Eight Senses:
A Primer for Neuroinclusive Design

Version 1 | December 2025

Perkins&Will

"I realize blindness is less about not having sight; it's really about focusing on all these other senses, and I think that gives a very unique contribution to the architectural experience."

— Chris Downey on Architecture for the Blind

Abstract

The Problem

Design practice has often focused on a limited understanding of our senses.

Through a long prioritization of the visual sense, design practices have frequently neglected the complex interplay of our eight senses and the effect that they have on our everyday lives. This document examines how multi-sensory design can cultivate well-being and inclusivity by embracing the full spectrum of human experience.

The Promise

There are unlimited possibilities in designing for the eight senses.

By embracing all eight senses, designers can create built environments that move beyond visual aesthetics and promote a deeper understanding of connection and inclusivity. A multi-sensory design approach not only accommodates occupants of a space but also enriches the human experience.

The Premise

There are eight senses that affect how people experience and interact with built environments.

We have sight, sound, touch, taste, smell, balance (vestibular), body awareness (proprioception), and internal sensation (interoception). Together, they shape how individuals perceive, experience, and interact within built environments. Acknowledging all **eight** senses deepens our understanding of how people interact with space, enabling the creation of environments that accommodate diverse sensory needs.

The Purpose

Through designing to create an intentional sensory-friendly world, we create spaces where people can thrive.

By creating a more sensory-friendly world through design, we build spaces where people feel grounded, understood, and able to be at their best without fear of overstimulation. The goal is to design environments that support—not detract—from how we naturally sense and move through the world. This allows everyone, regardless of age, background, or sensory experience, to find balance and belonging.

Why This Matters

All eight senses work together to shape the way we percieve qualities of space and matter.

Most people spend the majority of their lives indoors, over 90% of our time, in fact.[4] At the same time, urbanization is accelerating; the United Nations projects that nearly two-thirds of the world's population will live in cities by 2050. As more of our lives unfold within built environments, the quality of these environments becomes central to our lived experience. Our spaces must deliberately support multi-sensory well-being rather than inadvertently detract from it.

There are numerous opportunities to embed well-being and sensory experience into design. For example, spaces with a slight citrus scent invite occupants to engage in cleaning behaviors while polished stone and wood details evoke an awareness of mouth and taste.[5] Hotels pump signature scents through air vents to get guests to relax.

Multi-sensory design moves beyond the visual, and engages multiple senses such as sight, sound, touch, smell, and balance to create environments that are more inclusive, responsive, and meaningful for the full spectrum of users.[6]

These experiences are not linear.

Our senses are prone to change, especially with age and life experiences (below). A sense that elicits a strong reaction at one point in one's life can decrease over time and be replaced with another sense. What used to be an auditory sensory seeking behavior may now be a sensitivity. Designing with flexibility of a space ensures that any person, at any stage of life, can experience their surroundings in an environment that supports their diversity of sensory input.

Hyper-sensitivity

Hypo-sensitivity

What are the senses?

5 Common Senses

Auditory (Hearing)

Auditory receptors within our inner ear identify volume, pitch of sound, rhythm and tone.

Gustatory (Taste)

Taste receptors throughout our tongue create our sense of sour, bitter, salty, and sweet.

Olfactory (Smell)

Smell is processed through receptors in our nose that are associated with memory and scent recognition.

Tactile (Touch)

Tactile receptors exist throughout the skin to help us distinguish what we have touched.

Visual (Sight)

Our visual system is responsible for sight and helps us determine our attention in the world around us.

3 Hidden Senses

Vestibular (Balance)

This sense uses receptors located within the inner ear to keep ourselves balanced during movement.

Interoceptive (Internal Body Awareness)

Receptors within our internal organs transmit signals to our brains informing us of bodily functions like hunger.

Proprioceptive (External Body Movement)

Receptors are located within the muscles to provide information about where we exist within space.

Facts & Figures

Sensory difference is more common than you may think.

Globally, 15% of people live with a disability—many of which directly affect how they sense, process, and move through the world.[8] Prevalence also isn't evenly distributed. In the United States, African Americans are the most likely to have a disability (14%) followed by Non-Hispanic Whites (11%), Latinos (8%) and Asians (5%).[9] While nearly half of LGBTQIA+ adults reported a disability in the past year.[10] These aren't abstract figures; they reflect daily realities for people navigating sound, light, movement, and crowding in environments that were rarely designed with their needs in mind.

Sensory-related disabilities are especially widespread. By 2050, nearly 2.5 billion people will have some degree of hearing loss, and 430 million will experience profound or severe hearing loss.[11] Roughly 2.2 billion people already live with a vision impairment.[12] And because disability can emerge at any point in our lives, most of us will experience sensory change and challenges firsthand.

Sensory processing + disability inclusion = a shared design opportunity

There is meaningful overlap between disability and neurodivergence, particularly in how people process sensory information. Many individuals experience multiple disabilities or combined sensory sensitivities, making supportive environments essential for complex needs. Research shows disability is common, multi-layered, and rarely isolated to one sense—reinforcing the need for thoughtful multi-sensory design.

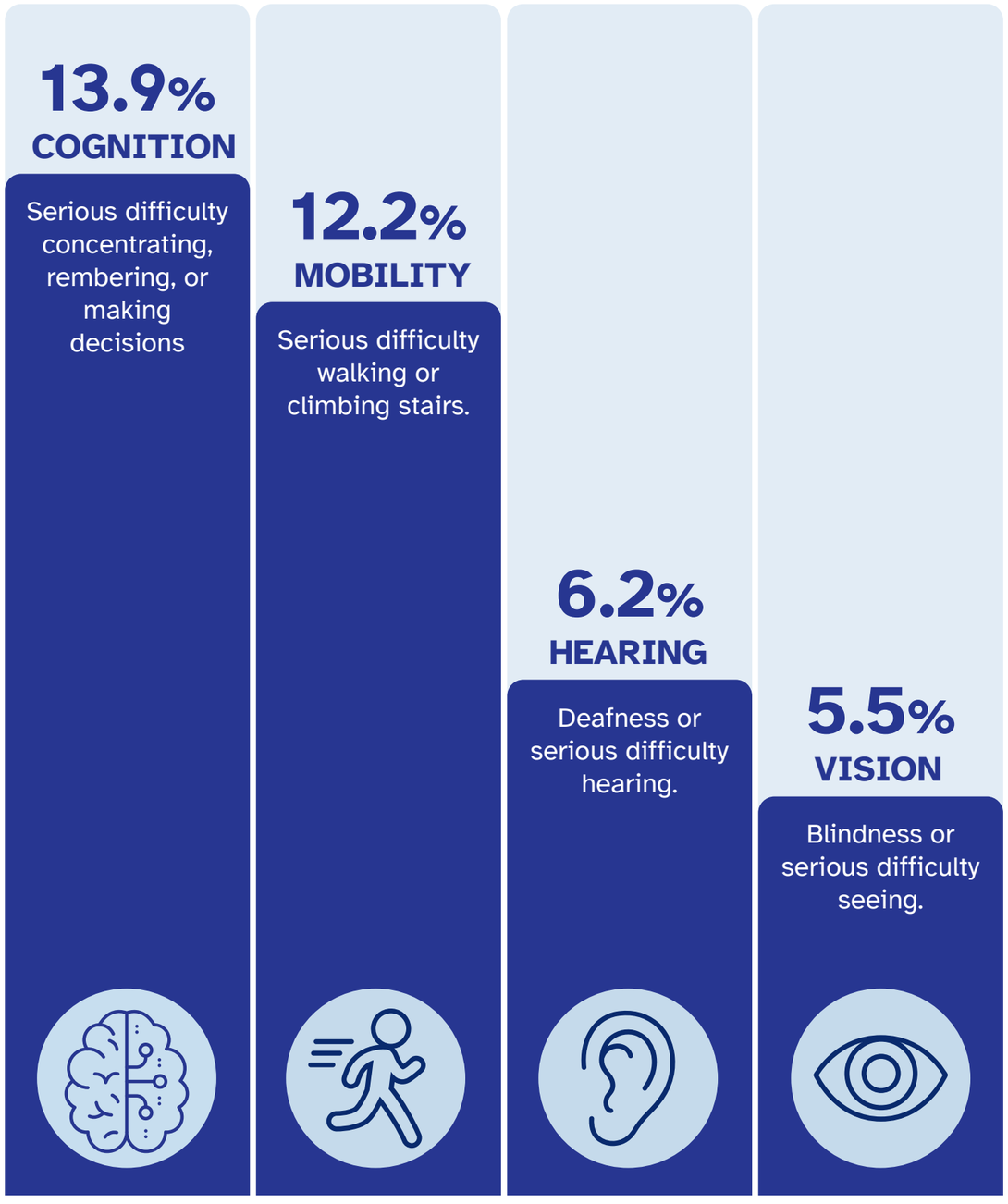
Age is one clear example of how sensory needs can compound over time.

Older adults face especially sharp sensory shifts: nearly 75% experience impairments to postural balance, which is the ability to maintain stability, and closely tied to the vestibular sense.[13] Environments that reflect the rich spectrum of human sensory experience beyond the traditional five senses enable the built environment to truly welcome all bodies and ways of sensing the world.

1 out of 4 older adults has a hearing impairment

3 out of 4 older adults have abnormal postural balance

Prevalence of sensory processing impairments of U.S. adults



Adapted from: **The CDC**

Multi-Sensory Variability

Our sensory experiences are both interconnected and diverse. While everyone's sensory experience is uniquely positioned along a spectrum, it can also range from hyper-sensitive to hypo-sensitive.

Hyper-sensitive responses are a heightened sensitivity to sensory stimuli, also known as sensory over-responsivity.

- May lead to experiencing sensory information more intensely
- Can increase the likelihood of being overwhelmed when stimuli change suddenly or itensify.
- Everyday sounds, like a ticking clock or a vacuum cleaner, seem excessively loud or sharp.

Hypo-sensitive responses are a reduced sensitivity to sensory stimuli, also known as sensory seeking.

- May lead to under responsive sensory experiences
- Can require more stimulation to register sensory input.
- Liking firm pressure, such as tight hugs or weighted blankets

Understanding Sensory Processing

Each of the eight senses can elicit different responses for each person. While someone may be hyper-sensitive in one sense, they could be hypo-sensitive in the other, while having no sensory difference in a third.

For example, two individuals with Sensory Processing Disorder can have very different experiences. One person might be hypo-sensitive to light and may need more intense visual stimuli while being hyper-sensitive in touch and uncomfortable around certain textures. Their friend with the same diagnosis may have a very different sensory profile.

In addition, people can be experiencing hyper-sensitivity in one sense and hypo-sensitivity in another sense at the same time.

Case Study: Airport Stimuli

Sensory processing is dynamic. Our thresholds for each of the eight senses shift based on context, stress, fatigue, and past experiences. Research on Sensory Processing Sensitivity (SPS) suggests that some individuals are more prone to overstimulation when environments, like busy transportation hubs, become intense.[14] Empirical studies also show that overload in environments with high sensory demands increase feelings of fatigue, stress, and sensory distress, even when objective task performance might remain stable.[15]

In the context of an airport, a person might feel hyper-sensitive in one domain (e.g., sound) and hypo-sensitive in another (e.g., interoception or vestibular) depending on moment-to-moment demands.

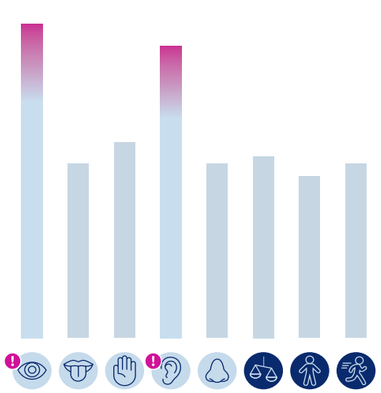
By mapping those fluctuations through a "sensory profile across journey" (right), it is clear that **sensory needs are situational states rather than fixed traits.** This insight helps designers and planners anticipate varied user experiences and embed options for relief, clarity, and sensory-regulation.

Think about walking through an airport.

Visually, you might focus on making out the signage for your gate. You might also be hyper aware of any announcements that can be heard over the intercom. With all this excitement, you forgot to feed yourself earlier, but now you feel hunger set in, and you locate food that satisfies your sense of taste and smell. As boarding begins, you're more interoceptively sensitive as the crowding around you becomes uncomfortable. While standing in line, you shift your weight from one foot to another for relief.

Sensory Profile Across Journey

Entrance / Check-in

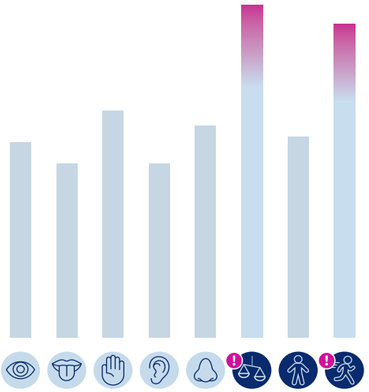


Sensory Stimulation

Confusing signage, glaring surfaces, and bright light can put strain on individuals with **hyper-sensitive visual** processing.

Speakers, crowds, and announcements can overwhelm people that are **hypersensitive to sound** and could even be painful to someone not anticpating them.

Circulation

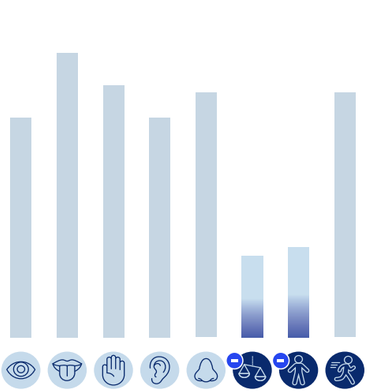


Sensory Stimulation

Cluttered spaces, moving sidewalks, and obstacles can disorient someone with **vestibular hyper-sensitivity**.

Being in a dense line of people with little personal space can be a source of stress someone who has **proprioceptive hypersensitivity**, who may not enjoy a lack of personal space and being touched by others.

Boarding



Sensory Stimulation

While waiting for their group to be called for boarding, a person with **hyposensitive vestibular** sensitivity might feel uncomfortable remaining still for an extended period.

Someone with **hypo-sensitive interoception** might have not registered the need for restroom access until it became urgent.

Navigating Sensory Variability

Sensory experiences can present differently across each sense;
the examples below are illustrative, not exhaustive.

Visual (Sight)

Hyper-sensitivity may include:

Seeking out dark environments and reacting strongly as if in pain to bright, fluorescent light. Individuals may be bothered by flashing lights and reflective surfaces.

Hypo-sensitivity may include:

Struggling to distinguish letters and numbers or judge the distance between people and other objects. Individuals may also struggle to recognize facial cues and crave visually intense videos.

Gustatory (Taste)

Hyper-sensitivity may include:

Specific food needs and avoid textures like chewiness. Individuals may be described as a "picky eater" and could be underweight due to low appetite.

Hypo-sensitivity may include:

Desire to chew or taste inedible objects, prefer textures like crunchiness, or seek strong flavors (for example, very spicy foods). Individuals may also have an unusually large appetite

Tactile (Touch)

Hyper-sensitivity may include:

A dislike of physical contact with dirt, water, or other people even in close proximity. Individuals may refuse to wear certain textures.

Hypo-sensitivity may include:

Desire to seek physical contact with specific surfaces, play roughly, and have a higher-than-usual pain tolerance.

Auditory (Hearing)

Hyper-sensitivity may include:

Desire to seek quiet spaces away from bothersome sounds. Individuals may cover their ears or react in pain to loud noises and frighten from unexpected ones.

Hypo-sensitivity may include:

A preference for loud environments, speak at higher volumes, make repetitive sounds, or prefer constant background noise.

Olfactory (Smell)

Hyper-sensitivity may include:

Being particular about odors and fragrances, noticing scents that others don't. Individuals might refuse certain pungent foods or avoid spaces with strong smells.

Hypo-sensitivity may include:

A preference for foods with strong aromas or less awareness of smells in their environment.

Vestibular (Balance)

Hyper-sensitivity may include:

A feeling of unsteadiness or motion sickness during movement-based activities. Slanted, uneven, or transparent floors may feel destabilizing.

Hypo-sensitivity may include:

An enjoyment of spinning sensations or reluctance to sit still, sometimes leading to rough or impulsive movement.

Interoceptive (Internal Body Awareness)

Hyper-sensitivity may include:

Feeling pain more intensely or feel hunger or restroom more frequently.

Hypo-sensitivity may include:

Struggling to register hunger, thirst, or restroom cues. Individuals might not feel tired until completely exhausted.

Proprioceptive (External Body Movement)

Hyper-sensitivity may include:

Avoidance of hugs or touch from others and anxiety in tightly enclosed spaces.

Hypo-sensitivity may include:

Enjoyment of rough play, bumping into objects, and deep pressure, sometimes making it hard to judge how much force they are using.

Design Implications

These implications are prompts for inclusive design across the spectrum, not a complete list.

Visual (Sight)

Goal: Reduce visual overload while supporting clear wayfinding and optional visual stimulation.

For **hyper-sensitive** users, soften environments with low-arousal colors, minimal patterning, adjustable dim lighting, and high-contrast signage to avoid nausea.[16]

Use structured colors and patterns for wayfinding. Offer optional visual stimulation for **hypo-sensitive** users (water tubes, lava lamps, dynamic lighting) while limiting clutter.

Gustatory (Taste)

Goal: Support eating and drinking comfort through choice, calm, and cues that match varied taste sensitivities.

Define eating zones with dimmable lighting to create calm, comfort, and control for **hyper-sensitive** users.[17]

Minimize competing sensory distractions to support diverse taste sensitivities. Provide sensory-friendly eating spaces that match individual preferences. Use clear, well-lit food prep areas to boost visual appeal and encourage eating for **hypo-sensitive** users.

Olfactory (Smell)

Goal: Limit unwanted odors and give users control over scent intensity, while enabling scent-based wayfinding.

Provide fragrance-free areas, avoid artificial scents, and offer aromatherapy. Ensure ventilation, purifiers, and diffusion. Use location-specific aromas.

Enable airflow/partition control for **hypo-sensitivity**.

Vestibular (Balance)

Goal: Support stability by reducing disorienting motion and offering predictable movement through space.

Avoid busy patterns for walls and flooring. Offer audio descriptions and optional gentle rocking furniture. Provide predictable paths and stable surfaces in transition areas. Avoid abrupt level changes or fast elevators.

Tactile (Touch)

Goal: Provide tactile variety and deliberately integrated touch experiences, with clear sensory transition zones.

Provide varied textures and deep-pressure opportunities. Use soft upholstery, textured panels, and clear transition zones between sensory areas, placing tactile moments strategically rather than everywhere. Offer temperature variety and natural materials (rough stone, embossed finishes, stimulating textiles).[18]

Auditory (Hearing)

Goal: Design acoustics to minimize distressing noise while offering helpful sound cues for navigation and engagement.

Control acoustics with sound-absorbing materials (carpeting, baffles) to reduce echo and reverb for **hyper-sensitive** users. Add soundproofing, limit noise pollution, provide sound masking, and include quiet zones.

Use biophilic sounds/music as buffers and auditory cues to support navigation for **hypo-sensitive** individuals.[19]

Interoceptive (Internal Body Awareness)

Goal: Help occupants notice and meet internal needs (hunger, thirst, rest, toileting) through clear cues and barrier-free access.

Use scent cues for meals and optional rocking for self-soothing. Clearly mark restrooms and hydration points. Subtle light or airflow changes at dawn/dusk support awareness of needs and circadian rhythms.[20]

Proprioceptive (External Body Movement)

Goal: Support body movement and spatial awareness using soft, legible environments and opportunities for controlled movement.

Use soft, padded finishes to support uncoordinated movement and body awareness. Reduce sharp edges and uneven surfaces. Add grab bars and padded seating. Provide predictable paths with clear boundaries to prevent collisions.[21]

Dig Deeper...

Interested in understanding more about neurodiversity? Take a deep dive into the **Language Matters** document

- **Your 8 Senses -** A detailed page from the STAR Institute describing each of the eight sensory systems and how they might present in sensory processing differences.

- **About the Senses -** A resource guide by the Twenty-One Senses aimed at describing the sensory systems and their qualities.

- **Sensory Sensitivities -** A UK based health board summary of the eight sensory systems including how sensory modulation works.

Acknowledgments

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How to cite:

Marchand, K., Sattler, L., et al. (2025). Language matters: Neuroinclusion. Perkins&Will, PRECEDE: Neuro Inclusion Initiative. https://www.precede.perkinswill.com

Author's Note

This research recognizes that while this model of senses serves as a necessary starting point for understanding our sensory experience, it should be noted that this system can be seen as an example of Eurocentric bias from its universal representation of humans.

Research of modern sensory discussion going forward should acknowledge and include the role of cultural contexts in shaping sensory perceptions as a more complex and multifaceted system. Inclusive, multi-sensory design practices support diverse opportunities for everyone to explore the world regardless of their sensory ability.

We acknowledge that neuroinclusion is a global issue, and hope that this work can be expanded upon and applied from an international perspective.

We welcome feedback! If you have any questions or insights to add, or you are interested in learning more, please reach out to the primary authors:

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In addition, we want to honor the rooted and invaluable feedback from our Community Insight Partners: Nicholette Driggs, Absolutely Accessible Kent. It was critical that we collaborated directly with the perspectives of members of the disability and advocate community. We value these voices and are always looking for feedback. Please reach out with any comments or questions.

This document was made with text, formatting, color, and word choice that is best suited for reading accessibility.

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