Who are the sub-Level 4 students going into English secondary schools aged 11 years? What are the fundamental underlying causes of their failure to thrive as effective learners by the end of primary school?

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27th April 2016

Abstract

Forty sub-level 4 students aged 11 years were assessed over a 2 year period at one South London school. All the students were found to struggle with aspects of motor skill control, bi-lateral integration, mid-line crossing, sound processing, control of binocular vision and cognitive visual processing.

The basic issues facing these students were physiological but potentially correctable with appropriate interventions. However, unless they change their physiology, these students will continue to struggle to cognitively process and to understand basic concepts. If they are to improve their life chances at 11 years these students need more fundamental interventions than just extra numeracy and literacy tuition.

Further research needs to be done with larger sample sizes of students and with cohorts from different age groups - from 7 years to adult - to understand whether the same issues are key, underlying factors in the persistent low skills problem in the UK that the OECD identifies[1]. Additionally, it would be useful to study students who are high achievers, to provide contrast and enhance understanding.

Background

The objectives of this paper are to:

- identify the barriers to efficient learning that are likely to be faced by a struggling student at 11 years of age in an English secondary school;
- suggest strategies that might be effective in helping them to fulfil their potential;
- propose areas that require further investigation and analysis.

In 2015 the UK Minister for Education, Nicky Morgan, announced plans for pupils with poor Key Stage 2 SAT's results (below level 4) to retake those tests in Year 7.

She argued that: "*only 7% of those pupils are likely to get five good GCSEs which will set them up for life - that's compared to 72% who get five good GCSEs who do reach those required standards...English and maths are the absolute basics, the building blocks of other* *education, other achievements in life, and that's why it's very important to get them right at the start of education.*" (BBC 8 April 2015)[2]**.**

Various stakeholders have debated the efficacy of such a policy but the focus has tended to be negative, with few if any positive solutions offered. There has been very little understanding of precisely who this group of children are and what exactly is preventing them from becoming effective learners.

Shayer, Ginsburg and Coe's 2007[3] paper suggested that Piagetian tests showed that overall performance of Year 7 students had "been getting steadily worse". There has also been public debate by a range of stakeholders about the fitness levels of UK children (Sandercock, 2015)[4] and the lack of physical activity and outside play that children are experiencing (Persil's "Dirt is Good" campaign[5], 2016; the Lego Foundation campaign for education through play until 8 years of age[6], 2016).

Fit 2 Learn Assessment and Programme

Since January 2014, Fit 2 Learn CIC has carried out detailed assessments of 40 sub-Level 4 Year 7 students in a South London girls' secondary school. The assessments evaluate physiological development in:

- gross motor skills, including mid-line crossing, bi-lateral integration, suppression of primary reflexes and core strength;
- sound processing skills using the Tomatis® Listening Test[7]
- binocular vision using ReadAlyzer® technology[8] to capture eye movements.

Students are also observed as they solve physical puzzles in order to see in action the coping strategies that they use daily at school.

Additionally, when possible, meetings are set-up with parents, at their homes or at school, in order to engage them in the process and collect any relevant background information.

The school then selects a smaller group of students who participate in the Fit 2 Learn programme in order to overcome as many of their barriers to learning as they can. The Fit 2 Learn programme typically runs for 12 months or longer.

Fit 2 Learn's fundamental premise is that if children have gaps in their basic development then they will struggle to learn efficiently.

"*Reading, writing and arithmetic require a great deal of sensory integration for the child to experience success at school, and the integration of the senses with motor experiences or moving in particular is important in this regard*." (De Wit, M.W. & Booysen, M. I., 1994)[9]

"*The child's sensory integration must first be developed before the perceptual modalities will be in place. The lack of development of sensory integration could result in otherwise bright learners having problems in school in terms of learning and behaviour.*" (Erna Van Zyl, 2004)[10]

This is encapsulated in the UNESCO 2010[11] statement: "*Early childhood is defined as the period from birth to eight years old. A time of remarkable brain growth, these years lay the foundation for subsequent learning and development.*"

A visual outline of Fit 2 Learn's programme is included in Appendix A.

Introduction

Study Aims and Rationale

The objectives of this paper are to:

- show the complexity of the issues facing struggling learners entering UK secondary school at 11 years of age;
- help all stakeholders to understand and articulate why a re-test of Year 6 SAT's tests in Year 7 will not in itself address the fundamental issues;
- advance an understanding of potentially effective interventions so that students may become efficient learners.

Study Questions

1. What is the typical profile of a struggling learner aged 11 years of age?
2. What interventions would be necessary in order to address their fundamental needs and ensure, as far as possible, that they become efficient learners?

Study Design

The key variables logged for this study were determined by the data gathered by Fit 2 Learn as a result of assessing three separate cohorts of sub-level 4, Year 7 students.

Students were selected to participate in the Fit 2 Learn programme on the basis that sub-Level 4 students received funding for extra support. Fit 2 Learn provided that support.

The first stage of the programme was to screen the students to identify whether they showed any indications of problems in the following areas:

1. Gross motor skills, including core strength, mid-line crossing and bi-lateral integration.
2. Sound processing, as measured by the Tomatis® listening test profile.
3. Visual processing, as measured by the ReadAlyzer® Eye Movement Recording System which measures: (a) fixations; (b) reading numbers in small font; (c) reading a simple story for meaning.

Once testing is complete, all the data is evaluated together in order to understand why the student functions as they do. Single variables do not provide the whole picture of a student's development.

Even in this relatively complex study, a number of key variables have been omitted, such as:

- control of fine motor skills in the face, hands and feet;
- posture including relative position of hips and legs;
- emotional damage that blocks development;
- sleep;
- diet;
- stability of home environment;
- various medical conditions that affect cognitive development.

Every student is unique but, nevertheless, there are some general inferences that can be drawn from this study.

Sampling Strategy

The school selected the Year 7 students to be assessed from those that had failed to achieve level 4's or better at Key Stage 2. Between January 2014 and January 2016, 40 students were assessed and Following the Fit 2 Learn assessments, the school then selected those students that they felt would benefit most from the Fit 2 Learn intervention. The primary purpose of the intervention was to help those students to improve their physiological development and become more confident learners.

The research aspect of the intervention was, for the school, a secondary consideration. As such, there was no attempt to randomise the sample that participated in the intervention.

Data Collection

The students were assessed by Fit 2 Learn's consultants at intervals before, during (and after, in the case of the first cohort) the intervention. Data comprised:

- the consultant's observations of students' ability to complete a range of physical and cognitive tasks;
- measurements and analysis from ReadAlyzer® Eye Movement Recorder[12], which was used to measure students' eye movements, including fixations, reading rates and reading comprehension;
- Tomatis Listening Test System results of the students' capacity for auditory processing.

Students were assessed individually in the presence of the consultant alone.

Data Analysis

Data was analysed by:

- student, to measure individual progress;
- individual activity, to identify trends and establish key activities;
- groups of activities, to identify broader trends and draw conclusions about the cohort's physiology.

Describing the Sample

The sample comprised 3 cohorts of female students - 40 students in total - who were assessed by Fit 2 Learn during Year 7 (11-12 years of age). The cohorts comprised Year 7 students in 2013-14, 2014-15 and 2015-16. Not all initially assessed students participated in the programme, and not all those that started the programme, completed it.

Describing the Context

The school is a girls' comprehensive in South London located in an area with a number of grammar schools.

According to OFSTED in 2014, it is a "*good school in all categories. This school is larger than most secondary schools. A substantial proportion of students are from minority ethnic backgrounds. The largest groups represented are of Black African, Black Caribbean and Asian heritage. The proportion of students supported by the additional funding provided for looked after children and students known to be eligible for free school meals is above average. The proportion of students known to be eligible for the Year 7 catch-up funding is above average. The proportion of disabled students and those with special educational needs supported at school action is above average. The proportion supported at school action plus or with a statement of special educational needs is also above average*".

"*A minority of students who are known to be eligible for additional funding achieve well. In the 2013 GCSE examinations, students supported by the pupil premium were a grade behind their peers in both English and mathematics. However, the gaps in attainment between these and other students in English and in mathematics are narrowing rapidly, and are currently insignificant.*"

	% of pupils making expected progress		% achieving 5 A*-C GCSE's	% achieving the E-Bacc	% achieving A*-C in English & Maths
	English	Maths			
England	71.1%	66.9%	57.1%	24.3%	59.2%
Local Authority	79.5%	76.5%	70.4%	43.1%	71.1%
School	76%	66%	59%	22%	60%

27.5% pupils with English not as a first language (England = 15%; LA = 20%)
36.5% pupils eligible for Free School Meals at any time during last 6 years (England = 29.4%; LA = 20.4%)

The sample of 40 students included:
29 (72.5%) White British
11 (27.5%) Asian and African/Afro-Caribbean origin

General Points

1. 40 out of 40 students displayed at least one problem with mid-line crossing, bi-lateral integration and suppression of primary reflexes. For example, they could not move with opposing limbs or they displayed involuntary movement of limbs as a result of primary reflexes not being suppressed.

   They all struggled to pass a ball in an arc from left hand to right hand and back across their mid-line i.e. they had not mastered using left and right sides of their body together.

   This would suggest that they had missed key developmental milestones such as crawling. Children who miss out on the crawling experience in Siegel and Burton's study[13] scored lower on the Bayley scales of mental and motor development.

Crawling enables a child to develop the bones, joints, ligaments, muscles and nervous system to achieve a good posture when standing[14].

Such motor difficulties that arise from missing key developmental milestones, particularly crawling, manifest as learning difficulties in a school environment (Cheung et al, 2005[15]; Goddard-Blythe, 2012[16]; McPhillips, 2007[17]). Better motor skills are related to better performance in cognitive tests (Livesey et al, 2006[18]; Niederer et al, 2011[19]; Nourbakhsh, 2006[20]; Pangelini et al, 2011[21]).

Visser and Franzen (2010)[22] identified the relationship between crawling and the development of visual perception, particularly spatial relationships. They noted that "*crawling is a multifaceted process assisting in the development of many components such as body scheming, motor planning, visual perception and eye-hand coordination.*" Further, they concluded that "*efficient pencil grip among crawlers was significantly better than among non-crawlers*".

According to the British Association of Behavioural Optometrists[23], "*Children are usually born with the necessary hardware to allow for the development of normal sensory skills but it takes a busy childhood of play, exploration and experience to develop and train the software… If this software is not established properly, it can result in problems with the visual system and therefore learning…*"

Research in the field of Occupational Therapy suggests that primary reflexes should have disappeared by 3½ years of age (Ayres, 2005)[24]. Yabe[25] in 1984 noted that "*young children aged 4-6 are in the phase of postural control, during which they begin to acquire the ability to integrate/modify visual input, proprioceptive input, and vestibular input, which are necessary for postural control.*"

This postural control phase cannot happen properly if the primary reflexes are not fully suppressed. The basic gross motor skills and coordination that we are documenting as being absent, should have been in place and be skilled by 7 or 8 years of age in order to provide a foundation for the other motor sensory development that is necessary in the years after.

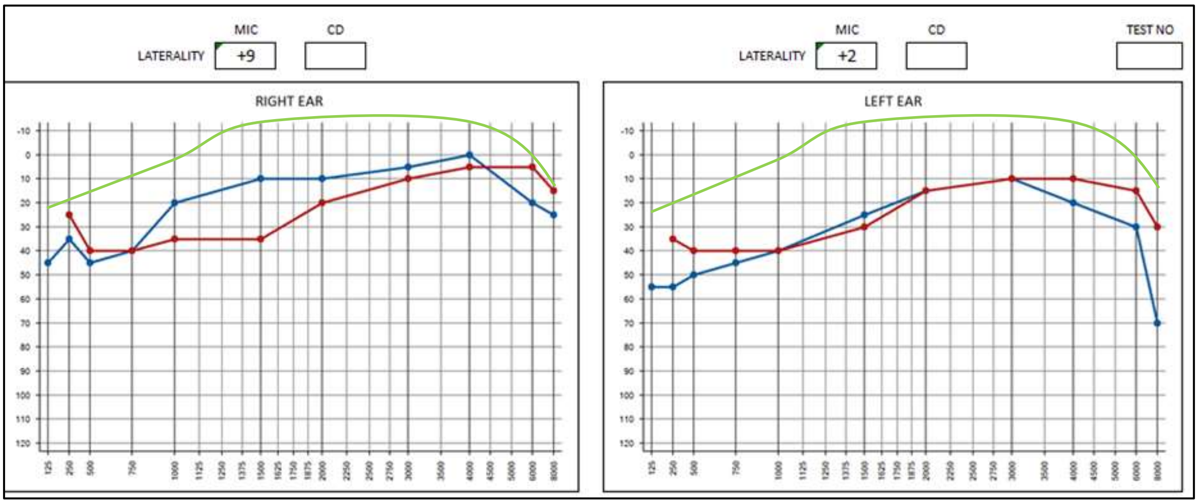
Of particular note are visual skills, particularly stereopsis of vision that requires a child to be able to hold their head upright and move their eyes independently of their head and body movements. Sigmundsun and Hopkins (2005)[26] concluded that "*the visual processing problems of clumsy children contribute to, or even strongly determine, not only their movement problems but also their learning difficulties.*"

Lack of crawling in the early years as a result of use of baby walkers should be conceptualised as "*early deprivation*" according to Siegal (1999)[27]. Also Garrett et al (2001)[28] found strong associations with baby walker use and developmental delay suggesting that 24 hours of use equated to 3.4 days in walking alone.

Zimmerman et al (2004)[29] concluded that "*early television exposure is associated with attentional problems at 7 [years of age]*". In 2012, OFCOM[30] estimated that the average 3-4 year old spends 3 hours a day in front of a screen. "*By the age of seven, a child born in Britain or the US today will have spent nearly one full year of 24 hour days watching recreational screen media*"[31].

Consequently, when considering the use of motor skills in early years it needs to be held in mind that there are issues where children are naturally not crawlers; and also where children are blocked in their development by more passive alternative activities such as television[32], baby walkers, long periods in car seats or in buggies, or in constricted seating of some kind that keeps the children "safe", but actually restricts their proper development (Belgau, 1982[33]).

2. 40 out of 40 students displayed some aspect of difficulty with sound processing, which impacted their ability to read for meaning. An example of Tomatis® sound processing analysis screenshot follows:



Tomatis® sound processing analysis looks at how a person conducts sound through air (blue line) and bone (red line). Ideally both left and right sides should look the same to give balance between the two sides. Further, air and bone conduction should not clash and the air curve should be in the region of the green curve (inserted by the author to aid understanding), with the bone conduction a consistent 10 decibels below. In the case of the student above it is possible to see that sound processing is suppressed, particularly on the left ear, and that air and bone conduction clash with each other.

The student also ought to be able to follow sound as it moves from one side to the other, indicated by the laterality score. In the case above it is possible to see that the student struggles with this task: on the right side the student score of "9" indicates that they have moved from right ear to left ear when the balance of sound is 28dB input to the right ear and 33dB to the left ear. However, on the left side the score of "2" indicates that the student does not extract themselves until the balance of sound is 10dB to the left ear and 50dB to the right ear i.e. they struggle to recognise a movement of sound from their left ear once it has started there even when the relative sound to the right ear far out-weighs the sound to the left ear.

This indicates that the student is left ear dominant which is significant because it causes a slight delay in speech processing (as speech processing is performed by the left hemisphere of the brain).

Furthermore, the person will struggle to track and interpret sound which moves in a room e.g. a moving teacher.

In practical terms the students know that they:

a) struggle to follow a teacher's speech in a classroom environment and find it particularly difficult when the teacher moves about;
b) struggle to read silently and prefer to read aloud;
c) struggle to make sense of text, even when read aloud, and often have to read text several times to understand it.

Conway et al (2009)[34] identified that "*sound appears to provide a perceptual and cognitive scaffold for the development of functions related to time and serial order behaviour… lack of auditory stimulation hinders the development of these skills*".

Hall et al (2007)[35] and Basyk et al (2010)[36] identified that listening therapy impacted positively on motor skills, language and behaviour.

Vestibular integration is an important part of the interface between sound, vision, balance and motor skills[37]. The vestibular system is located in the inner ear and is made up of the vestibular receptors in the inner ear and their connections to the central nervous system, i.e. the cochlear and the labyrinth of the inner ear.

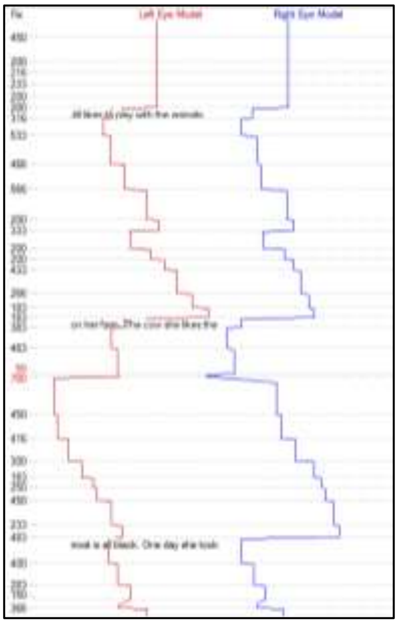
The semi-circular canals of the vestibular system interpret rotational movements of the head and the otoliths interpret linear movements. The vestibular nerve matures very early in utero and is complete in the fourth year of life.

The human labyrinth is significantly different from all other primates and its evolution is considered to have gone hand in hand with bipedalism and the development of language skills[38]. Quiros and Schrager (1978)[39] identified that there was a causal relationship between the development of language and learning disabilities. The human labyrinth and locomotor patterns are the foundation for visual-spatial-manipulative perceptions which underlie linguistic functions[37].

Laterality is the specialisation of the brain and the motor skills into separate sides. This specialisation allows humans to develop finely sequenced motor skills for activities such as tool making and hand gestures[37].

Coelho and Balaban (2015)[40] suggested that there should be a new subcategory of anxiety disorder named visio-vestibular fears arising from situations where a person experiences high levels of anxiety as a result of "*visual vestibular and postural interactions*" which "*act as* *a cue that trigger fear*". Although this was not specifically studied, several of the sample did experience chronic anxiety that made attendance at school very stressful for them.

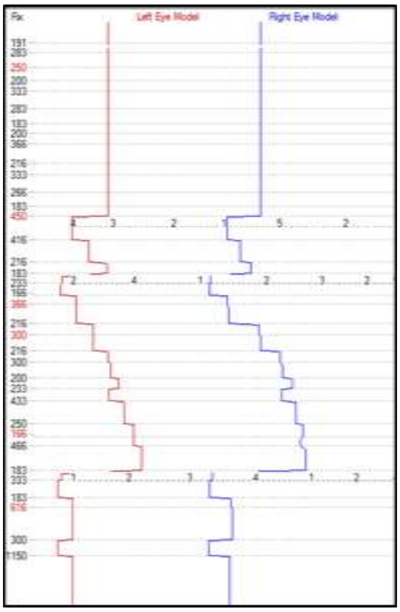
3. 40 out of 40 students exhibited some aspect of difficulty with tracking text when reading for meaning. 38 out of 40 students had problems with tracking text when not reading for meaning.



When a person reads text, ideally both eyes should be sending identical messages to the brain[8]. In order to do this, both eyes need to work together at all times.

It is clear from the graph to the left that the person is struggling with binocular vision when reading text and at times the eyes even move in opposite directions.

In order to understand whether there is a fundamental problem with the person's eye movements, or whether there is a problem with reading for meaning which is disrupting the eye movements, it is necessary to look at the eye movements when reading numbers i.e. text with no inherent meaning.

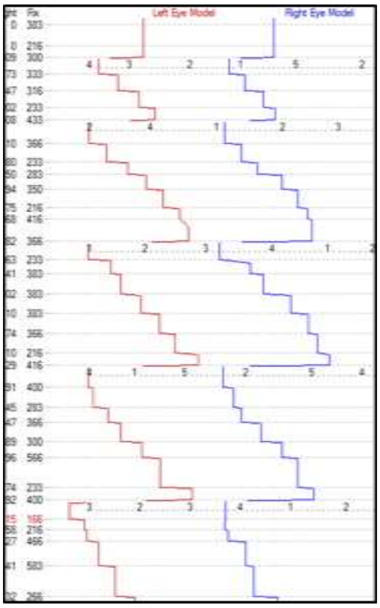


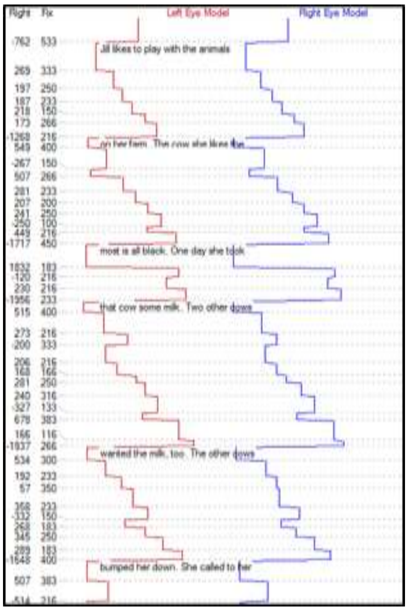
In the case of this student it can be seen that they also struggle to read numbers and that there are various anomalies in their eye movements and the rhythm of their reading.

Studying the underlying data reveals that the situation is worse when they are reading for meaning. Thus one can conclude that the student:

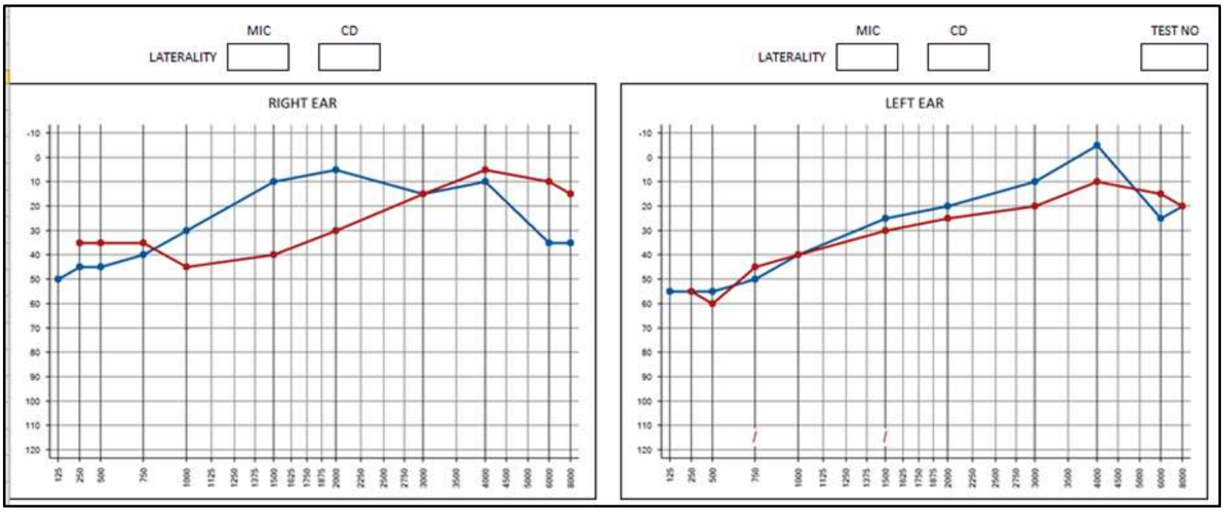
a. has a problem with controlling their eye movements;
b. has additional problems integrating sound and vision, such that when reading for meaning their eye movements become increasingly disrupted.

By contrast the student below does not struggle when reading numbers, but problems arise when reading for meaning.





The student's sound processing profile explains why reading becomes laboured when reading a text for meaning. Note that for this student it was not possible to assess their laterality of sound processing due to their anxiety.



4. All students displayed coping strategies when being observed solving problems such as simple jigsaw puzzles, memory games and pattern recognition exercises. Such coping strategies included:
   a. Using tapping, touch and physically holding a position with fingers in order to calculate relative physical space between items in a puzzle i.e. they are not using cognitive visual skills in order to judge relative space they use touch and/or they try to talk themselves through the process.

b. Using random trial and error until by luck a matching item is found. This was particularly obvious with simple jigsaw puzzles where many of the subjects did not distinguish between side and middle pieces i.e. they are not using cognitive visual skills to assess the possible location of a piece.

c. Verbally listing and reciting when playing memory games. However, this strategy could only work for a few items - up to five or six for the best of the group but many of them struggled at four items. If the student was momentarily distracted then they forgot their list entirely. Thus, it can be seen that the student is not using cognitive visual skills to hold a picture of the items in their mind's eye.

d. Avoiding crossing the mid-line by leaning off to one side or by working on one side with one hand and the other side with the other hand. The extreme of this could be observed where puzzles could be done in two halves but the student hesitated to grasp how to bring the two halves together. These coping strategies in themselves can unbalance the body and hence prevent learners developing an upright core to support the development of binocular vision and hence good cognitive visual skills

All of these coping strategies are laborious and exhausting for the student. They are also highly likely to fail so they are stressful for the learner. It is not possible to efficiently use these coping strategies to develop higher level skills in reading or mathematics. These students have not arrived at the sensory integration that Ayres[24] or Piaget[41] would consider necessary for a child to "process abstractions"

Conclusions

The study suggests that the typical profile of a female student aged 11 years of age who has scored below Level 4 at Key Stage 2 is one that has poor control of gross motor skills and will have missed some aspect of key developmental milestones expected of a 4 year old.

These issues have been compounded by subsequent developmental delays as the foundations were not present for the students to establish the good motor sensory integration expected by 8 years of age.

All of the students' problems were exacerbated by poor auditory processing skills which will have impacted their gross motor skill development and vestibular integration.

The combination of poor gross motor skills and poor auditory processing skills has undermined the development of good visual skills particularly binocular vision and hence cognitive visual processing skills. This constrains the students' ability to become efficient learners.

The students we have observed are all able to decode text but they struggle to integrate their motor sensory systems and hence see the world as a whole. Therefore, they are unable to read efficiently for meaning for application in mathematics or English lessons. They cope but they are not efficient learners.

In order to address the problems of the struggling learner and enable them to become efficient learners (and realise the ambitions of the Minister of Education to achieve five good GCSE passes) then students' fundamental problems must be addressed. Most notably:

a) Gross motor skill control including core strength, mid-line crossing and bi-lateral integration;
b) Sound processing skills to the point that the learner can combine sound and vision processing;
c) Binocular vision;
d) Cognitive vision to the extent where learners are able to "see" patterns in their mind's eye, read for meaning and picture what they are reading in their mind's eye.

These are all basic skills that should be developed in the learner prior to 8 years of age, and developed and mastered in the years thereafter.

Jean Ayres's contention that "*we cannot tell why things go wrong in a child*"[24] is considerably less true now than it was when she wrote in 2005. Technology and a better understanding of the holistic development of children mean that we are developing increasingly sophisticated tools to observe problems with child development; we need to use those tools to achieve good holistic solutions for the learner.

However, currently in the UK, the school curriculum's narrow focus on numeracy and literacy does not allow time for fundamental skill development, especially pre-reading skills in areas such as motor skills development, rhythm, speech and language and pattern recognition. Further work on a larger scale needs to be carried out in order to validate this initial study.

Sandercock[4] et al reported in 2015 that children's physical fitness in the UK is in decline and he called for a wider range of physical skills to be tested in school children. The authors of this paper would endorse such a call, along with targets to improve all children's coordination, mid-line crossing and core strength to minimum standards agreed by a wide range of stakeholders.

Dr Aric Sigman[42] has argued that the amount of time children spend in front of screens, versus time playing away from screens is a "*medical issue*". We endorse this call, but would suggest that there needs to be a greater public understanding of the need for all children from birth to be actively moving in order to maximise cognition. Other countries are issuing guidance to parents suggesting that parents should limit screen time, including the Australian Government which suggests no screen time for children below 2 years of age[43].

Extending play based learning to 8 years of age, as the Persil[5] and Lego[6] campaigns advocate, would help children to better develop their motor and cognitive skills. According to Professor Thomas Dee (Stanford University)[44], children who started kindergarten a year later (i.e. 7 years of age rather than 6 years) showed significantly lower levels of inattention and hyperactivity, which are jointly considered a key indicator of self-regulation. The beneficial result was found to persist even at age 11.

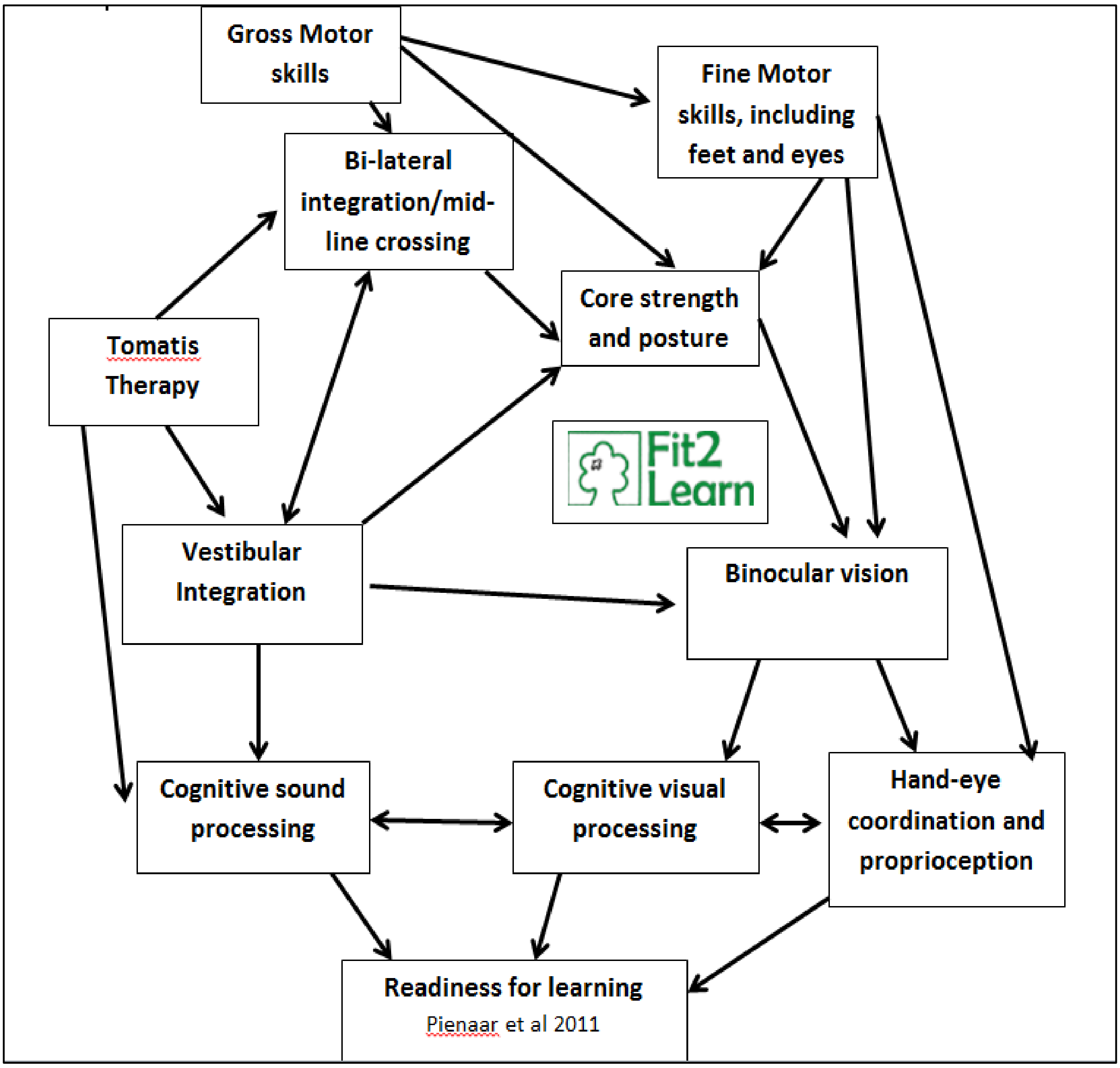
Finally, studies of aging adults and the impact of Alzheimer's disease highlight the importance of cognitive development in order to establish cognitive reserve (Mortimer et al, 2003[45] and Richards et al, 2004[46]). Further research needs to be done into identifying the importance of bi-lateral integration, sound processing skills, binocular vision and cognitive visual skills on the aging processing and the impact of Alzheimer's disease.

Overall, education in the UK needs to be underpinned by a fundamental understanding and philosophy of whole child development, and to a quality that will ensure that all children in mainstream schools can access all areas of the curriculum throughout their education with relative ease and enjoyment.

This study suggests that there are fundamental basic physiological developments in the first 7 years of a child's life that have to be mastered if a child is to access good cognitive and mental health. Furthermore, those skills need to be maintained and developed throughout school life.

Appendix A

Visual outline of the Fit 2 Learn Programme



Pienaar et al, 2011[43]

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