Designing for Autism Spectrum Disorders is a much-needed resource for administrators, teachers, care givers, and designers. It will be an invaluable asset that ultimately will improve the built environment for countless children and adults.

– Rupal Engineer, Principal, Design Plus LLC, Albuquerque, USA

"Designing for Autism Spectrum Disorders displays inventive environmental designs for people with disabilities, using a unique and sensitive understanding of their strengths and challenges to see these spaces from a different perspective. This attention to detail envisions beautiful spaces that allow those with autism to thrive. My organization will utilize this sensitivity as we grow our community for adults with intellectual disabilities, planning the living and working spaces we will build in the years to come.”

– Carol Whitmore, Director, Admissions and Education Programs, The Brookwood Community, Texas, USA

Designing for Autism Spectrum Disorders explains the influence of the natural and man-made environment on individuals with autism spectrum disorders (ASD) and other forms of intellectual/developmental disabilities (IDD). Drawing on the latest research in the fields of environmental psychology and education, the authors show how architecture and interior spaces can positively influence individuals with neurodiversities by modifying factors such as color, lighting, space organization, textures, acoustics, and ventilation. Now you can design homes, therapeutic environments, work environments, and outdoor spaces to encourage growth and learning for the projected 500,000 children with ASD (in the United States alone) who are expected to reach adulthood by 2024.

Topics discussed include:

- Environmental design theories
- Symptoms of ASD
- Sensory processing deficits
- Design needs of individuals on the spectrum at all ages
- Design methods and solutions for spaces, including residential, learning, work, and therapeutic environments encompassing a wide range of budgets
- Designing for self-actualization, well-being, and a high quality of life for the duration of an individual’s life
- Avenues for healthy living and aging in place
- Biophilic design
- Environmental impact on well-being
- Strategies to promote active living as an integral part of the welfare focus

Kristi Gaines is the Director of the Graduate Programs in Interior and Environmental Design at Texas Tech University. She received her Ph.D. in Environmental Design with collateral in architecture and special education. Dr. Gaines has a combined 20 years of professional interior design and teaching experience.

Angela Bourne is an Interior Designer and Educator at Fanshawe College in Canada. Over her 30 plus years in the profession, she has kept current by regularly practicing interior design and most recently combined her PhD research in Environmental Design with her practice to form her holistic company, “Neuro-Considerate Design.”

Michelle Pearson is an Assistant Professor in the Interior Design Program at Texas Tech University. She received her PhD in Interior and Environmental Design. Her research focuses on built environments that promote health and wellness in children.

Mesha Kleibrink graduated from Texas Tech University with a Bachelor of Interior Design and Master of Science in Environmental Design. She is an associate member of IDA and currently works as an interior designer and analyst at the Texas Tech University Health Sciences Center.


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CAROL WHITMORE
Director, Admissions and Education Programs,
The Brookwood Community, Texas, USA
DESIGNING FOR AUTISM SPECTRUM DISORDERS

Kristi Gaines, Angela Bourne, Michelle Pearson, and Mesha Kleibrink
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DEDICATIONS

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To Taylor, for his positive attitude and “can-do” approach to life that makes the world a better place.

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~Angie and Mom

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PART 1

Beginnings
Individuals with Autism Spectrum Disorders are part of a growing population that is usually ignored in design. The needs of those with ASD are excluded entirely from all building codes and design guidelines. This is a serious concern, since these individuals are more sensitive to their physical surroundings than the average person. When an individual is unable to understand or adapt to their environment, negative behaviors typically ensue. Although the surrounding environment has such a strong influence over people with ASD, there is very little information on how to design spaces for these individuals.

Another prominent challenge involved in designing spaces for individuals with ASD is that no two cases are alike. ASD is referred to as a spectrum disorder because each individual has different symptoms, different sensitivities, and a different level of functioning. Symptoms vary from mild to severe; some children on the spectrum have intellectual disabilities or impaired speech, while others do not. Ideally, spaces would be designed for each individual case and the space would accommodate each unique symptom but also help individuals with ASD build a tolerance to environmental stimuli. McCallister states that environments for individuals on the spectrum should prepare them for the challenges and problems they will face in everyday life: “Cocooning the ASD pupil from all external factors will not necessarily help them reach their full potential in life.” Therefore, designers should not overly cater to users with ASD and create unrealistic environments that will leave them unprepared to face other environments.

Individuals with Autism Spectrum Disorders (ASD) are particularly sensitive to the surrounding environment, primarily because of sensory processing deficits. For many, sensory processing deficits, such as sensitive eyesight or hearing, can make the built environment a distracting and even frightening place. In her autobiography, Temple Grandin described autism as “seeing the world through a kaleidoscope and trying to listen to a radio station that is jammed with static at the same time. Add to that a broken volume control, which causes the volume to jump erratically from a loud boom to inaudible.” Many individuals on the spectrum employ coping mechanisms in the form of rigid and repetitive behaviors to deal with incoming sensory stimuli. To an outsider, these behaviors appear like an inappropriate tantrum when in actuality, they are the result of an “imbalance between the environment and an individual’s ability to adapt to it.” Architecture and interior spaces can be modified to positively influence the behavior individuals
with ASD often exhibit by modifying factors such as color, texture, sense of closure, orientation, acoustics, ventilation, etc.8

Background/History

Autism is a developmental disorder that affects the functioning of the brain. Individuals with ASD are identified as having difficulty with social interaction, communication skills, and as having a small range of interests.9 IQ levels of individuals on the spectrum can vary in range from gifted to severe mental disabilities. At the mild end of the spectrum, ASD may be nearly indistinguishable from the general public. These individuals are commonly referred to as high functioning. Others with ASD exhibit severe or life-threatening behaviors. Self-injurious behavior is uncommon in individuals with ASD, but may include head banging or biting oneself.10

According to recent reports, cases of Autism Spectrum Disorders are on the rise. Some of the more recent statistics indicate that one in 68 children is diagnosed with ASD.11 This number has risen from approximately three per 1,000 children in the 1990s.12 Similar increases have also been documented in Japan, Europe, and the UK.13, 14 Whether the increase is due to ASD becoming more prevalent or because autism awareness and detection has broadened is unknown. Some researchers believe the rise is because the diagnostic criteria for ASD now include pervasive developmental disorder (PDD) and Asperger’s syndrome.15 Whatever the reason, the increase in reported cases qualifies as a serious public health concern.16 Some fear the rise in cases could lead to an ASD epidemic.17 There are a variety of treatments but, at present, no known cure. Experts do not yet fully understand how or why the disorder even occurs.

Sensory Processing

Individuals with ASD often have abnormal responses to incoming sensory information from the surrounding environment. Typically, people receive information about a space based on all of their senses collectively: smell, sight, taste, sound, and touch. This ability is known as sensory integration and is essential to achieve a coherent perception of a situation and to decide how to act.18 However, people with ASD have deficits in sensory integration due to the inability to process information from several senses at once. This may be manifested through being hyper-sensitive to stimuli or being hypo-sensitive (under-reactive) to stimuli. Rapid shifting of attention between two different stimuli is difficult, and abnormal sensory processing can cause individuals with ASD to demonstrate unusual behaviors. Additionally, a dysfunction in this sensory integration may result in language delays and academic under-achievement.19, 20, 21 There are some reports of sensory perception deficits in which sounds are perceived as smells or colors.22

Hypo- and Hyper-sensitivity

Generally, individuals with ASD are either hypo-sensitive or hyper-sensitive to certain information pertaining to smell, sight, taste, sound, or touch. There are also instances of hyper- or hypo-sensitivities in vestibular movement and proprioception, or the ability to sense the position of the body in space. Hypo-sensitive cases appear to be under-responsive, as if certain sensory information goes unnoticed or certain senses are impaired. Young children who were later diagnosed with ASD and had hypo-sensitive auditory tendencies were often thought to be deaf as infants.23 Hypo-sensitive cases are often qualified as “sensory-seeking,” meaning they often create or generate their own sensory experiences either for pleasure or to block out other unpleasant stimuli. Conversely, hyper-sensitive cases are over-responsive to sensory stimuli. Children with hyper-sensitivity can be easily overwhelmed by incoming sensory information. The environment can be terrifying at times because loud or sudden noises feel physically painful to hyper-sensitive individuals.24 Some experts believe that this kind of sensory overload is experienced more among individuals with Asperger’s syndrome than other individuals on the spectrum.25 A common occurrence among people with ASD is the inability to use all of the senses at one time and when attempting to use more than one sense, sensory overload occurs. Sometimes these individuals need an “anchor” for their environment: “I had to feel something that stood still, something anchored, in a world that had suddenly become totally unpredictable.”26 Individuals with ASD are often slow in shifting focus between visual stimuli and auditory stimuli.27 One individual on the spectrum reported a similar dilemma in that he was unable to use more than one sense at a time: “Most
people have a mind like a flashlight, with an area of high focus, and a larger area of partial awareness; my mind is more like a laser pointer, that highlights only a single small dot. “28

Table 1.1 lists examples of symptoms that individuals with autism may face related to sensory processing and whether the symptoms qualify as hypo-sensitive or hyper-sensitive. Out of the list of sensory processing deficits in Table 1.1, children with ASD appear to exhibit auditory and tactile processing difficulties the most.29

<table>
<thead>
<tr>
<th>Sense</th>
<th>Hypo-sensitive</th>
<th>Hyper-sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditory (Sound)</td>
<td>Does not respond when name is called;</td>
<td>Overly sensitive to loud noises;</td>
</tr>
<tr>
<td></td>
<td>Enjoys strange noises;</td>
<td>Appears to hear noises before others;</td>
</tr>
<tr>
<td></td>
<td>Enjoys making loud, excessive noises</td>
<td>Cannot function well with background noise</td>
</tr>
<tr>
<td>Tactile (Touch)</td>
<td>Touches people and objects unnecessarily;</td>
<td>Avoids wearing certain fabrics;</td>
</tr>
<tr>
<td></td>
<td>Has abnormally high pain threshold (does not appear</td>
<td>Becomes distressed during grooming;</td>
</tr>
<tr>
<td></td>
<td>to be hurt after a hard fall);</td>
<td>Does not like being wet or going barefoot;</td>
</tr>
<tr>
<td></td>
<td>Does not appear to feel extreme temperatures</td>
<td>Reacts negatively to being touched</td>
</tr>
<tr>
<td>Visual (Sight)</td>
<td>Disregards people or objects in environment;</td>
<td>Bothered by bright lights (covers eyes or squints);</td>
</tr>
<tr>
<td></td>
<td>Can see only outlines of certain objects;</td>
<td>Easily distracted by movement;</td>
</tr>
<tr>
<td></td>
<td>Likes bright colors and bright sunlight</td>
<td>Stares at certain people or objects</td>
</tr>
<tr>
<td>Vestibular (Motion)</td>
<td>Moves around unnecessarily;</td>
<td>Seems unbalanced;</td>
</tr>
<tr>
<td></td>
<td>Enjoys spinning in circles;</td>
<td>Becomes distressed when upside-down or when feet leave the ground</td>
</tr>
<tr>
<td></td>
<td>Becomes excited about any task involving movement</td>
<td></td>
</tr>
<tr>
<td>Smell/Taste (Olfactory)</td>
<td>Some reports of Pica or eating non-food substances;</td>
<td>Picky eater;</td>
</tr>
<tr>
<td></td>
<td>“Feels” objects with mouth;</td>
<td>Will only eat foods with certain textures, with particular</td>
</tr>
<tr>
<td></td>
<td>Seeks out strong smells;</td>
<td>smells, or at a certain temperature</td>
</tr>
<tr>
<td></td>
<td>Oblivious to some scents</td>
<td></td>
</tr>
<tr>
<td>Proprioception</td>
<td>Unaware of body position in space and body</td>
<td>Odd bodily posture;</td>
</tr>
<tr>
<td>(Sense of body's location)</td>
<td>sensations like hunger;</td>
<td>Uncomfortable in most positions;</td>
</tr>
<tr>
<td></td>
<td>Often lean against people or objects</td>
<td>Difficulty manipulating small objects</td>
</tr>
</tbody>
</table>
these kinds of repetitive behaviors are finger and hand flicking, rocking, or tapping objects. Many children with high-functioning autism or Asperger's syndrome seem to exhibit more repetitive, self-injurious behaviors and tantrums than other individuals on the autism spectrum. One study found that children who exhibit unusual sensory responses were much more likely to also have repetitive behaviors. These behaviors could be the child's attempt to either generate a sensory experience or to try to maintain control over their environment after sensory overload has taken place. Often, these behaviors are comforting to the child when an environment is overwhelming. In Asperger's syndrome, where difficulty with auditory processing is a common occurrence, repetitive behaviors may be the child's way of staying in control or keeping a grip on their environment when they miss an important auditory clue and become distressed. Also quite common among individuals on the spectrum is the desire for a predictable environment. Stimming is repetitive and predictable and may be a way to block out complex and confusing sensory stimuli.

Narrow interests also fall under the category of repetitive behaviors. A fascinating occurrence is that children with ASD sometimes show remarkable talent and mastery of particular interests, including music, math, or chess. Younger children or children that are on the lower functioning end of the spectrum may show an almost obsessive preference for a particular object such as dinosaurs, trains, or baseball. Though these interests can often be a distraction, they can also be used to calm a child or used as a reward for successfully completing homework or doing a chore. Repetitive, rigid behaviors also include insistence on sameness in routine and physical environment. This involves adherence to certain routines or rituals, insistence on the same foods, and wearing only certain types of clothing. Insistence on sameness can translate to details as small as the order of items on a bookshelf.

Individuals with ASD can become quite upset if their routine is disrupted. Like communication problems, these strong preferences for predictability may also be caused by sensory processing abnormalities. People on the spectrum may dislike being touched or trying new foods because it is uncertain or unreliable but might enjoy touching others or eating only foods with certain textures because it is predictable and familiar. Similarly, younger children might have strong preferences for theme songs, certain melodies, or other sounds and desire to hear them repeatedly. One explanation for this insistence on sameness and other rigid thinking is the Theory of Executive Function. Executive functions have to do with cognitive processes like concentration, planning, and attention, and most individuals with ASD are thought to have a lack of control over their executive functions. Executive dysfunction in ASD is the reason many individuals on the spectrum have trouble reorienting attention from one task to another and become distressed when routine is disrupted. Poor executive functions lead to poor impulse control, disorganized and inflexible thoughts or actions, and inappropriate, out-of-context behavior.

**Difficulties in Communication and Social Interaction**

Difficulties with communication and social interactions are another problem experienced by individuals with ASD. Struggles can begin as early as infancy when babies begin communicating with their parents. Signs of ASD in babies can be the delay of speech or babbling and a lack of early uses of gesture, as well as failure to respond to their own name. Parents of babies later diagnosed with ASD might feel dejected because of the non-communicative behaviors of their infant, which may lead to further complications in teaching and learning communication between parents and children. Children learn social norms and cultural norms, such as intimacy and the appropriate distance to keep from others, primarily through social play. Without positive friendships or appropriate play, even more communication and social deficits arise, since having friends provides benefits for all children with or without ASD. Having close friendships can be important for future development, building self-esteem, and helping a child better cope with stressful events. Children with ASD may struggle to make friends because their play does not attract or engage others, usually due to their highly structured and inflexible nature. Children often shy away from social interaction, and without consistent, sustained interactions with others, social skills fall even more behind. Frequently, communication deficits lead to extreme isolation or loneliness.

Individuals with ASD may experience problems with social interactions partly because of their repetitive behaviors, as they do not welcome social interaction from others. These kinds of difficulties are more common among individuals with Asperger's...
syndrome who have additional difficulty with social and emotional responsiveness.\textsuperscript{51} There is also evidence that social engagement is made even more difficult by sensory processing deficits. Some individuals with ASD have revealed that a sensory distraction in the environment has caused them to miss a social cue, making the current situation more confusing and stressful.\textsuperscript{52} Often, children may avoid social interaction, especially in larger groups, because they fear unwanted tactile contact or want to avoid uncomfortable volume levels if they have auditory sensitivities. However, one study disagreed, stating that there was no relationship between sensory deficits and social and communicative symptoms of autism.\textsuperscript{53} Despite their struggles, individuals on the spectrum can be taught social skills step by step. Most people learn social norms and practices intuitively or through observation; however, individuals with ASD do not easily pick up hidden meanings or unspoken social cues. Many higher functioning individuals learn some social norms and rules for interacting with others, but they do not work for every situation, since other people break these rules or change them.\textsuperscript{54} Children with ASD who have more play dates in their homes then show more initiative and success in social situations at school.\textsuperscript{55} For some children, practicing during play dates can help develop and fine tune social skills.

Many higher functioning individuals, such as those with Asperger's syndrome, are more aware of their own behaviors and more readily notice differences between themselves and others.\textsuperscript{56} Some individuals describe this awareness in autobiographical accounts as a "wide, unbridgeable gap between themselves and other people."\textsuperscript{57} These same autobiographical accounts also describe how individuals on the spectrum feel as if they are outsiders observing the actions of others and trying to understand.\textsuperscript{58} Some individuals with ASD feel lonelier and have lower quality relationships with others because they are more aware of their social limitations and therefore shy away from social communication.\textsuperscript{59} Awareness of being different is not necessarily negative for some of these individuals. Some describe some of their abilities and symptoms, such as picking up on small details that go unnoticed by others or strong memory and recall, with pride.\textsuperscript{60}

### The Importance of Designing for Autism Spectrum Disorders and Other Developmental Disabilities

ASD is a complicated neurological disorder, and there may never be a time where it is completely understood. Individuals on the spectrum are part of a growing population that is usually ignored in design, even though architects and designers are responsible for accommodating the needs of all users.\textsuperscript{61} This book applies evidence-based design methods to a wide range of everyday environments. Designing spaces for individuals with Autism Spectrum Disorders (ASD) can be a way to improve quality of life, foster independence, and ensure safety. The methods outlined in this book will help individuals on the spectrum despite their level of functioning or prevalence of particular symptoms and make the environment safer, more organized, and more comfortable for the user. These symptoms of ASD should not be stifled by parents and designers. These symptoms do not necessarily need to be embraced, but accepted and, if possible, turned into something positive. For example, individuals that are sensory-seeking should not always be discouraged. Instead they should be well-supervised and allowed to play, touch, feel, taste, and smell. Individuals with ASD can be taught what is safe and appropriate and still be allowed to be themselves.

Design professionals, educators, and parents must be aware of the sensory dysfunction experienced by individuals with ASD in order to provide appropriate environments. The underlying premise of this book is that systemic, empirical research combined with pragmatic approaches to design development can contribute to the planning and management of environments that enhance organizational effectiveness. This book will serve as a valuable tool for professionals involved in designing, building, developing, and administering the design of physical environments for individuals with ASD throughout the lifecycle. Educators and parents will also benefit from the contents. Environmental design theories, symptoms of ASD, and design solutions for a variety of spaces will be addressed. Chapters will focus on sensory processing deficits and the design needs of individuals on the spectrum. The remainder of the book will outline a variety of design methods and solutions for spaces, including residential, learning, work, therapeutic, and outdoor environments.
Notes


