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Developmental Dyslexia and Compensatory Skills: The man who could not read but learned to fly.

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ABSTRACT

The difficulties that individuals with developmental dyslexia face, makes it challenging to diagnose, to develop appropriate intervention strategies and teach coping and learning skills. However, many individuals with developmental dyslexia develop their own strategies and compensatory skills to cope. An instrumental single case study was used to explore the experiences of a young man, Paul, who had been formally diagnosed with severe developmental dyslexia as a child, with co-morbid difficulties with attention and dyspraxia.

The five dimensions of difficulties or barriers that Paul experienced, and thus where compensation had to take place were explored in this study. These allowed him to develop the strategies, methods and skills necessary to cope with the barriers he faced to become a pilot. Ongoing evidence of difficulties drawn from a screening test, despite the presence of a high IQ level, are also presented to enrich the data, and quotations from interviews included to allow the adult's voice to be heard.

Keywords: Developmental dyslexia, compensatory skills, barriers to learning, learning difficulties, coping mechanisms, instrumental single case study.

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INTRODUCTION

Developmental dyslexia affects between 10 – 17 % of the population, regardless of culture, class or gender, in countries with alphabetical languages (Dyslexia International, 2017; Shaywitz, 1998). This figure has been found to be as low as 3.9 % in countries such as China where people speak and read non-alphabetical languages (Sun, Zou, Zhang, Mo, Shao, and Zhong, et al., 2013). Regardless of the population affected by developmental dyslexia, it has been found that males are more severely affected than females by developmental dyslexia, and are thus more likely to be diagnosed with the disorder. Developmental dyslexia is a life-long, neurologically-based condition that is often inherited (Dyslexia International, 2017; Reid, 2011; Rutter, 2008; Snowling, 2000; Thomson, 2009). The advanced brain scanning equipment available today as well as ongoing brain study research linked to developmental dyslexia has been able to clarify developmental dyslexia as a brain-based, neuro-developmental disorder (Vellutino, Fletcher, Snowling, and Scanlon, 2004). Individuals with developmental dyslexia are at a distinct disadvantage, especially when they have a more severe form of this disability, as they struggle to learn to read, and therefore perform poorly at school. This may lead to several barriers and other co-morbid difficulties that they must compensate for if they are to succeed and pass secondary school.

LITERATURE

Owing to the complex nature of developmental dyslexia and unique combination of traits everyone may exhibit, it has taken many years for consensus to be reached about a universally recognised definition for this disorder. Although most definitions cover similar basics, all agree that developmental dyslexia is a brain-based disorder, characterized by a difference in the way the individual with dyslexia processes information, as the following definition explains:

> *"Dyslexia is a difference in how children and adults process information. That is, how they take information in (input), how they understand it, memorize it and organize it in their mind (cognitive processing), and how they demonstrate they know this information (output). Dyslexia is often characterized by difficulties in literacy acquisition affecting reading, writing, and spelling. It can also have an impact on cognitive processes such as memory, speed of processing, time-management, co-ordination, and automaticity. There may be visual and/or phonological difficulties and there are usually some discrepancies in educational performances"* (Reid, 2011, p. 13)

Without early, accurate diagnosis, and relevant intervention programmes, prognosis may be poor because, due to genotype and neurological impairments, the condition is irreversible. The importance of early diagnosis, treatment, and intervention has been stressed as vital to assist many individuals with developmental dyslexia to reach a

maximum level of reading competence (Reece, Booth, and Jones, 2016; Spitzer, 2012). It is also important to note that many dyslexic children and adults display a range of co-morbid conditions, with the incidence so high that Kaplan and colleagues (2001) note that comorbidity is the rule not the exception, with at least 50% of children with dyslexia also showing ADHD and or dyspraxia.

THEORETICAL FRAMEWORK

The Information Processing Model (IPM) (Ashcraft, 2006; Anderson, 2005; Ehri, 1995; Frith, 2002; Hunt and Ellis, 1999; Schunk, 2000; Morton and Frith, 1995; Seymour, 1997) was utilised as part of the fundamental theoretical framework or developing theory to underpin this study, as it addresses all the cognitive processes, which influence lexical access, as well as the ability to learn to read successfully and acquire functional reading skills. This may shed light on how individuals with developmental dyslexia compensate through processing information differently, thus learning how to read successfully in many cases.

In addition to the IPM, this study made use of the Causal Modelling Framework (CMF), described by Morton and Frith (1995) and Frith (1997, 1999, 2002) as an additional framework for understanding and discussing developmental dyslexia. The CMF framework was chosen because it included the three primary dimensions in which research on dyslexia focuses namely, the biological/neurological, cognitive/learning and behavioural/educational, as well as the interaction of these three dimensions with cultural and environmental factors. This model appeared to cover the majority of the current research available on dyslexia and seemed to be an appropriate model to conceptualise and explain developmental dyslexia. The IPM mentioned previously, fits within the cognitive domain of the CMF.

AIMS

An instrumental single case study was used to explore the experiences of a young man who had been formally diagnosed with severe developmental dyslexia. Firstly, the various barriers he faced as a result of having developmental dyslexia were examined. Secondly, the compensatory techniques and skills he used in order to learn to read sufficiently in order to pass secondary school, go on to tertiary studies and to realise his lifelong dream of becoming a pilot were also explored. Additionally, the study described how and by whom the male participant with developmental dyslexia was assisted to pass secondary school and go on to tertiary studies. The final aim of the study was to create a new five-dimensional interactive/multi-dimensional model from the results of the study, as well as additional information from the researcher's exposure to other people with developmental dyslexia over the course of the research period, as well as prior to, and after this. The model assists to illustrate the complexity of developmental dyslexia and the difficulty in diagnosing and treating the disorder, as each individual presents with a different set of difficulties or factors. This multi-dimensional model includes: the

neurological factors, the intrapersonal factors, the interpersonal factors, the behavioural factors, as well as the emotional factors. This model will be explained in a separate article; as will the explanation of how and by whom the participant was assisted to pass secondary school.

Compensating for Developmental Dyslexia

Reid (2011, p. 3) suggests that "dyslexic difficulties persist even when reading skills improve, and that dyslexia has an impact on all areas of learning". Reid (2011) proposes that as these children go through school, they learn to use compensatory strategies to cope with challenges and can become quite adept at this. However, he does not elaborate on how they go about doing this.

Individuals with developmental dyslexia often make use of individual compensatory techniques, strategies, methods and skills while learning or coping with the various difficulties they face because they have this disorder (Beaton, 2004; Bruck, 1990; Burns, Poikkeus, and Aro, 2013; Corkett, Hein, and Paririla, 2008; Frith, 1986; Nation and Snowling, 1998; Nicolson and Fawcett, 2010; Ramus, 2001; Ramus, Rosen, and Dakin et al., 2003; Reid, 2009; Ullman and Pullman, 2015). Approximately one-fifth of individuals with developmental dyslexia manage to compensate for their underlying learning difficulties and develop adequate reading skills by the time they reach adulthood (Lyytinen, Erskine, Aro, and Richardson, 2006). However, the mechanisms by which this compensation occurs remain largely unknown, and there is little evidence about long-term compensation towards adulthood (Hoeft, Mc Candliss, Black, Gantman, Zakerani, Hulme, et al., 2011). If individuals with developmental dyslexia are able to consciously compensate (CC) whilst reading, as described by Nicolson and Fawcett (2010), through hard work and an act of the will, and thus perform at seemingly normal levels, then, one could assume that they would be highly motivated human beings. Nicolson and Fawcett (2010, p. 64) suggest that motivation holds the key to most human learning, as does allowing the learner to be in control of his or her learning, as well as making learning and interventions relevant and fun.

Although many of these compensatory skills begin at school, not all these strategies are positive or useful. Scott (2004, p. 55) found that

> *"for the clear majority of dyslexic adults and children, school has been a place of academic, psychological and often physical torture ... school for them, was destructive and humiliating, a nasty degrading experience, sometimes of raw brutality, of which modern society should be deeply ashamed".*

These are comments that others in the field have echoed (Alexander-Passe, 2010, 2015; Fawcett, 1995; Riddick, 1996).

Participant

The participant in this study was a 28-year-old South African male, with pseudonym "Paul". He was diagnosed as a child with a severe form of developmental dyslexia. The disorder, which affected almost every area of his functioning, was diagnosed by a clinical psychologist in 1995, when he was 10 years old. A second cognitive test, the Wechsler Adult Intelligence Scale (WAIS, Wechsler, 1997); relevant scholastic tests; as well as the Dyslexia Adult Screening Test (DAST, Fawcett and Nicolson, 1998); were conducted by the researcher to confirm the severity of the developmental dyslexia experienced by Paul for this study; as well as the combination of challenges he faced as a result of his developmental dyslexia. Paul is Afrikaans-speaking, and attended a school where Afrikaans was the medium of instruction. He was taught English as a second language. He grew up in a small town in South Africa, where there were few resources available to children with learning challenges. At the time, very little was known about developmental dyslexia, and his teachers had received no training and thus had limited if any knowledge of this disorder.

Design

The research paradigm was based on social constructivism as described by Creswell (2012, 2013, 2014), Crotty (1998), Henning, Van Rensburg and Smit (2004); Lincoln, et al., (2011), Merriam (2002), Merriam and Tisdell, (2016), and Mertens (1998, 2010); and interpretivism as described by Cohen, Manion, and Morrison (2007). Within the combined constructivist-interpretivist worldview, a qualitative case study research design was used. Qualitative researchers study things in their natural settings, attempting to make sense of or, interpret phenomenon in terms of the meaning people bring to them (Denzin and Lincoln, 2013, p. 7). Therefore, this approach strove towards a more comprehensive, holistic understanding, in exploring, understanding, as well as making sense and meaning of the participants' recollection of how he compensated for his barriers arising from developmental dyslexia, and what compensatory strategies he used (Merriam, 1998, p. 75). A case study design was chosen as the appropriate qualitative design for this study, as it enables the researcher to understand a real-life phenomenon in depth; in context; relies on multiple sources of data or evidence. This data needs to converge and must be triangulated (Creswell, 2009, 2012, 2013, 2014; Mertens 2010; Stake, 1995, 2005, 2006; Yin, 2009, 2012, 2014).

METHOD

The data collection methods included two phases, namely, semi-structured interviews and collection of other collateral information. This was followed by verification of the data and data analysis. Data analysis commenced immediately after the first data was collected and was used to form the subsequent data.

Initially a multiple-instrumental case study of five male participants was described. However, the design was changed to a single instrumental case study design (Creswell, 2009, 2012, 2014; Geering, 2007; Mertens, 1998; Rule and John, 2011; Stake, 2006, 1995; Thomas, 2011; and Yin, 2009, 2012); where a single male participant was chosen, as Paul's data was more detailed than any of the other participants. An instrumental case study design allows for "thicker, rich descriptions", greater depth and understanding of developmental dyslexia within its real-life context, its contexts scrutinized, and activities detailed (Creswell, 2012, p. 465; Rule and John, 2011, p. 4 and Stake 2005, p. 445).

Data analysis

All data collected was analysed by using a six-phase thematic analysis method as described by Braun and Clarke (2006). Thematic analysis was conducted from a constructivist perspective; where meaning and experience are socially produced and reproduced; which does not seek to focus on motivation or individual psychologies, but instead seeks to theorize the sociocultural contexts, and structural conditions, that enable the individual accounts that are provided (Braun and Clarke, 2006, p. 85). Thematic analysis is a method for identifying, analyzing, and reporting patterns or themes within data. It minimally organizes and describes the data set in rich detail (Braun and Clarke, 2006, p. 79).

FINDINGS

The five dimensions of difficulties or barriers that Paul experienced, and thus where compensation had to take place, in order to allow him to develop the strategies, methods and skills necessary to cope with the barriers he faced, were identified according to the five dimensions explained previously.

Dimension 1: Biological and Neurological factors

Due to the fact that Paul did not undergo any scans, it is virtually impossible to comment on or to draw many concrete conclusions regarding the biological or neurological factors that may have affected him. Paul had a genetic vulnerability and probably inherited developmental dyslexia from his father and grandfather, as both had very similar reading and other difficulties to Paul. However, neither was officially "diagnosed" as having developmental dyslexia. Pennington (1999) suggested that if one parent is dyslexic that 50% of the children inherit this vulnerability. Gilger, Pennington and De Vries, (1991) estimate a slightly lower risk of 40%. Paul may have inherited the dyslexia via a combination of complicated and varied factors, but mention of any particular factor without evidence of such would be pure speculation. As a male he had a higher risk of having a more severe form of developmental dyslexia (Rutter et al., 2004).

There was nothing that could be done to prevent Paul from inheriting the developmental dyslexia which is a brain-based neurodevelopmental, life-long condition (Frith, 2002). The disorder, which affected almost every area of his functioning, was diagnosed by the clinical psychologist in 1995, when he was 10 years old and verified for this research by the Dyslexia Adult Screening Test (Fawcett and Nicolson, 1998).

However, Paul also inherited the cognitive potential for success, as the maternal side of his family were and are successful academic achievers in their respective fields. The importance of early diagnosis and intervention (Hulme and Snowling, 2009; Reid, 2009; Stein, 2008), and the fact that Paul was only diagnosed at age 10 means that he started at a "disadvantage" as a result of a late diagnosis (Elbro, Nielson and Pietersen, 1994; Reid, 2011; and Wise, Ring and Olson, 1999). On the continuum of developmental dyslexia from mild to severe, Paul has severe dyslexia.

Although visual stress is a complex and often controversial topic in the field of developmental dyslexia, it is appropriate to mention here that Paul was prescribed dark green glasses to assist with reduction of glare which he has found does affect him negatively as can be seen in the quotation that follows. To compensate for this, Paul saw an optometrist when he was in Grade 4, who used a colorimeter to test what specific colour lenses would reduce the glare or visual stress for him. The optometrist was able to prescribe the correct colour lenses which stopped some of the glare of the white paper and black ink that made him feel "blinded". To compensate for visual stress/glare, Paul uses bright yellow paper and writes with dark/black pens for contrast.

> *"I take the information and put it on yellow paper, it's less intimidating then. Somehow the brain responds to yellow paper, to a yellow background, it's got a calming influence…the white is too glary. I can't identify anything on white, it's just one enormous lump … it's just one big block … I can't see (black on white) … I've got green glasses that I read with, green glass lenses … from the colorimeter that assists with it … given specifically from a person that did tests for children with difficulty, with learning disorders (optometrist) … you get students who one lens is pink and the other one is blue … also I get headaches if I read too long from a page that's a white page without the glasses. I can't see the letters, it's as if I'm being bombarded with information".*

Due to the fact that no scans were conducted and having no access to what was happening in the participant Paul's brain, little more can be described about compensation in this domain.

Dimension 2: Intrapersonal factors

Intrapersonal factors includes the executive control; information processing; cognition; behaviors (which manifest in various learning difficulties); personality and disposition;

co-morbid conditions; as well as internal and personal coping skills.

Paul had to overtly take control of his Executive Functioning (EF) by choosing to persevere. From the beginning he was committed to never giving up and achieved this with help from his mother. He was constantly aware of the consequences of his choices, which took enormous internal energy and courage. Therefore, it is reasonable to assume that Paul adopted strategies which include various adapted executive functions such as planning, shifting and inhibiting skills, which he employed to either overcome his sequential and speed deficits, or to effectively and automatically utilise contextual cues in order to achieve maximal reading performance (Cohen-Mimran and Sapir, 2007; Locascio, Mahone, Eason, and Cutting, 2010).

When Paul was initially diagnosed, his mother gave up full time work and spent every afternoon assisting him to revise the work from the day at school. To compensate in EF, Paul learnt how to plan and organise himself, through the example set by his mother when he was young. Additionally, all his work thereafter was meticulously labelled, colour-coded, highlighted, summarised and rewritten in a form that made it easier for him to learn, understand and move to his long-term memory (LTM). Paul had to learn to plan and study months ahead of any test or examination to prepare adequately to pass and meet the minimum requirements. It took hours of rehearsal, anchoring, and the use of study techniques such as highlighting, acronyms and repetition, to move the work from his short-term memory (STM) to his LTM (Banai and Ahissar, 2010; Fry, 2012; Reid, 2011).

At the sensory level, Paul struggled to absorb information accurately in the visual and auditory form in the brain. He managed to compensate for this through constant rehearsal and, owing to plasticity of the brain, he was able to develop the skills of decoding and functional phonemic awareness (Francheschini, Gori, Ruffino, Viola, Molteni, Facoetti et al., 2011; Pruitt et al., 2016; Reece et al., 2016). This enabled transfer of information from his poor STM and working memory (WM) to his better-developed LTM. (A standardised cognitive assessment was conducted to determine this).

In terms of manifestations of life-long scholastic and literacy difficulties Paul experienced poor literacy skills including poor spelling, reading, word recognition, writing and numeracy skills, which is everything needed to succeed at school. Paul struggled with poor rapid naming speed, and automaticity, which has been linked to cerebellar dysfunction (Fawcett and Nicolson, 2008; Thomson, 2009); as well as poor working and short-term memory skills, which meant he had to repeat work to move it to his long-term memory store. Data from the DAST completed as part of this project will be reported later in this article to confirm and extend these findings, outlining the continuing difficulties suffered as an adult by a child with a full clinical diagnosis of dyslexia.

However, in spite of the above-mentioned learning barriers, Paul managed to learn to read by constant repetition, hard work and drilling in the afternoons with his mother. She

made him learn his spelling, sight words and times tables repeatedly. He also had Occupational Therapy (OT) to assist with poor motor skills, and extra lessons right through to secondary school. He was able to pass Grade 12, and gain entrance to University. Paul compensated by using various studying techniques to assist him. Although he was able to recall the facts through visual and auditory anchoring techniques, he had trouble applying, and comprehending the work, including understanding or interpreting what the questions required of him. Paul discovered through experience that to comprehend what he was learning he needed to see the bigger or whole picture and then fill in the details, so that he could make sense of it. Paul also struggles with poor sequencing ability.

In addition to developmental dyslexia and the associated learning difficulties, Paul was diagnosed with several co-morbid conditions which included attention deficit hyperactivity disorder (ADHD), dyspraxia or poor motor skills, anxiety, and depression. He also struggled with long-term trauma and sexuality issues.

In Grade 4, Paul was diagnosed by a Clinical Psychologist with ADHD, a common co-morbid condition found in children with developmental dyslexia However, the methylphenidate (Ritalin) prescribed at the time, to assist with concentration and attention had an adverse reaction to this, so it was discontinued.

Paul struggled from Grade 1 to develop automaticity, the automatic development of basic skills, including motor skills (Nicolson and Fawcett, 2010). His co-ordination, and fine motor skills were poorly developed, and he tended to be clumsy. He attended years of OT to address poor fine motor co-ordination, which assisted him in the long run owing to the formation of new brain pathways and intensive early intervention (Francheschini et al., 2013; Pruitt et al., 2016).

> *"It affected my balance, my co-ordination, my reading, my spelling, my writing, my ability to learn and remember, my spatial skills, and just about everything else including my self-image and emotions. I had to have extra classes in everything as well as aarbeidstherapie (Afrikaans for occupational therapy) … I was special … AKA … DUMB!!!".*

As he got older, he compensated by writing in capital letters so that his work was more legible. This avoided reversals and confusing of upper- and lower-case letters. This was an interesting compensatory technique that Paul used as there is documented evidence that for children with dyslexia, it is easier to teach them the upper case letters first, as there is less chance of reversals (Davis and Braun, 2010).

During his adolescence, Paul had difficulty with interpersonal skills, and admitted that he was always aware of the fact that he was not attracted to girls and yet he did not particularly prefer boys or men. This may have been his way of compensating for the

bullying, teasing and other emotional difficulties he faced at the hands of many of his peers, especially the boys. He tended to avoid relationships and spent so much of his time studying, he had no time to learn appropriate social skills and develop his sexuality appropriately. Due to poor motor skills and resultant clumsiness, Paul could not handle a ball and thus did not take part in rugby which was expected of boys in his school. He had an affinity for music and learnt to play the piano, which further isolated him from his peers, and added to the insults and teasing he endured. Paul reported that he does not remember anything about his adolescence. He spent all his time studying just to pass at school, missing out on a "normal" childhood and adolescence. Most days, school was not a pleasant place for him as he felt he did not fit in and was often bullied and abused (Alexander-Passe, 2010,2015; Scott, 2004).

> *"I wasn't good with anything at school and then also again your self-esteem evaporates, it disappears. You can't do sport, you don't like sport, well after a while you say you don't like sport … because you do bad at it … I'm not such a sporty person … but you're missing out again … on the sports field you learn to engage fellow students, you build interpersonal skills … I didn't have this from Grade 1 to Grade 12 … I built these walls around me to keep them away from me … the boys never understood because I was the only boy in a class in an Afrikaans high school in the countryside that didn't play rugby … so automatically there's a whole stigma that clings to someone that doesn't play rugby".*

Thus Paul struggled to develop appropriately on a psychosocial level (Erikson, 1950, 1963), due to extended hours spent trying to cope with the demands of passing school. However, what did develop fully was his occupational identity (Erikson, 1950, 1963) and this is what drove his success. Paul always had the dream of becoming a pilot. He had the end goal in sight as a young boy and he never took his eye off the prize. This was one of Paul's most important compensatory skills which kept him going despite the emotional and educational challenges he faced.

> *"I never forgot the end goal".*

Paul displayed a number of personality traits or characteristics which assisted him to manage and compensate for his barriers to learning, in order to pass secondary school and then go on to achieve success in his tertiary studies to become a pilot. Some worked to his advantage and could be strengths such as tenacity, the ability to work hard, a competitive nature and a good sense of humour. Other personality characteristics may be perceived as challenges for Paul, which made it more difficult for him to cope, such as the tendency to procrastinate and having a shy, retiring nature. Paul managed to cope successfully and effectively in a stressor rich environment, shape acceptable resolutions to difficult circumstances, and not only survive, but mature and thrive in the face of difficulty and hardship.

Dimension 3: Interpersonal barriers

This third dimension includes factors or barriers that are external to Paul and that he had to compensate for because of having dyslexia. Paul experienced many difficulties which made his schooling challenging. Prior to his original assessment, he told his Grade 4 class teacher that he was going for an assessment for dyslexia. Her response was "What's that, wat is fout met jou? (What is wrong with you?)". When he returned with the report from the Clinical Psychologist, the teachers did not know what dyslexia was, or how to assist Paul. He experienced difficulties because the principal and teachers had no exposure to developmental dyslexia in their teacher training, and they were thus not able to assist with remedial therapy.

After he received the dark green glasses to assist him to reduce the visual stress, the other children would then wear dark glasses to mock Paul. When the teacher asked them to remove their dark glasses, they would say that he wore dark glasses in class and would tease him. The lack of support and ignorance from the teacher made him feel humiliated and vulnerable, as she did not stop the teasing.

> *"They would say I was a freak and looked like a dragonfly … the teacher would make them take the dark glasses off, but she never stopped the teasing … it was humiliating".*

Paul experienced language difficulties, especially at secondary school and later at tertiary level, as his first language of learning was in Afrikaans which follows consistent patterns of spelling and grammar. When he studied to become a pilot, at tertiary level, Paul had to learn in English which follows totally different sounds and patterns to Afrikaans, which would have further confused him and made his barriers even more difficult.

The cultural, family and psycho-social difficulties that Paul experienced made it even more difficult for him to succeed. Paul came from a small town where his family was well known. All the female members of the maternal side of the family were academically strong. Paul was always aware of the fact that he was academically weak and afraid that he would bring "shame" on the family.

Dimension 4: Emotional barriers

Paul developed high anxiety levels, depression, was continually frustrated and struggled with poor self-esteem. He describes feeling in constant pain and anguish. He also had to overcome resentment as well as jealousy of his peers and siblings, as he had to spend all his time after school studying, at OT or extra lessons, while they could play, attend sports, extra murals or have fun.

However, he learnt coping mechanisms and was able to distance himself from the emotion by focusing on one thing at a time that he had to study, and thinking of nothing else, as he called "compartmentalizing".

> *"Well now I realise that it was all for the greater good and I'm not really bitter. I just, I was able to now distance myself from the emotion and deal with every step of the emotion and different kinds of emotion … and identify the coping mechanisms … that's what they were … they were coping mechanisms. They are not long-term solutions to anything".*

Making use of the coping mechanisms or compensation skills Paul used such as focusing on one thing at a time or "compartmentalising" whilst he studied or "pretending to be an ostrich" and hiding away from the reality of how difficult it was for him to study and how much work there was to do; ensured that he passed secondary school in the end. However, Paul described how he struggled to feel whole and integrated as a person on many levels, especially emotionally.

Additionally, Paul explained how he felt constantly traumatised from the time he was first diagnosed with developmental dyslexia, to the present time. These feelings are explained by Van der Kolk (2015), who proposes that trauma and its resulting stress harms people through physiological changes to the body and brain. This harm can persist throughout life, predisposing us to ongoing mental and physical health issues, employment, and education, relationship, as well as possible substance abuse and trust issues. However, Paul had the support and care of his mother when he was growing up and through adolescence and then sought the assistance of a psychologist and psychiatrist as an adult. He could not "run away" from the teasing, bullying, and resulting trauma of having dyslexia. This again speaks to Paul's ability to effectively cope in a stressor rich environment and the resilience that he developed (Strümfer, 1995; Wissing and Van Eeden, 1997). Paul learnt to shape acceptable resolutions to difficult situations and not only survived but matured in the face of difficulty and hardship (Moss, 2002).

The constant trauma Paul experienced led to a poor self-image, poor self-worth, as well as a feeling of not being able to do anything as well as his peers, and never feeling good enough. Paul explained throughout the interviews how having developmental dyslexia had a negative emotional impact on his life. At times he felt that he was so overcome by emotion that he was not even sure who he was anymore. He had to learn to cope with the constant fear of failure (Alexander-Passe, 2010,2015; Scott, 2004). This meant making a "mind shift" and trying to ignore the fear, so that he could study and learn the work daily.

Paul reported that after attending therapy as an adult, he learnt to face up to the reality of having dyslexia, and realised he could not run or hide from it. He began managing the trauma caused by having developmental dyslexia by working through it in the

therapy sessions. During the interviews, he realised how many coping skills and compensatory strategies he had successfully implemented to pass his examinations and cope with life.

The psychiatrist Paul saw in 2011, made an accurate diagnosis of dysthymia, which is a long-term underlying depression that Paul had been struggling with for years. Paul explained that the depression or dysthymia became so much a part of him that it felt like a constant "dark-grey cloud" over him for years. He referred to the depression as a cat that used to take over his lap and grow or shrink depending on how bad (depressed) he felt at the time. Sometimes the cat would grow so large he felt that it was smothering him. He even had a name for the cat as described in the quotation that follows.

> *"It's very dark, again, I used to describe depression as a cat that used to jump onto my lap. I had a name for it, you know, Felix. Maybe him and dyslexia were well-acquainted. … it's a constant presence, there's always something there … I think they (depression and Felix the cat) do feel one another"*

Paul never understood what depression was until he was officially diagnosed by the psychiatrist. He received medication (anti-depressants) for the first time, which lifted his mood and he started feeling better within a month. Besides depression, anxiety and trauma, other emotions described by Paul include fear, shame, anxiety, loneliness, feeling isolated and excluded, self-doubt, poor self-esteem, helplessness, and worthlessness.

> *"The characteristics of dysthymia …It's like an ivy, so it grows slowly, it manifests slowly, so it's difficult to detect, but once it is there it's difficult to get rid of because by the time you realise there's a problem it's been continuous for such a long time that it becomes you … so again you've got a lot of trauma to deal with. Pain, pain, pain, pain and pain. You can't do anything. You can't grow until you've addressed the cause of the pain"*

Figure 1 and 2 show Paul's views on fear and anxiety. His writing in capital letters can be seen here as well.

Paul succinctly describes his continual emotional struggle with developmental dyslexia with the following words:

> *"It's like you're climbing a hill being dyslexic and you're carrying big bags of sand or rock…. plus there's a rope that's pulling you back down the hill … and you need to carry on climbing and climbing. The hill is the work you have to study for the test or exam… you need to get to the top of the hill for the pass before you get so exhausted by everything else that's pulling you back, the emotional ummm*

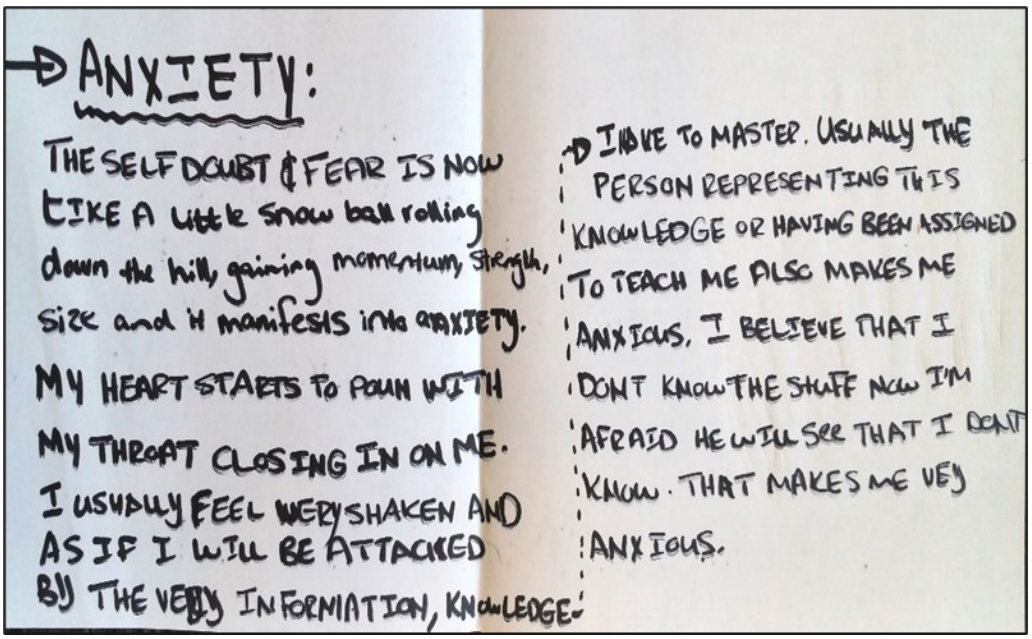

Figure 1: Paul's views on fear

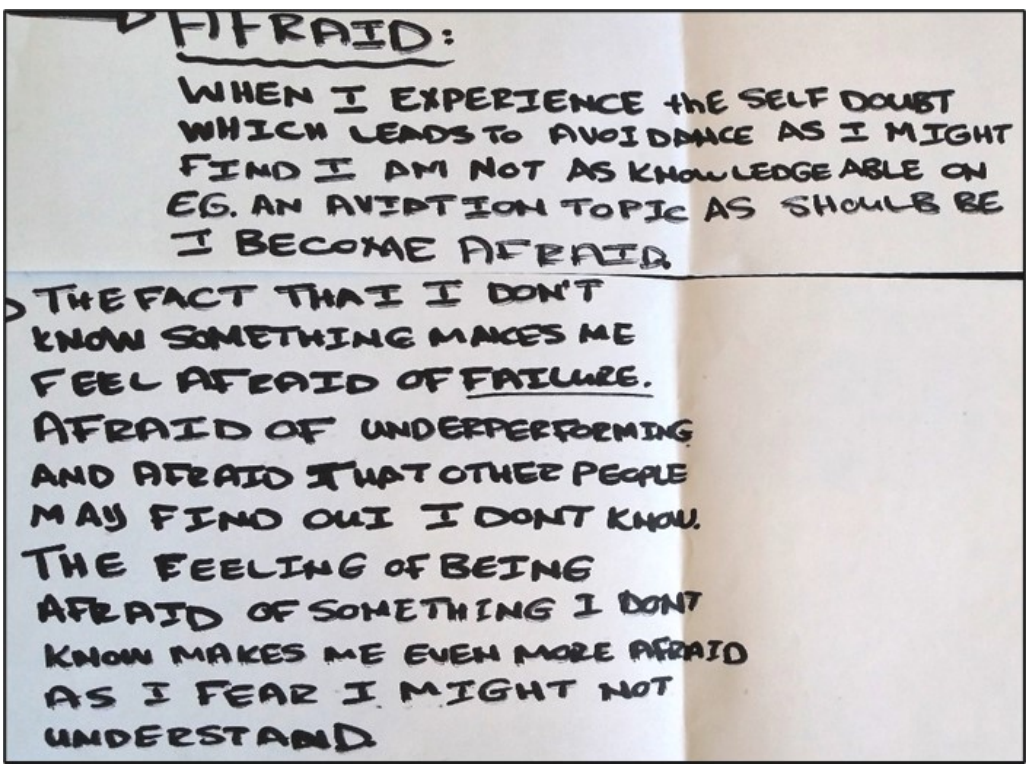

Figure 2: Paul's views on anxiety

> *stuff.....that you just give up and just fall backwards because you know when you get to the peak you'll just get 50 or 40 or 45 (percent) or whatever. It's never really wow something absolutely magical"*

Dimension 5: Behavioral barriers

Paul had received a number of formal diagnostic assessments, including most recently the Wechsler Adult Intelligence Test (WAIS). These showed that he had an intelligence level in the superior range, comprised of exceptional verbal skills, coupled with average speed of processing, memory, and visual perception.

As part of the assessment, Paul completed the Dyslexia Adult Screening Test (DAST) (Fawcett and Nicolson, 1998,) which revealed a range of ongoing difficulties in literacy, speed, memory and motor skills. Paul now uses Concerta to assist him in some of his tasks, and although the OT taught motor skills, Paul prefers to swim and exercises at the gym. There are still residual motor skills difficulties which he has not been able to compensate for as he still cannot catch a ball properly. On the DAST Paul scored in the very high-risk range (–) or bottom 5–11% for his age range for postural stability, meaning that he still has residual difficulties with balance and thus possible cerebellar abnormalities. Poor automaticity still affects reading speed, but Paul has made improvements through consistent practice, but continues to struggle to blend new skills into existing skills, as predicted by the ADHD and dyslexia.

Through intensive remedial therapy, constant rehearsal and drilling of spelling and reading skills, Paul learnt to decode, as well as to read, write and spell most of the familiar words in English and Afrikaans. However, as seen on the DAST nonsense passage sub-test he still exhibits residual phonemic difficulties with unknown words as he was only able to decode 8/15 unknown nonsense words in the passage correctly. He made no mistakes with the known words. His reading pace was slow on this DAST sub-test, but his accuracy was perfect. Paul scored in the very high-risk range or bottom 5–11% for his age range on this test.

Paul's areas of greatest weakness was shown to be in the DAST rapid naming sub-test, where he scored at extremely high risk (–) in the bottom 4% of his age range. He can name objects accurately but due to poor rapid "direct access" to words he needs time to do this. When he is rushed or interrupted, he becomes anxious, flustered, or loses concentration. Paul has found that since he started on the Concerta and is aware of this weakness, that if he uses "conscious compensation" skills when reading (Nicolson and Fawcett, 2010, p. 68), slows down, and deliberately tries to focus better by ignoring external stimuli; that with practice and a quiet environment, it becomes easier for him to manage better.

Additionally, through consistent practice, drilling and moving the whole words (sight words) to his long-term memory store, Paul has been able to speed up his rate of reading. Through extensive remedial therapy he also learnt to decode and break up words into syllables and sounds and improve his phonemic awareness sufficiently to compensate for this weakness. This is still not sufficiently fast to class him as a proficient reader. However, through hard work and using compensatory skills over the years, his accuracy is sufficient so as not to affect his comprehension of what he reads, as he is able to read at a functional level.

On the one-minute reading test, Paul read with perfect reading accuracy, but his reading speed was fairly slow. He scored within the very high-risk range (–) which is in the bottom 5–11% of people his age for reading rate when he read single words. This is due to taking a longer time to decode words accurately. He reads through the work many times, highlights the work, tries to make visual pictures and charts and flow diagrams of the work, as well as realistic looking pictures or takes photos of the real items to add to the explanations.

Thus the two areas that were the weakest on the WAIS cognitive test, his processing speed as well as his STM and WM, Paul still struggles to compensate for today. To cope, he must compensate by drilling, rehearsing and working up to twenty times longer to move the work he has to learn to his LTM store. Although his WMI on the WAIS was still within the normal range, this was well below the superior score he obtained for his verbal skills. The DAST confirms that his working memory is within normal ranges for his age as Paul scored in the average range for his age (0) which is between 13–77% of the individuals his age for the backward span sub-test. Paul's comorbid ADHD also affected his memory and after he started taking the Concerta this improved his concentration and he found he was able to focus for longer periods of time and it did not take as long to move the information from his STM to his LTM.

Paul has developed reasonably good phonemic awareness and so the spelling mistakes he does make are still phonetically correct. For example on the DAST he wrote "adress" for "address" and "sucess" instead of "success" so they were both phonetically correct and one could still make out what word Paul was trying to spell. Paul scored in the very high-risk range (–) on the two-minute spelling test on the DAST which is in the bottom 5–11% for his age group. This confirms that he still has residual spelling difficulties even after years of remedial therapy and drilling.

Paul has compensated for poor spatial skills ability and mixing up of upper- and lower-case letters by writing in capital letters only. On the DAST Paul fell into the high-risk range for the one-minute writing test (-), which is below average and in the 12–22% range for his age group. He writes fairly slowly as he takes time to copy accurately. He feels that accuracy is more important than speed. His handwriting is neat and legible which is not the case with many people with dyslexia, which means that the fine motor control

work that he did with the OT has paid off. Paul has found that his verbal expression is far superior to his written expression. This is confirmed by his superior scores on the WAIS verbal scales. However, he did obtain a distinction for English (Second Language) and a B symbol for Afrikaans (First Language) in Grade 12, which is an exceptional achievement for a learner with developmental dyslexia.

Paul does have difficulty interacting on a social level with others, but this is more because he is shy, introverted and he is afraid of rejection. He showed superior ability on the WAIS on the comprehension sub-test which reveals good knowledge of social norms and expectations. However, because of bullying and poorly developed social skills and very little interaction with his peers when he was at school, he had to develop these skills at a much older age when he left school.

Paul admits that he tends to "use people" sometimes which is a coping skill, but he is learning to trust people more, as he develops and grows more confident. He compensated for many of the emotional and social difficulties that he experienced by attending therapy with a psychologist, being diagnosed by a psychiatrist and taking the correct medication, learning to take care of himself (self-care) by listening to soothing music, exercising, playing with his dogs, using fantasy and escapism and through drawing spiritual strength through his faith in God.

Paul struggled with visual and auditory processing difficulties. These he learnt to compensate for by rehearsal and drilling of sight words, learning similar sounding and looking words off by heart and moving them to his LTM, as well as taking Concerta to assist with attention and concentration. He has compensated and managed to improve his ability to differentiate similar sounding words and is as fluent in English as he is in his mother tongue Afrikaans by listening to the British Broadcasting Corporation (BBC) and exposing himself to as many different mediums as possible so that he can speak with the correct English accent, as well as use the correct pronunciation and intonations. This is in spite of the fact that Afrikaans has a shallow orthography compared to English, which makes English a far more difficult language to learn to read, write and spell.

Paul has above average, well-developed verbal and semantic verbal fluency skills. He scored in the above average range, or top 23% for his age on these two tests on the DAST. This is confirmed by Pauls' superior verbal skills on the WAIS. Paul uses his superior verbal skills to compensate for his poor memory, reading, spelling, and writing skills.

Paul scored in the average range for his age on the DAST for the non-verbal reasoning sub-test. This correlates well with the block design and matrix reasoning sub-tests on the WAIS which were both in the average range for his age. His overall perceptual reasoning score on the WAIS was above average.

Using compensatory strategies to achieve his goals

How was it possible with the continuing issues with his literacy skills for Paul to attain the levels of skill necessary for a pilot? This can be attributed largely to his motivation to succeed in this field, which led him to commit himself to extraordinary compensatory strategies in order to be ultimately successful. It's important to note that he is likely to need these skills throughout his life.

In Figure 3 below, is a picture of how Paul wrote or printed all his notes onto yellow paper, to reduce visual stress, and wrote with dark/black pens. This contrast along with

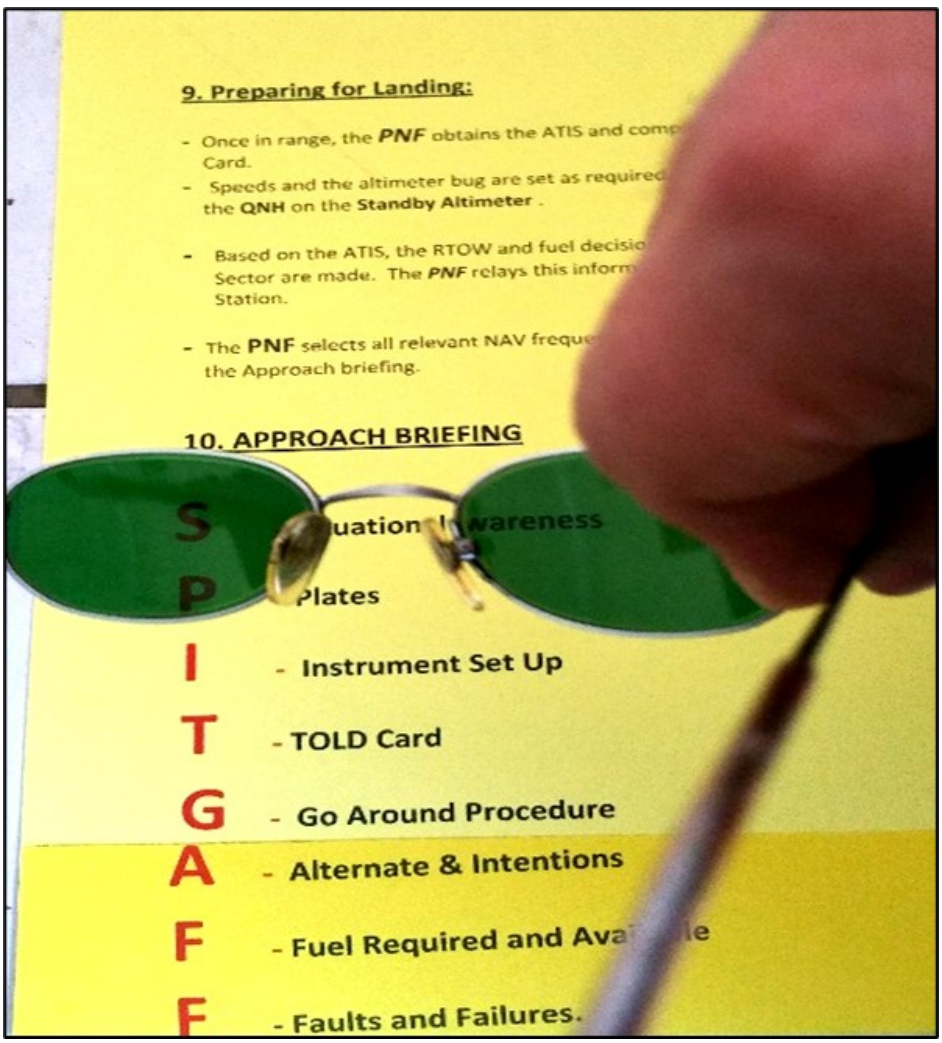

Figure 3: COMPENSATORY TECHNIQUES:. Use of dark green lenses to reduce visual glare; as well as black ink printed on yellow paper with bright red lettering as an acronym to assist learning

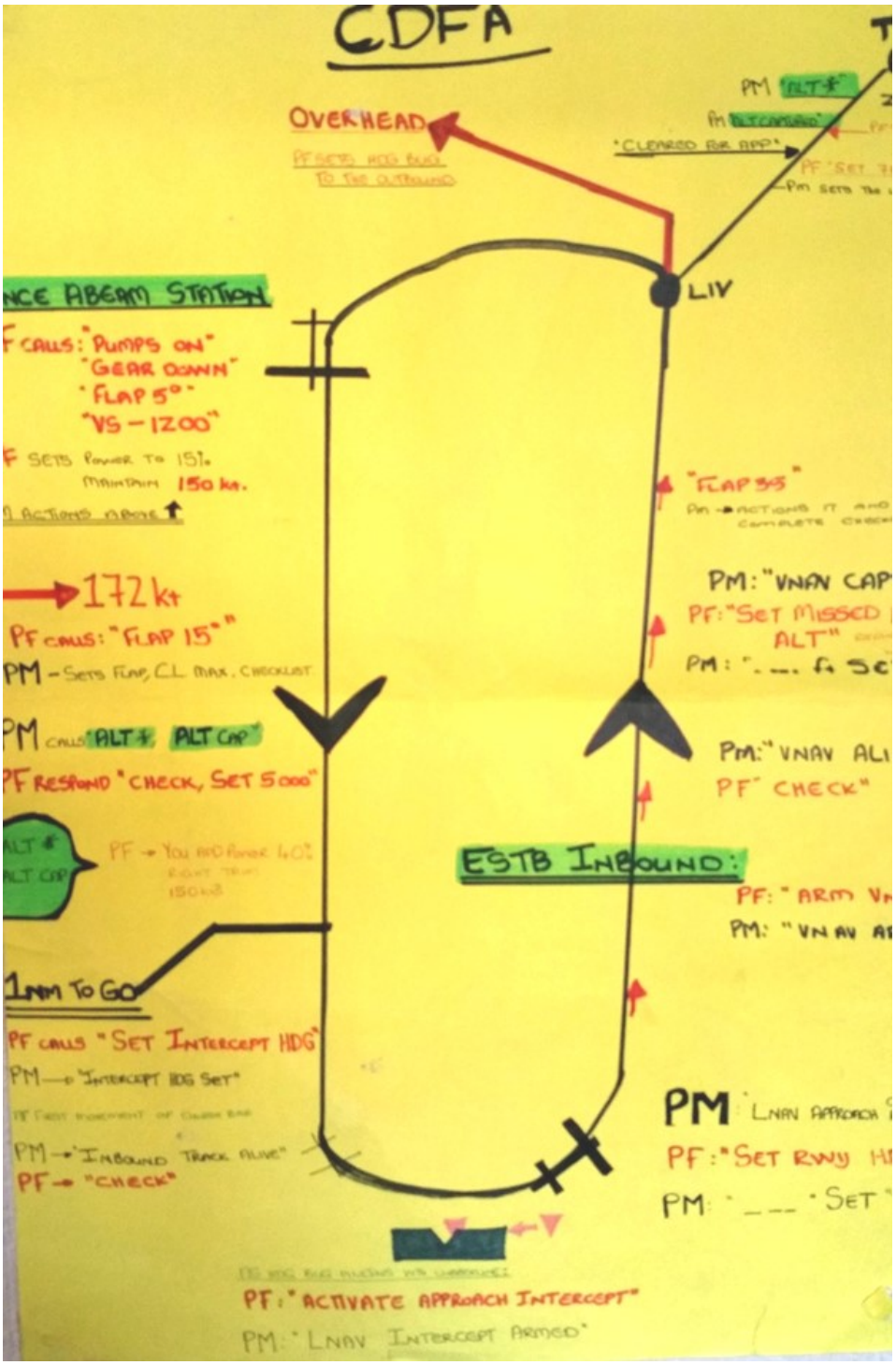

Figure 4: Compensatory technique: Use of visuals/diagrams, colour, sequencing, repetition, and multi-sensory approach.

the green lenses assisted him to learn more easily. If he wanted something to stand out, he wrote in red.

Paul runs through the complicated sequences he has to learn as a pilot such as pre-take-off or landing sequences both visually and verbally. Figure 2 is an example of how he learns a complicated take-off and landing sequence. This assists him to remember the work better when he has to write an examination, when he is in the flight simulator, or in an aircraft flying. He is able to visualise the sequences as he had verbalised and rehearsed them 20 to 30 times over during the learning process (Pruitt et al., 2016). The sequences to be learnt are copied onto the yellow paper. The correct contrasting colours that suited him were found through a process of trial and error.

Figure 4 shows how Paul makes use of different colours to highlight the sequence of events and the role of the pilot (PM in black), the co-pilot (PF in red) and the air traffic controller (highlighted in green) in the sequence of events. This helps Paul to anchor his learning and enables him to commit the procedure and sequence to his LTM. This method helps to limit discomfort or visual stress (Evans, 2001; Reid, 2009; Wilkin, 2003) and enables his brain to remember more easily what he has learnt/studied. The visual allows him to see at which point in the landing or take-off sequence the commands and actions need to take place. He rehearses the sequence taking on the roles of the three different people using different voices, as if acting out a scene from a play, which further enhances his learning as he is now using a multisensory approach, using his sight, voice, hearing and body (Oakland, Black, Stanford et al.,1998; Reid, 2011).

After repeating this 20 to 30 times he is able to remember, by moving the sequence to his better developed LTM and is able to visualise the entire process with the colours, off by heart as needed, as the brain forms new pathways due to plasticity (Pruitt et al., 2016). In other cases Paul uses numbers along with the visuals and colours to learn a set of landing, take off or any other sequences. This is one of the most remarkable compensatory techniques Paul uses, which has made one of the biggest impacts on his learning and ability to pass, even though he never learnt to do this at school. Through trial and error and working out what suits his brain and ability to remember best, Paul has managed to find a study method that is extremely effective for him.

Paul continues to use green glasses to cut down on visual glare and copied all his notes onto yellow paper as the black ink on white paper made it difficult for him to see the words. He highlighted important words in red and used various colors to differentiate between his voice (co-pilot at the time) and the pilot when writing out, or drawing diagrams of landing and other sequences. These compensatory skills he learnt through trial and error or by watching You Tube videos.

> *"This manual here with the white (paper) is kind of like almost invisible…I can't see the letters, it's as if I'm being bombarded with information".*

Paul had to learn how to organise, plan and work out time slots well in advance to ensure that he gave himself sufficient time to get through all the work he had to study as it took him twenty times longer than his colleagues at flight school and at the airline. Paul had to figure out his own study skills and methods as he had always relied on his mother up to Grade 12.

Due to the ADHD and his tendency to procrastinate, he had to become self-disciplined and force himself to study and learn even when he was exhausted, as well as keep the goal in mind. Paul compensated by CC and will-power as he wanted to earn his pilot's license more than anything else in the world.

> *"I don't know how to make summaries I don't know what's important and what's not".*

This is closely linked to automaticity.

Paul struggles to this day to write properly. He compensates for mixing upper- and lower-case letters by using all capital letters if he must write, but prefers to use a computer with a spell check. He still hesitates now and again regarding left and right but "writes with his right hand" so that is how he differentiates. This is important as he must make quick decisions regarding direction in the cockpit. He still cannot tell the time properly on a clock with numbers so uses a digital clock. Given enough time he can accomplish this functionally, but it takes longer as he has never automatised this skill. His balance is still poor as shown on the postural stability test on DAST.

For his pilot tests and examinations, all tests are conducted on the computer, so he compensates for poor spelling by using the spellcheck. This means that spelling is not an issue for him. Most of his examinations are multiple-choice questions so he has no need to spell. However, many of the choices have similar looking words with totally different meanings so he tries to learn the answer to the questions off by heart, again trying to shift the work from his STM and WM to his LTM store. This takes 20 times longer than for a person without dyslexia. If he does have to write, his spelling errors tend to be phonetically correct. In Grade 12 he was granted a spelling concession, so spelling was not counted against him during tests and examinations. He refused any accommodations for his pilot examinations and insisted that he would manage these "the hard way" on his own, as he did not want to be seen "as different". This was in spite of the Civil Aviation Association being willing to make allowances for him at the time this research was conducted.

Whilst studying to become a pilot, Paul had to learn take off, landing and other sequences. To accomplish this, he took actual pictures of the cockpit or copied and cut out the pictures from the manual and placed them onto the yellow paper. He wrote up the sequences in order, accompanied by pictures so that he had the visuals and the

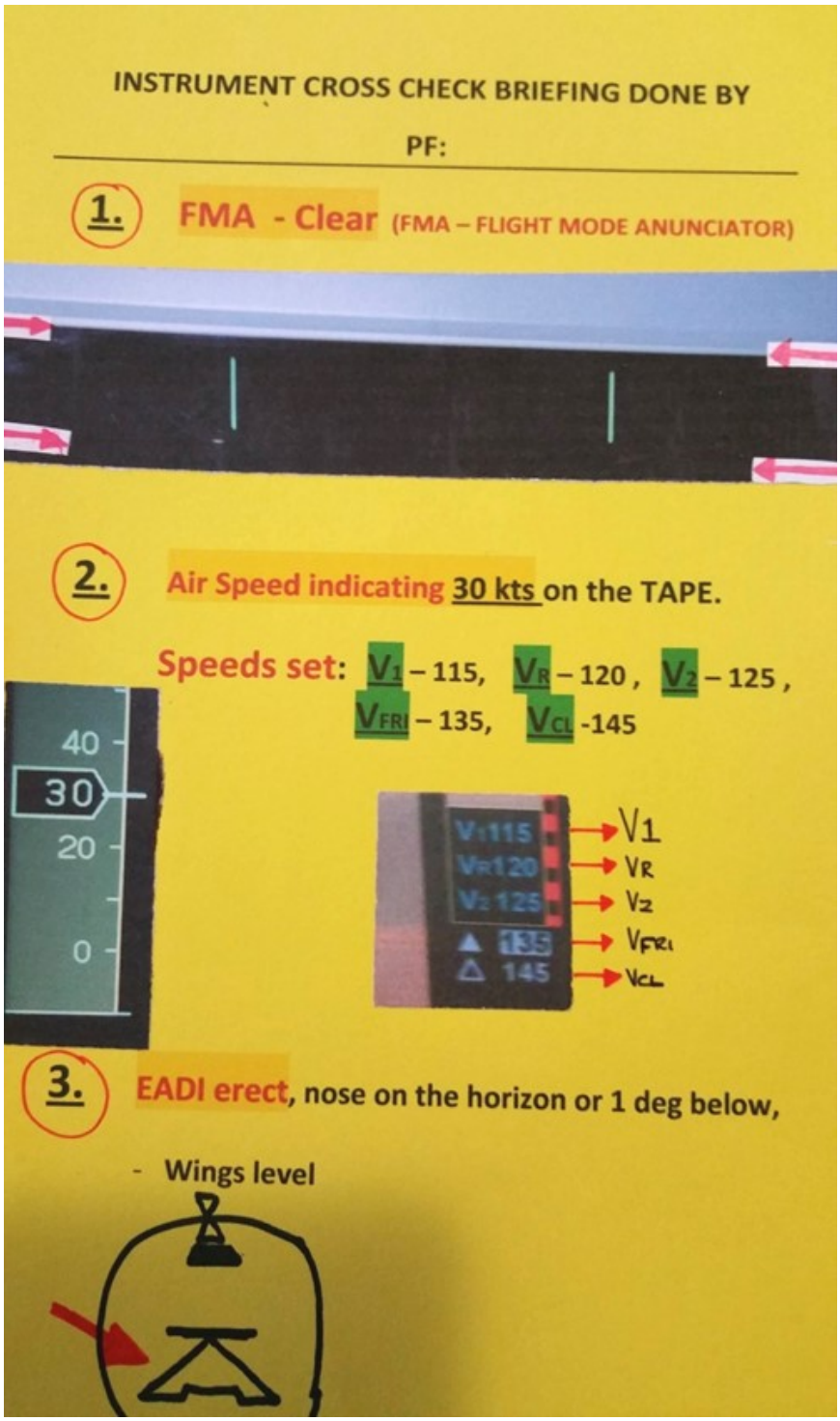

Figure 5: Compensating by using picture and sequences

written instructions alongside one another. Examples of these are shown in Figures 3, 4 and 5.

He received a flight manual from the airline, which is called a "Flight Standards Manual", and in the aircraft every procedure is followed word-for-word. There are precise words that must take place between the captain and the first officer (Paul at the time). This meant that he had to commit every word to his long-term memory, or he would have failed when placed under a stressful situation in the simulator when being tested or in an aircraft when flying. (See Figure 2 for an example).

Paul's organisational and time-management skills, as well as his summarizing techniques have always been poor as is common in people with developmental dyslexia (Davis, 1992; Reid, 2011; Thomson, 2009). He often felt overwhelmed by the volume of what had to be done and did not know where to start. Without the assistance of his mother, he has since learnt to use highlighting and organisational skills such as coloured tabs for indexing effectively for his own purposes. He has become adept at learning procedures off by heart and has managed to memorise the entire flight manual with pictures, as well as verbal and visual rehearsal techniques (Fry, 2012).

Paul cannot remember events or sequences out of order and must run through the sequences step by step. One of his greatest strength areas and compensatory techniques is that he can learn the flying sequences off by heart. The sequences must be followed "to the letter" so he cannot do anything out of sequence, which he struggles to do. Once he has committed a sequence to his LTM, he has it "forever'. However, if he forgets one section, or if it is asked out of sequence he must start from the beginning. At school in subjects like History he learnt facts well if he could learn the story behind the event and recall it as such. He could recall facts in Business Economics off by heart but if questions were asked out of context or if he had not learnt that section of work and or did not understand the question, he would fail.

> *"If you give me A and you put G, I can't get to G without running through the sequence of ABCDEF to G".*

Saying the word out aloud assisted Paul to remember the sequences as he made use of more of his senses.

> *"So for me, learning sequences is like learning a script. (The) multi-crew environment in a flight deck is like a play between the captain and the first officer … I memorise this".*

He used drama/play acting as another effective multi-sensory compensatory skill to help him learn.

CONCLUSION

It is important to take note that the barriers Paul faced continued to affect him and resulted in difficulties even after secondary school, as developmental dyslexia is a life-long, neurological disorder which cannot be fully cured. In Paul's case these difficulties are exacerbated by a number of co-morbid conditions, including ADHD and dyspraxia, as well as emotional difficulties and depression. This means we cannot conclude that all his struggles relate solely to his dyslexia, but they clearly play an important part in his ongoing difficulties. As an adult, Paul had to manage without the support system of his mother and the other professionals, and as a result had to work even harder to develop his own unique strategies to compensate for the dyslexia. He did this without concessions, by choice, for fear of being relieved of his duties as a pilot, although he was entitled to these.

These strategies and skills took extensive time, repetition, the use of colored paper, writing up posters in detail, rewriting all his notes with sequences and diagrams in order to assist learning, using a multi-sensory approach to learning by teaching himself. It is evident from the results and findings of the study that Paul made use of unique compensatory techniques and strategies that allowed him to not only complete secondary school, but also to go on to obtain his pilot's license.

Even though Paul realized his dreams he was subjected to humiliation and isolation, and this resulted in poor self-image as well as depression and anxiety. It is hoped that using the data gathered will assist other people with developmental dyslexia, and co-morbid disorders, as well as those who live with them and assist them, to use or implement some of the successful compensatory strategies used by the participant in this study.

REFERENCES

Alexander-Passe, N. (2010). *Dyslexia and depression* (1st ed.). NY: Nova Science Publishers.

Alexander-Passe, N. (2015). Investigating Post-Traumatic Stress Disorder (PTSD) Triggered by the Experience of Dyslexia in Mainstream School Education. *Journal of Psychology & Psychotherapy, 5*(6), 215–225. doi:10.4172/2161-0487.1000215

Anderson, J. (2005). *Cognitive psychology and its implications* (6th ed.). NY: Worth.

Ashcraft, M. H. (2006). *Cognition.* (4th ed.). New Jersey: Prentice-Hall.

Banai, K., & Ahissar, M. (2010). On the importance of anchoring and the consequences of its impairment in dyslexia. *Dyslexia, 16*, 240–257.

Beaton, A. (2004). *Dyslexia, reading, and the brain: A sourcebook of psychological and biological research* (1st ed.). New York: Psychology Press.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. http://dx.doi.org/10.1191/1478088706qp063oa

Bruck, M. (1990). Word-recognition skills of adults with childhood diagnoses of dyslexia. *Developmental Psychology, 26*(3), 439–454. http://dx.doi.org/10.1037//0012-1649.26.3.439

Burns, E., Poikkeus, A., & Aro, M. (2013). Resilience strategies employed by teachers with dyslexia working at tertiary education. *Teaching and Teacher Education, 34*, 77–85. http://dx.doi.org/10.1016/j.tate.2013.04.007

Corkett, J. K., Hein, S. F., & Parrila, R. (2006). Learning and study strategies of university students who report a significant history of reading difficulties. *Developmental Disabilities Bulletin, 34*(12), 57–79.

Creswell, J. W. (2009). *Research Design: Qualitative, Quantitative, & Mixed Methods Approaches*. (3rd ed.). Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (2012). *Qualitative inquiry and research design: Choosing among five approaches* (1st ed.). Thousand Oaks, California: Sage Publications.

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* (4th ed.). Thousand Oaks, CA: Sage Publications.

Crotty, M. (1998). The foundations of social research: Meaning and perspectives in the research process. Thousand Oaks, CA: Sage Publications.

Davis, R., & Braun, E. (2010). *The gift of dyslexia* (1st ed.). NY: Penguin Group.

Denzin, N. K. & Lincoln, Y. S. (2013). *Collecting and Interpreting Qualitative Materials.* (4th ed.). Thousand Oaks, CA: Sage Publications.

Dyslexia International. (2017). *Dyslexia International – Basics for teachers*. Dyslexia. Dyslexia International. Retrieved 2 May 2017, from http://www.dyslexia-international.org/eCampus/ONL/EN/Course/Intro.htm

Ehri, L. C. (1995). Phases of development in learning to read words by sight. *Journal of Research in Reading, 18*, 116–125.

Elbro, C., Nielson, I., & Pietersen, D. K. (1994). Dyslexia in adults: Evidence for deficits in non-word reading and in the phonological representation of lexical items. *Annals of Dyslexia, 44*, 205–226.

Erikson, E. H. (1950). *Childhood and society*. NY: Norton.

Erikson, E. H. (Ed.). (1963). *Youth: Change and challenge*. NY: Basic books.

Evans, B. J. W. (2001). *Dyslexia and Vision*. London: Whurr.

Fawcett, A. J. (1995). Case studies and some recent research. In T. R. Miles and V. Varma (Eds.)

Dyslexia and stress. London: Whurr.
Fawcett, A. J., & Nicolson, R. I. (1998). *The Dyslexia Adult Screening Test*. London: Pearson.
Fawcett, A. J., & Nicolson, R. I. (2008). Dyslexia and the cerebellum. In G. Reid, A. Fawcett, F. Manis & L. Siegel (Eds.), *The Sage Dyslexia Handbook*. London: Sage.
Franceschini, S., Gori, S., Ruffino, M., Viola, S., Molteni, M., & Facoetti, A. (2013). Action video games make dyslexic children read better. *Current Biology 23*(6), 462–466. doi:10.1016/j.cub.2013.01.044
Frith, U. (1986). A developmental framework for developmental dyslexia. *Annals of Dyslexia, 36*(1), 67–81. http://dx.doi.org/10.1007/bf02648022.
Frith, U. (1997). Brain, Mind and Behaviour in Dyslexia. In C. Hulme and M. J. Snowling (Eds.), *Dyslexia, Biology, Cognition and Intervention*. London: Whurr.
Frith, U. (1999). Paradoxes in the definition of dyslexia. *Dyslexia, 5*(4), 192–215.
Frith, U. (2002). Resolving the paradoxes of dyslexia. In G. Reid and J. Wearmouth (Eds.), *Dyslexia and Literacy, Theory and Practice*. Chichester: John Wiley & Sons.
Fry, R. (2012). *Improve your memory*. New York: Career Press Inc.
Geering, J. (2007). *Case study research: principles and practices*. Cambridge: Cambridge University Press.
Gilger, J. W., Pennington, B. F., & DeFries, J. C. (1991). Risk for reading disability as a function of family history in three family studies. *Reading and Writing: An Interdisciplinary Journal 3*, 205–217.
Henning, E., Van Rensburg, W., & Smit, B. (2004). *Finding your way in qualitative research*. Pretoria: Van Schaik.
Hoeft, F., McCandliss, B., Black, J., Gantman, A., Zakerani, N., Hulme, C., Lyytinen, H., Whitfield-Gabrieli, S., Glover, G., Reiss, A., & Gabrieli, J. (2011). Neural systems predicting long-term outcome in dyslexia. *Proceedings of The National Academy of Sciences, 108*(1), 361–366. http://dx.doi.org/10.1073/pnas.1008950108
Hulme, C., & Snowling, M. J. (2009). *Developmental disorders of language, learning and cognition*. Oxford: Blackwell/Wiley.
Hunt, R. R., & Ellis, H. C. (1999). Fundamentals of cognitive psychology. (6th ed.). New York: McGraw-Hill.
Kaplan, B. J., Dewey, D. M., Crawford, S. G., & Wilson, B. N. (2001). The term comorbidity is of questionable value in reference to developmental disorders: Data and theory. *Journal of Learning Disabilities, 34*(6), 555-565.
Lincoln, Y. S., Lynham, S. A., & Guba, E. G. (2011). Paradigmatic controversies, contradictions, and emerging confluences revisited. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research.* (4th ed.). (pp. 97–128). Thousand Oaks, CA: Sage Publications.
Locascio, G., Mahone, E. M., Eason, S. H., & Cutting, L. E. (2010). Executive functioning amongst children with reading comprehension deficits. *Journal of Learning Disabilities, 43*(5), 441–454. https://doi.org/10.1177/0022219409355476
Lyytinen, H., Erskine, J., Aro, M., & Richardson, U. (2006). Reading and reading disorders. In E. Hoff, & M. Shatz, (Eds.). *Handbook of Language Development*. Oxford: Blackwell Publishers. http://dx.doi.org/10.1080/87565641.2010.549868
Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco CA: Jossey-Bass Inc.
Merriam, S. B. (2002). *Qualitative research in practice* (1st ed.). San Francisco CA: Jossey-Bass Inc.
Merriam, S. B., & Tisdell, E. (2016). *Qualitative research* (1st ed.). San Francisco, CA: Jossey-Bass.
Mertens, D. M. (1998). *Research methods in education and psychology: Integrating diversity with*

quantitative and qualitative approaches. Thousand Oaks, CA: Sage Publications.
Mertens, D. M. (2010). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods*. Thousand Oaks, CA: Sage Publications.
Morton, J., & Frith, U. (1995). Causal modelling: A structural approach to developmental psychopathology. In D. Cicchetti & D. J. Cohen (Eds.). *Manual of Developmental Psychopathology.* (pp. 357–390). NY: John Wiley & Sons.
Moss, R. H. (2002). Context and coping: Toward a unifying conceptual framework. In D. F. Marks (Ed.), *The Health Psychology Reader*. (pp. 167-185). London, UK: Sage Publications.
Nation, K., & Snowling, M. (1998). Individual Differences in Contextual Facilitation: Evidence from Dyslexia and Poor Reading Comprehension. *Child Development, 69*(4), 996–1011. http://dx.doi.org/10.1111/j.1467-8624.1998.tb06157.x
Nicolson, R., & Fawcett, A. (2010). *Dyslexia, learning, and the brain.* (1st ed.). Cambridge, MA: MIT Press.
Oakland, T., Black, J. L., Stanford, G., Nussbaum, N. L., & Balise, R. R. (1998). An evaluation of The Dyslexia Training Programme: A multisensory method for promoting reading in students with reading disabilities. *Journal of Learning Disabilities, 31*(2), 140–147.
Pennington, B. (1999). Toward an integrated understanding of dyslexia: Genetic, neurological, and cognitive mechanisms. *Development and Psychopathology, 11*(3), 629–654. http://dx.doi.org/10.1017/s0954579499002242
Pruitt, D., Schmid, A., Kim, L., Abe, C., Trieu, J., Choua, C., Hays, S., Kilgard, M., & Rennaker, R. (2016). Vagus Nerve Stimulation Delivered with Motor Training Enhances Recovery of Function after Traumatic Brain Injury. *Journal of Neurotrauma, 33*(9), 871–879. http://dx.doi.org/10.1089/neu.2015.3972
Ramus, F. (2001). Outstanding questions about phonological processing in dyslexia. *Dyslexia, 7*(4), 197–216. http://dx.doi.org/10.1002/dys.205
Ramus, F., Rosen, S., Dakin, S., Day, B., Castellote, J., White, S., & Frith, U. (2003). Theories of developmental dyslexia: Insights from a multiple case study of dyslexic adults. *Brain, 126* (4), 841–865. http://dx.doi.org/10.1093/brain/awg076
Rees, P., Booth, R., & Jones, A. (2016). The emergence of neuroscientific evidence on brain plasticity: Implications for educational practice. *Educational and Child Psychology, 33*(1), 8–19.
Reid, G. (2009). *Dyslexia: A Practitioner's Handbook* (4th ed.). Chichester UK: John Wiley & Sons.
Reid, G. (2011). *Dyslexia: A Complete Guide for Parents and Those Who Help Them*. (1st ed.). Chichester UK: John Wiley & Sons.
Riddick, B. (1996). *Living with Dyslexia: The Social and Emotional Consequences of Specific Learning Difficulties* (1st ed.). London: Routledge.
Rule, P., & John, V. (2011). *Your guide to case study research* (1st ed.). Pretoria: Van Schaik.
Rutter, M. (2008). Developing concepts in developmental psychopathology. In J. J. Hudziak (Ed.), *Developmental psychopathology and wellness: Genetic and environmental influences* (pp. 3-22.) Washington, DC: American Psychiatric Publishing.
Rutter, M., Caspi, A., Fergusson, D., Horwood, L., Goodman, R., Maughan, B., Moffitt, T., Meltzer, H., & Carroll, J. (2004). Sex Differences in Developmental Reading Disability. *JAMA, 291* (16), 2007. http://dx.doi.org/10.1001/jama.291.16.2007
Schunk, D. (2000). *Learning Theories: An Educational Perspective* (3rd ed.). Upper Saddle River, NJ: Merrill.
Scott, R. (2004). *Dyslexia and counselling* (1st ed.). London: Whurr.
Seymour, P.H.K. (1997). Foundations of orthographic development. In C. A. Perfetti, L. Rieben, & M.

Fayol (Eds.), *Learning to read and spell: Research, theory, and practice across languages* (pp. 319–337). Mawah, NJ: Lawrence Erlbaum Associates Inc.

Shaywitz, S. (1998). Dyslexia. *New England Journal of Medicine, 338*(5), 307–312. http://dx.doi.org/10.1056/nejm199801293380507

Snowling, M. J. (2000). Dyslexia (2nd ed). Oxford: Blackwell.

Spitzer, M. (2012). Education and neuroscience. *Trends in Neuroscience and Education, 1(*1), 1–2. http://dx.doi.org/10.1016/j.tine.2012.09.002

Stake, R. E. (1995). *The art of case study research.* Thousand Oaks, CA: Sage Publications.

Stake, R. E. (2005). *Multiple case study analysis* (1st ed.). NY: Guilford Publications.

Stake, R. E. (2006). *Multiple case study analysis* (2nd ed.). NY: Guilford Press.

Stein, J. (2008). The neurobiological basis of dyslexia. In G. Reid, A. Fawcett, F. Manis & F. Siegel (Eds.), *The Sage Dyslexia Handbook*. London: Sage.

Stein, J., & Walsh, V. (1997). To see but not to read: The magnocellular theory of dyslexia. *Trends in Neurosciences, 20*(4), 147–152. http://dx.doi.org/10.1016/s0166-2236(96)01005-3

Strümpfer, D. (1995). The Origins of Health and Strength: From 'Salutogenesis' to 'Fortigenesis'. *South African Journal of Psychology, 25*(2), 81–89. http://dx.doi.org/10.1177/008124639502500203

Sun, Z., Zou, L., Zhang, J., Mo, S., Shao, S., Zhong, R., Ke, J., Lu, X., Miao, X., & Song, R. (2013). Prevalence and Associated Risk Factors of Dyslexic Children in a Middle-Sized City of China: A Cross-Sectional Study. *Plos ONE, 8*(2), e56688. http://dx.doi.org/10.1371/journal.pone.0056688

Thomas, G. (2011). *How to do your case study* (1st ed.). Thousand Oaks, CA: Sage Publishers.

Thomson, M. (2009). *The Psychology of dyslexia. A handbook for teachers.* (2nd ed.). London: Whurr.

Ullman, M., & Pullman, M. (2015). A compensatory role for declarative memory in neurodevelopmental disorders. *Neuroscience & Biobehavioural Reviews, 51*, 205–222. http://dx.doi.org/10.1016/j.neubiorev.2015.01.008

Van der Kolk, B. (2015). *The body keeps the score: Brain, mind, and body in the healing of trauma.* New York: Penguin Books.

Vellutino, F., Fletcher, J., Snowling, M., & Scanlon, D. (2004). Specific reading disability (dyslexia): What have we learned in the past four decades? *Journal of Child Psychology and Psychiatry, 45*(1), 2–40. http://dx.doi.org/10.1046/j.0021-9630.2003.00305.x

Wechsler, D. (1997). *WAIS-III* (1st ed.). San Antonio, TX: Psychological Corporation.

Wilkins, A. J. (2003). *Reading through Colour: How coloured filters can reduce reading difficulty, eye strain, and headaches*. Chichester: Wiley-Blackwell.

Wise, B., Ring, J., & Olson, R. (1999). Training Phonological Awareness with and without Explicit Attention to Articulation. *Journal of Experimental Child Psychology, 72*(4), 271–304. http://dx.doi.org/10.1006/jecp.1999.2490

Wissing, M. P. & van Eeden, C. (1997). *Psychological well-being: A fortogenic conceptualization and empirical clarification.* Paper presented at the 3rd Annual Congress of the Psychological Society of South Africa. Durban, South Africa.

Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). Thousand Oaks CA: Sage Publications.

Yin, R. K. (2012). *Applications of case study research* (3rd ed.). Thousand Oaks CA: Sage Publications.

Yin, R. (2014). *Case study research*. Thousand Oaks CA: Sage Publications.

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