To what extent does 'antecedent' sensory-motor activity facilitate attention and learning for students having difficulties with sensory regulation.

A Literature Review

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Table of Contents

ABSTRACT

To what extent does sensory-motor activity facilitate attention and learning for students having difficulties with sensory regulation?

Some students display severe disruptive and challenging behaviour, depressive symptoms and have difficulty with academic attention and achievement. The effects of physical exercise in reducing these behaviours while improving student academic attention, have been reviewed for this project. Years of research have highlighted the importance of physical exercise in reducing challenging behaviour and increasing academic attention and improvement for children with autism spectrum disorder (ASD) (Neely, Rispoli, Gerow and Ninci, 2015). A review of 18 studies of the literature around various types of exercise in 2010 by Lang and other authors indicated that there was significant reduction in challenging behaviour for students with ASD. This research was done in a controlled group by altering the endurance and severity of the physical exercise (Lang et al., 2010). A few of these studies also showed an increase in academic on-task behaviour as discussed by Powers and other authors (1992). Antecedent physical exercise has been identified as one approach in reducing challenging behaviour.

INTRODUCTION

The aim of this literature review is to describe the importance of antecedent exercise that is highlighted through the program 'In The Zone for Learning' (ITZ). This study was done within the context of a special school, but it can also be used in mainstream schools for children who struggle with sensory regulation. This investigation seeks to answer my research question:

To what extent do 'antecedent' sensory-motor activities and exercise facilitate attention and learning in an inclusive classroom for students having difficulties with sensory regulation?

In my work as a special educator and as a classroom teacher in a mainstream school the findings from these studies are relevant. Thus, analysing the importance of antecedent exercise as a means to facilitate attention and learning will have a huge impact on my professional philosophy and practice. Every child is different, and their individual needs are different, as different as their thumb print.

In The Zone for Learning (ITZ), a Clarke Road School program along with Autism Central Pty. Ltd. (2013), initiative that proposes the importance of understanding the student's brain and carefully observing and analysing their behaviour with the knowledge of their brain. The fundamental aim of this program is that teachers interpret a student's response and reaction (i.e. behaviour) with a sensory processing lens.

This paper begins with the methodology and analytical process, followed by an examination of the themes in the program ITZ. I will approach the question

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with the key research literature then explain it under three major themes and the conclude by highlighting the gaps in the research.

Theme 1 - Brain Development and sensory Deficits

Theme 2 - Effects of Physical Activity (PA) and Physical Exercise (PE) on academic achievements

Theme 3 - Effects of Acute aerobic exercise in the reduction of depression and anxiety and the possible reduction in the need for pharmacological treatments.

SUMMARY OF THE KEY RESEARCH LITERATURE AND PURPOSE OF THIS STUDY

One of the major problems encountered by teachers is the challenging and disruptive behaviour of their students. In a special school setting where children struggle to self-regulate their body and mind, this rate of challenging and disruptive behaviour is higher which frequently interferes with attention and learning. This in turn leads to students' struggling, as they find it difficult to be attentive and engaged or "in the zone for learning". However, research in the past 4 to 5 decades highlights the importance of physical exercise and physical activity that has a positive effect on learning as well as healthy mind and body connection. *Every Student Every School*, learning and support shows data collected between 2005- 2011 regarding the confirmed disability of students in NSW and the type of disability registered. Clarke Road School's In the Zone for Learning was developed to provide better learning and support for students with a disability, learning difficulties and behaviour support needs. The aim of the of the program is to help teachers understand the student's brain by carefully observing and analysing their behaviour with the knowledge of their brain and how they respond and react (i.e. antecedent and behaviour) to their surroundings. The program encourages teachers to interpret a student's response and reaction with a *sensory processing lens.*

Every Student, Every School (2005-2011) figure 1 shows although not as visible and predominant, sensory deficit is categorised as a type of behaviour. We respond to the world around us through our senses. Students with specific disabilities such as autism, struggle with sensory processing issues, students with Attention Deficit Hyperactivity Disorder (ADHD) struggle with deficit in motor and cognitive abilities, students with Attention Deficit

Disorder (ADD) and other behavioural and emotional problems. Students with intellectual disability have trouble regulating their senses. These students have been found to benefit from a sensory-motor rich academic program to keep them engaged.

Physical exercise performed as an 'antecedent' (i.e. before academic learning) is established as an optimistic treatment in the reduction of challenging behaviour and thus increasing academic outcomes in students with autism spectrum disorder (Neely, et.al 2015). A program that is rich in stimulating the senses is needed in order for them to be alert, engaged and actively participate in their everyday learning.

One of the major drawbacks of not being able to self-regulate is that these student struggle to learn as their age and stage peers do. The goal of students is to develop higher order skills such as reading, writing, math, reasoning and problem solving. The skills needed for these higher order thinking occur in the cortical part of the brain and requires the smooth functioning of the entire brain, a journey that begins in utero. The brain stem connects the spinal column to the brain and the motor and sensory nerve connections from the brain go through the brain stem to the rest of the body (ITZ, 2012). Some of these students who are still struggling with the brain stem level development require support as they struggle to control their outburst of behaviour.

The learning journey begins with exploring the world through your senses and it also manages sensations and body awareness (ITZ, 2012). Students might exhibit challenging behaviour that is often disruptive to the classroom and to their learning and that of their class. Lever (2013) describes challenging behaviour as one that causes the most disruption leading to immense stress to the teachers to the point of them leaving the profession. Not all behaviour the student displays is predetermined. When a child displays persistent behaviour that is disruptive the teachers and carers need to investigate and explore as

children often lack the ability to communicate their feeling and instead act out in a disruptive manner (Lever, 2013).

The initial literature review to analyse the program 'In the Zone for Learning' was conducted under these search headings:

- exercise
- physical activity
- antecedent exercise
- activity
- sensory motor
- sport for ADHD and ADD
- effects of acute exercise
- cognitive function
- sensory processing
- antecedent exercise in reducing challenging behaviour
- teacher intervention

The search was done on various data base such as:

- A+ Education
- Eric
- Google Scholar
- Sage
- Educations Sources
- PsycINFO

The search provided over 300 pages published in the last 10 years. Out of which a select 25-30 articles were looked at closely and on further analysis 20-25 peer reviewed articles were reviewed.

Over 30 short term and long-term studies positively supported the advantage of being fit and active for people with ADHD (Ng et al., 2017). The work of Ng and colleagues (2017) highlighted exercise as an underexplored option in managing behavioural, cognitive and physical symptoms of ADHD. Antecedent exercise has been proven to show reduction in challenging behaviour although the reason was unclear (Kasner, Reid, & MacDonald, 2012; Lang et al., 2010). The possibility of the reduction in challenging behaviour was hypothesised to be due to physical exhaustion. Other researchers have investigated this theory by managing the intensity of exercise and the effects or the response and reaction of these exercises on challenging behaviour (e.g. Kern, Koegel, &Dunlap 1984). Physical fatigue was not disregarded but the increase in appropriate behaviour suggested the possibility of other mechanisms in play to bring about the changes in behaviour (Lang et al., 2010). The research study by Neely and other authors (2015) highlighted that antecedent physical exercise led to increase in academic engagement for the participants in this study which supported the previous findings of the same.

Apart from this physical exercise has also been proven to be effective in reducing depressive symptoms (Conn, 2010). Again, the mechanism that enables PA to reduce depressive symptoms is unclear (Deslandes et al., 2009) but nonetheless the results are positive.

In the two consecutive 12 week study done by Ziereis, s. and Jansen, P. 2014, 2015 on the effects of physical activity (PA) on executive function and motor performance in children with ADHD showed several significant changes in the long term effects of PA. the evidence form this study supports long-term use of PA to improve motor abilities for children with

ADHD and PA administered with pharmacological treatment has the potential in reducing long-term pharmacological intake (Ziereis and Jansen, 2015).

Shaddock (2006), suggested potential barriers to inclusion such a lack of time; difficulty in focusing on individuals while teaching a whole class; lack of training and resources for teachers; a notion that making adjustments for some students might hinder the learning of other students, create a negative attention to their differences as well as fail to prepare them for the 'real world'. Sharma and other authors (2013) signify the importance of teachers and professionals to be prepared to implement changes, have the right skills to make inclusion a success.

A program that was developed by Clarke road school in partnership with Autism Central Pty Ltd (2013) to assist students to be in an ideal state of mind and body- 'In the Zone for Learning'. This program was developed by teachers and health professionals in partnership with parents to develop resources to assist teachers in helping them understand their students. It provides the teachers ideas and resources that will enable them to understand the complex layers of the human brain. The tutorial section of ITZ's online learning resources, layed the foundation of the themes that were reviewed and discussed. The focus of this program is around brain development, neurobiology of learning and how the human brain learns, sensory processing and concept development by understanding the world around us, levels of alertness and ways to modulate human alertness, i.e. through physical exercise (In the Zone for Learning, 2013).

THEMES DISCUSSED

These main themes emerged from searching the literature

Themes From Literature Review

Theme 1 - *Looking beyond the behaviour by understanding brain development and sensory deficit.*

Theme 2 *- Understanding and accepting student behaviour*

Theme 3 *- Effects of Physical Activity (PA) and Physical Exercise (PE) on academic achievements*

Theme 4 *- Effects of Acute aerobic exercise in the possible reduction of the need for pharmacological treatments- Focus on gut health.*

Themes developed from ITZ

Theme 1*:* Brain development and learning for student with sensory deficit.

Theme 2*:* Personalised educational programs to meet the learning needs of students.

Theme 3*:* Positive Impact that exercise has on children with challenging behaviours.

Theme *4*: Identify the needs of students to attain and maintain an optimum level of alertness.

Theme 1- Brain development and learning for student with sensory deficit.

As a special educator I primarily work with students who are categorised and separated as “moderate and severe” intellectually disabled (ID). These students are often

separated from their age peers who develop typically. Children with specific disabilities such as autism (with sensory processing issues (Huettig,2000)), learning disabilities, attention deficit disorder (ADD) and other emotional problems have been found to benefit from a sensory-motor rich program.

Before we go any further I want to make sure we understand the terms in my questions

"Sensory-Motor activities"

When we hear, sense or sensory we will promptly say the five, see, hear, touch, smell and taste. There are three more that we need to master which often goes unnoticed, these are (6), sense of movement called *'vestibular'*, (7), *'proprioception'* a sense and position of body and (8), the sense and function of our internal organs '*interoception*'. Research says, feelings and emotions come from changes within the body. Feeling of hunger and thirst that result in changes in behaviour has been linked to the internal function of our body i.e. 'gut health'.

Our brain is the primary processor of our senses (Ayres 1989, Kranowitz 1998). It is believed that only a mere 10% of nerves are connected at birth and the rest, the majority of the brain's nerve connections mostly fall in place by the time a child turns five, *with the right opportunities and the necessary experiences* (Connell & McCarty, 2014).

Research shows there has been an increase in mainstream teachers, facing student who struggle with self-regulation, focus and the ability to learn independently. Some children lack neuromotor development and sensory processing ability. In the first five years of life children need to develop certain physical demands such as conquering gravity, control body movement, sit to stand, receive and process information both visually and verbally and

store the information and learn to respond at the appropriate manner at the appropriate time.

Johnson, (2015) in her research paper suggests that sensory stimulation is regarded as food for brain and that in the body - brain connection learning is made possible with the connection of both sides of the brain. This then could promote action and focus by stimulating and alerting or calming and relaxing.

In the past 10 years, a multitude of research has focused on validating the effects of PA on academic achievement. Majority of these studies have concluded with a positive effect on construct related to academic achievement (Howie & Pate 2012).

Ayres, (1989) says that the first eight years of play and movement is said to give a child the 'sensory-motor intelligence' that becomes the foundation for their future personal and intellectual development.

Theme 2 - Personalised educational programs to meet the learning needs of students.

Research in the recent years have evidence that supports PA and deep pressure therapies directed at reducing the stereotypical behaviour associated with heightened arousal and anxiety act as an antecedent intervention to help students facilitate attention and learning in students who have difficulties with sensory regulation. (Losinski et al., 2017)

Students with ID do not develop as their typical peers and require regular PE for them to achieve stabilization on their lumber vertebra especially exercise focused around the abdominal muscle (Sons & Jeon, 2017). Some of the characters of specific disabilities include (but is not limited to), hyperactivity, self -stimulative, dysgraphia, inattentive, impulsive, clumsy, fidgety and more were referred to as, 'neurodevelopmental disorders. All the

reviewed studies by Lang et al 2010 has reported improvement in behaviour, academics with PE. Most behavioural improvement reported in eleven studies by Kern et al., (1982, 1984) to Birkan & Bumin (2004) identified increase in exercise that reduced stereotypy or self-stimulatory behaviours, as a result of fatigue resulting from exercise.

Behaviour modification studies by Neely et al,. 2015 evaluated the effects and benefits of PE contingently run prior to any academic instructional sessions, as targeted antecedent physical exercise (APE) concluded that the length and intensity will have to be individualised. APE was successful on off-task behaviour (Powers et al., 1992); and increased task completion (Rosenthal-Malek & Mitchell, 1997; Kern et al. 1982).

Studies on the effects of acute aerobic fitness showed increase from 33% to 50% (Lochbaum and Crews 2003) in academic engagement following PE at a significant rate (Nicholson et al,. 2011). Six years ago, a study by Pastula et al,. (2012) concluded that intensive exercise training at over 60% HR shows a significant improvement in the cognitive function of young adults with ID that drew on the successful findings of Rimmer and Rowland, (2008) on the significance and benefit of exercise on the overall health of youth and the challenges that they faced. The recommended length of PA was 45 minutes to an hour. But a decent 10-minute gross motor exercise can set the students up for a good 50-minute lesson. Most OTs who work with sensory deficits children do it in blocks of 60 minutes session, 10min: 50min ratio with plenty of brain breaks or 50min sensory motor: 10min academic or fine motor. The theory is that the higher order skills emerge if the brain is supported to function.

Theme 3- Positive Impact that exercise has on children with challenging behaviours (the effects of Acute aerobic exercise in the reduction of depression and anxiety and the possible reduction in the need for pharmacological treatments.)

The review of literature in the area and importance of PA and PE highlighted that possible reduction in need of medication (Conn, 2010). Children with ADHD not only struggle with impulsivity, inattentiveness and hyperactivity but also have deficit in executive functioning (EF) (Yang et al., 2011) and working memory (Alloway, 2011). Alloway (2011) also concluded that there is a relationship between EF and motor abilities in children with ADHD. Pharmacological treatment is a common method used to reduce the symptoms of ADHD which usually has adverse long-term effect on their health. Ziereis, s. and Jansen, P. 2014, 2015 did two consecutive 12-week study on the effects of physical activity (PA) on executive function and motor performance in children with ADHD. The evidence from this study supports long-term use of PA to improve motor abilities for children with ADHD. PA administered regularly has the potential in reducing long-term pharmacological intake (Ziereis and Jansen, 2015). PE and PA create a natural chemical in our body called Endorphins and these are to be referred as the "feel-good" chemical because they can act as a pain reliever and happiness boosters. Endorphins are primarily made in the hypothalamus and pituitary glands, but it is also found in other parts of the body and it can vary individual to individual. People who have reduced level of endorphins may have depressive symptoms or fibromyalgia (Berry, 2018). Conn, (2010) approached the subject of depressive symptoms outcomes of PA intervention with the century long background that linked PA to mental health outcomes and clinical depression. "An exercise session that last for 20-30mins at over 70% capacity releases pain-relieving endorphins", according to Robert G. McMurray of the University of Carolina at Chapel Hill. Based on extensive research and intervention studies a conclusion was drawn to say that depressive symptoms reduced with

PA interventions and exercise, irrespective of gender or weight (Conn 2010). Wiles et al,. 2008 deduced that children who engage in an hour of PA a day had better emotional health in the years to come. A weak yet a positive relation between PA and cardiovascular fitness & cognitive functioning was found in young people (Biddle & Asare, 2011)

Attention deficit hyperactivity disorder (ADHD) is one of the most common developmental disorder with symptoms such as hyperactivity, inattentiveness and impulsivity. Studies have shown that children with ADHD have difficulty in automated responses, impairment in motor control and uncontrollable impulsive behaviour need medication to ameliorate symptoms. Acute exercise has shown to provide similar impact as the medication, by increasing brain concentrations, (Cooper,1973). Recent studies have shown benefits in executive function (EF) in children with ADHD with a single bout of moderate intensity aerobic exercise (Chang et al., 2012; Pontifex, 2013). Sibley and Etnier (2003) Any PA no matter how small will enhance cognitive performance. AHDH often showed deficit in the EF which resulted in motor and cognitive disabilities which was often catered by pharmacological treatments. In recent year parents and carers are opting for non-pharmacological options and to this extent PA can be the better alternate. Best (2010) concluded that the interaction of single bout of aerobic activity will have stronger effects on the executive functioning. Ziereis & Jansen (2015) through their 12-week PA intervention study showed significant changes to the EF performance and motor abilities on long- term PA. Long-term use of PA has the potential to reduce the need of long-term pharmacological intake.

Theme 4- Identify the needs of students to attain and maintain an optimum level of alertness.

Personalised educational program to meet the learning needs of students- thinking and acting favourably towards people with disability. Children with ASDs struggle with social interactions mainly pertain to their lack of understanding and interpretation of others behaviour (Vandereijcken et al., 2008). This is the reason they struggle to respond to the others social and emotional signals as communicated through eye contact and facial expressions.

Some student with ASD exhibit challenging behaviour that can be socially unacceptable and as a result present as an obstacle in a learning setting for the student, peers and their teacher (Prupas &Reid, 2001). An experimental study by Cannella-Malone, Tullis and Kazee (2011), aimed at addressing three major limitations that prevail in presenting antecedent exercise as an effective measure is reducing challenging behaviour.

I. Only a few near zero demonstration of reducing challenging behaviour were captured in studies by Baumeister and MacLean, (1984)
II. Exercise was only provided once or twice a day
III. Data that was collected was not done so across the day instead only in 15-minute intervals.

Therefore, this study was done to implement an antecedent exercise program across the school day and by collecting data on the student from arrival to departure in a school day. This study was also done by the class teacher and the teacher assistant, two people who know the student well and thus providing an individually identified setting for each participant which led to the astounding generalised result of zero to near zero occurrence of

challenging behaviour. It highlighted the importance of providing antecedent exercise eight times a day across the school day. The antecedent exercise proved effective in reducing the frequency of challenging behaviour that was disruptive to classroom learning (Cannella-Malone, Tullis and Kazee, 2011. This study also highlighted the importance of having a program that is personalised to meet the needs of the student in a favourable manner.

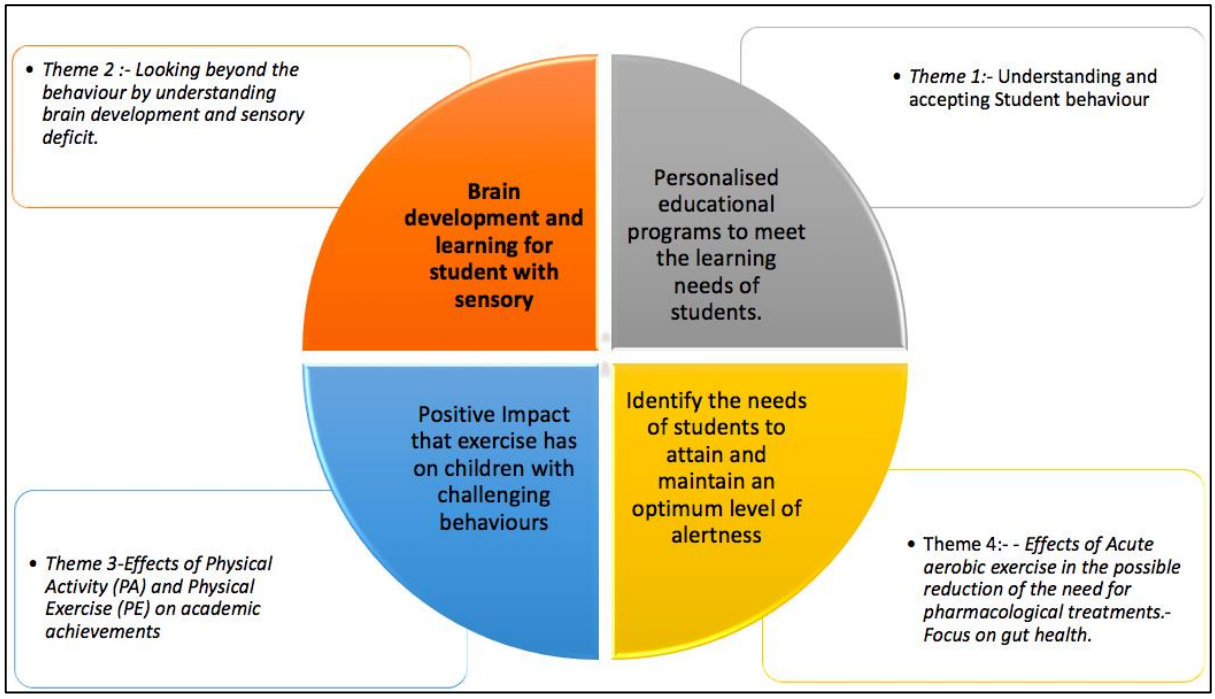

Figure 1-The four themes of ITZ and Literature Review

Figure 1 shows the relational theme that was reviewed for the program 'In the Zone and the literature from EDX701 (Vedamonickam, 2018). It addresses four points:

1. The importance of brain development and learning of students who have sensory deficit by looking beyond the behaviour that is being exhibited and looking at the things that might be causing the behaviour.
2. Understanding and accepting student behaviour by providing personalised educational program to meet the student's learning needs.
3. Impact of physical exercise and physical activity has in reducing challenging behaviour.
4. Identify the students' needs to attain and maintain optimal attention, through exercise while possibly reducing the need for long term pharmacological treatment

GAP IN RESEARCH

There are some gap that future researcher in this area could focus on. We know that every child is different so why should the exercise and activities they need, to get the most positive outcome, not be individualised. How to achieve this when teachers struggle with time constraints? Exercise especially for some of these students who have various sensory deficit and physical weakness needs to be tailored carefully for them. The input of occupational therapist, physiotherapist and specialist doctors should be sought during this process. How will specialist help be sought and incorporated effectively in an inclusive classroom while still catering for 25 other children in the class? Stephenson, Carter, and Arthur-Kelly (2010) suggested that teachers need to learn good classroom practice through individualised professional learning to increase the opportunities they can offer their students.

In recent years there has been a growing awareness of gut health and the use of continued medication that could potentially cause long term damage to gut health. It is imperative that we find alternate ways to reduce outburst of disruptive behaviour other than the use of medication for these children.

CONCLUSION

"Physical fitness is not only one of the most important keys to a healthy body, it is the basis of dynamic and creative intellectual activity." ~John F. Kennedy

This paper has addressed the research question, "To what extent do 'antecedent' sensory-motor activities facilitate attention and learning in an inclusive classroom for students having difficulties with sensory regulation?" It has not only reiterated the importance of antecedent exercise as an important activity to promote attention and learning of students with sensory deficit. It has also advocated the importance of creating a supportive and inclusive study environment in our school. Individual planning for students with disability in the form of IEPs is set aside as the cornerstone of good teaching practice in Australia (Dempsey, 2012). To achieve this teacher, need to work in collaboration with parents, students and para-professionals. The school and the community should get onboard too and supportive of the teacher and the families involved. Results from various research in and around the importance of sensory- motor activities, effects of physical activity and the need for regular exercise to reduce behaviour, depression and anxiety have all been positive.

We know that a child who is calm and relaxed can better focus resulting in increased academic achievement. There may be the occasional students who are an exception, but for most students the increase effects of PA and PE can reduce the need for medication. There is potential for more individualised testing and research in this area.

There is an increase in people wanting to understand through research the connection between brain, body and behaviour. There is an eagerness to choose a non-pharmacological option and an awareness of the damage the medication can be doing. There is a shift in thinking and understanding to rely on the natural endorphins. There needs to be more research into finding ways to naturally increase endorphins through exercise.

In conclusion, the sensory-motor activities facilitate attention and learning to a phenomenal extent. The Intensity and the types of exercise need to be individualised to the students and this should become part of their individual Education Plan and reviewed every 5 to 6 weeks and modified and changed every term.

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