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The Benefits of Outdoor Education for Students with Attention-Deficit Hyperactivity Disorder

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In a world which is becoming increasingly dependent on technology, and the expected behaviors surrounding it (increased time indoors, more time sitting at desks, focusing on tasks which have no physical outcome), awareness and diagnoses of Attention Deficit Hyperactivity Disorder (ADHD) have skyrocketed. In fact, between 2003 and 2017, ADHD diagnoses in children in the United States have nearly doubled, with stimulant medication use increasing by 250% (CDC, 2022b; Piper et al, 2018). Despite the prevalence of medication use, there has not been an equal increase in the use of behavioral treatments. Among U.S. children receiving treatment, just under half were receiving any sort of behavioral treatment, while 62% were taking medication (CDC, 2022b). Though medication use remains the most popular treatment, there is nonetheless some dissatisfaction among physicians and patients alike (Hodgkins et al, 2013; Padhilla, 2018). In addition, the recent Adderall shortage and its consequences have highlighted the need for alternate forms of treatment independent of medication, which have long-lasting positive impacts. One setting where children in particular struggle, is school. Overall, children are spending the majority of their day indoors, asked to spend several hours focused on tasks related to school. While recess breaks are common (often 2 15-minute breaks in the morning and afternoon), they are not required and teachers have the option to withhold these breaks (Josh Newman, Representing School District 29, 2023). In addition, the increased use of technology in learning means that children are spending less time physically engaged in tasks, and sitting in front of a computer. In a survey of technology use in schools, 70% of surveyed teachers said that they use technology to a moderate or large extent for work normally done in classrooms, though only about a third said that it helped students to become more independent and self-directed

(Grey & Lewis, 2012). While our current methods of education have their advantages, an increasing number of children are struggling in this setting, those with ADHD in particular.

ADHD children often struggle the most in school settings, which can lead to serious long-term consequences. In fact, those with ADHD report a lower quality of life (QoL) than neurotypicals in almost all domains (Capp et al., 2022). Children in particular have trouble sitting still, paying attention when someone speaks, and are often forgetful. All of these tasks become more difficult as we ask and expect children to stay still and pay attention to tasks which require directed attention. With the increasing demands on schoolchildren, ADHD levels and medication have increased dramatically though long-term sustainable treatments are still severely lacking. It is clear that we need to explore solutions which carry long term benefits and have no life-long price tag or adverse effects. One promising systemic change that would benefit all children but especially those with ADHD, is outdoor education. Exposure to green space in a variety of settings has been shown to improve ADHD symptoms both in the short and long term, even being as effective as medication (Faber Taylor, Kuo and Sullivan 2001; Faber Taylor & Kuo, 2009; Faber Taylor & Kuo, 2011; Kuo & Faber Taylor, 2004). There has not, however, been a significant amount of research done on the benefits of nature for ADHD symptoms in school settings, a place where children spend a significant part of their lives and ADHD symptoms can pose significant challenges. There is, however, a multitude of research showing how outdoor education has an array of benefits on neurotypical children, many of these benefits being areas where children with ADHD could use the most help. I argue that we have the evidence to suggest that outdoor education would be immensely beneficial to those with ADHD, providing long-term solutions to symptoms independent of medication or behavioral treatment. In this context I am defining outdoor education as school conducted (even over short periods

such as an hour) in an outdoor setting with some amount of green space, whether it be a garden, or even an empty lot overgrown with grass. The lessons can be about the setting (like learning about gardens) or indoor curriculum moved outside; the emphasis is simply to expose children to any sort of green space outdoors in a school setting. While I argue that outdoor education would be particularly beneficial to those with ADHD, this solution would be beneficial to all children. Benefits of bringing outdoor education into school regularly shows benefits for all children, increasing self-efficacy, resilience, and helping to equalize outcomes (Ernst, Juckett & Sobel, 2021; Ernst, Sobel, & Neil, 2022) So long as children are able to get outside in a school setting, from as little time as an hour to as much as a whole day, from a grassy lot to a nature park, outdoor education provides long term benefits to both children with ADHD, and those without.

ADHD Overview and Statistics

ADHD is considered a psychological attention disorder seen primarily in children but in adults as well, affecting between five and ten percent of the population (CDC, 2022b). The disorder is typically categorized by a "persistent pattern of inattention and/or hyperactivity–impulsivity that interferes with functioning or development" as well as maturity delays in comparison with same-age peers (CDC, 2022c). While in the past, ADHD had one categorization, it is currently divided into three categories: predominantly hyperactive-impulsive, predominantly inattentive, and combined presentation. Those with predominantly inattentive presentation show symptoms such as easy distraction, making careless mistakes, and trouble listening. Those with hyperactive presentation (the more traditional symptoms) show symptoms such as fidgeting, interrupting others, and having excessive amounts of energy. Combined presentation is for those who show symptoms of both inattentive and hyperactive presentations (CDC, 2022c). Those diagnosed with ADHD often show difficulties in school and trouble in

social interactions, which is often a key factor in leading to a diagnosis (CDC, 2022c). Although ADHD is an incredibly common disorder, it was only officially categorized within the last half-century.

Within this century, ADHD has become a household name and omnipresent throughout our culture. Despite its prevalence, the disorder was seen to only affect children and was not officially characterized by the Diagnostic and Statistical Manual of Mental Disorders (DSM) until 1968, as Hyperkinetic reaction of childhood (Lange et al., 2010). This disorder, seen as the precursor to our idea of ADHD was characterized as Attention Deficit Disorder (ADD) by the third edition of the DSM, and again as ADHD by 1987, in the revision of the third edition. (Lange et al.). There is some evidence to suggest that similar disorders have been described in literature as early as the late 18th century, although the descriptions are vague and don't present enough evidence to say with certainty that the behavior described would be attributed to our modern notion of ADHD (Lange et al.). It was not, however, until the publication of the fifth edition of the DSM that ADHD became a diagnosis applicable to the adult population. The appearance of ADHD (including Hyperkinetic reaction of childhood and ADD), also coincides with the marketing of methylphenidate in the mid 1950's, used initially to treat depression, lethargy and psychosis (Lange et al.). Methylphenidate, as well as other pharmaceuticals have now become a primary treatment of ADHD in both children and adults. One distinct change over time, is that since its categorization in the DSM in 1968, the criteria that must be met to diagnose ADHD has become consistently less specific. For example, between the DSM-IV and the current DSM-V, the list of possible symptoms has increased, the necessary age of onset increased from 7 to 12 years of age (meaning that ADHD symptoms no longer have to be present in early-mid childhood to receive a diagnosis), and the number of required symptoms to have a

diagnosis decreased from six to five (Epstein & Loren, 2014). The decreasing necessary criteria parallels the increase in overall diagnoses within this century. This trend certainly reflects our awareness and education on the disorder, but it may also reflect changing expectations of both children and adults within our culture.

Not only have the DSM criteria become less specific, the validity and reliability of the manual itself have been heavily criticized.Thomas Insel, former chair of the National Institute of Mental Health (NIMH) noted that because of the lack of relationship between biomarkers and DSM categories of mental disorders "NIMH will be reorienting its research away from DSM categories," (2012). He also criticizes the DSM's validity in his book, *Healing: Our Path from Mental Illness to Mental Health* stating that "The *DSM* had created a common language, but much of that language had not been validated by science" (Insel, 2022, p.130). Chair of the DSM-IV task force Allen Frances scathingly criticized the results from the DSM-V field trials, claiming the authors were misleading about the results by lowering the standards for what they consider "good" or "very good" reliability (Frances, 2012). These criticisms call into question the validity and reliability of the DSM-V categories, which suggests a need for the general public to shift focus away from DSM categories, and toward supporting the overall well-being of both children and adults. By shifting a focus from mental disorders to mental health, we take a healing approach which focuses on promoting well-being and equalizing outcomes as opposed to simply addressing symptoms. This shift away from DSM categories and toward mental health promotion is essential for finding new and creative ways to support children with ADHD.

According to the CDC (2022b), 9.8% of U.S. children between the ages of three and seventeen have been diagnosed with ADHD. Among those children, 77% were being treated, with about equal numbers being treated with medication and behavioral treatment and

medication alone (32% and 30% respectively), with 15% being treated with behavioral treatment alone (CDC, 2022b). The estimated lifetime prevalence of adults with ADHD is slightly less, at 8.1% (National Institute of Mental Health). Though diagnoses within the United States have increased by 140% since 2003, medication use has increased by 250% in this same timespan (Piper et al., 2018). The primary medications include slow and fast-acting methylphenidate (such as Ritalin) and amphetamines (such as Adderall) (Piper et al.). These statistics, however, don't necessarily reflect international trends.

The estimated worldwide prevalence is lower, at 7.2% for children under 18 and as low as 3.4% for adults (CHADD, 2023). There is significant variability among countries, with countries such as Finland reporting prevalence child and adolescent rates between 4 and 8% (University of Helsinki, 2016). However, European treatment trends do reflect those of the U.S. with mainland Europe favoring medication alone over behavioral therapy (BT) alone or a combo of the two (Hodgkins et al., 2013). Despite medication being the primary treatment, physicians overall don’t seem to be satisfied with current treatment outcomes (Hodgkins et al.). In addition, there have been concerns with the safety of medication as well as low agreement between teachers and physicians, which calls into concern the accuracy of diagnoses (European Medicines Agency, 2019; Molina et al., 1998).

Despite medication being the primary treatment of ADHD, there is nonetheless a growing desire to find adequate non-pharmaceutical treatments (Padhilla, 2018). Physicians and patients alike often show dissatisfaction with treatment results. In one study of ADHD treatment across Europe, less than a third of physicians reported full satisfaction with their treatments (Hodgkins et al., 2013). In addition, long-term safety and satisfaction with medication has been called into question (European Medicines Agency, 2019; Padhilla). Even with the scrutiny, many children

are taking medication without accompanying behavioral therapy. In the U.S., only half of children taking medication were also receiving behavioral therapy (CDC, 2022b). Of these children, 18% were age five or younger despite the American Academy of Pediatrics (AAP) recommending behavior therapy for children under 6 (CDC, 2022b). While medication remains the most popular treatment, it comes with many drawbacks. Medication may be beyond the price range of families, may produce undesirable side effects, and only provides benefits while one is actively taking medication. In contrast, behavior therapy provides coping mechanisms and skills development, which can be beneficial throughout the lifespan. In Padhila's (2018) study, around one third of participants who tried medication showed strong undesirable effects, or the medication had no effect at all. As more children and adults are being diagnosed, it is clear that more effective and long-lasting behavioral treatments are needed. Given the nature of the disorder, it's clear that traditional methods of therapy may not be effective. Long-term, creative solutions need to be researched and implemented.

Green space exposure for ADHD

One treatment currently showing short and long-term promise with no side-effects and no economic commitment is time spent in green space. Activities as simple as looking out a window with trees as opposed to houses can improve focus and well-being, at least in neurotypical participants (NT) (Kaplan, 1995). Stephen Kaplan draws from William James' Attention Restoration Theory (ART) as a potential mechanism to explain the restorative benefit of green spaces. In his 1995 study, Kaplan stated that there are two main sources of attention: involuntary effortless attention, and directed attention. Directed attention (such as concentration on a specific task) is susceptible to fatigue, and can be restored by activities (like spending time in nature) that only require involuntary attention. Researchers Andrea Faber Taylor and Frances Kuo suggested

the same mechanisms may help those with ADHD, finding evidence to suggest that time spent in green spaces may serve as a protective and restorative factor against ADHD symptoms (Faber Taylor, Kuo and Sullivan 2001; Faber Taylor & Kuo, 2009; Faber Taylor & Kuo, 2011; Kuo & Faber Taylor, 2004).

These studies suggested that time spent in green space (such as fields, parks or other natural spaces where nature dominates over built structures) can aid in reducing hallmark ADHD symptoms such as impulsivity and inattention, both in the short and long-term. Kuo (2004) found that these benefits hold regardless of age, gender, income, geographic location, and diagnosis (inattentive, hyperactive, or combined). The reduction in inattention and impulsivity symptoms have been demonstrated across various settings and activities, such as walking, in play spaces, and during after school and weekend activities (Faber Taylor, Kuo and Sullivan 2001; Faber Taylor & Kuo, 2009; Faber Taylor & Kuo, 2011; Kuo & Faber Taylor, 2004). Despite the promising evidence for the benefit of green space exposure in ADHD kids, studies have yet to be conducted in formal academic spaces for the ADHD population. There is, however, an abundance of studies suggesting the benefits of education conducted in green spaces within NT children. While these studies are not directly focused on children with ADHD, many of the suggested benefits are within areas where ADHD children need the most help. In addition, the studies reviewed below within the NT population did not screen for conditions such as ADHD, indicating that there likely were students with ADHD based on rates in the general population . This implies that the benefits we see in outdoor education would most likely extend to ADHD students. Between the benefits shown in ADHD children in a variety of green settings, and the studies on outdoor education, it is highly likely that outdoor education would be a promising support for students with ADHD.

Benefits of Outdoor Education and their Connection to ADHD Symptoms

Outdoor education, whether simply class conducted outside or lessons specifically designed for the outdoor setting, has shown a wide array of benefits for the children involved. While these studies were conducted within the neurotypical population, or at least without identification of students with ADHD, the outcomes found are the same ones that ADHD children would benefit from, in areas where they struggle the most. Studies on both green space exposure and outdoor education suggest benefits for improving attention, impulsivity, executive function, and self-efficacy: realms where ADHD children need the most help. Together, these studies build a strong case highlighting the potential positive benefits of outdoor education for all children, ADHD children in particular.

Attention and Impulsivity

Difficulty sustaining attention and impulsive behavior are hallmark symptoms of ADHD, which have detrimental effects in school settings where directed attention and delayed gratification are required for long stretches. Studies on Outdoor education with ADHD children are minimal. Studies have, however, been conducted that demonstrate a positive correlation between green space exposure and directed attention with ADHD children in non-academic settings. Andrea Faber-Taylor and Frances Kuo have pioneered this research, demonstrating that ADHD children showed better sustained attention after exposure to green play, a walk in the park, and simply being in green spaces (Faber-Taylor, Kuo & Sullivan, 2001; Faber Taylor & Kuo, 2009: Faber Taylor & Kuo, 2011; Kuo & Faber Taylor, 2004). Although these studies did not evaluate outdoor education specifically, green space exposure is inherent to outdoor education, which suggests this benefit would apply to any setting involving exposure to green space.

A notable study done within the NT population shows that outdoor and blended preschools are associated with stronger self regulation among preschool children, an area of distinct difficulty for those with ADHD (Ernst, Juckett, & Sobel, 2021). Not only did the results suggest benefits in self-regulation, Ernst et al. (2021) demonstrated that nature integrated into preschool classrooms promoted resilience and protective factors against anxiety, depression, and other mental health challenges. Given the struggles ADHD children often have with impulsivity, settings which inherently promote self-regulation skills from a young age are vital in supporting their healthy development, and should by no means be looked at as anything less than essential.

Not only do these studies suggest benefits in attention and self-regulation, they suggest benefits in overall ADHD symptoms. These studies combined with others on outdoor education suggest that green space exposure in an educational setting could help reduce symptoms and increase well-being for ADHD students.

Executive function

ADHD is seen as a disorder of executive function, and green space exposure and outdoor education suggest boosts in executive functioning (Ernst, Sobel, & Niel, 2022; Koepp et al., 2022). While these studies were conducted among the NT population, given the benefits demonstrated in several other green settings there is no reason to believe this benefit would not apply to ADHD children. Julie Ernst, David Sobel, and Ahna Niel (2022) explored nature-based practices in preschools and their relationship to executive functioning. They found that at the end of the school year, students who attended nature-based and blended schools showed greater executive functioning abilities than those who attended traditional schools. Deficits in executive functioning can have a negative cascade on several other aspects of life. ADHD children and adults often rank low on quality of life assessments in physical, psychological and environmental

health, with some researchers indicating executive functioning as a potential factor (Capp et al., 2022). Executive functioning deficits can lead to difficulties such as maintaining a home, maintaining employment, or managing money. A main reason for Ernst's study was to find long-term, sustainable ways to equalize outcomes for those in situations where executive function is diminished (low socioeconomic status in particular). While the study did not focus on ADHD children in particular, they are a population which also suffer from executive function challenges and need the equalizing outcomes of nature-based and blended school settings. Koepp et al. (2022) examined preschool children's executive function in circle time immediately following either indoor or outdoor free play. They found that the increase in executive function following outdoor free play was significant when children were physically active. While the statistical difference was not in outdoor exposure alone, education and play in an outdoor environment may allow for the physical activity necessary for children to self-regulate in subsequent classroom settings. The movement that outdoor education can provide is essential for ADHD students, especially those with hyperactive and combined presentations.

Hyperactivity

While not directly related to outdoor school, benefits shown from physical activity which is also inherent in outdoor and nature-based education should not be overlooked. For those who show hyperactive or combined presentation ADHD, the struggle sitting still in traditional classrooms is equally aggravating for students and teachers alike. With the lack of confined spaces, chairs and desks, outdoor education promotes physical activity and movement both in planned lessons and the environment itself. Whether simply walking to an outdoor location for a lesson, or teaching practices such as gardening, physical activity will be higher than it would in a traditional classroom setting which is absolutely vital for those with symptoms of hyperactivity.

Research suggests that while physical activity is associated with positive affect (mood/thoughts) for all participants including NT and inattentive presentation, the effects are the most impactful for those who are considered hyperactive (Koch et al., 2022). Elena Koch (2022) in particular examined overall physical activity through a typical day (from waking up to going to bed), to see the impact of physical activity on both positive and negative affect. This effect was strong enough to be significantly higher within combined/hyperactive ADHD participants than those with no ADHD or inattentive ADHD (Koch et al., 2022). In addition, for those with hyperactive or combined presentation, the inverse relationship is also true. When activity decreases, there is also a significant decrease in positive affect. These results suggest that regular physical activity is essential in regulating hyperactivity and affect. Koch et al. (2022) even suggested that integrating movement and physical activity into classrooms is beneficial to those with ADHD. In order to maintain the movement necessary to regulate hyperactivity and positive affect for ADHD students, we must integrate movement into the classroom which is inherent in class conducted outside. An important factor not to be overlooked in this study is that the benefit from movement was significant for *everyone*, but was doubly beneficial for those with ADHD (Koch et al., 2022).

Self-Determination and Well-being

Self-determination theory may be the most direct and impactful benefit from outdoor education for ADHD students. In short, Self-Determination Theory (SDT) highlights the importance of feelings of competence, relatedness and autonomy on well-being and performance. When these feelings are fostered, they promote success through self-esteem and intrinsic motivation (Connell & Wellborn, 1991). Essentially one succeeds because of internal factors, one's success is therefore self-determined. Students with ADHD often struggle both in

and out of school, and suffer from comorbid disorders such as anxiety and depression (CDC, 2022c). Numerous studies have examined the relationship between ADHD and Quality of Life (QoL), showing particular struggles in mental health (Capp et al. 2022; Krauss & Schellenberg, 2022). These studies consistently demonstrate that those with ADHD experience a lower QoL than their typically developing peers from childhood through adulthood, suggesting a need for help to equalize outcomes for ADHD children. The struggle that ADHD children experience in school is certainly detrimental to mental health, negatively impacting implicit ideas about competence, relatedness, and autonomy. If a student with ADHD struggles to succeed in a setting where other children may be, or needs extra help, this could be detrimental to feelings of competence and autonomy. We must therefore find flexible solutions where ADHD childrens' sense of self-efficacy is fostered, which would act as a protective factor independent of medication or behavioral interventions. Costello, Stone & The College of William and Mary (2012) found exactly this among college students. When positive psychology was used to increase self-efficacy (closely related to SDT), students with ADHD and other learning disabilities had greater success in school (Costello et al., 2012). By fostering feelings of self-efficacy and creating a positive learning environment, students with ADHD were particularly successful (Costello et al., 2012). This study suggests that by nurturing a sense of self-efficacy, these students may be able to better manage their coursework and be more successful in university settings. With the messages ADHD children receive regarding troubles with school, families, and social dynamics it comes as no surprise that ADHD children often suffer from low-self esteem, anxiety, depression, and other mental struggles (Capp et al., 2022; CDC, 2022c). Self-efficacy may therefore act as a protective factor against these external

messages, letting ADHD children use their own internal motivation and positive self-beliefs to succeed both in and out of school.

Ellen Skinner and the Learning Gardens Laboratory of Portland State found that in outdoor garden-based education, intrinsic motivation and engagement were essential ingredients (Skinner, Chi & The Learning-Gardens Educational Assessment Group 1, 2012). The group used the SDT model to measure success from both the student and teacher perspective, looking at perceived competence, autonomy and engagement. Skinner noted that in the gardens, there were high levels of engagement, which in turn promoted self-efficacy and autonomy. A notable feature of this study is that success was measured from the perspective of students, placing emphasis on how the students themselves felt in the gardens. Ultimately, there was a positive relationship between the students' perceived autonomy and engagement and their perceived success by teachers (Skinner et al., 2012). Skinner's study indicated that outdoor education promotes the essential qualities of SDT (competence, autonomy, and relatedness), which are essential in supporting those with ADHD. Outdoor education is therefore a way to naturally support the success and well-being of both NT and ADHD students.

Researchers Julie Ernst, Hannah Juckett and David Sobel found that outdoor school (at least in a preschool setting) provided similar protective factors and increased resilience (Ernst, Juckett & Sobel 2021; Ernst, Sobel, & Niel (2022). Again, given the struggles ADHD children often have with school and mood disorders, increasing resilience is an essential factor in helping them equalize outcomes and well-being. Ernst et al. (2022) conducted a study examining traditional, blended, and nature based preschools and their effect on three factors that impact resilience: initiative, self-regulation, and attachment. They found that nature-based and blended preschools had a significant impact on increasing these protective factors, although the difference

between nature-based and blended schools was not significant, suggesting that the impact lies within the difference between no-nature and some nature. One notable finding was that these factors were still significant when controlling for family nature exposure (how much time kids spend outdoors outside of school), suggesting that it is the outdoor exposure within the school context that contributes to increasing resilience. Initiative and self-regulation are within the realms of intrinsic motivation and self-efficacy examined previously, suggesting that these protective factors would be particularly beneficial to ADHD students.

Along with Ernst, Sobel & Neil's study examining how outdoor preschools boost executive function, ultimately helping equalize outcomes across a range of students, these researchers provide evidence that outdoor schooling could help to equalize outcomes and create protective factors which would benefit ADHD students in and out of school (Ernst et al, 2021; Ernst et al, 2022).

Limitations and Future Directions

Despite the promise of outdoor education for children with ADHD, there are limitations. A notable limitation which can be addressed through future research is that experimental studies on ADHD symptoms and outdoor education have yet to be conducted. While it is extremely likely that outdoor education will benefit those with ADHD, we do not yet have the evidence to suggest a causal relationship. This indicates that we must create and conduct studies which specifically examine how ADHD students function within outdoor education settings. A second limitation is the practicality of integrating outdoor education into school curriculum. The burden on teachers in the United States is high, with teachers working an average of 46 hours per week (Camera, 2019). Changing curriculum to integrate outdoor education could potentially add to the burden teachers carry, contributing to teacher burnout. To address this, we must push toward

funding education and providing resources for teachers to help create an educational environment which benefits both the students and teachers. Along with creating studies to provide empirical evidence for the benefits of outdoor education, we must continue to push for policy change and funding opportunities for outdoor education, whether it be school gardens or trips to the local park. A third and major limitation is the focus of these studies on non productivity-related deficits of ADHD. Studies whose benefits do not demonstrate measurable productivity or economic benefits can be difficult to justify to both publishers and policy makers. Common ADHD symptoms are often based on productivity and conformity, such as fidgeting, talking excessively, and having trouble focusing through class lessons (CDC, 2022c). In addition, ADHD is often diagnosed as a result of having trouble in school (often through poor grades and test scores). While comorbid disorders such as anxiety and depression are mentioned as common in those with ADHD, diagnosis and treatment rarely focus on the subjective experience and overall well-being of the patient themselves. While these are immensely important and under-regarded factors in helping children with ADHD, the focus of these studies on subjective-well being and self-determination may make it difficult to justify future studies being done, and policies being changed. Though benefits in the subjective well-being and engagement of ADHD and NT students alike should be enough to justify research in support of outdoor education, we must nonetheless design studies to demonstrate the objective success and tangible benefits of outdoor education to justify policy change. For example, studies could be conducted on the impact of outdoor education on ADHD students' test scores or to see whether the positive impacts from outdoor education extend to benefits in future employment and job success. By creating studies which demonstrate objective "success," it is more likely that the benefit of outdoor education on ADHD students will be taken seriously. While there are limitations in this

examination of current research, each of the limitations can be addressed and corrected through future research.

Conclusion

School has become increasingly sedentary and technology-focused and diagnoses of ADHD have doubled, with medication use seeing an even greater increase. While medication use has been the primary treatment for children and adults, it is expensive, there is a risk of addiction, and can come with adverse effects as well as providing no benefits when medication use has stopped (Padhila, 2018). The recent adderall shortage has emphasized these issues, highlighting the need for solutions which have no life-long price tag or side effects, and have long-term benefits. School settings in particular are in need of changes which help not only those with ADHD, but are beneficial to all children. Green space exposure through outdoor education provides a sustainable solution to these problems. While researchers Andrea Faber Taylor and Frances Kuo have provided a wealth of evidence suggesting the benefits of green space exposure for ADHD children, there are relatively few studies that explore the relationship between green space and ADHD symptoms in school settings. There are, however, a multitude of studies showing that for each area where ADHD children struggle, there is evidence to suggest that outdoor education can address these needs. From preschool through college, studies suggest that outdoor education provides benefits to attention, impulsivity, executive function, hyperactivity, motivation, resilience and well-being. Outdoor education requires no new technology which would need maintenance, has no side effects, can provide tangible connections to curriculum, and holds benefits in spaces as simple as an abandoned grassy lot, to nature trails. While one could spend significant amounts of money traveling to nature preserves, we see benefits in settings such as the nearest park which require only a few minutes of our time, and no entry fee.

Not only does outdoor education provide benefits to those with ADHD, it benefits all children, helping to equalize outcomes and promote self-determination, independence, resilience, and well-being in the long-term. Given that at least six million children throughout the U.S. are currently struggling with ADHD, and the low satisfaction amongst patients, parents and physicians with the quality of treatment, it is absolutely essential that we bring children back outdoors and implement the systematic changes needed to help them not only to cope but to thrive (CDC, 2022a).

Works Cited

Camera, L. (2019, June 19). *International survey: teachers overworked, feel underappreciated*. U.S. News. https://www.usnews.com/news/education-news/articles/2019-06-19/international-survey-us-teachers-are-overworked-feel-underappreciated

Capp, S. J., Agnew-Blais, J., Lau-Zhu, A., Colvert, E., Tye, C., Aydin, Ü., Lautaresu, A., Ellis, C., Saunders, T., O'Brien, L., Ronald, A., Happé, F., McLoughlin, G. (2022). Is quality of life related to high autistic traits, high adhd traits and their interaction? evidence from a young-adult community-based twin sample. *Journal of Autism and Developmental Disorders 52*(7). https://doi.org/10.1007/s10803-022-05640-w

Centers for Disease Control and Prevention. (2022a, August 9). *ADHD Treatment Recommendations.* Attention-Deficit/ Hyperactivity Disorder (ADHD). https://www.cdc.gov/ncbddd/adhd/guidelines.html

Centers for Disease Control and Prevention. (2022b, August 9). *Data and Statistics about ADHD.* Attention-Deficit/ Hyperactivity Disorder (ADHD). https://www.cdc.gov/ncbddd/adhd/data.html

Centers for Disease Control and Prevention. (2022c, August 9). *Symptoms and Diagnosis of ADHD.* Attention-Deficit/ Hyperactivity Disorder (ADHD). https://www.cdc.gov/ncbddd/adhd/diagnosis.html

CHADD. (2023). *General Prevalence of ADHD*. About ADHD. https://chadd.org/about-adhd/general-prevalence/

Connell, J. P., & Wellborn, J. G. (1991). Competence, autonomy, and relatedness: A motivational analysis of self-system processes. In M. R. Gunnar, & L. A. Sroufe (Eds.), *Self processes*

and development; self processes and development (pp. 43-77, Chapter xi, 268 Pages) Lawrence Erlbaum Associates, Inc, Hillsdale, NJ.

Costello, C. A., Stone, S. L. M., & The College of William and Mary (2012). Positive psychology and self-efficacy: potential benefits for college students with attention deficit hyperactivity disorder and learning disabilities. *Journal of Postsecondary Education and Disability, 25*(2). 119-129.

Ernst, J., Juckett, H., & Sobel, D. (2021). Comparing the impact of nature, blended, and traditional preschools on children's resilience: Some nature may be better than none. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.724340

Ernst, J., Sobel, D., & Neil, A. (2022). Executive function in early childhood: Harnessing the potential of nature-based practices to elevate and equalize outcomes. *Frontiers in Education*, *7*. doi:10.3389/feduc.2022.1011912

Epstein, J. & Loren, R. (2014). Changes in the Definition of ADHD in DSM-5: Subtle but Important. *Neuropsychiatry (London), 3*(5). Doi: 10.2217/npy.13.59

European Medicines Agency. (2019, November 15). *Questions and Answers on the Review of Medicines Containing Methylphenidate* [Press release]. https://www.ema.europa.eu/en/medicines/human/referrals/methylphenidate

Faber Taylor, A., Butts-Wilmsmeyer, C., Jordan, C. (2022). Nature-based instruction for science learning – a good fit for all: A controlled comparison of classroom versus nature. *Environmental Education Research, 28*(3), 1-20. Doi: 10.1080/13504622.2022.2076811

Faber Taylor, A., Kuo, F. E., & Sullivan, W. C. (2001). Coping with ADD: The surprising connection to green play settings. *Environment and behavior*, *33*(1), 54-77. Doi: 10.1177/00139160121972864

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

Faber Taylor, A., & Kuo, F. E. (2011). Could exposure to everyday green spaces help treat ADHD? Evidence from children's play settings. *Applied Psychology: Health and Well‐Being*, *3*(3), 281-303. doi: 10.1111/j.1758-0854.2011.01052

Frances, A. (2012, October 30). *DSM 5 filed trials discredit APA*. Psychology Today. https://www.psychologytoday.com/us/blog/dsm5-in-distress/201210/dsm-5-field-trials-discredit-apa

Grey, L. & Lewis, L. (2021). *Use of education technology for instruction in public schools: 2019-2020* [Brochure]. United States: U.S. Department of Education.

Hodgkins, P., Setyawan, J., Mitra, D., Davis, K., Quintero, J., Fridman, M., Shaw, M., Harpin, V. (2013). Management of ADHD in children across Europe: patient demographics, physician characteristics, and treatment patterns. *European Journal of Pediatrics, 172*(7), 895-906. Doi: 10.1016/j.biopsych.2019.04.009

Insel, T. (2012, April 29). *Transforming Diagnosis*. National Institute of Mental Health. https://psychrights.org/2013/130429NIMHTransformingDiagnosis.htm

Insel, T. (2022). H*ealing: Our Path from Mental Illness to Mental Health*. Penguin Press.

Josh Newman, Representing School District 29. (2023, February 2). *New Legislation Would Guarantee Daily Recess For All California Students K-8* [Press Release].

https://sd29.senate.ca.gov/news/press-release/new-legislation-would-guarantee-daily-recess-all-california-students-k-8#:~:text=Unlike%20other%20states%20which%20have,recess%20time%20in%20its%20schools

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15*(3), 169-182. doi:10.1016/0272-4944(95)90001-2

Koch, E. D., Freitag, C. M., Mayer, J.S., Medda, J., Rief, A., Grimm, O., … Ebner-Priemer, U. W. (2022). The dynamical association between physical activity and affect in the daily life of individuals with ADHD. *European Neuropsychopharmacology, 57*, 69-74. https://doi.org/10.1016/j.euroneuro.2022.01.110

Koepp, A., Gershoff, E. T., Castelli, D., Bryan, A. (2022). Preschoolers' Executive Functions Following Indoor and Outdoor Free Play. *Trends in Neuroscience and Education, 28*(1). doi:10.1016/j.tine.2022.100182

Krauss, A., & Schellenberg, C. (2022). ADHD symptoms and health-related quality of life of adolescents and young adults. *European Journal of Health Psychology 29*(4)*,* 165-209. https://doi.org/10.1027/2512-8442/a000104

Kuo, M., Browning, M. H., & Penner, M. L. (2018). Do lessons in nature boost subsequent classroom engagement? Refueling students in flight. *Frontiers in psychology*, *8*, 2253. Doi: 10.3389/fpsyg.2017.02253

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. Doi: 10.2105/ajph.94.9.1580

Lange, K.W., Reichl, S., Lange, K., Tucha, L., & Tucha, O. (2010). The history of attention deficit hyperactivity disorder. *ADHD Attention Deficit and Hyperactivity Disorders (2)*4, 241-255. Doi: 10.1007/s12402-010-0045-8

Molina, B. S. G., Pelham, W. E., Blumenthal, J., & Galiszewski, E. (1998). Agreement among teachers' behavior ratings of adolescents with a childhood history of attention deficit hyperactivity disorder. *Journal of Clinical Child Psychology*, *27*(3), 330–339. Doi: 10.1207/s15374424jccp2703_9

National Institute of Mental Health. (n.d.). *Attention-Deficit/ Hyperactivity Disorder (ADHD)*. Attention-Deficit/ Hyperactivity Disorder (ADHD). https://www.nimh.nih.gov/health/statistics/attention-deficit-hyperactivity-disorder-adhd#part_2554

Padilha, S. (2018). Efficacy and safety of drugs for attention deficit hyperactivity disorder in children and adolescents: A network meta-analysis. *European Child & Adolescent Psychiatry., 27*(10), 1335. doi: 10.1007/s00787-018-1125-0

Piper, B. J., Ogden, C. L., Simoyan, O. M., Chung, D. Y., Caggiano, J. F., Nichols, S. D., & McCall, K. L. (2018). Trends in use of prescription stimulants in the United States and Territories, 2006 to 2016. *PLOS ONE*, *13*(11), 1–15. https://doi.org/10.1371/journal.pone.0206100

Skinner, E. A., Chi, U., & The Learning-Gardens Educational Assessment Group 1. (2012). Intrinsic motivation and engagement as “active ingredients” in garden-based education: Examining models and measures derived from self-determination theory. *The Journal of Environmental Education*, *43*(1), 16-36. doi: 10.1080/00958964.2011.596856

University of Helsinki. (2016, August 30). *Understanding ADHD.* News and Press Releases. https://www.helsinki.fi/en/news/education/understanding-adhd