Adolescent Dyslexic Technical Vocational Pupils: An Advice for Classroom English Language Teaching and a Basic Neurocognitive Understanding of Dyslexia

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1.Introduction

Dyslexia is a learning disorder that has been the subject of a vast amount of research, as it effects a large group of individuals regardless of intellectual capabilities or social economical background (Hulme & Snowling, 2009; van Berkel, 1999; Harvey, 2010). Central to dyslexia is the difficulty to read accurately and fluently; the origin of this disorder lays in various neurological and genetic deficits (Hulme & Snowling, 2009). Traditionally, research has been conducted in order to investigate the problems encountered by dyslexics in their mother tongue (Oyler et al.,2012). Although a substantial body of literature exists on second language acquisition and dyslexia, little is known on how adolescent dyslexics in a specific niche of education acquire the ever increasing popular foreign language English. This specific niche of dyslexia and education is an area that deserves more attention.

English has developed to be the first foreign language in many European countries since the 1970's and is nowadays a compulsory subject in most European Educational systems (Bonnet,2009). In the Netherlands, being competent in the English language is regarded as a vital asset for employability. Yet, learning the English language can be quite a challenge for dyslexic students (van Berkel, 1999). The level of English required for all pupils attending a given level of education in the Netherlands is the same regardless of language difficulties (Noijons & Kuipers,2006). Not attaining the required level of English may well jeopardize the student's chances of qualifying for a degree (http://www.kwalificatiesmbo.nl/). This is perhaps especially crucial for technical vocational training schools, where the percentage of dyslexic pupils tends to be high and may account for 15% of the pupils in a given year (Automotive college, 2013) .

This paper sets out to explore the difficulty encountered by Dutch dyslexic adolescent pupils attending a tertiary technical vocational school in learning English as a foreign language. Interest in vocational training is derived from the fact that adolescent students with an average intelligence attending vocational education form a specific niche. One hypothesis, based on what is known about students in vocational education programs, is that adolescent students encountering difficulties in languages tend to specialize in a branch that is less language orientated. The participants in this research are all 'hands on' individuals and may demonstrate another manner of learning than theoretical oriented students. Thus students attending a technical vocational training may demonstrate more difficulty in language skills, especially dyslexic students. The hypothesis underling this study is that technical adolescent students may form a separate population as they learn differently than dyslexics in general.

The objective of this paper is to investigate which differences exist between dyslexic and typically developing (TD) native Dutch speaking adolescent technical vocational students. As such, a second aim is to create a basic neurocognitive understanding of dyslexia. Consequently, findings from this paper will be used to form a desirable didactical advice for classroom language teaching in technical vocational training.

2. Basic Neurocognitive Understanding and Definition of Dyslexia

2.1 Seeking a Definition of Developmental Dyslexia

One of the limitations in defining dyslexia is that terminological confusion still exists. According to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV; American Psychiatric Association,2004), dyslexia is characterized as follows: “reading achievement, as measured by individually administered standardized tests of reading accuracy or comprehension, is substantially below that expected given the person's chronological age, measured intelligence, and age-appropriate education”. In another vein, Harvey (2010) suggests that the term dyslexia has lost its credibility as many “misconceptions and misunderstandings” surround the term. Dyslexia has instead become a term that implies that there is a difficulty in reading, writing or understanding written language, and in labelling memory and grammar problems. Harvey even refers to dyslexia as a “ middle class disease”, as it is suggested that especially middle class parents look for a reason to explain the academic underachievement of their children.

Despite the diversity in definitions, or even lack of credibility in the term used for dyslexia, what is understood by the term dyslexia in this paper coincides with the definition employed by Hulme and Snowling (2009): “Dyslexia is a specific learning disability that is of neurobiological origin. It is characterized by difficulty with accurate and/or fluent word recognition, by poor spelling and inability to decode words (Hulme & Snowling, 2009). These difficulties typically result from a deficit of the phonological component of language”.

However, the quest in seeking a one glove fits all definition for dyslexia does not end here. The question if there are different types of dyslexia has been coined by various researchers (Hulme & Snowling, 2009; Harvey, 2010; Cherney, 2004). Hulme, Snowling and Harvey conclude that there are two types of dyslexia. On the one hand there is surface dyslexia and on the other there is phonological dyslexia. Individuals with surface dyslexia experience problems in reading and learning irregular verbs. In addition, they tend to have difficulty applying the grapheme to phoneme rules; “constructing the direct access route" is problematic and, therefore, a surface dyslexic seeks an indirect reading route. “Surface” refers to the known visual errors made by surface dyslexics, namely errors originating from incorrect scanning of the surface. Surface dyslexia does not entail a phonological problem; it is applying the rules and principles that are used to construct sentences that is problematic. Furthermore, surface dyslexics seem to develop reading skills at a slower rate (Hulme & Snowling, 2009; Harvey, 2010).

By contrast, phonological dyslexics experience the opposite and characteristics are as follows: firstly, there is a poor conversion of graphemes to phonemes. Secondly, phonological dyslexics experience difficulties in reading and spelling non-words. Finally, when compared to TD individuals there is no significant variation in the performance of reading regular and irregular words. ‘Phonological’ in phonological dyslexia refers to a phonological deficit in language perception and reproduction (Hulme & Snowling, 2009; Harvey, 2010).

The subdivision of dyslexia, with contrasting linguistic problems, indicates that dyslexia is not a learning deficit that can be approached using a limited number of remedial tools. Furthermore, dyslexia has been found to have a high comorbidity rate with disorders such as dyspraxia, ADHD (Harvey, 2010; Poljac,2009) and specific Language Impairment (Catts et al.,2005), which complicates investigations of ‘pure’ dyslexia. Comorbidity entails that there are distinct disorders which can be related and occur together in the same person (Catts et al., 2005). It would be a vast task to take all possible comorbidities into account, but it is fruitful to narrow down to the most common co-morbid factor in dyslexia, which is ADHD (Hulme & Snowling, 2009). Seeing the co-morbidity rate is high;, 15-35% between dyslexia and ADHD, the possibility that individuals with dyslexia will display features of ADHD is relatively high. The reverse situation would also hold. That dyslexia and ADHD share common traits can be attributed to common deficits in both Long Term Memory (LTM) and Working Memory (WM)

2.2 Working Memory (WM)

WM is often depicted as a ‘mental workbench”, which underlies thinking, reasoning, remembering and is suggested to correlate with consciousness (Rudner& Rönnberg, 2008). Both concentration and effort have been reported to be influenced by WM and it is for this reason that WM tends to be associated with educational progress (Henry, 2012). What is more, WM proves to be an indicator of conscious processes such as language-based communication (Rudner& Rönnberg, 2008). In dyslexia WM has been found to be impaired and, moreover, shifting attention tasks and executive memory cognitive processes that heavily rely on WM typically cause problems in dyslexics (Wiseheart et al; 2009;Poljac et al; 2009).

Despite the different definitions (Cowen, 2008) of WM, Baddeley's (2000) WM model remains salient in cognitive psychology literature. Baddeley's WM model consists of four components: central executive, episodic buffer, phonological loop and visuospatial sketch pad (see figure 1). In a nutshell, the central executive controls the execution of the other three WM systems while the episodic buffer accounts for the integration of visuospatial sketchpad and phonological loop.

The WM components are related to both storing and processing information (Baddeley, 2000). When considering WM it is crucial to realize that the central executive has a limited capacity and is primarily responsible for the supervision of attentional control. Attentional flow occurs at different levels and the central executive is responsible for prioritizing and filtering conflicting activities to ensure that disruptive behaviour will not follow (Baddeley, 1986).

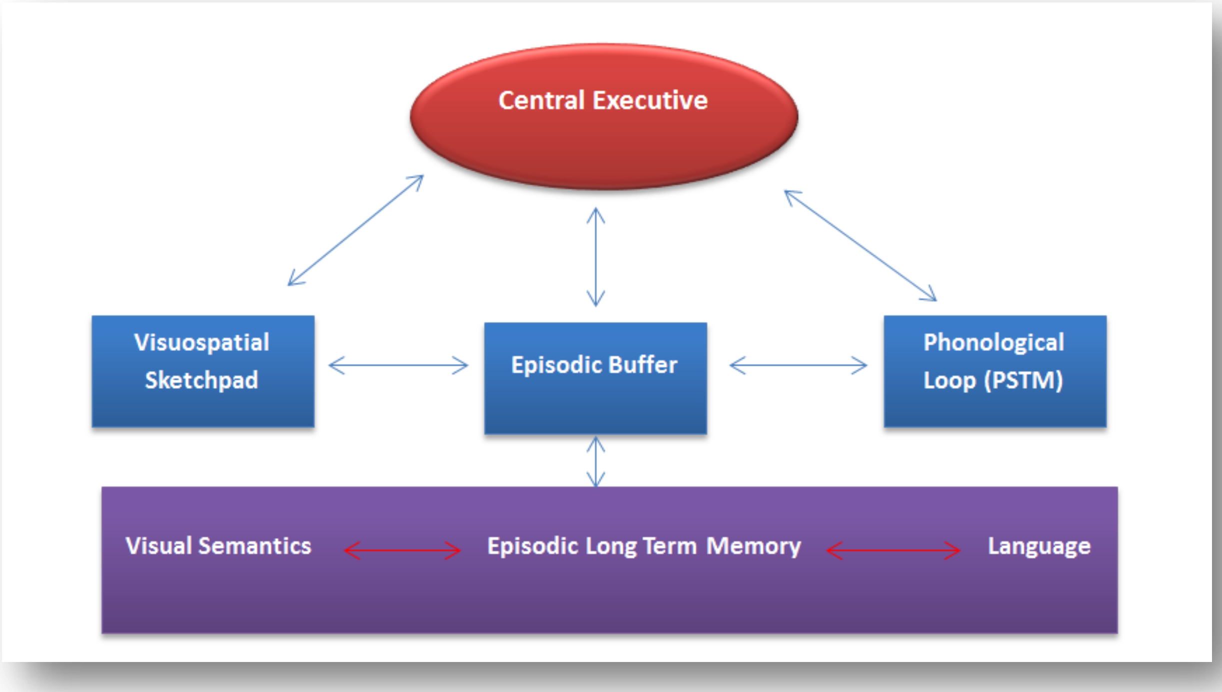

Figure 1: Baddeley's(2000) Working Memory model. *Taken from : Lucy Henry (2012)*

In addition, if capacity of the central executive exceeds what it can process there is a threat of overloading. Therefore, it is argued that the amount of information produced reflects the available capacity of the executive functions (Baddeley,2003; Baddeley,1986).

Central Executive

What is more, information processing and storage occur at the same time within the WM. The central executive has a particular role in seeking the balance between the forever competing information processing and storage functions. The competition between processing and storage result in a trade-off situation. The trade-off situation, in turn, has an implication for second language learning: if information processing is relatively effortless then more storage space is available for acquired knowledge. Seeing that a second language beginner is exposed to a vast amounts of new information he or she needs to allocate most resources to processing. However, as automaticity sets in there is less need for processing capacity and more resources can be allocated to storage, enabling a more efficient word learning process (Keijzer, 2013).

As previously mentioned, the episodic buffer accounts for the integration of the phonological loop and the visuospatial sketchpad. Both these systems are referred to as ‘slave-systems’, which implies that only short-term information is stored, and the system itself merely supports the central executive function of WM.

Of the two slave systems in WM model the phonological loop will be discussed in more detail given that the majority of dyslexics experience phonological processing deficits (Hulme & Snowling, 2009; Fletcher et al., 1994; Catts et al.,2005). However, previous findings indicate that the visuospatial sketchpad does play a role in reading tasks, and further research is needed to understand this role especially in surface dyslexia (Baddeley, 2003).

Phonological loop

The phonological loop processes both auditory and visual information (Baddeley, 2003 Henry, 2012). Perception of auditory information proceeds directly to the phonological store, and leaves auditory memory traces. However, visual imagery is translated into a verbal utterance during a process referred to as verbal rehearsal coding, and occurs in the articulatory rehearsal mechanism (see figure 2). Once the visual information has been coded it can be circulated between the articulatory rehearsal mechanism and the phonological store until decay (Henry, 2012).

Moving on to a neuroanatomical level of the phonological loop. Firstly, Baddeley’s (2003) findings confirm that the phonological loop system is located in different parts of the left brain hemisphere. However, in extremely demanding tasks the right hemisphere has been found to be co-activated. Moreover, in the case of dyslexic capable readers (readers who have ‘overcome early reading problems’ and developed strong literacy skills), it has been shown that during reading tasks dyslexic people use different neurological pathways than TD readers. During reading tasks dyslexic capable readers show more activity in the frontal lobe, and right brain hemisphere than TD individuals (Marshall, 2003).

Above all, the influence of the phonological loop in second language learning is central in this paper. Baddeley (2003) demonstrated the futile effect of foreign word learning for a 'pure' phonologically impaired native English speaking individual. Furthermore, the effect of stimuli interference on the phonological loop in foreign language learning shows that interference has a greater effect on foreign language word learning than in the mother language word learning (Baddeley, 2003).

Besides word learning tasks, picture naming tasks in dyslexia have been examined. Findings indicate that children with dyslexia show more difficulty in picture naming tasks than age-related TD children (Hulme& Snowling, 2009; Oyler et al., 2012). This coincides with research indicating that dyslexics have a normal representation of word meaning. However, it is the word sound representation in dyslexics that is lower than in TD children (Hulme & Snowling,2009). In addition, automaticity in which coding occurs in dyslexics functions less efficiently than in non-dyslexics (Ball, 2004).

All in all, the phonological loop holds a prominent position in foreign language learning. Further research is needed to establish the role of the phonological loop in second language learning especially in individuals with an impaired phonological loop, for both capable dyslexic readers and dyslexic readers who have not overcome early reading problems.

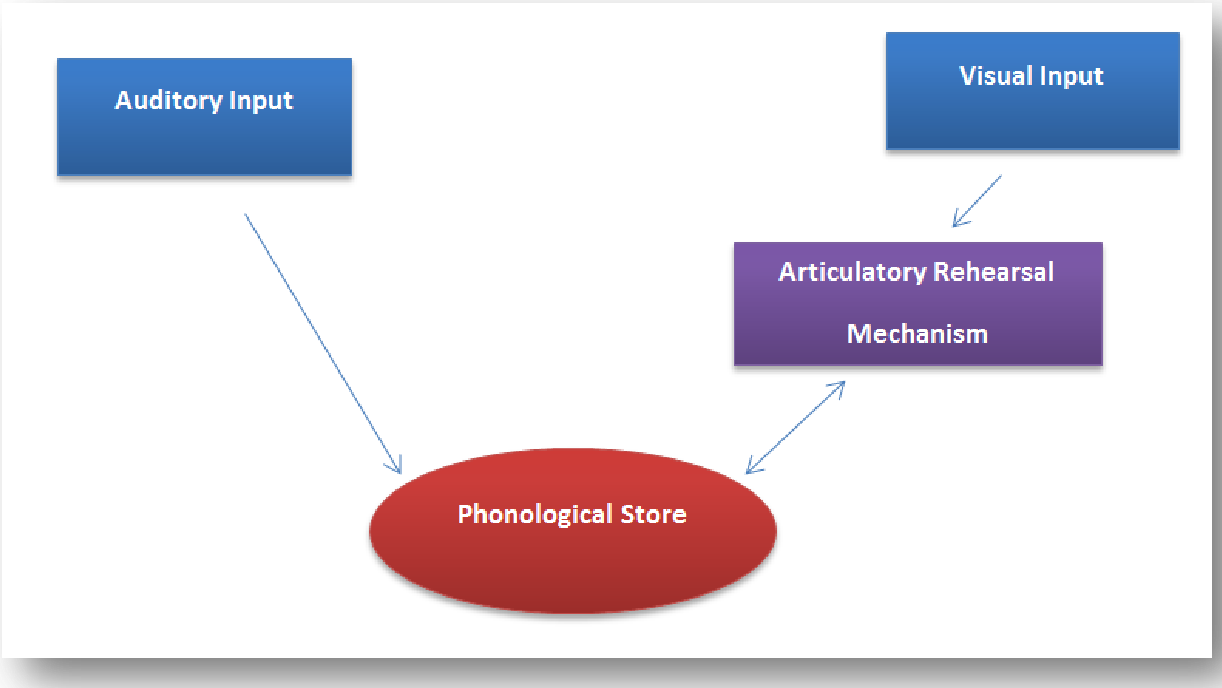

Figure 2: Baddeley's(2000) Working Memory model: The phonological loop. Taken from : Lucy Henry (2012)

Contrary to the specific tasks governed by the phonological loop and visuospatial sketchpad, the episodic buffer has a 'multidimensional storage and processing' function in WM and more specifically in language processing (Rudner& Rönnberg, 2008). It is evident that signals and processes from the WM need to be aligned with coded information from the Long Term Memory (LTM) to optimize matching of language based items. If a signal is distorted then more effort is required of the episodic buffer to match a signal to a registered sound from the LTM hence; a clear signal is easier to process (Rudner& Rönnberg, 2008). If information runs the risk of unsuccessful pairing then an appeal to 'explicit storage and processing' is made in an attempt to place the mismatched information in a broader context. The chance of finding a link to the difficult to pair signal is increased when placed in a broader context which the' explicit storage and processing' caters for (Alt, 2010).

Up until now, the function of the central executive, episodic buffer and the phonological loop has been discussed. All three components plus the visuospatial, which deserves more attention in further research, contribute to the WM span. Tests show that individual differences in WM span vary and in return influence comprehension capacity (Baddeley,2003). In order to determine various individual cognitive skills WM span tasks are generally used. WM span is associated with a 'type of reasoning' said to sustain common measures of intelligence (Baddeley, 2003). A task used in this paper to measure the WM span of dyslexic and TD technical vocational students is the Backward Digit-Span Test, which will be elaborated on later in this paper.

However, the functioning of the WM alone does not account for different individual language skills. Taking into account that the episodic buffer has access to both slave systems and LTM, where semantic knowledge is stored, it makes sense to review the basic principles of LTM.

2.3. Declarative/Procedural Long Term Memory model

Neurocognitive aspects of language acquisition

As previously mentioned WM influences individual language skills and ability to learn (Henry, 2012). Yet, WM alone is not responsible for individual language skills and relies on a crucial link to the LTM for semantics and mental grammar. However, LTM diverges into two different LTM memory systems. Ullman (2004) uses the declarative/ procedural model to explain these two LTM memory systems (see figure 3). Incidentally, linguistic and non-linguistic skills run parallel in the brain and, hence, functions in the brain which serve language simultaneously also subserve other functions (Keysers,2011; Ullman, 2004). On account of the nature of this paper only the language aspects of the D/P model will be discussed

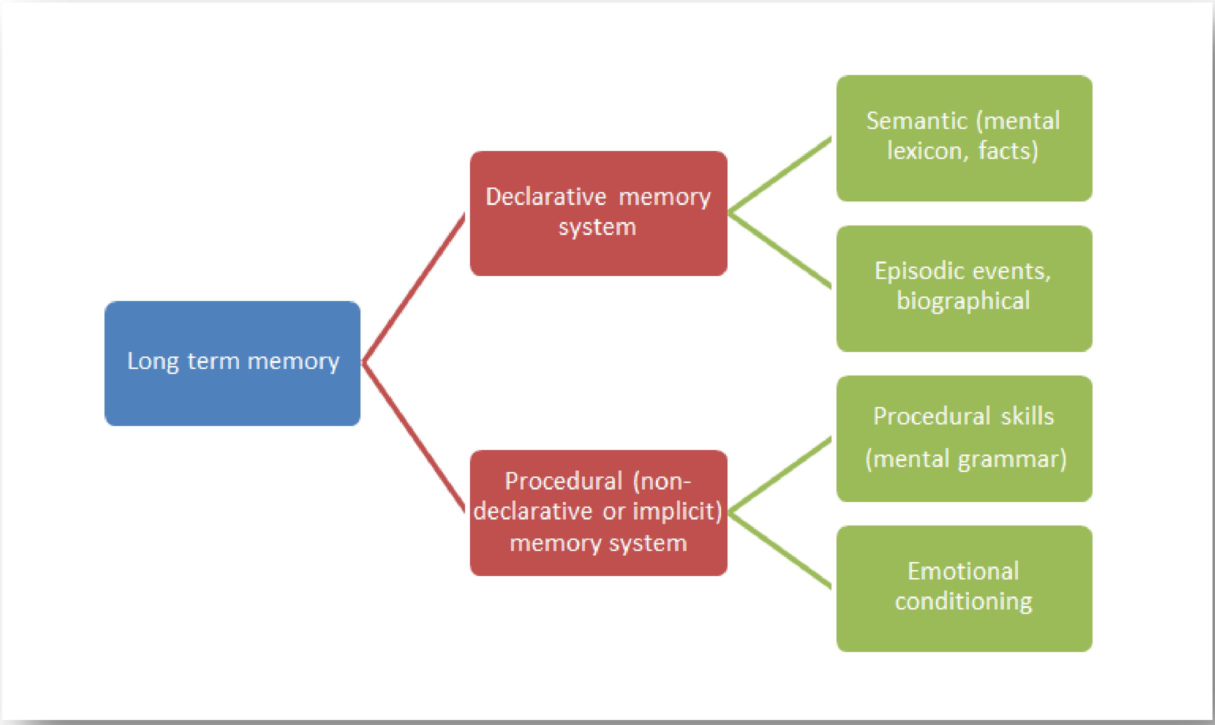

Figure **3. Hierarchy of long term memory Ullman's D/P model (S.de Bruin, 2012)**

The declarative and procedural model (D/P model), accounts for the mental lexicon on the one hand and the mental grammar on the other (fig. 5). The semantics, mental lexicon, is attributed to declarative memory. Here general facts are stored such as: words, foods, names of capital cities etc. (Ullman, 2004). In addition, it is argued that the declarative memory does not encapsulate information, which means that stored information is freely accessible for other memory systems (Squire & Knowlton, 2000). The connections to other memory systems make the declarative system a fast learning system.

Contrary to declarative memory, procedural memory (Squire & Knowlton, 2000) does encapsulate information and this explains why the procedural memory relates information in a stringent rule-like manner and is not exposed to other mental systems. Just like the declarative memory the procedural memory has a language based subsection; procedural skills which accounts for the execution of routines such as: riding a bicycle, catching and throwing a ball and applying grammatical rules etc. (Keysers, 2011). However, the procedural memory retrieves information at a subconscious level and is somewhat more complicated than the declarative memory.

Both declarative and procedural memories have their own network systems which are interconnected and complement each other (Ullman, 2004). For example; the declarative memory provides words committed to memory and the procedural memory forms sentences using the learnt rules and procedures governing grammar.

The Declarative and Procedural (D/P) Model in Dyslexia

Within the D/P model Ullman describes the “see-saw effect” between the two memory systems, as a result of dual competition, entailing that both memory systems cannot operate fully simultaneously. Moreover, age influences the employability of the two memory systems. Explicit cognition, which takes place in the procedural memory, is primarily displayed in older primary school learners (Muñoz,2008;Larson-Hall,2007). By contrast, implicit learning, which is governed by the declarative memory, is primarily activated in the youngest learners as to obtain a basic level of vocabulary, i.e. dog, ball, toy etc. (Rhode,2010). Further studies have shown that the D/P model does not function the same in all individuals regardless of age (Ullman, 2004). Malfunctions in the D/P model can be seen in some disorders such as dyslexia.

Ullman (2004) postulates that a deficit underlying dyslexia originates from the declarative memory. Considering the “see-saw” effect within the D/P model (Ullman,2004) it is safe to say that the procedural memory compensates for potential lack of activity in the declarative memory found in dyslexia. How the compensation within the D/P model could clarify and assist learning processes in young dyslexic learners is another aspect of potential research.

Up until now impairments in WM and LTM of dyslexia have been reviewed. The interaction of these two memory systems may play a major role in linguistic skills. It is for this reason that the next part of this paper will more closely examine the link between the WM and the LTM (see figure 4).

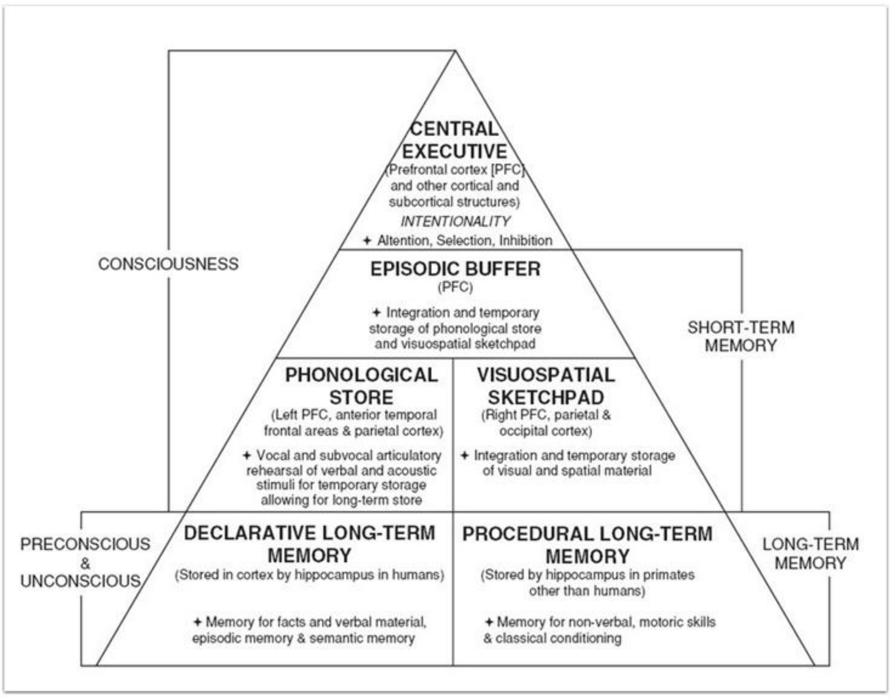

Figure 4: Working Memory and Long Term Memory. Taken from: ***http://aminotes.tumblr.com/image/1033143204***

2.4 Phonological Matrimony of Working Memory and Long Term Memory

As previously mentioned, the process of word learning requires more than reviewing the phonological loop. In-order to allocate meaning to a given sound it has to be compared to previous encoded words stored in LTM (Alt,2010). The phonological probability (the frequency of combined phonological segments) is embedded in LTM and assists in word learning tasks. If a novel word is perceived then the phonological probability is assessed before the new word is committed to memory. Hence, words containing a rare or non-existent combination of phonological segments have no reference point to LTM and are therefore more difficult to encode. Tests have indicated that familiar sound sequences are learnt with more ease than alien sounds (Storkel, 2001).

Furthermore, if words are not entirely heard correctly than phonological probabilities and semantic knowledge of LTM are consulted to 'fill in the blanks' (Alt, 2010; Ahissar, 2007; Rudner & Rönnberg, 2008). Retrieving information in order to 'fill in the blanks' is referred to as redintegration confirming that LTM and WM function as a team (Alt, 2010). With respects to foreign word learning, for which the phonological probability count might be expected to be low, the processing in the WM will most likely be very time consuming. However, taking the 'trade-off' in WM into account, once more phonological probabilities may have been established in LTM more room for storage develops in WM.

In addition, the actual process of learning to read can be explained along the lines of a triangle model (Hulme & Snowling, 2009). The triangle model illustrates pathways between three elements: orthography (the relation between spelling) to phonology and orthography to phonology via semantics (declarative memory). Taking into consideration that both phonological skills (Hulme & Snowling, 2009; Harvey, 2010) and semantics (Ullman,2004) are impaired in dyslexia it may be assumed that word reading and subsequently word learning is a problematic process in dyslexia. Learning English is further complicated for both TD learners and dyslexic learners as English has an irregular orthography. Hence, the formation of spelling rules varies resulting in various ways to translate sounds into words (Hulme & Snowling, 2009; van Berkel, 1999), which makes acquisition of the English language more laborious than a language with a transparent orthography such as German (van Berkel, 1999; Hulme & Snowling, 2009).

It appears that phonological probability and phonological strategies differ in dyslexia from those employed by TD individuals. As previously mentioned, there are two types of developmental dyslexia, phonological dyslexia and surface dyslexia. With respects to retrieving information from the LTM different effects are expected and have, in fact, been recorded. Strenuous reproduction of novel words, by a phonological dyslexic reader, reveal that difficulty is experienced in retrieving a phonetic reading strategy from the LTM (Alt, 2011; Ahissar, 2007). On the other hand, in surface dyslexia exception words tend to be pronounced incorrectly, as if spelling rules are persistently applied as a result of over reliance on the phonological strategy of the LTM (Hulme & Snowling,2011). It is thus evident that in dyslexia individuals are linguistically hindered in using the resources of the LTM.

Ahissar (2007) confirms that word components retrieval from the LTM is slower in dyslexia than in TD individuals. A valid explanation for the impairment in processing and categorizing new information in WM is given in the 'anchoring deficit hypothesis'. TD individuals tend to tune in quickly to incoming stimuli, 'anchor to them' and when exposed to the same stimuli respond to them more quickly. Dyslexics seem to have to 'anchor' a repeated incoming stimuli over and over again and therefore do not benefit from the automaticity experienced by TD individuals. In addition, by anchoring stimuli an individual is equipped to make better predictions for similar stimuli in the future. Furthermore, dyslexics are thought to be more sensitive to external noises while performing perceptual tasks (Ahissar,2007).

So far this paper has given a brief account of the principles of WM, LTM and the interaction between them. Moreover, it has shed some light on how these are impaired in dyslexia and may give an account for the problems experienced by dyslexics in language learning and skills. Further research, could elaborate on: any of the following or, indeed, a combination of these factors: executive functioning and set shifting, attentional control and attention maintenance. The next moves in this paper concern a research conducted at a technical vocational training in the Netherlands involving dyslexic and TD students.

3. Method

3.1 Participants

Participants were recruited from the first year of a four- year technical vocational training college in the Netherlands. A total of ten participants participated; their age ranged between 16 and 18 years at the time of testing. Five had been officially diagnosed as dyslexic. An inclusion criterion for the other five students, who formed the typically developing control group, was that no known learning or developing impairments had been diagnosed or suspected. A further eligibility criterion required individuals to be Dutch males and to have had received English as a second language since primary school.

The participants were recruited during school time and participation was voluntary. A degree of homogeneity was another selection criterion as all participants attended the same level of technical vocational school and then estimated Intellectual Quotient for all participants was therefore estimated to lie between 94-101, typical for their educational profile (http://cruciaaljunior.nl/).

Accordingly, overall school performance of the TD students was at an average level, but as grades tend to be awarded on the basis of different principles, an overall GPA was nearly impossible to name. A special program which offered extra guidance for school work was attended by all five dyslexic participants. The tests were conducted individually in a secluded room during regular school hours.

An individual intake and questionnaire was administered for each participant. The questionnaire was set up to gather information about the social economical background of the pupil, educational background and to assess if dyslexia ran in the family. Furthermore, the possible genetic disposition of dyslexia or other learning disabilities within the nuclear family was checked. Ethical clearance was not sought, as all participants were students taught by the researcher.

3.2 Test Battery

Data was gathered using the following tests: Backward Digit Span Test, Modified Wisconsin Card Sorting Test (M-WCST), Peabody Picture Vocabulary Test-IV (PPVT-4, English and Dutch version) and a Picture Recognition and Word Reproduction test. All of these tests are briefly explicated below.

Backward Digit Span Test

The Background and use of the Backward Digit Span Test

A considerable amount of literature has been published on the Digit Span Test (Howeison & Luzak,2002; Wijsman et al, 2000; Keijzer, 2011; Cowan, 2005). Often (Keijzer, 2011; Cowan, 2005), a reference is made to a prominent piece of literature published in 1956 by G. Miller: " The magical number seven, plus or minus two: some limits on our capacity for processing information". Miller's theory hypothesized that the average memory span of a young adult is limited to seven items, give or take the difference of two items. Miller's 7 has been readily accepted. However, Miller introduced the number 7 as a matter of convenience to tie in with two lines of investigation concerning memory span and his ideas were not meant to be taken as a guideline for test construction (Cowan,2005). Furthermore, Cowan(2008) and Keijzer (2011) argue that research findings indicate that Miller's "seven" plus or minus two items is even more flexible depending on various such as age and mental disorders. An extensive discussion of all the conflicting theories fall beyond the scope of this paper.

The Digit Span Test used in this study is based on that employed in the Wechsler Intelligence

Scale (WIS)(Wechsler, 1955, 1981, 1997) and the Wechsler Memory Scales (WMS)(Wechsler, 1945, 1987, 1997). Note that the Digit Span Test serves as an accurate indication of verbal IQ in adults (WAIS-R, Wechsler 1992) but not in children (WISC III, Wechsler, 1992) (Wijsman et al., 2000). In the Wechsler format of the Digit Span Test the test taker is shown a series of digits (e.g., ‘5, 3, 9, 1’) and asked to immediately repeat them. Repeating can be done verbally or written. If the series of numbers is repeated correctly than an a new series of numbers is presented plus an additional digit (e.g., ‘4, 8, 3, 9, 1’). Once again the test taker is asked to repeat the series and this is repeated continuous until a series of 9 digits has been completed. The longest series of digits a person can recall is said to be the digit-span for that individual.

In more general terms, the Digit-Span Task has three formats; firstly the Forward Digit-Span Test, the test taker is asked to reproduce the numbers in the same order viewed (Wijsman et al, 2000). Secondly, in the Backward Digit Span Test in participant were asked to reverse the order of the numbers seen which is a mental tracking component. Finally, a combination of both Forward and Backward Digit Span Test also exists. In this paper the Backward Digit Span Test was used as the mental tracking element of this test made it a more demanding task for the test taker and seemed therefore a better measure of individual differences. Participants were asked to write down the viewed series of numbers backwards and all candidates were given the chance to do the series of four up to nine digits.

The Backward Digit Span Test in previous dyslexia research

The Digit Span Test, taken from the WAIS-R, Wechsler 1992, has been widely used in dyslexia research (Wijsman et al.,2000). Wijsman et al., investigated the genetic component of dyslexia using a non-word memory task and the Digit Span Test. Both tests have indicated phonological deficits in people with reading impairments (Wagner & Torgesen, 1987). Research conducted by

Wijsman et al.(2000) confirmed Wagner and Torgesen's (1987) findings that a strong correlation existed between Non-word Memory Tasks and the Digit Span Test. As difficulties in non-word reading is a disposition of phonological dyslexics, which is approximately 94 % of all the dyslexics (Hulme & Snowling,2009), the Digit Span Test qualifies to be used in this research.

Aim for using the Backward Digit Span Test in this study

The Backward Digit Span Test was included in this study as it is an efficient and quick manner to test the attentional capacity of WM. Furthermore, it correlates strongly with non-word memory tasks and has proven to be a reliable indicator of phonological impairment (Wagner & Torgesen, 1987.,Wijsman et al., 2000).

Modified Wisconsin Card Sorting (M-WCST)

The Background and use of Modified Wisconsin Card Sorting Test

The Wisconsin Card Sorting Test (WCST) has often been used in clinical settings to neurophysiologically test the pre fontal cortex and, more precisely, Executive Function. Numerous studies have indicated the suitability of WCST to asses individual cognitive flexibility by measuring shifting response mode skills and judging abstraction abilities (Snow,2010; Poljac et al.,2009; Keijzer,2011). In the test, the test taker is required to solve a problem using feedback from the examiner, exercising WM and control of impulsive unfitting answers (Poljac et al.,2009). In this test battery the M-WCST was used. The original WCST test contains 128 response cards of which 80 share 'more than one attribute with a key card', in the Modified version these 80 cards have been ruled out resulting in a deck of 48 response cards (Keijzer, 2011) .As a result of justly eliminating 80 cards the compact modified version is easier, simpler and takes less timer to administer than the original WCST.

In the execution of the M-WCST four different key cards are lain down in front of the test taker. Each card has a different symbol, colours and differs in the number of symbol depictions (see figure 5). The examinee is told that there is a rule and that the objective is to find the rule.

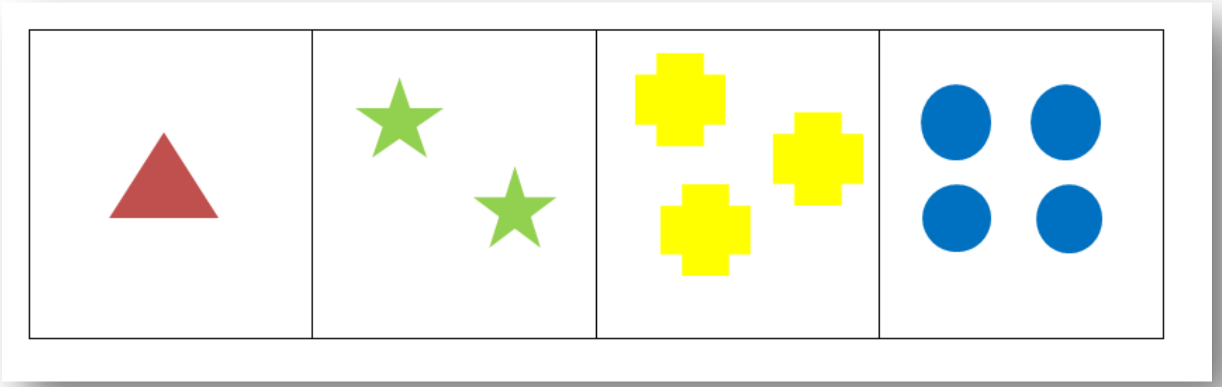

Figure 5: four different Key cards in M-WCST

During testing the examinee is given a stack of 48 ordered cards and is instructed to place the cards, one at a time, underneath the key words and to detect the correct rule. The examiner informs the test taker each time a card had been laid down if the card was right or wrong ("goed" of "fout" in Dutch). Once the examinee has figured out the rule, the rule needs to be applied six times consecutively. After these six trials the examiner instructs the test taker that the rules have changed and that another rule now has to be applied. However, if the participant fails to switch to a new rule and applies the old rule instead he or she is said to make a perseverative error. The number of perseverative errors made is seen as an indication of main signs of frontal lobe dysfunction (Barceló, 2001) . The amount of perseverative errors made during the test lowers the score. A lower score in turn is associated with a lower executive functioning .

The Wisconsin Card Sorting Test in previous dyslexia research

Previously, Poljac et al;(2009) used the WCST to examine cognitive flexibility in dyslexia. The participants (all Dutch native speakers) age ranged between 12 and 18 years old and they had all been diagnosed as either dyslexic, autistic or 'healthy'. The 'healthy' participants formed the control group. Poljec et al; focused on the 'task restarting cost' of the participants when a new rule was imposed during the administration of the WCST. Findings from the 'task restarting cost' revealed that dyslexic children made more errors than both the TD children. Furthermore, dyslexic children were found to make more severe (perseverative) errors than TD children.

Aim for using the M-WCST in this study

The M-WCST had been included in this study, as it is an efficient manner to test the shifting response mode, cognitive flexibility and abstraction abilities. Furthermore, the number of preservative errors made is an indicator of the inhibition abilities of the examinee and dysfunction of the frontal lobe (Barceló, 2002).

Peabody Picture Vocabulary Test –IV (PPVT-4), Dutch and English version

The Background and use of PPVT-4

In-order to test receptive vocabulary the Peabody Picture Vocabulary Test-IV (PPVT-4) has often been employed (Alt,2011; Keijzer,2011). The PPVT.4 (Dunn & Dunn,2007) was at the time of testing the most current version (Keijzer,2011). The test was administered in such a way that the participant was not required to read as the word in question was read aloud by the examiner. The PPVT-4 is divided into sets of 12 words. Initially the sets comprise 'easy' words and gradually the sets become more 'difficult'. The PPVT has been standardized for various languages. In this study the English and Dutch versions were administered. The number of sets for English and Dutch differ, as do the criteria for establishing the starting set, basal set rule and the ceiling set rule. First the English version will be discussed.

The examiner first establishes the starting set for the test taker based on his/her age or in the case of this study the number of school years English was taught and received as a second language. For all participants in this study the starting set was 10, ages 11 to 12. The basal set was determined by seeking the lowest set in which no more than one or no errors were made. Once the basal set had been established the participants were asked to complete the higher sets up until a set was reached in which eight or more errors were made. The set in which eight or more errors were made automatically became the ceiling set. To obtain the participants raw score the total number of errors made were added up and subtracted from the number of words tested during the execution of the test.

As previously mentioned the criteria for the Dutch version varies from the English version. In the Dutch version the starting set was established using chronological age (set 13, 16-35 years of age). Furthermore the basal set was determined by an error factor of no more than four errors and the ceiling set was the set in which no more than nine or more errors occurred.

As testing involved a Dutch and English PPVT-4 version in this study a Native Dutch speaking psychologist, known to the students, administered the Dutch version. The examiner of the English version of the PPVT-4 was a bilingual English teacher. Both examiners worked at the same school attended by the participants involved in this study. Further, administration of the PPVT-4 Dutch and English version differed as the Dutch version, was a paper version whereas the English version was presented digitally. In both cases the examiner conducted the test and administered the results individually. However, the results of both the English and Dutch PPVT-4 were calculated and administered by the same person.

The PPVT-4 in previous dyslexia research

The PPVT, revised version, had previously been used by Scuccimarra et al.(2008) in order to investigate variations between children with developmental dyslexia and children with the co-morbidity of developmental dyslexia and a specific language impairment. Scuccimarra et al.’s (2008) findings indicated that the standard scores on the PPVT for dyslexics were significantly below those for TD children. These findings are corroborated by other research (Badian et al; 1991). However, in both previously mentioned papers the participants tested attended a primary school. Research conducted on dyslexic adolescents seem scarce in comparison to research on primary school and kindergarten children.

Aim for using the PPVT.4 in this study

The aim of using the Dutch and English version of the PPVT was to compare the level of receptive vocabulary of the first language (Dutch) to the second language (English). Moreover, given that Dutch was the first language of the participants the score on the PPVT.4 Dutch version is hypothesized to surpass that on the English version. Conforming to previous research it was hypothesized that the dyslexic students would score lower overall on the PPVT.4 than typically developed students (Scuccimarra et al; 2008; Badian et al; 1991).

Picture Recognition and Word Recall Test

The Background and use of the Picture Recognition and Word Recall Test

The aim of including a picture recognition and word recall test used in this study was twofold, as it measured picture recognition and word recall. This test had been included in the test battery to investigate an assumption based on what is known about technical dyslexic students and the fact that they tend to be visually orientated but have problems with allocating the right spelling to an object (Hulme & Snowling, 2009). Subsequently, this test has never been used before and was constructed especially for the purpose of this study.

The test comprised of two parts. During the first part of the test participants were shown 12 individual pictures (all taken from the PPVT-4, set 18), accompanied by the correct word to describe the picture. Each picture plus the correct word was shown for five seconds. After all 12 pictures had been presented, the second part of the test was initiated. The individual pictures from part one were shown again, but this time the picture from part one was presented in a cluster with three new pictures. The four pictures were labelled 1, 2, 3 or 4, respectively. The examinee was instructed to circle the number that corresponded to the picture seen in part one of the test and was then asked to recall and write down the word that corresponded to that picture (see figure 6).

Part one: *Individual picture with corresponding word*

Part two (a): Individual picture is now in a cluster of 4 pictures.

Part two (b): The examinee is asked to circle the number corresponding to the picture seen in part one and to write down the word corresponding to that picture.

Dia nummer.	Omcirkel juiste nummer. Afbeelding 1 2 3 4	Welke woord hoort bij de afbeelding die jij eerder heb gezien in deze sessie.
Proef Dia:	1 2 (3) 4	Caster

Figure 6: Example from the Picture Recognition and Word Reproduction Test.

In total, participants viewed 12 pictures and 12 accompanying words in a time span of 72 seconds. Therefore, the test no longer relied on short term memory which only holds items for a few seconds or until rehearsal has been aborted (Baddely,1986; Henry,2012). Further research is needed to validate if this test makes use of LTM.

Aim for using the Picture Recognition and Word Recall Test in this study

As previously mentioned, this test had not been used before and hypotheses were therefore necessarily based on personal experience and motivated by findings that dyslexic and TD students do not differ in picture recognition. Conversely, word recognition has been found to be impaired in dyslexic individuals (Hulme & Snowling, 2009). The aim of this test was to determine if visualizing a picture together with a corresponding word aided the cognitive process of word learning in dyslexia. Furthermore, the difference in phonetic word recall between dyslexic and typically developed pupil in the presence of visual stimuli were looked at.

4. Results

The purpose of this paper was primarily to investigate the difference in acquisition level of English as a second language between Dutch dyslexic adolescent pupils and TD students attending the same technical vocational school. A secondary aim was to inform technical vocational language teachers which didactical forms are more desirable considering the high percentage of dyslexic pupils attending technical vocational education. Because most research on dyslexic students has been conducted in the context of pre-adolescent-age students attending non-specialized education, these results may help to understand language development in dyslexic adolescent technical pupils.

Demographics

Table 1 below first of all lists some demographics for the dyslexic and TD groups under investigation.

Table 1: demographic background information for the TD individuals and Dyslexic group under investigation

	Age at time of testing	Profession father	Profession mother	Educational background father	Educational background mother
TD (n=5)	17.50 (1.29)	1.25 (0.50)	1.75 (.50)	0.33 (0.58)	0.00 (0.00)
Dyslexic (n=!	17.40 (0.89)	2.40 (0.89)	3.00 (1.00)	0.50 (0.58)	0.40 (0.55)

The most striking result to emerge from the data was that both the education and the profession of both parents of the dyslexic students were markedly higher than that of the TD students. The relatively high standard deviation for the profession of the mother may be explained on the basis that the five dyslexic students under investigation had mothers who attended a higher form of education, whereas two other dyslexic students had mothers who had completed a vocational education. One dyslexic student had parents who had both completed a vocational education. TD students were not found to be at a familiar risk of dyslexia. Furthermore, of the five dyslexic students, two students had attended special secondary education, while this was not the case for any of the TD students.

Peabody Picture Vocabulary Test IV, English and Dutch

Moving on to the experimental results of this study, Table 2 indicates the receptive vocabulary scores, indicative of relative vocabulary sizes, for both Dutch and English. As all students had the same educational background and were all the same age at the time of testing, the raw PPVT scores were used as the standard ones would not alter the general picture obtained on the basis of this measure:

Table 2: mean scores (and standard deviations) of the two student groups on the PPVT NL and EN

	PPVT NL	**PPVT EN**
TD students (n=5)	169.80 (9.15)	151.00 (17.40)
Dyslexic students (n=5)	149.80 (10.47)	143.60 (21.31)

As can be seen, the difference between the TD group on the one hand and the dyslexic group on the other was considerable. The dyslexic group scored consistently lower than the TD group, indicating a smaller vocabulary size in both their native language Dutch and their second language English. Independent sample t-tests revealed that the difference between both populations was significant in the case of the Dutch PPVT ($t(8) = 3{,}216$, $p < .05$), but no such significant difference could be established for the English PPVT equivalent. Perhaps counterintuitive looking at the scores, the difference between the PPVT NL and PPVT EN was not significant for either group. In other words, on the basis of these scores the students were not better at Dutch than they were in English but this may have been a statistical power problem. It is interesting to note that the scores for the PPVT NL and EN were much closer together for the Dyslexic students but the range of score for greater (attested by the larger standard deviation), indicating greater individual variation among the dyslexic students.

Wisconsin Card Sorting Test & Backward Digit Span Test

Turning now to the monitoring and task shifting components of executive control, Table 3 lists the results with regard to the Wisconsin Card Sorting Test. The units represent the standard composite scores (see method):

Table 3: mean scores (and standard deviations) on the WCST

	WCST standard composite scores
TD students (n=5)	110.80 (11.37)
Dyslexic students (n=5)	117.40 (2.19)

The composite raw scores attained by both dyslexic and TD students yield to a high average score, the score having been equated using the provided tables of the WCST handbook. A high average score ranges in between the composite raw scores of 110-119.

No statistically significant difference was found between both groups. It does need to be pointed out , however, that the dyslexic students' scores were considerably higher and the students were also generally better across the board, as indicated by their smaller standard deviations. In terms of WM, the scores on the Backward Digit Span Test are presented in Table 4.

Table 4: mean scores (and standard deviations) on the Backward Digit Span Test.

	Backward Digit Span Test
TD students (n=5)	6.25 (2.06)
Dyslexic students (n=5)	7.40 (1.34)

In line with the executive control test, the dyslexic students outperformed the TD students, although this difference did not reach significance levels.

Picture Recognition and Word Recall Test.

Table 5, finally, depicts the scores on both the picture recognition and word recall task.

Table 5: mean scores (and standard deviations) on the picture recognition task and the word recall task.

	Word recall (max=12)	**Picture recognition (max=48)**
TD students (n=5)	11.75 (0.50)	33.75 (14.36)
Dyslexic students (n=5)	10.40 (2.61)	37.00 (28.85)

An unbalanced picture emerged here: whereas the TD students outperformed the dyslexic students on the word recall tasks, the situation was reversed in the picture recognition word association task. The word recall task was scored on the basis of four criteria. Points were awarded for an attempt to reproduce a word, phonetically correctness or correct spelling. If the student showed no attempt of reproducing the word no points were awarded. The combination of reproduction and phonetically correct spelling was awarded 0.5 points. Subsequent reproduction of the word correctly spelled received 1 point. Seeing that it was possible to reproduce 12 words the maximum amount of points that could have been awarded was 12. The picture recognition task was graded as being either correct or incorrect. The students had to recognise a picture viewed before this in a context of three new pictures. 12 pictures had to be recognized in total with each having four options (see method) hence, the maximum of 48 points. It must be pointed out that at no point were the differences statistically significant.

Bivariate Correlation Analyses

To see which tests were related, bivariate correlation analyses were run on all tests. For the TD groups, the scores on the tests were not correlated. In other words, the score on one particular tests did not (partly) predict the score on the other. For the dyslexic students, one (substantial) correlation was found in that the score on the PPVT 4 heavily tied in with the word recall task: $r = .93$, $p < .05$.

5. Discussion

The objective of this paper was to assess the difficulty experienced by technical vocational dyslexic students in learning English as a second language and to create a basic neurocognitive understanding of dyslexia. Moreover, the intention of this research paper was to inform technical vocational language teachers which classroom didactical forms are more desirable considering the relatively high percentage of dyslexic pupils. Previous findings have shown that dyslexic students demonstrate difficulty with word recognition, spelling and inability to decode words. The neurological origin of dyslexia has been attributed to impairments in WM and LTM. More specifically, various diagnostic tasks, word recognition and task shifting components of executive control reveal that dyslexics perform significantly more poorly than TD individuals.

The results in this paper represent a particular niche of students who have sought a specialized technical vocational training. Surprisingly, no literature was found which discusses how technically orientated dyslexic students vary in language learning. Instead, this niche seems very much unchartered terrain. It seems desirable to investigate language learning skills in students who have chosen to participate in a training that is less language orientated. Unfortunately, for dyslexic technical vocational students, regardless of their choice of specialization, their English language proficiency must reach an acceptable standard European level. However, the concept of lenient circumstances of language learning for dyslexic students seem improbable as there are various types of dyslexia. Mapping out the specific impairment per dyslexic student would be time-consuming and applying it would be nearly impossible in classroom situations due to lack of time. However as most dyslectics are phonological dyslexics it makes sense to focus on this group.

Moving to the investigation reported in this paper, the data accumulated in the results section of this paper must be interpreted with caution as the study is essentially a case study. Having said that, results of this current study indicate that when compared to TD technical vocational students (matched for age, IQ (plus or minus 5), native language and gender), dyslexic students score significantly lower in terms of their Dutch receptive vocabulary ($t(8) = 3,216$, $p < .05$). This outcome is in line with previous research (Scuccimarra et al; 2008). Surprisingly, the same results were not found for the PPVT-4 English version: the TD students did prove to have a larger vocabulary size but statistically there was no difference. The standard deviation attested for the dyslexic group may be justified on the account that two of the individuals have regular contact with family living in English speaking counties.

Another aspect to be taken into consideration when discussing the results of both PPVT tests is the amount of English that Dutch students are exposed to. An assessment of the number of hours students are exposed to English via the internet and other forms of media seems to be growing and given that English has become entangled in the Dutch society (Bonnet, 2002) immersion of the English language has increased.

Moreover, the ages at which English is learnt by pupils may explain why a statistical difference was found for Dutch vocabulary but not for English vocabulary. A majority of vocabulary is acquired by children at a young age when the LTM declarative memory is more active than the procedural memory. Therefore, young Dutch dyslexic children, whose declarative memory is impaired (Rhode, 2010; Ullman, 2004), are disadvantaged in Dutch vocabulary learning. Whereas Dutch children learn English as a second language in Dutch schools from the age 10 onwards. At approximately this age children's cognition processes start to rely more on procedural memory (explicit learning) than declarative memory. As English is learnt at a time that explicit learning is dominant and if word learning tasks are presented in a broader context, e.g. in a sentence, the student may learn words in a general context or in chunks and recall them in the same fashion. During implicit learning the students learn sole words and rely on the procedural LTM to form sentences (Ullman, 2004). This may mean that older dyslexic student may recall the context of English word directly from procedural memory instead of first consulting the declarative memory for a sole word. Moreover, the anchoring deficit in dyslexia was used to explain why word learning is more laborious in dyslexia. Yet, anchoring of words in dyslexia maybe further complicated at a young age as the declarative memory is impaired. However, taking into consideration that older children learn using procedural memory, which is not impaired in dyslexia, than the process of anchoring words (or rather chunks of words) may be less disadvantageous for older children. Preferably, research looking into the profitability of teaching English as a second language for young dyslexic students is called for especially as Dutch vocabulary seems impaired in dyslexic students. Further research should be done to investigate the effects of anchoring deficit in explicit learning as phonological probability and phonological strategies, impaired in dyslexia (Alt, 2011; Ahissar, 2007), are not taken into account. The difficulty experienced in phonological probability and strategies make it more bothersome to encode words for dyslexics.

The previous discussion ties in with the results of the Picture Recognition and Word Recall test. The picture reproduction test and the word recall test are thought to call upon the LTM as 155 seconds in total, which exceeds the capacity of the WM, had passed by before the student was asked to recall the first word and its corresponding picture. Seeing these tests were used for the first time there are no comparative results. Despite the fact that neither of the scores were statistically, significantly different the outcome does yield an potentially interesting discussion. The dyslexic pupils outperformed their TD peers on picture recognition task which might be explained along the lines of explicit learning. The initial pictures viewed by the test taker were all depicted in an holistic manner, as the subject of the picture is drawn using a background that contributes to the meaning of the subject (see figure 6). Furthermore, Hulme and Snowling (2011) describe findings in which dyslexic children were found to perform normally in picture associating tasks, although, this still fails to explain why the dyslexic group scored higher than TD individuals. A further explanation might be that dyslexic adolescents have learnt - via conditioning behaviour – to rely more on their visual skills as to compensate for a deficit in language skill

In contrast to the picture recognition task, TD students outperformed the dyslexic group in the word recall test. Bearing in mind that phonological probability and phonological strategies are impaired in dyslexia the results are not unexpected. As words unknown to the students were used for the word recall test, reproduction heavily relied on phonological probability and phonological strategies. Furthermore, given that students had ten seconds to memorize a word and its corresponding picture, it is probable that the articulatory rehearsal of the phonological loop was triggered in-order to commit a new word to LTM. The phonological loop being impaired in dyslexia makes word learning quite complicated. Yet, in this context it is worth mentioning that for dyslexic students, one (substantial) correlation was found in that the score on the PPVT-4 heavily tied in with the word recall task: $r = .93, p < .05$.

Moving on to the discussion of the M-WCST results. No statistically significant difference was found between both groups, although the dyslexic students' scores were considerably higher. What is more, the standard deviation was small. Bearing the statistical power problem in mind, previous findings indicate that (Wijsman et al.; 2000; Wagner & Torgesen's, 1987; Poljac et al; 2009) TD individuals score higher in task shifting components of executive control tasks dyslexic individuals. However, in the case of this paper the reason for the higher score for dyslexics in the executive control tasks may be clarified by over-compensation of the right brain hemisphere in dyslexia (Marshall, 2003). This could lead to a very tentative query: 'is tracking in the right hemisphere developed to such a degree in technical dyslexic students that it entirely compensates the left hemisphere in dyslexia?'. Future research would integrate a literature review on the development of the two brain hemispheres in dyslexic adolescences.

Taking into account that in previous WCST results dyslexics scored lower and in this paper they scored higher, it would be interesting to perform the WCST again for a larger group of technical dyslexic pupils and compare the results to an equivalent group of dyslexic students from a totally different vocational training (e.g. Business Management). An expectation for such a study is that dyslexics attending a technical vocational training will outperform dyslexics from a non-technical training. A possible explanation may take into account that development and activity of the left and right brain hemispheres differ between technical and non-technical students.

One of the most unexpectedly revealing results in this study was the higher educational and professional level of the parents from dyslexic students (table 1). All five of the dyslexic students interviewed indicated that one of their parents was dyslexic, as were other siblings, and in one case extended family was also referred to as being dyslexic. All in all, dyslexia ran in the family and accordingly appropriate measures had been taken to facilitate the dyslectic offspring. Provided that in dyslexia cognition requires more time and energy, which becomes evident during learning tasks at school, often lead to school results not corresponding to the assumed potential capacity of the student. Such incidents result in parents or guardians and teachers seeking explanations as to why education poses to be so laborious for their/a child . This could be seen as a fundamental argument to support Harvey's (2010) statement that the term dyslexia has become 'a Middle class disease to clarify underachievement of their child'. This statement will doubtless be much scrutinized, but in a more positive light recognition of dyslexia may implicate that parents are concerned about the future of their child. Parents' concern most likely shows an attempt to help their child acquire a comfortable position in society.

Overall, the literature review and results suggest that classroom pedagogical recommendations may be made for English language teaching in Dutch technical vocational education. Firstly, given that declarative (implicit learning) is impaired in adolescent dyslexic individuals and procedural (explicit learning) has the upper hand an advice is to present words to be learnt in a sentence construction, preferably each word in more than one sentence to indicate that a word may be used in different contexts and connotations. Secondly, as indicated, visual recall is intact in dyslexia and visuospatial may be impaired in some dyslexics. Didactical deductions made from these findings imply that dyslexic students are aided by books and lesson presentations with a spacious outlay and backed up by visual aids, pictures, comics, short video's, et cetera as suggested by Van Berkel (1999) & Ball (2004). Thirdly, as technical vocational training tend to cater for a significant amount of dyslexic students, it is advisable to use dyslexic 'friendly' methods for the whole class. As there is no indication that TD students will not benefit from these methods, all in all this could lead to a beneficial learning environment for all. Furthermore, by using methods that appeal more to dyslexics the work load of teachers may decrease and the probability that dyslexic pupils achieve better results may increase. Fourthly, with regards to the impaired phonological loop and phonological probability mechanism in dyslexia research is needed to indicate what the profitability of hearing and speaking more English in a classroom situation would be. Preferably English could be used as the language of tuition for various subjects such as: Technical lessons and practical lessons. As phonology is problematic in dyslexia a native or near native pronunciation of the English language seems desired. Finally, overall deficit in anchoring and automaticity would bequeath that repetition of the curriculum is desired. Presumably, as anchoring is impaired in dyslexia an advice for more time would extend further than only for language orientated school subjects.

A question that remains concerns the potentially stronger executive functions in this particular niche of dyslexics, but a larger group of technical dyslexics students need to be assessed to corroborate the results found in this paper. Moreover, if executive functions really do differ in this particular population how can didactical forms for dyslexic technical vocational students take this into account? What is more, dyslexia may not be the only learning disorder that relies more on the right brain hemisphere and other regions of the brain for cognition. Accordingly, the high co-morbidity with ADHD may call for further research in particular educational niches where ADHD is more common than in other specializations, in-order to design didactical forms that may cater for a substantial percentage of students in that particular vocational training.

6. Conclusion

The purpose of this study was to investigate dyslexic adolescent students in a particular niche namely that of Dutch technical vocational education. What is more, findings from the literature review and results section were used to form pedogically informed advice for English teachers at a technical vocational training school.

The main findings from both the literature review and the results section confirm that dyslexic students have impaired word learning skills, most likely resulting from a phonological impairment, anchoring deficit and an impaired declarative memory. Contrary, picture recognition was not found to be impaired. Surprisingly, the executive functions of WM and set shifting skills yielded different results than in previous studies, which creates opportunities for further research. Further research could be a reconstruction of this study but with a larger group of participants in order to overcome the statistical power problem of this paper. Taken together, these results suggest that dyslexic students attending a technical vocational education will benefit from didactics, lesson presentation and text books, taking the findings of this paper into consideration. A number of caveats need to be pointed out regarding the present study. The foremost limitation to be reckoned with is the statistical power problem, making it hard to generalize the present study's findings. Apart from limitations concerning this paper, what should not be forgotten is the feasibility of actually using adapted didactical forms which might be more time consuming for the teacher. However, the consequence of actually using appropriate didactic forms may strongly benefit dyslexic students on the long run and maybe even TD students.

Moreover, in further research the test battery should include more assessments and tests in-order to investigate other language skills. A potential test battery would consist of the following supplementary tests: Comprehension Assessment of Spoken Language (CASL), Test of Word

Reading Efficiency (Towre 2), The Diagnostic Assessments of Reading with Trial Teach Strategies (DAR-TTS): (http://dyslexiahelp.umich.edu/).

Hopefully, prospective findings of these above tests will contribute to a broader indication of understanding between the differences of dyslexic technical vocation students and TD technical vocational students. Such a growing amount of research findings could create a blueprint for sound didactical improvements. Moving away from the focus on technical vocational training, second language learning in vocational education on the whole deserves more attention as possessing knowledge of learning abilities per niche may enhance learning outcome.

7. References

Alt, M. (2011). Phonological working memory impairments in children with specific language impairment: where does the problem lie?. Journal of Communication Disorders 44 (2011) 173-185.

Ahissar, M.(2007). Dyslexia and the anchoring-deficit hypothesis. Trends in Cognitive Sciences. Vol.11 No. 11

Baddeley, A. & Hitch, G. (1974). Working Memory. The Psychology of Learning and Motivation. Volume 8. Bower, G.H. Academic Press INC.

Baddeley, A.(1986). Working Memory. Oxford science publications.

Baddeley, A.(2003). Working Memory and language: an overview. Journal of Communication Disorders 36 (2003) 189-208.

Badian, N.A., Duffy, F.H., Alb, H., McAnulty, G.B. (1991) Linguistic Profiles of Dyslexic and Good Readers. Annals of Dyslexia, Volume 41, Issue 1, pp 221-245.

Barceló, F., Muñoz-Céspedes, J.M., Pozac, A.M., Rubiac, F.J.(2000). Attentional set shifting modulates the target P3b Response in the Wisconsin card sorting test. Neuropsychologia 38 (2000) 1342±1355

Barceló, F., Knight, R.T. (2002). Both random and perseverative errors underlie WCST deficits in prefrontal patients. Neuropsychologia 40 (2002) 349-356

Ball, S. (2004). WESFORD 1 and WESFORD 2. Dyslexia Resource File. Wiltshire Learning Support Service, Country Hall, Trowbridge, Wiltshire, BA14 8JE.

van Berkel, A.J. (1999). Niet van horen zeggen. Leren spellen in het Engels als vreemde taal. Coutinho, Bussum.

Bonnet, G. (2002). The Assesment of Pupils' skills in English in Eight European countries. Commissioned by IE European Network of Policy Makers for the Evaluation of Educational Systems.

Catts, H.W., Adolf, S.M., Hogan, T.P., & Weimer, S.E. (2005). Are Specific Language Impairment and Dyslexia Distinct Disorders?. Journal of Speech, Language, and Hearing. Volume 48. 1378-1396.

Cowan, N. (2008). What are the differences between long-term, short-term, and working memory? Progress in Brain Research. 2008; 169: 323-338.

Cowan, N.(2005). Working Memory Capacity. Essays in Cognitive Psychology. East Essex: Psychology Press, Taylor & Francis Group.

Dunn, L. M., & Dunn, D. M. (2007). Peabody picture vocabulary test (fourth edition). Minneapolis: Pearson Assessments.

EF English Proficiency Index 2012. www.ef.com/epi

Ehri, L.C. (2009). Learning to Read Words: Theory, Findings, and Issues. Scientific Studies of Reading, 9:2, 167-188.

Fassbender,& Schweitzer (2006).Is there evidence for neural compensation in attention deficit hyperactivity disorder? A review of the functional neuroimaging literature.

Firth, U. (1985). Beneath the Surface of Developmental Dyslexia. icn.ucl.ac.uk

Harvey, T.A. (2010) Talking the Talk, Language: Psychology and Science. Psychology Press. Taylor & Francis Group. Hove and New York.

Hegarty, M.; Shah, P.; Miyake, A.(2007) Constraints in using the dual-task methodology to specify the degree of central executive involvement in cognitive tasks. *Memory and Cognition* **2007,** *28,* 376-385

Henry, L. (2012). The Development of Working Memory in Children. Sage publications

Hulme, C., & Snowling, M.J. (2009). Development Disorders of Language Learning and Cognition. Chichester: Wiley-Blackwell.

Keijzer, M. (2011). Crossing communication borders: first language reversion in healthy, aging Dutch migrants in Australia. Veni project 2011-2012, University of Utrecht.

Keijzer, M. (2013). Working memory capacity, inhibitory control and the role of L2 proficiency in aging, near-native L1 Dutch speakers of L2 English. Brain sciences .2013 manuscripts

Keysers, C. (2011). Het Empathische Brein, waarom wij socialer zijn dan we denken. Bert Bakker/Prometheus.

Marshall, A. (2003). How the Newest Studies Show why Dyslexics Must Use Unique Strategies for Reading, and How Davis Methods Build those Strategies. Brain Science and Dyslexia. July 2003

Noijons, J., & Kuipers, H. (2006). De koppeling van de centrale examens leesvaardigheid modern vreemde talen aan het Europees Referentiekader. Verslag van een onderzoek in opdracht van het Ministerie van Onderwijs, Culture en Wetenschap.

Owen, A.M., Roberts, A.C.,Polkey, C.E., Sahakian, B.J., Robbin,T.W.(1991).Extra-Dimensional versus Intra-Dimensional set shifting performance following frontal lobe excisions, temporal lobe excisions or amygdalo-hippocampectomy in man. Neuropsychologia.Vol29.No.10. pp. 993-1006.

Oyler, J.D., Obrzut,J.E., & Asbjornsen,A.E. (2012).Verbal Learning and Memory Functions in Adolescents With Reading Disabilities. Learning Disability Quarterly 2012 35:184

Poljac, E., Simon, S., Ringlever, L., Kalcik, D., Groen, W., Buitelaar, J.K. & Bekkering, B. (2009). Impaired task switching performance in children with dyslexia but not in children with autism. The Quarterly Journal of Experimental Psychology, 63:2, 401-416.

Poulsen, M., & Elbro, C. (2012). What's in a Name Depends on the Type of Name: The Relationships Between Semantic and Phonological Access, Reading Fluency, and Reading Comprehension. Scientific Studies of Reading, 00:1-12, 2013

Repovš, G. & Baddeley, A. (2006). The multi-component model of working memory: explorations in experimental cognitive psychology. Neuroscience 139 (2006) 5-21.

Rhode, A. (2010). Receptive L2 lexical knowledge in bilingual preschool children. In K. Kersten (ed.) *Bilingual preschools. Vol.1:Learning and Development.* WVT: Trier. Pp. 45-68.

Rudner, M. & Rönnberg, J. (2008). The role of the episodic buffer in working memory for language processing. Cognitive Processing (2008) 9: 19-28.

Sinzig et al;2008:Inhibition, flexibility, working memory and planning in autism spectrum disorders with or without comorbid ADHD-symptoms. Child and Adolescent Psychiatry and Mental Health 2008, 2.4.

Snow, J.H.(2010).Development Patterns and Use of the Wisconsin Card Sorting Test for Children and Adolescents with Learning Disabilities. Child Neuropsychology: A Journal on Normal and Abnormal Development in Childhood and Adolescence, 4:2, 89-97.

Scuccimarra, G., Cutolo, L., Fiorilli, P., Lembo, C., Pirone, T., Cossu, G. (2008). Is There a Distinct Form of Developmental Dyslexia in Children With Specific Language Impairment?: Findings from an Orthographically Regular Language.Cognitive & Behavioral Neurology: December 2008 - Volume 21 Issue 4 - pp 221-226.

Storkel, H.L. (2001) Learning New Words: Phonotactic Probability in Language Development. Journal of Speech, Language, and Hearing Research Vol.44 1321-1337.

Ullman, M.T. (2004). Contributions of memory circuits to language: the declarative/procedural model. Cognition, Volume: 92 Issue: 1-2 (May 2004 - June 2004), pp: 231-270

Vellutino, R.F, Fletcher, J.M, Snowling, M.J, Scanlon, D.M. (2004). Specific reading disability (dyslexia): what have we learned in the past four decades? Journal of Child Psychology and Psychiatry 45:1 (2004),pp 2-40

Wijsman, E.M, Peterson, D. Leutenegger, A, Thomson, J.B, Goddard, K.A.B, Hsu, L, Berninger, V.W, Raskind, W.H. (2000). Segregation Analysis of Phenotypic Components of Learning Disabilities. I. Nonword Memory and Digit Span. American Journal of Human Genetics 67: 631-646 (2000)

Wiseheart, R., Altmann, L. J. P. & Park, H.(2009). Sentence comprehension in young adults with developmental dyslexia. Annals of dyslexia. Volume: 59, issue:2(December 1, 2009), pp:p151, 17p

Internet sites:

http://www.cognitiveatlas.org/task/id/tsk_4a57abb949a5d

http://www.britannica.com/EBchecked/topic/130954/concept-formation#toc70201

http://www.kwalificatiesmbo.nl/taal-en-rekenen.html)

(http://dyslexiahelp.umich.edu/professionals/learn-about-dyslexia/diagnosing-dyslexia/tests).

rocmn.nl, 2013 intra net statistics dyslexia 2013