THE IMPACT OF OUTDOOR EDUCATION ON EXECUTIVE FUNCTION IN ADOLESCENTS

JARED MCKENZIE
Bachelor of Education, University of Lethbridge, 2010

A thesis submitted
in partial fulfilment of the requirements for the degree of

MASTER OF EDUCATION

in

GENERAL

Faculty of Education
University of Lethbridge
LETHBRIDGE, ALBERTA, CANADA

THE IMPACT OF OUTDOOR EDUCATION ON EXECUTIVE FUNCTION IN ADOLESCENTS

JARED McKENZIE

Date of Defence: December 3, 2020

Dr. P. Adams Thesis Supervisor	Associate Professor	Ph.D.
Dr. R. Gibb Thesis Examination Committee Member	Professor	Ph.D.
Dr. C. Mattatall Thesis Examination Committee Member	Associate Professor	Ph.D.
Dr. I. Matheson External Examiner Queens University Kingston, Ontario, Canada	Assistant Professor	Ph.D.
Dr. D. Burleigh Chair, Thesis Examination Committee	Associate Professor	Ph.D.

Dedication

To my family:

Sheena, for your support, patience, and partnership.

Ayla and Ellis, for your curiosity, wonder, and joy.

Your love keeps me going.

Abstract

This mixed-methods study investigated the nature of the impact of a multi-day outdoor education camp on the executive functions of sixth grade students (n = 29) in Alberta, Canada. The participants demonstrated statistically significantly improved reaction time in four of seven trials, and statistically significantly improved accuracy in three of eight trials, after camp. There were no statistically significant differences in either measure in a third round of testing approximately one month later. The improvements were not linked to parental education, previous experiences, or scores on the Amsterdam Executive Function Inventory. As well, eight participants were interviewed about their experiences. Three themes emerged from this analysis: the perceptions of learning, the importance of physical comforts, and the outdoors as a source of wildness. Here, I argue that these impacts to executive functions are linked to the three themes above, suggesting that elements of outdoor education can indirectly support executive functions.

Acknowledgements

I must sincerely thank my supervisor, Dr. Pam Adams, for her wisdom, support, and guidance throughout this entire process. Her encouragement and scholarship were instrumental at so many moments throughout this research and I am grateful for these incredible impacts on myself as a learner, teacher, and scholar. I also thank my committee members, Dr. Robbin Gibb and Dr. Chris Mattatall, for their feedback, support, and instruction throughout my coursework. I would also like to thank Lisa Halma for sitting down with me for a refresher on statistical methods, and Dr. Dawn Burleigh for the experiences she provided me as a research assistant, guiding my approach to qualitative interviews.

I also thank the members of my program cohort, who all finished their culminating activities ages ago. Having an opportunity to learn together each summer was a real treat, and I cherish so many of our conversations and experiences.

Finally, I must thank the students and staff at Connect Charter School. In particular, I thank Dr. Phil Butterfield for supporting this proposal from the beginning, and his unwavering support throughout all phases of this research. And lastly, a thank-you and warm hug to Susan Chomistek for her conversations, generosity, and love of outdoor education.

Table of Contents

List of Tables

List of Figures

Chapter One: Introduction

Executive functions (EFs) are cognitive skills that are critical to almost every aspect of human life. These skills, which include working memory, response inhibition, and cognitive flexibility, allow us to control our impulses, approach problems from multiple perspectives, hold information in mind, and perform mental manipulation (Diamond, 2013; Zelazo, Blair, & Willoughby, 2016). Furthermore, EFs allow individuals to purposefully exhibit, adjust, or inhibit, behaviours in situations where relying on impulse could be detrimental. EFs are important factors in school success as they are a greater predictor of literacy and numeracy skills than IQ (Alloway & Alloway, 2010; Borella, Caretti, & Pelgrina, 2010; Hassinger-Das, Jordan, Glutting, Irwin, & Dyson, 2014; Titz & Karbach, 2014), and individuals with stronger EFs demonstrate greater learning and retention as compared to those with weaker EFs (Benson, Sabbath, Carlson, & Zelazo, 2013; Zaitchik, Iqbal, & Carey, 2014). EFs can be improved from infancy to old age (Diamond, 2013; Diamond & Ling, 2016), with the greatest response to intervention noted for individuals in sensitive periods of development: early childhood, puberty, and adolescence. As these sensitive periods can often align with formal schooling, there is considerable interest in the field of education regarding ways to improve EFs in both typically-developing populations and those with impairments (Dawson & Guare, 2010; Zelazo, Blair, & Willoughby, 2016).

Efforts to improve EFs typically fall into two categories: directly improving EFs by specifically training working memory, response inhibition, and cognitive flexibility, or indirectly improving EFs by supporting other factors that benefit executive functions (Diamond, 2013; Diamond & Ling, 2016). These other factors include physical activity, positive peer relationships, and reducing stress. Currently, aerobic exercise, mindfulness training, and action-based video games have been considered (Zelazo, Blair, & Willoughby, 2016) as strategies to indirectly support executive functions. The intent of this research is to investigate whether outdoor, experiential, and place-based education could provide another category of experiences that may impact executive functions.

The Purpose of the Study

The proposed research hypothesized that students who engage in authentic, place-based, outdoor education activities would demonstrate variable impacts to their executive functions. Participants' pre- and post-intervention executive function skills were determined by interactive tasks developed by the Developmental Cognitive Neuroscience lab at the University of British Columbia.

While the main purpose of the study was to investigate the impacts of outdoor, place-based education experiences on students' executive functions, there was a secondary purpose of helping bridge the gap between current educational practices and developmental cognitive neuroscience. As such, this study used a mixed methods embedded research design that had the following research questions:

QUANT: To what extent does a multi-day, immersive outdoor education experience impact the executive functions of sixth-grade students?

QUAL: How do participants who display varying impacts describe their experiences?

Mixed Methods Research Question: What is the nature of the impact of an immersive, multi-day outdoor education activity on the executive functioning of sixth-grade students?

Busso and Pollack (2015) noted that the space between neuroscience and education can be often filled with misunderstanding and misappropriation; some educators can find appeal in neuroscience explanations and, lacking critical scientific literacy skills, adopt a problematic approach in their classroom. Likewise, Turner (2012) argued that the interactions between neuroscience and education can be a challenge, citing the proliferation of neuromyths in education as a key example. He suggested that, in order for effective interdisciplinary work to occur between the two fields, educators should resist “biologizing” (p.176) their understanding of learning and try to avoid overgeneralizing rudimentary neuroscience findings in their classrooms. Instead, he encourages true two-way conversations between educators and neuroscientists to further a collective understanding of learning and behaviour.

This proposed research does not try to overgeneralize a neuroscientific concept like “brain plasticity” or some other basic understanding of neurophysiology into K-12 education. Instead, it is an attempt to investigate how educators and clinicians might impact student outcomes on measures important to both educators and cognitive neuroscientists. The proposed research is meant to be interdisciplinary in that it should provide value to the literature in both education and neuroscience.

Context

I currently act as a classroom teacher at a public charter school in Alberta. In this province, public charter schools must demonstrate research and innovation in their teaching (Alberta Education, 2015). Throughout the school’s existence, it has included a robust outdoor education program: all students in the school (grades 4-9) participate in at least two multi-night trips as part of the regular school programming. These trips include spending a week at the Bamfield Marine Sciences Centre in Bamfield, British Columbia, winter camping in Kananaskis, exploring southern Alberta's history on a multi-day bus trip, and spending several days at Fort Steele Heritage Town near Cranbrook, British Columbia, among other activities depending on grade. These mandatory trips have also been supplemented by elective trips for students who choose to participate in activities such as backcountry camping, Nordic skiing, and cycling.

Furthermore, Connect Charter's already robust outdoor education programming has been bolstered by the inclusion of place-based education principles, which primarily involve taking students out of the classroom and into local environments to engage in experiential learning (Sobel, 2004). Students at Connect may be engaged in learning about wetlands, for example, by visiting a local wetland a short walk away. These students typically have a familiarity with the outdoor environment, and outdoor education, through their regular school-based activities. As such, this research context provides an investigative opportunity into the impacts, if any, of participating in outdoor, experiential, and/or place-based learning on the executive functions of adolescents.

Key Terms and Constructs

There are several key terms and constructs within this study, including:

- *executive function*, or three interrelated core skills of inhibitory control, working memory, and cognitive flexibility (Diamond & Ling, 2016)
- *experiential education*, a process through which a learner constructs knowledge, skill, and value from direct experiences (Luckman, 1996, p. 6)
- *place-based education*, using the local community and environment to teach curriculum through hands-on learning experiences that are available outside of the

classroom (Sobel, 2004)

- *outdoor education*, an experiential process of learning by doing, emphasizing relationships between and within people and natural environments, that takes place primarily out-of-doors (Priest, 1986, p. 13).

As well, this study references Kaplan's *Attention Restoration Theory* (ART), which argues that direct attention as a cognitive skill has a limited window of activation followed by fatigue (1995). Kaplan suggests that natural environments are best-suited to allow for restoration of attention and other cognitive skills.

As Diamond and Ling (2016) argued, EFs can be improved, and there are several programs and interventions that claim to directly improve working memory, response inhibition, and cognitive flexibility. As well, other activities, such as video games, exercise, and mindfulness training (Zelazo, Blair, & Willoughby, 2016) have been argued to indirectly improve EFs by supporting factors that benefit EFs. Here, as an outdoor education teacher interested in executive functions, my interest is investigating whether outdoor education can also indirectly improve EFs by supporting similar factors. As this research is interdisciplinary, the following literature review will discuss the cognitive neuroscience of executive functions as well as the educational paradigms of outdoor, experiential, and place-based education.

Chapter Two: Literature Review

This research explored the effects of outdoor education on executive function. Accordingly, the literature review includes sections on a variety of topics. Several models of executive functions, as well as their development and improvement, will be described. Next, Kaplan's attention restoration theory (ART) will be discussed, as well as current research that demonstrates the effects of natural environments on EF skills. Lastly, I will review the literature on outdoor, experiential, and place-based education.

Executive Functions

Executive functions (EFs) refer to a collection of cognitive processes that allow an individual to act in his or her self-interest when relying on instinct, impulse, or conditioned response would be inappropriate (Diamond, 2013). For instance, imagine you are lined up at a buffet, carrying a plate for you and one for a companion. As the line slowly moves forward, your instinct or impulse may be to shove those in front of you out of the way so you may grab as much food as you desire as quickly as possible. Or, perhaps your impulse would be to skip the buffet altogether, avoiding more healthful foods and head straight to the dessert table, filling your plate. EFs allow you to avoid making these choices and instead choose to act in a more appropriate manner. As well, EFs also allow you to remember what your companion had requested as you move through the line, selecting some items and rejecting others. Lastly, EFs allow you to make decisions in response to new information: perhaps an item requested by your companion is no longer available, but there is a reasonable substitute that could instead by included. Rather than responding with rigidity to your companion's requests, your EFs allow you to act with flexibility. This hypothetical example illustrates how EFs may be involved in a single instance, but EFs are essential skills for several aspects of life, including school readiness and success, mental and physical health, job success, quality of life, marital harmony, and public safety (p. 137).

EFs are essentially synonymous with the functions of the lateral prefrontal cortex (PFC) (Hughes & Graham, 2008). Stuss and Alexander (2000) described several cases involving individuals with frontal lobe lesions demonstrating impairment in areas including attention, inhibition of behaviours, and implicit and explicit memory. Likewise, Alvarez and Emory's (2006) meta-analysis offered evidence for the relationship between the frontal lobes and EFs in individuals with frontal lobe lesions. In healthy adults, Yuan and Raz's (2014) meta-analysis demonstrated that larger areas of the PFC correlate to higher scores on assessments of EFs. However, suggesting that only the PFC is involved in EFs overly simplistic; the PFC is not fully developed until early adulthood (Kolb & Whishaw, 2009) but children as young as 6 months old can demonstrate rudimentary working memory abilities (Tau & Peterson, 2010). Furthermore, healthy individuals with greater white matter connections between the PFC and posterior brain regions appear to demonstrate greater EF abilities (Smolker, Depue, Reineberg, Orr, & Banich, 2015). Stout (2010) argued that the PFC plays an "executive" role, while posterior and subcortical structures are engaged in executive functions (p. 615).

Models of executive functions. Operationally, there are a wide number of processes that could be labeled as executive functions, including verbal reasoning, sustaining attention, utilization of feedback, planning, sequencing, and cognitive flexibility (Chan, Shum, Touloupoulou, & Chen, 2008), but no clear consensus as to what constitutes EFs (Koziol & Lutz, 2013). Diamond (2013) argued that this variety of processes stems from three core EFs: inhibitory control, working memory, and cognitive flexibility (p. 136). Inhibitory control describes the ability to control one's behaviour, thoughts, attention, and emotions; it allows individuals to respond to novel contexts by making (or failing to make) appropriate choices. Working memory describes the ability to hold visual or auditory information in mind and use it. For example, mentally completing a two-digit by two-digit multiplication problem requires an individual to hold both sets of numbers in mind and manipulate them to reach the correct product. Lastly, cognitive flexibility describes the ability to change perspectives or approaches to problem solving as well as switch between tasks. An individual playing a game with evolving or changing rules would be required to demonstrate cognitive flexibility.

Diamond (2013, p. 16) structured these three core EFs as follows: working memory and inhibitory control form the two primary EFs that, together, allow for cognitive flexibility. In this model, inhibitory control also allows for the development of emotional self-regulation and motivation. Diamond also proposed that abstract reasoning, problem solving, and planning represent three higher-order EFs that emerge from the foundation of the three core EFs. Furthermore, she argued that fluid intelligence and these higher order EFs are, in effect, the same processes (p. 18).

Similarly, Miyake et al (2000) developed a three-factor model of EFs. In this model, these factors are labeled as "Shifting", "Updating", and "Inhibition". Shifting includes attending to and switching between tasks; updating refers to updating and monitoring working memory; and inhibition refers to inhibiting behaviours. While these three factors are similar to those described by Diamond (2013), Miyake et al (2000) argued that these three factors are separate, yet collaborative functions that speak to the "unity and diversity of executive functions" (p. 87). In this argument, executive functions can be distinct, but clearly delineating between EFs through cognitive tasks can be tremendously challenging. However, Miyake et al noted that these EFs do share an unknown commonality, and suggests two possibilities: first, that working memory represents a common element between all EFs as keeping information in mind and mentally manipulating it appears to be involved in all EF tasks, including attention; and secondly, that some form of inhibition represents a commonality between all EFs, as inhibiting responses to stimuli also appears to be involved in EF tasks (pp. 88-89).

Here, an understanding of Baddeley's multicomponent model of working memory may be appropriate. In this model, revised in 2012, working memory includes four specialized components: a visuospatial sketchpad for holding visual information in mind and manipulating that information; a phonological loop for vocal or subvocal rehearsal as well as non-linguistic auditory information; an episodic buffer that chunks sensory information into groups or episodes; and a central executive that allows individuals to focus attention on a task (or two or more tasks) as well as switch between tasks – essentially, components of executive functions. Working memory is distinct from short-term memory; short-term memory involves recall of information, while working memory involves holding information in mind and manipulating it (Diamond, 2013).

The multicomponent model of working memory has some overlap between models of EFs, in that it provides a more coherent understanding of working memory, but Baddeley (2012) did not suggest that this model presents a different operational definition of EF. Instead, he argued that the growing research on EFs "argue[s] against a unitary executive capacity" (p. 14), and instead posited that the central executive of his model is not a singular function, but instead a diverse collection of functions.

Another model of EFs is Barkley (1997)'s "hybrid" model. This model includes five essential elements: behavioural inhibition; nonverbal working memory; internalization of speech or verbal working memory; self-regulation of affect/motivation/arousal; and reconstitution, or behavioural flexibility. The "hybrid" term from the title of this model refers to the hybridization of previous research by Bronowski (1977) and Fuster (1995) related to the internalization of speech and motivational states stemming from the PFC. Within Barkley's (1997) model, behavioural inhibition serves to inhibit or interrupt responses related to verbal and nonverbal working memory, self-regulation, and reconstitution. Barkley suggested three properties of behavioural inhibition: to inhibit or interrupt a response that could lead to an undesired consequence; to inhibit or interrupt a behaviour that is not successful; and to respond to stimuli that could interfere with other executive functions. In this model, behavioural inhibition is the foundational executive function upon which all others are built.

Barkley's model was originally developed to conceptually understand attention deficit disorder, and he argued that nonverbal working memory and verbal working memory are two distinct executive functions. He included behaviours such as holding events in mind, hindsight and forethought, self-awareness, and nonverbal rule-governed behaviour as elements of nonverbal working memory, while reading comprehension, description and reflection, moral reasoning, and self-questioning are described as elements of verbal working memory, which he labels as internalization of speech (p. 191). While Barkley's hybrid model does have some support (ie Dawson & Guare, 2010), his inclusion of internalization of speech and emotional self-regulation, among other psychosocial skills, (Barkley & Lombroso, 2000, p. 1066) has led to Perry (2001) asking, essentially, "What human behaviour isn't EF?"

Alternatively, Koziol and Lutz (2013) suggested a dual-functioning model of EFs. Both Diamond and Barkley emphasized a top-down activation of *perceive-think-act* as an understanding of EFs. Using our previous buffet line example, an individual using this serial processing paradigm looks at the available options, thinks about those options in relation to specific desires, and acts in accordance to what he has seen and thought. Koziol and Lutz, however, argued that humans are continuously interacting with their environment in two ways, only one of which could be described as *perceive-think-act*. The other involves procedural memory: a form of learning that leads to automatic behaviours (Cozolino, 2013). Over time, behaviours develop automaticity; as individuals learn and practice behaviours, they exert top-down cognitive control until the behaviours become automatic. At this point, the automatic, bottom-up behaviour occurs in response to environmental cues, without cognitive control. For example, imagine a child learning to write with a traditional pencil. As the child learns the appropriate letter shapes, she practices and exerts top-down cognitive control to sustain attention, use a suitable pencil grasp, and push the pencil on the paper with enough force to create the desired shape. As this behaviour becomes more automatic, the child no longer needs to exert as much top-down control; eventually, she may be able to write a variety of letter shapes in novel combinations automatically. However, if given a new letter to form she will once again need to exert more top-down effort – perhaps even more effort if she has difficulty writing the letter forms she already has studied (Richards et al, 2009).

Koziol and Lutz (2013) argued that individuals continuously interact with environments that may require cognitive control and then require automatic behaviours. This continuous shift between top-down and bottom-up processing describes a dual-tiered model of functioning (p. 105) that allows us to respond automatically in certain contexts and, when provided with novel situations, react accordingly. Using a model of sensorimotor interaction (Cisek & Kalaska, 2010), Kuziol and Lutz described the neurophysiological architecture required to support this understanding as interactions between large regions of the cortex, basal ganglia, and cerebellum. In this model, the basal ganglia are primarily involved with reward probabilities and assisting in automaticity by transmitting information to the cortex about appropriate and inappropriate actions (Cockburn & Frank, 2011). Aside from the PFC, other major regions of the cortex are involved including the motor cortex, premotor cortex, and parietal cortex. Lastly, the cerebellum guides behaviour by essentially teaching the PFC to anticipate possible outcomes (Ito, 2011, as cited in Koziol & Lutz, 2013) for planning behaviour and movement.

In this dual-function model, EFs occur in large-scale brain networks involved in processing sensory information, determining rewards, and performing desired actions, as opposed to primarily the PFC. This shift in understanding EFs from a functional connectivity standpoint (Yeo et al, 2011) centered around sensorimotor interaction led Koziol and Lutz (2013) to propose three systems of EFs: the top-down cognitive control of classic EFs, like those described by Diamond (2013) and Barkley (1997); the role of the cerebellum as providing assistance to automaticity and contextual variables; and the reward valance of the basal ganglia (Greenhouse, Swann, & Aron, 2011).

It is important to distinguish between top-down, effortful cognitive control and bottom-up automatic behaviours as both are required for purposeful actions as opposed to acting on impulse. As Diamond (2013) noted, we need to use top-down EFs when faced with novel situations, but these are effortful and taxing. Ideally, we want those behaviours to become automatic so they require less effortful control. She explained:

> Phylogenetically, older brain regions have had far longer to perfect their functioning; they can subserve task performance ever so much more efficiently than can prefrontal cortex. You might say that your goal in trying to master something is to have it become so well learned that prefrontal cortex and EFs are no longer needed for it. (p. 153).

For the purposes of this proposed research, I am primarily interested in those top-down EFs as I will be presenting novel situations that require effortful cognitive control. As such, this research will utilize Diamond's three-factor model of EFs, focusing on response inhibition, working memory, and cognitive flexibility.

Development of executive functions. At the most basic level, EFs begin to develop in early infancy and continue to develop throughout young adulthood as PFC continues to develop (R. Gibb, personal communication, July 2016). Anderson (2002) noted that development of these skills may occur in spurts and that different EFs may not develop in step with one another. Furthermore, certain EFs such as inhibition can appear to have levelled off at a specific age, but then can change again during adolescence (Anderson, Anderson, Northam, & Taylor, 2000).

Development occurs in a proximal to distal fashion: that is, areas that are closer to the centre develop first. In terms of neural development, regions of the brain closest to the brainstem develop before those of the cerebral cortex, and PFC continues to develop into adulthood (Kolb & Whishaw, 2009). At birth, neural foundations for EFs are present, but as an individual's brain develops through their continued interaction with the environment and experience, these foundations are built upon and fine-tuned through synaptogenesis, dendritic arborization, and synaptic pruning (Casey, Tottenham, Liston, & Durston, 2005). In their review of fMRI on cognitive development in adolescence, Luna, Padmanabhan, and O'Hearn (2010) wrote

> What is evident across studies is that prefrontal systems and the ability to recruit distributed function are present early in development. However, recent work indicates that the connections between these distributed circuitries increase in strength, and incorporate more long range connections, through adolescence. That transition from adolescence to adulthood therefore can be seen as a change in *mode of operation* from initially relying on more regionalized processing, such as in the PFC, earlier in development to relying on a broader network of regions that share processing in an efficient and flexible manner at the systems level. (p. 112)

Recognizing that development of EFs can occur in spurts rather than linearly and that structural capabilities for EFs may be present prior to the demonstration of fully established behaviours, we can now look to ascertain the developmental trajectory of EFs.

Dennis (1989), as cited in Anderson (2002), described periods of cognitive skill development as three sequential stages: emerging, or structurally apparent but not functional; developing, or partially functional; and established, or fully mature. Using this understanding, Tau and Peterson (2010) noted that infants as young as six months of age can demonstrate developing working memory capabilities. These capabilities continue to develop throughout childhood, and, according to fMRI, older children are able to activate regions of the PFC when faced with simple working memory tasks. However, when faced with more complex tasks, older children recruit more diverse neural regions as compared to adolescents. Even adolescents' working memory skills are considered to be developing, as they appear to activate a wider array of PFC than adults when faced with challenging working memory tasks.

Likewise, behavioural inhibition can be demonstrated in infants as young as nine months old (Diamond, 1990). Much like working memory, infants and young children demonstrate developing skills in behavioural inhibition and, as they age, these skills develop further. Children who are eight to 12 years old may be able to inhibit their behaviour, but they activate different neural regions than adults when faced with response inhibition tasks (Bunge et al., 2002): both adults and children activate left ventrolateral PFC in these tasks, but only adults activate right ventrolateral PFC. Adolescents – whose propensity for challenges with response inhibition are well-documented – demonstrate neural activation somewhat between a typical child and a typical adult, but the activated regions related to impulse control may be overwhelmed by stronger responses from regions related to affect and motivation (Somerville, Hare, & Casey, 2011).

Lastly, cognitive flexibility appears to develop later than both working memory and behavioural inhibition, as it requires functional working memory and behavioural inhibition skills (Diamond, 2013). Children between three and four years of age demonstrate developing cognitive flexibility (Espy, 1997) and typically continue to show improvement as they age. Cepeda and Munakata (2007) suggested that younger children's propensity for perseveration is the result of still-developing working memory abilities, as these children struggle to retain the “rule” of a given task. Development of cognitive flexibility throughout childhood and into adolescence is marked by similar patterns as working memory and behavioural inhibition: adults activate different neural regions than children, especially when exerting cognitive effort, and adolescents demonstrate a unique pattern of neural activation (Luna, Padmanabhan, and O’Hearn, 2010).

Because EFs continue to develop from infancy through to adulthood, environmental factors can both improve and degrade executive functions. Andersen (2003) noted that critical periods of brain development occur at transitions between childhood, adolescence, and adulthood, and suggests that these critical periods can be both windows of opportunity or points of vulnerability. Furthermore, Tau and Peterson’s (2010) review of normal development of neural circuitry described the massive increase in brain volume in the first two years of life, followed by a plateau in volume from ages two to five. This plateau in volume is maintained as the brain undergoes significant myelination and synaptic pruning. Overall brain metabolism rises to effectively double that of typical adults around four to five years of age and remains high until around nine to 10 years, suggesting that the increased pruning, myelination, and synaptogenesis of childhood is metabolically demanding (p. 156). In sum, early and middle childhood represent yet another critical period of brain development, marked by both opportunity and vulnerability.

Improving and assessing executive functions. Diamond (2013) stated, “EFs can be improved. That is true throughout life from infancy through old age” (p. 20). As described earlier, EFs are important to nearly every aspect of life, including mental health, school and job success, physical health, and public safety (Diamond, 2013, p. 137), so improving an individual's EFs can improve his or her quality of life. In young children, for example, working memory skills at 5 are a better predictor of literacy and numeracy than IQ (Alloway & Alloway, 2010).

While EFs can be improved, the challenge lies in identifying what EF interventions could be most useful. In their meta-analysis of 84 peer-reviewed studies demonstrating empirical evidence of how certain tasks can improve EFs, Diamond and Ling (2016, pp. 36-41) developed nine general conclusions. They are:

- First, specific training in an EF skill may transfer, but it may not increase other EFs. An individual who shows growth in response inhibition may not show similar growth in working memory.
- Secondly, dose is important as more intervention or practice can lead to greater results.
- Third, the conduct of the leader of the activity or intervention can determine the efficacy of the intervention. A leader who believes in the intervention and presents it accordingly will be more effective.
- Fourth, EFs need to be challenged in order to improve.
- Fifth, individuals who have the weakest EFs will likely show the largest gains.
- Sixth, benefits of training diminish after practice ends.
- Seventh, pushing the limits of participants' EF skills may be required to show improvement.
- Eighth, exercise without a cognitive component is not an effective EF intervention. Aerobic activity and resistance training can increase quality of life, but without an

element of cognitive demand, EFs will not be affected.

- Ninth, and lastly, an intervention may work for reasons that appear to be counter-intuitive. That is, close attention is required to the subject matter and methodology of the intervention to determine what element leads to its efficacy.

Furthermore, Diamond and Ling's review also states the importance of both mental and physical health in supporting EFs. They note that stress, depressed mood, and loneliness all impair EFs (p. 41), as do poor sleep quality, illness, and poor physical fitness (p.42). Because of this connection between mental and physical well-being and EFs, Diamond and Ling (p. 43) state:

> Since (a) stress, sadness, loneliness, and poor physical health (e.g., not enough sleep) impair EFs (indeed their detrimental effects are also evident at the physiological and neuroanatomical level in prefrontal cortex) and since (b) EFs are better when we are less stressed, happier, well rested, and feel there are people who can share experiences with, who care about us, and who we can turn to for support, it follows, we hypothesize, that while training and challenging EFs is necessary for improving them, benefits will be greater if emotional, social, and physical needs are also addressed.

EFs can be improved, but assessments are required to determine if, and how much, EFs are improving. Executive function assessments were typically developed to aid clinicians in determining the severity of injury or insult to a patient's frontal lobes (Chan et al, 2008). As such, these assessments may not reflect EF skills of a non-impaired individual. Assessing normal EF skills is a challenge because EF assessments may not accurately reflect real-world behaviour (Anderson, 2002); an individual may show impeccable response inhibition in a laboratory or clinic, but may be unable to inhibit maladaptive responses while driving, for example. This lack of ecological validity for EF assessments led Koziol and Lutz (2013) to note, “The current neuropsychological testing paradigm for EF occurs approximately 5% of the time in the life of an adult” (p. 112). As well, accurately assessing EFs is further challenged by the measurement impurity problem: it is nearly impossible to measure only a single executive function in any task, as each behaviour represents a combination of executive functions (Zelazo, Blair, & Willoughby, 2017). That said, while ecological validity and measurement impurity remain key issues for the development and implementation of EF assessments, there are several task-based and survey-based assessments available.

Assessing inhibitory control typically involves a task that requires an individual to act differently than what is expected. These tasks include, among others, the Stroop Task. Here, an individual is given a colour word written in the colour of another ink (i.e., the word “blue” written in red ink); the individual is tasked with ignoring the meaning of the word and instead focus on the colour of the ink, which requires top-down effort (Stroop, 1935). Similarly, there is also a Spatial Stroop task that requires an individual to respond to information provided by the stimulus rather than where it is located (Diamond, 2013). A third assessment of inhibitory control is the Simon task (Simon & Small, 1969), where individuals are presented with a stimulus on one side but must respond to the opposite side (Liu, Banich, Jacobson, & Tanabe, 2004).

Other hands-on tasks for the assessment of response inhibition include the Flanker task (Eriksen & Eriksen, 1974). This requires an individual to attend to the central stimulus and ignore other stimuli that flank the central stimulus. To be successful, an individual has to exert top-down control to respond to the correct stimulus. Additionally, delay-of-gratification tasks can also be used to assess inhibitory control. Here, a treat is placed in front of a young child. The child is told that they can have more of the treat if they wait, or less if they cannot. The classic example of this type of assessment is Mischel, Ebbesen, and Raskoff Zeiss's (1972) Stanford Marshmallow experiment.

Finally, other response inhibition assessments include go/no-go tasks. These differ from those described above in that they do not require an individual to stop a response and create another; instead, they require the individual to stop a response and do nothing. In a go/no-go task, for example, an individual is expected to press a button when a stimulus appears, but when a different stimulus appears the individual is asked to not press the button (Diamond, 2013).

There are a variety of active tasks to assess working memory as well. The Corsi Block test, in which a participant watches the assessor touch a series of blocks in a specific order and then is asked to repeat the action, is one example (Kolb & Whishaw, 2009). Colloquially, digit-span tasks are considered to be assessments of working memory; here, a participant is told a series of items and has to repeat them back in the order in which they were told. Diamond (2013) argues that these tasks are not measures of working memory, but instead assess short-term memory. The difference, she argues, is that short-term memory tasks only require an individual to hold items in mind, whereas working memory tasks require an individual to hold items in mind and work with them somehow. So, instead of using a traditional digit span task, Diamond suggests digit span tasks that require an individual to re-order the items based on a specific rule such as alphabetic order (p. 147).

One challenge with assessing both working memory and inhibitory control is that these two core EFs are intertwined, reflecting the measurement impurity described above. Test developers must try to parse out if a given task is assessing working memory or assessing inhibitory control. Diamond (2013) stated:

> [Working memory and inhibitory control] generally need one another and co-occur. One prototypical instance of when EFs are needed is the class of situations where you are to act counter to your initial tendency on the basis of information held in mind. [Working memory] and inhibitory control support one another and rarely, if ever, is one needed but not the other. (p.143)

That said, there are ways to minimize or control for inhibitory control on working memory (p. 147). In the Spatial Stroop task described above, the delivered stimulus provides all the information for the correct response, so the participant does not need keep a rule in mind; this reduces requirements for working memory. The Hearts and Flowers task (Wright and Diamond, 2014) is a hybrid of a Spatial Stroop and a Simon task. Here, a participant is told to press a button on the same side as the presented stimulus in one block, and then told to press a button on the opposite side of the presented stimulus in the next block. In the third block, participants need to press the button on either side depending on whether a heart or a flower is presented as the stimulus (p. 2). This task keeps working memory constant as each testing block is accompanied by a rule that a participant must keep in mind to respond correctly.

Lastly, cognitive flexibility can also be assessed by a variety of tasks. One of the most classic assessments of cognitive flexibility is the Wisconsin Card Sorting Task (Kolb & Whishaw, 2009). Here, individuals need to use feedback and creativity to determine sorting order of a deck based on shape, number, or colour. Other task-switching tasks can be used to assess cognitive flexibility. In these types of tasks, individuals perform an action based on a rule. When the rule changes, the individual must adapt their action to fit the rule. An example of this is the Dimensional Change Card Sort Test. First, a participant sorts six cards by one dimension, such as colour or shape, and then they re-sort the cards based on the other dimension. Healthy adults typically have very little problem with this task, but young children will perseverate and be unable to switch dimensions (Diamond, 2013). Cepeda and Munukata (2007) noted that children will still be stuck on the first dimension, even though they can articulate that the rule has changed and that they should be sorting based on the second dimension.

Other assessments of cognitive flexibility that are not based on task-switching are those that require an individual to generate a list that satisfies certain criteria. In a verbal fluency task, for example, an individual is asked to generate a list of words that begin with a certain letter (Kolb & Whishaw, 2009). Similarly, a design fluency task asks individuals to generate a list of uses for a common item such as a table (Diamond, 2013).

Aside from hands-on tasks, there are a variety of survey-type assessments of EFs. These behaviour rating scales rely on an individual's perspective over a period of time rather than evidence from a laboratory setting. One commonly used assessment is the Behaviour Rating Inventory of Executive Function, or BRIEF. The BRIEF provides three surveys: a parent form, a teacher form, and a self-report form for adolescents. A ll feature 86 simple questions that are answered with "Never", "Sometimes" or "Often" (PAR Inc, 2012). Each form takes approximately 10 to 15 minutes to complete and can be scored in an additional 10 to 20 minutes (Gioia, Isquith, Guy, and Kenworthy, 2000). Another example of a behaviour rating scale used to assess EF is the Comprehensive Executive Function Inventory, or CEFI (Climie, Cadogan, & Goukon, 2014). Considered a "state of the art measure of EF" (Dixon, 2014), the CEFI also uses a parent form, a teacher form, and a self-report form. The CEFI uses a six-point Likert-type scale for each of the 100 questions on the form. A third survey-type assessment is the Amsterdam Executive Function Inventory (AEFI) (Van der Elst et al, 2012). This thirteen-item questionnaire uses a 3-point Likert scale (1=not true, 2=partly true, and 3=true) and allows students to self-report on three areas of executive function: Attention, Self-Control and Self-Monitoring, and Planning and Initiative. Unlike the BRIEF and the CEFI, the AEFI is considerably shorter and faster to administer and score.

The BRIEF, CEFI, and AEFI are all behaviour rating scales and, as such, carry some limitations. The first is that the assessments require impressionistic judgments from teachers, parents, and individuals (Hass et al, 2014). As Reynolds and Livingston (2012) described, humans in general cannot provide objective judgments about other people. So, measurements that rely on self-reports and judgments from others may not be entirely accurate. A second limitation to behaviour rating scales is that they may not account for the differing demands on executive functioning in different environments (Gioia, Isquith, and Kenealy, 2008, as cited in Hass, Peterson, Sukraw, & Sullivan, 2014). Because of this, inter-rater reliability could be low. A second limitation to behaviour rating scales is that they are designed to assess EFs within a generally longer time frame; the BRIEF, for example, asks the reporter about behaviours in the previous six months. As such, these behaviour rating scales may be better suited for clinical or treatment-planning purposes rather than experimental settings.

Aside from these survey-type assessments, there are other assessment batteries that include a variety of tests of executive function. These batteries typically do not rely on impressionistic responses, but instead use a variety of task-based measures. For example, the NEPSY-II – a developmental neuropsychological assessment used in clinical and some educational settings (Pearson Education, 2017a) – includes a variety of subtests pertaining to EFs including several discussed above, such as design fluency, a sorting task, and a Stroop-like task (Harcourt Assessment, 2007). Similarly, the Weschler Intelligence Scale for Children, 5th edition (WISC-V) as well as the Weschler Adult Intelligence Scale, 4th edition (WAIS-IV), includes several subtests related to EFs including working memory, fluid intelligence, and response inhibition (Pearson Education, 2017). Assessment batteries such as these can provide useful information for clinicians, educational psychologists, and teachers, but they can also be quite expensive and time consuming to administer and score. As well, test administrators for these batteries require extensive training and often a Registered Psychologist designation (Alberta Education, 2007).

Accurately assessing executive functions can be challenging due to ecological validity and measurement impurity. On one hand, there are several task-based measures that can provide information about an individual's specific executive function skill, but these tasks often lack ecological validity in that their setting may not reflect real world behaviour. It may be simpler, for example, for an individual to demonstrate response inhibition in a laboratory setting that is relatively distraction-free, but struggle in a fast-paced classroom. On the other hand, there are broad, behavioural-rating scales such as the BRIEF, CEFI, and AEFI that aim to provide information about real world behaviour, but over an extended period of time and by relying on a combination of self-reports and subjective reports from others. Recognizing this quandary, Isquith, Roth, and Gioia (2013) argued that behaviour-rating scales and hands-on tasks should be used congruently to provide complementary information, suggesting that "a multi-level approach to assessment of executive function is most beneficial by capturing more of the variance than either traditional performance-based measures or rating scales alone." (p. 5).

Attention Restoration Theory, EFs, and Outdoor Experiences

As discussed above, Diamond and Ling (2016) provided nine general conclusions for improving EFs. These nine conclusions are compounded by other factors that can impair EFs: sadness, loneliness, poor physical health, and stress (p.41). As such, Diamond and Ling argued that the best interventions for EFs would be those that "*directly* train and challenge EFs and *indirectly* support EFs by working to reduce things that impair them and enhance things that support them". So, reducing sadness, stress, and improving physical health can indirectly support EFs. One somewhat simplistic way to achieve this is to encourage people to go outside. Individuals in natural environments feel less stressed (Beil and Hanes, 2013; Klaunig, Chang, Ewert & Wang, 2016) than those in built environments, and frequent exposure to green spaces is associated with better physical and mental health outcomes (Triguero-Mas et al, 2015). Interaction with the natural environment can be considered effective at improving quality of life (Williams, 2017).

Kaplan's (1995) attention restoration theory (ART) theorized that cognitive control, or directed attention, is effortful and cannot be sustained indefinitely. As discussed earlier when describing Koziol and Lutz's (2013) dual-tiered model of functioning, individuals demonstrate both bottom-up and top-down attention; bottom-up attention is automatic and directed by environmental stimuli, while top-down attention is effortful and requires intention. Kolb and Whishaw (2009) used driving as an example; stopping at a red light is an example of bottom-up attention, while actively seeking a place to park is top-down attention (p. 624). Typically, we aim for tasks to become more automatic and bottom-up so we do not need to exert as much effort, as attention spans are limited. When we are fatigued and attempting to effortfully use directed attention, we are more prone to errors, more irritable, and less successful at focusing our attention (Felsten, 2009).

Kaplan (1995) contends that environments that fulfill four criteria are able to better restore an individual's ability to sustain attention. First, the environment should be away from the fatiguing task. This does not mean that a person needs to get up and move to a different environment, but instead suggests that a mental shift or a change in one's gaze would be sufficient. Secondly, the environment should be extent, or rich enough that there is a suggested "whole other world" (p. 175) contained there. Third, the environment must provide enough stimuli to maintain bottom-up attention, which Kaplan terms *fascination* (p. 172). Here, Kaplan argues that fascinating environments are those that include a variety of aesthetically pleasing sensory stimuli. Lastly, the environment should be compatible with the individual's goals and purposes; if one is aiming to recover from exerting cognitive effort, the environment should be relaxing, yet still provide enough environmental stimuli to sustain bottom-up attention (pp. 175-176).

ART suggests that the best environments to fulfill these four requirements are those found in natural settings. Kaplan notes that individuals looking for restorative experiences often choose natural environments, as these environments are often rich in aesthetically-pleasing stimuli. Empirically, there is some evidence that natural environments can serve to restore attention. Hartig, Mans, and Evans (1991) demonstrated that participants who went backcountry camping were more successful in a proofreading task than participants who went on a non-wilderness vacation or participants who had no vacation. Likewise, Hartig, Evans, Jamner, Davis, and Gärling (2003) demonstrated that participants performed better on attentionally-demanding tasks throughout a walk in a natural environment as opposed to an urban environment. Even images of natural environments can be effective; Berto (2005) asked participants to complete a sustained attention task until they were fatigued, then they viewed photographs of restorative natural environments, non-restorative environments, or geometric shapes. After viewing the images, the participants again completed a sustained attention task. Those that viewed the images of restorative natural environments performed better on their second attention test, while the other participants demonstrated no such improvement.

There has been a somewhat recent shift connecting the lexicon of ART, environmental psychology, and executive functions. Kuo and Faber Taylor's (2004) research suggested engagement with natural settings as a treatment for adolescents with Attention Deficit Hyperactivity Disorder (ADHD). In 2009, Faber Taylor and Kuo demonstrated that children with ADHD performed better on a Digit Span Backwards task (a test of working memory) after walking in a park as compared to walking in an urban area or in their neighbourhood. Likewise, Schutte, Torquati, and Beattie's (2017) research showed similar results for children who did not have ADHD.

"Nature Deficit Disorder". In 2005, Richard Louv developed the term "nature-deficit disorder" as a metaphor to describe the effects of what he viewed as a marked shift in childhood experiences from his generation as compared to younger generations. He explained that

> Nature deficit-disorder describes the human costs of alienation from nature, among them: diminished use of the senses, attention difficulties, and higher rates of physical and emotional illnesses. The disorder can be detected in individuals, families, and communities. (p. 36)

Louv's work has attracted considerable interest amongst lay people. Palamino, Taylor, Göker, Isaacs, and Warber (2016) noted that, at the time of their writing, there were over 800 000 search-engine hits for nature-deficit disorder, but only one citation available on PubMed. In particular, educators have taken an interest in nature-deficit disorder and Louv has been highly sought after to speak at events such as teachers' conventions, teacher education programs, and K-12 schools across North America and worldwide (Louv, 2016). While Louv did not intend for his terminology to represent a pathological condition (2005, p. 10), his choice of wording echoes that of Attention-Deficit Hyperactivity Disorder (ADHD).

For educators, however, there is a distinct appeal to the metaphor of nature-deficit disorder; the idea of supporting students who struggle -- with attention, have physical and emotional ailments, or experience sensory issues -- by walking through a park is charming in its simplicity. Not only is the natural environment readily available, it is also typically free to access. Unfortunately, however, the reality of nature-deficit disorder as a metaphor is somewhat problematic. Louv (2005) describes his childhood experiences of unstructured, unsupervised playtime in natural environments as both idyllic and character-building, and encourages today's children and young people (as well as their parents and caregivers) to try and recreate similar experiences. The image is to disengage from electronic devices, head outdoors, and engage with the natural world. Dickinson (2013) argued that Louv's ideas of engaging with nature are rooted in "his generation's middle-class post-WWII 1950s childhood" (p. 317) and that he idealizes his upbringing as the correct way of being in nature. This represents a fall-recovery narrative, or what Dickinson labeled as the "when I was young" trope: a sentimental, idealized view of an adult's childhood as something that should be recreated for current and future generations (p. 320). Within this fall-recovery narrative, children (and, arguably, adults) have been disconnected from the natural environment and must be re-connected, but only in the ways adults recognize from their own childhoods.

Louv (2005) offers several suggestions for reconnecting with nature, but all are rooted in his childhood's activities; he suggests things like fishing, birding, camping, crawdadding, cloudspotting, tracking, and night hikes (pp. 359-367), all of which may be unattainable for today's families. Yet, there may be some merit to suggesting that people of all ages spend more time actively engaging with their natural environment, as this has been linked to more positive mental and physical health outcomes in children and adults (Barton & Pretty, 2010; Williams, 2016). So, rather than discussing nature-deficit disorder as a metaphor for a variety of symptoms and relying on nature-based activities that are rooted in the idealized memories of baby-boomers growing up in predominantly white, middle-class neighbourhoods, educators may be better served by implementing current pedagogical practices that are relevant to the context of today's students in order to improve their skills.

Nature-deficit disorder, and the resulting discussion of the fall-back narrative, is problematic. But, as a metaphor, it can be a useful frame for understanding the potential impacts of outdoor experiences on individuals. That said, it is intended to be used in this study as an entrance point to examine how immersive experiences in the natural environment can impact the cognitive and behavioural functions of adolescents.

Experiential education. At this point, the literature review will shift towards pedagogical perspectives that could support EFs. The first of these is experiential education. Dewey (1938) maintained that education must be based upon the actual life experience of the individual in order to meet the needs of that individual and those of society (p. 89). He noted that all experiences lead to learning of some sort, but it is up to the educator to facilitate those experiences that would lead to more positive growth. He stated

> Every experience is a moving force. Its value can be judged only on the ground of what it moves toward and into. The greater maturity of experience which should belong to the adult as educator puts him in a position to evaluate each experience of the young in a way in which the one having the less mature experience cannot do. (p. 38)

Dewey’s ideas of learning through experience are echoed by Piaget’s stages of cognitive development (Kolb & Whishaw, 2009) wherein a child’s experiences guide them through various ordered developmental phenomena. Likewise, Piaget’s constructivist theory also argues that experience is key to learning (Kamii & Ewing, 1996). As well, Vygotsky’s understanding of zone of proximal development argues for social experience as a main driver of learning (Hedegaard, 2005). Furthermore, the fact that the brain is shaped by experience is a fundamental tenet of developmental neuroscience (Cozolino, 2013; Kolb & Whishaw, 2009).

However, there is *experiential learning*, which was discussed above, and *experiential education*, which attempts to offer more theoretical underpinnings, as well as pedagogical approaches, to schooling. Historically, experiential education has been synonymous with outdoor education, environmental education, field studies, and hands-on activities in the classroom (Roberts, 2012). All of these somewhat synonymous activities follow a seminal cycle of learning developed by Kolb (1984) that underpins experiential education.

This cycle can begin at any point but, for illustrative purposes, will start with a learner having a concrete experience. This is followed by reflective observation, wherein a learner seeks to observe and gain more understanding. Next, the learner engages in abstract conceptualization, where she thinks about the task and experience. The final step in this example of the cycle is active experimentation, where the learner makes attempts and continues on in the cycle (p. 33). As an example, think about learning to cook something new: perhaps you try a new restaurant and want to replicate something you enjoyed while there, at home. This would be a concrete experience. Next, you engage in reflective observation as you try and figure out what components are involved. You move into abstract conceptualization as you perhaps start searching for recipes and make your plan. Finally, you start cooking and make an attempt. Here, this is both active experimentation and concrete experience, which starts the cycle anew.

Kolb's understanding of experiential education has six main characteristics (pp.

26-38). They are:

- Learning is best conceived as a process, not in terms of outcomes. Rather than relying on the behaviourist understanding of learning as operant conditioning, the process of learning recognizes that each experience is different and shapes future experiences.
- Learning is a continuous process grounded in experience. “The Blank Slate” is inaccurate; all learners carry assumptions, presumptions, and background knowledge to school. Educators must teach new information through experiences, but also remove or reposition old ideas as well.
- The process of learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world. Learners must be able to engage in concrete experiences but also be able to engage in abstract thought about these experiences. Likewise, learners need to engage in reflection, yet also engage in action.
- Learning is a holistic process of adaptation to the world. Kolb states that “Learning is *the* major process of human adaptation” (p. 32) and it is how we engage in social interaction, scientific inquiry, and physical actions.
- Learning involves transactions between the person and the environment. Here, Kolb stresses that experience is both subjective and objective, or personal and environmental. He argues for the use of the word *transaction* as it implies that, after a concrete experience, both the person and the environment are equally changed.
- Learning is the process of creating knowledge. This requires both the social

> knowledge of previous generations and the personal knowledge of an individual's subjective experience. Taking an epistemological approach can benefit learners as they create knowledge.

Luckmann's (1996) definition of experiential education is somewhat more pragmatic in its characteristics. Here, principles have been developed that lay out responsibilities for learners and educators, including the importance of active questioning and constructing meaning, engagement in authentic tasks, and the possibility of experiencing success, failure, risk, adventure, and uncertainty (p. 7).

Finally, Freire's (1970) *Pedagogy of the Oppressed* discussed a banking model of education. He writes

> Education thus becomes an act of depositing, in which the students are the depositories and the teacher is the depositor. Instead of communicating, the teacher issues communiqués and makes deposits which the students patiently receive, memorize, and repeat. This is the "banking" concept of education, in which the scope of action allowed to the students extends only as far as receiving, filing, and storing the deposits. (p. 72)

Experiential education, as defined by Kolb (1984) and Luckmann (1986), represents the antithesis of this banking model. Instead of becoming receptacles for information, students in experiential education programs construct knowledge through guided concrete experiences, observations, abstract rationalization, and active experimentation.

Outdoor education. One somewhat common form of experiential education is specifically outdoor education (Luckmann, 1996). Priest (1986) defined outdoor education (OE) as an "experiential process of learning by doing, which takes primarily through exposure to the out-of doors" (p. 13). Throughout this process grounded in Kolb's (1984) experiential learning model, Priest argued that the learning is focused on four relationships: *interpersonal* (relationships between people); *intrapersonal* (one's relationship with one's self); *ecosystemic* (relationships within an ecosystem); and *ekistic* (relationships between humans and both the built and natural environment) (p. 14). This definition of OE includes, and argues for a blend of, two broad and common approaches to outdoor education: outdoor pursuits and adventure education which typically focus on interpersonal and intrapersonal relationships; and environmental education, which typically focuses on ecosystemic and ekistic relationships.

Within this experiential understanding of OE, a group of learners would be exposed to a novel situation or setting with a specific attached outcome or process. For example, learners could be involved in a multi-day rafting trip that is designed to increase group-work skills and encourage self-reflection (those inter- and intra- personal relationships discussed above) and transfer those skills back to an academic setting (Cooley, Burns, & Cumming, 2016). This presupposes, however, that each learner participating in the activities is able to articulate and transfer these skills from a novel, adventure-based activity towards future academic activities, which may be unreasonable (Wattchow & Brown, 2011). Sibthorp, Furman, Paisley, Gookin, and Schumann (2011) noted that this assumed transfer is often dependent on qualities of the OE instructor and group dynamics rather than the specific skills being emphasized in the outdoor environment.

OE is not a curriculum, nor is it a specific pedagogy. Instead, it is an assumption that whatever it is that occurs outside is going to be of some benefit for the learner. This assumption is occasionally correct: Hattie, Marsh, Neil, and Richards's (1997) meta-analysis of adventure-based outdoor education programs showed that some programs can have lasting positive effects on participants' self-esteem, independence, confidence, and self-understanding. Unfortunately, it is not clear as to what aspects of these programs lead to these effects. Similarly, Sibthorp et al. (2015) argued that outdoor adventure education programs can support what those authors termed "experiential self-regulation", or "the capacity to regulate interest and goal direction" (p. 27). However, the literature is still unsure as to how these cognitive abilities are supported or maintained through outdoor adventure education.

Wattchow and Brown (2011) suggested two major concerns regarding current outdoor education practice. The first of these is what they describe as a desire to return to wild nature rooted in Romantic, Western European ideology. Here, Romanticism "encourages people to dream of a transformation for all humankind through imagining an alternative to industrial despotism" (p. 29). In this ideology, humans are de-humanized through industrial activity and must experience solitude in wilderness periodically to fulfill the human spirit. The authors note that the wild quality of a natural environment becomes paramount; it should be discovered and explored, yet left pristine so that individuals may, in the future, flee from their industrial environments to seek solace and become re-humanized (p. 32). This is problematic for several reasons: first, it echoes Dickinson's (2013) fall-recovery narrative of aiming to experience nature as idealized forms that previous generations did, regardless of current norms. Secondly, it is a reflection of an Imperialistic understanding of the world that suggests that there is only one proper way to experience natural environments as opposed to respecting different cultural contexts (Wattchow & Brown, 2011, p. 33). Lastly, it simplifies and idealizes natural environments as static, untouched environments that should be briefly visited instead of recognizing the inherent messiness and constant change of vibrant ecosystems.

Wattchow and Brown's second concern for outdoor education was the emphasis on adventure as risk. Here, there is an assumption that risk-taking leads to positive outcomes for learners. While this may be perhaps accurate, there are other problematic aspects of adventure as risk. The first of these is that these activities present risk-taking as something you do outside in a novel environment as opposed to your everyday life. In these situations, the assumption is that one's experiences in an outdoor education environment will transfer to one's daily life, but as discussed above, the veracity of this assumption is still unclear. Secondly, often outdoor education activities present contrived, manipulated risks. Participants may believe they are engaging in high-risk behaviour, but in actuality the risk is very low (p. 36). In a high ropes course, for example, a participant may feel that they are engaging in high-risk behaviour as they are high above the ground, crawling or climbing on somewhat unstable platforms; in actuality, the participant's safety harness and attached cable mean that, even if he or she was to fall, the expected result would merely be mild discomfort. These manipulated risks are coupled with an expectation that participants acquire highly technical and expensive gear that minimizes real risk even further. Lastly, this emphasis on risk relies on the comfort zone model, which Wattchow and Brown described as

> …premised on the belief that, when placed in a stressful situation, learners will respond to the challenge, overcome their hesitancy or fear and grow as

> individuals. Interestingly, there is no comfort zone theory per se; rather it is a loose amalgamation of ideas (e.g. Piagetian cognitive development theory, Festinger's theory of cognitive dissonance mixed with cultural assumptions about role of adventure and adventurers.) Yet it has been accorded foundational status in outdoor education practice. (p. 41)

Wattchow and Brown disputed the comfort zone model and claimed it represents ineffective pedagogy as it could negatively impact instructor-student relationships and emotional well-being. As well, Leberman and Martin (2003) demonstrated that in some outdoor education programs, participants reported learning more from the tasks more closely related to their daily lives than those that involved higher perceived risks; for example, participants in an outdoor program learned more about working effectively within a group than about their physical capabilities in a taxing environment. Conversely, Bailey, Johann, and Kang (2017) studied novices rappelling while wearing an EEG headset and fitness tracker to measure skin response, and their results suggested that these stressful and novel situations can have positive impacts on individual's mood and affect.

Interestingly, as an outdoor education teacher, some of the most common responses I have received from students when queried as to why they joined the class are reflective of Wattchow and Brown's (2011) criticisms: students may be driven by notions of adventure and risk-taking and they often express a desire to access wild environments as a retreat from the city. Of course, one could argue that these responses are reflective of the societal understanding of outdoor education and the perceived role of the natural environment, but it is worth noting that the desire to participate in outdoor education experiences could be linked to the thrill of perceived risk taking. Furthermore, while aspects of current experiential outdoor education programs are problematic, students and teachers do see these programs as valuable uses of school time (James & Williams, 2017).

Place – based learning. In an effort to explore a more diverse understanding of outdoor education, this next section discusses pedagogy that builds off of experiential and outdoor education traditions. Place-based learning (PBL) is a pedagogical shift that emphasizes the local environment as a basis for interdisciplinary inquiry. Sobel (2004) defined it as:

> ... the process of using the local community and environment as a starting point to teach concepts in language arts, mathematics, social studies, science, and other subjects across the curriculum. Emphasizing hands-on, real-world learning experiences, this approach to education increases academic achievement, helps students develop stronger ties to their community, enhances students' appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens. (p. 6)

Within PBL pedagogy, students use their local environs as primary sources. For example, students learning about principles of democracy could attend their local government's proceedings and meet with their councillor. Likewise, students learning about historical significance could use personal artifacts and familial narratives to construct documentaries describing a historically significant event in their family's history. In an outdoor education context, students can also learn about their local ecosystem and environment by exploring their school yard and surrounding environs. In place-based education, "pedagogy becomes more relevant to the lived experience of students and teachers, and accountability is re-conceptualized so that places matter to educators, students, and citizens in tangible ways" (Gruenewald, 2000a, p. 620).

While PBL appears to be a relatively new approach to teaching, Dewey (1938) was suggesting its utility nearly a century ago. When describing traditional educational programs, he wrote

> There was no demand that the teacher should become intimately acquainted with the conditions of the local community physical, historical, economic, occupational etc., in order to utilize them as educational resources. A system of education based upon the necessary connection of education with experience must, on the contrary, if faithful to its principle, take these things constantly into account. (p. 40).

That said, there are other, more complex characteristics of PBL rather than just using a local community as a starting point.

Woodhouse and Knapp (2000) described several of these defining characteristics of place-based education, including: it emerges from the particular attributes of a place; it is inherently multidisciplinary; it is inherently experiential; it is reflective of an educational philosophy that is not based on individual's future earning potential; and it connects place with self and community. Much like Priest's (1986) definition of outdoor education, place-based learning is a matter of many relationships. Centrally, places in PBL "*teach* us about how the world works and how our lives fit into the spaces we occupy. Further, places *make* us: as occupants of particular places with particular attributes, our identity and our possibilities are shaped (Gruenewald, 2000a, p. 621).

Gruenewald (2003b) noted that PBL has been connected to a variety of pedagogies, including: “experiential learning, contextual learning, problem-based learning, constructivism, outdoor education, indigenous education, environmental and ecological education, bioregional education, democratic education, multicultural education, community education…” (p. 6) but does not have its own theoretical underpinnings. He argued that PBL should be linked to critical pedagogy, which is

> an effort to work within educational institutions and other media to raise questions about inequalities of power, about the false myths of opportunity and merit for many students, and about the way belief systems become internalized to the point where individuals and groups abandon the very aspiration to question or change their lot in life. (Burbules & Berk, 1999, p. 50, as cited in Gruenewald, 2003b)

PBL, through a lens of critical pedagogy, becomes a more reflective and transformative experience for students as they question the political, cultural, and economic factors in their inter- and intra- personal, ecological, and ekistic relationships. Gruenewald argued that PBL is necessary as “people must be challenged to reflect on their own concrete situationality in a way that explores the complex interrelationships between cultural and ecological environments” (p. 6).

Wattchow and Brown (2011, pp. 182-199) offered four signposts to developing PBL programs. The first of these, being present in and with a place, demands educators embrace the rich sensory information presented by a variety of environments. The authors encouraged vulnerability, wonder, and detachment from logic and rationale when engaging with what Kaplan (1995) would term *fascination.* Secondly, Wattchow and Brown (2011) claimed that educators should recognize the power of narrative when engaging in place-based education practice. Stories, as a fundamental aspect of being human (p. 185), are ways to connect cultural practices to ecological environments. These narratives shift our view "towards understanding the places [we] experience as much more than the simplistic versions of playgrounds, arenas, or backdrops for human action" (p. 190). Third, the authors stated that educators must apprentice themselves to outdoor places by seeking to understand what is available in each place, what the place will permit, what will it help the group do, and how the place is connected with the group's home. Here, place-based educators need to synthesize their sensory experience of a place with the questioning required to learn about a place with their students. Lastly, Wattchow and Brown assert that educators must work with students to develop representations of place based on authentic experiences and reflection. They wrote

> We are not proposing that outdoor educators and learners are aiming to *produce* art, historical accounts or literary products only for their own sake…what is important here is that learners are experiencing *doing* history, geology, ecology, and so on, in the field when they draw on those knowledge systems. (p. 195)

Taken together, these four signposts represent key elements of effective place-based pedagogy. Implementing PBL does appear to be a major pedagogical shift, but its goals alleviate several issues with more traditional outdoor education programs; the Romantic ideal of the Wilderness, the pedagogy of comfort zone and risk, and Dickinson's (2013) fall-recovery narrative as a criticism of Louv (2005). Instead of taking students to remote locations as a way to "get back to (an idealized, nonexistent) nature", PBL requires students to start in their true natural environment: their local community.

The literature reviewed in this chapter described approaches to understanding, evaluating, and improving executive functions. Next, the chapter discussed Kaplan's

Attention Restoration Theory (ART) as a theoretical model for investigating the influence of outdoor environments on EFs. Lastly, it also explained the foundations of experiential, outdoor, and place-based education. This interdisciplinary research, linking cognitive science and educational paradigms, presented a different methodological opportunity than simply investigating the impacts on EFs by being outdoors. As the next chapter describes, this research uses a mixed-methods design to include both the quantitative data describing impacts to EFs after participating in an outdoor education excursion and the qualitative data exploring the many relationships within the outdoor education excursion itself.

Chapter Three: Methodology

This study examines the hypothesis that participating in outdoor education activities will have an impact on the executive functions of adolescents. Current research suggests that there is a relationship between engaging with natural environments and improving elements of EF; individuals appear to perform better on EF tasks when exposed to natural environments. The literature is lacking, however, in regards to how immersion into natural environments, as well as outdoor education activities, impacts EF. Diamond and Ling (2016) noted that interventions to improve EFs may be successful for a wide variety of reasons that could be counterintuitive, and this study aimed to uncover adolescent participants' perspectives on the impact of an outdoor education experience on their executive functions.

The following quantitative (QUANT) and qualitative (QUAL) research questions guided this study:

QUANT: To what extent does a multi-day, immersive outdoor education experience impact the executive functions of sixth-grade students?

QUAL: How do participants who display varying impacts describe their experiences?

As this study used a mixed methods embedded design to use both qualitative and quantitative data, the following mixed methods question was also used to guide the study:

Mixed Methods RQ: What is the nature of the impact of an immersive, multi-day outdoor education activity on the executive functioning of sixth grade students?

Research Design

This study uses a mixed methods embedded design, which uses both qualitative and quantitative data to explore different research questions, and it uses a two-phase model where qualitative data is used to help interpret the quantitative findings (Creswell & Plano Clark, 2010). Here, participants first provided quantitative data from the Amsterdam Executive Function Inventory (AEFI), (Appendix A), two EF performance tasks (Appendix B), and demographic information prior to attending an outdoor education camp. A second round of the EF performance tasks were conducted upon return from camp. Next, a series of qualitative interviews were conducted regarding the participants' perspectives on the camp and previous experiences (Appendix C). Finally, an additional round of the EF performance tasks were conducted approximately 30 days after the return from the outdoor camp.

This research design is appropriate "for fields relatively new to qualitative approaches" (Creswell, 2014, p. 224) such as educational neuroscience. As an interdisciplinary field, educational neuroscience requires interdisciplinary methodology. Stein and Fischer (2011) write:

> The fMRI machine is very different from the classroom. What seems like a valuable explanation in one place may seem hopelessly divorced from what is relevant in the other. Educational issues involve values in shared cultural frameworks. Different from the abstract problems of the laboratory, they necessarily enlist a wide variety of methods, levels of analysis, and basic viewpoints (p. 59).

Participants. Participants were 29 grade six students from Connect Charter School in Calgary, Alberta, Canada. Connect Charter School is a publicly-funded charter school that has over 600 students in grades four to nine. Students are admitted to Connect on a first-come, first-served basis, and the student population includes students from a variety of neighborhoods throughout the city. Charter schools in Alberta are established to provide the Alberta program of studies in a different or enhanced way than what is provided in most public schools (Alberta Education, 2015) and Connect's charter emphasizes inquiry-based learning, meaningful integration of technology, and authentic outdoor education. As such, most participants have had some outdoor education experience prior to the study.

Parents of all students in grade six received a Letter of Information and Consent Form to allow their children to participate in the study. All grade six students (n=104) were invited to participate in the study, and 29 provided consent. As the participants were minors, parents provided informed consent. Each participant was assigned a randomly-generated identification number that was used to maintain anonymity and confidentiality throughout both phases of the study. Anonymity was compromised during the interview process, but pseudonyms were used during the interview recordings, data analysis, and final reporting. In addition, descriptions and identifying details were not included in any phase in order to protect participant anonymity. Only the primary researcher had access to all sources of data and all forms were kept in a locked filing cabinet in a separate area to maintain confidentiality.

All students who obtained permission participated in Phase One of the study by completing the computerized assessments. After the quantitative data from Phase One was collected and analyzed, four male students and four female students were selected to participate in the qualitative interviews during Phase Two. These students were selected on the basis of their quantitative results as they represented four male and four female participants that exhibited variable impacts on their EFs.

Data collection.

Quantitative data. As stated above, the AEFI (Appendix A) was used as baseline survey data and was administered when the research commenced. This thirteen-item questionnaire used a 3-point Likert scale (1=not true, 2=partly true, and 3=true) and allowed students to self-report on three areas of executive function: Attention, Self-Control and Self-Monitoring, and Planning and Initiative (Van der Elst et al, 2012). Total scores were calculated, and nine of the thirteen items were reverse-coded, with higher total scores being associated with perceived stronger executive functions. The AEFI is not used in clinical settings or for psychoeducational assessment (van Tettering & Jolles, 2017), so the likelihood of participants previously completing the inventory was low. The AEFI was included in this study to offer a complementary (Isquith, Roth, & Goia, 2013) view of each participant's EFs in comparison to the hands-on tasks.

Participants also completed a demographic form (Appendix D) asking for birthdate (to calculate age in months), gender, and parental level of education, which have all been linked to executive function (van Tettering & Jolles, 2017). The demographic information form also sought information on the participants' outdoor education experience, diagnosed attention-deficit hyperactivity disorder, and diagnosed learning disabilities.

Lastly, prior to the outdoor education experience, participants engaged in two performance-based tasks of EF: the Hearts and Flowers task and the FlankerFish/Reverse-Flanker task (Appendix B). Both of these tasks were developed and utilized in the literature (Wright & Diamond, 2014; Zaitchik, Iqbal, & Carey, 2014) by the Developmental Cognitive Neuroscience Lab at the University of British Columbia. These tasks were administered via Presentation® software running on a Lenovo laptop and utilized the laptop's keyboard as the input.

Both the Hearts and Flowers task and the Flanker/Reverse-Flanker task assess inhibitory control, working memory, and cognitive flexibility (Diamond, Barnett, Thomas, & Munro, 2007). Primarily, each task was designed to assess inhibitory control, but each task also required working memory, cognitive flexibility, willingness to engage in the task, processing speed, motor coordination, and a variety of other cognitive abilities. Recognizing that "there are no "pure" measures of any specific EF skill" (Zelazo et al, 2017, p. 40), data analysis and discussion emphasize impacts to executive function as a whole rather than specifically inhibitory control, working memory, and/or cognitive flexibility.

In the Hearts and Flowers task, working memory was consistently engaged, but the demand on inhibitory control increased (Wright & Diamond, 2014). There were three blocks of trials in the Hearts and Flowers task: 12 congruent trials, where a heart was presented as a stimulus and participants were intended to touch to the same side as the heart; 12 incongruent trials, where a flower was presented as a stimulus and participants were intended to touch to the opposite side of the flower; and 33 mixed trials, where both options were randomly presented. There were practice trials for each block. Participants responded using their left-hand for a left side input, and their right-hand for a right side input. Each stimulus was presented for 1500 milliseconds. Data from the Hearts and Flowers task included both reaction time in milliseconds and accuracy (correct or incorrect) for each trial, and responses that had a reaction time of less than 250 milliseconds were filtered due to the unlikelihood of the participant actually attending to the stimulus (D. Abbott, personal communication, May 3 2017).

The Flanker/Reverse-flanker task is similar to the Hearts and Flowers task in that participants must attend to a stimulus and respond accordingly. Here, the participant was presented with an image of four or five fish. The stimulus was the colour of the fish. If blue fish were presented, participants were instructed to press in the direction the middle fish is facing with the appropriate hand. If pink fish were presented, participants were instructed to press in the direction the outside fish are facing with the appropriate hand. There were practice trials for each block, and there were three blocks of trials in this task: 17 blue fish trials, 17 pink fish trials, and 65 mixed trials. Each stimulus was presented for 1500 milliseconds. In the Flanker/Reverse-flanker task, working memory and response inhibition are consistently engaged. As with the Hearts and Flowers task, data included both reaction time and accuracy for each trial. Responses with less than 250 milliseconds of reaction time were filtered out.

After these primary data were collected, participants engaged in an immersive outdoor education experience. The participants attended a Winter Camp in the Kananaskis region of southern Alberta. There were four separate Winter Camps that were attended by participants as well as non-participants in the study. Each camp was three days and two nights, and students and chaperones slept indoors in a local hostel. While each camp was distinct, all four camps had similar activities built into the programming: Nordic Skiing, quinzhee building, constellation stories and lantern building, outdoor games, snow science, fire building, and unstructured free time. Each camp was planned and facilitated by teachers, and this researcher did not attend any aspects of the camps, including planning.

Upon return from their experience, participants again engaged in the Hearts and Flowers and Flanker/Reverse-Flanker tasks within five days. Approximately one month after this second round of performance tasks, all participants engaged in a final round of the Hearts and Flowers and Flanker/Reverse Flanker task.

Qualitative data. After completing the quantitative data analysis, qualitative interviews were planned with selected participants. These participants were selected on the basis of their quantitative results as well as their availability to be interviewed: two males and two females who demonstrated a significant change in executive function as measured by their responses to the performance tasks, and two males and two females who demonstrated the lowest change (or perhaps no response) as measured by their responses to the performance tasks. For sampling purposes, only the results of the performance tasks preceding and immediately following the outdoor education experience were used when selecting interview participants. The interview questions were open-ended and focus on the participants' perceived experience of the outdoor education program. Questions were developed after the first round of quantitative data analysis (Creswell, 2014) but sought information on enjoyment, activities, emotion, and overall experience (Appendix C). The interviews were audio-recorded and conducted by the primary researcher in a private setting at the school.

Data analysis.

Quantitative data. The quantitative research question for this study was: to what extent does a multi-day, immersive outdoor education experience impact the executive functions of sixth-grade students? As such, the quantitative data analysis investigated changes in reaction time and accuracy of responses to the computerized performance tasks. Results from trials completed before, after, and one-month following the outdoor education experience were compared using the Statistical Package for the Social Sciences (SPSS) (26). After cleaning the data, paired-samples t-tests were used to compare results between the first and second testing periods, and Wilcoxon ranked tests were used for the same purpose when the data was not normally distributed. Friedman tests were used to investigate differences between all three testing periods. A three-way mixed ANOVA was used to analyze how variables such as sex, outdoor education experience, and parental level of education related to any changes in EF after the outdoor education experience and in the one-month follow-up. As well, a three-way ANOVA was used to analyze how attention-deficit disorder related to any changes in EF shortly after and one-month after the outdoor education experience.

Qualitative data. The qualitative research question for this research study is: how do participants who show variable impacts on executive functions after an outdoor education experience describe their experiences differently? The eight interviews were transcribed by the primary researcher and analyzed using thematic networks (Attride-Stirling 2001). This process involved developing basic themes, organizing themes, and global themes from the data. To begin the analysis, the transcribed interviews were coded by hand following Tesch's (1990, as cited in Creswell, 2014) eight steps in the coding process. After the transcribed interviews were coded, themes were identified and organized according to Attride-Stirling's (2001) basic, organizing, and global hierarchy. The thematic network was then described, explored, and summarized.

CHAPTER FOUR: FINDINGS

The research question that guided this mixed methods study was, "What is the nature of the impact of an immersive, multi-day outdoor education activity on the executive functioning of sixth grade students?" This mixed methods study was investigated through a specific qualitative sub-question (QUAL) and an additional quantitative sub-question (QUANT). The QUAL aspect of the study explored the question: How do participants who display varying impacts on executive functions describe their experiences after the multi-day, immersive outdoor education setting? The QUAN aspect of the study gathered data to ascertain: To what extent does a multi-day, immersive outdoor education experience impact the executive functions of sixth grade students?

This chapter will begin by describing the qualitative results, including the three global themes that emerged through the interviews. This is followed by a description of the quantitative results, including data cleaning procedures and statistical analysis.

Qualitative Results

Qualitative data was generated by interviews with eight participants. Each participant chose a pseudonym at the start of their interview. Four participants identified as female, ("Betty", "Anna", "Tim" and "Nicole") and four identified as male, ("Jeff", "Joe", "Dave", and "Brandon"). These participants were selected based on the change in accuracy in the third block of the FlankerFish task as well as availability during the interview period. This selection was made prior to the statistical analysis of much of the quantitative data and was based on the suggestion that the difference in accuracy in the third block is a simple measure of changes to EFs (D. Abbott, personal communication, 2017). Table 1 summarizes these scores.

Table 1

Changes in Accuracy on FlankerFish task and the Interview Participants

Pseudonym	Sex	% Correct Before Camp	% Correct After Camp	Overall Change (%)
Jeff	Male	93.8	89.1	-4.7
Joe	Male	89.1	90.6	2.5
Brandon	Male	85.9	95.3	9.4
Anna	Female	75	85.9	10.9
Tim	Female	65.6	79.7	14.1
Dave	Male	70.3	93.8	23.5
Betty	Female	60.9	90.6	29.7
Nicole	Female	18.8	89.1	79.3

Each interviewee was asked about general outdoor experiences, the specific outdoor education experience that they had recently attended, and their self-perceptions of their classmates' behaviours in outdoor and classroom environments (See Appendix C). The eight interviews were transcribed by the primary researcher and analyzed using thematic networks (Attride-Stirling, 2001).

Specifically, the first set of questions inquired about participants' outdoor experiences both unrelated and related to the most recent Winter Camp. Participants answered questions regarding experiences with their families, other groups, and previous school trips. In addition, these questions asked participants to reflect generally on the overall Winter Camp Experience. Two themes that arose from the axial thematic analysis of these questions included perceptions of learning and the importance of physical comforts.

The second set of questions asked participants about self- and peer- behaviours in and out of classroom settings. After completing an individual response analysis for each question, a third theme emerged: the outdoors as a source of "wildness".

Question set one: participants' histories of outdoor experiences. This set of questions asked participants about preferred outdoor activities, their perceptions of the purpose of the school's overnight trips, and enhancing and detracting aspects of these trips. It also asked about the participants' perceptions of the most recent Winter Camp experience.

Preferred outdoor activities with family. Seven of eight interviewees described participating in low skill, low cardiovascular-intensive activities with their families. These include such activities as walking, hiking, and camping. Three of the eight also described higher skill, higher cardiovascular-intensive activities such as skiing and biking (both with families or individually). One participant, Joe, stated that, "I like biking because I just like being on a bike and going around, but I really like skiing because I love going fast, just zooming down the hill."

Five of eight participants mentioned going on overnight trips with their families. These trips included staying at a family cabin, camping, and backpacking. Dave described the reasons he enjoys backpacking as, "…you get to sleep in a tent outdoors, make your own food, do whatever you want." There was also one mention of participating in outdoor activities with other groups such as Scouts and Guides.

Perceived purpose of overnight trips. All participants identified learning as the primary purpose of the overnight trips, accompanied by a variety of intended learner outcomes. Two participants were initially unsure of the purpose but, upon further reflection, suggested learning as the primary purpose. Four participants described learning about the environment through these overnight trips, while three participants focused on learning activities that supported some aspect of classroom curriculum. Tim explained that, "…because when we are learning; instead of just learning what a lake looks like, it'd be better to go out and see a lake just to experience it." Two participants were unsure about the intended learner goals, yet believed the trips were related to school and that they were enjoyable. Another participant stated that the trips allowed students to spend more time in an environment and learn more through that immersion. As well, two participants stated that these overnight trips allowed for better relationship building with their peers.

Enhancing and detracting aspects of overnight trips. All eight participants depicted the overnight trips as being fun and enjoyable. Four of eight participants highlighted the learning activities that occurred during these trips as the primary source of enjoyment. For example, Joe described his trip to Fort Steele the previous year:

> I like it because there's like a lot of activities we do that are different. It's more retro, like making ice cream out of a bucket. There's a farm there which is pretty cool, kind of, and there is like kind of like an older village there which is cool.

Aside from the learning activities, four of the eight participants also identified relationship-building with their peers as a source of enjoyment on the overnight trips. Betty believed her class trips were, "…just more fun because we get to like sleep over with friends. It's like giant sleep over parties and you get to eat meals with friends." Similarly, Brandon expressed his enjoyment during one particular camp: "…it was not very warm, but you slept in a tent and I love sleeping in tents, and I love having friends as, you know, tent mates."

Sleeping and other biological requirements, such as food and thermoregulation, were seen as positives for some participants and detractors for others. For example, some participants reported that the food provided during these camps was not enjoyable, while others singled out the food as a highlight. Others enjoyed sleeping in tents, barracks, or hostels, but some students described these conditions as uncomfortable because, "we stay up so late".

Aside from these biological requirements, some participants noted that the significant amount of time away from their families was a major detractor. Dave stated that, "I like them [the trips]. I mean, sometimes it's hard, like I want to go home, see my family, pet the dog, but I enjoy them."

Reflecting on the Winter Camp experience. After discussing the overnight trips in general, participants were asked about their most recent excursion: the three-day Winter Camp. Since the interviews occurred after the excursion, participants were asked if they had been excited to attend the camp prior to departure. All participants indicated that they had been looking forward to the trip. Specifically, the participants were most excited to participate in two planned activities that were new to most students: quinzhee building and Nordic Skiing.

These planned activities were identified by the participants as perceived sources of success for them. Six of the eight participants stated that quinzhee building was their biggest achievement of the camp and they specifically mentioned teamwork and overcoming challenges as part of this success. Tim stated,

> I was pretty proud that me and my friends could make a really big quinzhee and work together. Because me and my friend got to work with a different group of friends that said, “Let’s do this together”, and we made a really big quinzhee but the other groups started to fight a lot. So, we all decided to move the quinzhee once we were almost all the way done, so that took awhile, but otherwise it was pretty good.

Similarly, participants also mentioned Nordic skiing as a source of success. This, like the quinzhee building, was viewed by students as overcoming a challenge. Betty stated that learning how to Nordic ski was significant for her because she, “had never done it before and I was super scared about it, and accomplishing it was fun and more fun than I thought it would be.”

When asked about their strongest memories of Winter Camp, seven of the eight participants described positive situations. These responses referred to fun, novel, engaging situations that were planned or unplanned. For example, Jeff laughingly described throwing a snowball at his teacher, and his teacher dragging him through the snow in response, resulting in “a huge snow war”. Betty recalled visiting the quinzhees in the evening, saying, “we were seeing how many people we could fit in the quinzhee which was pretty funny because we were piling people on top of each other and because it was with friends.” Likewise, Tim perceived:

> …the most funnest (sic) part, and why that was when we were going to demolish our quinzhees, one of my group member’s dad came and he wanted to take a photo of her on top of it, and she busted right through the top! And everyone just

> started to like jump on, like fall through it was really fun. It was like a fun bonding time and it was really something to remember how fun it was.

In contrast to the other participants, Nicole's strongest memory was negative. She had fallen while Nordic skiing on the second day of the trip, resulting in a fracture. This cut her trip short as she left camp for medical attention. Nicole described it as, "falling in a funny position". As well, she offered another negative memory when describing a glowing red light above the bunk that she was sleeping in, which she found to be annoying.

Aside from these negative memories, other participants provided examples of challenges at Winter Camp. Five of the eight participants identified biological requirements related to physical comfort as challenges. Four of the eight participants stated that the lack of sleep was the most challenging, either due to lack of comfort, or a strange environment, or the noises produced by their classmates. Another participant noted that having consistently wet and cold feet throughout the trip was the biggest challenge. Aside from physical comfort, two participants describe quinzhee building and other planned activities as the most challenging.

Question set two: learning in and outside of classroom settings. These questions inquired into how participants perceived their abilities to attend to instruction in more typical classroom settings as compared to outdoor learning environments. Participants were also asked how their own behaviours changed when participating in learning activities on overnight trips. As well, participants were asked to reflect on how their peers' abilities to attend to instruction changed depending on environment and, specifically, on overnight trips.

Perceptions of self-attention. Only one of the eight participants stated that they found it relatively easy to pay attention in a classroom setting. Of the remaining seven participants, five stated that they were able to attend to instruction if certain environmental conditions were met. These conditions included subject matter, physical comfort, teaching strategies, and peer behaviours. For example, Anna expressed that it was harder to pay attention in math and science classes because, “I just find it less exciting, kind of boring.” Likewise, Betty stated that paying attention in class was, “Pretty easy, if I’m comfy. Like if there’s people around me like goofing around, I find it harder to like pay attention because … my attention’s drawn to them”. Tim noted that some topics are not as engaging as others, saying, “If it’s like boring, like talking about some stuff really bores me, then it’s really hard to pay attention because it’s boring, in a way.” The remaining two participants stated that paying attention in class was simply difficult. Joe described his challenges in the classroom by stating, “[it is challenging to be] just sitting, just sitting down and listening.” Likewise, Brandon expressed that paying attention in class, “is a bit of a struggle sometimes”.

Some participants referred to personal strategies that they use to attend to, and avoid distraction during, situations where the teacher is speaking for an extended period of time. Dave stated, “I don’t know, I just, I can say, ‘I’m not going to listen to [my peers], I’m going to listen to my teacher’ and suddenly I can’t hear them. I don’t know.” Another participant, Nicole, described her strategy of doodling: “If I have like some pen and a paper on me I like to doodle…like I can listen to a conversation while doodling, so for me it just helps me do something.” Regardless of available strategies, some participants noted that certain specific situations were harder to attend to than others. Jeff, who earlier identified paying attention in class as relatively easy, noted, "[it is harder sometimes] if [the teacher] is talking for a long time or I'm tired." As well, Joe noted that sitting on the gym floor during assemblies presented an additional challenge. Lastly, Tim described a specific situation with a guest speaker:

> …another one was about this person coming to our school and talked about, I'm pretty sure it was about like parks and stuff and how animals have to move, and she talked for like hours and each minute felt like a day, so…

When asked about their self-perceptions of paying attention in outdoor environments, five of the eight participants reported that it is easier to pay attention to class material when they are outside. These participants stated that the "fresh air" allows for easier attention and that the learning activity can be more active. As well, two of the five participants specifically noted that the outdoor environment can be the focus of a lesson. Anna, for example, posited that, "Maybe when we are learning in the classroom we're just sitting there writing stuff down, but when we're outside we get to see the stuff we're talking about."

In contrast, three of the eight participants reported that they find learning in an outdoor environment more challenging due to distractions. They characterized these distractions as primarily environmental ("the birds, the trees, and sound carrying differently" – Dave), but also referenced peer behavior.

When asked if their behavior is different on overnight trips as compared to the regular classroom, four of the eight participants stated that they are more engaged, have more fun, and can be more "wild". Nicole believed that:

> I feel like on overnight trips you more just wanna (sic) go outside and play, where in the class you're more just ok to sit there because you know what the expectation is but in overnight trips you haven't been there before and you just want to explore. I think you just want to run around more, and you act a bit more wild.

The remaining four participants did not report that their behavior was different during the overnight trips as compared to their regular classroom. Tim perceived that, "No, it's just like we're learning in a different place, but its, we're still learning the same way."

Perceptions of peers' levels of attention. All eight participants reported that peer behaviours outside of the conventional classroom setting are dependent on the individual student and the situation. As in the previous section, participants often responded that the outdoor environment can provide more distractions and can lead to more active behaviours. For example, Tim observed that, "…it sort of depends on the classmates. There's those really rambunctious boys that keep on like doing stuff and making weird things…". As well, two of the participants noted that there can be less teacher supervision in outdoor environments, leading to more of what Jeff referred to as, "silly stuff". In terms of overnight trips, it was Betty's perception that:

> I find its positive for [her peers] and also negative. Well, like the distractions outside, and some are crazy when they get back from an overnight trip because they're tired. But like positives I find the class is way more relaxed when we get back from camp and most kids have better bonds with their friends."

Axial thematic analysis: question sets one and two. Subsequent to a response analysis of answers, three themes arose that transcended the focus or topic of each question. These three themes are: (a) perceptions of learning; (b) the importance of physical comforts; and (c) the outdoors as a source of “wildness”.

Perceptions of learning. All participants understood that “learning” was the purpose of the school’s overnight trips. Based on their responses, participants had varied understandings of what constitutes learning. Some participants described studying and experiencing the environment while others mentioned science or social studies objectives related to classroom activities, courses, or curricula. Yet, when describing their favourite aspects of the overnight trips, those participants who stated that learning was the purpose of these trips instead described novel non-curricular activities that sounded like simply fun experiences. For example, Brandon believed that students attended these trips to, “learn about the environment… [and] more about the stuff that we’re learning in class”. But, when asked about his favourite overnight trip and the reasoning behind his choice, Brandon described getting to sleep in a tent with his friends. In another example, Tim mentioned using overnight trips to reinforce concepts taught in class, stating, “It’s better to go out and see a lake [rather than just reading about it], just to experience it.” But, when asked about their strongest memory of winter camp, Tim described the energy, silliness, and excitement of demolishing a quinzhee.

This disconnection between the perceived learning purpose of the trips and the favourite moments or memories continued for other participants when asked specifically about the Winter Camp. Here, participants emphasized novel activities unique to the winter environment. While these activities were planned (aside from the previously mentioned class-wide snowball fight), they are significantly different than the activities participants described earlier when asked about the purpose of overnight trips. All participants described either quinzhee building or Nordic skiing as their biggest successes at Winter Camp, but these activities are not explicitly linked to any classroom instruction prior to or upon return to school. Rather than learning specifically about the environment or supporting lessons that had been previously taught in the classroom, these participants instead focused on the fun and novelty aspect of the Winter camp experience.

Likewise, only two participants stated that the purpose of the overnight trips is "relationship building" between peers. Yet, when asked later about favourite aspects of previous trips, half of the participants expressed how sharing these experiences with their peers helped increase engagement. These participants described how experiencing new activities with friends made these activities more enjoyable, even otherwise mundane things such as sleeping. For example, Jeff explained that, "It was cool sleeping in [the bunk room]." Similarly, Brandon enjoyed having his friends as tent mates. Betty also described the importance of sharing these novel activities with friends, but from a different perspective, stated that, "Sometimes I don't like [the trips] because my friends are in the other class." She explained that, for her trip to Winter Camp, she was most excited to "sleep in the dorms with [her] friends".

Participants also describe how positive peer-relationships enhanced aspects of winter camp. Of the six participants who identified quinzhee building as a major success at winter camp, all described how it was also a fun activity with their friends. For example, Tim stated that, "[building the quinzhee was fun] because me and my friend got to work with a different group of friends that said, 'let's do this together' and we made like a really big quinzhee but the other groups started to fight a lot so we all decided to move the quinzhee once we were almost all the way done". Likewise, Jeff described, "building the huge quinzhee" that eventually involved the entire class creating a video filmed by the teacher.

The importance of physical comfort. Participants' needs for adequate physical comforts was discussed by several participants throughout the interviews. For example, when describing previous trips, Dave stated that he "just wants to go to sleep" at the end of each day as opposed to participating in further activities. The quality of the food was also mentioned throughout several responses regarding previous trips as well as the winter camp. Furthermore, five of the eight participants noted that the lack of physical comforts during winter camp comprised the biggest challenges. Four of these participants struggled with sleeping in the dormitories, while the other had cold and wet feet due to poor quality footwear.

The importance of physical comforts was also mentioned in later questions about attention and behaviour. Here, participants stated that the lack of physical comfort impacted their levels of attention during class time. Betty believed that she finds it easy to pay attention if she is 'comfy', while it is harder to pay attention when she is "in an uncomfortable position". Jeff described having difficulty paying attention when he is tired. Likewise, Nicole explained how she'll move around if she is sitting on the gym floor during an assembly: 'I listen, but I'll move around a bit because, I just, you know, it's not the comfiest thing.'

Nicole's perspective on comfort as a modifier of attention was also reiterated when asked about attending to information in outdoor environments. She stated that, "I feel like in [daily physical activity] (a class similar to physical education in the student's timetable) it's kind of harder [to pay attention] because there is no where you can sit.

You're just all kind of squishing, everyone's talking and you can't hear as well." In contrast, other participants specifically mentioned "fresh air" as a positive modifier of attention and perceived it is easier for them to pay attention in outdoor environments. For example, Jeff expressed that, "it's just like your own fresh air, helps you focus better, without falling asleep." Brandon described the classroom as "hot", so it is "much easier" for him to pay attention in an outdoor environment.

The outdoors as a source of distraction and "wildness". When asked about their own behaviours in outdoor environments and in overnight trips, participants' perceptions were divided; four participants believed their behaviours and ability to attend were the same in outdoor environments as compared to the classroom, while the other four considered their behaviours and attention abilities to be different. As described above, Nicole relayed her experience that, "…on overnight trips you just want to go outside and play, where in the class you're more just ok to sit there because you know what the expectation is…". As well, other participants noted that they found the outdoor environments more distracting, for a variety of reasons. Dave perceived that, "…there's so many more distractions. The birds, the trees, just the landscape, and sound carries differently". Conversely, Betty found the outdoor environments "relaxing", although she identified the potential for distraction, stating, "It can also be hard because there's distracting things around like maybe people are playing with snow, or the grass, or the park…".

Similarly, when asked about their classmates' behaviours and ability to attend in an outside environment, all participants responded that this was dependent on the individual. That said, each participant described specific students who were more rambunctious during these activities. Nicole used the word "wild" to describe how her own behaviour changed during overnight trips, and perceived that "a lot of people" in the class became more wild on these trips. Other participants also used "wild" to describe behaviours specifically related to playing and having fun, while both Jeff and Joe used the word "goofier" to describe their classmates' behaviours during outdoor trips, specifically mentioning being outside and running around.

The participants stated that the outdoor environments can allow for more "wildness" or "goofiness" because of opportunities for more distractions, as well as less direct supervision. However, in previous questions, some participants describe novel activities that are directly supervised. For example, Jeff relayed his strongest memory of winter camp:

> Interviewer: What was your strongest memory of winter camp?
>
> Jeff: Me throwing a snowball at my teacher.
>
> Interviewer: You throwing a snowball at your teacher? Did it hit him?
>
> Jeff: Yes.
>
> Interviewer: [laughs] What did he do when it hit him?
>
> Jeff: He dragged me in the snow for a while.
>
> Interviewer: [laughs] So why does that memory stand out for you?
>
> Jeff: It was just like fun and, yeah, we started a huge snow war after.

This interaction was directly supervised and directly involved a teacher. Yet, Jeff identified in a later question that his classmates can become "goofier" in outdoor environments because of less supervision. His explanation is an exemplar of how supervision has not necessarily changed in the outdoor environment; instead, the perceived expectations regarding appropriate behaviour are believed by participants to have changed. In a typical day at school, throwing a snowball at a teacher would not likely result in a retaliatory dragging through the snow and then a 'huge snow war', but in this novel outdoor setting, behavioural expectations were perceived to be different, allowing more "wildness" or "goofiness".

The following table summarizes the three themes in the qualitative analysis.

Table 2

Axial Thematic Results of Interviews

Name of Theme	Explanation	Illustrative Quote
Perceptions of Learning	Interviewees describe "learning" as the purpose of the excursions, but their responses illustrate that they value relationships, fun, and engagement significantly more. Are "relationships" just as, if not more, valuable?	"[The purpose of the overnight camps] is to, so we can learn outside the classroom. We get to learn some stuff, some different stuff that we learn in the class." "[My strongest memory of camp] was when we were playing Camouflage at night, that was really fun [because] it was harder for the 'it' person, and the fact that I was one of the people that won." -Anna
The Importance of Physical Comforts	Interviewees note that quality of the excursion and engagement in the activities can be hampered by poor sleep quality, physical discomfort, and unfamiliar surroundings and food.	"[My biggest challenge was] wet socks and shoes…I got my boots and shoes wet on the first day, so it was just like cold and I didn't like it…It kind of took away from the experience, that you were always cold, not enjoying your time…" - Jeff

The Outdoors as a Source of Wildness	Interviewees describe the outdoors as a place for “wilder”, “goofier” behaviour. Risk taking is encouraged, and behavioural expectations are different than in the classroom.	“I feel like on overnight trips you more just wanna [sic] go outside and play, where in the class you’re more just OK to sit there because you know what the expectation is but in overnight trips you haven’t been there before and you just want to explore…I think you just want to run around more, and you act a bit more wild.” - Nicole

Quantitative Results

The QUANT sub-question for this study asked: To what extent does a multi-day, immersive outdoor education experience impact the executive functions of sixth grade students? Data was gathered through two distinct, computerized tests in three separate rounds: once before the Winter Camp excursion, once within five calendar days of returning from the excursion, and a third time approximately 30 calendar days after returning from the excursion.

Overview of computerized EF assessments. Each of the following tasks were developed by the Developmental Cognitive Neuroscience Lab at the University of British Columbia and provided with permission. Each task was completed using Presentation® software running on a Lenovo laptop. All tasks were administered by this researcher in a quiet, secure office to 29 participants at the site of their school. All participants completed identical tests in each of the three rounds (before camp, within five days of returning from camp, and then approximately 30 days after returning from camp.

FlankerFish. The first computerized test had three blocks (see Appendix B). In the first block, participants were presented with a series of images (trials) of one, four, or five blue fish arranged in a horizontal line in the centre of the screen. Each trial was presented for 1500 milliseconds with 21 trials in total, including four practice trials. Participants were instructed to attend to the central stimulus (in this case, a rudimentary drawing of a blue fish) and ignore the distractor stimuli (the remaining four blue fish). When each trial was presented, the participant was expected to press an appropriate key in the direction that the central fish was facing. For example, if the central fish was facing to the right, the participant was instructed to press the 'control' button on the far right, bottom side of the keyboard. If the central fish was facing to the left, the participant was instructed to press the 'control' button on the far left, bottom side of the keyboard. In either case, participant response time and accuracy were measured.

In the first block, participants were exposed to four different types of trials: congruent trials (where the central stimulus is facing the same direction as the distractor stimuli); incongruent trials (where the central stimulus is facing in the opposite direction as the distractor stimuli); no distractor trials (where only a central stimulus is presented); and neutral trials (where the distractor stimuli are facing either up or down, both of which are not available as a response). At the beginning of the first block, participants completed four practice trials. Aside from these practice trials, no positive or negative feedback was provided to participants throughout the block.

In the second block, participants were again presented with 21 trials of one, four, or five fish presented in a horizontal line in the center of the screen. However, in this block the fish were pink and the participants were instructed to ignore the central stimulus and instead attend to the outside stimuli. As in the previous block, each trial was presented for 1500 milliseconds. Reaction time and accuracy were measured via the participants' key presses on the same buttons as in block one. Participants were again exposed to four different types of trials: congruent (the outside stimuli are congruent with the central distractor stimuli); incongruent (the outside stimuli are incongruent with the central distractor stimuli); no distractor trials (there is no central distractor present); and neutral trials (the central distractor is again facing either up or down). Four practice trials were presented at the beginning of the second block, and there was no positive or negative feedback provided to the participants outside of these practice trials.

In the third block, participants were presented with a total of 73 trials. These trials continued to present a horizontal line of one, four, or five fish, but each trial presented either all blue fish or all pink fish. As in both previous blocks, the trials were presented for 1500 milliseconds. Reaction time and accuracy were measured by key presses. Here, the third block asked participants to remember the "rules" from the previous two trials and to flexibly switch between those rules depending on which colour of fish was present. If the trial displayed blue fish, participants were expected to press the appropriate button by attending to the central stimulus. If the trial displayed pink fish, the participants were expected to press the appropriate button by ignoring the central stimulus and attending to the outside stimuli. As in the previous two trials, the participants were exposed to four different types of trials: congruent (the target stimulus matches the distractor stimulus); incongruent (the target stimulus does not match the distractor stimulus); no distractor (only the targeted stimulus is present); and neutral (the distractor stimulus is facing either up or down). Eight practice trials were presented at the beginning of this block. Aside from these practice trials, no positive or negative feedback was provided to the participant.

Hearts and Flowers. There were also three blocks in this computerized assessment (see Appendix B). In all of the blocks, a large green rectangle was presented in the centre of the screen. The stimulus was inside the green rectangle and was present on either the left or right side. In the first block, the stimulus was a drawing of a heart. The participants were instructed to press the corresponding keyboard button of the side congruent to the heart stimulus. If the heart stimulus was presented on the right side of the rectangle, the participant was expected to press the 'control' button on the bottom right of the keyboard. If the heart stimulus was presented on the left side of the rectangle, the participant was expected to press the corresponding button on the bottom left of the keyboard. Each stimulus was presented for 1500 milliseconds. Reaction time and accuracy were measured via the participants' key presses. In this block, there were four practice trials, followed by twelve congruent trials. There was no positive or negative feedback given to the participants, aside from the practice trials.

In the second block, participants were again presented with a series of trials with a green rectangle. In this block, the stimulus inside the rectangle was a drawing of a flower. Here, participants were asked to press the corresponding button on the keyboard that was the opposite of the stimulus's location: an accurate response to a flower on the left side would be pressing the 'control' button on the bottom right of the keyboard. Stimuli in this trial were presented for 1500 milliseconds, and reaction time and accuracy were measured via key presses. There were four practice trials, followed by twelve incongruent trials. As with the other tests, there was no positive or negative feedback given, aside from the practice trials.

The third block of the Hearts and Flowers tasks combined the flower and heart stimuli. Participants were reminded of the rules before completing four practice trials. Then, participants were presented with 33 trials that were either congruent (a heart stimulus was presented on one side of the rectangle and participants were expected to press the key that corresponds to that side) or incongruent (a flower stimulus was presented on one side of the rectangle and participants were expected to press the key on the opposite side of the stimulus). Each trial was presented for 1500 milliseconds, and reaction time and accuracy were measured via key presses. Aside from the practice trials, no positive or negative feedback was given to the participant.

Data cleaning for analysis. In the FlankerFish task, all practice trials were filtered from the analysis. As well, the initial trial in each block was removed from the analysis, resulting in 16 trials for blocks one and two, and 64 trials in block 3. There were an equal number of congruent, incongruent, neutral, and no distractor trials in each block. In the Hearts and Flowers task, all practice trials were also filtered out from the analysis. The initial trial in each block was removed, resulting in 11 trials in block one, 11 trials in block two, and 32 trials in block three. Both block one and block two were entirely congruent and incongruent, respectively, but block three had 16 congruent trials and 16 incongruent trials.

In the FlankerFish task, accuracy and response times for neutral and no distractor trials were filtered out of the data analysis. Raw scores and accuracy percentages were calculated for congruent and incongruent trials in all three blocks. When calculating response times, all incorrect responses were filtered out of the congruent and incongruent trials. Mean response times were calculated for each block, as well as distinct mean response times for the incongruent and congruent trials within each block. Response times that were more than two standard deviations below the mean were also filtered out for each block. A Flanker Effect was calculated by subtracting the mean response time of the congruent trials from the mean response time of the incongruent trials.

In the Hearts and Flowers task, raw scores and percentages were calculated for the accuracy in each of the three blocks. As with the FlankerFish analysis, inaccurate responses were filtered out of the response time calculations. Mean response times were calculated for each block, as well as for incongruent and congruent trials in block three. Response times that were more than two standard deviations below the mean were also filtered out of each block.

Pre- and post-Winter Camp data comparison. Participants completed both the Hearts and Flowers and FlankerFish tasks prior to and after returning from Winter Camp. The initial analysis examined differences between these two testing periods. All analysis was completed using the Statistical Package for Social Sciences (26) and Microsoft Excel. This section of analysis included 18 statistical comparisons, and a Bonferroni correction was conducted. An alpha level of .0028 was used for all statistical tests in this section.

Accuracy and percent correct. A Wilcoxon Signed Ranks test was used to determine the significance of the changes in accuracy in block one of the Hearts and Flowers Task. Accuracy in the first block was not normally distributed, as assessed by Shapiro-Wilk's test ($p < .05$). There were no missing values ($n = 29$). The mean percentage correct score was 96.552 (*SD* = 6.15) prior to the camp, and 95.611 (*SD* – 6.71) after the camp. These results indicated no significant change between the mean scores (p = 0.808, 2-tailed). Likewise, when comparing accuracy in the second block of the Hearts and Flowers task, a Wilcoxon Signed Ranks test was used again. Accuracy in the second block was not normally distributed, as assessed by Shapiro-Wilk's test ($p < .05$). There were no missing values ($n = 29$). The mean percentage correct score in round one was 97.179 (*SD* = 4.92) and was 97.492 (*SD* = 4.80) in the second round. The results indicated no significant change between the mean scores (p = 0.855, 2-tailed). In the third block, a Wilcoxon Signed Ranks test was used again, and there were no missing values ($n = 29$). Accuracy in the third block was not normally distributed, as assessed by Shapiro-Wilk's test ($p < .05$). The mean score in round one was 92.707 (*SD* = 6.72) and in round two was 93.862 (*SD* = 6.75). The results indicated no significant change between the mean scores (p = .120, 2-tailed).

A comparison between accuracy on incongruent trials in the third block of the Hearts and Flowers task was also completed. Accuracy in the incongruent trials was not normally distributed, as assessed by Shapiro-Wilk's test ($p < .05$). Again, a Wilcoxon Signed Ranks test was used. There were no missing values (n=29). The mean percentage correct score was 95.043 (*SD* = 5.38) prior to the camp, and 95.474 (*SD* = 6.23) after the camp. The results indicated no significant change between the mean scores (p = .617, 2-tailed).

Likewise, pre-camp accuracy in the first block of the FlankerFish task was compared to the same block post-camp. Accuracy in the first block was not normally distributed, as assessed by Shapiro-Wilk's test ($p < .05$). A Wilcoxon Signed Ranks test was used. There was one missing value (*n=28)*. The mean score was 94.420 (*SD* = 7.67*)* prior to camp and 98.060 (*SD* = 4.45) after camp, which was not statistically signficiant (p = .027, 2-tailed). For the second block of the FlankerFish task, a Wilcoxon Signed Ranks test was used again. Accuracy in the second block was not normally distributed, as assessed by Shapiro-Wilk's test (*p* < .05*)*. There was one missing value (*n* = 28). The mean percentage correct score was 92.598 (*SD* = 10.63) prior to camp and 97.543 (*SD* = 5.37) after camp. These results indicated a significant change between the mean scores (p = .001, 2-tailed). In the third block, a Wilcoxon Signed Ranks test was used. Accuracy in the third block was not normally distributed, as assessed by Shapiro-Wilk's test (*p* < .05*)*. There was one missing value (*n* = 28). The mean score was 78.75 (*SD* = 14.68) prior to camp and 90.086 (*SD* = 4.9985) after the excursion. The results indicated a significant difference between the mean scores (p = .00005, 2-tailed).

A comparison between accuracy of incongruent trials in the third block of the FlankerFish task was also completed. Accuracy in the incongruent trials of the third block was not normally distributed, as assessed by Shapiro-Wilk's test (*p* < .05*)*. A Wilcoxon Signed Ranks test was used. There was one missing value (*n = 28)*. The mean percentage correct score was 58.705 (*SD* = 17.21) prior to camp and 72.198 (*SD* = 12.45) after the camp. These results indicated a statistically significant difference between the mean scores (p = .0012, 2-tailed).

Response times. Mean response times prior to and after returning from camp were calculated in milliseconds (ms). Mean response times in the first block were normally distributed, as assessed by Shapiro-Wilk's test (*p* > .05*)*. A paired-samples t-test was used to compare mean response times from the first block of the Hearts and Flowers tasks. There was one missing value (*n = 28)* which was excluded from the analysis. There was no significant difference between the mean millisecond scores in block one prior to camp (M = 484.0019, *SD* = 79.47) and the scores after camp (M = 486.3120, *SD* = 75.21); (t(27) = -.144, p = .887, 2-tailed.)

A paired-samples t-test was used to compare the mean response times from the second block of the Hearts and Flowers task as well. Mean response times in the second block were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). There was one missing value ($n = 28$) which was excluded from the analysis. There was no significant difference between the mean millisecond scores in block two prior to camp (M = 601.9534, *SD* = 90.48) and the scores after camp (M = 547.0003, *SD* = 95.53); (t(27) = 2.541, p = .017, 2-tailed).

In the third block of the Hearts and Flowers task, a paired-samples t-test was used again to compare mean response times in milliseconds before and after the camp. Mean response times in the third block were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). There was one missing value (*n = 28)* which was excluded from the analysis. There was not a significant difference between the mean response time scores in block three prior to camp (M = 794.3365, *SD* = 115.91) and the scores after camp (M = 736.8196, *SD* = 95.17); (t(27) = 3.143, p = .004, 2-tailed).

Mean response times were also calculated to compare performance on incongruent trials in block three of the hearts and flowers task. There was one missing value which was excluded from the analysis ($n = 28$). Mean response times for incongruent trails in the third block were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). Here, a paired-samples t-test was used. There was a mildly significant difference between mean response times on incongruent trials in block three prior to attending camp (M = 782.0222, *SD* = 121.20) and after returning from camp (M = 715.4087, *SD* = 89.22); (t(27) = 3.385, p = .0021, 2-tailed).

Likewise, mean response times were calculated in milliseconds for each block of the FlankerFish task before and after camp. There was one missing value which was excluded from the analysis (*n*= 28). For the first two of these blocks, paired-samples t-tests were used. Mean response times in the first and second block were normally distributed, as assessed by Shapiro-Wilk's test (*p* > .05). In the first block, there was a significant difference between mean response times before camp (M = 869.7849, *SD* = 160.39) as compared to after camp (M = 714.3899, *SD* = 113.36); (t(27) = 5.050, p = .000, 2-tailed). In the second block, there was a significant difference between mean response times before camp (M = 859.3822. *SD* = 172.73) as compared to after camp (M = 712.3556, *SD* = 131.47); (t(27) = 5.617, p = .000, 2-tailed). In the third block, mean response times were not normally distributed as assessed by Shapiro-Wilk's test (*p < 0.5)*. Here, a Wilcoxon Signed Ranks test was used. There was a significant difference (p = .000, 2-tailed) between mean response times before camp (M = 944.815, *SD* = 104.06) as compared to after camp (M = 838.240, *SD* = 108.65). As in previous blocks, the missing value was excluded from the analysis (*n* =28).

A Flanker effect was calculated for each participant by subtracting the mean response time in congruent trials from the mean response time in incongruent trials (*n* = 28). The Flanker effect was normally distributed in the second block as assessed by Shapiro-Wilk's test (*p* > .05), but not normally distributed in the first and third blocks as assessed by the same measure (*p < .05).* In the first block, a Wilcoxon Ranked Signs test was used to compare the Flanker effect before and after camp. There was no significant difference (p = .194, 2-tailed) between the Flanker effect before camp (M = 56.741, SD = 135.53) and after camp (M = 24.319, SD = 134.40). In the second block, a related-samples paired t-test was used to compare the Flanker effect before (M = 73. 2411, SD = 170.71) and after camp (M = -21.6905, *SD* = 129.12). A mild significant difference was found between the two time periods (t(27) = 1.005, p = .034, 2-tailed). In the third block, a Wilcoxon Ranked Signs test was used to compare the Flanker Effect before (M = 87.034, *SD* = 152.73) and after (M = 99.027, *SD* = 93.50) camp. There was no significant difference between the two time periods (p = .524, 2-tailed).

The following table summarizes the results from before and after camp.

Table 3

Comparing EF Results Before and After Camp

Measure	Computerized Assessment	*n*	Mean Before Camp (s.d)	Mean After Camp (s.d.)	Difference (Percent correct or millisecond)	P value	t
Accuracy (percent correct)	HF block 1	29	96.552 (6.15)	95.511 (6.71)	-1.041	0.808	--
	HF block 2	29	91.179 (4.92)	97.492 (4.80)	6.313	0.855	--
	HF block 3	29	92.707 (6.72)	93.862 (6.75)	1.115	.120	--
	HF block 3 incongruent only	29	95.043 (5.38)	95.474 (6.23)	.0431	.617	--
	FF block 1	28	94.420 (7.67)	98.060 (4.45)	3.64	.027	--
	FF block 2	28	92.598 (10.63)	97.543 (5.37)	4.945	.001*	--
	FF block 3	28	78.75 (14.68)	90.086 (4.9985)	11.336	.000*	--
	FF block 3 incongruent only	28	58.705 (17.21)	72.198 (12.45)	13.493	.002*	--
Response Times	HF block 1	28	484.0019 (79.47)	486.3129 (75.21)	+2.311	0.887	.144

(millisecond)							
	HF block 2	28	601.9534 (90.48)	547.0003 (95.53)	-54.9531	.017	2.541
	HF block 3	28	794.3365 (115.91)	736.8196 (95.17)	-57.5169	.004	3.143
	HF block 3 incongruent only	28	782.0222 (121.20)	715.4087 (89.22)	-66.6323	.002*	3.385
	FF block 1	28	869.7849 (160.39)	714.3899 (113.36)	-155.395	.000*	5.050
	FF block 2	28	859.3822 (172.73)	712.3556 (131.47)	-147.0266	.000*	5.617
	FF block 3	28	944.815 (104.06)	838.240 (108.65)	-106.875	.000*	--
Flanker Effect (response times in congruent trials minus response times in incongruent trials)	FF block 1	28	56.741 (135.53)	24.319 (134.40)	--	.194	--
	FF block 2	28	73.2411 (170.71)	-21.6905 (129.12)	--	.034	1.005
	FF block 3	28	87.034 (152.73)	99.027 (93.50)	--	.524	--

** notes statistical significance ($p < .0028$)*
HF = Hearts and Flowers task
FF = FlankerFish task

Comparing scores after three testing periods. The next set of results compared scores for each participant in both the Hearts and Flowers and FlankerFish tasks over the three testing periods: prior to, after returning from, and one month after Winter Camp**.** These results are illustrated in Table 4 on page 83. This level of analysis includes those scores in which changes were found to be statistically significant in the previous section.

Accuracy and percent correct. Accuracy, recorded as percent correct, was calculated in both the Hearts and Flowers task and the FlankerFish task for all three blocks and during the three testing periods. In the previous analysis, there was no statistically significant difference in accuracy during the Hearts and Flowers tasks.

Accordingly, this analysis will focus on accuracy in the FlankerFish task. Figure 1 provides a visualization of changes to accuracy over the three testing periods.

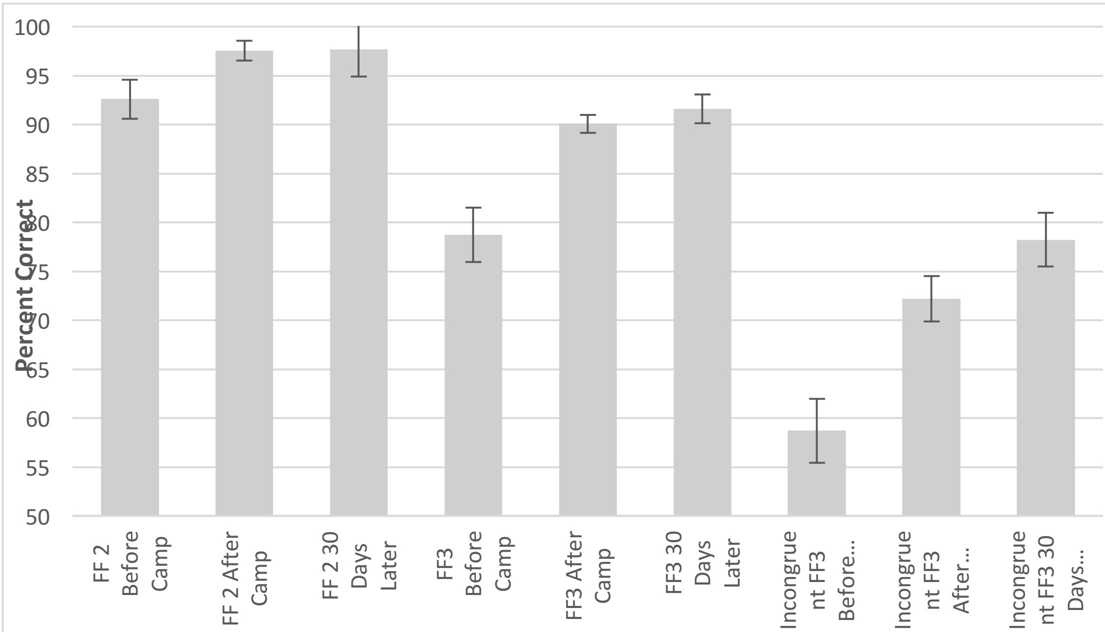


Figure 1. Comparing mean accuracy scores before, after, and 30 days after camp.

A Bonferonni correction was conducted due to the multiple comparisons used in this section of the analysis. As such, the alpha levels were set at .0024 for all statistical tests in this section. Accuracy from the second block of the FlankerFish task was analyzed at all three testing periods. The data was not normally distributed, as assessed by Shapiro-Wilk's test ($p < .05$) and there were several outliers in the data that have been included in the analysis. A Friedman test was run to determine if there were significant differences in accuracy through all testing rounds of block two. While the Friedman test suggested statistical significance, $x^2(2) = 12.808$, $p = .002$, pairwise comparisons were performed with a Bonferroni correction for multiple comparisons. Post hoc analysis revealed no statistically significant differences between before camp accuracy (*Mdn* = 93.75) and directly after camp (*Mdn* = 100.00, p = .066), directly after camp (*Mdn* =

100.00) and approximately 30 days after camp (*Mdn* = 100.00, p = 1.000), and before camp (*Mdn* = 93.75) and approximately 30 days after camp (*Mdn* = 100.00, p = .113).

Next, accuracy from the third block of the FlankerFish task was also analyzed at all three testing periods. The data was not normally distributed, as assessed by Shapiro-Wilk's test ($p < .05$), and there were several outliers in the data that have been included in the analysis. A Friedman test was run to determine if there were significant differences in accuracy through all testing rounds of block three. Pairwise comparisons were performed with a Bonferroni correction for multiple comparisons. Accuracy in block three was statistically significantly different at the three response times, $x^2(2) = 28.140$, $p < .0005$. Post hoc analysis revealed statistically significant differences in accuracy from before camp (*Mdn* = 82.813) to directly after camp (*Mdn* = 92.19, $p < .0005$) and from before camp to thirty days after camp (*Mdn* = 92.82, $p < .0005$), but not from directly after camp to thirty days after camp (p = 1.000).

Finally, accuracy for only the incongruent trials in the third block of the FlankerFish task was analyzed at all three testing periods. The data was not normally distributed, as assessed by Shapiro-Wilk's test ($p < .05$) and there were several outliers in the data that were included in the analysis. Again, a Friedman test was run to determine if there were significant differences in accuracy in the three rounds of testing. Accuracy of the incongruent trials in the third block was statistically significantly different at the three response times, $x^2(2) = 13.553$, p = .001. Post hoc analysis revealed no statistically significant differences between the before camp period (*Mdn* = 93.75) and directly after camp (*Mdn* = 100.00 *p* = .032), nor directly after camp (*Mdn* = 100) to thirty days later (*Mdn* = 93.75, *p* = .563). It did, however, suggest statistically significant results between the pre-camp scores (*Mdn* = 93.75) and the scores from 30 days after camp (*Mdn* = 93.75, *p* = .001).

Response times. Mean response times were calculated in block three of the Hearts and Flowers task from testing sessions before, directly after, and one month after returning from Winter Camp. As well, mean response times were also calculated for each of the three FlankerFish blocks. Figure 2 provides a visualization of the changing response times over the three testing periods below.

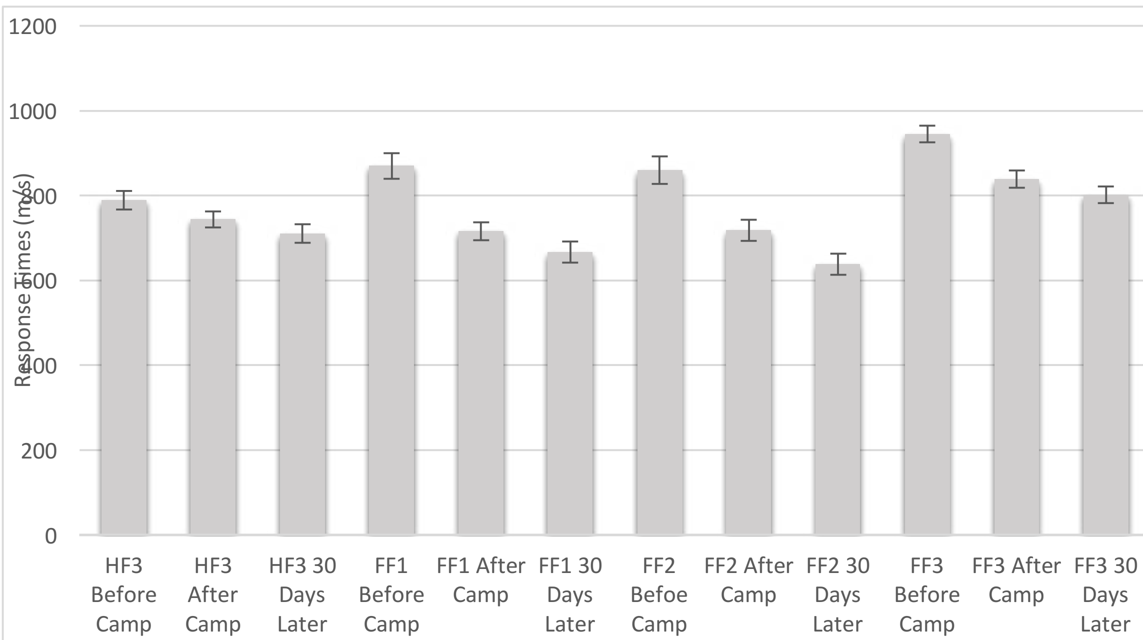


Figure 2. Comparing mean response times before, after, and 30 days after camp.

Response times were distributed normally in all three rounds, as assessed by Shapiro-Wilk's test ($p > .05$), but there were several outliers in the data that have been kept in to the analysis. As such, a Friedman test was run to determine if there were significant differences in mean response times through all testing rounds of block three. Pairwise comparisons were performed with a Bonferroni correction for multiple comparisons. Mean response times in block three were statistically significantly different at the three different time points, x2(2) = 14.552, *p* = .001. Post hoc analysis revealed statistically significant differences in mean response time from before camp (*Mdn* = 780.769) to one month after camp (*Mdn* = 681.593) (p < .0001). There was no significant difference of mean response times from before camp to directly after camp (*Mdn* = 737.185) (p = .107) nor from directly after camp to one month after camp (p = .263).

In the FlankerFish tasks, mean response times were calculated for all three blocks. Data in the first block was normally distributed in all three rounds, as assessed by Shapiro-Wilk's test (p > .05) but there were several outliers in the data that have been included in the analysis. A Friedman test was run to determine if there were significant differences in mean response times through all incongruent trials in block three. Pairwise comparisons were performed with a Bonferroni correction for multiple comparisons. Response times in block one were statistically significantly different at the three testing points, x2(2) = 16.692, p < .0005. Post hoc analysis revealed statistically significant differences in response times from before camp (*Mdn* = 886.985) to directly after camp (*Mdn* = 709.500, p = .025) and from before camp to approximately thirty days after camp (*Mdn* = 639.188, p < .0005), but not from directly after camp to one month after camp (p = .497).

In the second FlankerFish block, mean response times were normally distributed for the first two rounds, but not the third, as assessed by Shapiro-Wilk's test (p < .05). As well, there were several outliers that have been included in the analysis. Again, a Friedman test was run to determine if there were significant differences in reaction time in block two across the three testing periods. Pairwise comparisons were performed with a Bonferonni correction for multiple comparisons. Response times in block two were statistically significantly different at the three testing points, $x2(2) = 20.615$, $p < .0005$. Post hoc analysis revealed statistically significant differences in response times from before camp (*Mdn* = 897.669) to directly after camp (*Mdn* = 692.063, $p = .007$) and from before camp to approximately thirty days after camp (*Mdn* = 616.100, $p < .0005$), but not from directly after camp to one month after camp ($p = .497$).

Next, response time was compared for all three testing periods of the FlankerFish third block. Mean response times were normally distributed for the first two rounds, but not the third, as assessed by Shapiro-Wilk's test ($p < .05$). As well, there were several outliers that have been included in the analysis. Again, a Friedman test was run to determine if there were significant differences in reaction time in block two across the three testing periods. Pairwise comparisons were performed with a Bonferonni correction for multiple comparisons. Response times in block two were statistically significantly different at the three testing points, $x2(2) = 33.612$, $p < .0005$. Post hoc analysis revealed statistically significant differences in response times from before camp (*Mdn* = 937.783) to directly after camp (*Mdn* = 826.459, $p < .0005$) and from before camp to approximately thirty days after camp (*Mdn* = 787.444, $p < .0005$), but not from directly after camp to one month after camp ($p = .288$).

The following table summarizes the results from the three testing periods.

Table Four

Comparing Results from Three Testing Periods

Measure	Computerized Assessment	Median before camp (period 1)	Median After Camp (period 2)	Median 30 Days Post Camp (period 3)	*P* value comparing period 1 and 2	*P* value comparing period 2 and 3	*P* Value comparing period 1 and 3
Accuracy	FF block 2	93.75	100	100	.066	1.00	.113
	FF block 3	82.813	92.19	92.82	<.000*	1.00	<.000*
	FF block 3 incongruent	93.75	100	93.75	.032	.563	.001*
Response Times (milliseconds)	HF block 3 incongruent	776.876	723.730	695.679	.005	1.000	<.001*
	FF block 1	886.985	709.500	639.188	.008	.497	<.000*
	FF block 2	897.669	692.063	616.100	.002*	.497	.<.000*
	FF block 3	937.783	826.459	787.444	<.000*	.288	<.000*

** notes statistical significance* ($p < .0027$)
HF = Hearts and Flowers task
FF = FlankerFish task

Connecting quantitative results to demographic data. After comparing scores on the computerized EF assessments in the three time periods, interactions between self-reported demographic data and results previously found to be statistically-significant results were investigated through a series of two – and three- way ANOVA. First, interactions between statistically-significant changes in reaction time and accuracy were investigated with regards to diagnosed learning disabilities and attention deficit hyperactivity disorder. Next, interactions between the same statistically-significant results and parental education were investigated. Third, interactions between the same statistically-significant results and previous outdoor experiences, as well as sex, were investigated. Lastly, interactions between the same statistically-significant results, sex, and scores on the Amsterdam Executive Function Inventory were also investigated.

Diagnosed learning disabilities and ADHD. In their demographic forms, the participants had been asked if they had been diagnosed with a learning disability in reading, math, or processing speed. These forms were completed individually by each participant. As these forms were self-completed, only one of the 28 participants with a complete demographic form self-identified as having a learning disability in any (or, in this case, all) of the three categories described above. 13 participants stated that they had no learning disabilities, and the remaining 14 participants stated that they were "not sure". With only one participant self-reporting a diagnosis, this research is unable to reach conclusions regarding improving EFs for individuals with learning disabilities and outdoor education.

However, participants were also asked if they had been diagnosed with attention-deficit hyperactivity disorder (ADHD). Here, six participants self-identified that they had a known ADHD diagnosis, seven self-identified that they did not, and 15 self-identified that they were not sure. As such, a series of two-way ANOVA were completed to investigate potential relationship between ADHD and reaction time and accuracy as measured in the Hearts and Flowers and FlankerFish tasks. Only those computerized assessments that were found to be statistically significant in the first round of analysis were analyzed in this section. As well, a Bonferonni correction was conducted due to multiple comparisons. The alpha level was set to .01 for the statistical tests in this section.

A two-way ANOVA was completed for reaction times in the third block of the Hearts and Flowers task. Mean reaction times were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$), and there was one outlier that remained in the analysis. Sphericity was assumed as there were only two factors in the within-subjects variable.

There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance (p > .05). There was no significant main interaction between ADHD diagnosis ($F(2,25) = 3.085$, $p = .063$, partial $\eta^2 = .198$) and reaction times in this block.

Next, a two-way ANOVA was completed for reaction times in the first block of the FlankerFish task. Mean reaction times were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$), and there were two outliers that remained in the analysis. Sphericity was assumed as there were only two factors in the within-subjects variable. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p > .05$). There was no significant interaction between ADHD diagnosis ($F(2,24) = 1.566$, $p = .230$, partial $\eta^2 = .115$) and reaction times in this block.

Likewise, a two-way ANOVA was completed for reaction times in the second block of the FlankerFish task. Mean reaction times were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$), and there was one outlier that remained in the analysis. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p > .05$). Sphericity was assumed as there were only two factors in the within-subjects variable. There was no significant interaction between ADHD diagnosis ($F(2,24) = .360$, $p = .702$, partial $\eta^2 = .029$) and reaction times in this block.

A two-way ANOVA was also completed for reaction time in the third block of the FlankerFish task. Mean reaction times were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p > .05$). Sphericity was assumed as there were only two factors in the within-subjects variable. There were no outliers. There was no significant interaction between ADHD diagnosis ($F(2,24) = 1.289$, $p = .294$, partial $\eta^2 = .097$) and reaction times in this block.

Potential impacts of a confirmed ADHD diagnosis on accuracy as measured in the FlankerFish tasks were also explored. In both the second and third blocks of FlankerFish, two-way ANOVA could not be completed because the data was not normally distributed as assessed by Shapiro-Wilk's test ($p < .05$). However, a two-way ANOVA was completed for the incongruent stimuli in the third block of the Flankerfish task. Mean reaction times were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). There were no outliers. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p > .05$). Sphericity was assumed as there were only two factors in the within-subjects variable. Again, there was no significant interaction between ADHD diagnosis ($F(2,24) = 5.008$, $p = .015$, partial $\eta^2 = .294$) and accuracy in this block.

Parental education. Likewise, participants were asked about maternal and paternal education in their self-completed demographic forms. Here, the participants could report that their parents had: not completed high school; completed high school; attended some college or university; completed a bachelor's degree; completed a master's degree; completed advanced graduate or PhD; and "unsure". Of the 28 participants with a complete demographic form, 18 noted that their mother had attended or completed some college or university, and the remaining 10 were unsure: three participants stated that their mother completed some college or university, nine stated that their mother completed a bachelor's degree, four stated that their mother completed a master's degree, and two stated that she had completed an advanced graduate degree or PhD. Similarly, 16 of the 28 participants stated that their father attended or completed some college or university, and the remaining 12 were unsure. Here, one participant stated that their father attended some college, eight stated that their fathers had bachelor's degrees, four had master's degrees, and four had advanced degrees or PhDs.

To investigate the impacts of parental education on EFs, several two-way repeated measures ANOVA were completed. Each of these two-way ANOVA looked at maternal and paternal education separately in relation to those reaction time and accuracy scores that were statistically significant in the previous section. A Bonferonni correction was conducted due to the multiple comparisons used in this section. As such, alpha levels were set at .004 for the statistical tests in this section of the analysis.

The first pair of two-way ANOVA looked at the improvements to reaction time in only the incongruent stimuli in the third block of the Hearts and Flowers task in related to parental education. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p > .05$). There were five outliers in the data, as assessed by inspection of boxplots, and they were kept in the analysis. Sphericity was assumed as there were only two factors for the within-subjects variable. Mean response times were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). There was no significant interaction between maternal education ($F(1,23) = .673$, $p = .617$, partial $\eta^2 = .105$) or paternal education ($F(1,23) = .666$, $p = .632$, partial $\eta^2 = .104$) and reaction times in this block.

Next, another pair of two-way ANOVA was completed to investigate improvements in reaction time in the first block of the FlankerFish task in relation to parental education. Mean response times were normally distributed, as assessed by

Shapiro-Wilk's test ($p > .05$). There were no outliers in the data as assessed by inspection of boxplots, and sphericity was assumed due to only having two factors for the within-subjects variable. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p > .05$). There was no significant interaction between maternal education ($F(1,22) = 1.425$, $p = .259$, partial $\eta^2 = .206$) or paternal education ($F(1,22) = 1.150$, $p = .360$, partial $\eta^2 = .173$) and reaction times in this block.

Similarly, a third pair of two-way ANOVA was completed to investigate impacts of parental education on improvements to reaction time in the second block of the FlankerFish task. There was one outlier in the data as assessed by inspection of boxplots, and it was kept in the analysis. Sphericity was assumed due to only having two factors for the within-subjects variable. Mean response times were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p > .05$). There was no significant interaction between maternal education ($F(1,22) = 1.820$, $p = .161$, partial $\eta^2 = .249$) on reaction times in this block, and there was no significant interaction between paternal education ($F(1,22) = 3.175$, $p = .033$, partial $\eta^2 = .366$) and reaction times.

The fourth pair of two-way ANOVA investigated potential impacts of parental education on improved reaction times in the third block of the FlankerFish task. Here, there were two outliers as assessed by inspection of boxplots, and they were kept in the analysis. Sphericity was assumed due to only having two factors for the within-subjects variable. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p > .05$). Mean response times were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). There was no significant interaction between maternal education ($F(1,22) = .264$, $p = .898$, partial $\eta^2 = .046$) or paternal education ($F(1,22) = .390$, $p = .814$, partial $\eta^2 = .0.66$) and reaction time in this block.

The seventh pair of two-way ANOVA investigated potential impacts of parental education on improvements to accuracy in the third block of the FlankerFish task. There were six outliers that were kept in the analysis. Levene's test of homogeneity of variance was violated ($p < .05$). Sphericity was assumed due to having two factors in the within-subjects variable. Mean accuracy was normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). There was no statistically significant interaction between maternal education ($F(1,22) = 3.002$, $p = .041$, partial $\eta^2 = 0.353$) and accuracy, and a mildly statistically significant interaction between paternal education ($F(1,22) = 5.276$, $p = .004$, partial $\eta^2 = 0.490$) and accuracy in this block.

Lastly, the final pair of two-way ANOVA investigated the effects of parental education on improvements in accuracy to the incongruent stimuli in the third block of the FlankerFish task. There were no outliers in the data, and sphericity was assumed as there were two factors in the within-subjects variable. Mean accuracy was normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). Levene's test of homogeneity of variance was violated ($p < .05$). There was no significant interaction between maternal education ($F(1,22) = 2.108$, $p = .114$, partial $\eta^2 = .277$) or paternal education ($F(1,22) = 1.793$, $p = .166$, partial $\eta^2 = .246$) and accuracy in this block.

Changes to accuracy in the second block of the FlankerFish task were not normally distributed as assessed by Shapiro-Wilk's test ($p < 0.05$). As such, a two-way ANOVA could not be completed for this block of computerized testing.

Previous outdoor experiences and sex. Next, a series of three way mixed ANOVA were completed. Each of the three-way mixed ANOVA investigated connections between sex, previous outdoor experiences, and those scores that were statistically significant in the previous section. When completing their demographic forms, participants self-identified how often they had participated in outdoor experiences outside of school in the past six months, and could respond with: often (more than 30 days); frequently (13 – 29 days); rarely (1 – 12 days); and never (only with the school). Due to the number of multiple comparisons, a Bonferonni correction was conducted. Alpha levels were set at .0028 for all statistical tests in this section of the analysis.

The first three-way mixed ANOVA looked at the incongruent trials in the third block of the Hearts and Flowers task. There were two outliers in the data, which were kept in the analysis, and mean reaction time was normally distributed as assessed by Shapiro-Wilk's test ($p > .05$) except for males with more than 30 days outdoor experience of school in the past six months ($p = .007$). This was also included in the analysis. There was homogeneity of variances according to Levene's test ($p > .05$). Sphericity was assumed due to only two factors in the within-subjects variable of time. The three way interaction between reaction time, sex, and previous outdoor experiences was not statistically significant ($F(2,21) = .928$, $p = .411$, partial $\eta^2 = .081$). The two-way interaction between changes in reaction time and previous outdoor experiences was also not statistically significant ($F(3,21) = 1.785$, $p = .181$, partial $\eta^2 = .203$), nor was the two-way interaction between changes in reaction time and sex ($F(1,21) = .587$, $p = .452$, partial $\eta^2 = .027$) statistically significant.

The next three-way mixed ANOVA looked at the same variables in relation to mean reaction time in the first block of the FlankerFish task. There were no outliers in the data and mean reaction time was normally distributed as assessed by Shapiro-Wilk's test ($p > .05$). There was homogeneity of variances according to Levene's test ($p > .05$). Sphericity was assumed due to only two factors in the within-subjects variable of time. The three way interaction between reaction time, sex, and previous outdoor experiences was not statistically significant ($F(2,20) = .060$, $p = .942$, partial $\eta^2 = .006$). The two-way interaction between changes in reaction time and previous outdoor experiences was also not statistically significant ($F(3,20) = .794$, $p = .512$, partial $\eta^2 = .106$), nor was the two-way interaction between changes in reaction time and sex ($F(1,20) = .789$, $p = .385$, partial $\eta^2 = .038$) statistically significant.

Likewise, the third three-way mixed ANOVA also looked at the interactions between sex, previous outdoor experiences, and changes in reaction time in the second block of the FlankerFish task. Sphericity was assumed due to only two factors in the within-subjects variable. There was one outlier, which was included in the analysis. Mean reaction time was normally distributed as assessed by Shapiro-Wilk's test ($p > .05$). There was homogeneity of variances as assessed by Levene's test ($p > .05$). As with the previous three-way mixed ANOVA, there were no significant interactions. The three-way interaction between changes to reaction time, sex, and previous experiences was not statistically significant ($F(2,20) = .331$, $p = .722$, partial $\eta^2 = .032$). The two-way interaction between reaction time and sex was not statistically significant ($F(1,20) = .202$, $p = .658$, partial $\eta^2 = .010$) nor was the interaction between previous outdoor experiences and reaction time ($F(3,20) = 1.798$, $p = .180$, partial $\eta^2 = .212$).

In the final three-way mixed ANOVA investigating interactions on reaction time, mean response times from the third FlankerFish block were used. Sphericity was assumed due to only two factors in the within-subjects variable. There was one outlier, which was included in the analysis. Mean reaction time was normally distributed as assessed by Shapiro-Wilk's test ($p > .05$). There was no homogeneity of variances in the second testing period, which violated Levene's test ($p = .000$), but the ANOVA was completed with this violation. The three-way interaction between changes to reaction time, sex, and previous experiences was not statistically significant ($F(2,20) = .871$, $p = .434$, partial $\eta^2 = .080$). The two-way interaction between reaction time and sex was not statistically significant ($F(1,20) = .411$, $p = .529$, partial $\eta^2 = .020$). As well, the interaction between previous outdoor experiences and reaction time was not statistically significant ($F(3,20) = 3.660$, $p = .030$, partial $\eta^2 = .354$).

As with the previous section, potential impacts of previous outdoor experiences and sex on changes to accuracy in the FlankerFish task were also investigated. The data was not normally distributed in the second block of FlankerFish as assessed by Shapiro-Wilk's test ($p < .05$) so a three-way ANOVA could not be completed. In the third block, accuracy was normally distributed as assessed by Shapiro-Wilk's test ($p > .05$). Sphericity was assumed due to only two factors in the within-subjects variable. There were two outliers in the data, which were kept in the analysis. As such, a three-way mixed ANOVA was completed. There was no homogeneity of variances in the second testing period, which violated Levene's test ($p < .05$), but the ANOVA was completed with this violation. The three-way interaction between accuracy, sex, and previous outdoor experiences was not statistically significant ($F(2,20) = 1.127$, $p = .344$, partial η^2

= .101), nor was the two-way interaction between accuracy and previous outdoor experiences (F(3,20) = .826, p = .495, partial η^2 = .110). There was no statistically significant interaction between accuracy and sex regarding changes in accuracy in this block (F(1,20) = 7.134, p = .015, partial η^2 = .263).

The final three-way ANOVA regarding accuracy used data from only the incongruent stimuli in the third block of FlankerFish. Mean accuracy was normally distributed according to Shapiro-Wilk's test (p > .05). Sphericity was assumed due to only the two factors in the within-subjects variable. There were four outliers in the data, as assessed by visual inspection of boxplots, which were kept in the analysis. There was homogeneity of variances as assessed by Levene's test (p > .05). The three-way interaction between sex, accuracy, and previous outdoor experiences was not statistically significant (F(2,20) = 3.251, p = .06, partial η^2 = .245). The two-way interaction between accuracy and previous experiences was also not statistically significant (F(3,20) = .366, p = .778, partial η^2 = .052) nor was the two-way interaction between accuracy and sex (F(1,20) = 3.748, p = .067, partial η^2 = .158) statistically significant.

Amsterdam Executive Function Inventory (AEFI) and sex. The final series of analyses investigated interactions between participants' scores on the Amsterdam Executive Function Inventory (AEFI), sex, and statistically significant changes to reaction time or accuracy on the FlankerFish and Hearts and Flowers tasks. As with the several previous ANOVA, only those changes that were found to be statistically significant in the initial data analysis were explored in relation to this demographic data. A Bonferroni correction was conducted due to the use of multiple comparisons within this section. As such, alpha levels were set at .0014 for statistical tests in this section of the analysis.

Participants completed the AEFI by answering 13 questions related to their self-reported behaviours (Appendix A). Each question had one of three possible responses: not true, partly true, and true. The primary researcher scored all of the AEFI forms, resulting in three composite scaled scores for each participant: Attention, Self Control, and Planning. Those participants with highest scaled scores self-reported greater levels of attention, self control, and planning, while lower scaled scores indicated lower self-reported levels of the same executive functions.

The first series of ANOVA looked at reaction time, AEFI scores, and sex for only the incongruent stimuli in the third block of the Hearts and Flowers task. Attention scores were used first. Mean reaction times were normally distributed according to Shapiro-Wilk's test ($p > .05$) and there were no outliers. Sphericity was assumed as there were only two factors in the within-subjects variable. There was homogeneity of variances in the first testing period according to Levene's test ($p > .05$), but not in the second ($p = .004$). The ANOVA was continued with this violation. The three-way interaction between Attention scores, sex, and reaction time was not statistically significant (F(4,16) = 1.544, $p = .237$, partial $\eta^2 = .279$). As well, the two way interactions between sex and reaction time (F(1(,16) = .057, $p = .814$, partial $\eta^2 = .004$) and between reaction time and Attention scores (F(5,16) = 1.302, $p = .312$, partial $\eta^2 = .289$) were not statistically significant.

Interactions between Self Control scores, reaction time, and sex regarding the incongruent stimuli in the third block of the Hearts and Flowers task were similar. Mean reaction times were normally distributed according to Shapiro-Wilk's test ($p > .05$) and there were no outliers as assessed by visual inspection of boxplots. Sphericity was assumed as there were only two factors in the within-subjects variable. There was homogeneity of variances according to Levene's test ($p > .05$). The three-way interaction between Self Control scores, sex, and reaction time was not statistically significant ($F(5,15) = 2.111$, $p = .120$, partial $\eta^2 =.413$). As well, the two way interactions between sex and reaction time (F(1(,15) = .109, $p = .746$, partial $\eta^2 =.007$) and between reaction time and Self Control scores ($F(5,15) = 1.140$, $p = .382$ partial $\eta^2 = .275$) were not statistically significant.

Likewise, interactions between Planning scores, reaction time, and sex regarding the incongruent stimuli in the third block of the Hearts and Flowers task were also not statistically significant. Mean reaction times were normally distributed according to Shapiro-Wilk's test ($p > .05$), but there was one outlier as assessed by visual inspection of boxplots. The outlier was kept in the analysis. Sphericity was assumed as there were only two factors in the within-subjects variable. There was homogeneity of variances in the second testing period according to Levene's test ($p > .05$), but not in the first ($p = .012$). The ANOVA was completed with this violation. The three-way interaction between Planning scores, sex, and reaction time was not statistically significant ($F(4,16) = 1.674$, $p = .205$, partial $\eta^2 =.295$). As well, the two way interactions between sex and reaction time (F(1(,16) = .136, $p = .718$, partial $\eta^2 =.008$) and between reaction time and Planning scores ($F(5,16) = .307$, $p = .901$, partial $\eta^2 = .088$) were not statistically significant.

The second series of three-way ANOVA investigated interactions between AEFI scores, sex, and changes in reaction time in the first block of the FlankerFish task. Again, Attention scores were used first. Mean reaction times were normally distributed according to Shapiro-Wilk's test ($p > .05$) and there were no outliers. Sphericity was assumed as there were only two factors in the within-subjects variable. There was homogeneity of variances in the first testing period according to Levene's test ($p > .05$), but not in the second ($p = .005$). The ANOVA was continued with this violation. The three-way interaction between Attention scores, sex, and reaction time was not statistically significant (F(5,15) = .403, $p = .804$, partial η^2 =.097). As well, the two way interactions between sex and reaction time (F(1(,15) = 1.895, $p = .189$, partial η^2 =.112) and between reaction time and Attention scores (F(5,15) = 1.232, $p = .342$, partial η^2 = .291) were not statistically significant.

Similarly, interactions between reaction time, sex, and Self Control scores were also not statistically significant in this block. In this three-way ANOVA, mean reaction times were normally distributed according to Shapiro-Wilk's test ($p > .05$) and there were no outliers as assessed by visual inspection of boxplots. Sphericity was assumed as there were only two factors in the within-subjects variable. There was homogeneity of variances in both testing periods according to Levene's test ($p > .05$). The three-way interaction between Self Control scores, sex, and reaction time was not statistically significant (F(1,14) = .896, $p = .510$, partial η^2 =.242). As well, the two way interactions between sex and reaction time (F(1(,14) = .033, $p = .858$, partial η^2 =.002) and between reaction time and Self Control scores (F(5,14) = 2.725, $p = .064$, partial η^2 = .493) were not statistically significant.

The final ANOVA in this series used Planning scores. In this three-way ANOVA, mean reaction times were normally distributed according to Shapiro-Wilk's test ($p > .05$)

and there were no outliers as assessed by visual inspection of boxplots. Sphericity was assumed as there were only two factors in the within-subjects variable. There was homogeneity of variances in the first testing period, according to Levene's test ($p > .05$), but not in the second ($p = .000$). The three-way ANOVA was completed with this violation. The three-way interaction between Planning scores, sex, and reaction time was not statistically significant ($F(4,15) = .626$, $p = .652$, partial $\eta^2 =.143$). As well, the two way interactions between sex and reaction time ($F(1,15) = .510$, $p = .486$, partial $\eta^2 =.033$) and between reaction time and Planning scores ($F(5,15) = 1.352$, $p = .297$, partial $\eta^2 = .311$) were not statistically significant.

The next series of three-way ANOVA investigated interactions between AEFI scores, sex, and changes in reaction time in the second block of the FlankerFish task. Again, Attention scores were used first. Mean reaction times were normally distributed according to Shapiro-Wilk's test ($p > .05$) except for results from the second testing period from males with Attention scaled scores of five ($p = .005$). The ANOVA was completed with this violation. Sphericity was assumed as there were only two factors in the within-subjects variable. There were two outliers, which were kept in the analysis. There was homogeneity of variances in the both testing periods according to Levene's test ($p > .05$). The three-way interaction between Attention scores, sex, and reaction time was not statistically significant ($F(4,15) = 3.013$, $p = .052$, partial $\eta^2 =.446$). As well, the two way interactions between sex and reaction time ($F(1,15) = .965$, $p = .341$, partial $\eta^2 =.060$) and between reaction time and Attention scores ($F(5,15) = 1.963$, $p = .143$, partial $\eta^2 = .395$) were not statistically significant.

Similarly, interactions between reaction time, sex, and Self Control scores were also not statistically significant in this block. In this three-way ANOVA, mean reaction times were normally distributed according to Shapiro-Wilk's test (p > .05) except for results from the first testing period from males with Self Control standard scores of 11 (p = .476). There were no outliers as assessed by visual inspection of boxplots. Sphericity was assumed as there were only two factors in the within-subjects variable. There was homogeneity of variances in both testing periods according to Levene's test (p > .05). The three-way interaction between Self Control scores, sex, and reaction time was not statistically significant (F(5,14) = 1.189, p = .363, partial η^2 =.298). As well, the two way interactions between sex and reaction time (F(1(,15) = .109, p = .747, partial η^2 =.008) and between reaction time and Self Control scores (F(5,14) = 1.639, p = .214, partial η^2 = .369) were not statistically significant.

As with the others, the final ANOVA in this series used Planning scores. In this three-way ANOVA, mean reaction times were normally distributed according to Shapiro-Wilk's test (p > .05) and there were no outliers as assessed by visual inspection of boxplots. Sphericity was assumed as there were only two factors in the within-subjects variable. There was homogeneity of variances in the second testing period, according to Levene's test (p > .05), but not in the first (p = .000). The three-way ANOVA was completed with this violation. The three-way interaction between Planning scores, sex, and reaction time was not statistically significant (F(4,15) = .558, p = .697, partial η^2 =.129). As well, the two way interactions between sex and reaction time (F(1,15) = .721, p = .409, partial η^2 =.046) and between reaction time and Planning scores (F(5,15) = .106, p = .989, partial η^2 = .034) were not statistically significant.

The fourth series of three-way ANOVA investigated interactions between AEFI scores, sex, and changes in reaction time in the third block of the FlankerFish task. Again, Attention scores were used first. Mean reaction times were normally distributed according to Shapiro-Wilk's test (*p* > .05). Sphericity was assumed as there were only two factors in the within-subjects variable. There were three outliers, which were kept in the analysis. There was homogeneity of variances in the both testing periods according to Levene's test (*p* > .05). The three-way interaction between Attention scores, sex, and reaction time was not statistically significant (F(4,15) = .211, *p* = .928, partial η^2 =.053). As well, the two way interactions between sex and reaction time (F(1(,15) = .200, *p* = .661, partial η^2 =.013) and between reaction time and Attention scores (F(5,15) = .276, *p* = .919, partial η^2 = .084) were not statistically significant.

The data for interactions between reaction time, sex, and Self Control scores in the third block of the FlankerFish task violated the assumption of normal distribution, as mean reaction times were not normally distributed in several instances according to Shaprio-Wilk's test (*p* < .05). As such, a three-way ANOVA could not be completed. Likewise, the data for interactions between reaction time, sex, and Planning scores int his block violated the assumption of normal distribution, so an ANOVA could not be completed for those interactions as well.

The fifth series of three-way ANOVA intended to investigate interactions between sex, AEFI scores, and accuracy in the second block of the FlankerFish task. Again, Attention scores were used first. Mean reaction times were not normally distributed in several instances according to Shaprio-Wilk's test (*p* < .05). As such, a three-way ANOVA could not be completed for Attention scores. Similarly, the three-way

ANOVA for interactions between accuracy, sex, and Self Control scores violated the assumption of normal distribution, as mean accuracy percentages were not normally distributed in several instances according to Shaprio-Wilk's test ($p < .05$). A three-way ANOVA could not be completed for interactions between accuracy, sex, and self-control scores.

As with the previous series, Planning scores were used next. Mean accuracy percentages were normally distributed according to Shapiro-Wilk's test. There was homogeneity of variances in the first testing period, according to Levene's test ($p > .05$), but not in the second ($p = .000$). The ANOVA was completed with this violation. Sphericity was assumed as there were only two factors in the within-subjects variable. The three -way interaction between Planning scores, sex, and accuracy was not statistically significant ($F(4,15) = 2.562$, $p = .081$, partial $\eta^2 = .406$). As well, the two-way interaction between accuracy scores and Planning scores was not statistically significant ($F(5,15) = 2.876$, $p = .051$, partial $\eta^2 = .489$) nor was the two-way interaction between accuracy and sex ($F(1,15) = .582$, $p = .457$, partial $\eta^2 = .037$).

Next, an additional three-way mixed ANOVA investigated interactions between AEFI scores, sex, and improvements in accuracy in the third block of the FlankferFish task. Again, Attention scores were used first. Mean accuracy percentages were not normally distributed, according to Shapiro-Wilk's test ($p < .05$) but the ANOVA was completed with this violation. Sphericity was assumed due to only two factors in the within-subjects variable. There were no outliers as assessed by visual inspection of boxplots. Levene's test showed no homogeneity of variances in both testing periods ($p = .000$). As such, results of this ANOVA should be interpreted with appropriate reservation.

The three-way interaction between accuracy scores, sex, and Attention scores was found to be not statistically significant (F(5,15) = 1.279, p = .322, partial η^2=.254). The two-way interaction between accuracy scores and Attention scores was also not statistically significant (F(5,15) = 2.110, p = .121, partial η^2=.413). The interaction between accuracy scores and sex was found to be statistically significant (F(1,15) = 8.573, p = .010, partial η^2=.364).

Next, Self Control scores were used. Mean accuracy percentages were not normally distributed, according to Shapiro-Wilk's test ($p < .05$) but the ANOVA was completed with this violation. Sphericity was assumed due to only two factors in the within-subjects variable. There was one outlier that was kept in the analysis. There was homogeneity of variances in the second testing period, according to Levene's test ($p >$ .05), but not in the first (p = .000). Again, results of this ANOVA should be interpreted with the knowledge of the violation of the homogeneity of variances assumption as well as the assumption of normal distribution. The three-way interaction between changes in accuracy scores, sex, and Self Control scores was not statistically significant (F(5,14) = .619, p = .688, partial η^2=.181). As well, the two-way interaction between accuray and Self Control scores was also not statistically significant (F(5,14) = 1.253, p = .337, partial η^2=.309). The two-way interaction between accuracy and sex, however, was statistically significant (F(1,14) = 6.186, p = .026, partial η^2=.306).

The final three-way ANOVA in this series used Planning scores. Here, mean accuracy scores were normally distributed according to Shapiro-Wilk's test ($p > .05$). There were no outliers as assessed by visual inspection of boxplots. Sphericity was assumed due to only having two factors in the within-subject variable. There was no homogeneity of variances in both testing periods according to Levene's test ($p < .05$), but the ANOVA was completed with this violation. The three-way interaction between changes in accuracy scores, sex, and Planning scores was found to be statistically significant ($F(4,15) = 9.366$, $p = .001$, partial $\eta^2 =.714$). As well, the two-way interaction between changes in accuracy scores and Planning scores was also statistically significant ($F(5,15) = 7.642$, $p = .001$, partial $\eta^2 =.718$) as was the two-way interaction between changes in accuracy scores and sex ($F(1,15) = 32.528$, $p = .000$, partial $\eta^2 =.684$).

Lastly, a final series of three-way mixed ANOVA investigated the interaction between AEFI scores, sex, and accuracy for the incongruent stimuli only in the third block of the FlankerFish task. Attention scores were used first. Mean accuracy scores were normally distributed according to Shapiro-Wilk's test ($p > .05$), and there was one outlier that remained in the analysis. Sphericity was assumed as there were only two factors in the within-subjects variable. Levene's test showed homogeneity of variance in both testing periods ($p > .05$). The three-way interaction between accuracy, sex, and Attention scores was not statistically significant ($F(4,15) = .102$, $p = .980$, partial $\eta^2 =.027$). The two-way interaction between accuracy and Attention scores was also not statistically significant ($F(5,15) = 1.606$, $p = .218$, partial $\eta^2 =.349$), nor was the two-way interaction between accuracy and sex ($F(1,15) = 2.752$, $p = .118$, partial $\eta^2 = .155$).

Next, Self Control scores were used. Mean accuracy scores were normally distributed, according to Shapiro-Wilk's test ($p > .05$), except for males with Self Control scores of 11 in the second testing period. There were no outliers as assessed by visual inspection of boxplots, and sphericity was assumed due to there only being two factors in the within-subjects variable. Homogeneity of variances was found in both testing periods according to Levene's test ($p > .05$). The three-way interaction between accuracy, Self Control scores, and sex was not statistically significant ($F(5,14) = .910$, $p = .502$, partial $\eta^2 =.245$). The two-way interaction between accuracy and sex was also not statistically significant ($F(1,14) = 1.886$, $p = .191$, partial $\eta^2 =.119$), nor was the two-way interaction between Self Control scores and accuracy $(5,14) = 1.054$, $p = .425$, partial $\eta^2 =.274$) in this block.

Finally, Planning scores were used. Mean accuracy scores were normally distributed, according to Shapiro-Wilk's test ($p > .05$). There were no outliers as assessed by visual inspection of boxplots, and sphericity was assumed due to there only being two factors in the within-subjects variable. Homogeneity of variances was found in both testing periods according to Levene's test ($p > .05$). The three-way interaction between accuracy, Planning scores, and sex was not statistically significant ($F(4,15) = 2.390$, $p = .097$, partial $\eta^2 =.389$). The two-way interaction between accuracy and sex was also not statistically significant ($F(1,15) = 1.886$, $p = .081$, partial $\eta^2 =.189$), nor was the two-way interaction between Planning scores and accuracy ($F(5,15) = .589$, $p = .708$, partial $\eta^2 =.164$) in this block.

In summary, participants demonstrated statistically-significantly mproved reaction time in four of seven measures, and statistically-significantly improved accuracy in four of eight measures. These improvements were not linked to sex, previous outdoor experiences, AEFI scores, or parental education.

Chapter Five: Discussion and Conclusion

This mixed-methods research study investigated the nature of the impact of an immersive, multi-day outdoor education activity on the executive functions of sixth grade students (n = 29) attending a public charter school in Alberta, Canada. Participants completed two computerized tests of executive functions prior to attending a three-day Winter Camp experience and then completed the same two computerized tests within five days of returning from camp. The participants completed a third round of the same computerized tests approximately one month later in an effort to investigate whether changes to executive functions were sustained. When comparing results from the first and second rounds of computerized testing, the participants demonstrated statistically significantly improved reaction time in four of seven comparisons, and statistically significantly improved accuracy in three of the eight comparisons. There was no statistically significant Flanker effect. As well, there were no statistically significant differences in accuracy nor reaction time in the third round of testing, suggesting that improvements to reaction time and accuracy were sustained.

As well, interactions between the statistically significant improvements to reaction time and accuracy and demographic information related to learning disabilities and attention deficit hyperactivity disorder, previous outdoor experiences, sex, parental education, and self-reported scores on the Amsterdam Executive Function Inventory were also investigated. In general, nearly all of these interactions were found to not be statistically significant.

Eight of the 29 participants were asked to participate in interviews. Three themes emerged from the analysis of these interviews. The first theme, perceptions of learning in an outdoor experience, centered on the comparison between what the participants believed to be the most valuable aspects of the outdoor education experience and what they believed to be the intended purpose of the experience. The next theme, the importance of physical comforts, reinforced how positive aspects of outdoor experiences can be disrupted by a lack of pre-trip attention to food, shelter, clothing, and sleep, as well as the importance of attending to those physical comforts during the excursion. Finally, the third theme explored the outdoors as a source of “wildness”, or a place where learning and behaviour may be different than a classroom setting.

Through the synthesis of the qualitative and quantitative results, this study suggests that participants demonstrated improvement in their core EFs after attending a three-day outdoor education excursion, and that these improvements were still present approximately one month after the excursion. Several possible explanations surround this suggestion; however, findings indicated that improvements to EFs that are correlated to this specific outdoor education setting appear to be linked to participant relationships, appropriate level of risk and stress, and general feelings of joy and belonging. This argument will be followed by a discussion of the limitations of the current study, implications for future research, and suggestions for teachers in the field.

Reaction Time, Accuracy, and Executive Functions

In general, participants in this study improved their results on computerized measures of executive functions after completing a multi-day, immersive outdoor education experience. The participants demonstrated statistically significantly improved reaction time on four of the seven computerized trials. As well, participants demonstrated statistically significant improvements in accuracy on three of the eight computerized trials.

Reaction time and accuracy were measured in both the Hearts and Flowers task and the FlankerFish task. As described in the literature review and procedure, both of the computerized tasks tax the three core executive functions – working memory, inhibitory control, and cognitive flexibility – simultaneously. Therefore, while this research cannot state that the participants demonstrated improvement specifically in their working memory, it can suggest that participants demonstrated improvement in their core executive functions.

As an illustration, the third block of both the FlankerFish and the Hearts and Flowers tasks required participants to remember rules, to attend to visual stimuli, to change their behaviours based on the visual stimuli presented, and to ignore visual distractions over several trials. Here, and in another six of the 18 measures, participants became faster and more accurate after completing their outdoor education experience. For example, in the third block of the FlankerFish task, participants demonstrated a mean increase in accuracy of 11.336% (p = .0005, 2-tailed) and a mean decrease in response times of 106.875 milliseconds (p = .0005, 2-tailed). In the third block of the Hearts and Flowers task, participants demonstrated a statistically insignificant mean increase in accuracy of 1.115% (p = .122, 2-tailed), but a statistically significant mean decrease in reaction time of 57.5169 milliseconds (p = .004, 2-tailed).

This study aimed to also investigate if any gains in accuracy or reaction time were still present approximately one month after the second testing window. As described above, there were several instances of statistically significant improvement to reaction time or accuracy when comparing results from before and after camp. But, when comparing the post-camp results to the third testing window approximately one month after camp, there were no statistically significant changes to accuracy or reaction time. The participants' reaction times and accuracy continued to improve in the third testing period, but not at a statistically significant level, suggesting that further positive changes to accuracy and reaction time did not occur. Improvements to reaction time and accuracy were maintained, as these scores did not decrease in the third testing period.

These results could be interpreted as a correlation between the immersive, multi-day outdoor education experience and improved executive functions. In general, participants performed statistically significantly better on the computerized measures of EFs after their outdoor education experience. In the third testing period, participants continued to show improvement to their performance, but not at a statistically significant level in comparison to their performance in the second testing period.

An alternate interpretation could be that participants continued to perform better on the computerized tasks because it was their second or third time completing each task. The tasks themselves, and the order of trials, did not change between each testing period; perhaps participants showed improvement because they had become more comfortable with the tasks and the associated procedures. While this is a possibility, it is important to note that participants received no feedback on their performance on these tasks at any time and had no accurate way of knowing if they had improved or not, aside from their own perceptions of their performance. As well, if time and experience with the tasks were responsible for the statistically significant increases in several of the measures in the second testing period, one would assume that the increases would continue, and that results in the third testing period to be statistically significantly different from the second. Conversely, if the statistically-significant improvements in the second testing period were the result of relatively recently completing the first testing period, one would expect that results in the third testing period would be worse than in the second; these tests were approximately 30 days apart, yet the improvements were maintained.

Diamond and Ling (2016) argued that improvements to EFs are difficult to maintain, stating that benefits will diminish when training ends. As such, the sustained improvements to reaction time and accuracy presented in this study could warrant further investigation. There could be alternative explanations for these results; perhaps different activities (in school or otherwise) within the period between testing windows had an impact. Future research that investigates this further would be valuable.

Reaction time and accuracy. There is a noted difference when comparing quantitative results that measure accuracy to those that measure response times. There was no statistically significant change in participant accuracy in any of the three blocks of the Hearts and Flowers tasks, nor was there a statistically significant change in accuracy when only analyzing the incongruent trials on the third block. In the FlankerFish task, however, blocks two and three had a statistically significant change, as did only the incongruent trials in the third block. Participants in the post-camp window were statistically significantly more accurate in three of the eight trials than they had been prior to attending the camp. In contrast, when response times were analyzed, participants were statistically significantly faster on four of the eight trials after camp.

A possible interpretation of this difference emerged by examining the data that compared results in each of the three testing periods. Participants did not demonstrate a statistically significant increase in accuracy in the Hearts and Flowers and FlankerFish tasks because they had already demonstrated high levels of accuracy in the first testing period. In effect, the participants' scores in the first round were not in a wide enough range to demonstrate significant improvement. In the first FlankerFish block, for example, the median percentage correct prior to camp was 100. After camp, the median percentage correct was also 100. Essentially, participants did not show significant improvement in accuracy in the initial FlankerFish blocks because the initial blocks were too easy. Participants did show a statistically significant increase in accuracy on the third FlankerFish block, as that block has a greater number of trials and the participants demonstrated a wider range of scores in the pre- and post- camp testing windows.

Connecting to demographic data. The participants completed demographic forms after providing informed consent. These forms were completed individually, and included information on age, sex, parental levels of education, diagnosed learning disabilities, and the Amsterdam Executive Function Inventory (AEFI). This demographic data was used in a second round of data analysis that investigated interactions in those computerized trials that had been previously found to be statistically-significant.

Learning disabilities and ADHD. As described above, only one participant self-identified as having a diagnosed learning disability. Therefore, this study cannot provide specific information related to the impacts of outdoor education on the executive functions of individuals with learning disabilities. With regards to participants with a diagnosis of ADHD, six of the 28 participants with a completed demographic form stated that they were diagnosed with attention-deficit hyperactivity disorder, and seven stated that they did not. 15 self-reported that they were “not sure”. Even though six and seven are relatively small sample sizes, the associated data could be useful.

However, these three self-reported groups did not demonstrate statistically significant differences in accuracy or reaction time. There was one instance where the participants did show changes that were nearly statistically significant, however: the incongruent trials in the third block of FlankerFish. In this block, individuals with ADHD demonstrated mean accuracy of 51.25% in their first attempt, and then demonstrated mean accuracy of 78.75% in their second attempt. Individuals without ADHD demonstrated mean accuracy of 54.46% in their first attempt, and 76.79% in their second. Individuals who stated that they were “not sure” demonstrated mean accuracy of 63.33% in their first attempt, and 67.08% in their second. Both the ADHD group and the non-ADHD group demonstrated substantial improvement in their scores (27.5% and 22.33%, respectively), while the “not sure” group only demonstrated relatively smaller improvement (3.75%). The results from the “not sure” group are quite different than either of the other groups, which does not provide particularly meaningful information regarding how the executive functions of individuals with ADHD are impacted by outdoor education.

ADHD and executive functions are linked in the literature (i.e., Barkley, 1997; Dawson & Guare, 2010; Kuo & Faber Taylor, 2004) and individuals with ADHD have performed better on tests of executive functions after experiencing natural environments (Faber Taylor & Kuo, 2009). As such, it is unfortunate that in this study just over half of the participants self-reported that they were “unsure” whether they had an ADHD diagnosis. Future research regarding individuals with ADHD, executive functions, and outdoor education should not use self-reported diagnosis data to more clearly investigate any potential impacts and to potentially investigate outdoor education as a universal or targeted intervention in an RTI framework.

Parental education. Van Tetering and Jolles (2017) showed that parental education can influence teacher and parental views on the developing executive functions in older children. Likewise, Rinderman & Baumeister (2014) state that parental education, and in particular parental educational behaviour, can be a stronger influence on children's cognitive abilities than socioeconomic status. The present study looked to parental education as a potential influence on executive functions as measured by the Hearts and Flowers and FlankerFish tasks. However, parental education levels provided a statistically significant interaction in only one of the 12 ANOVA in this series: paternal education provided statistically significant interactions with accuracy in the third block of the FlankerFish task.

Based on the literature, one would hypothesize more statistically-significant interactions between parental education and executive functions in this study. One possible interpretation for the lack of statistically-significant influence here is the homogeneity of the participants' parental education. Over half of the participants reported that their fathers attended post-secondary school, and 17 of the participants reported that their mothers had attended post-secondary school as well. The remaining participants stated that they were "not sure" of their parents' education. Future research regarding parental education and executive functions would benefit from a larger sample size with a wider variety of parental education.

A second interpretation for these results is the presence of outliers in the data. For example, the interaction between paternal education and accuracy in the third block of the FlankerFish task was statistically significant ($F(1,22) = 5.276$, $p = .004$, partial $\eta^2 = .490$). In this task, participants whose fathers attended some college or university demonstrated mean accuracy of 89.06% in their first attempt, and 95.313% in their second. Participants whose fathers had bachelor's degrees demonstrated mean accuracy of 80.13% in their first attempt, and 88.39% in their second. Likewise, participants whose fathers had master's degrees demonstrated mean accuracy of 83.98% in their first attempt, and 91.41% in their second. As well, participants who were unsure of their paternal education demonstrated mean accuracy of 82.08% in their first attempt, and 89.71% in their second. Participants whose fathers had advanced graduate work or PhDs, on the other hand, demonstrated mean accuracy of 51.04% in their first attempt, and 91.67% in their second. While all groups demonstrated improvements in their mean accuracy in this task, the significant improvements for the three members of the advanced graduate work or PhD group in this instance suggest outliers.

Sex and previous outdoor experiences. When completing their demographic forms, participants self-identified how often they had participated in outdoor experiences outside of school in the past six months and could respond with: often (more than 30 days); frequently (13 – 29 days); rarely (1 – 12 days); or never (only with the school). However, previous outdoor experiences were not found to be statistically significantly related to changes to accuracy or reaction time in the computerized assessments.

As this lack of statistical significance does not provide meaningful information, questions still persist regarding any interactions between previous outdoor experiences and the impacts of outdoor education on executive functions. Specifically, do participants with more outdoor experiences in their recent history experience different impacts to their EFs by participating in a specific outdoor excursion? Similarly, is there an appropriate "dose" of outdoor education, in this context? Furthermore, does the content of previous outdoor activity itself have an impact?

It is possible that previous outdoor experiences have no consistent, statistically-significant effect on impacts to EFs. Another possibility, relative to this study, is that these participants often spend time doing activities in the outdoors. Here, 13 participants self-identified that they had participated in outdoor activities more than 30 days in the past six months, while eight self-identified that they were in these activities "frequently", or between 13 and 29 days. 21 of the 28 participants selected these two values, and five participants self-identified as "rarely" participating in outdoor activities, and two self-identified as only participating in these activities with school. Future research in this area could benefit from specifically including participants with relatively little outdoor education experience as a comparison group to one with more experience.

Sex was also included in this series of ANOVA, and it was found to have no statistically-significant interactions to changes in reaction time, accuracy, or previous outdoor experiences. Grissom and Reyes's review (2019) argues that executive functions are not systematically linked to sex or gender, which is reflected in the present study.

Sex and Amsterdam Executive Function Inventory scores. The final investigation of interactions between statistically-significant changes in reaction time and accuracy in the Hearts and Flowers and FlankerFish tasks and demographic data focused on participants' scores on the Amsterdam Executive Function Inventory (AEFI).

Participants completed a 13-item questionnaire (Appendix A), which was then scored by the primary researcher. Each participant received three composite scaled scores: one for each of Attention, Self Control, and Planning.

Diamond and Ling (2016) posit that individuals with weaker EFs would receive greater benefit from EF interventions than those with stronger EFs. In the present study, collecting the AEFI scores allowed for participants to self-report their own perceptions of their EFs, as an additional measure of executive functions, to be used in conjunction with their scores on the computerized performance tasks. However, there were only three statistically-significant interactions between each of the AEFI scores, sex, and accuracy or reaction time in the 32 interactions that were tested. These three statistically-significant interactions were for both two- and three-way interactions with Planning scores and accuracy in the third block of the FlankerFish task.

Here, there is some evidence that supports Diamond and Ling's (2016) assertion that those with weaker EFs would benefit more than those with stronger EFs, but it is inconsistent. As well, this ANOVA did not have homogeneity of variances, according to Levene's test ($p < .05$), so generalizations of this data should be approached with restraint. Future research with a larger sample size could provide more impactful data for this interaction. Furthermore, when the total number of participants is instead separated by sex, outliers and individual cases can further cloud the significance of the interaction.

In general, there were very few statistically-significant interactions between AEFI scores, reaction time, and accuracy. One possible interpretation of this is that the sample size was too small to provide robust interactions. A second interpretation is that the AEFI measures were not necessarily indicative of the participants' actual EFs. In future research, perhaps the self-reported AEFI measures could be corroborated with another perspective, such as the participants' teachers or parents, or with another survey measure of EFs.

While sex was included in this series of ANOVA as well, there was only one significant interaction as described above. This significant interaction contradicts Grissom and Rayes (2019) review, but, as described above, is likely the result of a significant outlier in the data.

Experiential Learning, Attention Restoration Theory, and EFs

The participants showed statistically-significant improvements to reaction time and accuracy in several computerized assessments, but these improvements did not appear to be consistently linked to parental education, previous outdoor experiences, ADHD, or pre-camp scores on the Amsterdam Executive Function Inventory. An initial potential explanation for improvements to EFs after the excursion is the prolonged exposure to natural environments. Kaplan's (1995) Attention Restoration Theory (ART) suggests that effortful, top-down attention is finite, and that natural environments are well-suited to restore an individual's ability to sustain attention. According to ART, environments that fit four criteria are better suited to restoring effortful attention than others; they are away from the fatiguing task; are extent, or rich enough in stimuli to suggest an unseen world; allow for fascination, or include enough stimuli to maintain bottom-up attention; and match the individual's goals and purposes. There is some empirical evidence connecting executive functions to ART (i.e: Schutte, Torquati, & Beattie, 2017; Faber Taylor & Kuo, 2009; Kuo & Faber Taylor, 2004), but these studies' methodologies involved participants completing an EF assessment before and after relatively short exposure to the natural environment, rather than an overnight outdoor education excursion.

The outdoor environment in the present study met at least three of the four criteria described above. Participants spent three days and two nights in the foothills of the Rocky Mountains in the Kananaskis region of southern Alberta in winter conditions. This environment was away from the fatiguing EF tasks that had been completed at the school, is rich in sensory stimuli that suggests a "whole other world" (Kaplan, 1995, p. 175) and allows for fascination. It is less clear if this environment is aligned with the individual's goals and purposes, as the goals of the excursion were set by the teacher and school, rather than the individual students. There is a possibility that the teacher's goals and the students' goals were aligned in this instance, but at this point is hypothetical.

While the environment in the present study meets most of the criteria for ideal restorative environments in ART, the methodology limits any serious claims to empirically support ART. Participants did demonstrate statistically significant improvements in reaction time in seven of the eight computerized tasks, and statistically significant improved accuracy in four of the eight tasks; however, whether this was due to ART is unsubstantiated. Future research using a similar environment could better establish support for ART by including a control group that completed the EF tasks without access to the natural environment. Likewise, Kaplan (1995) theorized that it is not necessary for individuals to have to physically move to a different environment to restore attention, but can instead simply shift their gaze to the natural environment. As such, there are opportunities for future research involving participants completing EF assessments while in the field, as opposed to completing them in the classroom or other area of the built environment, at different time points throughout the outdoor education excursion.

A second, more compelling explanation for improvements to EFs after participating in the outdoor education excursion centers around the trip itself, not the environment. The research methodology used did not delineate between the variety of activities at the Winter camp, but perhaps the programming and philosophy of outdoor education used in the excursion supported EFs. As well, the inclusion of peer relationships and collaboration within the activities could play a role, as Kolb's (1984) experiential learning theory emphasized the constructivist nature of learning, describing the importance of reflection and active experimentation. Likewise, Luckmann's (1996) understanding of experiential education includes the importance of active questioning and constructing meaning, engagement in authentic tasks, and the possibility of experiencing success, failure, risk, adventure, and uncertainty (p. 7).

Furthermore, Priest's (1986) definition of outdoor education (OE), which is grounded in Experiential Learning Theory, delineated the four types of relationships that are central to OE. These include interpersonal, or relationships between people; intrapersonal, or one's relationship with one's self; ecosystemic, or relationships within an ecosystem; and ekistic, or relationships between humans and the environment (p. 14). Due to the inclusion of these four relationships, Priest's experiential definition of OE includes outdoor pursuits, adventure education, and environmental education.

Thematic analysis

Relationships. These core elements of experiential learning and outdoor education are echoed in the first theme of the qualitative analysis, perceptions of learning.

Initially, all interview participants stated that "learning" was the intended purpose of the outdoor excursion. When queried further, participants stated the value of experiencing an element of the curriculum rather than reading about it in a classroom. However, when describing their favourite experiences at previous outdoor camps, the participants described engaging non-curricular activities such as sleeping in tents or making ice cream. Similarly, when asked about favourite aspects of the Winter Camp specifically, participants described novel activities such as Nordic Skiing and quinzhee building. Furthermore, half of the participants specifically mentioned peer relationships as being central to their enjoyment of these trips. As stated above, Luckmann (1996) describes the possibility of experiencing success, failure, risk, and uncertainty as a core tenet of experiential education. Both Nordic Skiing and quinzhee building allow for this possibility. Likewise, participants described the significance of positive peer relationships in their enjoyment of the trips, which echoes Priest's (1986) emphasis on interpersonal relationships as central to outdoor education.

Furthermore, the programming and philosophy behind outdoor education can create an environment that supports and improves executive functions. Diamond and Ling's (2016) review of interventions for EFs concluded by noting the connection between overall mental and physical health and executive functions. The authors wrote:

> Since (a) stress, sadness, loneliness, and poor physical health (e.g., not enough sleep) impair EFs (indeed their detrimental effects are also evident at the physiological and neuroanatomical level in prefrontal cortex) and since (b) EFs are better when we are less stressed, happier, well rested, and feel there are people who we can share experiences with, who care about us, and who we can turn to

> for support, it follows, we hypothesize, that while training and challenging EFs is necessary for improving them, benefits will be greater if emotional, social, and physical needs are also addressed. (p.43)

These hypothesized supportive factors for EFs are reflected in all three themes of the qualitative analysis of participant interviews. In the first theme, perceptions of learning, interview participants described the importance of peer (as well as student-teacher) relationships in their enjoyment of the outdoor education experiences. Six of the eight interview participants discussed quinzhee building as being a favourite activity, and they specifically described teamwork and overcoming challenges as being central to their enjoyment. For example, Tim stated that, "I was pretty proud that me and my friends could make a really big quinzhee and work together". While Tim was excited to have built the quinzhee, his account of the event emphasizes working within a group and being successful in the face of challenge rather than the act of building the quinzhee itself. Tim described the event further, stating:

> …the most funnest (sic) part, and why that was when we were going to demolish our quinzhees, one of my group member's dad came and he wanted to take a photo of her on top of it, and she busted right through the top! And everyone just started to like jump on, like fall through, it was really fun. It was like a fun bonding time and it was really something to remember how fun it was.

Tim's recollection, coupled with Diamond and Ling's (2016) assertion that "EFs are better when we are less stressed, happier, well rested, and feel there are people who we can share experiences with" (p. 43), suggests that participants' improvements in reaction time and accuracy on the FlankerFish and Hearts and Flowers tasks could be connected to the sense of belonging developed while at Winter Camp. Recall that only two interview participants stated “building relationships” as the primary purpose of the outdoor education excursion, but nearly all of the participants described peer relationships as being central to their enjoyment of and engagement in the camp experience.

Physical comforts. Likewise, the second theme emerging from the axial analysis connects to Diamond and Ling’s conclusions regarding the impact stress and physical health have on EFs. In this theme, the importance of physical comforts, five of the eight interviewees described how poor sleep quality as well as cold and wet feet impacted their enjoyment of Winter Camp. As well, when asked about challenges at previous camps, several participants described difficulties sleeping in different environments, late bedtimes, and unenjoyable food. Inadequate physical comforts can be stressful for any age group, but children’s physical needs in particular should be attended to by camp leaders and teachers. Furthermore, some participants referred to homesickness as a challenge at previous camps. Dave, for example, said, “I like them [the trips]. I mean, sometimes it’s hard, like I want to go home, see my family, pet the dog, but I enjoy them.” So, in an outdoor education context, working towards an engaging, common goal with peers can support Efs, but the stress of inadequate physical comforts can hamper them.

The interview participants also described how physical comforts can act as a modifier for attention both in and outside of the classroom. Betty stated the importance of feeling “comfy” when she was attending to instruction, which, for her, meant being physically comfortable and away from distracting peers. When asked about how her peers behave on overnight trips, Betty continued to note the importance of physical comforts and perceived,

> I find its positive for [her peers] and also negative. Well, like the distractions outside, and some are crazy when they get back from an overnight trip because they're tired. But like positives I find the class is way more relaxed when we get back from camp and most kids have better bonds with their friends.

Here, Betty notes how lack of sleep can negatively impact her peers' behaviour, but also notes how stronger peer relationships can positively impact her classmates.

The Wild Ones and expectations. The third and final theme of the thematic analysis was the outdoors as a source of "wildness". Four of the eight interviewees described their own behaviours in the outdoors as different than in the classroom. Nicole believed that:

> I feel like on overnight trips you more just wanna (sic) go outside and play, where in the class you're more just ok to sit there because you know what the expectation is but in overnight trips you haven't been there before and you just want to explore. I think you just want to run around more, and you act a bit more wild.

Other interviewees used the words "wild" and "goofier" to describe their behaviours (and those of their classmates) on outdoor education excursions. When asked to elaborate on the behaviours themselves, the interviewees typically told of running around, playing, and having fun. Diamond and Ling (2016) note that, "Physical activity (without cognitive challenge, that brings little joy, and lacks any social involvement) appears *not* to improve EFs" (p. 43). As such, it is worth investigating in future research whether the types of activities that these interviewees described meet Diamond and Ling's criteria, and whether these activities improve EFs. Running around, playing, and having fun has an obvious connection to joy and social involvement. Navigating and exploring a novel environment could be viewed as cognitively challenging. Future research would be useful to investigate the impacts this unstructured play has on EFs.

Moreover, a central aspect of the outdoors as a source of wildness theme is the shift in behavioural expectations from those of the classroom to something different. Jeff's story of throwing a snowball at his teacher, which resulted in a friendly "snow war" between several parties including the teacher, is an example of this shift; throwing snowballs is considered inappropriate behaviour in this school setting, yet in this instance it was accepted and reciprocated.

This shift in acceptable behaviour, and this example specifically, describes an element of risk. Jeff did not indicate in his interviews whether his teacher had outlined the different expectations for the Winter Camp experience. As such, Jeff could have received a much different reaction from his teacher when he threw that initial snowball. Rather than recalling the memory as a favourite activity with a positive outcome, Jeff could have been retelling a different memory: that of his teacher getting upset and Jeff being disciplined.

Interviews specifically described facing risks and overcoming challenges in regards to the programming at Winter Camp. The quinzhee building activity was repeatedly described as a favourite activity, but the interviewees' responses highlight a sense of accomplishment by working with a team to complete a challenging task, rather than the actual task of building a massive pile of snow and hollowing it out. Nordic skiing was also described as a success for several students. One interviewee mentioned the feeling of skiing down the hill as the reason for his enjoyment, but others described their pride and sense of accomplishment. Betty explained her significant experience with Nordic skiing, in that she, "had never done it before and [she] was super scared about it, and accomplishing it was fun and more fun than [she] thought it would be." However, it should be noted that one interviewee, Nicole, fractured her arm while Nordic skiing. While Nicole did describe this as her strongest memory of the trip, her other interview responses indicated that she enjoyed many aspects of the programming as well as the trip as a whole.

Nicole's experiences emphasize the possibility that risk can lead to injury, which can be an unfortunate consequence on an outdoor education excursion. Wattchow and Brown (2011) are critical of the comfort zone model discussed within the outdoor education literature, stating that the model is premised on a belief that learners will rise above a stressful situation and grow as both learners and individuals (p. 41). Wattchow and Brown argued that putting learners in higher-risk, stressful situations could negatively impact relationships, emotional well-being, and enjoyment of the activity. This criticism of the comfort zone model is echoed in the second theme within the qualitative analysis, which emphasizes the importance of physical comforts. In this study, interview participants did not describe quinzhee building as a high-risk behaviour outside of their comfort zones, but five participants did describe how their enjoyment of the entire winter camp experience was hampered by ineffective gear, poor sleep, and food that was not enjoyable. For these five interview participants, their inadequate physical comforts presented their greatest challenge in their experience at winter camp. They did not "rise above" this situation, but instead were negatively impacted enough to discuss these challenges with the interviewer. This study's research methodology does not allow an investigation into how impactful the lack of physical comforts was on participants' EFs, but this could be an engaging area for future research.

The concept of risk, in the context of this study, leads to an interesting problem. Is there an appropriate "dose" for risk? In the OE literature, Wattchow and Brown (2011) are critical of risk-taking as a core feature of outdoor education for two reasons: it presents risk-taking as something done in a novel environment outdoors; and, it can negatively impact participants' emotional well-being and instructor-student relationships. Conversely, Luckmann (1996) states that risk, as the possibility of experiencing success, failure, adventure, and uncertainty, is an important feature of experiential education. In these definitions, risk is a stressor. Similarly, with regards to EFs, Diamond and Ling (2016) noted that stress negatively impacts executive functions, writing, "Stress can make anyone look like he or she has an EF disorder, such as ADHD, when that is not the case" (p. 42). The authors further argued that EFs may be improved by individuals, "believing that through effort you can improve, and treating errors and failed attempts as learning opportunities or as simply what happens when you push past your comfort zone" (ibid).

The interviewees also indirectly describe risk as something both valuable and as a negative stressor. For example. Betty described her sense of accomplishment after she successfully learned to Nordic ski, and Jeff had the opportunity to make a fun, positive memory in a situation with changing behavioural expectations. These successes are coupled with the second theme within the analysis, which describes physical stressors experienced by the interviewees at Winter Camp as well as previous outdoor education excursions.

One possible way to reconcile the space between appropriate stress that could support executive functions and inappropriate stress that could impair them is to refer to Vygotsky's Zone of Proximal Development (ZPD) (1978). Here, an individual's ZPD refers to three types of tasks: those that the individual can complete on their own, those that can be completed with guidance, and those that cannot be completed with guidance or assisted. In a risk-as-stressor context, a group of people would all have a varied ZPD depending on the task. For some, the task would be easy to accomplish alone, while others would not be able to do it even with assistance. In this instance, there would be little stress for individuals in the first group, while individuals in the latter group would be experiencing high stress that would impair their EFs. In the context of this study, the novel activities such as quinzhee building and Nordic skiing could have been planned with individual students' ZPDs in mind, allowing the participants to complete the tasks with peers and demonstrating those feelings of happiness, pride, and accomplishment that Diamond and Ling (2016) assert could improve EFs.

In summation, Diamond and Ling hypothesized that EFs could be improved in situations where individuals feel that they have people to share experiences with, are physically active, and are happier (p. 43). Outdoor education excursions, like the Winter Camp discussed in this study, can allow for these social, emotional, and physical needs to be met. The participants in this research study did, in general, demonstrate statistically-significant improvements to their core EFs after their excursion into Kananaskis, but this study's research design limits potential explanations for these improvements to correlation and speculation. Future studies should investigate outdoor education, and place-based education, as educational approaches that benefit executive functions.

Connecting Qualitative and Quantitative Results

The quantitative research question for this study was, "To what extent does a multi-day, immersive outdoor education experience impact the executive functions of sixth grade students?" Participants in this study, in general, demonstrated some improvements to their core executive functions after attending the outdoor education experience. The participants demonstrated statistically-significant improvements in accuracy in three of eight measures, and statistically-significant improvements to reaction time in four of seven measures, when results from before and after the outdoor education experience were compared. Improvements to accuracy and reaction time appeared to be maintained approximately one month after the experience, as accuracy and reaction time neither increased nor decreased at a statistically significant level in the third testing window. As well, the improvements to accuracy and reaction time were not linked to parental education, previous outdoor experiences, or scores on the AEFI.

In addition, the qualitative research question for this study was, "How do participants who display varying impacts describe their experiences?" While the eight interview participants all demonstrated varying impacts to their EFs after attending the winter camp experience, they each presented fairly uniform responses to the interview questions. Jeff, for example, demonstrated an improvement of only 1% in his accuracy in the FlankerFish task. His biggest challenge at camp involved cold and wet feet for the duration of the experience, and his strongest memory involved the joy and engagement of a massive snowball fight that he initiated. Both of these elements reflect major themes found throughout the analysis: the importance of physical comforts and the outdoors as a source of wildness. Conversely, Dave demonstrated an improvement of 23% in the same measure. Dave's biggest challenge was also related to physical comforts, as he struggled with the later bedtimes at camp. His strongest memory was running through the woods, being chased by a predator in the Animal Game, which reflects the outdoors as a source of wildness.

As well, Nicole demonstrated significant improvement in accuracy, increasing her score from 12 correct answers in her first testing trial to 57 correct after camp. In addition, her experience at camp was significantly different than other students when a fall during Nordic Skiing resulted in a fractured arm. Yet, most of her interview responses were thematically similar to her peers. For example, when asked about her biggest challenge, she described a glowing red light in the dormitory that made sleep difficult after mentioning that she fractured her arm.

Lastly, the mixed methods research question for this study was, "What is the nature of the impact of an immersive, multi-day outdoor education activity on the executive functions of adolescents?" Core executive functions did, in general, improve after the outdoor education excursion, but these improvements were not linked to other quantitative data. As well, regardless of impacts to EFs or specific personal circumstances at camp, the interview participants uniformly describe their experience with three themes: perceptions of learning, the importance of physical comforts, and the outdoors as a source of Wildness.

However, each of these three themes connect to one of Diamond and Ling's (2016) assertions regarding interventions that may or may not positively impact executive functions. In regards to perceptions of learning, participants describe the importance of peer and teacher relationships when describing their experiences at camp. This links to Diamond and Ling's understanding that EFs will be better improved in environments where we share experiences and have a sense of belonging. The next theme was the importance of physical comforts. Here, participants described how their enjoyment of their excursions (and their classroom activities) was hampered by inattention to physical comforts such as cold or wet feet and poor sleep quality. This theme connects to Diamond and Ling's assertion that EFs will be negatively impacted by stress and lack of sleep. Lastly, in regards to the outdoors as a source of Wildness, participants describe behaviours that represent risk, challenge, and potential for accomplishment and success. This final theme links to Diamond and Ling's claim that, while stress can negatively impact EFs, EFs can be improved by individuals who approach challenge and potential failure as a learning opportunity.

The interview responses, coupled with the quantitative results showing general improvements to core EFs after the outdoor education excursion, suggest that the excursion and its associated activities provide indirect supports for improving executive functions. Improvements to executive functions here appear to be linked to participant relationships, appropriate levels of risk and stress, and participant feelings of connection and belonging. This study suggests that an immersive, multi-day outdoor education activity can have positive impacts on the executive functions of adolescents by creating an atmosphere that allows for a sense of belonging, challenge, wildness, and joy.

Limitations

One limitation to this study is the relatively small sample size of an already fairly homogenous population. Future studies exploring the impacts of outdoor education on executive functions would benefit from a wider sample from a wider population, as most participants here had experience in outdoor environments and parents with university degrees. Furthermore, all participants were members of the same privileged educational community, which explicitly values outdoor education.

This segues to another limitation of this study, which is that the primary researcher is also a member of the same educational community. While the researcher was not the teacher of any of the participants during the study, he was still known to the participants as a teacher in the school. This limitation is important here because, as a teacher in the school, this researcher wonders how student responses to interview questions were impacted by this power imbalance. As well, the planned and un-planned interview questions were implicitly informed by this researcher's experience leading overnight outdoor educational experiences within the school. This inherent bias, coupled with the power imbalance between teacher and student, could have led to incomplete or questionable interview responses. For example, were students saying that learning is the purpose of the outdoor and overnight trips provided by the school because that is what they believed, or because that is the expected response? Perhaps participant responses would have been different if they had been speaking to an independent researcher. Furthermore, as the interview responses were relatively homogeneous, future qualitative research into the impacts of outdoor education on adolescents could benefit from selecting interviewees based on their perspective and enjoyment of the event, rather than the quantitative changes to EFs. Likewise, expanding the number of interviewees could also broaden the participant perspective and provide a more varied view of the experience.

A third limitation here is that, due to the homogenous population sample as well as the research design, generalizations of the research findings should be made with restraint. In general, participants in this study did show improvement on several computerized tests linked to executive functions after an outdoor education experience, but that does not imply that all students would show comparable levels of improvement. The results cannot state that an outdoor education experience will improve executive functions, nor can the results state that an outdoor education experience will improve academic or behavioural outcomes.

Implication for Future Research

Future studies in this area would benefit from attending to the limitations in this study by sampling from a larger, more representative population and by using an independent research associate to complete qualitative interviews. As well, there are several opportunities to expand upon the results of this study by approaching the topic with a different research design. In particular, a quantitative study between the EF measures of a participant group that attended an outdoor education experience and one that did not would be valuable. As well, there are several variables within the outdoor education experience that could be adjusted and impacts on EFs could be measured accordingly. For example, perhaps specific activities could have a different impact, as could the duration of the experience. Would an overnight trip in a campground have similar impacts as an afternoon in an urban park setting? Could activities in a school yard or other available outdoor space have an impact on EFs? Lastly, as the participants of this study noted, physical comforts are front-of-mind in an outdoor education experience; how would executive functions be impacted by a trip that returned early due to heavy rains, for example, as compared to one that had ideal weather?

Furthermore, participants in this study described how interpersonal relationships are an integral part of their outdoor educational experiences. Future research could explore this perspective further by manipulating this variable. For example, would impacts on EFs be different for those who participated in an experience with a group of friends as compared to a group of relative strangers? Perhaps impacts on student EFs would be different in an outdoor experience at the start of the year, with a new class, as compared to a culminating outdoor activity at year-end.

Third, this researcher would also suggest including teachers and outdoor education leaders into a phase of the research design. This would have the potential to yield valuable insights into the student-teacher relationship, the importance of physical comforts, and the shift in behavioural expectations when in an outdoor environment. The student participants in this study noted the importance of positive peer relationships in their enjoyment of outdoor education experiences, but further investigation into the student-teacher relationship in outdoor education experiences would be valuable. Perhaps teacher perspectives on the purpose of learning in the outdoor education experiences, and the rationale behind planned activities, could correlate with different impacts on EFs. As well, it would be pertinent to include teacher and leader perspectives on the outdoors as a source of wildness; how do teachers and leaders view student behaviours in an outdoor setting as compared to behaviours in the classroom?

Lastly, future research regarding the impact of outdoor education on executive functions could also include specific training to support EFs delivered in an outdoor education setting. The current study investigates whether outdoor education in general could improve EFs, but future research that couples working memory training, for example, with an environment that is well-suited to benefit EFs would be of particular interest.

Implications for the Field

The participants in this study highlighted the importance of physical comforts, peer and teacher relationships, and the outdoors as a source of "wildness" when describing their experiences in outdoor educational settings. Educators may benefit from attending to these themes when planning field experiences and outdoor education excursions.

Relationships. In this study, participants described that they most valued building interpersonal relationships through novel activities throughout their outdoor education experience. However, this contrasted with their earlier responses that stated that "learning" was the purpose of these experiences. Here, the participants connected "learning" to the content taught in their classrooms, presumably connected to the provincially-mandated curriculum. As educators are determining the purpose of their planned excursion, specific attention should be placed on ensuring opportunities for relationship building throughout the experience. This could involve structured activities led by a facilitator, unstructured time where participants could explore their environment with their peers, or a combination.

Educators could choose to plan outdoor experiences where building and improving relationships is the intended primary purpose because, in this study, that appears to be more valued by the participants than attending to specific curricular outcomes. An educator or administrator may balk at this suggestion, because planning and participating in these excursions can be time-intensive. Yet, both outdoor education and place-based education are centered around relationships, not specific pedagogy or curricula. If developing stronger relationships are the goal of the excursion, including the associated skills of cooperation, collaboration, social problem solving, and resolution of social norms, then an outdoor, experiential environment is well suited to meet that goal.

The reality of many school budgets is that outdoor education can be prohibitively and disproportionately costly, and risks associated with outdoor education (and outdoor pursuits, in particular) can also limit access to these activities. Woodhouse and Knapp (2000) noted that place-based learning (PBL) does not require any travel beyond one's local community, and also is not associated with the culture of risk that often characterizes outdoor education settings (Wattchow & Brown, 2011) Place-based education allow students to build interpersonal, intrapersonal, ecological, and ekistic relationships in a more easily-accessed setting. Furthermore, because place-based education encourages educators to access the local environment, teachers could plan to access these spaces, and examine their relationships, throughout the academic year.

Physical comforts. In terms of physical comforts, learners and participants may benefit if, after determining the purpose of the excursion, the first step in planning the excursion is the leader asking, "How can I ensure that my students will be safe and comfortable in the field?" In any outdoor experience, responding to this question would involve attending to the participants' skill level, physical fitness, toilets and personal hygiene requirements, and general preparedness for the activity as well as simply being outdoors for the required length of time. For an overnight trip or longer, planning would also be required for meal planning and nutrition, as well as appropriate bedtimes and sleeping arrangements. The results of this research suggest that attending to these biological requirements should be a priority.

Here, one is reminded of Maslow's (1943) hierarchy of needs, with physiological needs resting at the foundation. Maslow argued that if physiological needs were not met, then further needs such as safety, love, and esteem could not be approached until those physiological needs were managed. Likewise, an individual who does not feel safe will not be able to meet higher needs. Therefore, educators should keep physical comforts and safety front-of-mind when planning these excursions.

Returning to the present study, one participant noted that their physical comfort was negatively impacted by poor quality or inadequate footwear. Here, after addressing general student safety and comfort in the planning process, educators would also benefit from ensuring that the participants have access to appropriate equipment as well as providing additional equipment as a contingency. As the cost of high-quality equipment can be prohibitive, educators would benefit from considering the participants' equipment and adjusting the purpose of, setting, or activities within, the excursion as necessary to ensure safety and physical comfort.

Educators would also benefit from applying Vygotsky's Zone of Proximal Development to stress both in classroom settings and on the land. Diamond and Ling (2016) clearly articulate the deleterious impacts stress can have on EFs, and questions around appropriate amounts of stress remain. Therefore, educators should continue to consider the appropriate level of risk when planning excursions as well as classroom activities.

The Wild Ones and expectations. The final theme identified in the thematic analysis focused on the idea of the outdoors as a source of “wildness”. Here, the participants described their behaviours (and those of their classmates) as either being similar to in a classroom setting or, conversely, as more rambunctious, energetic, or (as described by some participants) “goofier”. These differences in behaviour described by the participants could be attributed to distracting elements present in an outdoor setting, or alternatively due to the novelty and excitement of being on a new excursion away from the typical school setting. The participants, however, indicated that this difference in behaviour is due to changed teacher expectations. In a classroom, the teacher may have certain behavioural expectations, but in an excursion these behavioural expectations may be different. In this study, the participants described less stringent expectations which allowed them to engage in wilder and “goofier” behaviour. For example, Jeff, when asked for his favourite memory of camp, described throwing a snowball at his teacher, and the teacher retaliating, leading to a “huge snow war”. In the school yard, Jeff would likely have been disciplined for throwing a snow ball, let alone throwing one at a teacher, but at camp Jeff is able to form a favourite memory and interact in a novel, positive way with his teacher.

Perhaps the participants were able to do this because of this particular teacher’s comfort level with the excursion and own letting down of his guard at camp, as it is unclear whether this particular instance was explicitly described as appropriate behaviour to the participants. Therefore, when planning excursions, educators could benefit from also planning behavioural expectations. Safety and physical comforts are still of most importance, but what about behaviours? How should students act when on the land? How should teachers act on the land? Educators could also prepare by assessing their own comfort level and stress regarding “wildness”.

Planning outdoor excursions around the importance of relationships, physical comforts, and “wildness” could allow educators to implicitly improve EFs, as executive functions are well-supported in environments where individuals feel a sense of belonging in shared experiences, are physically active, and feel happy (Diamond & Ling, 2016). Outdoor experiences, including outdoor, experiential, and place-based education, are opportunities to provide an environment to support the emotional, physical, and social well-being of individuals, and could indirectly support EFs.

Conclusions

Executive functions continue to be a topic of great interest for both developmental neuroscientists and educators, as they are linked to greater quality of life (Diamond, 2013) and success in schooling (Alloway & Alloway, 2010). As such, there are a wide variety of purported claims of programs and interventions to improve EFs (Diamond & Ling, 2016). This research coupled these approaches with improving EFs with Louv’s (2005) non-clinical metaphor of “nature-deficit disorder” as a way of understanding an apparent disconnect between today’s children and their natural environment.

This research study aimed to answer the mixed methods research question, “What is the nature of the impact of an immersive, multi-day outdoor education activity on the executive functions of sixth-grade students?” As hypothesized, the participants in this study exhibited varied impacts to their EFs after attending camp, but in general they demonstrated statistically-significant improvements to reaction time in four of seven computerized assessments and statistically-significant improvements to accuracy in three of eight computerized assessments. These improvements were not linked to sex, previous outdoor experiences, parental education, or diagnosed learning disabilities or attention-deficit hyperactivity disorder. When describing their experiences at camp, participants uniformly emphasized the importance of relationships, the need for adequate physical comforts, and the outdoors as a source of wildness. Here, the participants described how their enjoyment and experience can be supported or impaired by the quality of the peer and teacher relationships throughout the excursion, the quality of physical comforts such as sleep and footcare, and by activities and experiences that provide a challenge and a sense of accomplishment. Furthermore, the participants emphasized a shift in expectations when on the excursion, allowing for greater risk and "wilder" behaviour. By linking the qualitative responses and the quantitative data, I argue that outdoor education experiences can positively impact executive functions by creating an environment wherein supportive factors for EFs are provided. Diamond and Ling (2016) stated, "EFs are better when we are less stressed, happier, well rested, and feel there are people who we can share experiences with" (p. 43), and the participants in this study often described these types of shared experiences as their highlights of their excursions. Whether it was building and destroying a quinzhee, rushing down the hill on Nordic Skis, or throwing a snowball at a teacher and initiating a "huge snow war", the activities within the outdoor education experience provided elements that support the improvement of executive functions.

References

Alberta Education. (2007). *Information Bulletin on Standards for Special Education, Amended June 2004*. Retrieved from: https://education.alberta.ca/media/3115424/information-bulletin-on-standards-for-special-education-amended-june-2004.pdf

Alberta Education. (2015). *Charter Schools Handbook.* Retrieved from: https://education.alberta.ca/media/3227599/charter-schools-handbook-september-2015.pdf

Alloway, T. P., & Alloway, R. G. (2010). Investigating the predictive roles of working memory and IQ in academic attainment. *Journal of Experimental Child Psychology, 106*(1), 20-29. doi: https://doi.org/10.1016/j.jecp.2009.11.003

Andersen, S. L. (2003). Trajectories of brain development: Point of vulnerability or window of opportunity? *Neuroscience & Biobehavioral Reviews, 27*(1-2), 3-18. doi: 10.1016/s0149-7634(03)00005-8

Anderson, P., Anderson, V., Northam, E., & Taylor, H. (2000). Standardization of the contingency naming test for school-aged children: A new measure of reactive flexibility. *Clinical Neuropsychological Assessment, 1*, 247-273.

Anderson, P. (2002). Assessment and development of executive function (EF) during childhood. *Child Neuropsychology, 8*(2), 71-82. doi: 10.1076/chin.8.2.71.8724

Alvarez, J. A., & Emory, E. (2006). Executive function and the frontal lobes: A meta-analytic review. *Neuropsychology Review, 16*(1), 17-42. doi: 10.1007/s11065-006-9002-x

Attride-Stirling, J. (2001). Thematic networks: An analytic tool for qualitative research.

Qualitative Research, 1(3), 385-405.

Baddeley, A. (2012). Working memory: Theories, models, and controversies. *Annual Review of Psychology, 63*, 1-29. doi: 10.1146/annurev-psych-120710-100422

Bailey, A. W., Johann, J., & Kang, H. (2017). Cognitive and physiological impacts of adventure activities: Beyond self-report data. *Journal of Experiential Education, 40*(2), 153-169. doi: 10.1177/1053825917701250

Barkley, R.A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin, 121*(1), 65-94.

Barkley, R. A., & Lombroso, P. J. (2000). Genetics of Childhood Disorders: XVII. ADHD, Part 1: The Executive Functions and ADHD. *Journal of the American Academy of Child & Adolescent Psychiatry, 39*(8), 1064-1068. doi: https://doi.org/10.1097/00004583-200008000-00025

Barton, J., & Pretty, J. (2010). What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. *Environmental Science & Technology, 44*(10), 3947-3955. Doi: 10.1021/es903183r

Beil, K., & Hanes, D. (2013). The influence of urban natural and built environments on physiological and psychological measures of stress--a pilot study. *International Journal of Environmental Research and Public Health, 10*(4), 1250-1267. doi: 10.3390/ijerph10041250

Benson, J. E., Sabbagh, M. A., Carlson, S. M., & Zelazo, P. D. (2013). Individual differences in executive functioning predict preschoolers' improvement from theory-of-mind training. *Developmental Psychology, 49*(9), 1615-1627. doi: 10.1037/a0031056

Berto, R. (2005). Exposure to restorative environments helps restore attentional capacity. *Journal of Environmental Psychology, 25*(3), 249-259. doi: https://doi.org/10.1016/j.jenvp.2005.07.001

Borella, E., Carretti, B., & Pelegrina, S. (2010). The specific role of inhibition in reading comprehension in good and poor comprehenders. *Journal of Learning Disabilities, 43*(6), 541-552. doi: 10.1177/0022219410371676

Bronowski, J. (1977). Human and animal languages. In J. Bronowski (Ed.), *A Sense of the Future*. Cambridge, MA: MIT Press.

Bunge, S.A., Dudukovic, N.M., Thomason, M.E., Vaidya, C.J., & Gabrieli, J.D.E. (2002). Immature frontal lobe contributions to cognitive control in children: Evidence from fMRI. *Neuron, 33*, 301-311.

Burbules, N., & Berk, R. (1999). Critical thinking and critical pedagogy: Relations, differences, and limits. In T. Popkewitz & L. Fendler (Eds.), *Critical Theories in Education*. New York, NY: Routledge.

Busso, D. S., & Pollack, C. (2015). No brain left behind: Consequences of neuroscience discourse for education. *Learning, Media and Technology, 40*(2), 168-186. doi: 10.1080/17439884.2014.908908

Casey, B. J., Tottenham, N., Liston, C., & Durston, S. (2005). Imaging the developing brain: What have we learned about cognitive development? *Trends in Cognitive Science, 9*(3), 104-110. doi: 10.1016/j.tics.2005.01.011

Cepeda, N.J., & Munakata, Y. (2007). Why do children perseverate when they seem to know better: Graded working memory, or directed inhibition? *Psychonomic Bulletin & Review, 14*(6), 1058-1065.

Chan, R. C. K., Shum, D., Toulopoulou, T., & Chen, E. Y. H. (2008). Assessment of executive functions: Review of instruments and identification of critical issues. *Archives of Clinical Neuropsychology, 23*(2), 201-216. doi: https://doi.org/10.1016/j.acn.2007.08.010

Check, J.W., & Schutt, R.K. (2012). *Research Methods in Education.* Thousand Oaks, CA: Sage Publications Ltd.

Cisek, P. & Kalaska J.F. (2010). Neural mechanisms for interacting with a world full of action choices. *Annual Review of Neuroscience, 33,* 269-298. doi:101146/annurev.neuro.05108.135409

Climie, E. A., Cadogan, S., & Goukon, R. (2014). Test review: Comprehensive executive function inventory. *Journal of Psychoeducational Assessment, 32*(2), 173-177. doi: 10.1177/0734282913494169

Cockburn, J., & Frank, M. (2011). Reinforcement learning, conflict monitoring, and cognitive control: An interactive model of cingulated-striatal interaction and the ERN. In R. Mars, J. Sallet, M. Rushworth, & N. Yeung (Eds.), *Neural Basis of Motivational and Cognitive Control*. Cambridge, MA: The MIT Press.

Connect Charter School, (n.d.). Admissions process. Retrieved from: http://www.connectcharter.ca/schoolprogram/admission_process.asp

Cooley, S. J., Burns, V. E., & Cumming, J. (2016). Using outdoor adventure education to develop students' groupwork skills. *Journal of Experiential Education, 39*(4), 329-354. doi: doi:10.1177/1053825916668899

Cozolino, L. (2013). *The social neuroscience of education: optimizing attachment and learning in the classroom*. New York, NY: W.H. Norton & Company, Inc.

Creswell, J. W., Plano Clark, V.L., Gutmann, M.L., & Hanson, W.E. (2003). Advanced mixed methods research designs. In A. Tasakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 209-240). Thousand Oaks, CA: Sage Publications Inc. Retrieved from: http://www.corwin.com/sites/default/files/upm-binaries/19291_Chapter_7.pdf

Creswell, J.W., & Plano Clark, V.L. (2010). *Designing and conducting mixed methods research* (2nd ed.). Thousand Oaks, CA: Sage Publications Inc.

Creswell, J.W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches (*4th ed.). Thousand Oaks, CA: Sage Publications, Inc.

Dawson, P., & Guare, R. (2010). *Executive skills in children and adolescents* (2nd ed.). New York, NY: Guilford Press.

Dennis, M. (1989). Measurement of executive function. In G. Reid Lyon (Ed.), *Frames of reference for the assessment of learning difficulties*. Baltimore, MD: Brookes Publishing Co.

Dewey, J. (1938). *Experience and education*. New York, NY: Free Press.

Diamond, A. (1990). The development and neural bases of memory functions as indexed by the AB and delayed response tasks in human infants and infant monkeys. In A. Diamond (Ed.), *The Development and Neural Bases of Higher Cognitive Functions* (Vol. 608, pp. 267-317). New York, NY: The New York Academy of Sciences.

Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*(1), 135-168. doi: 10.1146/annurev-psych-113011-143750

Diamond, A., & Ling, D.S. (2016). Conclusions about interventions, programs, and approaches for improving executive functions that appear justified and those that, despite much hype, do not. *Developmental Cognitive Neuroscience, 18*(2016), 34-48. doi: 0.1016/j.dcn.2015.11.005

Dickinson, E. (2013). The misdiagnosis: Rethinking “Nature-deficit Disorder”. *Environmental Communication, 7*(3), 315-335. doi: 10.1080/17524032.2013.802704

Dixon, J. W. (2014). Review of the comprehensive executive function inventory. In J. F Carlson, K.F. Geisinger, & J.L. Johnson (Eds.), *Nineteenth Mental Measurements Yearbook*, Lincoln, NE: Buros Centre for Testing

Eriksen, B. A., & Eriksen, C. W. (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perception & Psychophysics, 16*(1), 143-149. doi: 10.3758/bf03203267

Espy, K. A. (1997). The shape school: Assessing executive function in preschool children. *Developmental Neuropsychology, 13*(4), 495-499. doi: 10.1080/87565649709540690

Faber Taylor, A., & Kuo, F. E. (2009). Children with attention deficits concentrate better after walk in the park. *Journal of Attention Disorders, 12*(5), 402-409. doi: 10.1177/1087054708323000

Felsten, G. (2009). Where to take a study break on the college campus: An attention restoration theory perspective. *Journal of Environmental Psychology, 29*(1), 160-167. doi: https://doi.org/10.1016/j.jenvp.2008.11.006

Fuster, J.M. (1995). Memory and planning: Two temporal perspectives of frontal lobe function. In H.H. Jasper, S. Riggio, & P.S. Goldman-Rakic (Eds.), *Epilepsy and the functional anatomy of the frontal Lobe*, (pp. 9-18). New York, NY: Raven Press.

Freire, P. (1970). *Pedagogy of the oppressed* (30th Anniversary Ed.) (M. Bergman Ramos, Trans.). New York, NY: Continuum International Publishing Group.

Gioia, G. A., Isquith, P. K., Guy, S. C., & Kenworthy, L. (2000). TEST REVIEW Behavior Rating Inventory of Executive Function. *Child Neuropsychology, 6*(3), 235-238. doi: 10.1076/chin.6.3.235.3152

Gioia, G.A., Isquith, P.K., & Kenealy, L.E. (2008). Assessment of behavioral aspects of executive function. In V. Anderson, R. Jacobs, & P.J. Anderson (Eds.), *Executive functions and the frontal lobes: A lifespan perspective*. Philadelphia, PA: Taylor & Francis.

Greenhouse, I., Swann, N.C., & Aron, A.R. (2011). Fronto-basal-ganglia circuits for stopping action. In R.B. Mars, J. Sallet, M.F.S. Rushworth, & N. Yeung (Eds.), *Neural Basis of Motivational and Cognitive Control*. Cambridge, MA: The MIT Press.

Grissom, N.M., & Reyes, T.M. (2019). Let's call the whole thing off: Evaluating gender and sex differences in executive function. *Neuropsychopharmocology, 44,* 1-11. Doi: https://doi.org/10.1038/s41386-018-0179-5

Gruenewald, D. A. (2003a). Foundations of place: A multidisciplinary framework for place-conscious education. *American Educational Research Journal, 40*(3), 619-654.

Gruenewald, D. A. (2003b). The best of both worlds: A critical pedagogy of place. *Educational Researcher, 32*(4), 3-12.

Harcourt Assessment. (2007). Design and purpose of the NEPSY-II. In *The NEPSY* (2nd ed). Retrieved from: http://images.pearsonclinical.com/images/Products/NEPSY-II/Clin_Chp_2.pdf

Hartig, T., Mang, M., & Evans, G. W. (1991). Restorative effects of natural environment experiences. *Environment and Behavior, 23*(1), 3.

Hartig, T., Evans, G. W., Jamner, L. D., Davis, D. S., & Gärling, T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology, 23*(2), 109-123. doi: https://doi.org/10.1016/S0272-4944(02)00109-3

Hass, M.R., Patterson, A., Sukraw, J., & Sullivan, B.M. (2014). Assessing executive functioning: A pragmatic review. *Contemporary School Psychology, 18,* 91-102. Doi:10.1007/s40688-013-002-6

Hassinger-Das, B., Jordan, N. C., Glutting, J., Irwin, C., & Dyson, N. (2014). Domain-general mediators of the relation between kindergarten number sense and first-grade mathematics achievement. *Journal of Experimental Child Psychology, 118*, 78-92. doi: 10.1016/j.jecp.2013.09.008

Hattie, J., Marsh, H. W., Neill, J. T., & Richards, G. E. (1997). Adventure education and outward bound: Out-of-class experiences that make a lasting difference. *Review of Educational Research, 67*(1), 43-87.

Hedegaard, M. (2005). The zone of proximal development as basis for instruction. In H. Daniels (Ed.), *An Introduction to Vygotsky* (2nd ed) [electronic resource]. Retrieved from: http://web.b.ebscohost.com.ezproxy.uleth.ca/ehost/ebookviewer/ebook/bmxlYmtfXzEyMjk2MF9fQU41?sid=42bb1eba-4487-486e-9d6b-a08bfc823aec@sessionmgr102&vid=0&format=EB&rid=1

Hughes, C., & Graham, A. (2008). Executive functions and development. In *Child neuropsychology: Concepts, theory and practice.* J. Reed and J. Warner-Rogers (Ed.). (Kobo edition).

Isquith, P. K., Roth, R. M., & Gioia, G. (2013). Contribution of rating scales to the assessment of executive functions. *Applied Neuropsychology: Child, 2*(2), 125-132. doi: 10.1080/21622965.2013.748389

Ito, M. (2011). *The cerebellum: Brain for an implicit self*: Upper Saddle River, NJ: FT Press.

James, J. K., & Williams, T. (2017). School-based experiential outdoor education. *Journal of Experiential Education, 40*(1), 58-71. doi: 10.1177/1053825916676190

Johnson, R.B., Onwuegbuzie, A.J., & Turner, L.A. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research, 1*(2), 112-133. doi:10.1177/155868906298224

Kamii, C., & Ewing, J. K. (1996). Basing teaching on Piaget's constructivism. *Childhood Education, 72*(5), 260.

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15*, 169-182.

Klaunig, J., Chang, Y., Ewert, A. W., & Wang, Z. (2016). Reducing levels of stress through natural environments (2016). *International Journal of Health, Wellness & Society, 6*(1), 35-43. doi: 10.18848/2156-8960/CGP/v06i01/35-43

Kolb, B., & Whishaw, I.Q. (2009). *Fundamentals of human neuropsychology* (6th ed.).

New York, NY: Worth Publishers.

Kolb, D.A. (1984). *Experiential learning: Experience as the source of learning and development.* Englewood Cliffs, NJ: Prentice Hall.

Koziol, L.F, & Lutz, J.T. (2013). From movement to thought: The development of executive function. *Applied Neuropsychology: Child, 2*:(2), 104-115. doi: 10.1080/21622965.2013.748386

Kuo, F. E., & Faber Taylor, A. (2004). A potential natural treatment for Attention-Deficit/Hyperactivity Disorder: Evidence from a national study. *American Journal of Public Health, 94*(9), 1580-1586.

Leberman, S., & Martin, A. (2003). Does pushing comfort zones produce peak learning experiences? *Australian Journal of Outdoor Education, 7*(1): 10-19.

Liu, X., Banich, M. T., Jacobson, B. L., & Tanabe, J. L. (2004). Common and distinct neural substrates of attentional control in an integrated Simon and spatial Stroop task as assessed by event-related fMRI. *Neuroimage, 22*(3), 1097-1106. doi: https://doi.org/10.1016/j.neuroimage.2004.02.033

Liu, Z., Yang, Y., Shi, Z., Liu, J., & Wang, Y. (2016). The risk of male adult alcohol dependence: The role of the adverse childhood experiences and ecological executive function. *Comprehensive Psychiatry, 68*, 129-133. doi: http://dx.doi.org/10.1016/j.comppsych.2016.04.006

Louv, R. (2005). *Lost child in the woods: Saving our children from Nature-Deficit Disorder.* New York, NY: Workman Publishing.

Luckmann, C. (1996). Defining experiential education. *Journal of Experiential Education, 19*(1). 6-7.

Luna, B., Padmanabhan, A., & O'Hearn, K. (2010). What has fMRI told us about the development of cognitive control through adolescence? *Brain and Cognition, 72*(1), 101-113. doi: 10.1016/j.bandc.2009.08.005

Maslow, A.H. (1943). A theory of human motivation. *Psychological Review, 50*(4), 370-396. Doi: 10.1037/h0054346

Mischel, W., Ebbesen, E. B., & Raskoff Zeiss, A. (1972). Cognitive and attentional mechanisms in delay of gratification. *Journal of Personality and Social Psychology, 21*(2), 204-218.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "Frontal Lobe" tasks: a latent variable analysis. *Cognitive Psychology, 41*(1), 49-100. doi: 10.1006/cogp.1999.0734

Mothes, L., Kristensen, C. H., Grassi-Oliveira, R., Fonseca, R. P., Lima Argimon, I. I., & Irigaray, T. Q. (2015). Childhood maltreatment and executive functions in adolescents. *Child & Adolescent Mental Health, 20*(1), 56-62. doi: 10.1111/camh.12068

Nikulina, V., & Widom, C. S. (2013). Child Maltreatment and Executive Functioning in Middle Adulthood: A Prospective Examination. *Neuropsychology, 27*(4), 10.1037/a0032811. doi: 10.1037/a0032811

Palomino, M., Taylor, T., Göker, A., Isaacs, J, & Warber, S. (2016). The online dissemination of nature-health concepts: Lessons from sentiment analysis of social media relating to “Nature-Deficit Disorder”. *Environmental Research and Public Health, 13.* doi:10.3390/ijerph13010142

Par Inc. (2012). Behavior rating inventory of executive function (BRIEF). Retrieved from: http://www4.parinc.com/Products/Product.aspx?ProductID=BRIEF

Pearson Education, Inc. (2017a). *NEPSY® - Second Edition*. Retrieved from: http://www.pearsonclinical.com/psychology/products/100000584/nepsy-second-edition-nepsy-ii.html

Pearson Education, Inc. (2017b). *Weschler Intelligence Scale for Children® - Fifth Edition*. Retrieved from: http://www.pearsonclinical.com/psychology/products/100000771/wechsler-intelligence-scale-for-childrensupsupfifth-edition--wisc-v.html

Perry, R. (2001). Executive function and ADHD. *Journal of the American Academy of Child & Adolescent Psychiatry, 40*(5), 501. doi: https://doi.org/10.1097/00004583-200105000-00001

Priest, S. (1986). Redefining outdoor education: A matter of many relationships. *Journal of Environmental Education, 17*(3), 13-15.

Reynolds, C.R. & Livingston, R.B. (2012). *Mastering modern psychological testing: Theory & methods.* New York, NY: Pearson.

Richards, T. L., Berninger, V. W., Stock, P., Altemeier, L., Trivedi, P., & Maravilla, K. R. (2009). Differences between good and poor child writers on fMRI contrasts for writing newly taught and highly practiced letter forms. *Reading and Writing, 24*(5), 493-516. doi: 10.1007/s11145-009-9217-3

Rindermann, H., & Baumeister, A.E.E. (2015). Parents' SES vs parental educational behavior and children's development: A reanalysis of the Hart and Risley Study. *Learning and Individual Differences, 37*, 133-138. Doi: 10.1016/j.lindif.2014.12.00

Roberts, J.W. (2012). *Beyond learning by doing: Theoretical currents in experiential education*. New York, NY: Routledge.

Schutte, A. R., Torquati, J. C., & Beattie, H. L. (2017). Impact of urban nature on executive functioning in early and middle childhood. *Environment and Behavior, 49*(1), 3-30. doi: 10.1177/0013916515603095

Sibthorp, J., Furman, N., Paisley, K., Gookin, J., & Schumann, S. (2011). Mechanisms of learning transfer in adventure education: Qualitative results from the NOLS transfer survey. *Journal of Experiential Education, 34*(2), 109-126. doi: 10.5193/JEE34.2.109

Simon, J. R., & Small, A. M. (1969). Processing auditory information: Interference from an irrelevant cue [Abstract]. *Journal of Applied Psychology, 53*(5), 433-435. doi: 10.1037/h0028034

Smolker, H. R., Depue, B. E., Reineberg, A. E., Orr, J. M., & Banich, M. T. (2015). Individual differences in regional prefrontal gray matter morphometry and fractional anisotropy are associated with different constructs of executive function. *Brain Structure and Functioning, 220*(3), 1291-1306. doi: 10.1007/s00429-014-0723-

Sobel, D. (2004). *Place-based education: Connecting classroom and community.* Retrieved from: http://www.antiochne.edu/wp-content/uploads/2012/08/pbexcerpt.pdf

Somerville, L. H., Hare, T., & Casey, B. J. (2011). Frontostriatal maturation predicts cognitive control failure to appetitive cues in adolescents. *Journal of Cognitive*

Neuroscience, 23(9), 2123-2134.

Stein, Z., & Fischer, K. W. (2011). Directions for Mind, Brain, and Education: Methods, Models, and Morality. *Educational Philosophy and Theory, 43*(1), 56-66. doi: 10.1111/j.1469-5812.2010.00708.x

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18*(6), 643-662.

Stout, D. (2010). The evolution of cognitive control. *Topics in Cognitive Science, 2*(4), 614-630. doi: 10.1111/j.1756-8765.2009.01078.x

Stuss, D.T., & Alexander, M.P. (2000). Executive functions and the frontal lobes: A conceptual view. *Psychological Research, 63*, 289-298.

Tashakkori, A., & Teddlie, C. (2010). Putting the human back in “human research methodology”: The researcher in mixed methods research. *Journal of Mixed Methods Research, 4*(4), 271-277. doi: 10.1177/1558689810382532

Tau, G.Z., & Peterson, B.S. (2010). Normal development of brain circuits. *Neuropsychopharmacology, 35,* 147-168. doi:10.1038/npp.2009.115

Titz, C., & Karbach, J. (2014). Working memory and executive functions: effects of training on academic achievement. *Psychological Research, 78*(6), 852-868. doi: 10.1007/s00426-013-0537-1

Triguero-Mas, M., Dadvand, P., Cirach, M., Martinez, D., Medina, A., Mompart, A., . . . Nieuwenhuijsen, M. J. (2015). Natural outdoor environments and mental and physical health: relationships and mechanisms. *Environment International, 77*, 35-41. doi: 10.1016/j.envint.2015.01.012

Turner, D. A. (2012). Education and neuroscience. *Contemporary social science, 7*(2), 167-179. doi: 10.1080/21582041.2012.692096

Wattchow, B., & Brown. M. (2011). *A pedagogy of place: outdoor education for a changing world.* Victoria, AUS.: Monash University Publishing.

Williams, F. (2017). *The nature fix: Why nature makes us happier, healthier, and more creative*. New York, NY: W.W. Norton & Company, Inc.

Wright, A., & Diamond, A. (2014). An effect of inhibitory load in children while keeping working memory load constant. *Frontiers in Psychology, 5*, 213. doi: 10.3389/fpsyg.2014.00213

Woodhouse, J., & Knapp, C. (2000). *Place-based curriculum and instruction*. (ERIC Document Reproduction Service No. EDO-RC-006).

Yuan, P., & Raz, N. (2014). Prefrontal cortex and executive functions in healthy adults: A meta-analysis of structural neuroimaging studies. *Neuroscience and Biobehavioral Reviews, 42*, 180-192. doi: 10.1016/j.neubiorev.2014.02.005

Van der Elst, W., Ouwehand, C., van der Werf, G., Kuyper, H., Lee, N., & Jolles, J. (2012). The Amsterdam Executive Function Inventory (AEFI): psychometric properties and demographically corrected normative data for adolescents aged between 15 and 18 years. *Journal of Clinical and Experimental Neuropsychology, 34*(2), 160-171. doi: 10.1080/13803395.2011.625353

van Tetering, M. A. J., & Jolles, J. (2017). Teacher Evaluations of Executive Functioning in Schoolchildren Aged 9-12 and the Influence of Age, Sex, Level of Parental Education. *Frontiers in Psychology, 8*, 481. doi: 10.3389/fpsyg.2017.00481

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press

Zaitchik, D., Iqbal, Y., & Carey, S. (2014). The effect of executive function on biological reasoning in young children: An individual differences study. *Child Development, 85*(1), 160-175. doi: 10.1111/cdev.12145

Zelazo, P.D., Blair, C.B., & Willoughby, M.T. (2016). Executive function: Implications for education. (NCER 2017-2000). Washington, DC: National Center for Education Research, Institute of Education Sciences, U.S. Department of Education. Retrieved from: http://ies.ed.gov/

Appendix A:

Amsterdam Executive Function Inventory

Please circle the appropriate response.

(1=not true; 2=partly true; 3=true)

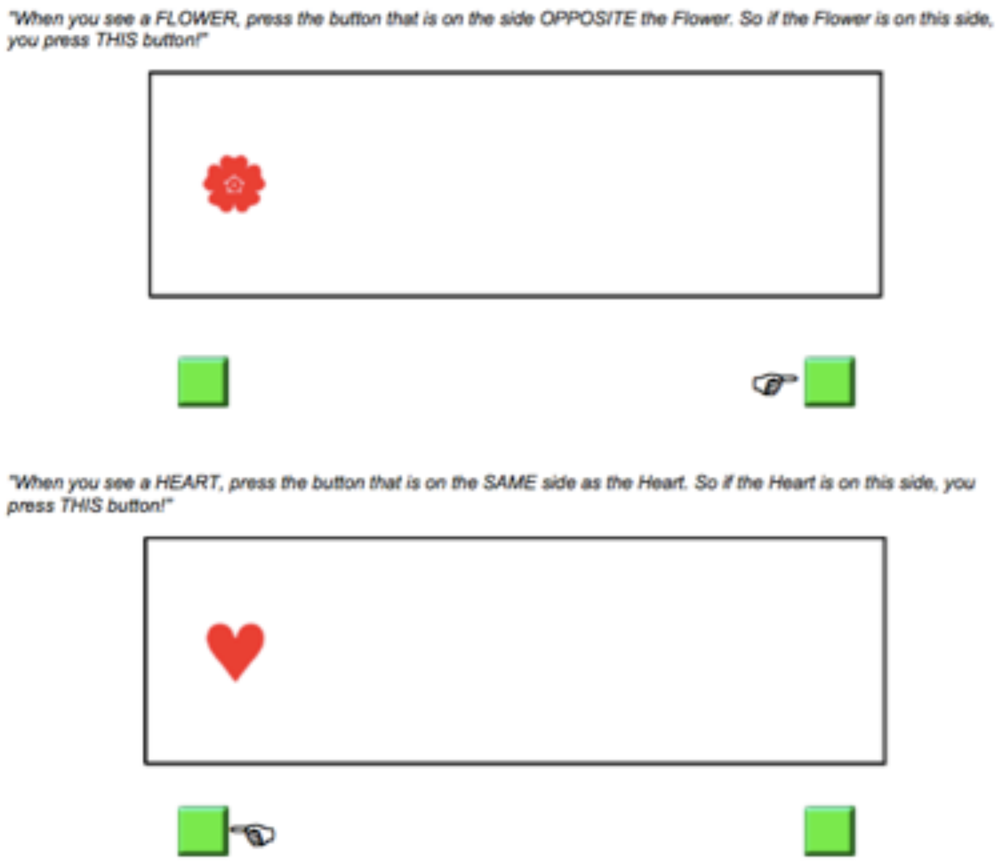
1. I am not able to focus on the same topic for a long period of time.	1 2 3
2. I can make fast decisions (e.g. in lessons).	1 2 3
3. I am well-organized. For example, I am good at planning what I need to do during a day.	1 2 3
4. I am easily distracted.	1 2 3
5. I often react too fast. I've done or said something before it is my turn.	1 2 3
6. My thoughts easily wander.	1 2 3
7. It is difficult for me to sit still.	1 2 3
8. It is easy for me to come up with a different solution if I get stuck when solving a problem.	1 2 3
9. I am full of new ideas.	1 2 3
10. It takes a lot of effort for me to remember things.	1 2 3
11. I often forget what I have done yesterday.	1 2 3
12. I often lose things.	1 2 3
13. I am curious, I want to know how things work.	1 2 3

Appendix B:

Overview of Computerized Tasks

Hearts and Flowers Task

*Note: This screenshot is from the training module of the task. The instructions at the top of each box are not present in the administration of the task.

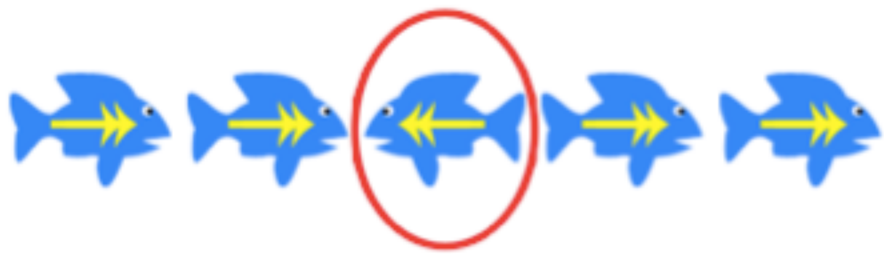


(D. Abbott, Personal Communication, May 3, 2017).

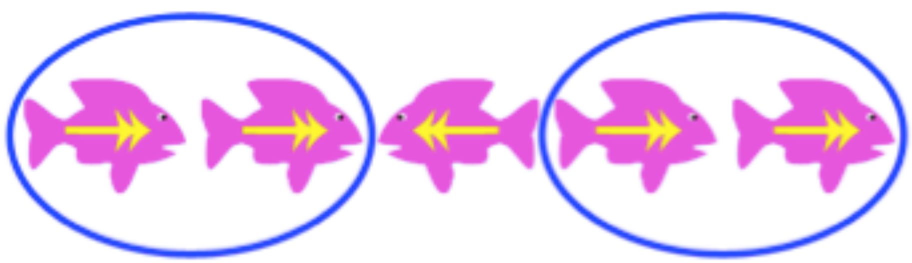
Flanker/Non-Flanker Task (screenshots)

* Note: The circles are not present in the test administration. They are present in these screenshots to illustrate which item the participant is required to attend.

1. Flanker Task: In this example, the participant is to attend to the central fish. Here, the fish is facing left, so the participant would respond on the left side.



2. Non-Flanker Task: In this example, the participant is to attend to the fish on either side of the central fish. These fish are facing right, so the participant should respond to the right side.



(D. Abbott, Personal Communication, May 3, 2017).

Appendix C:

Interview Questions

1. What types of activities do you and your family like to do out of doors?
2. What do you think the purpose is of our overnight trips at school?
3. How do you feel about our overnight trips? Do you enjoy them, or not?
4. Before you went to winter camp, what were you most excited about doing while you were there?
5. Did Winter Camp live up to your expectations?
6. What was your biggest success at Winter Camp? What is something that you are really proud of?
7. What was one of your biggest challenges at winter camp? Why was it challenging?
8. Looking back at camp, can you describe your strongest memory of camp? It can be a positive memory, or a non-positive memory, but something that really sticks out for you.
9. How easy do you find it to pay attention to a class discussion or lecture by your teacher? Why do you think that is?
10. Now, what about when you are outside, or on day trips? Is it easier or harder to pay attention to your teacher?
11. Do you think you behave differently on overnight trips than you do in the regular classroom? Why do you think that is?
12. Do you think your classmates behave differently on overnight trips than you do in the regular classroom? Why do you think that is?
13. Is there anything you'd like to add?

Appendix D:

Demographic Form

1. Birthday: ____________________________ (Day/Month/Year)

2. Sex: _____ Male ___ Female _____ Prefer Not To Say

3. What is the highest level of education achieved by your mother? (check one):

   _______ Did not complete High School
   _______ High School
   _______ Some college or university
   _______ Bachelor's Degree
   _______ Master's Degree
   _______ Advanced graduate work or PhD
   _______ Not Sure

4. What is the highest level of education achieved by your father? (check one):

   _______ Did not complete High School
   _______ High School
   _______ Some college or university
   _______ Bachelor's Degree
   _______ Master's Degree
   _______ Advanced graduate work or PhD
   _______ Not Sure

5. Have you been **diagnosed** with any of the following? Check all that apply:
   _______ Attention-Deficit Hyperactivity Disorder (ADHD)
   _______ Learning Disabilities in Reading and/or Writing
   _______ Learning Disabilities in Mathematics
   _______ Learning Disabilities in Processing Speed or Working Memory
   _______ Not Sure

6. Aside from your experiences with this school, how frequently do you engage in outdoor activities like camping, hiking, skiing, climbing, paddling, etc?
   _______ Often (More than 30 days in a year)
   _______ Frequently (13-29 days in a year)
   _______ Rarely (1 – 12 days in a year)
   _______ Never (only with school)