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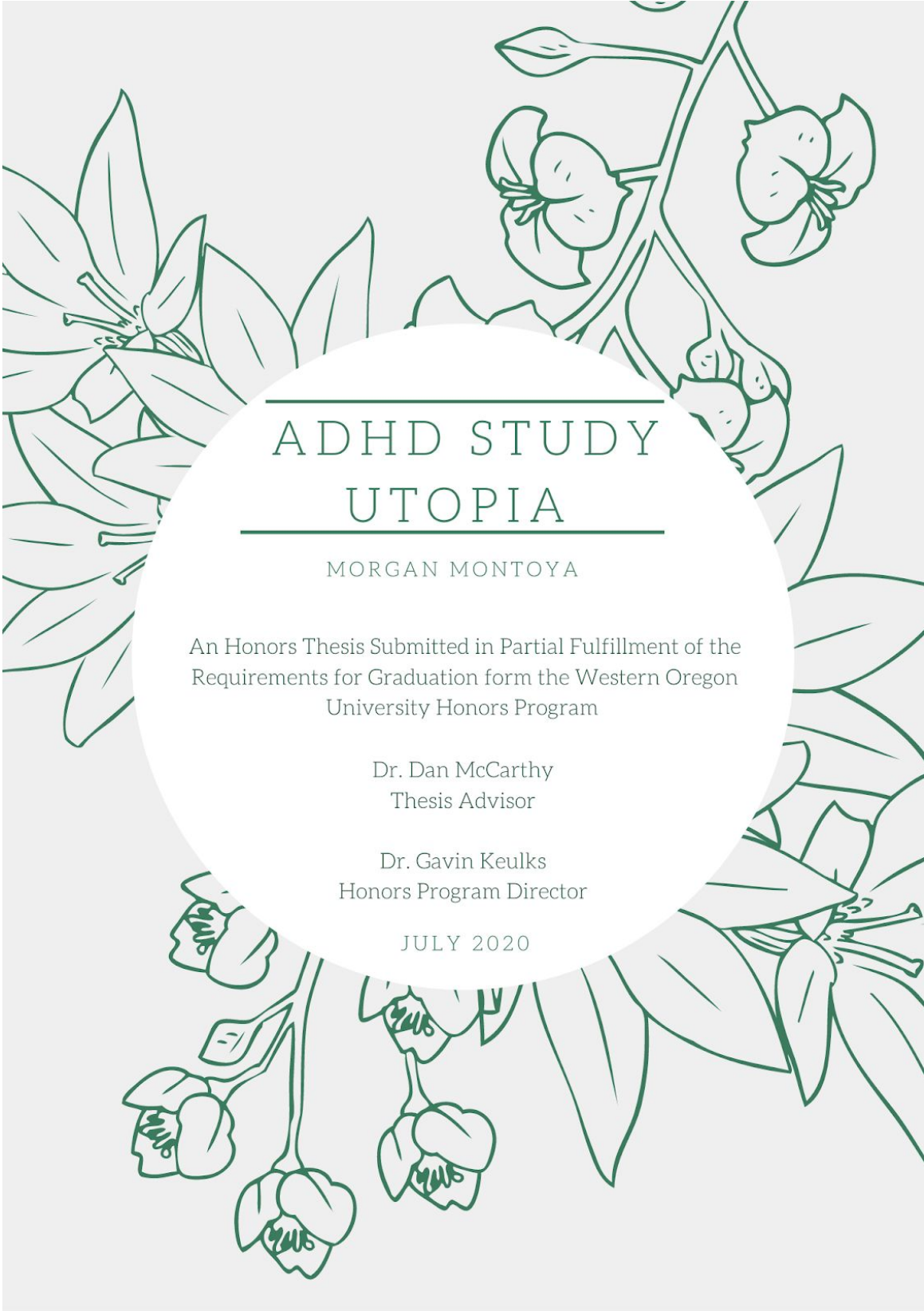
Summer 2020

**ADHD Study Utopia**

Morgan Montoya

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# ADHD STUDY UTOPIA

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MORGAN MONTOYA

An Honors Thesis Submitted in Partial Fulfillment of the  
Requirements for Graduation from the Western Oregon  
University Honors Program

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## Abstract

This thesis describes how educators and students alike can physically alter a learning environment to increase attention of students with ADHD. Attention deficit hyperactive disorder is a brain disorder in which there is a pattern of inattention and or hyperactivity and impulsivity that interferes with functioning. These symptoms frequently present themselves in childhood and continue into adulthood.

Despite ADHD often being a lifelong disorder, the majority of research done to understand and support those with ADHD is focused on elementary-aged children. By focusing on such a young group, research has neglected students in high school and college who would be in greater need of learning strategies, symptom regulation, as well as environment and time management. Additionally, few studies are directed for adults with ADHD to manage their own behavior and symptoms.

The goal of this thesis is to provide practical environment interventions to create a functional study environment that promotes attention. To accomplish this, various research has been compiled on environment factors that affect attention, productivity, and physical health. The research addressed symptoms of ADHD, how those symptoms affect school performance, and how teenagers and adults with ADHD are in need of solutions/ interventions to increase attention. To spread awareness of issues faced and solutions, compiled research was applied to create a utopian study environment for college students with ADHD.

## Introduction

Higher education continues to require more work outside of the classroom despite the increased demands of everyday life. For a student in today's world, the ability to succeed in school demands both a great deal of focus and the ability to divide attention between a wealth of important tasks. To cope, students often flock to a standard bare library space with simple furniture and fluorescent lighting; however, research indicates that such study spaces may not be best when it comes to focusing attention (Zentall, 1983). The study of individual differences has seen a recent boom in the field of Psychology, seeking to no longer define performance by the average, but rather capture the variability and nuance of humans as a whole. This consideration is paramount not only to neurotypicals, but, especially individuals with cognitive deficits such as Attention Deficit Hyperactivity Disorder (ADHD).

Attention Deficit Hyperactive Disorder (ADHD) is a brain disorder set apart by a continuous presence of inattention and or hyperactivity-impulsivity that impedes growth or functioning (The National Institute of Mental Health). Common symptoms include trouble with organization, forgetfulness, restlessness, impulsive behavior, trouble starting and finishing tasks, along with being easily distracted. Despite the fact that these symptoms conflict with the demands and independence of college, few researchers have studied how to help college students with ADHD succeed. Instead, previous research has fixated on primary school aged children and ways *parents* can help their child, or *teachers* can help the child focus in the classroom.

The environment someone studies in can have a substantial effect on attention and productivity, therefore it is crucial for study spaces to accommodate different learning needs. Additionally, students with ADHD must be given the tools and knowledge to create their own ideal environment where they can focus. An environment that minimizes distractions and increases attention can lead to better learning for all students.

## Literature Review

Attention Deficit Hyperactive Disorder (ADHD) is a brain disorder set apart by a continuous presence of inattention and or hyperactivity-impulsivity that impedes growth or functioning (The National Institute of Mental Health). Common characteristics of inattentive ADHD include being easily distracted, forgetful, disorganized, making frequent careless mistakes, and difficulty finishing tasks. The Center for Disease Control and Prevention estimates that nearly 9.4% of children ages 2-17 have been diagnosed with ADHD (Center for Disease Control and Prevention, 2016). As the rate of diagnosis has increased, so has the research aimed at understanding and helping people with ADHD. One area of research specifically focuses on helping students structure their environment for learning in schools and in personal study spaces. Environment is indicated as a crucial factor to creativity, attention and engagement (Carbone, 2001; Guney, & Selda, 2012). The purpose of this review is to discuss (1) the heterogeneity of ADHD subtypes and associated systems, (2) the difficulties these impairments introduce to the learning process, (3) learning strategies that may be implemented to reduce these difficulties, (4) factors within the study environment that aid with focus and retention, and (5) identify what an ideal study space for a person with ADHD may look like. Additionally, a digital model of an ADHD-focused study space will be generated based on empirical findings of learning strategies and external environmental factors designed to minimize ADHD-related impairments.



## ADHD Subtypes (the subs)

Within ADHD there are 3 modes: hyperactive-impulsive, inattentive, and combined (American Psychiatric Association, 2013). Common hyperactive-impulsive characteristics include hasty actions without thought, restless movements, difficulty relaxing, constant tapping or fidgeting, interrupting others, and impatience. Common inattentive characteristics include disorganization, easily distracted, careless mistakes, difficulty finishing tasks, and forgetfulness. Although less common, some people with ADHD experience mood swings, quick temper, difficulty dealing with stress, and are prone to engage in risky behavior (NHS, 2018). The presentation of ADHD symptoms and related difficulties varies widely among individuals, indicating there is no single solution, therefore multiple theories will be explored.

For example, although inattention is one of the central symptoms of ADHD, it varies according to the person and according to the situation. Contrary to misconception, inattention does not mean people with ADHD are completely unable to focus, but instead refers to the difficulty of focusing attention on things they do not find exciting. When the task is engaging and interesting, people with ADHD are able to attend as well as neurotypicals. Research found that people with inattentive ADHD were able to pay attention to video games for hours at a time because the games increased arousal (Diamond, 2005). Arousal is a state of being physiologically alert (i.e. stress or excitement) and is necessary for higher cognitive functions such as attention.

A possible explanation for this phenomenon is the Yerkes-Dodson Law of arousal and performance (Yerkes, & Dodson, 1908). The law states that a certain degree of stimulation or arousal is necessary to achieve optimal performance. Too much arousal,

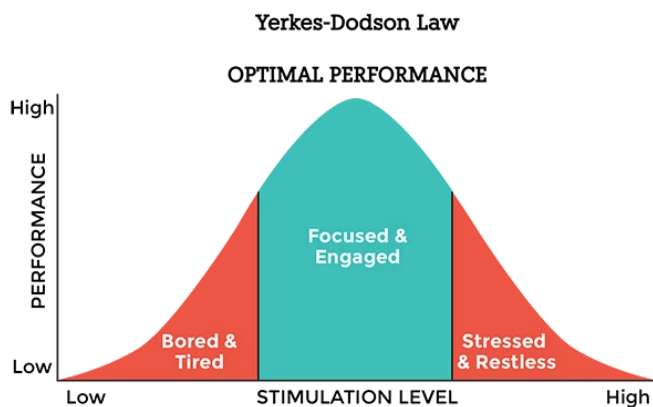


Figure 1. Yerkes-Dodson Law of arousal. This figure illustrates the correlation between stimulation and performance.

<https://bouncyband.com/blogs/news/yerkes-dodson-the-science-behind-woboo-s-effectiveness> ; photograph

especially when the task is difficult, can overwhelm an individual with stress, thus interfering with performance. Alternatively too little arousal can interfere with performance by causing a disinterest or disengagement in the task. The goal is to reach optimal arousal, but how one

reaches this differs depending on the task and the individual. A simple task is often too easy to engage an individual, meaning that arousal must be high in order for performance to increase. Performance increases on a difficult task when arousal is low, this is due to difficult tasks inherently raising arousal to the red 'stressed & restless' zone seen in the figure, so to better performance the individual must lower arousal.

The Yerkes-Dodson law can also be seen in the inattentive and hyperactive subtypes of ADHD. Optimal arousal allows for peak performance in attention and learning (Littman, 2018). Managing these arousal levels is a major concern for people with ADHD: those with inattentive ADHD have lower baseline arousal, while people with hyperactive-impulsive ADHD have higher baseline arousal to perform well on tasks.

Typically, non-ADHD brains are sufficiently aroused and able to maintain steady attention when doing an everyday activity like studying, but a person with ADHD is constantly searching for engagement that can increase or decrease their current state of arousal (Littman, 2018). The type of engagement an individual searches for is dependent on their subtype. Similar to those working on a simple task, people with inattentive ADHD are naturally understimulated and need a high-arousal situation to improve performance. For example, a student who is unable to pay attention during 3-hour lectures unless they take several breaks to jump or walk around. Conversely, people with hyperactive ADHD perform similarly to people working on a difficult task, where the initial state is to be overstimulated and a lower rate of arousal is needed to help the individual focus attention. For example, a student who is overstimulated and fidgety in class but is able to concentrate on their work when in an isolated, comfortable area.

While the Yerkes-Dodson Law neatly applies to inattentive and hyperactive-impulsive ADHD, it does not explain how performance can be optimized for the combined subtype. Instead of looking to explain the differences between subtypes, the World Health Organization looks at the number of shared symptoms that affect behavior and in turn affect education, employment, and social lives. The World Health Organization conceptualizes the impact of health disorders like ADHD into three areas: body function, activities, participation (2006). Body functions would include mental functions such as sustaining attention, emotion regulation, and memory. ADHD can also interfere with activities like finishing tasks, in addition to learning and applying knowledge. Hence, the disorder can result in problems succeeding and moving in one's

education. The figure below gives a more detailed description of this relationship (Loe & Feldman, 2007).

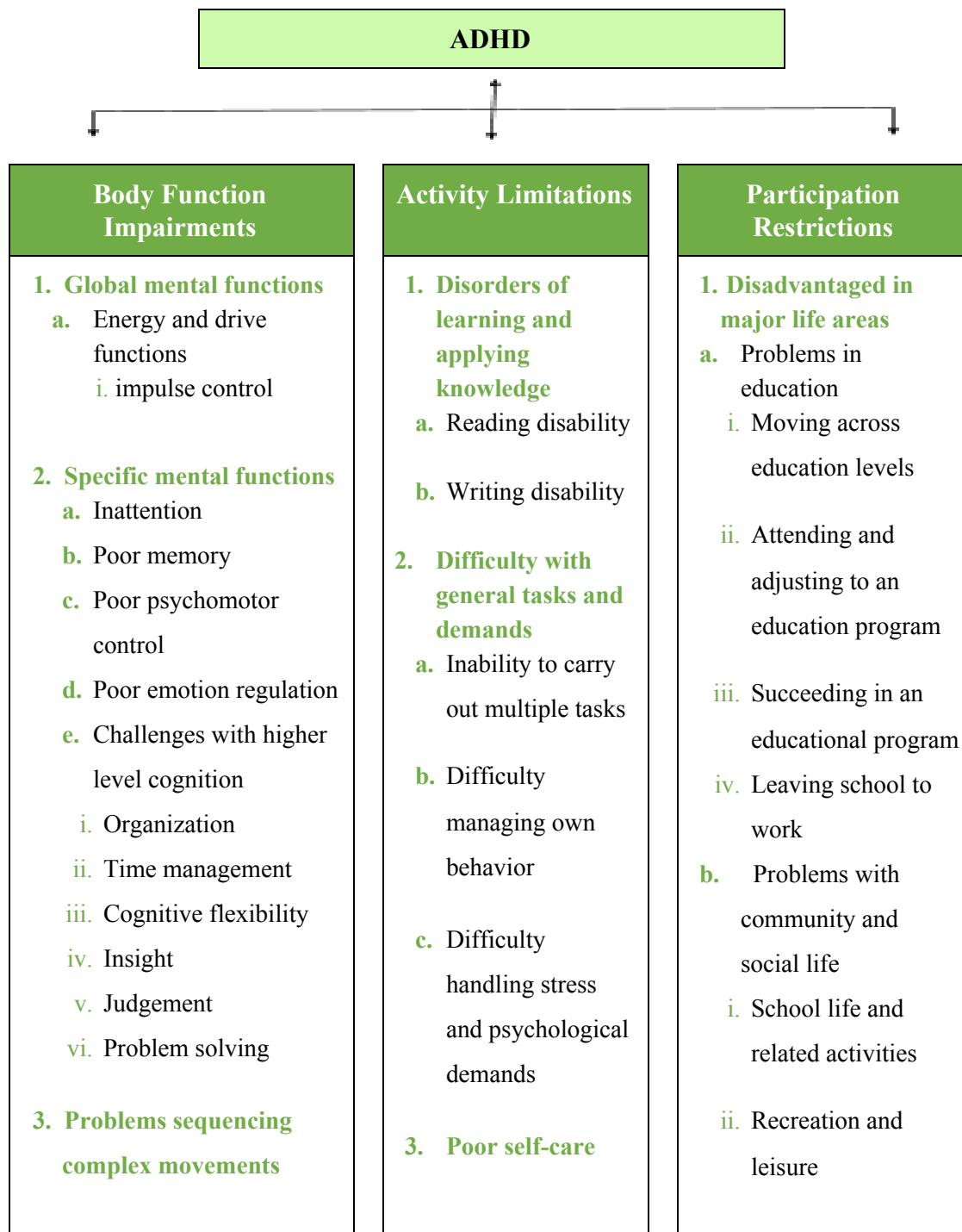


Figure 2: International Classification of Functioning. Model shows how ADHD affects different areas of functioning from symptoms to behavior to life areas. Adapted from <https://academic.oup.com/jpepsy/article/32/6/643/1021192>

## Associated Learning Difficulties

In children, ADHD symptoms can lead to significant functional impairment in school, at home, and in friendships leading to relational problems as well as academic issues. (Loe & Feldman, 2007). While ADHD symptoms and diagnosis typically start in childhood, symptoms and related academic impairments often continue into adulthood (Heiligenstein et al., 1999; Weyandt, DuPaul, 2008). Unlike children with ADHD who struggle in multiple life areas, adults with ADHD have impairments confined to the area of learning (Heiligenstein et al., 1999). Examples of such impairments include trouble sustaining attention, poor prioritization and organization skills, and being easily distracted in a learning environment. For instance, high school students with ADHD are more likely to have poor academic performance, including lower GPAs and a higher rate of academic probations than their neurotypical peers (Heiligenstein et al., 1999; Currie & Stabile, 2006). Additionally, they may be more likely to drop out of school: 15% of non-ADHD students dropout of high school, compared to 32.2% of students with combined ADHD (Breslau et al. 2011). While studies on high schoolers with ADHD are fairly congruous that students with ADHD are more likely to have academic and disciplinary issues, studies on college students with ADHD having the same struggles are inconsistent and require more research (Gray, Fettes, Woltering, Mawjee & Tannock, 2015). It is estimated that nearly 30% of children with ADHD grow into functional adults that do not significantly differ from neurotypical peers, whilst 50-60% of people continue to have substantial issues with attention and impulsivity (Hechtman, 2008). Impairments

in attention, organization, and time management, to name a few, can lead to academic limitations like those described above.

### *Inattention*

The ‘attention deficit’ aspect of ADHD has a considerable effect on success in school. A large part of the learning difficulties students with ADHD have, relates back to all subtypes having difficulties with sustained attention. Sustained attention is the ability to ignore distracting stimuli to concentrate on a task over a long period of time, until the task is finished. For inattentive subtype the task must be engaging enough to catch and keep their attention, for hyperactive subtype this skill can be difficult because they have trouble lowering arousal enough to complete a task.

Evidence for sustained attention can be seen in the fluctuations of time it takes people with ADHD to finish a task. These fluctuations or inconsistencies are the result of an inability to keep up an optimal level of performance, possibly due to inconsistent effort (Marchetta et al., 2008). Imagine a student working on an assigned reading and taking thirty minutes to read the first chapter, an hour to read the second, and an hour and half to finish the third chapter. The time fluctuations of time are not necessarily a reflection of task difficulty, but instead a reflection of the difficulty students with ADHD have maintaining an optimal level of attention which can be seen in their performance fluctuations. An inability to maintain a consistent level of attention may account for college students with ADHD reporting straining to keep up with academic demands,

reporting that they take longer to finish assignments, and struggle to finish timed tests (Lewandowski, Lovett, Coddington, & Gordon, 2008).

Along the same lines, a person must first pay attention in order to learn. The goal with most learning opportunities is for the skill, information, and or perspective to be saved in long-term memory so that the student can retrieve said lesson in the future. To learn information and create long-term memories a person's brain first takes in various sensory information such as sight and sound and shortly detains it in immediate memory. Those sensory clues are then brought together and consolidated in working or short-term memory. Then, if the information is reinforced through practice or memory aids the information will move from working memory to long-term memory (Ranpura, 2013); however, creating long-term memories is contingent on a few factors. First, information is only able to move from immediate memory to short-term memory if the individual was attending to the sensory information. If for example, a student is focused on the squeaking of their chair or the look of the instructor's presentation instead of the information being taught then a great deal of information will be lost. This can cause issues for students when it comes to tests where a student struggles to remember information they did not properly learn and store. Second, if the information was learned through a process called rote memorization where information is memorized through repetition, it is less likely to be saved in long-term memory (McTighe, & Willis, 2019). Rote memory can work well like memorizing the alphabet, but it can work poorly with students who are cramming for a test and attempting to absorb too much information in

too short of time. For students with ADHD this combination of caveats can cause a great deal of stress as a student scrambles to jam unlearned information into their head.

In brief, attention plays a critical role in everyday functioning, most notably when it comes to academic performance. Deficits in attention, like those seen in ADHD, can result in a multitude of issues.

### *Disorganization*

Problems with organization are a key issue people with ADHD face: in children impairments in organization concerning managing supplies, planning, monitoring assignments, and recalling due dates are common (Abikoff, Gallagher, Wells, Murray, Huang, Lu, & Pekova, 2012). Consequently, students tend to come to class unprepared, have messy work and living areas, and frequently misplace items (American Psychiatric Association, 2013). One cause behind ADHD organizational issues has to do with an impaired working memory.

As stated before, working memory or short-term memory is the liaison between external stimuli and long-term memory but it is also responsible for things like taking notes (Cohn, Cohn, Bradley, 1995), following instructions (Jaroslawska, Gathercole, Allen, Holmes, 2016), listening comprehension (McInnes, Humphries, Hogg-Johnson, Tannock, 2003), and organization – all regularly practiced skills in a school setting. As a result, students with ADHD can have a difficult time recalling an instructor's explanation or instructions for an assignment, trouble studying for a test with incomplete notes, and



difficulty keeping track of papers. In addition, working memory impacts disorganization by influencing inattentive ADHD symptoms and behavior.

One of the reasons students with ADHD find postsecondary education increasingly difficult is because it holds greater demands for long-term planning and efficient organization skills (Nugent, Smart, 2014). In interviews, college students with ADHD reported struggling to organize and store papers and notes, struggling to follow multi-stepped assignments, and difficulty organizing their thoughts into a smooth-flowing essay (Gray, Fettes, Woltering, Mawjee, & Tannock, 2015). Additionally, working memory deficits, like those seen in ADHD, encumber the foresight required to prepare for due dates, organize materials, and ignore distracting thoughts or stimuli (Baddeley, 2007).

Ultimately, impairments in organization affect not only how individuals manage their physical world and possessions, but also how individuals manage their thoughts and memories. Organization impairments seen in ADHD can lead to activity limitations such as difficulty carrying out multiple tasks, in addition to participation restrictions in succeeding in one's education (Loe & Feldman, 2007).

### *Poor time management*

Skills in organization, time management, and planning (OTP) typically overlap with one another in presentation and causes. OTP behaviors are significantly linked with grades, especially in high school and beyond where there are a greater number of long-term assignments and projects (Langberg, Epstein, Girio-Herrera, Becker, Vaughn, & Altaye, 2011). When there problems in OTP arise, they act as a driving force for

failure in students with ADHD (Sibley, Campezo, Perez, Morrow, Merrill, Altszuler, Coxe, & Yeguez, 2015).

Similar to attention and disorganization, OTP problems are most prevalent in relation to school work. Issues with OTP include trouble dividing time between homework and daily tasks, disorganized items, trouble monitoring assignments, and difficulty planning long-term projects (Sibley, Campezo, Perez, Morrow, Merrill, Altszuler, Coxe, & Yeguez, 2015). More specifically, problems with time management are the result of deficiencies in time perception, sustained attention, ability to ignore distractions, and planning. This concept of time perception is the natural stopwatch or clock in the brain that allows a person to estimate how long it has been since they had breakfast, or how long they have been waiting at the dentist office. Unfortunately, individuals with ADHD do not have a strong concept or perception of time and frequently underestimate the duration of time necessary for challenging tasks while overestimating the time they have available. For instance, a student with ADHD who believes they have hours to spend immersed in a school project because the other assignments they have due seem easy and can be done in a short period of time. With impaired time management, such students ultimately fall into procrastination and likely increase their stress as they hurry to submit those easy assignments late, incomplete or poorly done, which is typical with impaired time management (Solanto, Marks, Mitchell, Wasserstein, Kofman, 2008). This aligns with the Yerkes-Dodson law that a seemingly easy task provides minimal arousal and results in disinterest, while the challenge to

submit tough assignments before the deadline provides too much arousal and leads to stress and poor performance.

In a broader sense, it is theorized that inadequate time estimation may be responsible for executive dysfunctions such as impatience, impulsivity, and difficulties in delaying gratification (Smith, Taylor, Rogers, Newman, & Rubia, 2002). Essentially, those with ADHD struggle to resist an immediate reward in favor of a later reward. A decision between playing video games now or playing after finishing homework would be increasingly difficult for someone with ADHD as their brain actively searches for the most rewarding activity to supply optimal stimulation; however, activities like watching television, or playing video games are rewarding to the point of addiction for people with ADHD resulting in trouble reducing screen time, spending more time than intended, and failing to meet their other responsibilities (Mathews, Morrell, & Moelle, 2019).

### *Other*

Although the World Health Organization chart of impact for ADHD is a helpful resource, it is not comprehensive. It neglects to include other areas and factors such as internal and external motivation, self-esteem, and the transformation of symptoms.

Most neurotypical people are able to sustain attention on homework and studying thanks to having enough internal motivation: the desire to do something for its own sake based on feelings, thoughts or goals. Meanwhile people with ADHD are driven to fulfill a need for optimal stimulation as opposed to external demands like due dates or time (Littman, 2008). If a student with ADHD had a free weekend to prepare for a test, they

might spend a good deal of the weekend playing video games instead. This is not because they are indifferent, but because the pleasure inducing hormone dopamine that comes with playing the video game is far greater than the minimal intrinsic reward of studying for the test. When it comes to difficult or long school related tasks, those with ADHD tend to operate more heavily on external motivation: the desire to do something for the external reward. Extrinsic rewards could be something like praise from an instructor, or a good grade, or dessert after studying.

Difficulty controlling and sustaining motivation is a point of frustration that leads a number of students with ADHD to develop low self-esteem. Compared to neurotypical peers, college students with ADHD have significantly lower self-esteem, meaning they have a poor view of themselves or little to no confidence in their own abilities (Dooling-Litfin, Rosén, 1997). Struggling to overcome symptoms of ADHD to succeed in school only to underachieve can lead to feelings of low self-worth, and low self-esteem (McFarland, Kolstad, Briggs, 1995). The frustration of not being in control of one's ADHD symptoms can lead to depression and an apprehension to try for fear of failure (Marks, Newcorn, Halperin, 2006; Tse, 2012). This phenomenon is known as learned helplessness, and is a behavioral response to adverse conditions that end in persistent failure, as a result the individual believes they are powerless to change the situation (Seligman, 1972). Interestingly, not all students with ADHD struggle with low self-esteem, some students actually have an inflated sense of their abilities similar to issues with time management, where the individual overestimates the number of tasks they can get done (Reaser, Prevatt, Petscher, & Proctor, 2007). As a response to

managing their ADHD symptoms, students with ADHD may be more optimistic in facing challenging school work and encourage themselves with positive thinking (Shmulsky, Gobbo, 2007)

Hyperactivity is another symptom that affects the study habits of students with ADHD. Originally, medical professionals thought ADHD was limited to childhood because children's brains are not yet fully developed (Barkley, 2019; Laufer, 1962; Mendelsohn, Johnson, & Stewart, 1971). Areas like the right inferior frontal gyrus-in charge of attention, inhibition and motor control develop as children age and may be the reason ADHD symptoms are more pronounced in children (Barnea-Goraly, Menon, Eckert, Tamm, Bammer, Karchemskiy, Dant, Reiss, 2005; National Health Survey, 2018; Morein-Zamir, Dodds, Van Harteveld, Schwarzkopf, Sahakian, Müller, Robbins, 2014). This leads into the theory that the ADHD symptoms present differently over time, with hyperactive ADHD symptoms vanishing in adults, replaced with an increase in inattention (National Health Survey, 2018). Conversely, one study found that college students with ADHD still experience hyperactivity symptoms manifesting as frequent leg swinging, or fidgeting, or leg bouncing (Gray, Fettes, Woltering, Mawjee, & Tannock, 2015).

The evolution of hyperactivity in elementary aged children with ADHD who run around the classroom, or frequently interrupt others when speaking, to adults with ADHD that bounce their leg could be the result of maturity and or coping mechanisms (Gentile, Atiq, & Gillig, 2006). If a young student with ADHD is punished for frequently walking

around the classroom, or interrupting them, as they grow up, they may look for more discreet ways to deal with those hyperactive and inattentive impulses. Leg movements or hand fidgeting are acceptable coping mechanisms for impulses as they indicate that the individual with ADHD is trying to manage their symptoms. Too often students with ADHD resign to the idea that academic achievement with their disorder is doomed to be an uphill battle, and believe they will have to work harder than their neurotypical peers (Lewandowski, Lovett, Coddling, & Gordon, 2008). For example, college students with ADHD have a harder time taking tests, concentrating, and managing their time than college students with learning disabilities and college students without disabilities (Reaser, Prevatt, Petscher, & Proctor, 2007). When asked, however, neurotypical college students felt they dealt with similar problems to students with ADHD (Lewandowski, Lovett, Coddling, & Gordon, 2008), indicating that students with ADHD may be quick to perceive their learning difficulties as ADHD limitations rather than relate the difficulties to a tough course. This combination of findings suggest that students with ADHD require study and learning strategies that address their unique difficulties related to their symptoms and self-esteem.

## Learning Strategies

To help counteract and manage the symptoms of ADHD, parents, teachers, and researchers alike have comprised a number of strategies to help students with ADHD learn. Unlike other works that have focused on how teachers or parents can help children, this combination of tools is designed to be implemented by students themselves, helping the students to take control of their education and ADHD symptoms.

### *Seating*

In children, it is recommended that students with ADHD be seated near focused students who can act as a positive influence, and be seated close to the teacher so that there are fewer visual distractions between them and the lesson (McFarland, Kolstad, & Briggs, 1995). This same principle can be applied to students in college sitting near serious students when studying; however, if an individual is attempting to detect minute changes then the presence of an evaluator may be more beneficial in reducing errors than the mere presence of other students (Claypoole, & Szalma, 2018). More research is needed to determine how the presence of others can be used to increase attention.

Similar to how the peers one sits near affect attention, the location of a seat also affects attention. It is important for people with ADHD to avoid sitting in distracting areas such as seats near an entrance or front window where it is easy to get distracted by people walking by. Where one chooses to study can have a significant effect on their behavior. Studying in a crowded, high stimulus area can strain sustained attention meaning tasks would take longer to finish (Marchetta, Hurks, De Sonnevill, Krabbendam,

Jolles, 2008), likewise sitting near people who are not serious about studying can be incredibly distracting and cause an individual to adopt a similar attitude (Heinzen, Goofriend, 2018). Students should be mindful when choosing a learning environment that the surroundings help facilitate learning.

### *Token economy*

A promising approach to helping children with ADHD manage behavior and improve learning is a token economy: specifically, the student is awarded a token for positive behavior, and loses rewards for inappropriate actions (Buchoff, 1990). A system like this works because people enjoy being rewarded, especially when it comes after engaging in a task they find unenjoyable. To reiterate the findings of Littman (2008), people with ADHD are more drawn to behavior that is internally motivated than behavior that comes from external pressures. Like a student who spent the weekend hard at work on a minor assignment due next week but did not spend any time on the paper due the next day: the student was motivated to work on the project because they found it enjoyable, and unmotivated to work on their paper because there was no reward. A token economy could encourage students to adhere to external demands by providing them with a reward. College students can implement this by making weekend plans with friends that they can only keep if they finish their school work, or rewarding themselves with a giant cookie after studying.

The concept of reward often goes hand in hand with the need for frequent feedback and can be seen in multiple facets of life. In the classroom, research has shown



that children with ADHD greatly benefit from immediate or frequent feedback from the teacher, and added teacher attention (Luman, Goos, & Oosterlaan, 2015). Outside the classroom, items like smart watches which monitor physical activity and alert users to walk or stand every hour are a great example of frequent feedback. By creating a tangible goal such as walking 250 steps per hour, reminding the user to complete the goal, and tracking if that behavior was achieved the goal behavior of walking is reinforced.

Behavioral psychology shows that these elements are effective in reinforcing a desired behavior. Students can replicate a similar concept by setting timed goals related to their studying, like breaking down a 200 page reading assignment by setting a goal to read 50 pages every thirty minutes. Setting a timer for those timed goals could help ensure the student stays on task.

Researchers have also found that when individuals are compared to the group around them and told how others behave, the individual tends to conform to the group endorsed behavior (Heinzen, & Goofriend, 2018). For example, an electric bill saying that four out of five of your neighbors use a small amount of energy and are in the ‘green zone’, and that you are in the ‘yellow zone’ for using a medium amount of energy will likely prompt you to use less energy. Another example would be finding out that all of your coworkers actively donate money to an animal shelter might prompt you to follow suit. This concept can be applied to the education setting by having a platform that allows students track and record how long they spent studying or finishing an assignment, and see how that compares to other people in their class. Students could check the platform to

see the average time it takes to complete an assignment, and be better prepared to manage their time accordingly.

### *Coaching*

Breaking down tasks into smaller, more manageable goals is one of the tools used in ADHD coaching, a type of hands on intervention where an individual with ADHD learns skills in time management, organization, and goal setting (Prevatt, 2016). Similar to cognitive behavioral therapy (CBT), ADHD coaching gives the student the tools to manage their own behavior and can be incredibly helpful for students entering college who are accustomed to relying on their parents to help manage their ADHD symptoms (Prevatt, 2016).

One of the benefits of ADHD coaching is that it helps to improve a student's self-esteem. As stated earlier, people with ADHD often struggle with low self-esteem due to underachieving, and struggling to keep up with their peers. ADHD coaching addresses these issues by teaching self-awareness, helping students realize their personal strengths and teaching them how to create realistic goals (Prevatt, 2016). By helping students understand their symptoms, and teaching them study and learning strategies that address ADHD specific difficulties, students are better able to manage their own behavior.

ADHD coaching also helps students set goals that are Specific, Measurable, Attainable, Relevant, and Time-based, otherwise known as S.M.A.R.T. goals (Doran, 1981; Drucker, 1955). The acronym is used to help people establish goals that will have a higher likelihood of being achieved. A goal 'to do well in school' is too broad, and needs

a measurement aspect to determine if the goal was accomplished. Likewise, a goal ‘to become valedictorian’ while admirable in ambition is not attainable if the student is barely passing their courses, additionally, if this goal is not personally important and relevant to the goal-setter there is a high likelihood of it failing. Lastly, if the goal does not have a time frame, it is likely to be pushed off until the goal-setter forgets about it or loses motivation to act on said goal. With this acronym, the goal ‘to do well in school’ can be transformed into ‘I want to spend 2 hours in the library every week day going over my class notes and doing homework’.

Lastly, ADHD coaching can assist students with OTP skills. An important part of organization is to have the tools to organize materials, whether that be multiple computer files, physical binders and folders, or shelf bins. Everything should have a place, and each day an individual should spend a few minutes putting things in their proper place. Additionally, students should utilize planners to create a schedule of tasks to be completed, breaking them down to smaller steps, prioritizing based on urgency and relevance, and follow through on completing those tasks. There are key phrase to remember when it comes to OTP: ‘if you have trouble starting a task, then your first step is too big’, and ‘if it is not in the planner, it does not exist’ (Solanto, Marks, Mitchell, Wasserstein, & Kofman, 2008). Often, starting a task, especially if it is a large task, can seem overwhelming to the point where avoiding the task is preferred to confrontation. CBT is helpful at making tasks manageable by encouraging the individual to focus on one step at a time. Instead of a student thinking they need to finish an entire essay in one sitting, individuals are encouraged to simply focus on the first small step of turning on

their computer, since the computer is on they might as well then a new document. And since they made a document for their essay, it might help to read the prompt and maybe jot down a few ideas. It is simple steps like these that allow students to feel rewarded instead of paralyzed when it comes to working on a large task.

The reasoning behind the second key phrase, ‘if it is not in the planner it does not exist’ (Solanto, Marks, Mitchell, Wasserstein, & Koffman, 2008) is important as people with ADHD have an impaired working memory. Writing things down, making detailed lists, and using digital or physical reminders all help makeup for this impairment by easing the strain on working memory (Gathercole & Alloway, 2008).

### *Studying intervals*

Along with teaching the optimal ways for students with ADHD to learn, ADHD coaching helps students to study in more productive ways. For instance, rereading textbook chapters to prepare for a test is not nearly as beneficial as using flashcards and practice tests, similarly studying for a short time over a few weeks is better for learning than cramming over a weekend (Dunlosky, Rawson, Marsh, Nathat, & Willingham, 2013). The practice of spreading out studying between multiple days is referred to as spaced learning and has been seen to help move information into long-term memory (Ebbinghaus, 1913). Along with spacing out the number of days spent studying, it is also important to take frequent breaks: taking 17 minute breaks every 52 minutes of work can help increase productivity, sustain energy, and ease muscle fatigue (Hedge, 1999). However, to receive the full benefits of frequent breaks, participants should be away from

their computer and spend their break away talking with others, or walking (Gifford, 2014). Additionally, it is crucial for individuals to develop a contingency plan, an if-then agreement, to account for situations when they veer off their homework schedule. If a student knows they have the tendency to fall asleep when studying geography, their contingency plan might be 'if I start to feel sleepy when studying, I will set a timer for x minutes, and make up that time by staying up later tonight to study'. By creating a plan to prepare for common pitfalls, individuals are less likely to abandon their goals when they get off their studying schedule (Tagliabue, Sandaker, & Ree, 2017).

Briefly, studying is most successful when an individual creates a study plan that spans multiple days, if not weeks, includes frequent breaks, and includes ways to address pitfalls.

## Study Environment Findings

In studying restaurants, researchers found that the environment's ability to evoke pleasure or arousal significantly affected the extent that customers stayed longer, recommended it to a friend, and their desire to return to the restaurant (Ryu & Jang, 2007). This finding may be generalized to study environments to show that environment has an effect on engagement and behavior, and because of this it is important to provide environments that meet the needs of different people. Those with inattentive ADHD require a minimally-distracting setting that provides adequate stimulation or arousal, and those with hyperactive-impulsive ADHD require a minimally-distracting setting that allows them to move around in addition to outlets for releasing energy.

One theory is that the environment should replicate the function of stimulant drugs in treating symptoms of ADHD. Although it seems counterintuitive, stimulant drugs are often prescribed to help reduce ADHD symptoms because they improve neuron communication in the brain in addition to providing necessary stimulation- leg bouncing, fidgeting, humming, and pacing are all ways individuals with ADHD self stimulate and when given stimulant medication, the drive to self stimulate is eradicated (The Hospitalist Team, 2010). Just as medication stimulates students, so too should the environment. A stimulating environment promotes optimal stimulation which leads to optimal performance, a non stimulating environment promotes boredom and diminishes performance (Yerkes, Dodson, 1908). Environmental elements seen in a typical 'distraction free' study environment such as fluorescent lights, uniform furniture, and

muted colors all contribute to increased boredom and depleted interest in studying (Olds, 1979). Instead study areas should enhance and inspire learning in order to compete for the attention of ADHD students which can increase the students' drive to pay attention (Parker, 1992). Interesting and colorful wall art can greatly help to hold the attention of ADHD students, but must be used cautiously as large flashy decorations that do not pertain to the lessons would act as distractions (Zentall, 1983). When decor is overly stimulating it is no longer beneficial to performance and instead leads to anxiety and distractibility (Yerkes, Dodson, 1908).

### *Colors in space*

Similarly to the wall decor, the colors in a space have the capability to evoke different emotions and memories. Colors like red remind people of eating and hunger, while colors like blue, green and purple are seen as calming colors, and yellow, blue and green are perceived as arousing colors (The Interior Design Academy; Valdez & Mehrabian, 1994). Arousal is an important aspect to keeping individuals with ADHD engaged; the ADHD brain is continually searching its surroundings for optimal stimulation, regardless of external pressures like deadlines.

Other than the colors included in a space, arousal can be increased by having easy to see clocks and timers built into desks. Similar to how clocks increase arousal for people who are trying to sleep (Ree, 2016), clocks can be used to increase arousal and help students monitor how long they are spending on a task and take breaks accordingly as frequent breaks also increase arousal.

Another way to increase arousal and focus is through exercise which can be introduced to a study space by having an area where people can jump, run, and stretch. This would be similar to structural strategies seen in some primary school classrooms where there is a designated area free of distractions where students with inattentive ADHD could increase arousal through movement (Carbone, 2001). Conversely, students with hyperactive subtype would need a distraction-free comfortable space that would allow them to lower arousal.

### *Ergonomic and functional seating*

Movement could also be catered by having bicycle pedals underneath seats which could be useful for both people with hyperactive ADHD and inattentive ADHD. A high gear would be helpful for people with hyperactive subtype as it would release some hyperactive fidgeting impulses and since it is more difficult to pedal it can force the user to slow down so they can focus on their work. A low gear would allow the user to go faster, increasing heart rate and arousal, which would aid those with inattentive subtype. In children, fidgeting is often a sign that a child has not gotten enough movement and the solution is to provide them opportunities to move so that they can pay better attention and learn (Strauss, 2014). School teachers accommodate this by providing a number of chair and desk options for students to choose between: standing desk, bean bag chair, yoga ball, office chair with wheels, etc. Unfortunately, little research has been done on the effect of alternative seating options on learning: while some found spinning chairs to increase attention (Pfeiffer, Henry, Miller, Witherell, 2008), others found yoga balls to have no effect on attention (Taipalus, Hixson, Kanouse, Wyse, Fursa, 2017). The main issue



that arose with children using alternative seating was the children using the seats as toys, but if adults were given these seating options there would be a smaller likelihood of playing around. Having a variety of seating options available to college students would accommodate different needs in a learning setting. A standing desk for example may help ameliorate the risks of diabetes and obesity that come with sitting for prolonged periods of time (Simon, 2018). Chairs that do not adjust to the user's size, do not allow the user to lean back, or do not provide the necessary support for good posture can lead to distracting lower back pain (McGrane, 2001; Fettweis, Henrist, Vanderthommen, 2014). However, the best way to avoid back problems is to avoid sitting for long stretches of time, and to take periodic breaks to move around (McGrane, 2001).

In short, the seat one chooses to study in affects their ability to move and increase arousal, their ability to pay attention, and their physical well-being. Ultimately, individuals should choose the seating option that best fits their comfort and needs, whether that be a bean bag chair or a wooden chair.

Likewise, temperature is an environmental element that is best suited when an individual is comfortable. Most people are comfortable with a room temperature between 69°F and 71°F, with productivity being the highest at these temperatures (Seppänen, Fisk, & Lei, 2006).

### *Nature/plants*

Exposure to nature is an element that has been examined in terms of its arousing effect on attention and ability to comfort individuals. Arousal and comfort both act to

increase attention. Researchers have studied how exposure to nature can help restore the mental energy that was exerted through directed attention, which is making a cognitive effort to intentionally focus on something and limit distractions (Grill, 2003). For someone with ADHD, more mental energy and effort would be required to focus attention on things like school work, meaning nature could help refresh students studying. In children, a simple 20 minute walk in the park can drastically increase attention by replenishing the brain's ability to attend (Taylor, & Kuo, 2009). Students report feeling a new surge of energy and feeling more awake after they spent time in nature (Taylor, Kuo, 2009). Experiencing nature can help reduce mental fatigue and also help buffer feelings of stress and anxiety (Trau, Kennan, Goforth, & Large, 2015; Merritt, 2017). Incorporating plants into a space, and providing easy access to spend time outdoors in nature would help individuals truly rest from their studies and gain a sense of calm that can sometimes be lacking when studying.

### *Lighting*

Proper lighting is essential to help people see and work, in addition proper lighting provides a sense of comfort (Shishegar, Boubekri, 2016). Different sources of lighting can set the tone or character of an area (The Interior Design Academy). Electrical lighting, specifically fluorescent lights, often feels too artificial causing people to feel drained. In a study that looked at office productivity under daylighting and electrical lighting, researchers found that under electrical lights participants feel tired sooner, and less physically healthy compared to daylighting (Borisuit, Linhart, Scartezzini & Münch, 2014). Additionally, the humming noise fluorescent lights make can be a source of

distraction and agitation for students with ADHD (Richards, 2001). Alternatively, when given access to natural light individuals report less eye strain, improved moods and confidence, and more energy likely the result of natural sunlight providing the body with vitamin D and increasing blood circulation (Shishegar, Boubekri, 2016). Similar to movement and exposure to plants, natural light can increase arousal in students making them more alert and bringing them closer to optimal performance (Yerkes, Dodson, 1908; Shishegar, Boubekri, 2016). Natural light has numerous positive effects on well-being, while the absence of natural light can have a negative impact on well-being. Students who learned in a windowless room were found to have more complaints and less interest in their studies compared to students who learned in a classroom with windows (Edwards, Torcellini, 2002).

Incorporating natural light into a space and making time to experience sunlight are beneficial to an individual's health, and mental performance as it provides a similar refreshed feeling to that felt in nature.

### *Noise*

Student preference for a silent study area or one with consistent background noise is partially due to personal preference, but is also dependent on the task they are working on and the type of noises surrounding them. For example, in an open layout room where noise can more easily travel students have reported getting distracted by the people around them talking, especially if the student was spending a greater amount of cognitive effort on tasks like writing or taking a test (Braat-Eggen, Van Heijst, Hornikx,

Kohlrausch, 2017). In order to learn and store information in long-term memory, individuals must first attend to their sensory input. This process is complicated when a task requires focused attention but there are multiple sensory items competing for attention (Smith, 1991). For example, listening to loud intense music while trying to take a test or writing a paper can cause attention to be split between multiple sensory inputs. As a result of high noise levels, an individual's brain has to work harder to maintain attention, reaction times are slowed, and more errors are made (Zhang, Zhang, 2018). The overstimulation of loud extraneous noise, along with strained attention leads to a decrease in performance and can increase feelings of frustration and stress as seen in the Yerkes Dodson law of optimal arousal (Yerkes, Dodson, 1908). Similar to lighting, noise and music can be used to set the tone for a study session but to not detract from attention, noise should not be too loud or overly engaging.

### *Distracting Phones*

Aside from noise, one of the most common sources of distraction are phones. As technology and social media have grown, so have the reliance people have on them. It is typical for students to check social media, or watch TV shows while they do homework, a habit that divides their attention lengths the amount of time it takes to complete a task and increases the likelihood of errors (Carrier, Rosen, Cheever, & Lim, 2015). But frequently checking one's phone often takes more time than anticipated, in addition it detracts attention from school work. Another challenge with phones is the tendency for students to simultaneously use phones and study. Contrary to popular belief, the brain is not able to attend to multiple things at once and instead quickly shifts attention between

stimuli. Additionally, attempting to multitask can actually result in tasks taking more time to complete. In one study, students that tried to multitask instant messaging and completing a reading assignment ended up taking longer to complete the assignment than if they had simply taken a break to instant message (Bowman, Levine, Waite, Gendron, 2010). This may be the result of resumption lag or switch cost which is the time it takes the brain to switch between tasks.

In conclusion, phones can be incredibly distracting in a learning environment and should be put completely out of sight so as to minimize temptation to check it.

## Study Environment Proposal

The purpose of this proposal is to show that the school environment can be adapted to meet the needs of a variety of students. Below are links to panoramic videos of the created study environment: <https://roomstyler.com/rooms/39238755/panorama#/pano> , <https://roomstyler.com/rooms/39238755/panorama#/pano> .



*Created in roomstyler.com*

The wall paint of purple, yellow and green/blue were selected based on research showing that these colors can promote either calm and or arousal (The Interior Design Academy; Valdez & Mehrabian, 1994). Numerous windows are incorporated to bring in natural light that can increase arousal, and benefit health and mental performance (Shishegar, Boubekri, 2016; Yerkes, Dodson, 1908; Edwards, Torcellini, 2002), windows close to eye level should be frosted to block outside distractions (Marchetta, Hurks, De Sonneville,

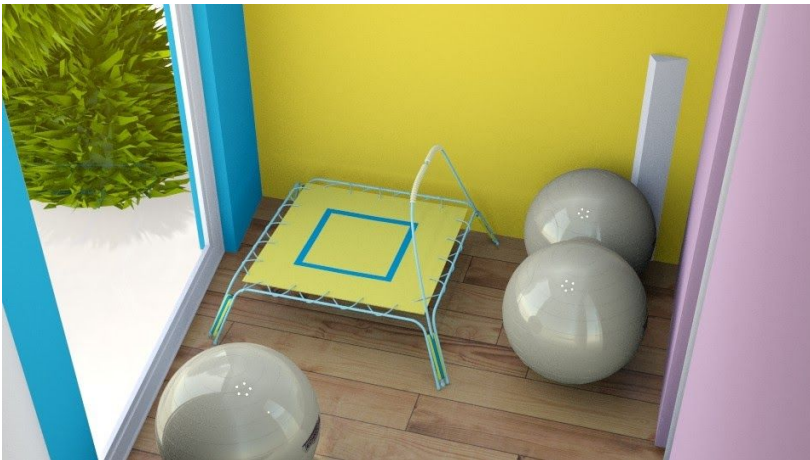
Krabbendam, Jolles, 2008). Another feature of the study space is a variety of seating options.



This is an example of desks that have bike pedals built into them, allowing users to pedal while they work. Bike pedals with adjustable gears would be helpful

to increase arousal in inattentive subtypes, and decrease arousal in hyperactive subtypes.

Additionally, the storage basket underneath allows users to put unnecessary items, like



cell phones, out of sight and out of the way from distraction.

Another movement element incorporated into the space is a

separate room with trampolines, and yoga balls. The equipment can be used to increase movement and arousal which is lacking for students with inattentive ADHD to focus.

Alternatively, quiet areas closed off from the larger study space were designed to help decrease stimulation for students with hyperactive ADHD. The quiet closed off areas would also be



beneficial for students working on high attention tasks like tests or writing assignments (Zhang, Zhang, 2018). The curtains are used to close off the indented quiet space.



Likewise, the small wall and frosted glass wall block out some of the extraneous noise in the room, to produce a relaxing, quiet space.

The incorporation of plants and creation of an outdoor area serve to help renew energy, increase attention, and reduce anxiety that can accompany school work (Grill, 2003; Taylor, & Kuo, 2009; Trau, Kennan, Goforth, & Large, 2015; Merritt, 2017). Plus the outside plant area would give students space to stretch their legs between study intervals, increasing muscle function and reducing fatigue (Hedge, 1999; Gifford, 2014).





Lastly, small tablets or screens attached to the table can be used for students to create checklists, create a study plan with study intervals and set breaks, and monitor how long they are spending on tasks.



Apps similar to smart watches can be installed for students to track how many study intervals are completed. This tracking feature could be expanded to allow students to track how long they spend on specific tasks for a class and see how long others in their class have spent on tasks.

## Limitations

The primary limitation to the generalization of these results is a lack of previous research. As a whole, little research has been done on college students with ADHD, and on study strategies used by college students (Raggi, Chronis, 2006). A number of theories discussed were based off of research done on children with ADHD, which may not be easily transferable to adults with ADHD. Typically, research is easier to conduct on children as researchers can gather reports from teachers, parents, and classroom observations while research on college students is often restricted to self-reports. It should be noted that self-reports may be subject to exaggeration and bias on the part of the participants. Future experimental and empirical research should be conducted on the appearance and effect of ADHD on college students. Additionally, more research should be conducted to verify current interventions for adult ADHD.

## Overall Conclusions

The variation of needs for a study environment is an ongoing field of study. As higher education continues to require more work outside the classroom, it is important to reevaluate the ability for current study environments to positively influence behavior, productivity and comfort. The aim of this research is to encourage the creation of study environments that accommodate different learning needs, additionally this research aims to provide students with ADHD basic tools and knowledge to modify their space to improve attention. Dependent on the subtype of ADHD, an individual requires either an increase or decrease in stimulation in order to reach a state of optimal performance. A number of ADHD impairments like attention, OTP, and motivation are linked with activity limitations and restrictions in life areas related to school. Behavioral and environmental interventions can have a large impact on increasing attention.

While one of the goals for this project is to help encourage study spaces that accommodate different needs, and it is acknowledged that the compiled methods for studying may not apply to every person, as preferences and needs vary. More research is needed on college aged students and adults with ADHD as these groups face greater stress, greater workload, and far less structure than younger age groups.

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