



Benefits of Antecedent Physical Exercise In Reducing Challenging Behaviour

Jemimah Vedamonickam (2020)

As educators and enablers from different allied health professions and parents working with children with complex learning needs we are always in the lookout for new ways to improve our knowledge so we can better help our students. We know that for learning to happen students need to be in an appropriate state of mind, 'in the zone' so higher order thinking and learning can take place. This becomes a challenge when a student with complex learning needs are given a task that becomes overwhelming for them. They tend to respond with stereotypic behaviour or challenging problem behaviour.

In 2005 Rapp and Vollmer reported that a stereotypic behaviour is considered a problem behaviour and warrants intervention due to the prolonged time and energy and the hinderance that it can be for children with autism and other intellectual disability and those around them. When they are engaged in stereotypies they are unable to learn from and respond to their surrounding environment (Koegel & Covert, 1972; Runco, Charlop, & Schriebman, 1986; Lovaas, Litrownik, & Mann, 1971). Stereotypies, along with other problem behaviours, increase the risk of social, education, and communal exclusion (Horner et al, 2002) from their peer. Studies have shown that one stereotypic behaviour can serve multiple functions within multiple environments. Due to the heterogeneous nature and the various functions they serve, research has shown that this problem behaviour has responded to a variety of different interventions. Interventions that have been used to reduce stereotypic behaviours in people with autism have been deeply rooted in the principles of Applied Behaviour Analysis (ABA) began in the 1980.

Watters and Watters (1980) were the first to use 'exercise' as an intervention to decrease stereotypic behaviours in students with autism. The second author of this study was an educator and observed decreases in stereotypic behaviours soon after gym classes, field trips, and periods of outside exercise. This observation prompted this marquee study. Watters and

Watters (1980) studied the stereotypic behaviours of five children with autism within the school setting. Each participant was asked to participate in 8-10 minutes of physical exercises. Immediately following these brief periods of exercise the students were presented with a language training session. Correct responses during the language training and stereotypic behaviours were recorded. The results of this study demonstrated that following the periods of physical exercise stereotypic decreased. However, there was no effect on correct responses. Watters and Watters (1980) demonstrated that 8-10 minutes of antecedent exercise was adequate to decrease stereotypic behaviours in five students with autism. Since Watters and Watters (1980) several studies have been conducted on the effects of physical exercise on stereotypic behaviours in autism. These studies have used physical exercise as an antecedent intervention and as a contingency based intervention. These studies have resulted in two common themes:

(1) physical exercise reduces stereotypic behaviours and

(2) vigorous exercise is more effective than mild exercise in reducing stereotypic behaviours.

Studies have demonstrated that various exercises, types, intensities and durations have decreasing effects on stereotypic behaviours **regardless** of functions of the behaviours or gender, age, and severity of the participants.

******The results of Watters and Watters (1980), using physical exercise as an antecedent based intervention, have been replicated numerous times since. Kern, Koegel, Dyer, Blew and Fenton (1982) used physical exercise to reduce stereotypic behaviours in seven children diagnosed with autism. Kern, Koegel, and Dunlap (1984) used physical exercise to decrease stereotypic behaviours in three children with autism. Reid et al. (1988) reduced stereotypic in three adolescents with autism using physical exercise. Powers, Thibadeau, and Rose (1992) demonstrated that physical exercise significantly decreased the stereotypic behaviours of an eight year old boy with autism. A study conducted by Levinson and Reid (1993) resulted in decreased stereotypic behaviours for three individuals with autism after acute bouts of exercise. Elliott, Dobbin, Rose, and Soper (1994) reduced stereotypic behaviours in six adults diagnosed with autism following physical exercise. Stereotypic behaviours were decreased immediately after physical exercise in a study conducted by Rosenthal-Malek and Mitchell

(1997). *The stereotypic behaviours of a five year old boy were reduced after physical exercise in a study by Celiberti, Bobo, Kelly, Harris, and Handleman (1997). Prupas and Reid (2001) demonstrated that physical exercise reduced the stereotypic behaviours in four children with autism. Yilmaz, Yarnadag, Birkan, and Bumin (2004) showed that physical exercise decreased stereotypic behaviours in a nine year old child with autism. Morrison, Roscoe, and Atwell (2011) used physical exercise to reduce the stereotypic behaviours in three out of four participants diagnosed with autism. Anderson-Hanley, Turek, and Schneiderman (2011) decreased the stereotypic behaviours of 22 individuals with autism using physical exercise. Bahrami, Movahedi, Marandi, and Abedi (2012) conducted research that resulted in the reduction of stereotypic behaviours after physical exercise for fifteen individuals with autism. Fedak (2012) reduced stereotypic behaviours in twenty-three individuals with autism following exercise. Finally, Liu, Fedak, and Hamilton (2016) replicated the results of Fedak (2012) by conducting research that reduced the stereotypic behaviours in twenty three children with autism following physical exercise. All of these studies successfully used physical exercise as an antecedent based intervention to reduce stereotypic behaviours in autism. ***

Applied behaviour analysis (ABA) is a scientific approach for discovering environmental variables that reliably influence socially significant behaviour and for developing a technology of behaviour change that takes practical advantage of those discoveries (Cooper, Heron & Heward, 2013). Prior to this, interventions were dominated by *punishment/consequence* based interventions (Cooper, Heron, & Heward, 2013 which creates a stimulus change that follows a behaviour of interest (Cooper et al., 2013). Cooper et al. (2013) wrote that behaviour analysts often neglected to study the effects of antecedent events on behaviour.

Antecedent interventions used to reduce stereotypies were used less frequently until the 1990's (Horner, Carr, Strain, Todd, & Reed, 2002). Some of the antecedent interventions that have been used successfully to reduce stereotypic behaviours have consisted of sensory extinction (Rincover, Cook, Peoples, & Packard, 1979), matched stimuli (Piazza, Adelinis, Hanley, Goh, & Delia, 2000; Rapp, 2006; Rapp, 2007), differential reinforcement interventions (Eason, White, & Newsom, 1982; Shabani, Wilder, Flood, 2001), peer mediated instruction and intervention (Lee, Odom, & Lofitn, 2007), non-contingent reinforcement

(Britton, Carr, Landaburu, & Romick, 2002; Carr, Dozier, Patel, Adams, & Martin, 2002), and **Physical exercise** (Watters & Watters, 1980).

Table 5
Interventions Used to Decrease Stereotypic Behaviors

Punishment/Consequence Based Interventions	Antecedent Based Interventions
Electric Shock	Sensory Extinction
Timeout	Matched Stimuli
Overcorrection	Differential Reinforcement Interventions
Physical Exercise	Peer Mediated Instruction and Intervention
Visual Screening	Non-Contingent Reinforcement
Water Mist	Physical Exercise
Response Blocking	

Figure 1- Meta-analysis

One type of intervention that has been successfully used to reduce stereotypic behaviours in individuals with autism as a consequence based intervention and separately as an antecedent based intervention is **Physical exercise** intervention.

Physical exercise is defined as a planned, structured, and repetitive activity that has a final or intermediate objective of maintaining or improving physical fitness (Caspersen, Powell, & Christenson, 1985). Physical exercise has been used to treat and/or prevent various physical, mental, and behavioural problems.

Research has demonstrated that individuals with autism often spend less time engaged in physical activity than their peers (Srinivasan, Pescatello, & Bhat, 2014). This is despite the fact that research has shown that individuals with autism benefit physically, behaviourally, and psychologically from physical exercise. Individuals with autism have experienced physical improvements by way of increases in muscular strength, endurance, physical appearance, and decreases in percent body fat and body mass index (Cannella-Malone, Tullis, & Kazee, 2011; Pan, 2010; Pitetti, Rendoff, Grover, & Beets, 2007).

They have also experienced increases in self-confidence (Cannella et al., 2011). Behaviourally, studies have shown that physical exercise can increase social skills, decrease antisocial behaviours and aggressive behaviours (Pan, 2010; Allison, Basile, & MacDonald, 1991). These results have been produced by a variety of different exercises. Aquatic exercises, running, and treadmill walking have been used routinely to produce positive results (Cannella et al., 2011; Pan 2010, Allison et al., 1991; Pitetti et al., 2007).

1. Research has repeatedly demonstrated the physical and psychological health benefits of physical exercise.
2. Exercise has proven to decrease the risk of premature death by preventing type II diabetes, reducing cardiovascular disease, reducing risk of colon and breast cancers, and reducing the risk of osteoporosis (Warburton, Nicol, & Bredin, 2006).
3. Physical exercise has also proven to improve glucose metabolism, lower blood sugar, and decrease the risk for developing hypertension (Barbour, Edenfield, & Blumenthal, 2007).
4. The antecedent exercise proved effective in reducing the frequency of challenging behaviour that was disruptive to classroom learning (Cannella-Malone, Tullis and Kazee, 2011).
5. Barbour, Edenfield, and Blumenthal (2007) conducted a meta-analysis and cited numerous studies that demonstrated an inverse relationship between physical exercise and depressive symptoms in individuals with depression.
6. Lawlor and Hopker (2001) reported that a number of studies showed that the effect of *physical exercise was comparable to medication treatment in individuals with depression*.
7. 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.
8. Individuals diagnosed with anxiety have also experienced positive results after engaging physical exercise.

9. A number of studies have demonstrated that physical exercise has resulted in a reduction of state anxiety, panic attacks, and anxiety sensitivity (Barbour, Edenfield, & Blumenthal, 2007).
10. The Association for Applied Sport Psychology (2016) reported that people who perform physical exercise on a regular basis experience psychological benefits. These benefits include improved mood, reduced stress, improved ability to manage stress, improved self-esteem, increased satisfaction with oneself as well as others (Association for Applied Sport Psychology, 2016).
11. Szabo (2003) demonstrated that people who jogged or ran at a self-selected intensity for 20 minutes expressed improvements in mood based on responses on the Mood States Inventory questionnaire.

***Morgan and O'Connor (1988) postulated four ideas to explain the positive effects of physical exercise on mood and affect. These include the monoamine hypothesis, endorphin hypothesis, thermogenic hypothesis, and the distraction hypothesis. The monoamine hypothesis suggested that the major brain monoamines of serotonin, dopamine, and norepinephrine are altered by physical exercise. This hypothesis has been supported by Meeusen and Meirleir (1995) who demonstrated that physical exercise produce changes in synthesis and metabolism of monoamines. ***

*** These results were produced by in vivo measuring techniques. The endorphin hypothesis suggested that physical exercise produces a release of endorphins, which improved mood. The thermogenic hypothesis suggested that physical exercise increases the body's temperature and therefore produces a relaxed state. Finally, the distraction hypothesis suggested that resting quietly in an environment free from distractions produced reduction in anxiety and blood pressure. Morgan and O'Connor (1988) suggested that it is possible that these hypotheses independently had the potential to improve affect, however they recognized that improved mood from exercise could result from a combination of any of these hypotheses. Fenton (1982) demonstrated that physical exercise decreased stereotypic behaviours and increased appropriate play and academic responding.** (Tarr, Rineer-Hershey and Larwin, 2019)*

Hypotheses on Why Exercise Decreases Stereotypic Behaviours

Researchers have proposed a number of hypotheses to explain the effectiveness of physical exercise on reducing stereotypic behaviours. The first hypothesis is related to fatigue. Researchers suggest that stereotypic behaviours decrease because the body is too fatigued following exercise to engage in stereotypic behaviours. The second hypothesis suggests that stereotypes are reduced due to a matching effect. These researchers suggest that vigorous exercises may produce similar automatic reinforcement effects as the stereotypic behaviours. A third hypothesis involves the effects of physical exercise on the body's neurotransmitters.

A study conducted by Powers, Thibadeau, and Rose (1992) showed that physical exercise decreased stereotypic behaviours and increased on-task behaviours. Rosenthal-Malek and Mitchell (1997) conducted a study that measured the effects of physical exercise on stereotypic behaviours, academic responding, and completion of work tasks. The results of this study showed that exercise decreased stereotypic behaviours and increased academic responding and the completion of work tasks. Oriel, George, Peckus, and Semon (2011) measured the effects of physical exercise on stereotypic behaviours, correct academic responding, incorrect academic responding, and on-task behaviour. This study demonstrated that physical exercise did not decrease stereotypic behaviours or increase on task behaviours. However, it did result in 7 of 9 participants increase in correct responding. The evidenced presented by these studies could discredit the fatigue hypothesis. Lang et al. (2010) suggested it could be assumed that if a body is too fatigued to engage in stereotypical behaviours then other appropriate behaviours would not increase. Exercise research has shown that physical exercise has the potential to positively change the synthesis and metabolism of monoamines (Meeusen & De Meirleir, 1995).

Various durations of exercise have been successful in decreasing stereotypic behaviours. Luce, Delquadri and Hall (1980) required participants to complete 10 stand ups and sit downs (lasting 30 seconds). Celiberti, Bobo, Kelly, Harris, and Handleman (1997) demonstrated success with bouts of exercise that lasted 6 minutes per session. Burns and Ault (2009) demonstrated success in reducing stereotypic behaviours with bouts of exercise that lasted 5-8 minutes. Watters and Watters (1980) were successful in using physical exercise to decrease stereotypic behaviours with 8-10 minute acute bouts of exercise. Powers,

Thibadeau, and Rose (1992) and Morrison, Roscoe, and Atwell (2011) found success with 10 minute bouts of exercise. Kern, Koegel, Dyer, Blew, and Fenton (1982) were successful in using acute bouts of exercise that lasted 5-20 minutes in length. A number of studies used 15 minute bouts of exercise (Kern, Koegel, & Dunlap, 1984; Levinson & Reid, 1993; Oriel, George, Peckus, & Semon, 2011; Fedak, 2012; Liu, Fedak, & Hamilton, 2016). Many studies exercised participants for 20 minutes per exercise session (Elliot, Dobbin, Rose, & Soper, 1994; Rosenthal-Malek & Mitchell, 1997; Anderson- Hanley, Turek, & Schneiderman, 2011). Yilmaz, Yarnardag, Birkan, and Bumin (2004) had participants exercise for 60 minutes per session. Bahrami, Movahedi, Marandi, and Abedi (2012) required participants to exercise for 30-90 minutes per exercise session. Liu, Fedak, and Hamilton (2016) concluded that 15 minutes of physical reduced stereotypic behaviours for 2.5 hours before returning to baseline. Tarr, C suggest researchers and behaviour analysts to adopt an **Always Understand The Inner Stereotypic Message** mindset.

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