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Sensory Processing Disorder: A Design Research Report

Ashley Booth
abooth@siu.edu

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SPD

**SENSORY
PROCESSING
DISORDER: A DESIGN
RESEARCH REPORT**

A. BOOTH'S HONORS THESIS



CONTENTS



Introduction

What is sensory processing disorders

- characteristics
- types of therapy
- helpful products



Survey Insights:

- demographics
- how people are effected



Conclusion

- research insight
- design direction



INTRODUCTION

Many children, teens, and adults have sensory processing disorder or experience the same symptoms. Symptoms include over-sensitivity or under-sensitivity to the environment, poor balance, meltdowns, and more.

Although many people do not realize that they have SPD, **research suggests that this effects 15 million people in the U.S.**

More specifically, 5 to 15% of all school-aged children have some type of sensory processing disorder. 40 to 85% of children with other disabilities like Autism, also experience SPD.

This wide demographic shows the need for further exploration into SPD. After further exploration, **I will identify a specific area that holds opportunities** for my industrial design thesis.

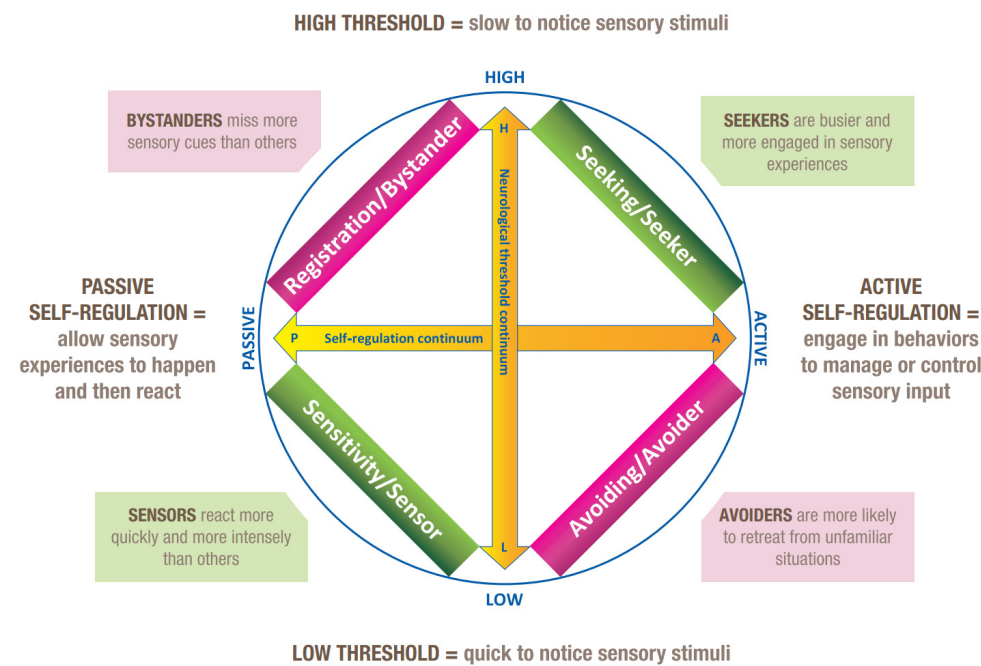
● WHAT IS SPD?

Sensory Processing Disorder (SPD) is a **neurological disorder that causes a person's nervous system to misinterpret the environment via the senses.**

In order to **understand the relationships between behaviors and neurological thresholds patterns**, occupational therapist Dr. Dunn created the Sensory Processing Framework. When people with SPD behave a certain way, his matrix can help understand their behaviors.

With SPD, however, comes controversy. Not all doctors, schools, and caretakers recognize SPD as a proper diagnosis. It is often mistaken for ADHD and other behavioral problems.

Dunn's Sensory Processing Framework



● THE SENSES AND THE BRAIN

What's happening

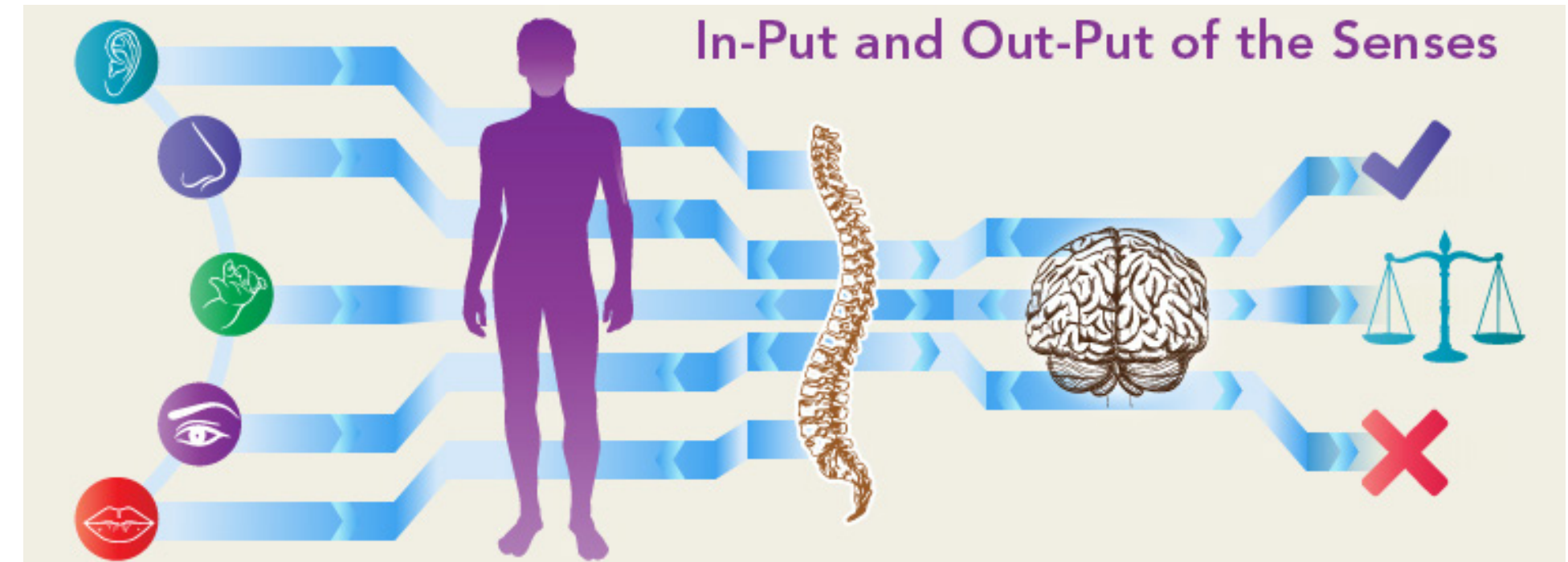
According to neuroscientist Dr. Hylin, sensory processing disorders occur because the patients' brain and central nervous system are not wired the same as the majority of the population.

A deeper look

As demonstrated below, people with SPD do not have effective sensory "gates" and their environment is not filtered. This can lead to sensory craving, over-sensitivity, and other SPD subtypes.

Causes

Although we know the neurological causes of SPD, we do not know why some brains are like this. From genetics to environmental factors neuroscientists and doctors have not found a direct cause for sensory processing disorders.



● A NEUROLOGICAL VIEW

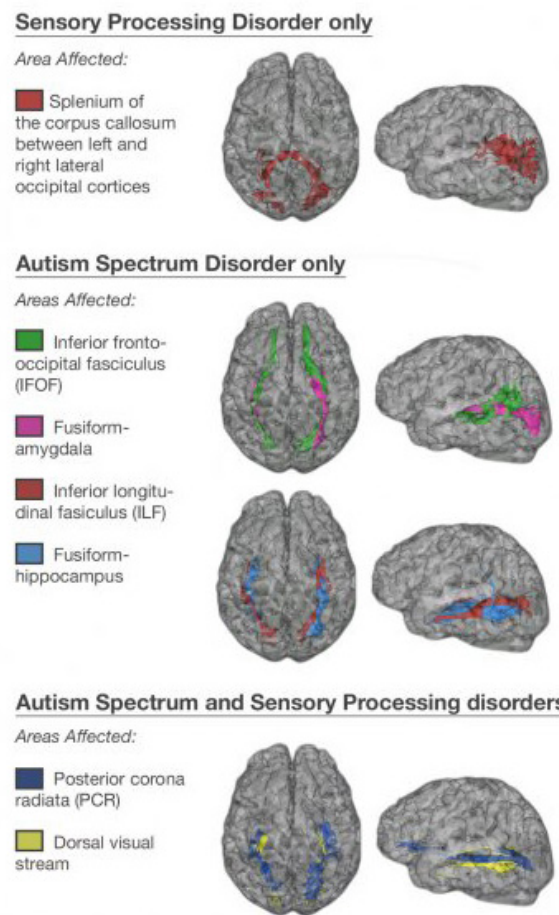
There are many types and behaviors associated with SPD that can often resemble other behavioral disorders. However, **even though behaviors often look similar from the outside, they are neurologically different.**

The study, as shown here, investigated the areas of the brain affected in children with SPD, Autism, and both. It discovered that the area affected in SPD children is the corpus callosum. Although it appears to be slightly on those on the Autism Spectrum, the **disconnectivity of the corpus callosum is mostly isolated with SPD.** The corpus callosum is responsible for coordinating motor skills, processing sensory information from the nervous system, and other cognitive tasks.

Not only does this explain why processing sensory information is different for people with SPD, but it concretely shows that **SPD brains are wired differently** instead of being a symptom of different issues like many skeptics believe.

Mapping Sensory Processing Disorders in the Brain

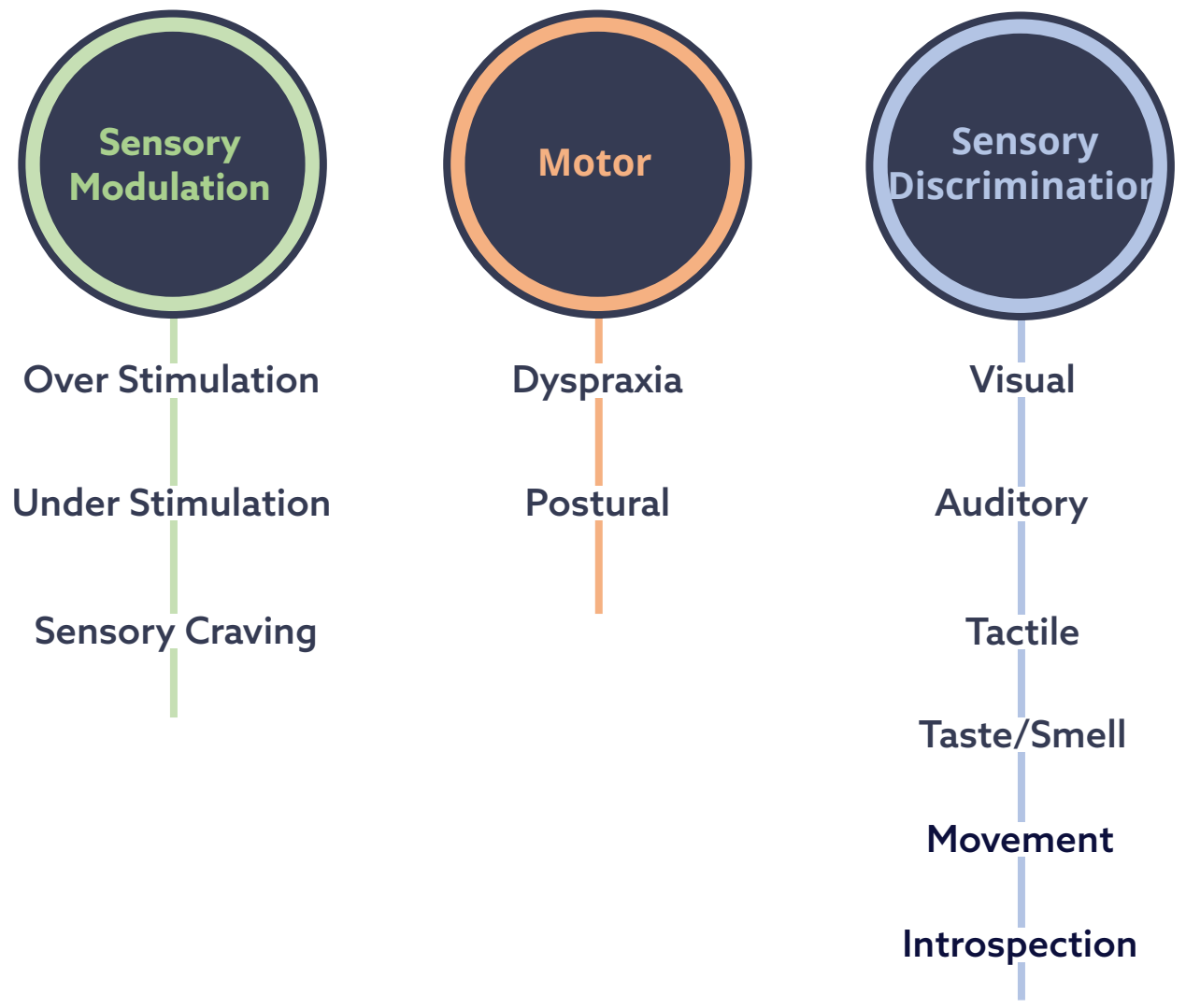
Children with sensory processing disorders have decreased structural brain connectivity in specific sensory regions different than those in autism. Here's a closer look at the areas affected.



Source: Mukherjee lab/UCSF

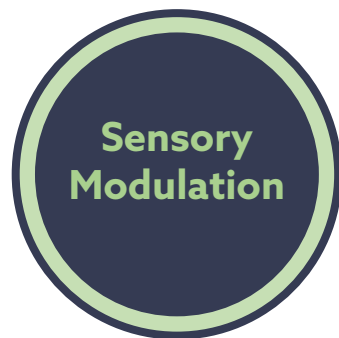
● TYPES OF SPD

Characteristics of sensory processing disorder have been organized under three umbrella terms. Within those terms, the behaviors and physiology problems have been furthered defined and categorized.



<https://www.ucsf.edu/news/2014/07/116196/kids-autism-and-sensory-processing-disorders-show-differences-brain-wiring>
<https://www.ucsf.edu/news/2013/07/107316/breakthrough-study-reveals-biological-basis-sensory-processing-disorders-kids>
http://cnsvp.stanford.edu/atlas/corpus_callosum.html

● SPD: SENSORY MODULATION



People with sensory modulation **struggle with the organization of the senses.** Their brains are unable to efficiently sort the information received and distribute the information as needed.



Over Stimulation

Those with over-stimulation are more sensitive to their environment. This can cause anxiety and panic attacks. In response to these feelings, they may try to avoid contact with triggers.



Under Stimulation

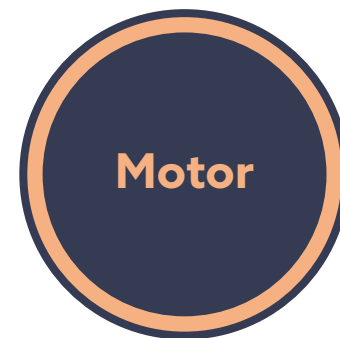
Unable to detect sensory stimuli properly, those with under stimulation may struggle with body movements. In children, this can look aggressive as they may accidentally run into others.



Sensory Craving

These people feel the need to consistently seek out sensory stimuli. This could involve anything from trying to touch everything to spinning in circles for long durations.

● SPD: MOTOR



Those with motor-based sensory disorder have issues with **controlling balance and have poor body awareness.**



Dyspraxia Disorder

Controlling motor skills and processing sensory information into organizational methods is an issue for people with dyspraxia. This often includes like making and following a plan.



Postural Disorder

Postural disorder makes it difficult for the body to understand its orientation. This makes controlling one's body, especially when standing or sitting, difficult.

● SPD: SENSORY DISCRIMINATION



With sensory discrimination, the brain is **unable to process information** from the senses accurately. This often means **associating stimuli with the wrong connotation**. More specific examples include:

Visual: unable to see the difference between the letters "O" and "Q".

Tactile: unable to feel the difference between acorns or walnuts.

Movement: unable to feel if tripping backward or falling forward.

Auditory: unable to differentiate similar sounding words like "pen" and "pin".

Taste/Smell: struggles to taste the difference between oranges and grapefruits.

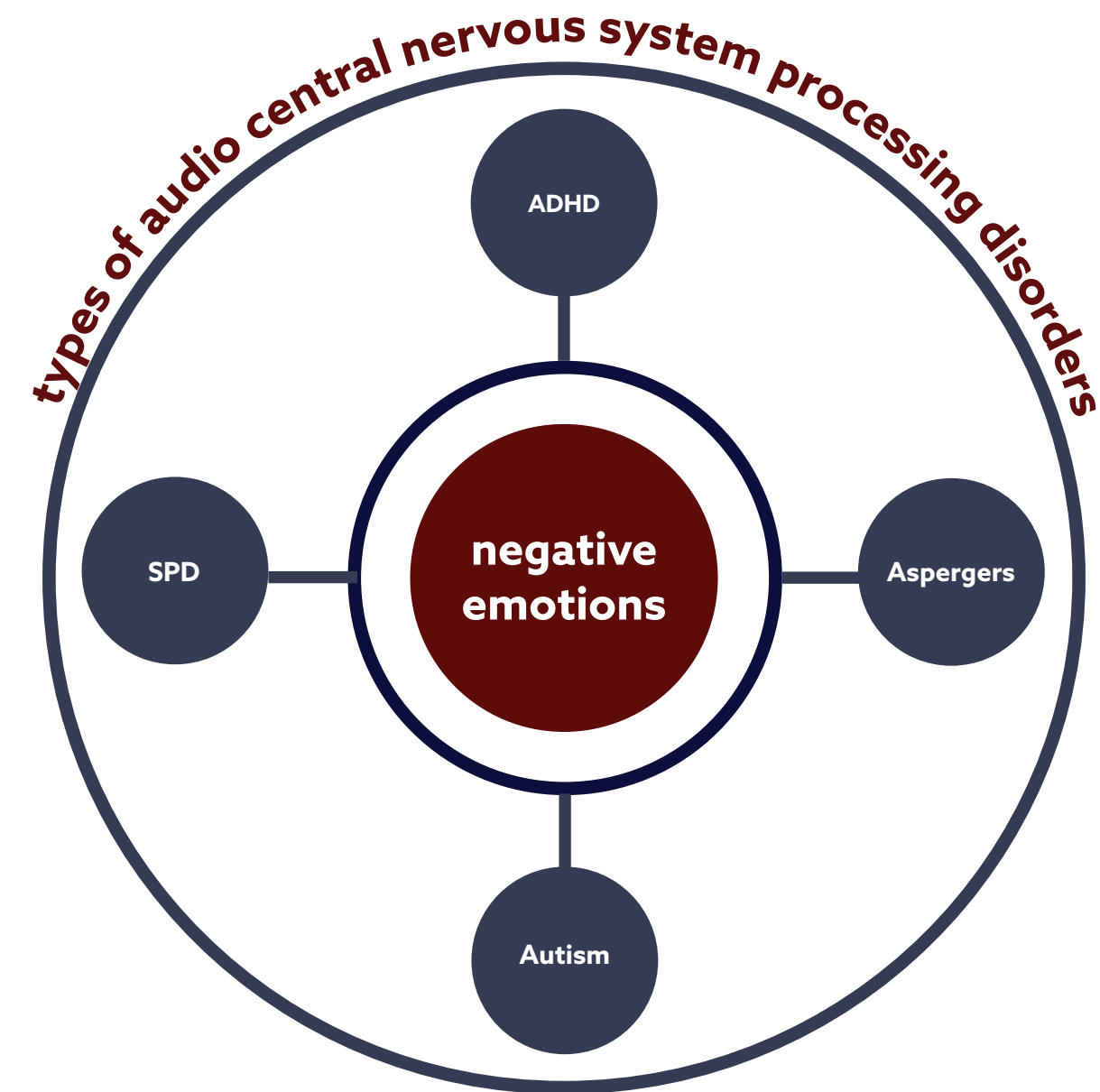
Introspection: not able to understand if food craving is out of need or because of want.

● SPD: IT'S A COMBO

People who may have Autism, ADHD, ADD, Aspergers, and more often have some form of SPD.

Those with SPD often experience more than one subgroup. for example, a child may have issues with visual discrimination, craves tactile senses, but is over stimulated by sounds.

However, **a side effect that all of these neurological disorders include is negative emotions** for the person with the disorder, caretakers, and surrounding people who lack the understanding.



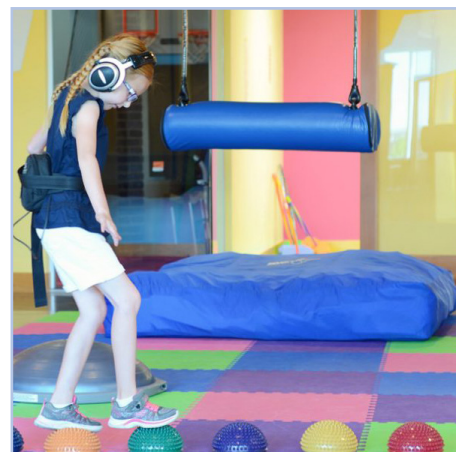
● A HELPING HAND: THERAPY

Therapy Types

Depending on the type of SPD and the personality characteristics of the person, **the approach and the type of therapy varies.**

Despite the differences in SPD types, there are some standard therapy genres that are applied in order to help with SPD. This includes sensory integration therapy, occupational therapy, physical therapy, cognitive behavioral therapy, and play therapy.

Together, these therapy methods can be tailored to be more individualized. This will be a more effective treatment.



Sensory Integration Therapy

Many therapists use sensory integration as a way to help a person cope with sensory issues. By changing a person's experience and stimuli association, this method aims to make SPD easier to manage.

Although sensory integration therapy can be used on its own, it is more effective when paired with occupational therapy and other types of therapy.



Occupational Therapy

OT's evaluate the child and work to find a method that helps them focus and changes behaviors via mindset. Common methods include brushing, a sensory gym, and sensory diet.

Occupational therapy is widely used for all subtypes of SPD but can be more effective when paired with another therapy type to address the SPD issues in a more personalized manner.



Physical Therapy

Often used with occupational therapy, physical therapy focuses on developing motor skills, spatial awareness, coordination, motor planning abilities, and flexibility.

Although this focuses on the physical health of the patient, physical therapy can help boost self-esteem, social skills, and self-regulation.



Cognitive Behavioral Therapy

Unlike physical or occupational therapy, cognitive behavioral therapy focuses on behavior and mindfulness. Doing this addresses anxiety, depression, eating disorders, and obsessions without dependence on medication.

This type of therapy focuses on working with the therapist to create treatment plans, understand self-help, and keeping track of progress.



Play Therapy

Play therapy gives the patient, normally a child, a chance to relax at their own pace. This encourages communication, explores thought processes, and insights on behaviors.

Play is essential for healthy childhood development. It can help develop social, and emotional skills.

Tools for play include dancing, storytelling, dolls, and other toys.

● THE SPD COMMUNITY ONLINE

By following blogs and joining online support groups for SPD, I was able to participate in conversations, find resources, see rants, and ask questions.

Topics that appeared repeatedly in these communities include:

- finding the right type of therapy
- everyday coping methods
- sensory-friendly products
- anxiety and panic attacks
- advice for talking about SPD
- tips for handling overwhelming environments like work or school



SPD Sensory Processing Disorder



The Sensory Spectrum



you have it.

Going to a restaurant and asking not to sit near children, is always trouble. The parents tend to have complete ignorance of the fact their children do make sudden loud sounds. You are considered a child hater, because it's assumed you have a problem with children. Hardly anyone, is willing to realize it's due to my sound sensitivity.

I'm tired of people suggesting wearing earplugs 24/7 is supposed to be some sort of magical fix for my condition. I need to still hear people, earplugs interfere with that. Most of my troubles are due to other people refusing to behave appropriately. If your child is crying and making noise in a restaurant, take them outside the public space till they calm down. Don't want to do that, hire a babysitter.

Marcia Akhmedov · Sensory Processing Disorder Adult Support

I'm confused about something. Many of you mention using noise canceling headphones. So, I decided to look into them. Many of them are for listening to music. WHAT?!? I thought they were for helping to create quiet, like earplugs. Also, some are wired and some are wireless. I just don't get it. I wear glasses too, and I wonder about the feeling of squeezing my head. Please share with me what you use/recommend and how you use them (w/ music or w/o music). Thanks.

Yes for me. I do meditation to ground me with headphones on I usually listen to Of monsters and men radio, I also do light exercise and eat well (lots of veggies and protein lower sugar and fats no dyes). I have found the more tuned in with my body and mind the easier it is to control these regressions. I practice the same with my children when they allow it lol

Like · Reply · 1h

10 mins of each everyday keeps me steady

Like · Reply · 1h

Write a reply...

I have a severe level of SPD since I'm four months old (but I get diagnosed in December), it fluctuates from one day to another, from one moment to another. Sometimes almost everything is unbearable to me. I'm trying meditation, but it's challenging because of my concentration problems.

Like · Reply · 1h

This is why I use music. If you focus on one thing it helps the rest fall away. Some people find it too distracting though do you have something that holds your focus that is relaxing? Or have tried meditation in water that helps too

Like · Reply · 1h

3 hrs · 📖

Sensory Processing Disorder Adult Support

Not diagnosed. I suspect audio. When overstimulated, do you feel disconnected like things aren't real (can't think of another way to describe this)? I will feel foggy, detached, "out of it".

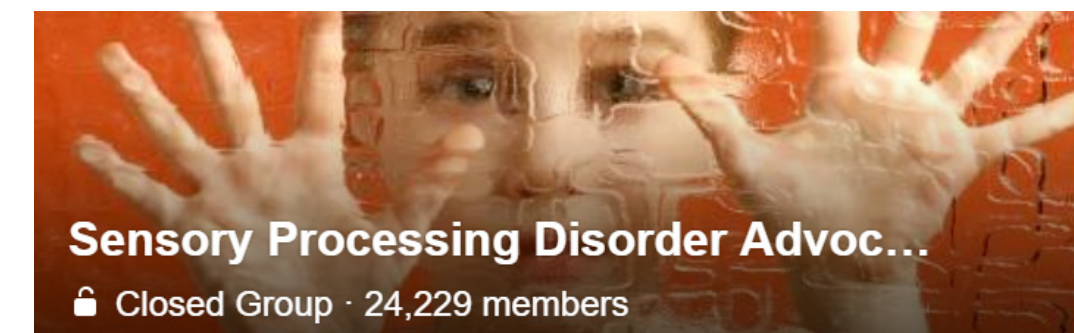
Like · Comment

● REACHING OUT: SURVEY

In order to understand the issues and the demographics SPD, I reached out to the Facebook group Sensory Processing Disorder Advocacy.

Within 24 hours, multiple members reached out expressing their interest, offering support, and overall appreciation for investigating and discussing SPD.

Within 48 hours, 190 people had responded to the survey. This led to invaluable stats and insights into the daily life of a person with SPD.



Sensory Processing Disorder Advoc...

Closed Group · 24,229 members

Ashley Booth shared a link. January 13 at 12:54pm

Hello, everyone!

I am a design student at Southern Illinois University and I am concentrating on SPD for my thesis project. If you could take a moment to complete this anonymous survey, I would love to hear what you all have to say.

Thank you!



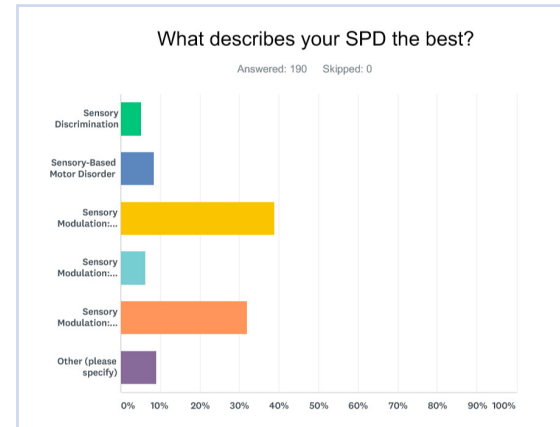
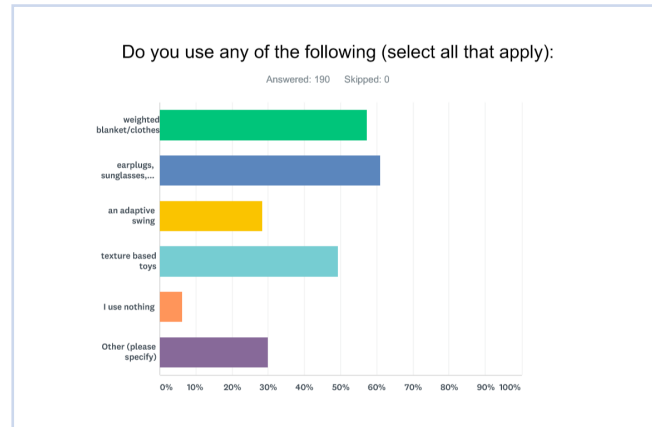
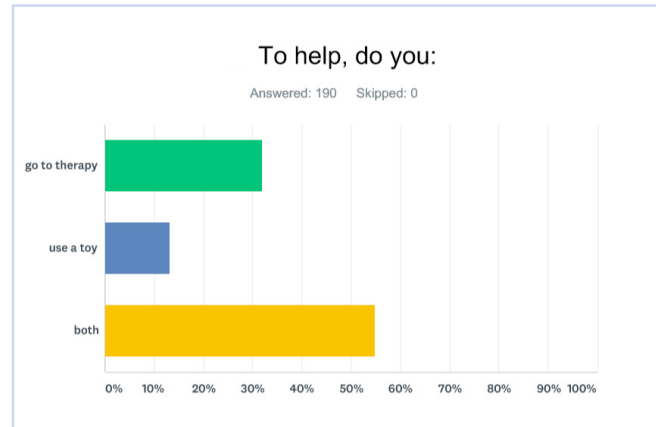
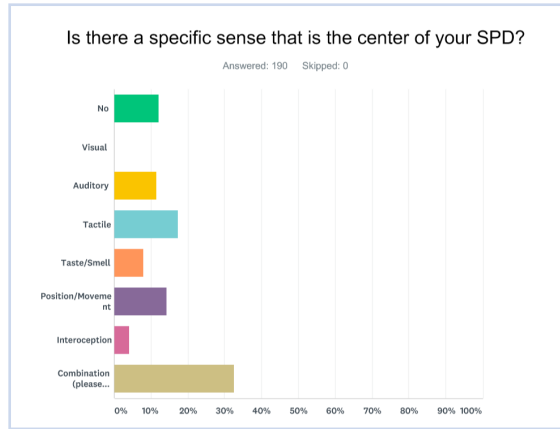
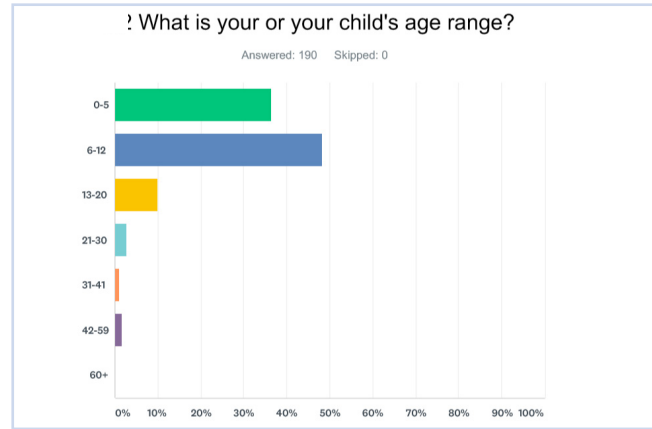
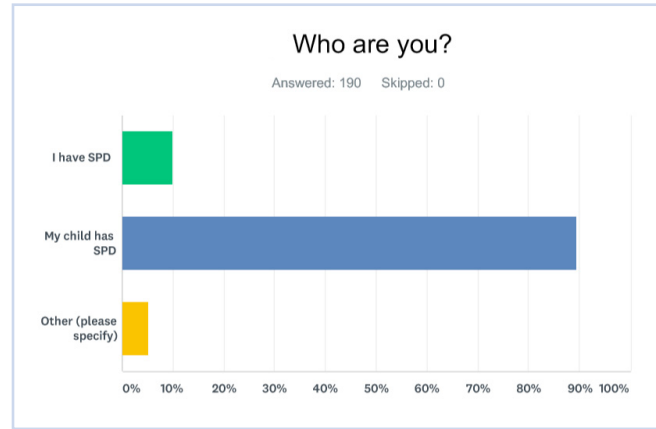
Sensory Processing Disorder Survey

Web survey powered by SurveyMonkey.com. Create your own online survey now with SurveyMonkey's expert certified FREE templates.

SURVEYMONKEY.COM

39 33 Comments

SURVEY RESULTS



SURVEY INSIGHTS

What the results say

The average age of a child with SPD is **6-12 years**

At **40%**, **over-stimulation is the most common subtype of SPD**

Most people experience issues and behaviors that involve **multiple senses**

Over **50%** of people use **both toys and therapy** to cope with their SPD

Of all the products used, **masking and calming products are the most widely used**

What the results mean

Both **parents and children 6-12 yrs.** should be considered when designing

Sensory **over-stimulation** needs to be **further explored**

Multiple senses should be addressed **in the solution**

Toys and therapy work well together and **need to be included** in designing the solution

Further investigation needs to be completed with **masking and calming products** in order to **understand their uses, their effectiveness, and their opportunity areas**

● LIVING WITH SPD: ADULTS

Child vs. Adult SPD

Adults living with SPD have the same issues that many children do. However, **many adults may not have been diagnosed correctly or at all, do not know that they have SPD, or were diagnosed post-childhood.**

Addressing this issue is similar to therapy for children. However, unlike children, adults have less neuroplasticity than children. This can require more intensive therapy. Some things that need to be consciously learned can include **relearning behaviors and motor skills, developing adapting and coping methods, sensory diet programs, and communicating issues to others.**

A Hidden Issue

Additionally, because behaviors had time to simmer and develop, **it is difficult to distinguish SPD related behavior from other disorders** like depression, anxiety, and anti-social. A more behavioral example is refusing to eat because of tactile sensitivity can look like anorexia.

Daily Impact

Another issue is the extent of the affect of SPD in the adult's life. It branches to effect **the different levels of life like work, socializing, romantic, financial, and family life.**

For example, an adult with hypersensitivity may have to work in specific environments or must wear masking tools like sunglasses and ear protection. As an adult, wearing things like this becomes more frowned upon.

● LIVING WITH SPD: KIDS

Factors

Besides therapy physical or occupational therapy, children's **behaviors are influenced by internal and external factors.** This includes allergies, amount of sleep, nutrition habits, environmental atmosphere, and characteristics of brain function.

Tools

Children often use toys to cope and to learn. Although useful, these **tools are often distracting if used in school.** Some schools offer sensory rooms to help with therapy. In early education, teachers often use mats, puzzle, and weight blankets to help students regulate sensory issues.

Behavior

Behaviors are influenced by one's internal fight or flight response that is triggered by stimuli. **Those with SPD, however, often react to this response intensely.** An example of this could be spinning for hours, refusing to talk, or rejecting to wear certain clothes because of the material's texture.

Diagnosis

With children, it can be difficult to understand if a child's behavior is caused by SPD, a behavioral disorder like ADHD, or if a child is just having a rough day.

The tell-tale difference between SPD and other disorders, however, is that SPD shows different neurological wiring. This, as discussed previously, can be seen via CAT scans. However, most diagnoses are given by occupational therapists.

Being able to get a diagnosis involves teachers, parents, counselors, and other caretakers.

To help, some schools offer programs like Individualized Education Program (IEP) or reach out to therapists.

● LIVING WITH SPD: CARETAKERS

What's happening

When it comes to diagnosis, therapy, and coping methods, it is primarily the caretakers' responsibility. This is especially true when it comes to children. **Caretakers must reassure the SPD person while reinforcing positive behaviors and mindfulness.**

When doing this, caretakers are often searching for therapists and answers to specific behaviors. Caretakers often find these answers and other information **online, in social media, from therapists, and while talking to others.**

Creating an environment

Caretakers must also consider creating a sensory friendly environment in the home. This can include adjusting the environment by dimming lights, adding tactile-friendly areas, and minimizing noise-making areas. **To understand if this is working, caretakers can track process in order to gain insights about changing behaviors.**

All of these responsibilities, consistent problem solving, and attentiveness, **can wear a caretaker down after a period of time.**

● THE OUTSIDE PERSPECTIVE

At School

Teachers are a major part of noticing behaviors and diagnosing disorders. However, because classrooms are overwhelmed with students, it is difficult to be able to spend time understanding each child. Additionally, **educating educators about SPD takes time and resources that schools may not have.**

Other students may give the SPD student unwanted attention. If the SPD student is still learning coping methods, then other students may also feel negative emotions.

At Work

Like school, adults with SPD may have difficulty being apart of the office community. SPD may make it difficult to be complete tasks efficiently, socialize, and concentrate during the work day. If coworkers do not understand and work around the issues, then it could lead to anxiety and job-switching.

In public

Sometimes strangers do not understand why people with SPD are behaving the way they are. This can lead to assuming bad attitude or parenting skills and harsh judgment can be made. **This spreads and endorses negative emotions.**

Occasionally, entertainment and educational businesses will factor in SPD into their environment. This often **includes dimming lights, minimizing sounds, and creating sensory friendly areas for calming.**

● OUTSIDE PERSPECTIVE

Kelly Richter

St. Louis City Museum
Sensory Day Organizer



"I was trying to imagine something we could do to accommodate those with special needs [...] and Sensory Days was born."

When: started last year and worked with Autism Speaks for an understanding of how to be more sensory friendly.

Why: looked at other museums that were becoming more accommodating to those with special needs and wanted to widen their breadth of accessibility.

How: Exhibits are adjusted to be less obnoxious with sound and lights are dimmed. Also created a quiet area to provide a sensory break. It is held on a Sunday since fewer people tend to come on that day.

Response: Overwhelmingly positive and supportive response. However, the museum does not limit admission and that was the only complaint.

● PARTICIPATORY RESEARCH

To understand the user experience, I wore earplugs while pet sitting vocal animals.



ANALYSIS: MIND MAP

A pamphlets from government-run therapy places.

B ideating design requirements

C analyzing survey results

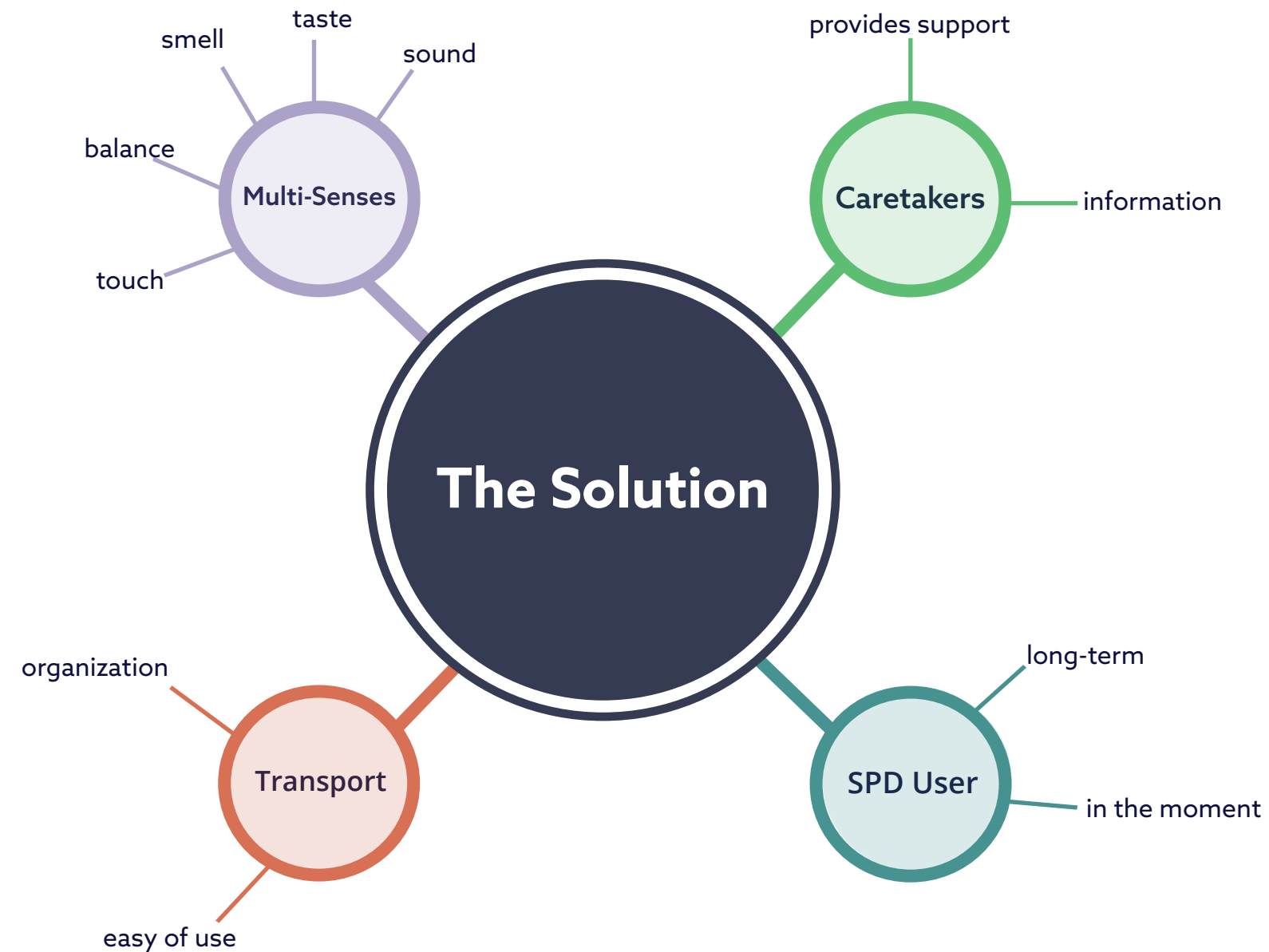
D understanding coping methods



KEY RESEARCH ELEMENTS

- Every person with SPD has a **unique neurological wiring and behavioral issue.**
- **Caretakers need support** and often go online to search for help.
- Users need access to coping methods no matter when or where. This calls attention to the need for **constant availability.**
- Therapy, even when done properly, needs years of practice and **reinforcement from caregivers**
- SPD involves multiple senses. The most effective coping methods and therapy also **incorporate multiple senses.**
- Along with behavioral issue and pain, **negative emotions** and connotation are often found in SPD and similar disorders.
- From family members to teachers and doctors, this is a need for **understanding and acknowledgment of SPD.**

CONSIDERATIONS



DESIGN DIRECTION

Using these key elements as guidelines, there are **requirements** that must be **included in the design** process and solution. This includes:

- Centering the solution around **children and teens**
- Looking at **over responsiveness** as a more specific user group
- Encouraging **mindfulness**
- Being readily **available and transportable**
- **Assisting** the caretaker