnaire questions on an ordinal scale.

Results indicate that all were questions were reliable on test-retest measures since the correlation coefficient was always close to 1. Moreover, the alternative hypothesis was accepted for all measures since the *p*-value was consistently below the .05 level of significance on all assessment measures, and hence, the null hypothesis has been rejected. Five questions on the nominal scale indicated a constant; this shows that the answers on the two separate dates were 100% equal. Therefore, the alternative hypothesis is accepted on all questions of the adapted *The Home Literacy Environment Questionnaire* (Boudreau, 2005).

Table B2

Test re-test reliability results for Questionnaire questions on a nominal scale

	Value	*SE*	Approximate T	*P*
Question1a	0.800	0.186	2.582	0.010
Question 1b	Constant			
Question 2	Constant			
Question 3	Constant			
Question 25	Constant			
Question 26	Constant			

Note. The Kappa Test assesses test-re-test reliability in questions on a nominal scale.

Table B3

Test re-test reliability results for Questionnaire questions on an ordinal scale

Questions	Value	*SE*	Approximate *T*	*P*
Question 4	.666	.154	4.117	.000
Question 5	.845	.137	5.477	.000
Question 6	.666	.154	4.117	.000
Question 7	.864	.094	4.520	.000
Question 8	1.00	.000	5.814	.000
Question 9	.805	.112	3.811	.000
Question 10	.941	.039	11.314	.000
Question 11	.941	.039	11.314	.000
Question 12	.921	.052	7.206	.000
Question 13	.519	.170	3.299	.001
Question 14	.904	.062	8.352	.000
Question 15	.934	.042	8.808	.000
Question 16	.919	.035	17.000	.000
Question 17	.391	.278	1.482	.138
Question 18	.819	.114	3.795	.000
Question 19	.942	.050	10.445	.000
Question 20	.945	.052	9.712	.000
Question 21	.895	.097	4.725	.000
Question 22	1.000	.000	1.936	.053
Question 23	.788	.148	2.828	.005
Question 24	1.000	.000	3.000	.003

Note. The Kendall Tau Test assesses test-re-test reliability in questions on an ordinal scale.

Internal Consistency

Internal consistency includes the reliability of the different test constituents. This measures how well a set of components measures a particular skill or behaviour (Drost, 2011). For example, in this study, The Phonological Awareness Screen consisted of 5 individual components. The internal consistency of these components was investigated to ascertain how well these show the abilities of a student on phonological awareness tasks. Internal consistency is measured by the coefficient alpha, also known as *Cronbach's Alpha* (Drost, 2011; Kimberlin & Winterstein, 2008). Three assessment tools from this study were investigated for internal consistency: the Phonological Awareness Screen, the Test of Visual Perception Skills-Revised (TVPS-R), and the adaptation of the Home Literacy Questionnaire. Results for the Home Literacy Questionnaire will be portrayed in the section: Factor Analysis of the adapted Home Literacy Questionnaire. The Phonological Awareness Screen had five components, while the TVPS had seven components. Results are shown in Table B4 hereunder.

Table B4

Inter-item correlations of reliability of the Phonological Awareness Screen and TVPS

Assessment Tools	Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	N of Items
TVPS	.814	.822	7
Phonological Awareness Screen	.847	.858	5

Results indicate that both TVPS and the Phonological Awareness Screen have strong inter-item correlations; therefore, strong consistency since correlation scores are above the .70 criterion (Nunnally, 1978).

A summary of the outcomes of Validity and Reliability testing on the assessment tools

In this study, a combination of assessment tools was utilised to gain information about the participants' abilities. The researcher used assessment tools that were both standardised and validated on the Maltese population and others which were not. Accordingly, the researcher attempted to verify the reliability and look into the validity of the assessment protocol. This was not the study's main aim; nonetheless, it adds additional testing and ascertaining aspects of validity and reliability to the protocol used in this study.

External validity.

External validity looks into the ability to generalise with confidence the research findings to other situations (Roberts & Priest, 2006). Statistical analysis showed that this study's results could be generalised to the total population of Maltese students with DS. However, results are only generalisable to the DS population in the Maltese islands when this pertains to the DS group's age cohort in this study. One hundred fifty-six individuals with DS fall within these age parameters.

Content Validity.

Content Validity of the tools was first ascertained through a literature search. Content validity is a qualitative measure that confirms that the tools look into the specific concept assessed by the researcher (Drost, 2011). The authors of some assessment tools ascertained content Validity: The Test of Word Reading Efficiency and Phonemic Decoding Efficiency 2nd Edition TOWRE; Word Reading Test and Nonword Reading Test; Nonword Repetition Test; and Test of Visual Perception Skills-Revised (TVPS-R). The authors of The Sentence Imitation Task (Grech et al., 2011), The Phonological Awareness Screen (Grech et al., 2011) and The Home Literacy questionnaire (Boudreau, 2005) did not provide any information about content validity; however, this was ascertained by the researcher. This is discussed hereunder for the Phonological Awareness Screen and SIT.

The Phonological Awareness Screen was used to obtain information about the participants' phonological awareness abilities. This tool was validated on a sample of Maltese bilingual children. This tool allows for the assessment of five phonological awareness skills: syllabification, rhyme awareness, identification of initial sounds in words, phoneme segmentation and sound-to-letter conversion, which according to vast literature, support the development of reading abilities, hence sustaining content validity

As discussed in the Literature Review chapter, the Sentence Imitation Task (Grech et al., 2011) was used to collect data about the participants' sentence imitation skills and was also a predictor of receptive language (Grech et al., 2011; Grech, in press). This tool also provides the researcher with an indication of the receptive skills of participants. Content Validity was ascertained since it has been used within other local studies for older children by Calleja et al. (2013) and Xuereb et al. (2011). Norms for this tool are also available.

No attempts to assess content validity have been found by Boudreau (2005) on The Home Literacy Questionnaire (Boudreau, 2005); however, the researcher ascertained this. As discussed on p. 360), this tool has been utilised in numerous studies investigating the Home Literacy Environment. Research studies involving this questionnaire are available with typically developing participants and participants with learning difficulties (van Bysterveldt, 2010).

Test-retest reliability.

Test-retest reliability was measured to test the stability of the tools over two points in time. The researcher tested test-retest reliability on all the assessment tools, including measurements of both metric and nonmetric scales. Results (see p. 371 and p. 373) indicate that all were reliable on test-retest measures since the correlation coefficient was always close to 1. The researcher administered this measure to both TD participants and participants with DS. Both groups showed positive test-retest reliability results.

Internal Consistency.

Internal consistency comprises the reliability of several test constituents. This encompasses how well a set of components measure a specific skill or behaviour (Drost, 2011). Internal consistency was tested for tools with different subtests. The Test of Visual Perception Skills-Revised (TVPS-R) and the Phonological Awareness Screen were tested for Internal Consistency. As shown on p. 374, the investigation indicates that the Test of Visual Perception Skills-Revised (TVPS-R) and the Phonological Awareness Screen have strong inter-item correlations. Therefore, they offer strong consistency since correlation scores are above the .70 criterion (Nunnally, 1978).

Criterion Related Validity.

Criterion-related validity shows how well tools measure similar skills. In this study, two measures of reading were tested for correlation. Measures of Word reading positively correlated to

Nonword reading (*r*(13) = .59 *p* = .05). The other assessment tools in the protocol were not tested for correlation with a similar tool investigating the same skill for lack of time and considering that this validity was not a main focus of the study.

In summary, this study's results indicate that this group of participants with DS was successful both in Word and Nonword reading tasks. The fact that this group of participants faired particularly well in PA tasks, as already discussed, could have contributed to the success of these tasks. Validity and reliability testing have indicated strong validity and reliability of the assessment tools; however, this analysis also indicated that reliability is not adequate in all aspects of the Adapted Home Literacy Questionnaire through the Factor Analysis presented in Appendix L.

Due to time constraints, an assessment of reliability and validity is unavailble for the School Environments Questionnaire and The Peabody Picture Vocabulary Test 4th Edition (Dunn & Dunn, 2007). This is considered a limitation of the study.

Appendix C

Letter of Information and Consent Forms

Participation in Research

Dear Parents/Carers,

I am Loredana Muscat a Speech-Language Pathologist and I am currently carrying out research for my Ph.D study *Reading Development in Maltese Children and young adults with Down Syndrome.* My study involves the assessment of pre-reading and reading skills of Maltese students with Down Syndrome who are both Maltese and English Speaking. I will be considering students from the age of one till any schooling age, so Nursery, Kinder, Primary, Secondary and Post Secondary.

My aim is to assess all students with Down Syndrome in Malta. This is a first of a kind study and I am asking for your help to obtain as much information as possible. This information will eventually help so that the children will obtain the best teaching techniques available.

I will be assessing the students for approximately two hours split on two different days. The assessments will be carried out either at your house or any other place which is mostly convenient for you. I will be screening the students for hearing skills during this meeting. I will also be inquiring about the students visual skills. If such information is not available, I will refer the student for a visual test at the Ophtalmic clinic at the local Health Centre or Mater Dei Hospital.

The assessment sessions will be audiorecorded and all data will be password protected and stored in a safe cabinet.

Should you need more information please contact me on

Student:	Loredana Muscat	Contact: [redacted]
Supervisor:	Prof. Helen Grech	Contact: [redacted]

Thanking you in advance,

Loredana Muscat

Parteċipazzjoni f'Riċerka

Għeżież Ġenituri,

Jiena Loredana Muscat Speech-Language Pathologist, u bħalissa qed nagħmel riċerka għall-Ph.D tiegħi *Reading Development in Maltese Children and young adults with Down Syndrome*. Ir-riċerka se tinvestiga kif studenti Maltin b'Down Syndrome jiżviluppaw il-qari. F'din ir-riċerka se jieħdu sehem studenti li jitkellmu bil-Malti kif ukoll bl-Ingliż u ta' eta' minn sena 'l fuq. Kull min jattendi skola jista' jieħu sehem f'din ir-riċerka: nursery, kinder, primarja, sekondarja u post-sekondarja.

L-istudju jinvolvi li jien nagħmel testijiet tal- qari jew ta' preparazzjoni tal-qari. Dan kollu se jieħu madwar sagħtejn, li jinqasmu fuq jumejn. Dawn it-testijiet niġi nagħmilhom id-dar tagħkom, jew fejn hu l-aktar post komdu għalikom. L-istudent ser isirilhom test sabiex naċċerta l-livel ta' smigħ. Matul dan l-assessment se nsaqsikom ukoll informazzjoni dwar il-vista tal-istudenti. Jekk ma jkollkomx din l-informazzjoni se nissuggerilkom li tagħmlu appuntament tal-vista l-Ophtalmic Clinic f'policlinic jew fl-isptar Mater Dei.

Dawn l-assessments se jiġu irrekordjati u l-informazzjoni miġbura inkluż l-'audiorecording' ser tiġi protetta b' *password* u miżmuma ġo kabinett.

Jekk tixtiequ aktar informazzjoni ikkuntatjawni fuq:

Studenta:	Loredana Muscat	Contact: [redacted]
Supervisor:	Prof. Helen Grech	Contact: [redacted]

Nirringrazzjakom,

Loredana Muscat

<u>Participation in Research</u>

Dear Parents/Carers,

I am Loredana Muscat a Speech-Language Pathologist and I am currently carrying out research for my Ph.D study *Reading Development in Maltese Children and young adults with Down Syndrome*. My study involves the assessment of pre-reading and reading skills of Maltese students with Down Syndrome who are both Maltese and English Speaking. I will be considering students from the age of one till any schooling age, so Nursery, Kinder, Primary, Secondary and Post Secondary.

The aim of this study is to compare the results of students with Down Syndrome with typically developing children.

I will be assessing the students for approximately 1 hour on their own in a location deemed appropriate by the Head of School. The assessments will be carried out at school during school hours. I will also be asking you to fill in a short questionnaire related to the child's home literacy environment.

The assessment sessions will be audiorecorded and all data will be password protected and stored in a safe cabinet.

Should you need more information please contact me on

Student:	Loredana Muscat	Contact [redacted]
Supervisor:	Prof. Helen Grech	Contact: [redacted]

Thanking you in advance,

Loredana Muscat

<u>Partećipazzjoni f'Rićerka</u>

Għeżież Ġenituri/Gwardjani,

Jiena Loredana Muscat Speech-Language Pathologist, u bħalissa qed nagħmel rićerka għall-Ph.D tiegħi *Reading Development in Maltese Children and young adults with Down Syndrome*. Ir-rićerka se tinvestiga kif studenti Maltin b'Down Syndrome jiżviluppaw il-qari. F'din ir-rićerka se jieħdu sehem studenti li jitkellmu bil-Malti kif ukoll bl-Ingliż u ta' eta' minn sena 'l fuq. Kull min jattendi skola jista' jieħu sehem f'din ir-rićerka: nursery, kinder, primarja, sekondarja u post-sekondarja.

L-għan ta' dan l-istudju huwa li jiġu mqabbla r-riżultati ta' tfal b'Down Syndrome ma' riżultati ta' tfal li qed jiżviluppaw b'mod tipiku. L-istudju jinvolvi li jien nagħmel testijiet tal-qari jew ta' preparazzjoni għall-qari. Dan kollu se jieħu siegħa u t-tifel/tifla se jkun waħdu. Dawn it-testijiet nagħmilhom l-iskola tat-tifel/tifla f'post li jiddeċiedi s-surmast. Se jingħatalkom ukoll kwestjonarju biex timlewh id-dar.

Dawn l-assessments se jiġu irrekordjati u l-informazzjoni miġbura inkluż l-'audiorecording' ser tiġi protetta b' *password* u miżmuma ġo kabinett.

Jekk tixtiequ aktar informazzjoni ikkuntatjawni fuq:

Studenta: Loredana Muscat Contact: [redacted]

Supervisor: Prof. Helen Grech Contact: [redacted]

Nirringrazzjakom,

Loredana Muscat

FORMOLA TA' KUNSENS

L-iskop u d-dettalji tal-proġett *Reading Development in Maltese Children and young adults with Down Syndrome* ġew spjegati minn Ms Loredana Muscat. Jiena stess spjegajt lit-tifel /tifla tiegħi dak li ser isir.

Jiena naf li l-informazzjoni miġbura ser tinżamm b'mod kunfidenzjali, u li ser tintuża biss għal skopijiet xjentifiċi. Naf ukoll li ser isir rapport bil-miktub tar-riżultati, u li meta jsir dan, jiena/it-tifel/tifla tiegħi bl-ebda mod m'aħna ser inkunu nistgħu niġu identifikati. Jiena naf li l-informazzjoni kollha miġbura li jinkludu awdjo-recordings huma protetti b'password, maħżuna diġitalment u meqruda hekk kif jitlesta l-proġett.

Għalhekk qed nagħti l-kunsens tiegħi lill-persuna responsabbli għal din ir-riċerka biex tagħmel l-osservazzjonijiet li hemm bżonn fuq it-tifel/ tifla tiegħi ______________________.

Naf li ma għandi l-ebda dmir nagħmel dan, u li nista' nirtira fi kwalunkwe punt, mingħajr ma nagħti raġuni.

Jekk ikolli diffikulta' waqt l-istudju, nista' nistaqsi għal:

Loredana Muscat
[redacted]

Isem tal-parteċipant: ______________________________

Numru tat-telefon: ______________________________

Firma

Isem tal-persuna responsabbli għall-istudju:

Studenta: Loredana Muscat
Supervisor: Prof. Helen Grech

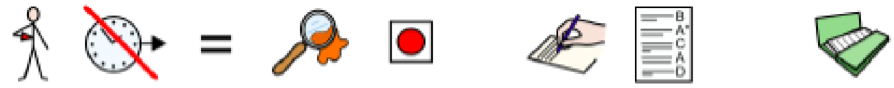
Firem: [redacted]

Consent Form Minors

The aims and details of the project "Reading Development in children and young adults with Down Syndrome" have been expalined to me.

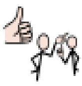
I know that:

- any data collected will be confidential and used solely for research purposes.
- I do not have to participate.
- information collected, including audio-recordings, will be password protected and destroyed when no longer needed.

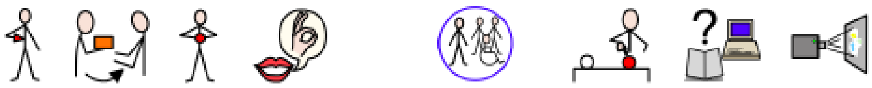


- I will not be identified in the written report of the project.

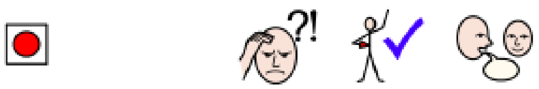
- I can stop participating at any moment without giving a



reason.



I give my consent to participate in this research project.



In case of any difficulty I can contact:

Researcher: Loredana Muscat

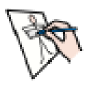
Telephone [redacted]

Supervisor: Professor Helen Grech

Telephone [redacted]

______________________________ ______________________________

Name of participant: ______________________________

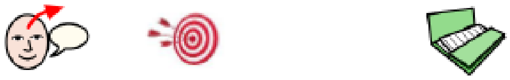


Signature: ______________________________

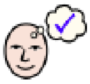
Name of parent/carer: ____________________

Signature: ______________________________

Formula tal-Kunsens (Minuri)



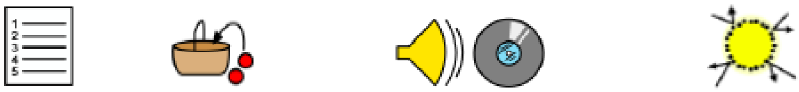
Lili spjegawli l-għanijiet u d-dettalji tal-proġett: "Reading Development in children and young adults with Down Syndrome".



Naf li:

- l-informazzjoni miġbura se tkun kunfidenzjali u użata biss għar-riċerka.

- minix se nkun identifikat(a) fir-rapport miktub tal-proġett.

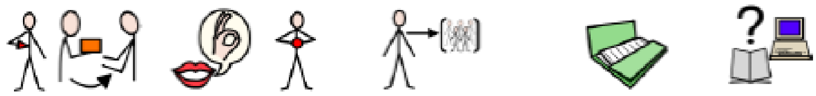


- l-informazzjoni miġbura, inklużi *audio-recordings*, se tkun protetta b'

password u meqruda meta ma tibqax bzonnjuża.

- M'hemmx għaltejn nieħu sehem bilfors.

- Nista' nieqaf meta rrid mingħajr ma nagħti raġuni.



Jien nagħti l-kunsens tiegħi biex nipparteċipa f' dan il-proġett ta' riċerka.

F' każ ta' diffikulta' nista' nikkuntattja lil:

Riċerkatriċi: Loredana Muscat

Telephone [redacted]

____

Supervisor: Professor Helen Grech

Telephone [redacted]

____

Isem tal-parteċipant(a): ____________________________________

Firma: ____________________________

Isem tal-persuna responsabbli: ________________________________

Firma: ____________________________

Appendix D

Ethical Approval Phase 1

original 177/2014

UNIVERSITY OF MALTA

UNIVERSITY RESEARCH ETHICS COMMITTEE

Check list to be included with UREC proposal form

Please make sure to tick **ALL** the items. Incomplete forms will not be accepted.

		YES	NOT APP.
1a.	Recruitment letter / Information sheet for subjects, in English	✓	
1b.	Recruitment letter / Information sheet for subjects, in Maltese	✓	
2a	Consent form, in English, signed by supervisor, and including your contact details	✓	
2b	Consent form, in Maltese, signed by supervisor, and including your contact details	✓	
3a	In the case of children or other vulnerable groups, consent forms for parents/ guardians, in English	✓	
3b	In the case of children or other vulnerable groups, consent forms for parents/ guardians, in Maltese	✓	
4a	Tests, questionnaires, interview or focus group questions, etc, in English	✓	
4b	Tests, questionnaires, interview or focus group questions, etc, in Maltese	✓	
5a	Other institutional approval *for access to subjects*: Health Division, Directorate for Quality and Standards in Education, Department of Public Health, Curia...	✓	
5b	Other institutional approval *for access to data*: Registrar, Data Protection Officer Health Division/Hospital, Directorate for Quality and Standards in Education, Department of Public Health...	✓	
5c	Approval from person *directly responsible for subjects*: Medical Consultants, Nursing Officers, Head of School...	✓	

Received by Faculty office on	27.06.14
Discussed by Faculty Research Ethics Committee on	24.07.14
Discussed by university Research Ethics Committee on	24.09.14

UNIVERSITY OF MALTA

Request for Approval of Human Subjects Research
Please type, or print legibly with black pen. You may follow this format on separate sheets or use additional pages if necessary.

FROM: *(name, address for correspondence)* Loredana Muscat, [redacted] TELEPHONE: [redacted] E-MAIL: COURSE AND YEAR: Ph.D Faculty of Health Sciences 2014	PROJECT TITLE: Reading development in Maltese children and young adults with Down Syndrome.
ANTICIPATED FUNDING SOURCE: Personal funding *(include grant or contract number if known)*	FACULTY SUPERVISOR'S NAME: Professor Helen Grech [redacted]
DURATION OF ENTIRE PROJECT: from July 2014 to July 2015	

1. Please give a brief summary of the purpose of the research, in non-technical language.

The aim of the study is to investigate aspects of reading development of Maltese children and young adults with Down Syndrome (DS). Data on reading development and skills of Maltese children with DS is very scarce and what is currently available is focussed on a small sample population and on specific components of reading skills (e.g., Wirth, 2008). Locally, individuals with DS are being exposed to different methods of reading instruction and to date we do not know which methods are effective.

The objectives of the study are to investigate aspects of pre-reading and reading skills in Maltese children and young adults with DS. More specifically, the participants' skills in Non-word reading, phonological awareness, visual perceptual processing and early literacy skills will be assessed and compared with those of typically developing individuals who will be matched in terms of spoken language skills, cognitive abilities, maternal level of education, language use, geographical area and school which each student attends.

An additional objective is to investigate what reading strategies are appropriate for children and young adults with DS.

2. Give details of procedures that relate to subjects' participation
(a) How are subjects recruited? What inducement is offered? *(Append copy of letter or advertisement or poster, if any.)*
The recruitment process will take place in 2 phases

Phase 1: Recruitment of students with Down Syndrome.

The students with DS will be recruited through 4 different institutions:

1. The Down Syndrome Association
2. Inspire
3. The Equal Partners Foundation
4. The Speech-Language Department

Permissions to recruit participants from these institutions is attached in Appendix A.

The parents/carers will be given an information letter and consent form by the Head of the institution. Information letters attached Appendix B. Consent form Appendix C. The parents/carers will then return the form to head of the institution who will then forward them to the researcher. The researcher will then contact only the parents/carers who returned the consent form. Therefore the researcher will not have access to the personal data of the participants through the institutions. The institutions will only give out the information letter provided to them by the researcher. Data such as language age, cognitive age, school and maternal level of education will only be collected during the meeting with the parents/carers and participants.

Once Phase 1 is completed the researcher will then match students with DS with TD students.

Phase 2: Recruitment of typically developing (TD) cohorts.
Phase 2 will start once recruitment and data collection of Phase 1 is completed. This will be done since the researcher will first have to identify the students with DS, carry out the necessary assessments to obtain information about their language age, cognitive age, school, mother's level of education and geographical location and then match to a TD student. Therefore Phase 2 cannot commence before Phase 1 is completed.

Once all the above information is obtained TD students will then be recruited from Church Schools (Permission attached: Appendix D), State schools and Independent schools possibly matching with the corresponding school that each DS match attends. Permission from state schools and independent schools will be sought once the specific schools which students with DS attend will be identified, therefore once Phase 1 is completed. This could not be done at this stage since the state schools and independent schools are requesting to give details of the specific school before they consider approving the data collection.

A small incentive ie. a book token will be given to all the participants.

(b) Salient characteristics of subjects—number who will participate, age range, sex, institutional affiliation, other special criteria:

For Phase 1 of the study, criteria for inclusion include:

- All children and young adults with DS who are Maltese citizens and who attend formal schooling both in Malta and Gozo, that is, between Year 1 and Post-Secondary School. As per information provided by the Public Health Register of Births, 138 students with DS between the age of 4 and 20 can potentially participate in the study. If students over the age of 20 still attend formal schooling, these will also be included in the study. However no official records are currently available of this age group, therefore the number of the students might increase when contact with the schools is achieved. Moreover, children born after 2009 will also be included in the study. Thus enabling a larger population sample, which will be as close as possible to the total population of school-age students with DS in Malta.

- To obtain a score in the Sentence Imitation Test equivalent to at least 5 years as measured on *Language Assessment for Maltese Children (LAMC)* Grech, H., Franklin, S., & Dodd, B. (2011) (Assessment form attached in Appendix E)

- To obtain a score of at least 6 years, on The Raven's Coloured Progressive Matrices Test (Raven, J.C., Court, J.H. & Raven, J.C. ,1990) (Assessment form attached in Appendix F)

- Given that fluctuating or compromised health status is prevalent in children with DS, informants will not be excluded on the basis of significant ongoing medical concerns, hearing or visual impairment or a diagnosis of additional developmental disabilities. However participants will be screened with pre-set criteria. Participants with mild hearing loss will be included in the study, however they will be sub-grouped. The researcher is qualified to screen hearing acquity. In the case of visual skills, the researcher will collect information about visual skills in the initial meeting with the parents/carers as per parent report. Should this information be unavailable, the participants will be referred for a visual assessment. Participants with moderate/mild difficulties and with corrected visual skills will be included, however sub-grouped so that data will be analyzed for significant differences.

Exclusion Criteria for Phase 1:

- Participants with moderate/severe/profound hearing loss will be excluded from the study .
- Participants with severe visual difficulties will be excluded from the study.

For Phase 2 of the study, TD students will be recruited. Students conforming to the following criteria will be included in the study.

- Have Maltese or English as their first Language. The TD will be matched to participants with DS according to which language is used as a primary language.

- Maltese citizens
- No sensory impairment. A screening test for hearing abilities will be carried out by the researcher. Information about visual skills will be collected during the first meeting with the parents. Should this information be unavailable, the participants will be referred for a visual assessment.(Permission to refer for assessment; Appendix G)
- To have an equivalent Cognitive age of at least 6 years, as measured on The Raven's Coloured Progressive Matrices Test (Raven, J.C., Court, J.H. & Raven, J.C. ,1990)
- No learning and/or reading difficulties. This will be determined by asking the teacher or head of school to identify participants with no history of learning/and or reading difficulties.

(c) Describe how permission has been obtained from cooperating institution(s)—school, hospital, organization, prison, or other relevant organization. *(Append letters.)* Is the approval of another Research Ethics Committee required?

The institutions have been contacted by the researcher (please find letter attached). Moreover, the researcher met with three heads of the institutions: Inspire, Equal Partners Foundation, The Down Syndrome Association, to explain in detail the aims and methods of the project. All institutions provided written consent to help with recruiting the participants (permissions attached). Refer also to Section 2A where the procedure of recruitment of participants via institutions and carers is explained.

(d) What do subjects do, or what is done to them, or what information is gathered? (Append copies of instructions or tests or questionnaires.) How many times will observations, tests, etc., be conducted? How long will their participation take?

The researcher will meet the student twice. The assessment sessions will take approximately $1^1/_2$ to 2 hours in total, these will then be divided in two different sessions according to the needs and abilities of the participants. Will discontinue testing if any informant shows signs of fatigue or indicate that s/he wishes to discontinue the session. The following tests will be administered:

- Test of Visual-Perceptual Skills (non-motor), Third Edition (Martin, N. 2006) During this test the participants will have to point to images and shapes. (Assessment form in Appendix H)

- *Language Assessment for Maltese Children* (Phonological Awareness) (Grech, H., Franklin, S., & Dodd, B., 2011) (Appendix E) The test includes the following tasks:
  Syllable counting – the student will be asked to clap the number of syllables.
  Rhyme awareness – the student will be asked to identify which word does not rhyme.
  Identification of first sound – the student will be asked to say what is the first sound of each word.
  Phoneme Segmentation- the student will be asked to segment words into individual

sounds.

Sound to letter conversion – the students will be asked to say the sound of the printed letters.

- Non Word Reading Test (Agius 2012) – the students will have to read a list of words.

- Phoneme Decoding Efficiency Test from TOWRE (Torgesen, Wagner & Rashotte, 1999) (Assessment form Appendix J) – for students with English as primary language. The students will be asked to read a list of words in English. This has been standardised on typically developing Maltese children by Agius (2012)

- Early Literacy Questionnaire adapted and translated with permission from the author (Boudreau, 2005)(Appendix K). These questions will be asked to parents/carers.

- Test of English Non-Word Repetition & Test of Maltese Non-Word Repetition (Calleja, Unpublished) The students will have to repeat words. (Appendix L)

(e) Which of the following data categories are collected?

Data that reveals – race or ethnic origin	YES / NO
political opinions	YES / NO
religious or philosophical beliefs	YES / NO
trade union memberships	YES / NO
health	YES / NO
sex life	YES / NO
genetic information	YES / NO

3. How do you explain the research to subjects and obtain their informed consent to participate? (If in writing, append a copy of consent form.) If subjects are minors, mentally inform, or otherwise not legally competent to consent to participation, how is their assent obtained and from whom is proxy consent obtained? How is it made clear to subjects that they can quit the study at any time?

The parents/carers of the participants will be informed in writing. The parents/carers will also inform the participants about the research. It will be made clear that they can quit the study at any time, both in writing and during the first meeting. Two different consent forms will be used; one where parents/carers will provide consent, the second, in the case of young adults who can read, in this case the researcher will also request their own consent. Parents/carers will be informed that audiorecording will take place during the assessment sessions. They will also be informed that all data will be password protected and stored in a secure cupboard.

4 .Do subjects risk *any* harm—physical, psychological, legal, social—by participating in the research? Are the risks necessary? What safeguards do you take to minimize the risks?

No the subjects do not risk any harm. The participants will only need to repeat words or respond to questions verbally or non-verbally.

5. Are subjects deliberately deceived in *any* way? If so, what is the nature of the deception? Is it likely to be significant to subjects? Is there any other way to conduct the research that would not involve deception, and, if so, why have you not chosen that alternative? What explanation for the deception do you give to subjects following their participation?

No, the subjects are not deceived

5. How will participation in this research benefit subjects? If subjects will be "debriefed" or receive information about the research project following its conclusion, how do you ensure the educational value of the process? *(Include copies of any debriefing or educational materials)*

Both institutions and participants will be given a summary of the research results at the end of the study. This study can possibly yield significant results that will improve quality of life and enhance reading skills of individuals with DS. Teachers/educational staff can gain more information about how reading develops in students with DS and what are the appropriate methods of reading instruction to be used.

TERMS AND CONDITIONS FOR APPROVAL IN TERMS OF THE DATA PROTECTION ACT

- Personal data shall only be collected and processed for the specific research purpose.
- The data shall be adequate, relevant and not excessive in relation to the processing purpose.
- All reasonable measures shall be taken to ensure the correctness of personal data.
- Personal data shall not be disclosed to third parties and may only be required by the University or the supervisor for verification purposes. All necessary measures shall be implemented to ensure confidentiality and where possible, data shall be anonymised.
- Unless otherwise authorised by the University Research Ethics Committee, the researcher shall obtain the consent from the data subject (respondent) and provide him with the following information: The researcher's identity and habitual residence, the purpose of processing and the recipients to whom personal data may be disclosed. The data subject shall also be informed about his rights to access, rectify, and where applicable erase the data concerning him.

I, the undersigned hereby *undertake* to abide *by* the terms and conditions for approval as *attached to this application.*

I, the undersigned, also give my consent to the University of Malta's Research Ethics Committee to process my personal data for the purpose of evaluating my request and *other matters related to this application.* I also understand that, I can request in writing a copy of my personal information. I shall also request rectification, blocking or erasure of such personal data that has not been processed in accordance with the Act.

Signature:

APPLICANT'S SIGNATURE	FACULTY SPONSOR'S SIGNATURE I have reviewed this completed application and I am satisfied with the adequacy of the proposed research design and the measures proposed for the protection of human subjects. [redacted]
DATE 04/06/14	DATE 5/6/2014

ATTACHMENTS:

☒ Recruitment letter, poster ☒ Other institutional approval ☒ Subject instructions
* Tests or questionnaires * Information sheets or debriefing materials
* Written consent form (or script) *Other

Return the completed application to your faculty Research Ethics Committee

To be completed by Faculty Research Ethics Committee

We ~~have~~ examined the above proposal and advise

Acceptance **Refusal** **Conditional acceptance**

For the following reason/s:

[redacted]

22/8/ 2014

Signature Date

To be completed by University Research Ethics Committee

We have examined the above proposal and grant

Acceptance **Refusal** **Conditional acceptance**

For the following reason/s:

Permission is granted only for first part of the project. Student will need to reapply for permission for the second part.

Signature [redacted] Date 8/10/2014

Appendix E

Ethical Approval Phase 2

Original   001/2016

UNIVERSITY OF MALTA

UNIVERSITY RESEARCH ETHICS COMMITTEE

Check list to be included with UREC proposal form

Please make sure to tick **ALL** the items. Incomplete forms will not be accepted.

		YES	NOT APP.	
1a.	Recruitment letter / Information sheet for subjects, in English	✓		
1b.	Recruitment letter / Information sheet for subjects, in Maltese	✓		
2a	Consent form, in English, signed by supervisor, and including your contact details	✓		
2b	Consent form, in Maltese, signed by supervisor, and including your contact details	✓		
3a	In the case of children or other vulnerable groups, consent forms for parents/ guardians, in English	✓		
3b	In the case of children or other vulnerable groups, consent forms for parents/ guardians, in Maltese	✓		
4a	Tests, questionnaires, interview or focus group questions, etc, in English		✓	Phase 1
4b	Tests, questionnaires, interview or focus group questions, etc, in Maltese		✓	Phase 1
5a	Other institutional approval *for access to subjects*: Health Division, Directorate for Quality and Standards in Education, Department of Public Health, Curia...	✓		
5b	Other institutional approval *for access to data*: Registrar, Data Protection Officer Health Division/Hospital, Directorate for Quality and Standards in Education, Department of Public Health...	✓		
5c	Approval from person *directly responsible for subjects*: Medical Consultants, Nursing Officers, Head of School...	✓		

Received by Faculty office on	29.09.15
Discussed by Faculty Research Ethics Committee on	06.10.15
Discussed by university Research Ethics Committee on	

UNIVERSITY OF MALTA

Request for Approval of Human Subjects Research
Please type, or print legibly with black pen. You may follow this format on separate sheets or use additional pages if necessary.

FROM: *(name, address for correspondence)* Loredana Muscat, [redacted] **TELEPHONE:** [redacted] **E-MAIL:** [redacted] **COURSE AND YEAR:** Ph.D Faculty of Health Sciences 2014	**PROJECT TITLE:** Reading development in Maltese children and young adults with Down Syndrome.
ANTICIPATED FUNDING SOURCE: Personal funding	**FACULTY SUPERVISOR'S NAME:** Professor Helen Grech
DURATION OF ENTIRE PROJECT: from Feb 2014 to Feb 2020	

1. **Please give a brief summary of the purpose of the research, in non-technical language.**

The aim of the study is to investigate aspects of reading development of Maltese children and young adults with Down Syndrome (DS). Data on reading development and skills of Maltese children with DS is very scarce and what is currently available is focussed on a small sample population and on specific components of reading skills (e.g., Wirth, 2008). Locally, individuals with DS are being exposed to different methods of reading instruction and to date we do not know which methods are effective.

The objectives of the study are to investigate aspects of pre-reading and reading skills in Maltese children and young adults with DS. More specifically, the participants' skills in Non-word reading, phonological awareness, visual perceptual processing and early literacy skills will be assessed and compared with those of typically developing individuals who will be matched in terms of spoken language skills, cognitive abilities, maternal level of education, language use, geographical area and school which each student attends.

An additional objective is to investigate what reading strategies are appropriate for children and young adults with DS.

This is Phase 2 of the study. Ethical approval for Phase 1 was received on 8/10/14 ref: 177/2014. Original Assessment forms can also be found in the original application.
Attached to this document are: Consent Forms, Letter of Information and permissions from institutions related to data collection from Typically Developing children.

2. Give details of procedures that relate to subjects' participation
(a) How are subjects recruited? What inducement is offered? ***(Append copy of letter or advertisement or poster, if any.)***

The recruitment process will take place in 2 phases

Phase 1: Recruitment of students with Down Syndrome.
This process has been completed.

Phase 2: Recruitment of typically developing children (TD) to act as control group.

TD students will be recruited from State Schools and Church Schools. The process will be carried in the following way; the researcher will contact the head of school and inform him/her that a number of students will be invited to take part in the study. The researcher will provide an information letter (Appendix A) and a consent form to the head of school (Appendix B). The head of school will forward the letters and forms to potential students. The head of school will then contact the researcher if any consent forms have been returned.

Permissions from School authorities (Appendix C), College Principals (Appendix D) and Head of Schools (Appendix E) are attached.

If more than 70 students are identified, the researcher will ask the head of school to randomly pick the number of students needed from that particular school. The other students will not be contacted by the researcher.

The assessment sessions will be carried out at school in any place deemed appropriate by the head of school. A small incentive ie. a book token will be given to all the participants.

(b) Salient characteristics of subjects—number who will participate, age range, sex, institutional affiliation, other special criteria:

For Phase 2 of the study, 70 TD students will be recruited. Students conforming to the following criteria will be included in the study.

- Maltese or English as the first Language. The TD will be matched to participants with DS according to their primary language use.
- Maltese citizens
- No sensory impairment. A screening test for hearing to check the hearing acuity of participants will be carried out by the researcher during the session.
- Cognitive age of at least 4 years of age, as measured on The Raven's Coloured Progressive Matrices Test (Raven, J.C., Court, J.H. & Raven, J.C. ,1990)
- No learning and/or reading difficulties. This will be determined by asking the teacher or head of school to identify participants with no history of learning/and or reading difficulties.

Agius (2012)

- Early Literacy Questionnaire adapted and translated with permission from the author (Boudreau, 2005). These questions will be asked to parents/carers.
- Test of English Non-Word Repetition & Test of Maltese Non-Word Repetition (Calleja, Unpublished) The students will have to repeat words.

These assessments are the same tests used in Phase 1 with participants with DS. All relevant permissions to use these tests have been included as attachments in the Ethics Form for Phase 1.

(e) Which of the following data categories are collected?

Data that reveals – race or ethnic origin	YES / NO
political opinions	YES / NO
religious or philosophical beliefs	YES / NO
trade union memberships	YES / NO
health	YES / NO
sex life	YES / NO
genetic information	YES / NO

3. How do you explain the research to subjects and obtain their informed consent to participate? (If in writing, append a copy of consent form.) If subjects are minors, mentally inform, or otherwise not legally competent to consent to participation, how is their assent obtained and from whom is proxy consent obtained? How is it made clear to subjects that they can quit the study at any time?

The parents/carers of the participants will be informed in writing. The parents/carers will also inform the participants about the research. It will be made clear to both parents and students that they can quit the study at any time, both in writing and during the first meeting. Special consent forms for minors will be presented to the students (Appendix B).

(c) Describe how permission has been obtained from cooperating institution(s)—school, hospital, organization, prison, or other relevant organization. *(Append letters.)* Is the approval of another Research Ethics Committee required?

State Schools: The researcher obtained permission to recruit students through state schools by first applying for permission through the Research and Development Unit. Secondly College Principals and Head of Schools were contacted and their permission was requested. Not all schools granted their permission. Permissions have been granted from the following schools (permissions attached); Naxxar Primary, Rabat Primary, Kirkop Primary, Mosta Primary, Floriana Primary. The other schools which have not granted their permission will not be included in the study.

Church Schools: Permission from Malta Diocese was obtained. Additionally permission from the Head of Schools was also requested and obtained from the following schools; St. Albert The Great College, Archbishop's Seminary Malta.

Independent Schools: Permission from the Head of Schools was requested however no school gave consent therefore no collection of data will be carried out in Independent Schools.

(d) What do subjects do, or what is done to them, or what information is gathered? (Append copies of instructions or tests or questionnaires.) How many times will observations, tests, etc., be conducted? How long will their participation take?

The researcher will meet the students once. The assessment sessions will take approximately 1 hour. The researcher will discontinue testing if any informant shows signs of fatigue or indicate that s/he wishes to discontinue the session. The following tests will be administered:

- Test of Visual-Perceptual Skills (non-motor), Third Edition (Martin, N. 2006) During this test the participants will have to point to images and shapes.

- *Language Assessment for Maltese Children* (Phonological Awareness) (Grech, H., Franklin, S., & Dodd, B., 2011) The test includes the following tasks:
  Syllable counting – the student will be asked to clap the number of syllables.
  Rhyme awareness – the student will be asked to identify which word does not rhyme.
  Identification of first sound – the student will be asked to say what is the first sound of each word.
  Phoneme Segmentation- the student will be asked to segment words into individual sounds.
  Sound to letter conversion – the students will be asked to say the sound of the printed letters.
- Non Word Reading Test (Agius 2012) – the students will have to read a list of words.

- Phoneme Decoding Efficiency Test from TOWRE (Torgesen, Wagner & Rashotte, 1999) – for students with English as primary language. The students will be asked to read a list of words in English. This has been standardised on TD Maltese children by

4 .Do subjects risk *any* harm—physical, psychological, legal, social—by participating in the research? Are the risks necessary? What safeguards do you take to minimize the risks? No the subjects do not risk any harm. The participants will only need to repeat words or respond to questions verbally or non-verbally.
5. Are subjects deliberately deceived in *any* way? If so, what is the nature of the deception? Is it likely to be significant to subjects? Is there any other way to conduct the research that would not involve deception, and, if so, why have you not chosen that alternative? What explanation for the deception do you give to subjects following their participation? No, the subjects are not deceived
6. How will participation in this research benefit subjects? If subjects will be "debriefed" or receive information about the research project following its conclusion, how do you ensure the educational value of the process? *(Include copies of any debriefing or educational materials)* Both institutions and participants will be given a summary of the research results at the end of the study. This study can possibly yield significant results that will improve quality of life and enhance reading skills of individuals with DS. Teachers/educational staff can gain more

information about how reading develops in students with DS and what are the appropriate methods of reading instruction to be used.

TERMS AND CONDITIONS FOR APPROVAL IN TERMS OF THE DATA PROTECTION ACT

- Personal data shall only be collected and processed for the specific research purpose.
- The data shall be adequate, relevant and not excessive in relation to the processing purpose.
- All reasonable measures shall be taken to ensure the correctness of personal data.
- Personal data shall not be disclosed to third parties and may only be required by the University or the supervisor for verification purposes. All necessary measures shall be implemented to ensure confidentiality and where possible, data shall be anonymised.
- Unless otherwise authorised by the University Research Ethics Committee, the researcher shall obtain the consent from the data subject (respondent) and provide him with the following information: The researcher's identity and habitual residence, the purpose of processing and the recipients to whom personal data may be disclosed. The data subject shall also be informed about his rights to access, rectify, and where applicable erase the data concerning him.

I, the undersigned hereby *undertake* to abide *by* the terms and conditions for approval as *attached to this application*.

I, the undersigned, also give my consent to the University of Malta's Research Ethics Committee to process my personal data for the purpose of evaluating my request and *other matters related to this application*. I also understand that, I can request in writing a copy of my persona[redacted]also request rectification, blocking or erasure of such personal da[redacted]cessed in accordance with the Act.

Signature: [redacted]

APPLICA[redacted] DATE 22/9/15	**FACULTY SPONSOR'S SIGNATURE** I have reviewed this completed application and I am satisfied with the adequacy of the proposed research design and the measures proposed for the protection of human subjects. DATE [redacted] 22/9/2015

ATTACHMENTS:

Information Letter
Consent Forms
Permission from Institutions
Permission from College Principals
Permission from Head of Schools

Return the completed application to your faculty Research Ethics Committee

Appendix F

Ethical Request for Phase 3 and Phase 4

Request for Additional data for Ph.D research

Loredana Muscat <loredana.muscat.02@um.edu.mt>
To[redacted], [redacted]
Cc: [redacted]

Dear Dr Pace Parascandolo,

As part of my Ph.D research 'Reading development in children and young adults with Down Syndrome' I have requested permission to collect data in 2 Phases; Phase 1: Approval to recruit and research students with Down Syndrome (Reference no. 177/2014, approval is attached), Phase 2: Approval to recruit and research typically developing students who matched DS (Reference no. 001/2016, approval is attached). During my M.Phil. to Ph.D. transfer viva voce, it has been recommended that I include an additional test in my assessment protocol, i.e., a Word Reading Test. No change in the participants was required; nor was there a need to change the conditions of the data collection process. It has also been recommended to include Reliability testing; therefore, some participants need to be reassessed on the same assessment protocol. I would like to request permission for this tool to be included as part of my assessment battery and to have phase 3 of the data collection process, whereby the Maltese Word Recognition Test is administered to those participants who were identified in the earlier stages as being eligible.

Whilst thanking you for your time, I await further instructions,

Yours sincerely,

Loredana Muscat

Appendix G

Ethical Request for Phase 5

Rita Pace Parascandalo [redacted] [redacted]
to me, Research, Helen

Images are not displayed. Display images below - Always display images from [redacted]

Dear Loredana,

your recently submitted amendments as requested by FREC have been reviewed and all issues have been adequately addressed. You are granted approval for your study oBo FREC and may proceed with your study and collect the data.

Good luck

Regards
Dr Rita PP

Dr Rita Pace Parascandalo PhD (UCLan)
BSc(Hons) (Melit.), MSc(Melit.), RM

Senior Lecturer, Department of Midwifery

Appendix H

Permission to adapt The Home Literacy Questionnaire (Boudreau, 2002)

Gmail

Loredana Muscat <lo[redacted]

Permission for Adaptation

3 messages

Loredana Zahra <[redacted] 13 January 2013 at 14:32
To: [redacted]

Dear Profs. Boudreau,

I am a Speech-Language Patholoist currently in the process of commencing research for a Ph.d. within the University of Malta. My study will focus on the development of reading skills in Maltese children with Down Syndrome. Throughout this study I will also investigate the reading environment of the children with Down Syndrome.

I am seeking your permission to use your questionnaire from: **Use of a Parent Questionnaire in Emergent and Early Literacy Assessment of Preschool Children** Boudreau, Donna *Language, Speech & Hearing Services in Schools;* Jan 2005; 36, 1; ProQuest Education Journals.pg. 33 .

I also seek your permission for adapting part of this questionnaire to suit the need of my research. The questionnaire will be adapted to the Maltese language.

Thanking your for your time,

Yours Sincerely,

Loredana Muscat

Boudreau, Donna <Donna.Boudreau@unco.edu> 14 January 2013 at 19:10
To: Loredana Zahra <[redacted]

Dear Loredana,

Certainly! I would appreciate it if you would maintain some indication of original authorship on your revision.

Best,

Donna Boudreau

From: Loredana Zahra [lor.zahra@gmail.com]
Sent: Sunday, January [redacted]
To: Boudreau, Donna
Subject: Permission for Adaptation

[Quoted text hidden]

Loredana Zahra <lor.zahra@gmail.com> 14 January 2013 at 21:57
To: "Boudreau, Donna" <Donna.Boudreau@unco.edu>
[redacted]

Dear Profs. Boudreau,

Thank you for you acknowledgement. I will definetly indicate original ownership.

Yours sincerely

Loredana Muscat

Appendix I

Adapted version of The Home Literacy Questionnaire

Home Literacy Environment Questionnaire

Adapted with permission from the Early Literacy Questionnaire (Boudreau, 2005[1]).

Name of Student: ____

Code number: (for administration) ____

Date of Completion: ____

Date of Birth of Student: ____

Adult completing the questionnaire ____

Job/Profession of adult ____

Instructions:

Please answer as many questions as possible. Answer by circling your reponse on the scale provided and filling in the information in the space provided. Participants are not expected to develop all the skills mentioned in the questionnaire and may demonstrate other skills which are not included in the questionnaire.

[1] Boudreau, (2005). Use of a parent questionnaire in emergent and early literacy assessment of preschool children. *Language Speech and Hearing Services in Schools*, 36, 1, 33 – 47.

Educational Background

1.Does the student attend school? If yes, what year are they in?

____

2.Does your child have additional support at school? If yes, what support do they have? (E.g. LSA)

____

3.Does your child receive any type of additional therapy at the moment? If yes, please state the therapy being received.(E.g. Speech Therapy, Occupational Therapy)

____

____

Language Background

4.Which language/s does your child use at home?

Maltese ☐ English ☐ Both ☐

5.Which language/s does your child use at school?

Maltese ☐ English ☐ Both ☐

6.Which language does he prefer to watch tv or videos in?

Maltese ☐ English ☐ Italian ☐ Other: ______________

7.If s/he reads, which language/s do they read in?

Maltese ☐ English ☐ Both ☐

8.In which language are they better at reading?

Maltese ☐ English ☐ Doesn't read yet ☐

9.When reading to your child, are most books in Maltese or English?

Maltese ☐ English ☐ Other:_______________

Reading Books

10. Does your child ask you to read to him/her?

1	2	3	4
Never/Rarely	On occasion	Daily Several times a day	

11. How often do you read to your child?

1	2	3	4
Never/Rarely	On occasion	Daily	Several times a day

12. Does your child point independently to or talk about pictures when you read stories?

1	2	3	4	5
Not currently	Has but rarely	Occasionally	A few times per story	Very Frequently

13. Do you attempt to teach the names of the letters in the alphabet and/or alphabet sounds when reading?

1	2	3	4		5
No Never	Rarely	Sometimes	Often	Always	

Response to Print

14. Do you point out signs and words such as restaurant names or street signs to your child? (e.g McDonald's M sign)

1	2	3	4		5	
Not currently		Have but rarely	Occasionally	Weekly		Daily

15. Does your child show interest in adult reading material? (ie. Newspaper, magazine)

1	2	3	4		5	
Never/Rarely	On occasion		Weekly	Daily		Several times per day

16. Does your child identify words in the environment? (ie. Food packing, restaurant names, labels)

1	2	3	4	5
Never/Rarely	On occasion	Weekly	Daily	Several times per day

17. Does your child read any words by sight? (words that have been memorised e.g. mum, cat)

1	2	3	4	5
Not currently	On Occasion	Knows a word	Knows several words	Knows many words

18. Did your child start reading through the use of flashcards?

Yes / No / Both flashcards and alphabet

19. How many flashcards can your child read?

0 -5 6 – 10 11 – 20 21 – 50 51 or more

20. At what age did s/he start using flashcards if he/she used any?

____

21. Are flashcards still being used? If no, why have these been stopped?

____

22. At what age did s/he start being exposed to the alphabet?

1	2	3	4	5
Pre-school	Kindergarten	Year 1	Year 2	Year 3 or later

Interest in Letters

23. Can your child read the letters of the alphabet?

Yes / No / Not all letters

24. Can your child put letters together to sound out words?

Yes / No / Not all sounds

25. Does your child write letter and/or words?

Yes / No / Some letters

Additional Questions

26. Do you have a computer or any other electronic devise such as a tablet at home?

____

27. If so, does your child use it?

____

28. Does your child use the devise independently?

____

29. Average number of hours per day or week?

____

30. What programs, applications or websites does your child use or visit?

____

Appendix J

School Literacy Environment Questionnaire

Investigating the Literacy Practices in the Classroom with Maltese students with Down Syndrome

I am Loredana Muscat and I am currently reading for a PhD in Communication Therapy. The title of the study is: LITERACY-RELATED SKILLS AND LITERACY ENVIRONMENTS OF MALTESE CHILDREN AND ADOLESCENTS WITH DOWN SYNDROME. The aim of the questionnaire is to investigate reading/literacy practices in Maltese schools when working with students with Down Syndrome.

Class Teachers and Learning Support Educators who currently have a student with Down Syndrome in their classroom are invited to take part in questionnaire.

The questionnaire is anonymous and data is available to the lead researcher and supervisors. Should you wish to terminate the questionnaire, you can do this at any time.

*Required

1. I give consent to use this questionnaire for research purposes. *

   Mark only one oval.

   - Yes
   - No

2. Are you currently working with a student with Down Syndrome in a school setting? *

   Mark only one oval.

   - Yes
   - No

Section A: Setting and Student information

3. What is your role with the student? *

Mark only one oval.

- Class Teacher
- Learning Support Educator (LSE)

4. In what school setting do you teach? *

Mark only one oval.

- State School
- Church School
- Independent School
- Resource Centre (Formerly known as Special School)

5. Which school year does the student attend? *

Mark only one oval.

- Early Years (KG2- Year1)
- Primary Years (Year 2- Year 6)
- Middle School (Year 7-8)
- Senior School (Year 9-11)
- Resource Centre: Primary Years
- Resource Centre: Secondary Years

6. How old is the student? *

Mark only one oval.

- 3 years - 5 years
- 6 years - 8 years
- 9 years - 11 years
- 12 years - 14 years
- 14 years +

7. Has the student been suspected/reported to have hearing difficulties? *

Mark only one oval.

- Yes
- No
- I am not aware of the hearing abilities of the student

8. Has the student been assessed for reading / writing difficulties by an Educational Psychologist or Literacy Specialist? *

Mark only one oval.

- Yes
- No
- I am not aware of the assessment

9. Does the student participate in a mainstream classroom /school setting? *

Mark only one oval.

- Yes
- No
- Mainstream in Resource Centre

10. If yes, approximately what proportion of the average school day does the student follow the mainstream classroom/school setting? *

Mark only one oval.

- 100%
- 80%
- 60%
- 40%
- 20%
- < 20%

11. Does the student attend other services such as NGO, CDAU or others? *

Mark only one oval.

- Yes
- No

12. What is the dominant language the child uses at school? *

Mark only one oval.

- Maltese
- English
- The student uses both languages

13. If both languages are used at school, can you give an estimate of the use of each language? *

Mark only one oval.

- 50% Maltese 50% English
- 60% Maltese 40% English
- 60% English 40% Maltese
- 70% Maltese 30% English
- 70% English 30% Maltese
- 80% Maltese 20% English
- 80% English 20% Maltese

14. What language does the student use at home? *

Mark only one oval.

- Maltese
- English
- Both
- I don't know

15. In what language is literacy instruction carried out?

Mark only one oval.

- Predominantly Maltese
- Predominantly English
- Literacy instruction is given in both Maltese and English

16. How was the language of instruction decided?

Mark only one oval.

- During an IEP
- By the Teacher
- By the Parents / Guardians
- Other: ______________________

Section B: Reading and Writing Abilities

This section will explore the reading and writing abilities of the student.

17. Does your student recognise letters of the alphabet in Maltese? (such as pointing to the letter "A" when you ask him/her to?) *

Mark only one oval.

- Not yet
- Has sometimes
- Occasionaly
- Often
- Usually always

18. Does your student recognise letters of the alphabet in English? (such as pointing to the letter “A” when you ask him/her to?) *

Mark only one oval.

- Not yet
- Has but rarely
- Occasionaly
- Often
- Usually always

19. Can the student link letter sounds to letters?

Mark only one oval.

- Yes in both Languages
- Yes in Maltese
- Yes in English
- No in both languages

20. Can the student blend letter sounds such as /m-a-r/ mar ?

Mark only one oval.

- Yes in Maltese
- Yes in English
- Yes in both Maltese and English
- No in both Maltese and English

21. If yes, what level of blending can the student achieve in Maltese?

Mark only one oval.

- Kv (ma)
- KvK (mar)
- KvKv (mama)
- Longer and more complex words

22. If yes, what level of blending can the student achieve in English?

Mark only one oval.

- CvC (dog)
- CCvC (frog)
- CvCC (lamp)
- Longer and more complex words

23. Can the student read sentences in Maltese?

Mark only one oval.

- Yes
- No

24. Can the student read sentences in English?

Mark only one oval.

- Yes
- No

25. Can the student read paragraphs in Maltese?

Mark only one oval.

- Yes
- No

26. Can the student read paragraphs in English?

Mark only one oval.

- Yes
- No

27. What level of reading comprehension does the student have in Maltese?

Mark only one oval.

- The student finds it difficult to understand the meaning of written words.
- The student can understand the meaning of single words
- The student can understand the meaning of short phrases
- The student can understand the meaning of short paragraphs
- The student can understand the meaning of a long text
- I do not know the level of reading comprehension

28. What level of reading comprehension does the student have in English?

Mark only one oval.

- The student finds it difficult to understand the meaning of written words.
- The student can understand the meaning of single words
- The student can understand the meaning of short phrases
- The student can understand the meaning of short paragraphs
- The student can understand the meaning of a long text
- I do not know the level of reading comprehension

29. Does the student read books independently in Maltese?

Mark only one oval.

- Yes
- No

30. Does the student read books independently in English?

Mark only one oval.

- Yes
- No

31. Can you give an example of a book / level that the student reads independently in Maltese?

____

32. Can you give an example of a book / level that the student reads independently in English?

____

33. Does the student pretend to read the story in a book, such as sitting with a book and producing speech that is similar to the actual story in the book?

Mark only one oval.

- Yes
- No

34. Can the student write?

Mark only one oval.

- Yes independently
- Yes but with aids (flashcards, computer, tablet)
- No

35. What are the writing abilities of the student?

Mark only one oval.

- Can write letters
- Can write words
- Can write sentences
- Can write paragraphs

36. In what language is the student better at writing?

Mark only one oval.

- Maltese
- English
- A balance between both languages

Section C: Reading instruction

This section will explore the reading instruction and intervention used with a student with Down Syndrome in a Maltese school setting.

37. What is the frequency of participation of the student in activities relating to reading instruction in the classroom?

Mark only one oval.

- Never/rarely participates
- Occasionally participates
- Participates sometimes
- Participates often

38. Please describe what reading or literacy activities he/she participates in the classroom. List a few if applicable.

39. Please describe what reading or literacy activities he/she participates in small groups. List a few if applicable.

40. Please describe what reading or literacy activities he/she participates in during one-to-one sessions. List a few if applicable.

41. How much time per week is dedicated to literacy activities?

Mark only one oval.

- Less than 30 minutes a week
- Between 1-2 hrs a week
- 3 -4 hrs a week
- More than 4 hrs a week

42. Are there activities related to reading instruction your student does not participate in?

Mark only one oval.

- Yes
- No

43. If you have answered Yes to the previous question. Please list activities that the student DOES NOT participate in.

44. Does your student take reading books home from school for home practice?

Mark only one oval.

- Never/rarely
- Occasionally
- Once a week
- Several times/week

45. Does your student receive extra help with his/her reading at school?

Mark only one oval.

- No extra help
- Occasionally extra help is given
- Extra help is given whenever reading is needed

46. If yes, what type of help does the student receive?

47. Who provides the extra help? (you can select more than 1)

Tick all that apply.

- [ ] Teacher
- [ ] LSE
- [ ] Peer help
- [ ] Complimentary Teacher

48. List some resources that are used for reading instruction.

49. Are there challenges providing reading instruction for this student?

Mark only one oval.

- Yes
- No

50. If yes, please describe what the challenges are, as well as ways you find to manage them.

51. Does the student follow an alternative programme for reading instruction?

Mark only one oval.

- Yes
- No

52. Who is responsible for planning the reading programme? (you can select more than 1)

Tick all that apply.

- [ ] Teacher
- [ ] LSE
- [ ] Early Intervention Teacher
- [ ] Speech-Language Pathologist
- [ ] Reading Specialist
- [ ] Complimentary Teacher

Other: [ ] ______________________

53. Who is responsible for implementing the programme?

Mark only one oval.

- ( ) Teacher
- ( ) LSE
- ( ) Teacher and LSE
- ( ) Teacher, LSE and Complimentary Teacher
- ( ) Complimentary Teacher
- ( ) Other: ______________________

54. What method of reading instruction is used with the student?

Mark only one oval.

- ( ) Phonic Method (for example sounding out the letter sounds)
- ( ) Look and Say (using flashcards)
- ( ) Both Methods

55. Can you give more information about the type of reading instruction if more than 1 method was used?

____

56. In your opinion, what is the best method for reading instruction for students with Down Syndrome?

Mark only one oval.

- Phonic Method (for example sounding out the letter sounds)
- Look and Say (using flashcards)
- Both Methods

Section C: Writing Instruction

In this section, methods of writing instruction will be explored.

57. Does your student participate in activities relating to writing activities in the classroom?

Mark only one oval.

- Never/rarely
- Occasionally
- Weekly
- Several times/week
- Daily Several times/day

58. If yes, please describe what activities he/she participates in.

59. How much time is spent on writing activities?

Mark only one oval.

- Less than 30 minutes a week
- Between 1-2 hrs a week
- 3 -4 hrs a week
- More than 4 hrs a week

60. Are there activities related to writing instruction your student does not participate in?

Mark only one oval.

- Yes
- No

61. If yes, please list them here.

____
____
____
____
____

Section D: Technology

In the next section, the use of technology in relation to literacy instruction will be evaluated.

62. Do you have a computer in the classroom?

Mark only one oval.

- Yes
- No

63. If yes, does your student use it for literacy training?

Mark only one oval.

- Yes
- No

64. Does the student have a tablet to use in class?

Mark only one oval.

- Yes
- No

65. What programs / website / apps are used for literacy activities?

66. Does the student use the computer for other educational activities?

Mark only one oval.

- Yes
- No

67. What programs / websites / apps are used for other educational activities?

Section E: Conclusion

68. If you have any further comments you would like to make, please do so here.

Appendix K

Testing for Normality Distribution

In the following Appendix, the results of Normality testing for the different assessment procedures will be described. The evaluation is subdivided according to the different studies.

Normality Testing for Study 1

Test of Normality for scores from Raven's Colored Progressive Matrices (RCPM)

The *Shapiro-Wilk test* indicated that scores from the RCPM in both the DS group and the TD group were normally distributed. The Histograms (Figure K1 & Figure K2) also show a normal distribution curve. *The skewness* value shows the normal distribution in both groups (DS: -0.024; TD: -0.081) since both scores range between ±1. The z scores derived from *skewnes*s confirm the normality of distribution in both groups. *Kurtosis* value and z score from kurtosis also confirm that the data was normally distributed. For all these reasons, the data from RCPM was considered to be normally distributed.

Table K1

Test of Normality for DS and TD groups for scores from RCPM

	Shapiro-Wilk			Skewness			Kurtosis		
Group	Statistic	*N*	*P*	Value	*SE*	*z*	value	*SE*	*z*
DS	0.088	42	0.2		0.363	-0.07		0.717	-1.08
TD	0.077	36	0.2	-0.026	0.393	-0.07	-0.771	0.768	-1.04

Figure K1

Histogram depicting the distribution of data on scores from RCPM for the DS group

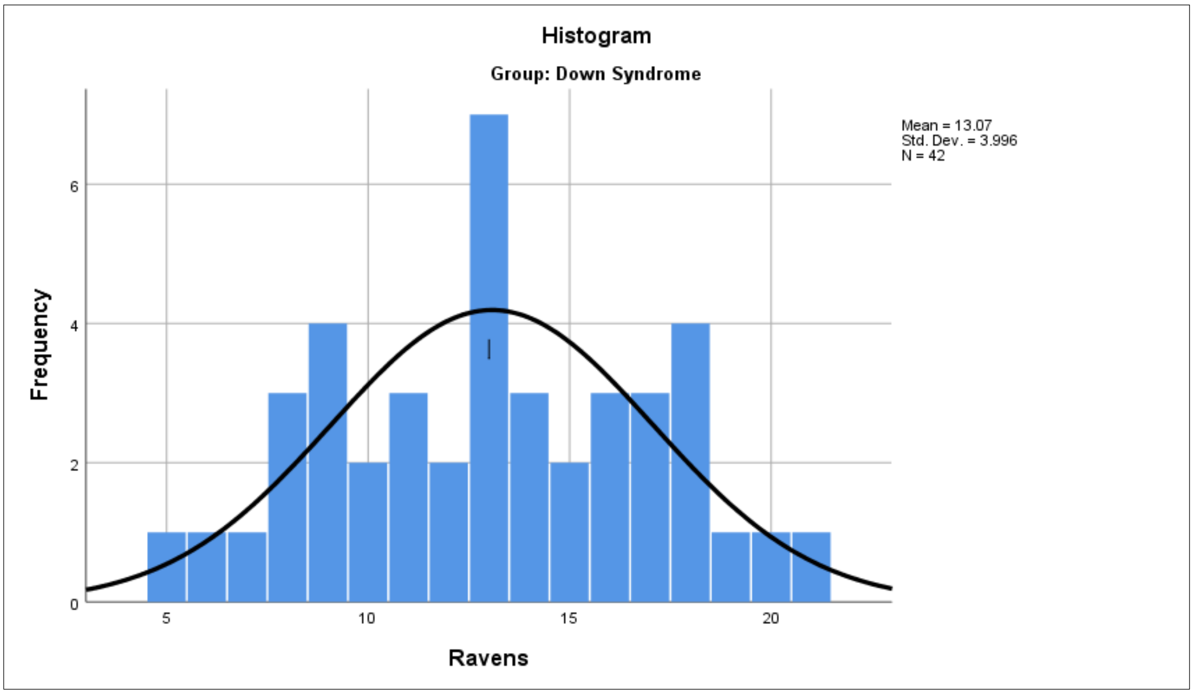
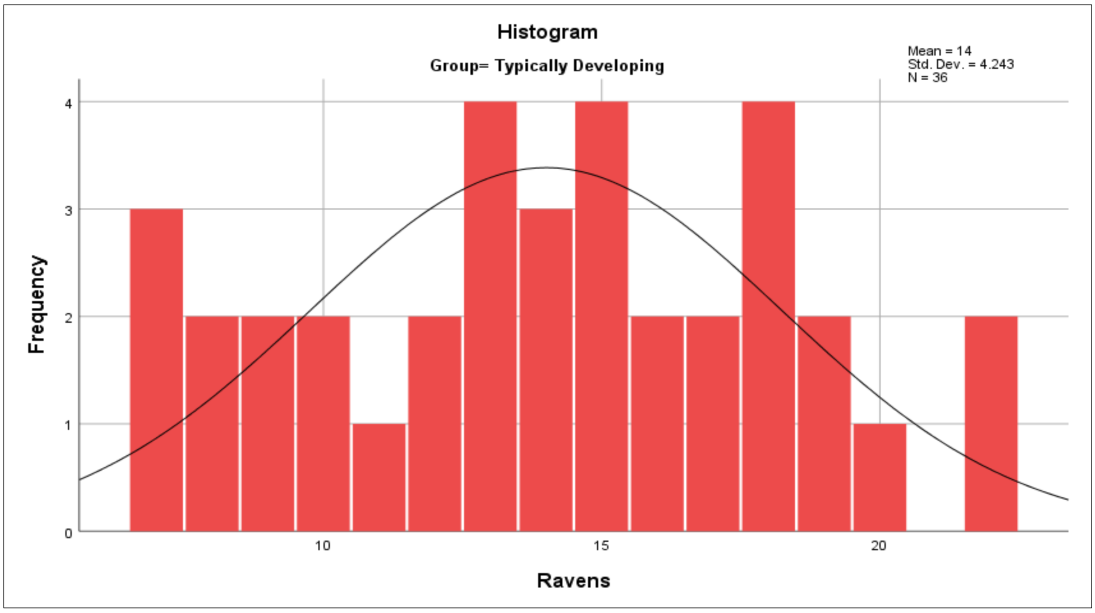


Figure K2

Histogram depicting the distribution of data on scores from Raven's Colored Progressive Matrices for the TD group



Test of Normality for Phonological Awareness Tasks

Table K2 indicates that the Shapiro-Wilk test of normality on all PA tasks in both DS and TD groups is not normally distributed since all scores are below the .05 level of significance. Further testing of normality was carried out through Skewness and Kurtosis. Results showed that skewness shows both normal and non-normally distributed data; however, when the critical value of skewness (z value) was computed, the majority of the data indicated it was non-normally distributed since the majority of the values were outside ±1.96. Mixed normality results were also given through the evaluation of kurtosis, as indicated in Table K2. The highlighted sections of the table show a distribution of non-normality. Moreover, the Histograms, which can be found here, confirm that data is not normally distributed. For all the reasons formerly mentioned, non-parametric testing was considered. The *Mann Whitney test* was used to compare PA scores between the DS and TD groups.

Table K2

Test of Normality for DS and TD groups on PA Tasks

PA Tasks	Group	Shapiro-Wilk Statistic	*N*	*P*	Skewness Value	*SE*	*Z*	Kurtosis value	*SE*	*z*
Syllable Counting	DS	.790	42	.00	.907	.365	2.74	-.592	0.717	-0.83
	TD	.696	36	.00	1.269	.393	-3.23	.087	0.768	0.11
Rhyme Awareness	DS	.759	42	.00	.920	.365	2.52	-.503	0.717	-0.70
	TD	.926	36	.019	.346	.393	0.88	-.750	0.768	-0.98
Identification of first sound	DS	.665	42	.00	.846	.365	-2.32	-1.152	0.717	-1.60
	TD	.536	36	.00	2.351	.393	-5.98	5.360	0.768	6.97
Phoneme Segmentation	DS	.812	42	.00	-.637	.365	-1.79	-1.153	0.717	-1.61
	TD	.802	36	.00	-.806	.393	-2.05	-.854	0.768	-1.11
Letter to sound conversion	DS	.670	42	.00	-1.812	.369	-4.91	2.729	0.724	3.79
	TD	.623	36	.00	-1.760	.393	-4.47	2.054	0.768	2.67

Note. *N* = number of participants; *SE* = Standard Error.

Figure K3

Histogram depicting data distribution for Rhyme Awareness in the group of participants with DS

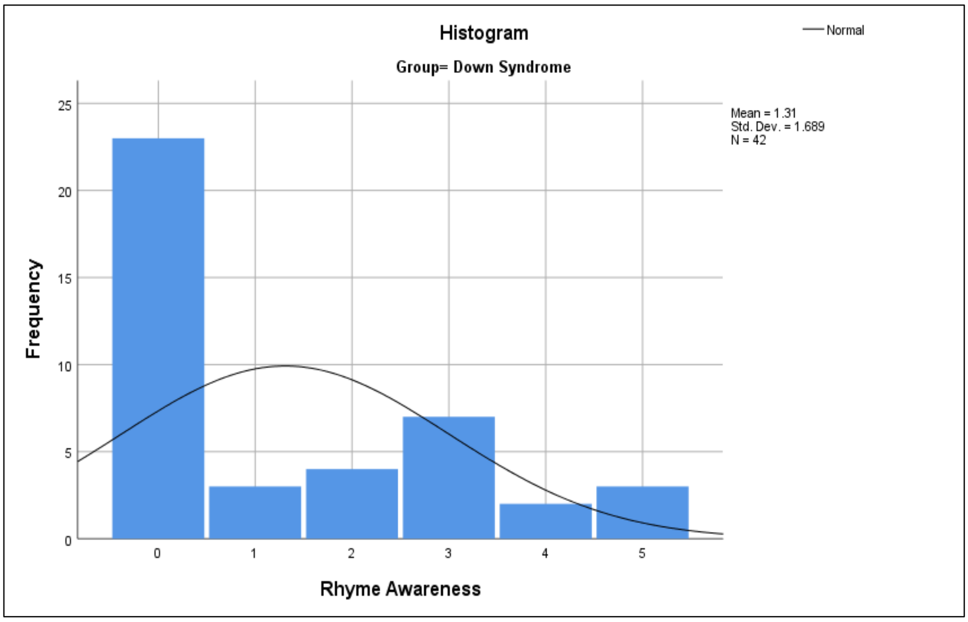


Figure K4

Histogram depicting data distribution for Identification of First Sound in the group of participants with DS

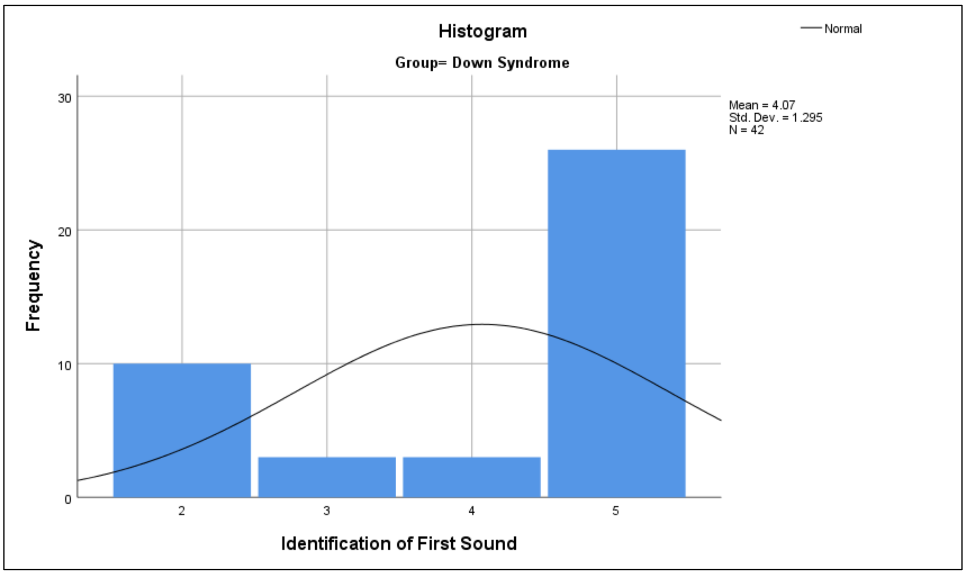


Figure K5

Histogram depicting data distribution for Phoneme Segmentation in the group of participants with DS

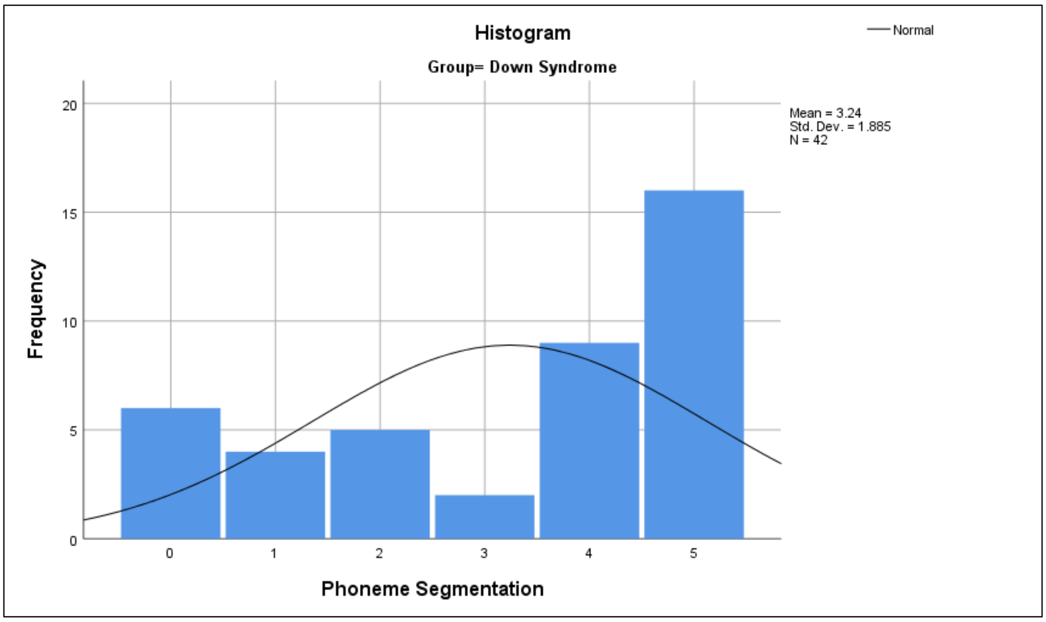


Figure K6

Histogram depicting data distribution for Phoneme Segmentation in the group of participants with DS

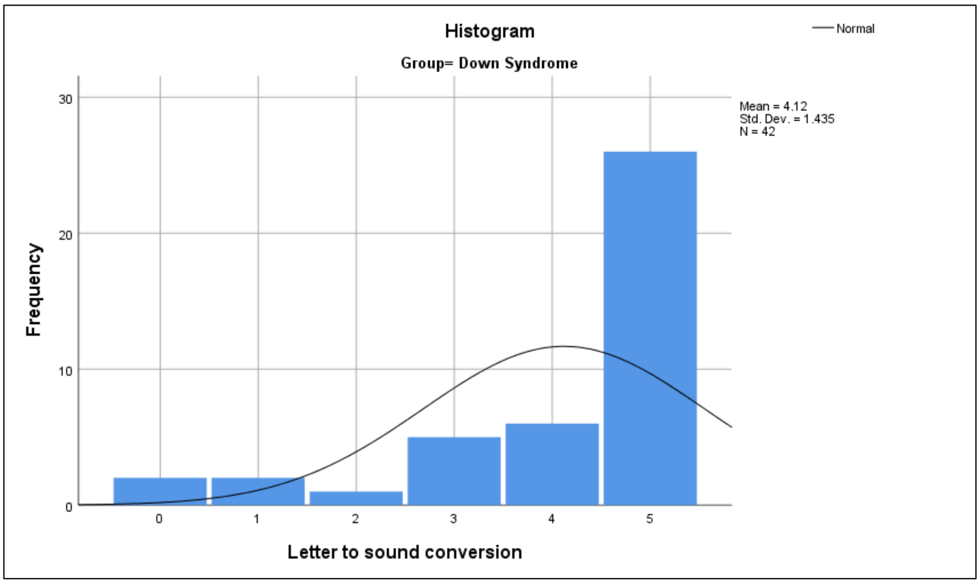


Figure K7

Histogram depicting data distribution for Syllable Counting in the control group

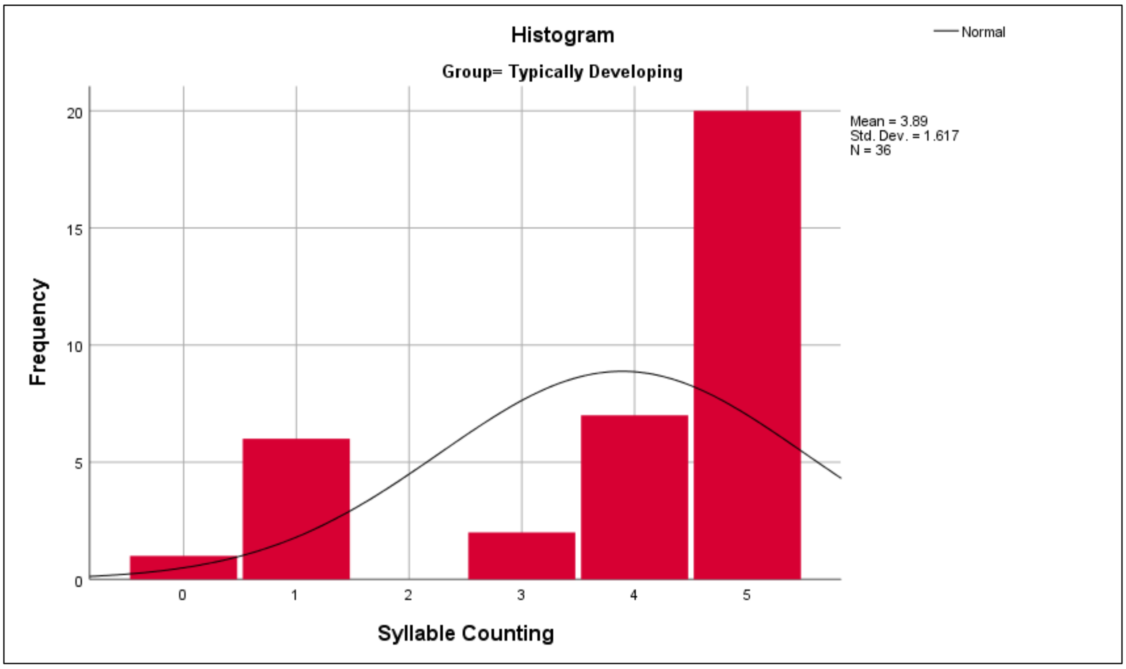


Figure K8

Histogram depicting data distribution for Rhyme Awareness in the control group

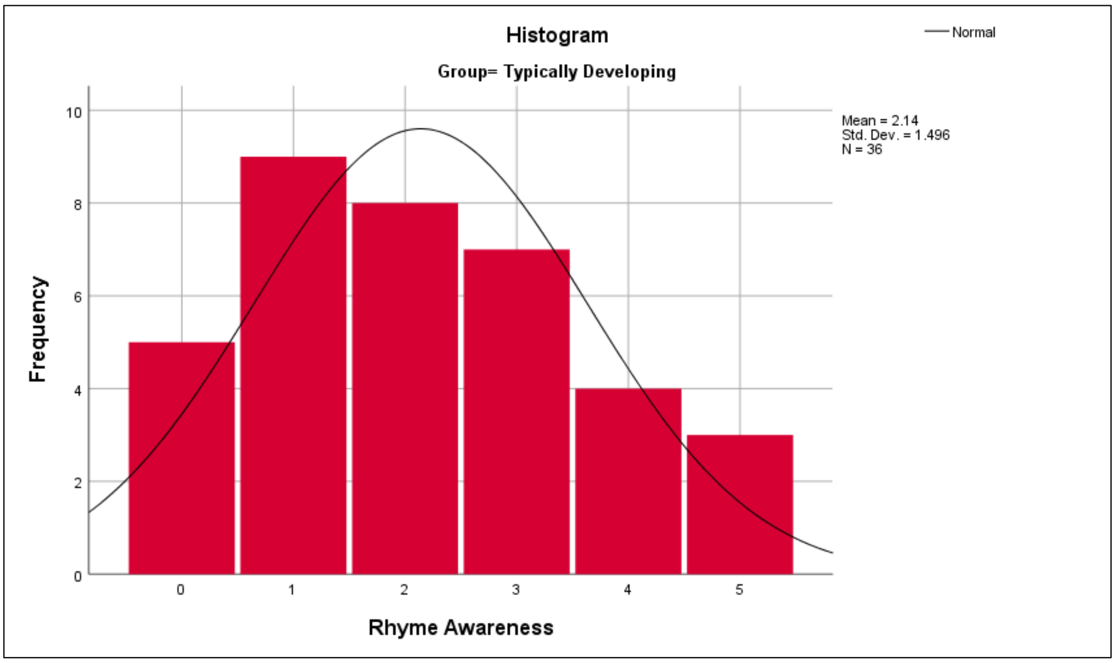


Figure K9

Histogram depicting data distribution for Identification of First Sound in the control group

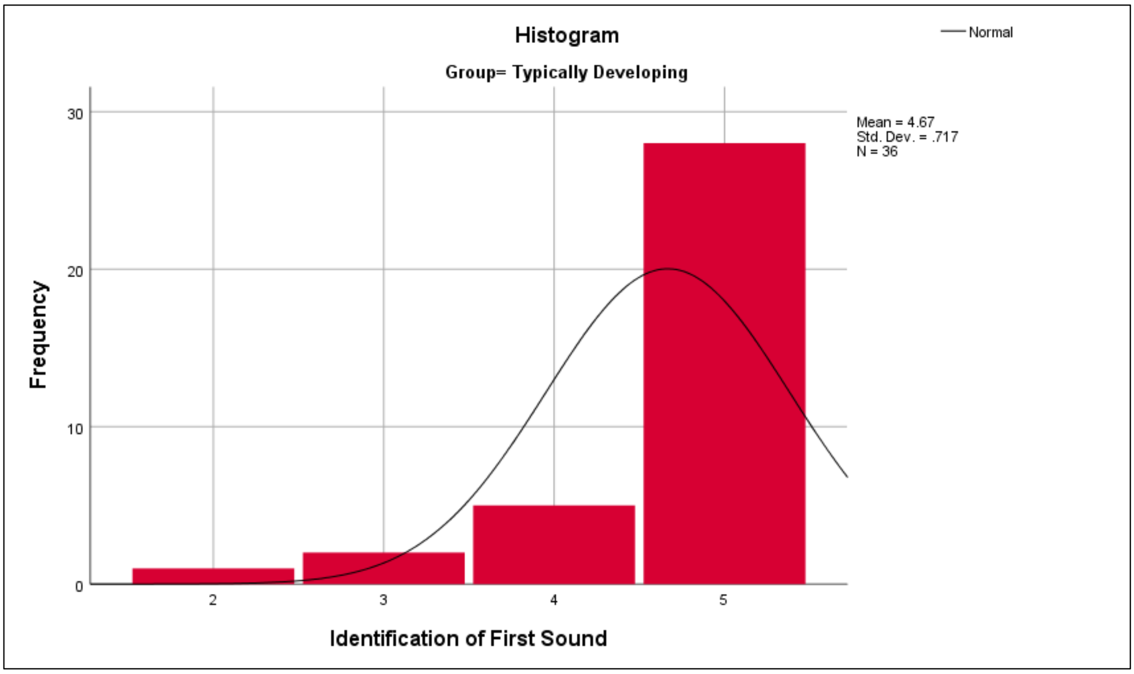
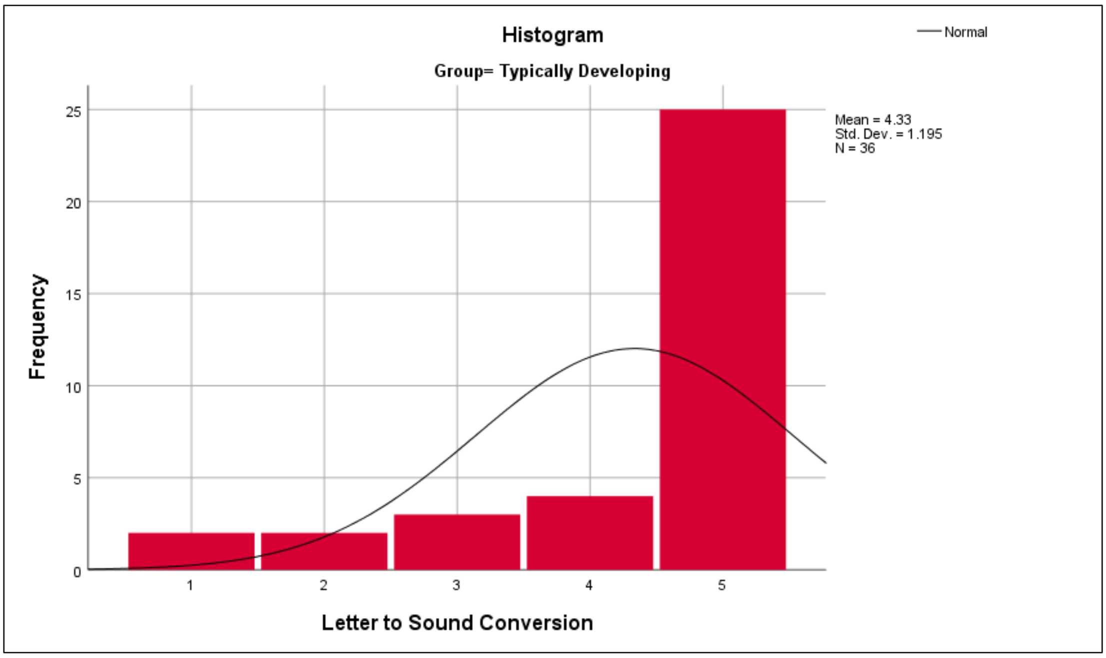


Figure K10

Histogram depicting data distribution for Letter to Sound Conversion in the control group



Test of Normality of Nonword Reading

The Shapiro-Wilk test was the first test to assess normality. The Shapiro-Wilk test of normality on Nonword Reading in both DS and TD groups indicated that data was not normally distributed. This result is represented in Table K3 hereunder. The Histograms, Figures K11 and K12, also show that the distribution is not normal. Skewness results supported the notion of non-normality since both skewness value and derived z scores portrayed a pattern of non-normality.

On the other hand, mixed results are found through kurtosis since only the DS group is non-normally distributed. However, z scores derived from kurtosis show normally distributed data. Due to the robust results obtained by the Shapiro-Wilk and the Skewness results, it has been considered appropriate and safe to consider the data as non-normally distributed.

Table *K3*

Tests of Normality for Nonword reading in DS and TD groups

	Shapiro-Wilk			Skewness			Kurtosis		
Group	Statistic	*N*	*P*	Value	*SE*	*Z*	value	*SE*	*Z*
DS	.806	42	.00	1.394	.365	3.82	1.121	.717	1.57
TD	.194	36	.002	1.357	.393	3.45	.895	.768	1.17

Figure K11

Histogram depicting the distribution of data on Nonword reading for the DS group

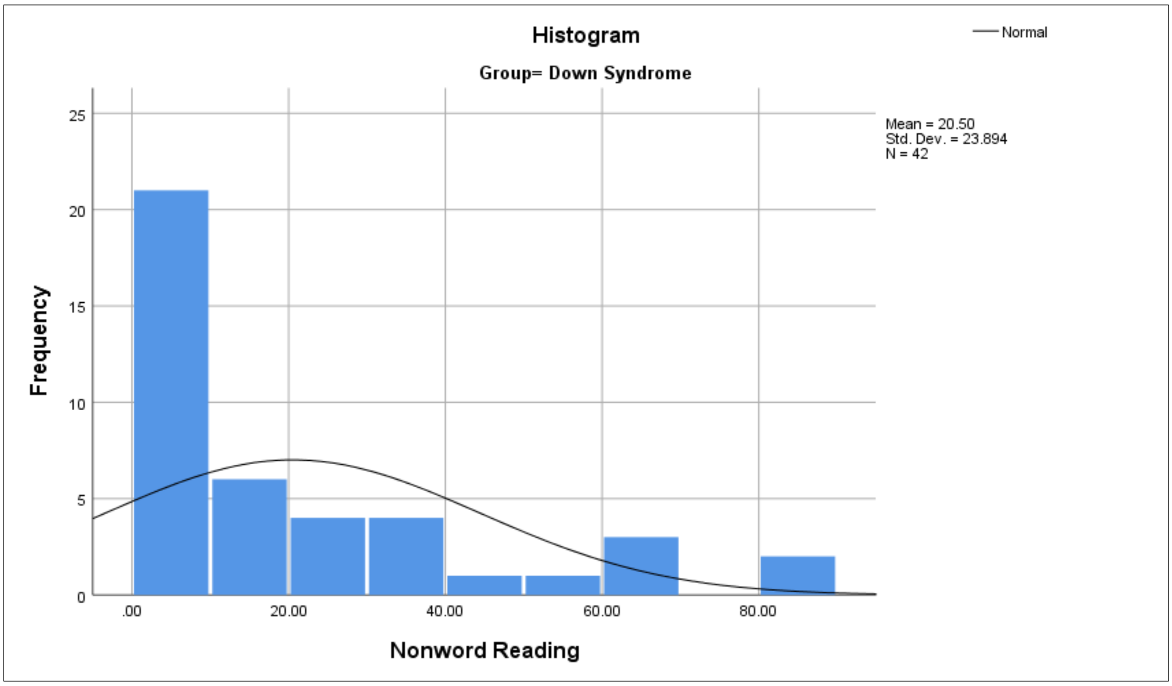
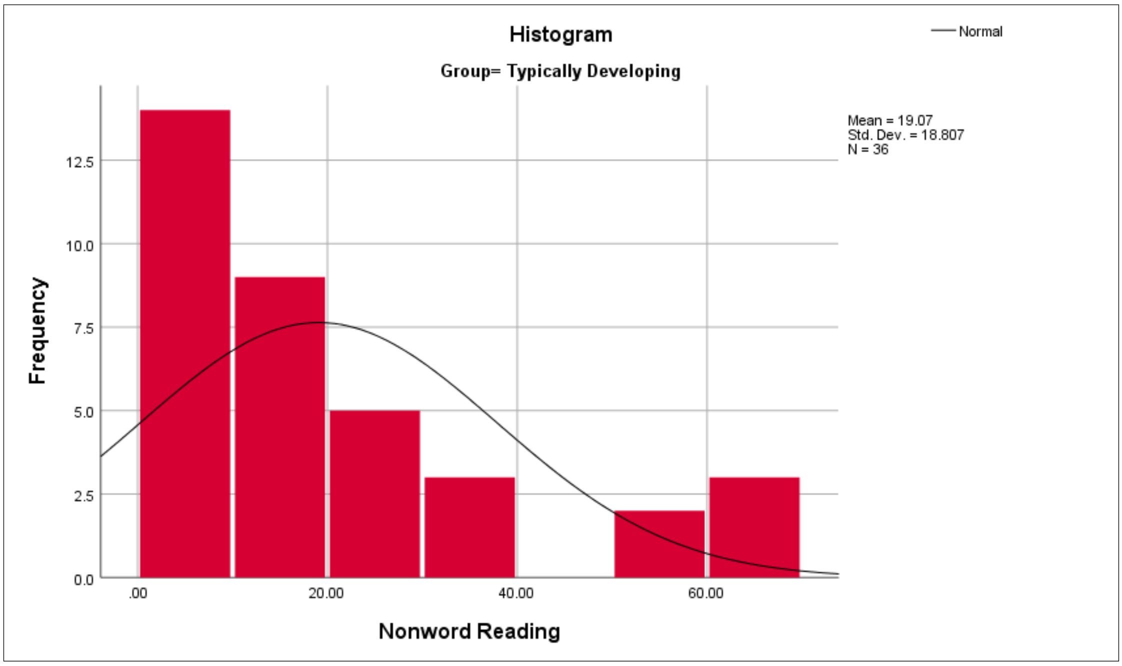


Figure K12

Histogram depicting the distribution of data on Nonword reading for the TD group



Test of Normality Sentence Imitation Task

The Shapiro-Wilk test was the first test to assess normality. Results indicated that the Sentence Imitation Task scores in the DS group were normally distributed while non-normally distributed for the TD group. However, the *p*-value of the TD group is close to the .05 level of significance (p = .039). The Histograms, Figures K13 and K14, hereunder, also showed differences in distribution; however, the histograms were not sufficiently clear to the researcher. Therefore, further tests were warranted. The skewness value showed a normal distribution in both groups (DS: -.017, TD: .454) since both scores range between ±1. The z scores derived from skewness confirmed the normality of distribution in both groups. Kurtosis value and z score from kurtosis also confirmed that the data were normally distributed. Only one score highlighted in Table K4 shows non-normality. There was a higher indication that the data are normally distributed, and parametric tests will be employed for comparisons between groups for all the reasons already highlighted.

Table K4

Tests of Normality for Sentence Imitation Task (SIT) scores in DS and TD groups

Group	Shapiro-Wilk			Skewness			Kurtosis		
	Statistic	*N*	*P*	*Value*	*SE*	*z*	*Value*	*SE*	*z*
DS	.968	42	.274	-.017	.365	-.05	-.790	.717	-1.10
TD	.936	36	.039*	.454	.393	1.16	-.694	.768	-.90

Note. *N* = number of participants; *SE* = Standard Error; *the *p*-value *of* 0.039 is the only score that indicates that data is non-normally distributed.

Figure K13

Histogram depicting the distribution of data on SIT for the DS group

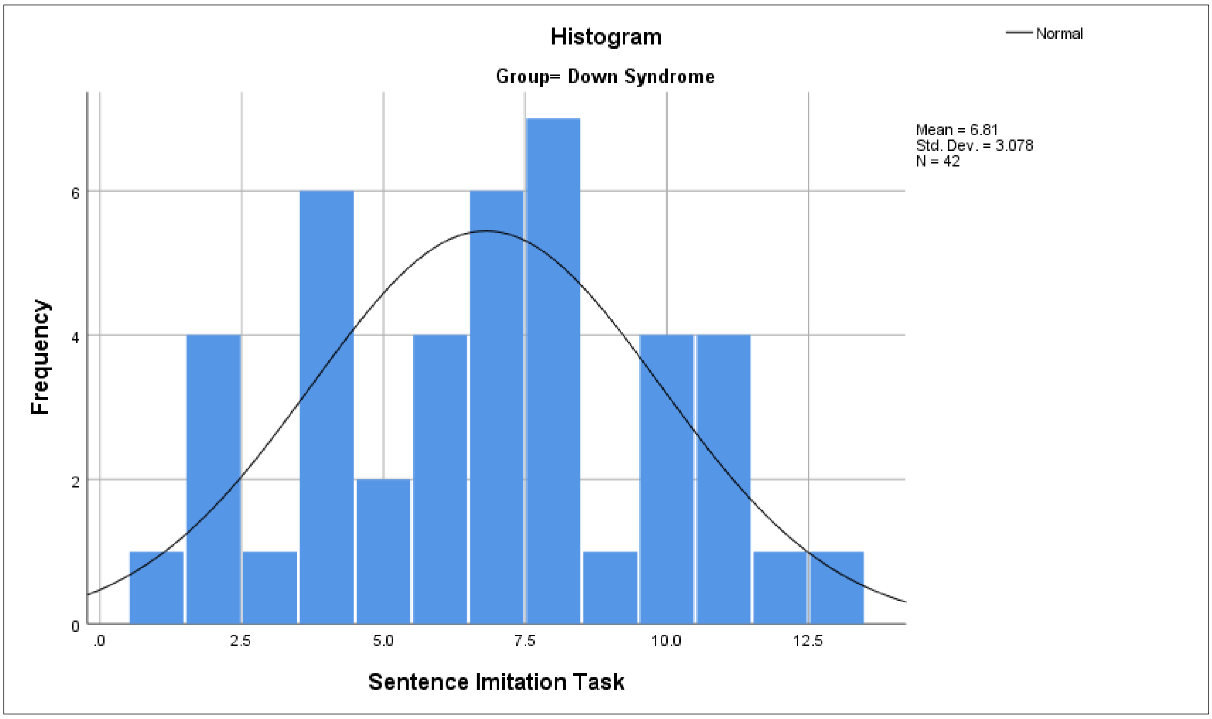
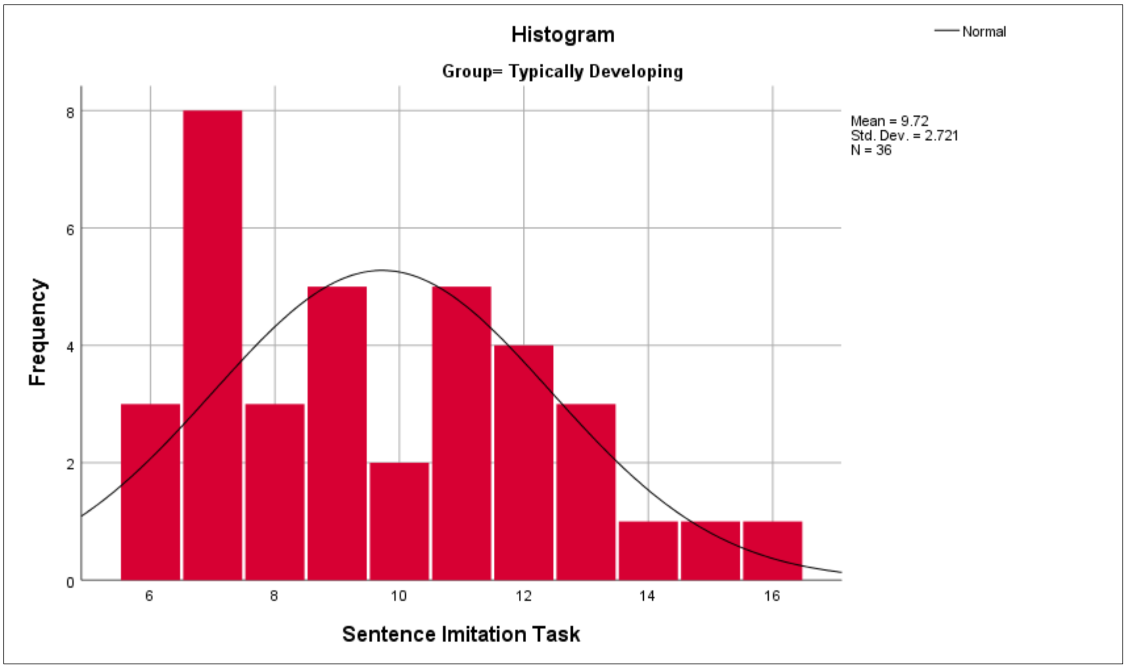


Figure K14

Histogram depicting the distribution of data on SIT for the TD group



Test of Normality for Nonword Repetition Task

Tests for normality for Nonword repetition tasks indicated that data were skewed. In this case, the Alternative hypothesis is accepted as the *p*-value is less than .05. The Histograms in Figures K15 and K16 hereunder also confirmed that data is not normally distributed. Skewness and kurtosis of the TD group confirmed that data is non-normally distributed in the TD group. However, this was not established in the DS group. The highlighted sections in Table K5 indicate that the data are non-normally distributed. Non-parametric tests and the *Mann Whitney test* were used to compare Nonword repetition scores due to the clear non-significance of the *p*-value and the shape of the histograms.

Table K5

Test of Normality for DS and TD group on Nonword repetition Task

	Shapiro-Wilk			Skewness			Kurtosis		
Group	Statistic	*N*	*P*	Value	*SE*	*z*	value	*SE*	*Z*
DS	.857	42	.00*	-.668	.365	-1.83	-1.046*	.717	-1.45
TD	.746	36	.00*	-2.085	.393	-5.31*	5.172*	.768	6.73

Note. *Scores which highlight non-normal distribution.

Figure K15

Histogram depicting the distribution of data on Nonword Repetition for the DS group

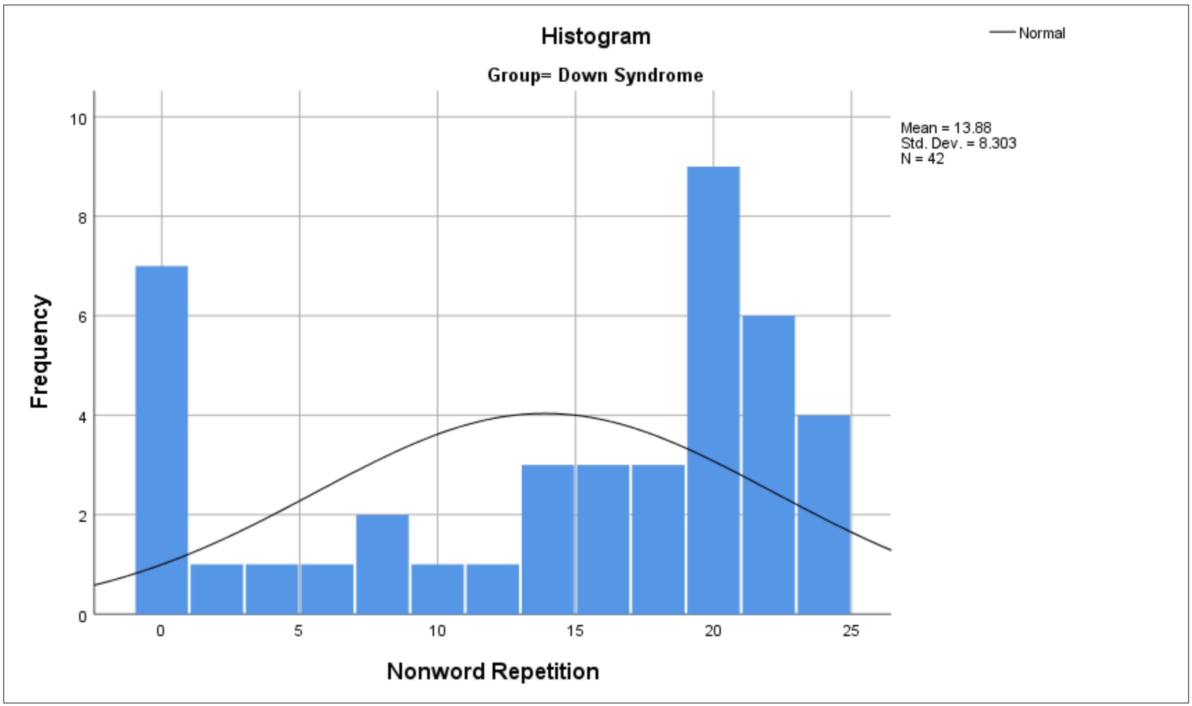
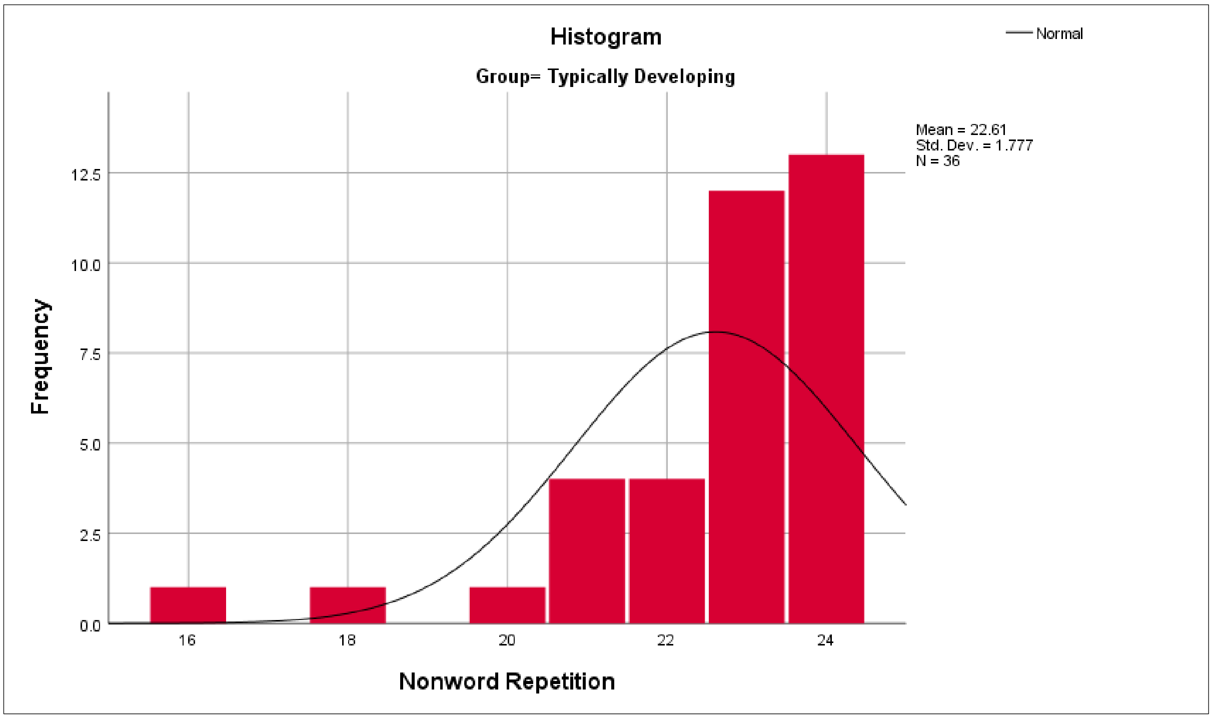


Figure K16

Histogram depicting the distribution of data on Nonword Repetition for the TD group



Test of Normality for Visual Perceptual Processing Skills

Testing normality through the Shapiro-Wilk Test on the VPPS task indicated that most of the data were skewed, except for Sequential Memory and Visual Closure in the TD group. The Histograms also confirmed that distribution was not normal. The histograms in Figures K17 – K30 Further skewness and kurtosis testing confirmed that the data were not normally distributed. Skewness and kurtosis indicated that fewer data sets are skewed. In Table J6, results that marked skewness are highlighted. Since most results from the Shapiro-Wilk test accept the alternative hypothesis that these are mostly supported by skewness and kurtosis, non-parametric tests will be used to compare the groups, even though there is mixed normality (Nahm, 2016).

Table K6

Test of Normality of DS and TD groups on Visual Perceptual Processing Tasks

		Shapiro-Wilk			Skewness			Kurtosis		
PA Tasks	Group	Statistic	*N*	*P*	Value	*SE*	*z*	value	*SE*	*z*
Discrimination	DS	.927	42	.010*	0.350	.365	.96	-0.684	.717	-.95
	TD	.700	36	.000*	2.719*	.393	6.91	10.075*	.768	13.12
Memory	DS	.821	42	.000*	2.046*	.365	5.61	7.829*	.717	10.92
	TD	.919	36	.012*	.073	.393	0.19	-1.239*	.768	-1.61
Spatial Relations	DS	.878	42	.000*	1.141*	.365	3.13	1.490*	.717	2.08
	TD	.920	36	.013*	.501	.393	1.28	-.753	.768	-.98
Form Constancy	DS	.895	42	.001*	.889	.365	2.43	.410	.717	.57
	TD	.930	36	.026*	.106	.393	0.27	-.314	.768	-.41
Sequential Memory	DS	.875	42	.000*	.688	.365	1.88	1.261*	.717	1.76
	TD	.959	36	.205	.208	.393	0.53	-.095	.768	.13
Figure-Ground	DS	.885	42	.001*	1.071*	.365	2.93	1.554*	.717	2.17
	TD	.924	36	.017*	-.502	0.393	-1.28	-.476	.768	-.62
Visual Closure	DS	.932	42	.015*	.249	.365	.68	-.283	.717	-.39
		.956	36	0.161	.321	.393	.82	.049	.768	.06

Note. *Scores that highlight non-normal distribution.

Figure K17

Histogram depicting data distribution for Visual Discrimination task in the group of participants with DS

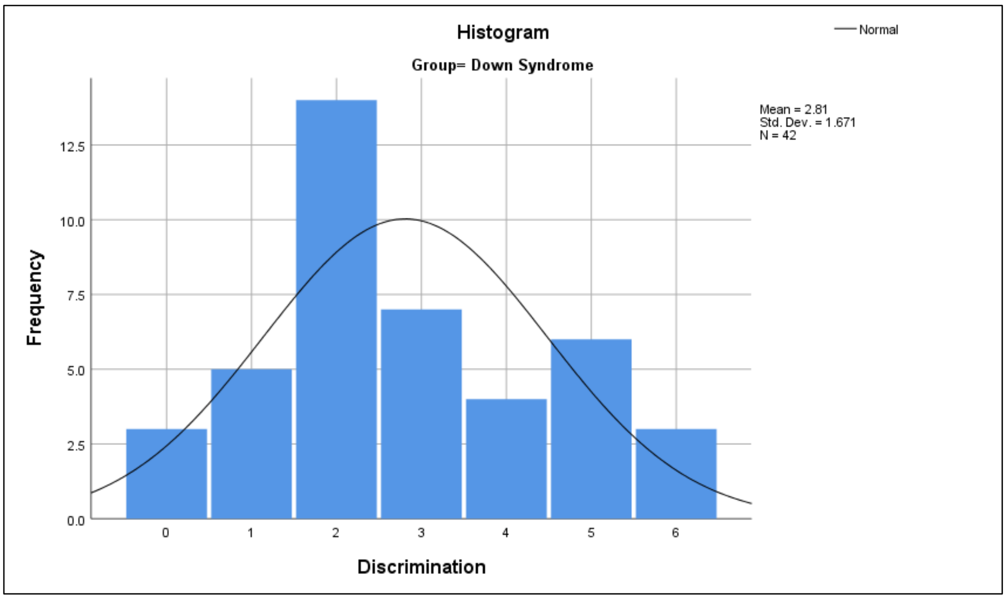


Figure K18

Histogram depicting data distribution for the Visual Memory task in the group of participants with DS

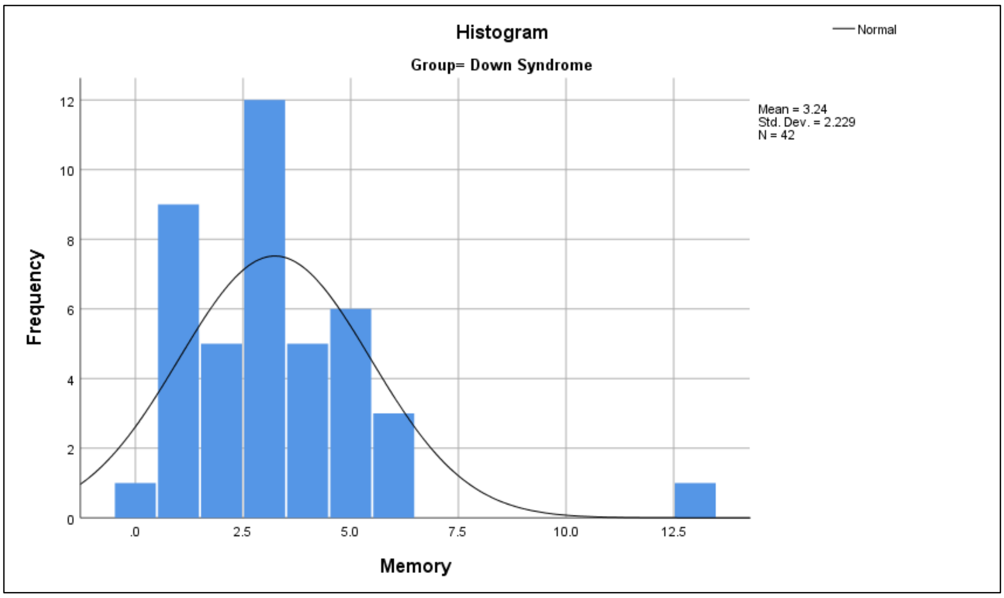


Figure K19

Histogram depicting data distribution for the Spatial Relations task in the group of participants with DS

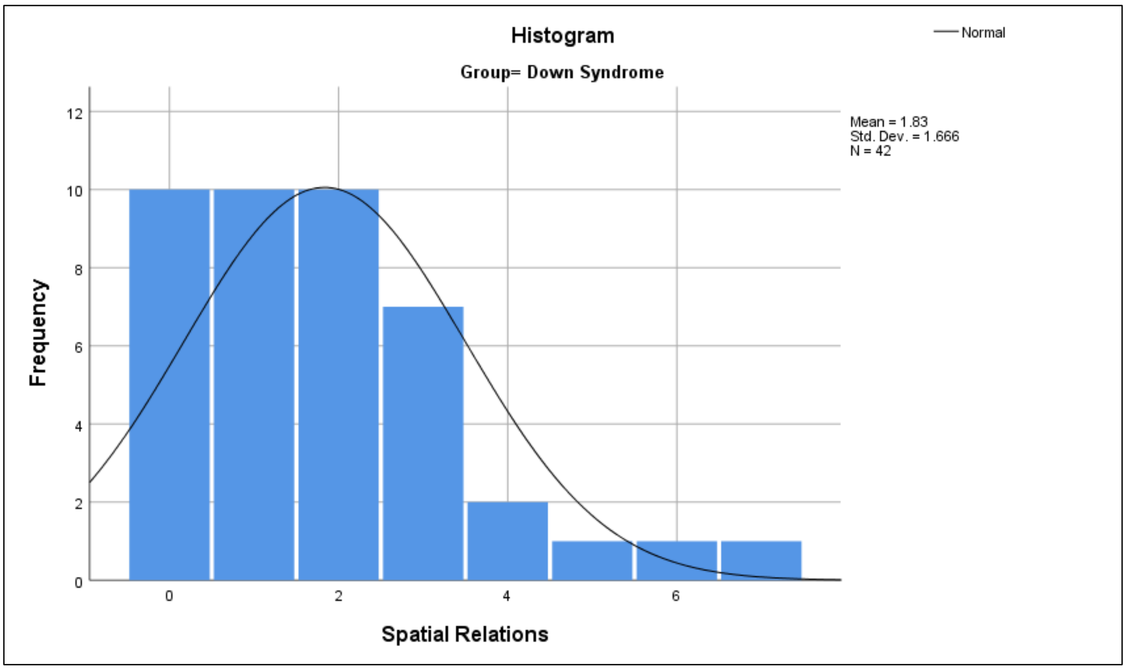


Figure K20

Histogram depicting data distribution for the Form Constancy task in the group of participants with DS

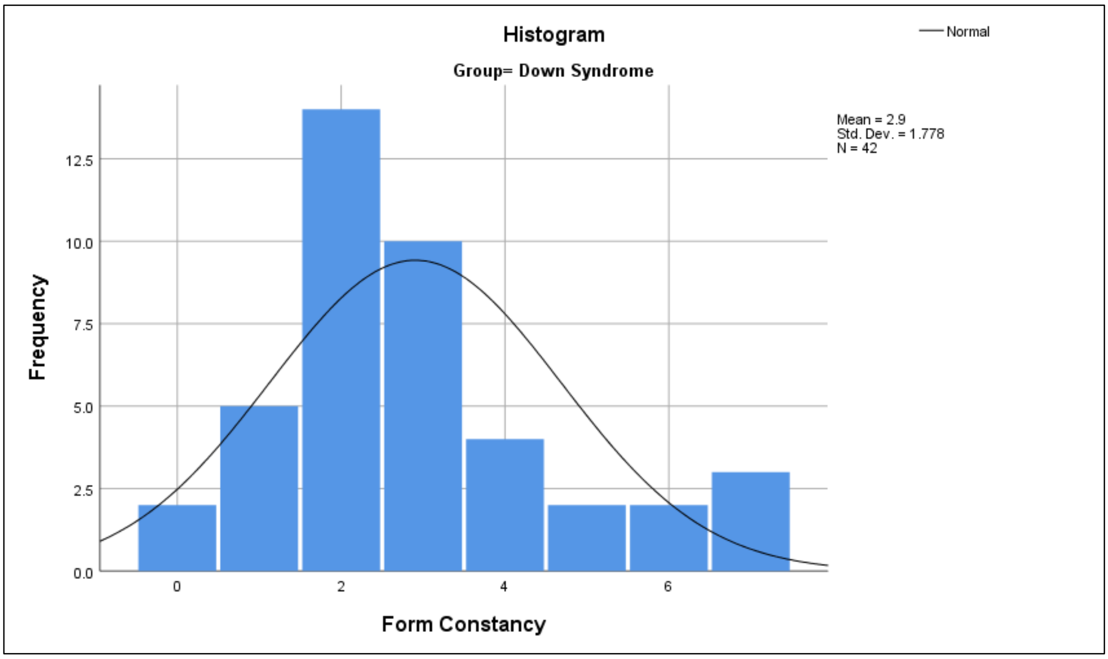


Figure K21

Histogram depicting data distribution for the Sequential Memory task in the group of participants with DS

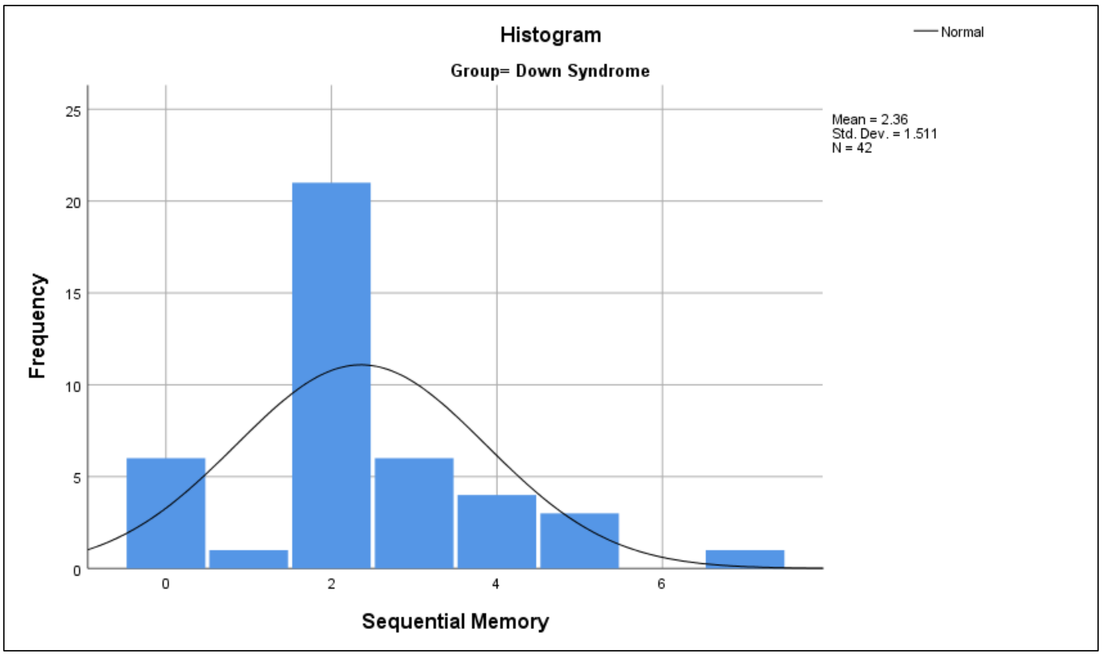


Figure K22

Histogram depicting data distribution for the Figure-Ground task in the group of participants with DS

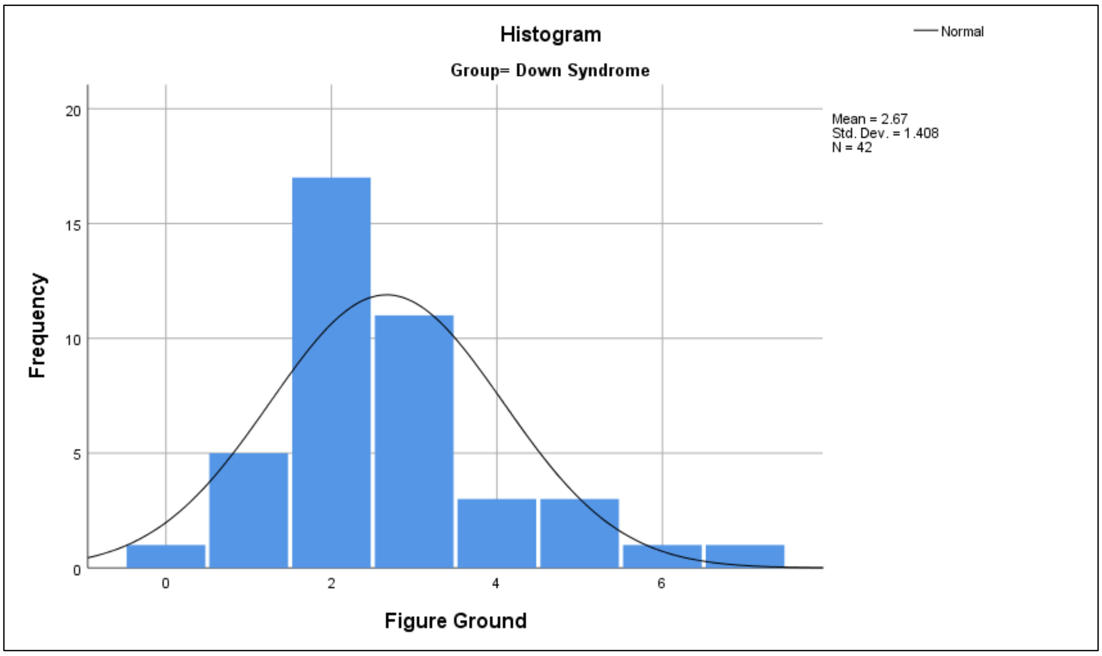


Figure K23

Histogram depicting data distribution for the Visual Closure task in the group of participants with DS

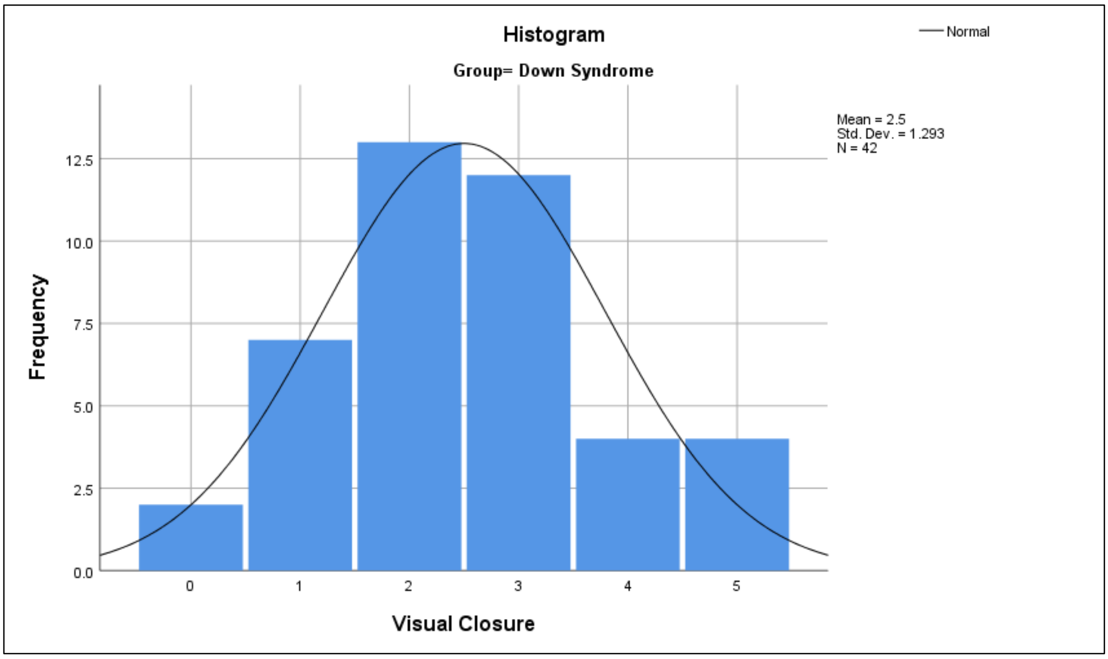


Figure K24

Histogram depicting data distribution for the Visual Discrimination task in the control group

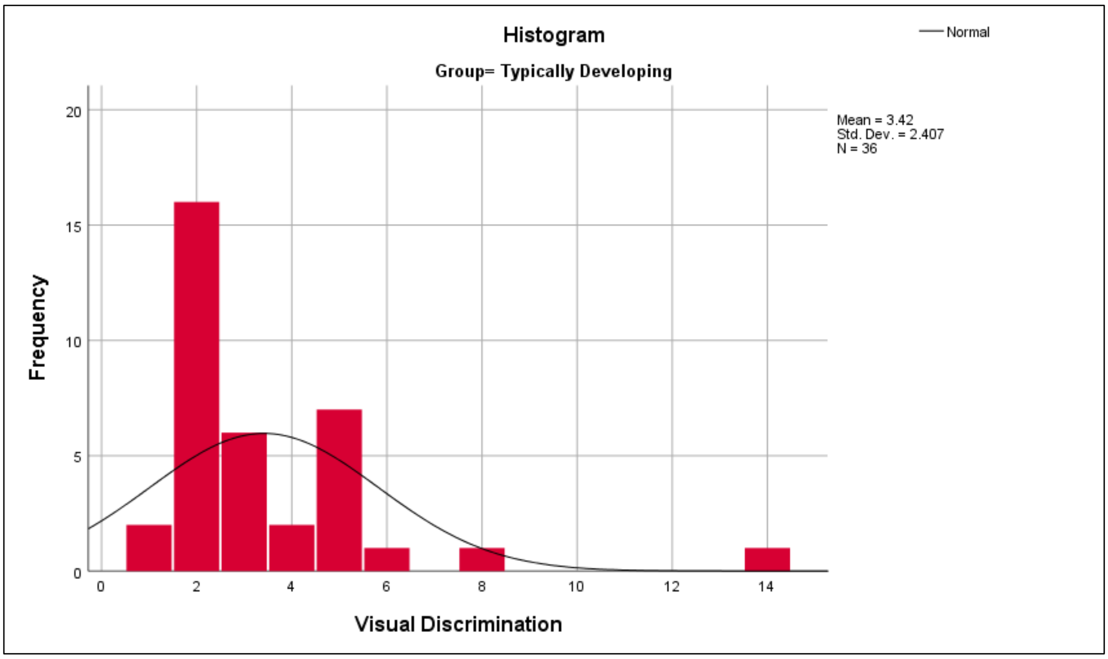


Figure K25

Histogram depicting data distribution for the Visual Memory task in the control group

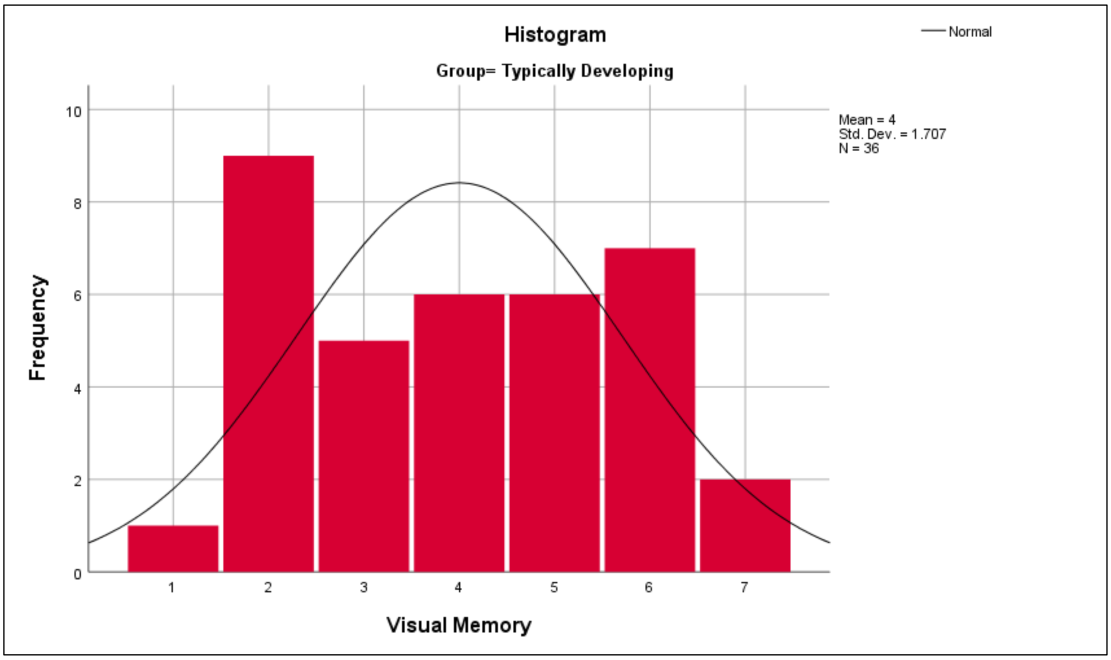


Figure K26

Histogram depicting data distribution for the Spatial Relations task in the control group

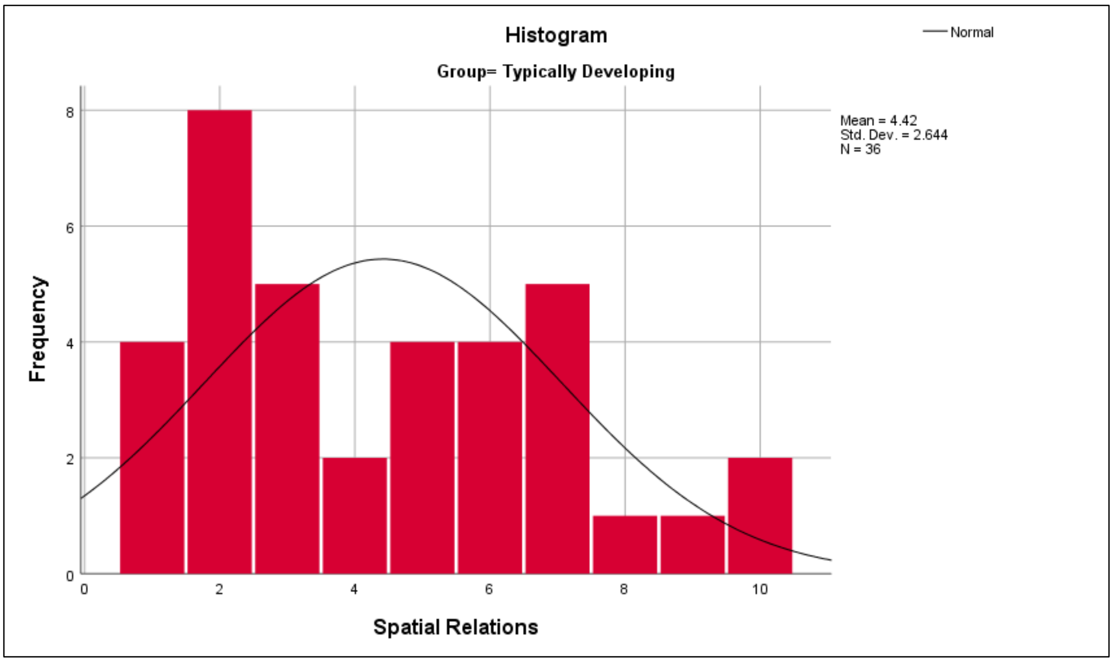


Figure K27

Histogram depicting data distribution for the Form Constancy task in the control group

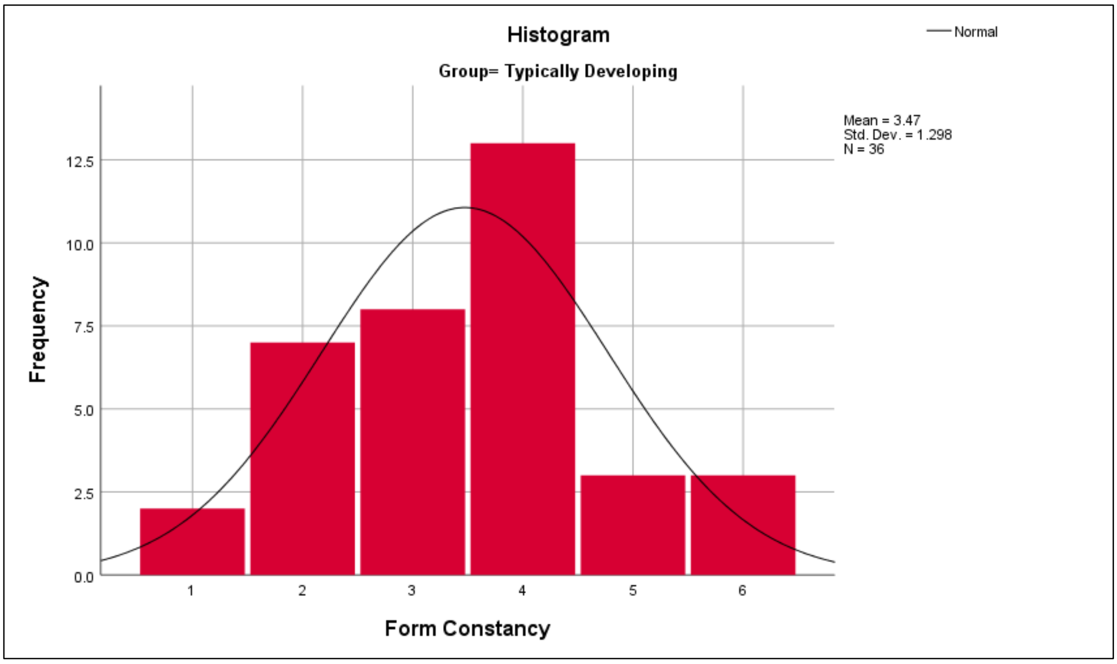


Figure K29

Histogram depicting data distribution for the Sequential Memory task in the control group

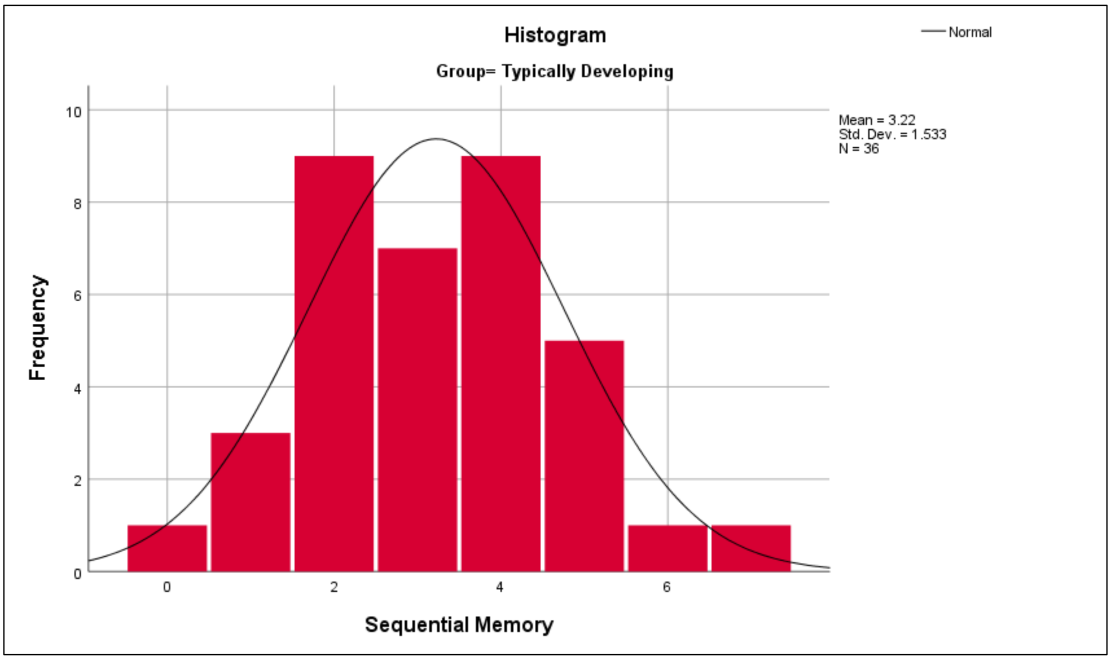


Figure K29

Histogram depicting data distribution for the Figure Ground Discrimination task in the control group

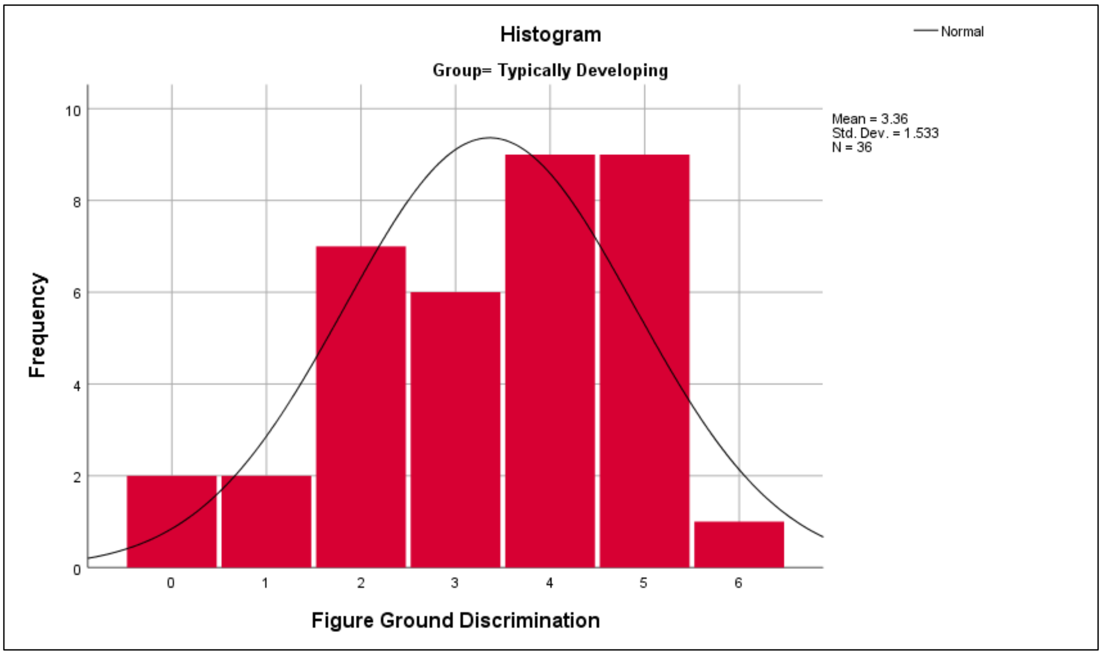
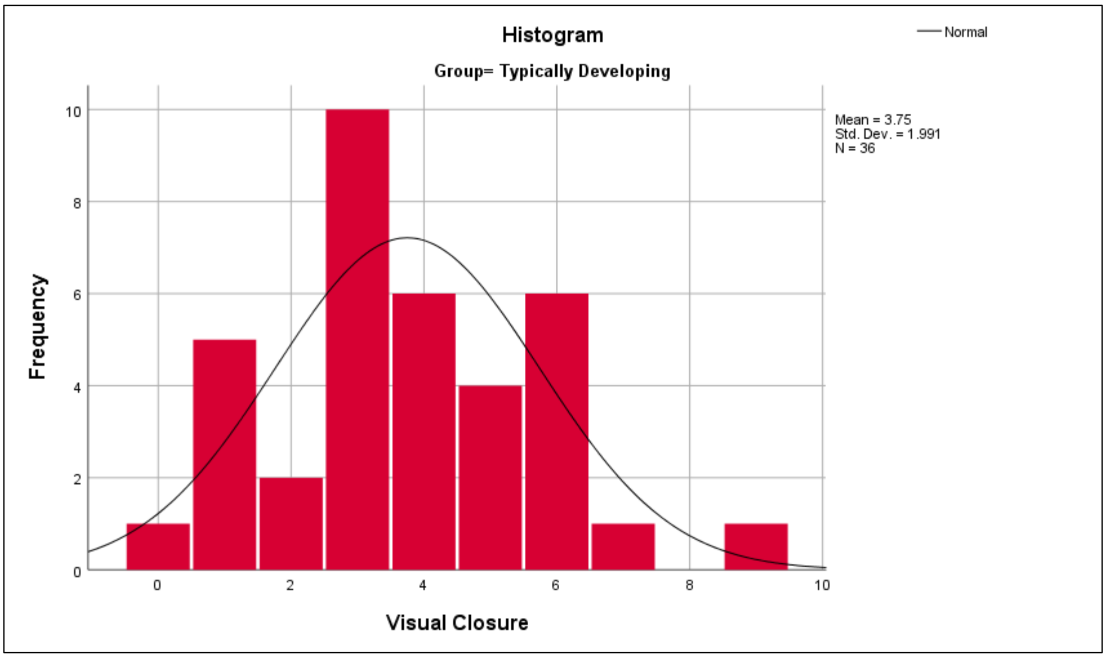


Figure K30

Histogram depicting data distribution for the Visual Closure task in the control group



Normality Testing for Study 2

The assessment battery for Study 2 was tested for normality. The Shapiro-Wilk, Skewness, and Kurtosis indicated that tests have both Normal and Skewed distribution in both DS and TD groups (refer to Table K9 and Table 10). Some results which are highlighted* from the Shapiro-Wilk test accept the alternative hypothesis that these are mostly supported by skewness and kurtosis; non-parametric tests will be used to compare the groups, even though there is mixed normality (Nahm, 2016).

Table K9

Test of Normality for DS group of the test battery for Study 2

	Shapiro-Wilk			Skewness			Kurtosis		
Assessments	Statistic	*N*	*P*	Value	*SE*	*Z*	Value	*SE*	*Z*
RCPM	.945	31	.113	-.379	.421	-0.90	1.476	.821	1.80
PPVT Maltese	.930	8	.521	-.577	.752	-0.77	-.533	1.481	-0.36
PPVT English	.963	8	.835	-.203	.752	-0.27	-.023	1.481	-0.02
SIT Maltese	.945	15	.442	-.204	.580	-0.35	-.869	1.121	-0.78
SIT English	.926	16	.210	.145	.564	0.26	-3.10	1.091	-2.84
English Word Reading	.907	27	.020*	.397	.448	0.89	-1.085	.872	-1.24
Maltese Word Reading	.838	21	.003*	1.264	.501	2.52	.771	.972	0.79
English Nonword Reading	.890	19	.032*	.572	.524	1.09	-.900	1.014	-0.89
Maltese Nonword Reading	.616	19	.000*	1.873	.524	3.57	1.986	1.014	1.96
Composite Score VPPS	.942	16	.378	.768	.564	1.36	.097	1.091	0.09
Composite Score Maltese PA	.922	9	.410	-1.044	.717	-1.46	2.057	1.400	1.47
Composite Score English PA	.894	13	.111	-.262	.616	-0.43	-1.612	1.191	-1.35

Note. *Scores that highlight non-normal distribution.

Table K10

Test of Normality for TD group of the test battery for Study

	Shapiro-Wilk			Skewness			Kurtosis		
Assessments	Statistic	*N*	*P*	Value	*SE*	*Z*	Value	*SE*	*z*
RCPM	.152	31	.286	.123	.421	0.29	.654	.821	0.80
PPVT Maltese	.969	9	.884	-.223	.717	-0.31	-.731	1.400	-0.52
PPVT English	.936	7	.603	1.069	.794	1.35	1.807	1.587	1.14
SIT Maltese	.212	16	.073	-.391	.564	-0.69	-.827	1.091	-0.76
SIT English	.933	15	.30	-.276	.580	-0.48	-.453	1.121	-0.40
English Word Reading	.938	20	.224	.310	.512	0.61	.334	.992	0.34
Maltese Word Reading	.765	15	.001*	2.195	.580	3.78	5.792	1.121	5.17
English Nonword Reading	.799	16	.003*	1.822	.564	3.23	4.181	1.091	3.83
Maltese Nonword Reading	.916	15	.166	-.830	.580	-1.43	1.019	1.121	0.91
Composite Score VPPS	.939	16	.337	-.332	.564	-0.59	-.640	1.091	-0.59
Composite Score Maltese PA	.802	11	.010*	-1.743	.661	-2.64	4.659	1.279	3.64
Composite Score English PA	.787	9	.014*	-1.358	.717	-1.89	.624	1.400	0.45

Note. *Scores that highlight non-normal distribution.

Appendix L

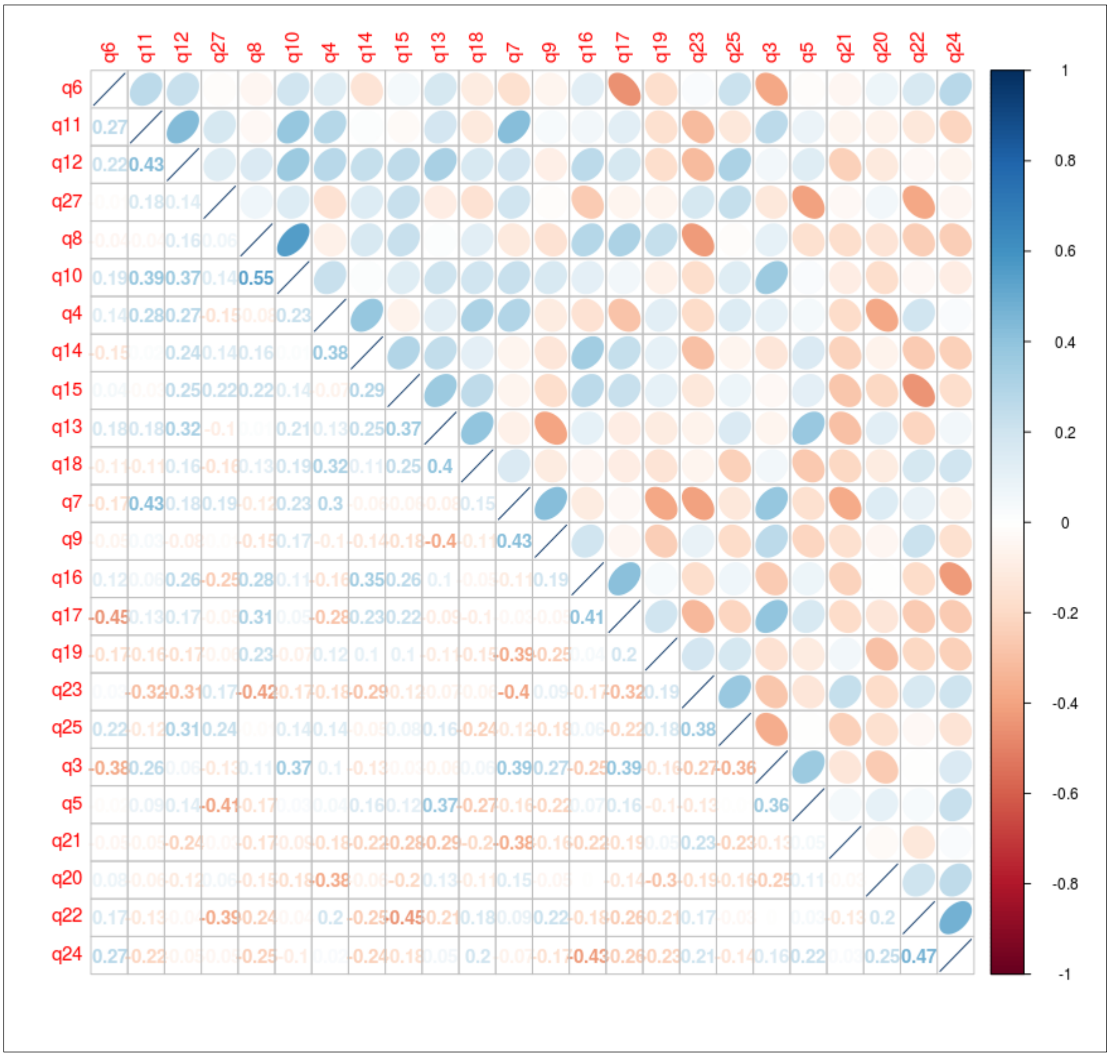
Factor Analysis of the adapted Home Literacy Questionnaire

Factor analysis looks at the relationship between variables (Fricker et al., 2012). The researcher chose this questionnaire since it had been used in research both with TD and DS populations (van Bysterveldt et al., 2010). The tool was culturally appropriate and was also easy and time-efficient to administer. However, the researcher added to the questionnaire to investigate aspects that she deemed pertinent to the local situation. The researcher included questions relating to the language used in the home and the use of flashcards. The questions related to language use were considered important due to the local bilingual context. At the same time, the questions pertinent to the use of flashcards were considered important due to the history of literacy practices within the local Maltese scenario. The researcher needed to ascertain the absence or presence of these practices within the participants with DS compared to the TD population.

A polychoric correlation matrix was first computed. This type of correlation was used since data had both nominal and ordinal questions, and some questions had four or fewer answer categories (Izquierdo et al., 2014). An initial examination identified errors on two questions: Question 2 and Question 26. Both questions yielded the same answer from all the participants; therefore, these were removed from the correlation investigation. Figure L1 represents the polychoric matrix, and correlations between questions are marked. The stronger blue colours indicate a higher positive correlation, and the stronger red colours indicate a stronger negative correlation.

Figure L1

Polychoric Correlation Matrix for questions from the adapted Home Literacy Questionnaire



The factorability of the variables was first examined. The matrix in Figure L1 shows that each variable correlates with at least another variable above the .3 level. The *Kaiser-Meyer-Olkin* measure of sampling adequacy was .514, and Bartlett's test of sphericity was significant (χ^2 (276) = 840.26, $p <$ .00). The Principal Component Analysis was employed, with varimax as a method of rotation. The initial Eigenvalues indicated seven factors above the 1 criterion. The extraction of 7 factors was confirmed through parallel analysis and visually through a scree plot represented in Figure L2 hereunder. The seven factors accounted for 70.6% of the total variance. Table L1 shows the Factor loadings and commonalities.

Figure L2

Scree Plot indicating the seven factors

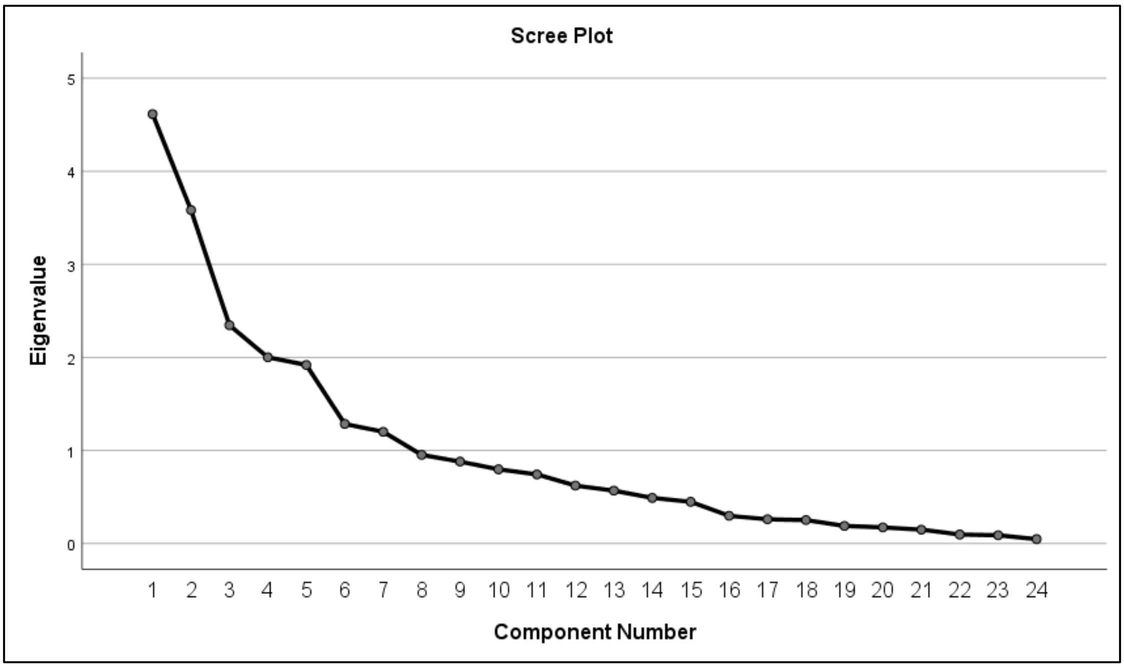


Table L1

Factor Loadings and Communalities

	Factor Loading						
Factor 1							
How often do you read to your child?	**823**						
Does your child ask you to read to them?	**778**						
Does your child point independently to or talk about pictures when you read stories?	**773**						
Did your child start reading through the use of flashcards?	**649**						
Which language do they use at home?	**595**					414	
Which language do they prefer to watch tv or videos in?	**574**						
Do you attempt to teach the names of the letters in the alphabet and/or alphabet sounds when reading?	**551**	540			.401		
Factor 2							
Are flashcards still being used? If no, why have these been stopped?		**.819**					
Do you point out signs and words such as restaurant names or street signs to your child?		**785**					
Does your child show interest in adult reading material?		**640**					483
Factor 3							
Can your child read the letters of the alphabet?			**707**				
Can your child put letters together to sound out words?			**663**				
How many flashcards can your child read?			**.583**	.445			
In which language are they better at reading?			**.512**				
Does your child write letters and/or words?			**492**				463
Factor 4							
If they read, which language/s do they read in?				**859**			
When reading to your child, are most books in Maltese or English?				**822**			
Factor 5							
Does your child read any words by sight?					**836**		
Does your child identify words in the environment?		542			**582**		
Does your child receive any type of additional therapy at the moment?	494				**497**		
Factor 6							
Does your child use the device independently?						**.747**	
Which language/s does your child use at school?						**727**	
Factor 7							
At what age did they start using flashcards if they used any?							**.817**
At what age did they start being exposed to the alphabet?							**.451**

Internal Consistency for each of the extracted Factors was computed using Cronbach's alpha and is portrayed in Table L3. The alpha of the Factors ranged from moderate to low. The researcher removed and added variables to the factors to adjust the alpha. Piedmont (2014) maintains that the inter-item correlation for a set of items must be between .20 and .40, suggesting homogeneity of items and maintaining unique variance to be too similar to each other. Throughout this analysis, two variables were excluded: *How many flashcards can your child read?* And *Are flashcards still being used? If no, why have these been stopped?*

These questions were still discussed and evaluated as they are important to investigate the local scenario; however, their exclusion from the factor analysis needs to be warranted when discussing the results.

Table L3

Inter-item correlations of reliability

Factors	A	Variables Removed	Variable Included	*N*
1	.788			6
2	.595	1		2
3	.462	1		3
4	.634		2	3
5	.721	1		2
6	-.432	1		2
7	.323			2

Note. α = Cronbach's Alpha.

Factor analysis identified that the adapted questionnaire could be subdivided into seven components allowing for the questionnaire's subdivision into seven sections. Internal consistency for each of the extracted Factors was also calculated using Cronbach's alpha, and the alpha of the Factors ranged from moderate to low. (see Table L2) These results indicate that the questionnaire does not have a strong internal consistency between variables. These outcomes could have been due to two main reasons: Primarily the inclusion of additional questions by the researcher; and secondly, the small sample size on which the factor analysis was computed. For these reasons, the researcher decided to discuss the questionnaire according to the author's proposed subdivisions and not subdivide the questionnaire according to the seven components identified through the Factor analysis. Additional Factor analysis is recommended with a bigger sample.

Moreover, two questions were excluded when analysing and interpreting results: ‘How many flashcards can your child read?’ and ‘Are flashcards still being used? If no, why have these been stopped?’. The researcher has deemed these two questions useful, adding more insight into the local scenario and providing information about sight-word reading. However, it is a limitation that these have been eliminated from the model. Consequently, it has been decided to include these in the discussion.

Appendix M

ANCOVA Anaylsis for Verbal Short Term Memory Tasks

Table M1

An *analysis of ANCOVA with Nonword repetition as a DV and controlling for SIT*.

Dependent Variable							
Nonword Repetition							
	Type III Sum of Squares	Df	Mean Square	F	*p*	Partial Eta Squared	R Squared
SIT	446.578	1	446.578	16.123	.000	.177*	.529
Age	1493.851	1	1493.851	42.729	.000	.363**	.390

Note: *small effect size; **medium effect size.

Appendix N

Nonword Repetition and Syllable Errors Data

Table N1

Data distribution of Nonword repetition task according to percentage syllable errors.

Group	Language of Administration	Nonword Repetition Score	2 Syllable Errors	3 Syllable Errors	4 Syllable Errors	% Score 2 Syllable Errors	% Score 3 Syllable Errors	% Score 4 Syllable Errors
DS	Malt.	0	0	0	0	.0	.0	.0
	Malt.	15	5	1	3	55.6	11.1	33.3
	Malt.	14	0	5	5	.0	50	50
	Malt.	8	5	6	5	31.3	37.5	31.3
	Malt.	23	1	0	0	100	.0	.0
	Malt.	0	0	0	0	.0	.0	.0
	Malt.	19	2	1	2	40	20	40
	Malt.	0	0	0	0	.0	.0	.0
	Malt.	23	0	1	0	.0	100	.0
	Malt.	21	0	2	1	.0	66.7	33.3
	Malt.	3	9	7	8	42.9	33.3	38.1
	Malt.	17	2	2	3	28.6	28.6	42.9
	Malt.	8	5	6	5	31.3	37.5	31.3
	Malt.	15	3	3	3	33.3	33.3	33.3
	Malt.	24	0	0	0	.0	.0	.0
	Malt.	22	1	1	0	50	50	.0
	Malt.	0	0	0	0	.0	.0	.0
	Malt.	18	1	4	1	14.3	57.1	14.3
	Malt.	20	1	2	1	25	50	25
	Malt.	19	2	3	3	33.3	50	50
	Malt.	15	3	2	6	27.3	18.2	54.6
	Malt.	2	8	8	8	36.4	36.4	36.4
	Malt.	13	6	2	2	54.6	18.2	18.2
	Malt.	21	1	1	1	33.3	33.3	33.3
	Malt.	9	5	5	5	33.3	33.3	33.3
	Malt.	22	1	1	0	50	50	.0
	Malt.	14	4	3	3	40	30	30
	Malt.	19	2	2	1	40	40	20
	Malt.	19	2	3	0	40	60	.0
	Malt.	17	3	1	3	42.9	14.3	42.9
	Malt.	20	2	1	1	50	25	25
	Malt.	19	3	2	0	60	40	.0
	Eng.	0	0	0	0	.0	.0	.0

	Eng.	0	0	0	0	.0	.0	.0
	Eng.	0	0	0	0	.0	.0	.0
	Eng.	5	5	6	8	26.3	31.6	42.1
	Eng.	20	0	3	1	.0	75	25
	Eng.	24	0	0	0	.0	.0	.0
	Eng.	20	1	2	1	25	50	25
	Eng.	22	1	0	1	50	.0	50
	Eng.	21	1	1	1	33.3	33.3	33.3
	Eng.	12	2	5	4	16.7	41.7	33.3
TD	Malt.	16	3	0	5	37.5	.0	.0
	Malt.	18	2	1	3	33.3	16.7	100
	Malt.	21	2	1	0	66.7	33.3	.0
	Malt.	20	0	1	3	.0	25	100
	Malt.	24	0	0	0	.0	.0	.0
	Malt.	22	0	0	2	.0	.0	100
	Malt.	23	0	0	1	.0	.0	.0
	Malt.	24	0	0	0	.0	.0	66.7
	Malt.	23	0	1	0	.0	100	.0
	Malt.	23	1	0	1	100	.0	.0
	Malt.	22	0	2	1	.0	100	.0
	Malt.	21	0	1	2	.0	33.3	50
	Malt.	24	0	0	0	.0	.0	.0
	Malt.	24	0	0	0	.0	.0	.0
	Malt.	21	2	1	1	50	25.0	10
	Malt.	24	0	0	0	.0	.0	.0
	Malt.	24	0	0	0	.0	.0	.0
	Malt.	21	1	0	2	33.3	.0	.0
	Malt.	23	0	1	0	.0	100	
	Malt.	24	0	0	0	.0	.0	
	Malt.	24	0	0	0	.0	.0	
	Malt.	24	0	0	0	.0	.0	
	Malt.	24	0	0	0	.0	.0	
	Malt.	23	0	0	1	.0	.0	100
	Malt.	23	0	1	0	.0	100	.0
	Malt.	22	0	2	0	.0	100	50
	Malt.	23	0	1	0	.0	100	66.7
	Eng.	24	0	0	0	.0	.0	.0
	Eng.	23	0	0	1	.0	.0	.0
	Eng.	23	0	0	0	.0	.0	25
	Eng.	22	1	0	1	50	.0	.0
	Eng.	23	0	1	0	.0	100	.0
	Eng.	24	0	0	0	.0	.0	.0
	Eng.	23	0	0	1	.0	.0	.0
	Eng.	24	0	0	0	.0	.0	

Appendix O

ANCOVA Analysis for VPPS

Table *O1*

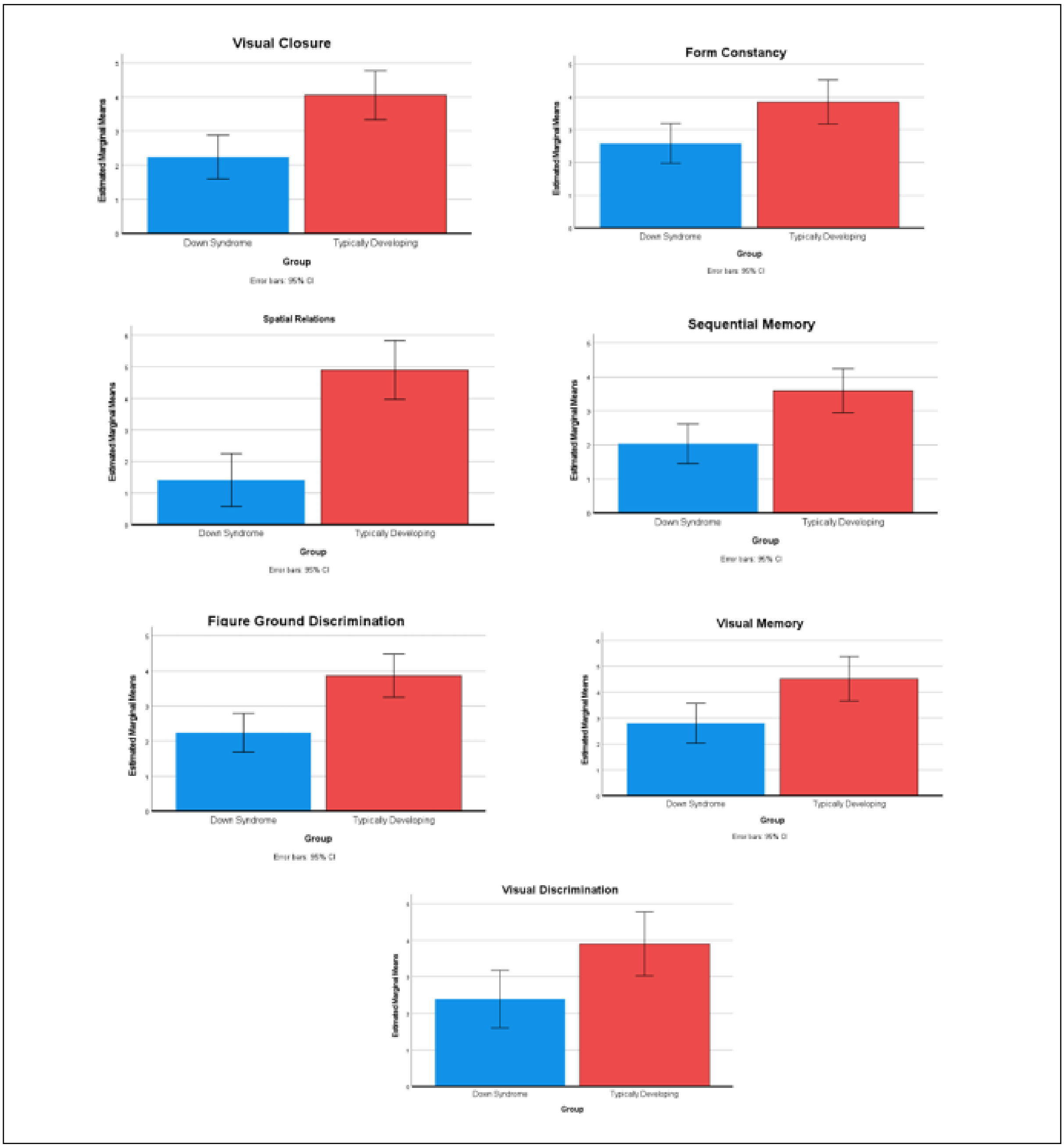
ANCOVA for comparison between groups on VPPS with Age as a covariate

Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	R^2
Visual Discrimination	19.114	1	19.114	4.697	.033	.059	.059
Visual Memory	24.823	1	24.823	6.375	.014	.078	.078
Spatial Relations	101.925	1	101.925	22.059	.000	.227	.290
Form Constancy	13.366	1	13.366	5.525	.021	.069	.069
Sequential Memory	20.413	1	20.413	9.074	.004	.108	.114
Figure-Ground Discrimination	22.273	1	22.273	11.084	.001	.129	.129
Visual Closure	27.471	1	27.471	10.168	.002	.119	.147

Note: N = DS: 42

Figure O1

Bar charts depicting the difference between groups on VPPS Tasks with Age as a covariate



Appendix P

Correlation Analysis PA Study 1

Table P1

Correlation Analysis for the DS group on PA tasks, SIT and Nonword Reading

Control Variable		Variables	*N*	*M*	*SD*	1	2	3	4	5	6	7	8	9
	1	SIT Maltese	*28*	*6.51*	*2.88*									
	2	SIT English	14	7.51	3.05	.072								
	3	RCPM	42	13.07	3.9	.435*	-.234							
	4	Syllable Counting	42	3.5	1.71	.647**	-.274	.231						
	5	Rhyme Awareness	42	1.3	1.6	.590**	-.182	.006	.475**					
	6	Identification of First Sound	42	4.07	1.29	.601**	.168	.100	.701**	.410*				
	7	Phoneme Segmentation	42	3.23	1.88	.538**	.222	-.012	.652**	.528**	.616**			
	8	Letter to Sound Conversion	42	4.23	1.28	.442*	-.077	.245	.444**	.310*	.566**	.315*		
	9	Nonword Reading English	14	17.6	17.09	-.037	-.200	-.288	.084	-.103	.039	.127	.111	
	10	Nonword Reading Maltese	28	14.57	14.01	-.124	.500	-.181	-.002	-.272	-.079	-.243	-.020	.
Age	2	SIT English				-.102								
	3	RCPM				.456*	-.195							
	4	Syllable Counting				.576**	-.563*	.333*						
	5	Rhyme Awareness				.519**	-.324	.069	.364*					
	6	Identification of First Sound				.557**	-.015	.202	.725**	.358*				
	7	Phoneme Segmentation				.491**	.199	.089	.602**	.400*	.602*			
	8	Letter to Sound Conversion				.469*	-.163	.273	.552**	.276	.586**	.404*		
	9	Nonword Reading English				.212	-.150	-.247	.161	-.117	.117	.118	.250	
	10	Nonword Reading Maltese				-.147	.	-.046	.120	-.309	-.075	-.140	.218	.

Table P2

Correlation Analysis for the TD group on PA tasks, SIT and Nonword Reading

Control	Variables	N	M	SD	1	2	3	4	5	6	7	8	9
	1	SIT Maltese	24	9.88	2.69								
	2	SIT English	12	9.42	2.87	-.322							
	3	RCPM	36	14.00	4.24	.402	-.275						
	4	Syllable Counting	36	3.89	1.62	.228	.000	.473**					
	5	Rhyme Awareness	36	2.14	1.50	.113	.195	.402*	.603**				
	6	Identification of First Sound	36	4.67	.72	.198	.	.569**	.597*	.479**			
	7	Phoneme Segmentation	36	3.39	1.81	.434*	.303	.625**	.664*	.370*	.560**		
	8	Letter to Sound Conversion	36	4.33	1.20	.354	.187	.588**	.489**	.381*	.551**	.633**	
	9	Nonword Reading English	11	12.18	10.76	.582	-.462	.007*	-.207	-.263	-.461	.417	.102
	10	Nonword Reading Maltese	21	13.81	11.95	-.219	1.000**	-.151	-.191	-.184	-.111	-.133	-.047
Age	2	SIT English				-.446							
	3	RCPM				.210	-.237						
	4	Syllable Counting				.276	.083	.626**					
	5	Rhyme Awareness				.069	.008	.409*	.590**				
	6	Identification of First Sound				.057	.	.583**	.688**	.447**			
	7	Phoneme Segmentation				.334	.298	.556**	.818**	.409*	.610**		
	8	Letter to Sound Conversion				.300	.045	.504**	.639**	.319	.573**	.649**	
	9	Nonword Reading English				.449	-.535	-.166	.002**	-.280	-.475	.220	-.085
	10	Nonword Reading Maltese				-.202	.	.246	.033	-.074	.061	.143	.114

Table P3

Correlation Analysis for TD group on Composite PA

Control Variable	Variables		*N*	*M*	*SD*	1	2	3	4	5
	1	RCPM	*36*	14.0	*4.2*					
	2	SIT Maltese	21	9.57	3.0	.578*				
	3	SIT English	15	9.64	2.46	.600*	.			
	4	Nonword Reading English	11	12.18	10.75	.007	.	.185		
	5	Nonword Reading Maltese	21	13.8	11.95	-.151	-.266	.	.	
	6	Composite PA Scores	36	18.4	5.67	.539**	.652**	.264	.021	-.195

Appendix Q:

Correlation Analysis VSTM TD group

Table Q1

Correlation Analysis for VSTM in the TD group reading in Maltese

Control Variable	Variables		*N*	1	2	3
	1	RCPM	*25*			
	2	SIT Maltese	25	.565**		
	3	Nonword Reading Maltese	25	.724*	.441*	
	4	Nonword Repetition Maltese	25	.174	.361	.095
Age	1	RCPM				
	2	SIT Maltese		.356		
	3	Nonword Reading Maltese		.583*	.389	
	4	Nonword Repetition Maltese		..084	.212	-.023

Table Q2

Correlation Analysis for VSTM in the TD group reading in English

Control Variable	Variables		*N*	1	2	3
	1	RCPM	*11*			
	2	SIT English	11	.631*		
	3	Nonword Reading English	11	-.222	.259	.
	4	Nonword Repetition English	11	-219	.242	.415
Age	1	RCPM				
	2	SIT English		.446	.	
	3	Nonword Reading English		-.133	.559	-
	4	Nonword Repetition English		-.471	.234	.461

Appendix R

Correlation Analysis VPPS Study 1

Table R1

Correlation and Partial Correlation analysis of VPPS in the group of participants with Down Syndrome

Control Variable	Variables		*N*	*M*	*SD*	1	2	3	4	5	6	7	8	9	10
	1	RCPM	42	13.0	3.99										
None	2	SIT Maltese	28	6.6316	3.11	.557**									
	3	SIT English	14	7.33	3.4	.109	.								
	4	Visual Discrimination	42	2.81	1.68	.069	.685**	.316							
	5	Visual Memory	42	3.24	2.22	-.034	.307	.228	.463*						
	6	Spatial Relations	42	1.83	1.68	-.118	-.369	.424*	-.047	.099					
	7	Form Constancy	42	2.9	1.8	.159	.301	.448*	.383*	.358*	.277				
	8	Sequential Memory	42	2.36	1.52	.033	.194	.460*	.244	.241	.254	.274			
	9	Figure-Ground	42	2.67	1.422	.032	.162	.375	.342*	.383*	.392*	.295*	.408*		
	10	Visual Closure	42	2.5	1.306	.321*	.376	.439*	.306*	.270	.246	.304*	.260	.548**	
	11	Nonword Reading English	14	17.6	17.09	-.288	.	.083	-.213	-.423	.027	-.291	.047	.007	.110
	12	Nonword Reading Maltese	28	14.57	14.01	-.181	-.278	.	-.069	.101	.367	.023	-.194	.240	-.145
Age	1	RCPM													
	2	SIT Maltese				.567*									
	3	SIT English				.203	.								
	4	Visual Discrimination				.101	.611*	.251							
	5	Visual Memory				.033	.295	.284	.250						
	6	Spatial Relations				-.092	-.437	.305	.046	.094					
	7	Form Constancy				.105	.360	.501*	.347*	.484*	.256				
	8	Sequential Memory				.064	.062	.475*	.146	.447*	.296	.380*			
	9	Figure-Ground				.086	.113	.235	.261	.264*	.359*	.168	.357*		
	10	Visual Closure				.334	.379	.395	.317*	.275	.341*	.342*	.360*	.562**	
	11	Nonword Reading English				-.247	.	.292	-.033	-.300	.036	-.059	.111	.112	.076
	12	Nonword Reading Maltese				-.046	-.308	.	-.133	.147	.107	-.040	.002	.432	-.232

Note. N = 42; **p* < .05; ***p* < .01.

Appendix S Additional Statistical Results for the HLE Questionnaire

Table S1

Percentage results for question: Do you have a computer or any other electronic device such as a tablet at home?

Answer		Group		Total
		TD	DS	
Yes	% within Group	100%	98%	98.9%
No	% within Group	0%	2%	1.1%

Table S2

Percentage results for questions: Does your child use the device independently?

Answer		Group		Total
		TD	DS	
Yes	% within Group	83.3%	86.3%	84.9%
No	% within Group	16.7%	13.7%	15.1%

Table S3

Percentage results Question 11: Do you attempt to teach the names of the letters in the alphabet and/or alphabet sounds when reading?

	Group			No Never	Rarely	Sometimes	Often	Always
TD	Age Group	1-5	% within Age Group	19.0%	4.8%	38.1%	19.0%	19.0%
		6-10	% within Age Group	0.0%	9.5%	23.8%	38.1%	28.6%
DS	Age Group	1-5	% within Age Group	42.9%	0.0%	14.3%	14.3%	28.6%
		6-10	% within Age Group	0.0%	10.0%	40.0%	30.0%	20.0%
		11-15	% within Age Group	0.0%	23.8%	28.6%	28.6%	19.0%
		16 and over	% within Age Group	15.4%	30.8%	23.1%	0.0%	30.8%

Note: TD group: X2(1)= 6.759, p= 0.149 DS Group: X2(1)= 19.886, p= 0.069

Table S4

Percentage results for Question 22: Does your child write letter and/or words?

	Group			Yes	No	Some letters
TD	Age Group	1-5	% within Age Group	38.1%	42.9%	19.0%
		6-10	% within Age Group	66.7%	4.8%	28.6%
DS	Age Group	1-5	% within Age Group	14.3%	85.7%	0.0%
		6-10	% within Age Group	30.0%	20.0%	50.0%
		11-15	% within Age Group	76.2%	14.3%	9.5%
		16 and over	% within Age Group	84.6%	0.0%	15.4%

Note: TD group: X2(1)= 8.436, p= 0.015 DS Group: X2(1)= 30.759, p= 0.000

Table S5

Percentage results for Question 24: Does your child use the device independently?

Group				Yes	No	Total
TD	Age Group	1-5	% within Age Group	71.4%	28.6%	100.0%
		6-10	% within Age Group	95.2%	4.8%	100.0%
DS	Age Group	1-5	% within Age Group	42.9%	57.1%	100.0%
		6-10	% within Age Group	80.0%	20.0%	100.0%
		11-15	% within Age Group	95.2%	4.8%	100.0%
		16 and over	% within Age Group	100.0%	0.0%	*100*.0%

Note: TD group: X2(1)= 4.286, p= 0.038 DS Group: X2(1)= 14.969, p= 0.002

Appendix T

Chi-Square results investigating School Setting and School Year Effect

Table T1

Chi-Square Analysis: Effect of School setting on Reading and Writing Instruction.

Question	Chi-Square Value	p-value
What is the frequency of participation of the student in activities relating to reading instruction in the classroom?	8.206	.514
How much time per week is dedicated to literacy activities?	11.115	.268
Are there activities related to reading instruction your student does not participate in?	6.533	.088
Does your student take reading books home from school for home practice?	14.923	.093
Does your student receive extra help with his/her reading at school?	9.678	.139
Who provides the extra help?	27.837	.145
Are there challenges in providing reading instruction for this student?	6.439	.092
Does the student follow an alternative programme for reading instruction?	.342	.952
Who is responsible for planning the reading programme?	24.415	.273
Who is responsible for implementing the programme?	12.929	.374
What method of reading instruction is used with the student?	1.719	.787
In your opinion, what is the best method for reading instruction for students with Down Syndrome?	10.431	.108
Does your student participate in activities relating to writing activities in the classroom?	5.274	.948
How much time is spent on writing activities?	10.452	.315

Are there activities related to writing instruction your student does not participate in?	4.973	.174

Table T2

Chi-Square Analysis: Effect of School Year on Reading and Writing Instruction.

Question	Chi-Square Value	p-value
What is the frequency of participation of the student in activities relating to reading instruction in the classroom?	25.087	.14
How much time per week is dedicated to literacy activities?	25.087	.014
Are there activities related to reading instruction your student does not participate in?	10.975	.027
Does your student take reading books home from school for home practice?	13.536	.331
Does your student receive extra help with his/her reading at school?	4.801	.779
Who provides the extra help?	23.436	.711
Are there challenges in providing reading instruction for this student?	3.282	.512
Does the student follow an alternative programme for reading instruction?	7.870	.096
Who is responsible for planning the reading programme?	28.046	.462
Who is responsible for implementing the programme?	14.810	.539
What method of reading instruction is used with the student?	6.053	.641
In your opinion, what is the best method for reading instruction for students with Down Syndrome?	21.674	.006
Does your student participate in activities relating to writing activities in the classroom?	23.210	.108
How much time is spent on writing activities?	8.510	.744
Are there activities related to writing instruction your student does not participate in?	4.891	.299