North Carolina State University

ADHD-Friendly Design:

Environments and Social Constructs

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DS 483: Design Studies Capstone Research Paper

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Abstract

Throughout this paper, I explore the psychology of ADHD, neurotypical design, and knowledge of current or future development of ADHD-friendly design. I also elaborate on how gender plays a role in the effectiveness of generalized ADHD-friendly design. First, I explain why the topic of ADHD-friendly design is important to evaluate and discuss. Second, I talk about my personal experience with my diagnosis ADHD, predominant symptoms, and environments designed for neurotypicals. Third, I talk about my main three influences for the topic which includes: the prominence of ADHD negatives in research, research about how the ADHD mind works, and current design for ADHD. Fourth, I discuss the disciplines psychology and architecture, specifically subcategories of those disciplines, and how they relate to the topic of ADHD-friendly design. Fifth, I talk about three theories, the theory of neurodiversity, the theory of mind, and the sensory integration theory, and their connections to ADHD-friendly design. Lastly, I provide general guidelines for ADHD-friendly design using colors, lighting, materials, decorations, and spaces, discussing key points about the effectiveness of the design based upon gender.

Keywords: ADHD, ADHD-friendly, neurodiversity, design, interior design

Statement of Work

It is estimated that two to five percent of adults are diagnosed with attention deficit hyperactivity disorder, also referred to as ADHD (Stibbe et al. 2). While two to five percent may not sound like a lot, that is about 160 million to 400 million people in the entire world affected by ADHD. It is found that more women than men get diagnosed with ADHD during adulthood, which is seen through the diagnostic ratios between genders during childhood and adulthood. The childhood gender ratio of diagnosis is one female for every 1.8 to 16 males. In comparison, the adult gender ratio of diagnosis is one female for every 1.6 males (Stibbe et al. 2). This abrupt change in diagnostic statistics between childhood and adulthood is due to women being more likely to be misdiagnosed throughout childhood and adolescence.

According to the article "Attention-deficit/hyperactivity Disorder during Adulthood" written by Magnin and Maurs, there are three different types of ADHD: inattentive, hyperactive, and a combination of inattentive and hyperactive. ADHD in women tends to go undiagnosed or misdiagnosed through childhood due to women having a predominantly inattentive presentation of ADHD, as well as the presence of psychiatric disorders such as depression, anxiety, and obsessive-compulsive disorder (Patricia and Madhoo para. 3). However, each category of ADHD comes with challenging symptoms based on the DSM-V diagnostic requirements. Inattentive ADHD involves difficulties with

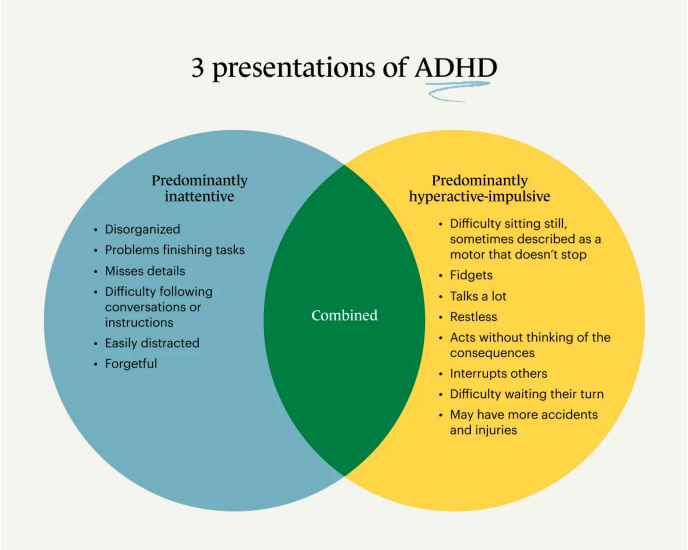

Fig. 1

focus, being easily distracted or side-tracked, often losing essential items, forgetfulness, difficulty following directions, and difficulty initiating and completing tasks. Hyperactive ADHD involves fidgeting, being talkative, difficulty remaining seated, waiting their turn, interrupting others, and seeming to be run by a motor (Magnin and Maurs 508). The list of inattentive and hyperactive ADHD symptoms does not express the magnitude of struggles it causes with school, work, personal schedules, and household chores. However, design has the ability to help adults manage their ADHD.

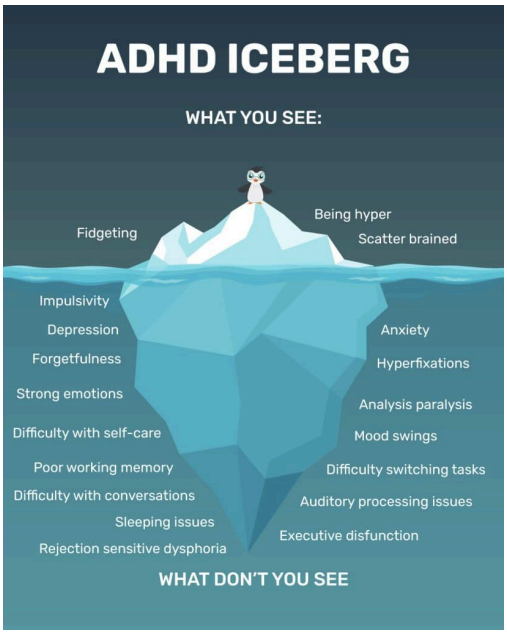

Fig. 2

People with ADHD are expected to adapt to a world physically and socially designed for neurotypical men. However, through design, there are ways to make the world a more ADHD-friendly environment. When referring to the term "ADHD-friendly design," I am discussing the design of physical environments and the design of social constructs that are generally created for neurotypical persons and does not consider a brain that operates differently. Throughout my project, I plan to explore the psychology of ADHD, neurotypical design, and knowledge of current or future development of ADHD-friendly design. I am also exploring how gender plays a role in the effectiveness of generalized ADHD-friendly design. Further expanding my knowledge of the psychology of ADHD will allow me to understand more fully how the ADHD mind works; however, it will also be important for me to explore the psychological differences between ADHD men and women. Understanding the basis of neurotypical design will provide a foundation of what is generally seen and allows designers to build upon already established

environments to make them ADHD-friendly. Lastly, knowing how designers and architects are currently working to create ADHD-friendly environments gives us a basis to work upon and provides evidence of what is working and what can be improved on.

Background

As stated earlier, it is estimated that two to five percent of adults are diagnosed with attention deficit hyperactivity disorder, also referred to as ADHD (Stibbe et al. 2). My ADHD diagnosis story started when I was 15 years old in high school; however, I was not diagnosed the first time being evaluated. To be exact, I was tested three times over five years before being officially diagnosed at 20 years old. Once I got my official diagnosis, I could finally understand more about how my brain worked, which gave me insight into why traditional school and work environments did not work for me, as well as my difficulties with what was expected of me at home. It helped me become more patient with myself and start to learn how to do things in a way that worked for me rather than what worked for the neurotypical person. Prior to my diagnosis, I experienced a lot of self-doubt and beat myself up for not being able to conform to a world created for neurotypical men. Of course, there is still a lot I struggle with because of my ADHD and I am slowly learning methods that help me manage and understand myself. However, adaptations to make physical environments and social constructs more ADHD-friendly can lessen the amount of struggle people with ADHD experience on a daily basis.

Fig. 3

I have a predominantly inattentive presentation of ADHD with a few hyperactive signs. My struggles with ADHD include but are not limited to difficulties with focus, under-stimulation, overstimulation, mood swings, staying organized, easily getting bored,

following a routine, hyper-fixations, chronic procrastination, fidgeting, random energy spurts, and energy burnouts. In my personal experience, difficulties with focusing or being easily distracted causes issues with school, work, and personal life because I cannot decide when I will be able to focus on a particular topic or task. Under-stimulation often goes hand and hand with boredom, which can cause me to overindulge in food, school media, games, etc. On the other hand, overstimulation is caused by large social gatherings or crowds, excessive messiness, and busy schedules/workloads. When I become overstimulated, my body shuts down emotionally and physically, making it very difficult to do anything for up to three days. In general, people with ADHD are more sensitive to emotions because we feel everything at 110 percent, which means even tiny things can heavily affect our mood.

Fig. 4

Depending on the environment, I can go from sad to happy in 10 minutes. Following a routine, staying organized, and procrastination all go together because they affect my ability to function daily and during the school year. While I deal with hyper-fixations, especially with new hobbies, I do not feel this is a bad trait. It allows me to find many new things I like through creation or research. Lastly, fidgeting and energy spurts go together in a way. Fidgeting helps me stay as focused as possible during class, work, and conversation. However, while energy spurts can lead to me being productive for a bit of time, they often happen around the time I want to go to sleep, so they tend to disrupt my sleep schedule. I will further explore these traits and how current

environments and social constructs affect the prevalence of their presentation in people with ADHD throughout my project.

In environments designed for people who are neurotypical, I tend to experience a lot of discomfort which is attributed to many characteristics of designed environments. Characteristics such as bright lights, bright colors, and loud noises are incredibly overwhelming and exacerbate my distractibility.

Fig. 5

Through my research, I will explore characteristics of environments created for neurotypical people and how they affect ADHD traits will allow designers to discover what aspects of environments need to be adjusted to make them ADHD-friendly. Also, based upon prior research of what environments are comfortable for people with ADHD, designers can better understand the types of environments that work to help decrease ADHD symptoms. Overall, I want this project to create a better understanding of the ADHD mind, how this differs based on gender, and what designers can do to create ADHD-friendly environments.

Influences

1. Introduction

When evaluating what influences the topic of ADHD-friendly design, I found that there were three main categories that needed to be addressed. First, there is a focus on negative impacts ADHD had on the neurotypical world. Another theme is discovering how the ADHD mind works and how it differs from neurotypicals. Lastly, I focused on the effects of current design on ADHD individuals.

2. Prominence of ADHD Negatives in Research

2.1 Validity of Adult ADHD as a Diagnosis

In the article "Is ADHD a Valid Diagnosis in Adults?," three psychiatrists are arguing about the validity of an adult ADHD diagnosis. Philip Asherson and his colleagues agree that adult adhd is a valid diagnosis, while Joanna Moncrieff and Sami Timimi believe that the diagnosis of adult adhd is simply for the purpose of marketing adhd meds to adults. Moncrieff and Timimi state in their argument that "[e]ven if we accept childhood ADHD as valid, the validity of adult ADHD does not automatically follow" (736 Asherson et. al.). This is influential to my research because it is displaying both sides of how people view the concept of adult ADHD. A lot of people believe ADHD only affects children and that those children grow out of it as they get older. On the other hand, some people believe ADHD is not a real disorder at

Fig. 6

all. These viewpoints on ADHD leads to a lot of issues for adults with adhd due to a lack of support and resources/design that can help them function in a world designed for neurotypicals.

2.2 Negative Connotations Placed on ADHD Individuals

Susan Hawthorne's article "Institutionalized Intolerance of ADHD: Sources and Consequences" focuses on the accidental negative values placed on people with ADHD due to gaining more understanding of how ADHD affects them. In trying to gain a better understanding of ADHD to better the diagnostic criteria and mechanisms to help them manage it, it created an idea of restricted "success" for those with ADHD in an institutionalized environment. There are particular labels that are placed on those diagnosed with ADHD that negatively affect them in school, work, and social situations, which creates the likelihood to lower self-esteem in those with ADHD. These connotations also lead to a negative public view on those with ADHD, often leading to the false idea that people with ADHD are less likely to be successful.

Fig. 7

2.3 ADHD Diagnosis Adversities between Genders

In the article "Road to diagnosis and treatment," written by Klefsjö et al., they discuss differences between the ADHD diagnosis journey for boys and girls based upon a case study they conducted. First, they discuss the lack of studies that have been conducted to see the

differences in the process of diagnosing ADHD between boys and girls. Next they discussed their study, which consisted of 50 boys and 50 girls under the age of 18. Klefsjö et. al. reviewed the data for why each child was referred for further testing with Child and Adolescent Psychiatric (CAP), the process they went through for diagnosis, and the treatment they received. In their case study, they found that girls were oftentimes referred for further testing due to emotional symptoms, where boys were referred for neurodevelopmental problems. Girls would also have to go through more visits than boys before getting diagnosed with ADHD. Lastly, girls were more likely to be treated with non-ADHD medications before and after their ADHD diagnosis than boys. Their case study shows how girls are more likely to have to go through a long process to get an official diagnosis of ADHD than boys. This is due to women's ADHD symptoms being viewed as "emotional problems" and oftentimes being written off as just anxiety and depression. The negative connotations of women being "more emotional" is one of the contributing factors of women being misdiagnosed or going undiagnosed with ADHD for longer than men. Also, the lack of research involving the presentation of ADHD in women versus men leads to the difficulties with diagnosing ADHD in women.

Fig. 8

3. How the ADHD Mind Works

3.1 Abilities and Disabilities of ADHD Persons

The article "An international clinical study of ability and disability in ADHD using the WHO-ICF framework," written by Madhi et. al. discusses a study conducted with 112 ADHD persons using the World Health Organization (WHO), International Classification of Functioning (ICF) framework to understand the abilities and disabilities of people with ADHD. The WHO-ICF framework assesses interpersonal interactions and relationships, interpersonal interactions, social cues, and social interaction initiating. The study found that people with ADHD struggle with activities that require attention, initiating and completing a sequence of tasks, time management, planning, making decisions, and problem solving. Environmental factors that created difficulties for ADHD individuals include unsupportive family, doctors, and psychologists, as well as technology such as cell phones. Lastly, it was found that people with ADHD are likely to struggle with "gastro-intestinal issues, hypersensitivity problems and motor coordination difficulties" (Madhi et. al. para. 16). On the other hand, the study also found the strengths of individuals with ADHD which include: openness, participation in hobbies and socializing, persistence, creativity, and positive attitude towards finance, social skills, and prior traumatic experiences.

3.2 ADHD Presentation Differences Amongst Genders

Stibbe et. al.'s article "Gender differences in adult ADHD" analyzes the differences between male and females in terms of cognitive function. They found that women tend to have the inattentive presentation of ADHD that displays symptoms similar to depression and anxiety, while men deal with more hyperactivity and impulsivity. During a test that analyzed working

memory and impulse control, they found that women had lower reaction times compared to men. At this time, ADHD diagnosis criteria does not evaluate with gender differences in mind despite proof that there are differences in ADHD presentation between males and females.

In the article “ADHD in Girls and Boys” written by Skogli et. al., they explore the presentation of ADHD in boys and girls in terms of coexisting symptoms and executive dysfunction. In the study, they found that ADHD girls are more likely than boys to display coexisting symptoms such as anxiety and depression. This leads to girls being more likely to internalize ADHD symptoms while boys are more likely to externalize symptoms. When evaluating executive dysfunction, “[c]ognitive flexibility and verbal fluency were the most important distinguishing variables in males, whereas working memory and inhibition were the most important distinguishing variables in females" (Skogli et. al. para. 33). Skogli et. al.’s study found that the executive function evaluations were better at distinguishing between ADHD and non-ADHD males, while the evaluation of co-existing symptoms worked for both ADHD boys and girls.

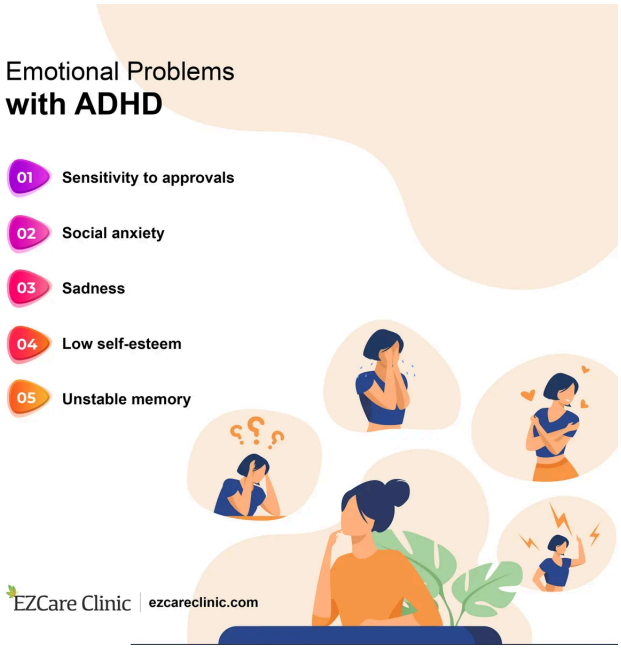

Fig. 9

3.3 Sensory Sensitivity

The article “The relationship between ADHD traits and sensory sensitivity in the general population” written by Maria Panagiotidi et. al. is a research study that links sensory difficulties

to ADHD traits. Difficulties with sensory processing is one of the lesser known issues for those within the ADHD community. Sensory processing issues often leads to overstimulation in various circumstances such as social interactions, work, platforms, public settings, etc. Overstimulation within these environments are caused by noise, texture, color, light, and even smell. Understanding what leads to these issues can help people design in a way that is friendly to sensory issues.

Maria Panagiotidi et. al. in the article "Relationship between sensory processing sensitivity and attention deficit hyperactivity disorder traits" explored the connection between sensory sensitivities and ADHD traits in a study. They used the Highly Sensitive Person Scale which has 27 items that evaluate how particular stimuli makes the person feel. With the study, they found that there is a correlation between ADHD symptoms and self-reported sensory sensitivities. One of the findings was that external stimuli can lead to inattention, one of the main traits of ADHD.

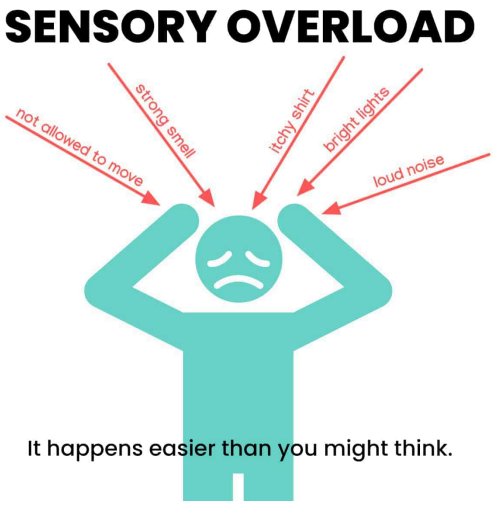

Fig. 10

4. Design for ADHD

4.1 Classroom Design for Neurodivergent Learners

The article "Radical Inclusion" written by Mary Lord discusses the idea of optimizing the classroom environment to be more inclusive for students that are neurodivergent. "Just how many neurodivergent undergraduates might benefit from retooled curricula and pedagogy remains to be seen, but these students' underrepresentation is striking. ADHD, for instance, has

been shown to correlate with creativity, inventiveness, and risk taking—potential assets in engineering" (30 Lord). Lord discusses the link between creativity and neurodivergence, and how these people can be the future of creative problem solving, however they are underserved in academic settings. She brings up various accommodations that could be implemented into the classroom to help optimize neurodivergent students' learning.

4.2 Impact of Occupational Environments on ADHD Individuals

In the article "ADHD in context: Young adults' reports of the impact of occupational environment on the manifestation of ADHD" by Lasky et. al. explore how environments can affect the intensity of ADHD symptoms in adults. They explore this through a study that consisted of ADHD adults that were diagnosed during childhood. It was found that school and work environments that were ill-suited for people with ADHD oftentimes led to poor performance which "often prompts an ADHD diagnosis" (Lasky et. al para. 47). They found that occupational environments that are under-stimulating for ADHD persons leads to inattention. For my research, it is important to address the fact the people with ADHD can both be understimulated and overstimulated by their environments.

4.3 Sensory Sensitivity Friendly Design

Asha Hegde's article "Sensory Sensitivity and the Built Environment" discusses the main sensory processing issues consistent with neurodivergence and how designing a safe environment can be beneficial. They also acknowledge the lack of disability regulation involving inclusive design for those with developmental disorders. With regulations in place, environments

can be more neurodivergent friendly, creating less daily overstimulation and comfortable environments for everyone.

5. Conclusion

In a world designed for neurotypicals, there is a heavy push for those with ADHD to conform to their world, instead of creating a design that would be ADHD friendly. With the negative connotations placed on those with ADHD, it is hard to get support and resources that would help someone with ADHD function in a world not designed for them. There needs to be more focus on designing for people with ADHD and other neuro-diversities to create a more inclusive and comfortable environment for everyone.

Related Disciplines

1. Introduction

While studying ADHD, I have found that the disciplines psychology and architecture are most related to the topic of ADHD-friendly design. In psychology, I will be focusing specifically on the branches brain science and cognitive psychology, human factors and engineering psychology, and the topic of gender differentiation within psychology. For architecture, I will be focusing on environmental design and interior design. Each of these disciplines play a different role in the development of ADHD-friendly design.

2. Psychology

2.1 What is Psychology?

Psychology is the study of "the relationships between brain function and behavior, and the environment and behavior" ("Science," para 1). A psychologist often uses the scientific method to research how people's minds operate, resulting in findings that help people navigate new ways of functioning in this convoluted world. The types of findings found during research depends heavily upon the subcategory of psychology a psychologist is focused on. Subcategories within psychology include: brain science and cognitive, climate and environmental, clinical, counseling, developmental, experimental, forensic and public service, health, human factors and engineering, industrial and organizational, teaching and learning, quantitative, rehabilitation, sport and

Fig. 11

performance, and social psychology. For the purposes of my research in ADHD, I will focus on cognitive psychology and human factors and engineering psychology. I will also be discussing the idea of gender differentiation within psychology.

2.2 Brain Science and Cognitive Psychology

Brain science and cognitive psychology is the "study [of] how the human mind thinks, remembers, and learns" ("Science"). This branch of psychology helps people understand the decision making process and world perception. Research of ADHD through the lens of cognitive psychology helps create a better understanding of how the ADHD mind works differently from the neurotypical mind. Knowing these differences can help designers evaluate current designs geared towards neurotypicals, and brainstorm ways to improve them to make them ADHD friendly.

2.3 Human Factors and Engineering Psychology

Human factors and engineering psychology is the use of the science of human behaviors to create products, systems, and devices that improve everyday life and make it easier. Using studies that have already been conducted about how a person with ADHD behaves would help designers consider what types of design would be most effective for those with ADHD. Knowing the common behaviors of people with ADHD helps designers create on their actual behaviors, rather than the behaviors than people except people with ADHD to conform to.

2.4 Gender Differentiation within Psychology

Gender differentiation in psychology is not considered a branch of psychology like brain science and cognitive psychology and human factors and engineering psychology; however, it is still an important aspect of psychology to address for the topic of ADHD-friendly design. According to the American Psychological Association, gender differentiation is defined as "typical differences between men and women that are specific to a particular culture and influenced by its attitudes and practices" ("APA"). In the article "A Study of Psychological Gender Difference," Prakash and Flores completed a study on psychological differences between men and women, finding that women tend to exude more empathy and have an easier time with interpersonal relationships, while men tend to display high levels of aggression and hostility (para. 3). Gender differences such as these are essential to note when evaluating men and women for ADHD because these differences can play a role in the ineffectiveness of current ADHD testing that caters to the male display of ADHD.

3. Architecture

3.1 What is Architecture?

Architecture is "the art and science of designing and making buildings, or the style of a building" ("Architecture"). The discipline of architecture focuses on creating an environment that matches the purpose of the building. Architecture is broken down into many sub-disciplines such as, landscape, naval, urban design, seismic, commercial, and interior architecture, just to name a few. For the

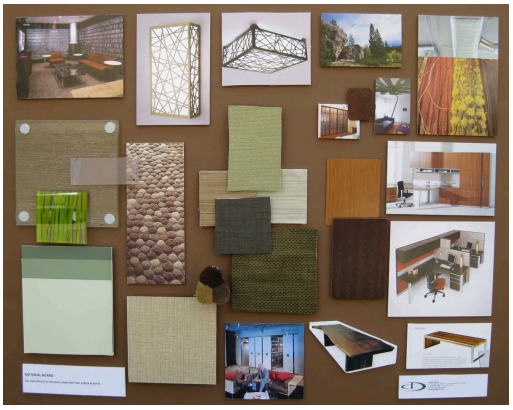

Fig. 12

purposes of my research in the designing of ADHD friendly environments, I will focus on the discipline of interior architecture, which is a focus of the design of spaces that is structured by physical boundaries and the human interactions that are to occur within them. Specifically, I will be focusing on the two subcategories: environmental design and interior design.

3.2 Environmental Design

Environmental design is the process of developing ways to create a certain atmosphere in buildings, plans, and products. This type of design works to make environments comfortable for people that will be interacting with them, whether it be frequently or every now and then. Environmental design is related to my topic of ADHD friendly design in terms of ADHD friendly environments. Environments that will accommodate someone with ADHD will look different to what we currently see, which is design created for the neurotypical. We need environmental designers to help plan and make the changes to the environment to make it comfortable for all, not just neurotypicals.

3.3 Interior Design

Interior design is the use of design to create comfortable and aesthetic interiors of buildings. There is a branch of interior design called commercial interior design, which is the interior design of industrial buildings, offices, restaurants, multi-dwellings units, retail buildings, hotels, and luxury estates (Aey). This type of design is used in a large number of buildings that people interact with everyday, however it is normally geared towards the neurotypical. The current focus on design for neurotypicals is what brings interior design into relation with my research topic. With particular attention to what type of furniture, colors, lighting, and spaces is

ADHD-friendly, there could be a focus to make environments more comfortable and pleasing to those with ADHD.

4. Conclusion

Through my research, I found that the disciplines psychology and architecture relate to my research on ADHD and ADHD-friendly design. Each of these disciplines play a different role in understanding, developing, and implementing designs that will be ADHD-friendly. Psychology helps build a better understanding of the ADHD brain and why they react positively or negatively to certain designs while architecture directly addresses the design people will be submerged into on a daily basis.

Theories and Philosophies

1. Introduction

I found that the theory of neurodiversity, the theory of mind, and the sensory integration theory relate most to the topic of ADHD. I will be elaborating upon these theories in further detail, as well as discussing the two theories' relationship to ADHD-friendly design.

2. Theory of Neurodiversity

2.1 What is the Theory of Neurodiversity?

According to the article “What is Neurodiversity,” written by Baumer and Frueh, “[n]eurodiversity describes the idea that people experience and interact with the world around them in many different ways; there is no one ‘right’ way of thinking, learning, and behaving, and differences are not viewed as deficits" (Baumer). The term neurodiversity refers to autism, ADHD, dyslexia, bipolar, anxiety, post-traumatic stress, and schizophrenia. Traditionally speaking, these neurodiversities are viewed as disorders that need to be fixed by psychologists and psychiatrists. However, the theory of neurodiversity labels these as diverse ways of thinking rather than disorders that need to be fixed. Many people disagree with this theory and believe that neurodiversities need to be labeled as mental illnesses that need to be cured.

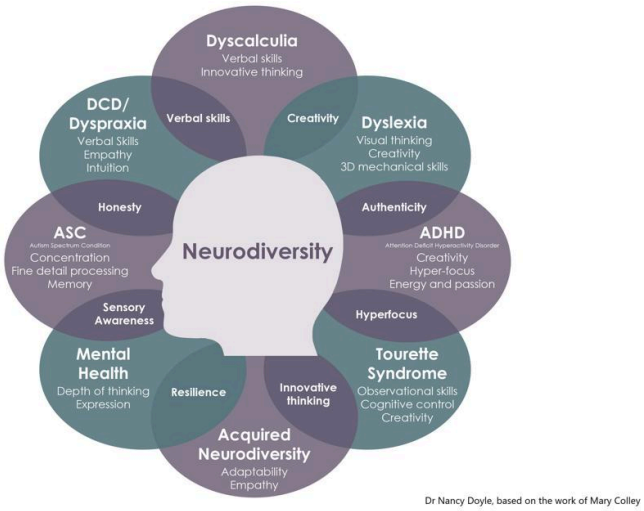

Fig. 13

The theory of neurodiversity also goes into the idea of creating environments that are compatible with neurodiverse minds. They discuss creating environments that are not overwhelming or overstimulating to those who are neurodiverse. Qualities of an environment that is neurodiverse-friendly mainly caters to sensory issues such as noise, light sensitivity, and clear communication.

2.2 Relationship to ADHD-Friendly Design

Each of the neurodiversities discussed above come with challenges that have to be overcome such as difficulties with functioning and socializing in a society that is made for the neurotypical. The theory of neurodiversity plays a direct role in the advocacy of ADHD-friendly design and is one of the driving forces of this idea. ADHD-friendly design prevents the neurodiverse from having to conform to a world that was not designed for their unique way of thinking.

3. Theory of Mind

3.1 What is the Theory of Mind?

According to the article “How the Theory of Mind Helps Us Understand Others” written by Ruhl, the “[t]heory of mind is the ability to attribute mental states - beliefs, intents, desires, emotions, and knowledge - to ourselves and others” (Ruhl). A person’s theory of mind is what helps them understand and predict other people's physical and mental actions. Theory of mind is a necessary process for complex social interactions such as teaching someone a new action but being able to take into account that they have never completed this action before meaning they will possibly need extra guidance.

There are multiple components that make up a person's theory of mind that develops overtime. First, I will discuss the categories agents, goals, and intentionality. Agents are what gives people the ability to identify moving objects as something that can act by themselves. Being able to recognize goals is the ability to recognize and physically interact with agents. Lastly, the concept of intentionality is the ability to recognize unintentional actions versus intentional actions. This concept also discusses the skill and understanding needed to intentionally perform a specific action.

Second, I will discuss imitation, synchrony, and empathy. Imitation is "the human tendency to carefully observe others' behaviors and do as they do - even if it is the first time the perceiver has seen this behavior" (Malle). Synchrony is directly related to the concept of imitation for it is when people simultaneously mimic each other. An example of this would be two people having a conversation with each other and they are mimicking each other's body language and hand movements. Lastly, the concept of automatic empathy acts upon imitation and synchrony where people are affected by another person's emotions and the physical portrayal of these emotions.

Third, I will discuss joint attention and visual perspective taking. The concept of joint attention is when multiple people focus their attention on a particular object or action. Visual perspective taking is when someone takes into consideration the other person's positioning to an object rather than just thinking about it from your own personal perspective. Fourth, I will be discussing simulation and projection. Simulation is the idea of modeling others' mental states based upon your own mental states. The concept of social projection is when someone assumes that another person's perspective is the same as our own, which can be viewed as the lack of perspective taking. Last concept to discuss is the idea of the explicit mental state inference. The

explicit mental state inference is "[t]he ability to truly take another person's perspective requires that we separate what we want, feel, and know from what the other person is likely to want, feel, and know" (Malle).

3.2 Relationship to ADHD-Friendly Design

The levels at which theory of mind operates in a person's life depends upon the way their brain works. In the article "The Relationship between the Theory of Mind Skills and Disorder Severity among Adolescents with ADHD," Senay Kilincel conducted a study to determine if there was an impaired theory of mind in those with ADHD. Kilincel's study found that "[t]he group with ADHD was seen to have ToM skills impairment" where ToM means theory of mind (Kilincel 1). With an impaired theory of mind, people with ADHD may struggle more with understanding or predicting people's behaviors or actions which can make complex social interactions more difficult and frustrating. So, in terms of design, creating environments that are not overstimulating to help eliminate outside distractions for those with ADHD so that they are able to better focus on using the skills associated with the theory of mind. Adjustments in a physical environment can help decrease the amount of frustration that can occur in everyday life for those with ADHD.

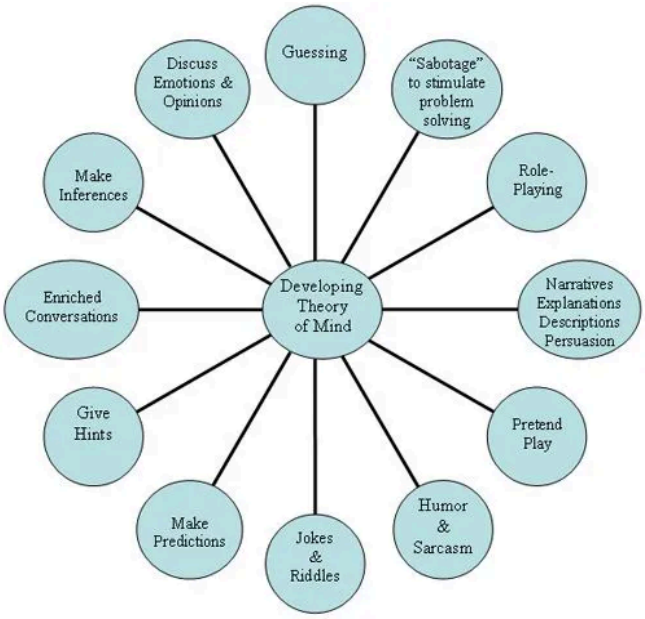

Fig. 14

4. Sensory Integration Theory

4.1 What is the Sensory Integration Theory?

Sensory Integration is a theory that was developed by the occupational therapist Jean Ayres which is defined as "the neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment" (DiMatties para. 3). The term sensory integration is also referred to as sensory processing, which was discussed previously. Sensory integration refers to the main five senses of touch, sound, sight, taste, smell as well as the two senses vestibular and proprioception. Vestibular refers to a person's sense of movement and balance which is the sense of where one's head and body are in relation to space and the surface. Proprioception is the joint/muscle sense, which is the ability to sense where one's body parts are and how they are functioning.

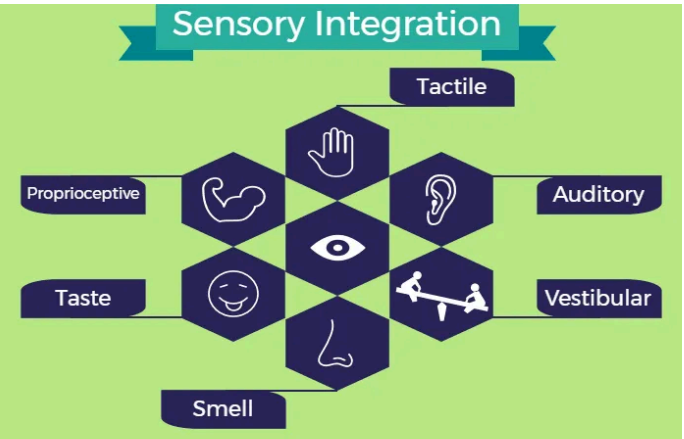

Fig. 15

A component of the Sensory Integration theory is the idea of dysfunction in sensory integration (DSI) which affects a person's ability to perceive sensation. How well someone is able to process senses affects a person's ability to discriminate sensory information and modulate sensory information. Discriminate sensory information is what creates a person's awareness of their body and environment and directly affects their ability to interact with the physical world. For example, motor planning, which is the ability for someone to plan for an unfamiliar body movement, is related to discriminating sensory information. Modulating sensory information is

what creates a person's ability to adjust to various types of stimuli. An example of a modulating sensory information dysfunction is called sensory defensiveness which is when a person has "aversive or defensive reactions to non-noxious stimuli across one or more sensory systems" (DiMatties para. 10).

4.2 Relationship to ADHD-Friendly Design

Sensory integration, also known as sensory processing, can be affected by the way a person's brain works or processes the information. "Current estimates indicate that 5% to 16.5% of the general population have symptoms associated with sensory processing challenges and these estimates are higher for clinical populations such as autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD)" (Miller para. 5). Five percent to 16.5 percent of the population ranges from 400 million to 1.3 billion people in the world that deal with sensory processing disorders. With a large percentage of the people that deal with sensory processing disorders also dealing with ADHD, it is fair to conclude that environments that account for sensory processing issues would in turn be ADHD-friendly. Environments that are created to be sensory-friendly will allow for people with ADHD to experience less overstimulation within the environment, in turn creating less distractions.

5. Conclusion

The theory of neurodiversity, theory of mind, and sensory integration theory all help people understand the idea of designing for those with ADHD. Theory of neurodiversity discusses the idea of labeling neuro-diversities as just different ways of thinking rather than labeling them as mental illnesses. On the other hand, the theory of mind is the ability to

understand people's mental states based upon various forms of observation. Lastly, sensory integration theory explains how sensory information is processed and what issues sensory dysfunction can create. The theory of neurodiversity directly advocates for ADHD-friendly design and the theory of mind shows one of the many reasons there is a need for ADHD-friendly design while sensory integration theory shares a way for designers to create environments that are sensory-friendly, and in turn ADHD-friendly.

ADHD-Friendly Design Guidelines

1. Introduction

Based on the research presented throughout this paper, I have found that ADHD-friendly environments need to primarily focus on design that is not overstimulating. On the other hand, the design also needs to create some stimulation for the ADHD mind. Both overstimulation and under stimulation can lead to struggles with focus in ADHD individuals. Another important component of ADHD that needs to be considered when creating ADHD-friendly design is design that promotes emotional regulation and positively affects a person's mood. In this section, I will be outlining general guidelines for ADHD-friendly interior design, primarily focusing on colors, lighting, materials, decoration, and spaces.

2. Design Guidelines

2.1 Colors

For large areas or over all color schemes, it is best to use muted green or blue earth tones and neutral colors.

Fig. 16. Muted Green Earth Tones

Fig. 17. Muted Blue Earth Tones

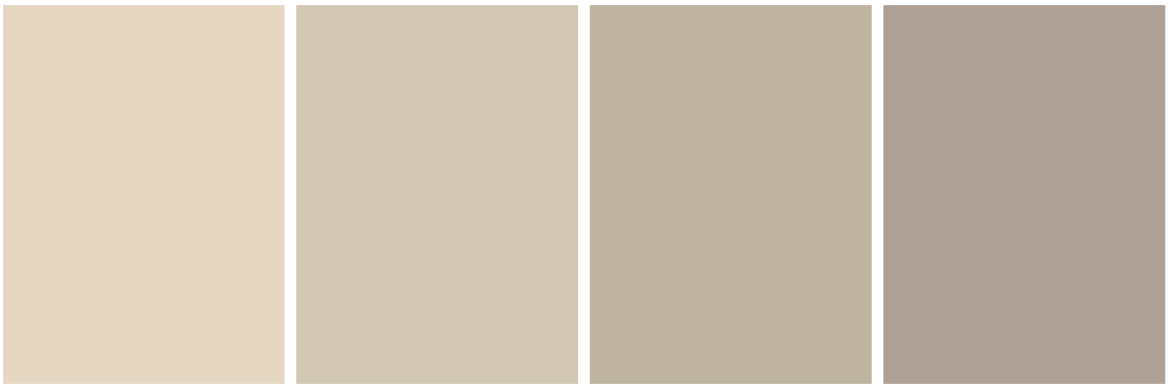

Fig. 18. Neutral Tones

Earth tones and neutral colors help prevent overstimulation in ADHD individuals, leading to less distractions caused by color in their environment. Plus, earth tones and neutral colors help create feelings of calmness in individuals, thus helping with emotional regulation.

To help counteract under stimulation, brighter colors such as red or yellow can be used sparingly to create stimulus.

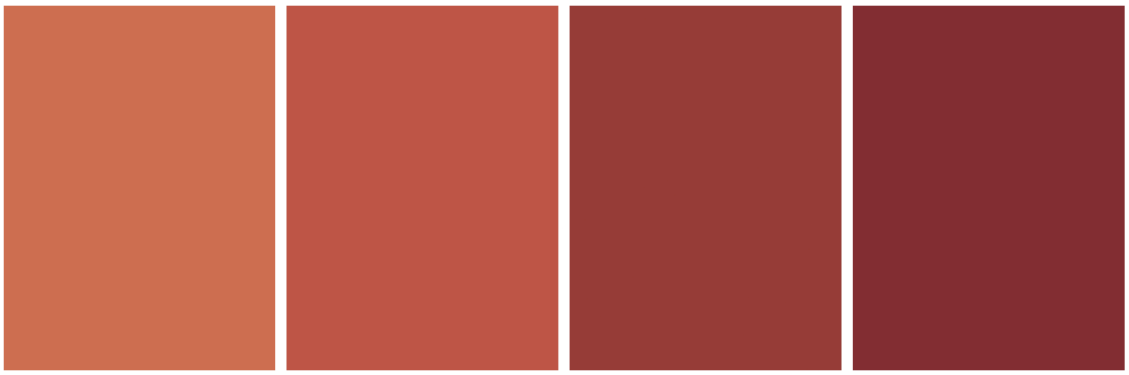

Fig. 19. Red Earth Tones

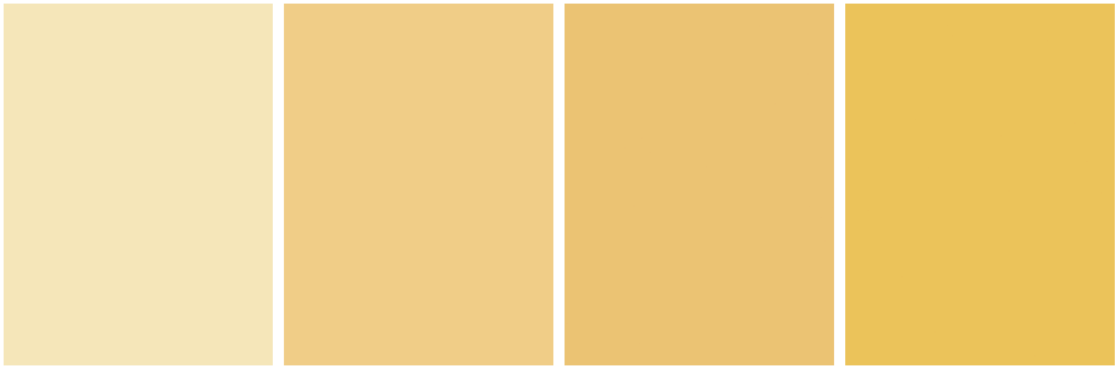

Fig. 20. Yellow Earth Tones

However, I would suggest keeping these colors within the realm of earth tones to help create stimulus without creating visual distractions or dysregulated emotions. A good way to bring these colors into an environment would be through decorations.

2.2 Lighting

Bright lighting in interior environments is one of the main contributors to overstimulation in those with ADHD. The best type of lighting for individuals with ADHD is natural lighting. One of the best ways to achieve effective natural lighting is with big windows, as seen in Figures 21 and 22 below.

Fig. 21

Fig. 22

When considering alternative lighting options for those with ADHD, it is best to avoid the use of harsh, white light and use soft, yellow-tinted light instead. The lighting referred to as 6000k in Fig. 23 is a good example of harsh, white light that should not be used. On the other hand, the 4000k and 3000k lighting is a good example of lighting that would be ADHD-friendly. However, 4000k might still be too harsh for some ADHD-individuals depending on their personal level of sensitivity to processing light. When referring to the use of yellow-tinted light, I am mainly focusing on overhead lighting in rooms, lamps, and string lights. Figures 24 and 25 are good examples of string lights and lamps that would be ADHD-friendly due to their minimalistic design using soft-yellow lighting.

Fig. 23

Fig. 24. String Lights

Fig. 25. Floor Lamp

Lighting that is able to be adjusted is best for ADHD individuals because it allows them to determine what brightness level they need or are able to handle that particular day.

2.3 Materials

For ADHD individuals, it is best to use natural materials such as stone and wood when choosing furniture. Good examples of furniture using natural materials are figures 26 and 27 below.

Fig. 26. Desk

Fig. 27. Bedframe

In terms of upholstery, it is best to choose textures that are not scratchy or dry due to those textures being the most likely to cause sensory issues for those with ADHD. However, in personal spaces, the materials used will fully depend on the individual's sensory likes and dislikes.

2.4 Decoration

In terms of decorating an ADHD-friendly interior, it is best to take a minimalistic approach. The interior should have some decorative elements to create stimulus, but not so much decoration that it becomes distracting to the individual. Fig. 28 provides a wonderful example of a minimalistic style that would be ADHD-friendly. The interior has minimal decoration, a simple painting, a lamp, and furniture, which will lead to less distractions and overstimulation for an ADHD individual. Another good object to incorporate into ADHD-friendly environments are labels. Incorporating a labeling system into the environment will help with organization and an ADHD-individual's ability to locate particular items.

Fig. 28

2.5 Spaces

For individuals with ADHD, it is important to have designated spaces for particular tasks to help create a connection to a particular task or routine. An example of this would be only laying or sitting in bed when you are actively trying to go to sleep or only doing schoolwork at a

desk. Only type of space that can be created in a space that helps with overstimulation and under stimulation. Fig. 29 shows a sensory swing which helps people when they are experiencing extreme overstimulation by applying pressure to the person's body to help regulate their elevated emotions. In this same space it would be good to incorporate items such as rugs, textured paintings, and sensory toys that would give something for the person something to mess with for stimulus. The textures incorporated into this space would fully depend on the individual's sensory likes and dislikes.

Fig. 29. Sensory Swing

3. Conclusion

As stated at the beginning of the paper, it is estimated that two to five percent of adults are diagnosed with attention deficit hyperactivity disorder, which is about 160 to 400 million people (Stibbe et al. 2). ADHD affects a large number of people throughout the world, creating a need for environments that are ADHD-friendly. Based upon my research, the main difficulties ADHD individuals experience with neurotypical environments is overstimulation and understimulation, both of which are caused by sensory processing issues. Both overstimulation and under stimulation can cause issues with focus and emotional regulation. However, gender plays a role in the exacerbation of particular ADHD symptoms. Male ADHD tends to be expressed through hyperactivity and impulsivity while female ADHD tends to mimic anxiety and depression. Despite the predominance of different symptoms between men and women with ADHD, the design solution to help minimize symptoms such as hyperness, distractibility, and emotion dysregulation are the same.

Overall, the general framework of ADHD-friendly design focuses on the use of colors, lighting, materials, decorations, and spaces to help prevent overstimulation while also providing some stimulus to prevent understimulation. Muted greens, blues, and neutral tones help promote focus and feelings of calmness, while reds and yellows can be used sparingly to create stimulus. Lighting should either be natural or a soft-yellow color to avoid overstimulation. Natural materials and materials that are not scratchy or dry are best for those with ADHD. Decoration should be kept minimal to prevent distracts but still provide some stimulus for the individual. Lastly, having designated spaces for particular tasks or activities helps someone with ADHD formulate habits and regulate emotions. The general design guidelines I have provided are a good place to start when designing for individuals with ADHD, however personal preferences, sensory likes, and sensory dislikes will all play a role in the effectiveness of these guidelines and should be adjusted accordingly.

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