TRANSPORTATION 2022 CONFERENCE

Shaping places for children with autism spectrum disorder

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ABSTRACT

Our urban spaces and neighbourhoods are currently being re-imagined, creating vibrant places that increase our liveability, the opportunity to engage with the built and natural environment and allow people to live locally. The soft elements of the city including the smells, the sounds, the colours and lights all contribute to the sense of place but for some their senses significantly affect how they feel in a negative and distressing way, creating an anxiety and fear of socialising and engaging in our urban spaces (Rapp et al, 2019). Urban characteristics can cause a frightening, sensory overload for neuro divergent children, such as those with Autism Spectrum Disorder (ASD) (Davidson & Henderson, 2016). Making their experiences of our cities a very distressing which limits their ability to grow, learn and enjoy equally on a social, emotional, mental and spiritual level (Congiu et al, 2020).

Most of the research found on environment and inclusive design for neurodivergent children is primarily around buildings and private spaces. This shows a research gap regarding the transport and built environment sector and ASD.

Through engagement with families of children and young adults with autism, this think piece paper will explore the many things that could be done to make our urban centres, specifically streets and spaces, friendlier, safer, and more inclusive to children with autism. This paper will conclude that whilst there is variability across the spectrum that could make it difficult to define specific criteria, there are many elements which could be incorporated into urban spaces to improve the experiences of those with or who have a relationship with those who have ASD. Small improvements can make a significant difference to the wellbeing of families of those with ASD and also build the confidence of those with ASD in growing up into confident, healthy and psychologically supported adults.

INTRODUCTION

Street and space design has a considerable impact on our happiness and how we engage with our environment (Montgomery, 2013). The well-being of people in our neighbourhoods and communities can be enhanced by incorporating health and movement into natural and built environments. Thanks to recent discourse, a general, overarching understanding of relationships between the accessibility of transport mode choice in built environments, active lifestyles, and physical well-being have been developed (Ken, Ma & Mulley, 2017; Carmona, 2019; Montgomery, 2013). Currently, it is theorised that more walkable neighbourhoods and active community environments with access to good public transport enable engagement in higher levels of physical activity increases physical well-being (Edwards & Tsouros, 2006; Lee & Moudon, 2008; Van Dyek et l, 2010).

There is now an increasing degree of academic attention being drawn to the importance of urban landscapes for increasing mental health, well-being and the benefits within neurodiversity (Holt-Damant et al, 2013; Mondeschein & Moga, 2018). Neurodiversity is a positive term that encompasses us all, whether we are neurodivergent (an atypical neurological configuration and encompasses applied, clinical and acquired), neurotypical (neurologically typical, conforming to what people would perceive as normal) or neurodegenerative (progressive loss) (Jurgen, 2020). The term neurodivergent originally focussed on those who were autistic, before progressing to a wider understanding describing people who think, learn or behave differently to what is 'typical'.

Judy Singer first used the term neurodiversity in her thesis in the mid-90's;

"For me, the key significance of the Autism Spectrum lies in its call for, and anticipation of a politics of neurological diversity, or 'neurodiversity.' The neurologically different represent a new addition to the familiar political categories of class/gender/race and will augment the insights of the social model of disability."

Kirby (2021) recently used the analogy of neurodiversity and biodiversity. She pointed out we have all different kinds of cognition, just like many types of animals. Many animals have specialist traits such as chameleons and hummingbirds, from an evolutionary perspective, commenting*;*

"why would we have maintained these specialisations if it wasn't for a good reason".

As Singer states, *"A high level of biodiversity within an ecosystem is considered desirable and necessary for an ecosystem to thrive".*

The relationship between neurodivergent children, such as those with autism spectrum disorder (ASD), and their environment can be problematic. Cities, in particular, can be unfriendly places for people with autism.

"Cities are outfitted to non-autistic people, typically created for an idealised individual without disability or limitation. Urban environments add to sensory overload, have limited mass transit accessible to those with neurological disabilities, provide few affordable housing units, offer very little employment opportunity, and have no green spaces designed for those with autism or other differences" (Decker, 2014).

Research conducted by the Ministry of Health suggests that as many as 1 in 100 New Zealanders has ASD (2020). A statistically under-represented figure, especially in ethnic minority communities (McConkey, 2020). This emphasises the importance of making our cities inclusive and capable of supporting the diverse needs of neurodivergent citizens. Whilst this is a significant challenge in urban design, there are considerably more benefits to overall well-being by enabling greater inclusion levels. Not only for the socialisation of young people with ASD but also for the families supporting them by widening their network of opportunity and support (McConkey, 2020). Providing those with ASD greater access to our cities, we can increase the opportunities available to them as they grow and function independently as adults, which will benefit the wider community (Rapp et al, 2019). In support of this, Blume (1998), an American writer, further popularised the term neurodiversity and recognised the positive contributions it can bring to society in stating;

"Neurodiversity may be every bit as crucial for the human race as biodiversity is for life in general. Who can say what form of wiring will prove best at any given moment?"

If up to 1 in 100 New Zealanders have ASD, those individuals and their family members and carers represent a significant percentage of New Zealand's population. It is essential that these families can engage in urban community life especially when those are children or young adults. Safe and non-discriminatory access to green spaces and being able to travel safely to these spaces could have large impacts on the frequency of use during vital social, emotional and cognitive developmental stages of childhood (Dankwi et al., 2020). During these developmental stages, play and exposure to nature can be highly beneficial to developing physiological and cognitive well-being and encourage social interactions with peers which is an impairment synonymous with ASD (Li et al, 2019)

SKILLS AND SENSES

Autism is a lifelong neurodevelopmental condition that affects how people perceive the world, how they think and behave, and how they communicate and interact with others (Hyman et al, 2020). Altogether Autism state that, *"put simply, autistic people see, hear and feel the world differently to other people"*.

Autism - takiwātanga (ASD) is a spectrum condition. This means that some people are affected more than others. Three general areas of development could be affected, known as the triad of impairments, as shown in Figure 1. This means that children could have trouble using spoken language, which could be severe enough to make the child non-verbal. They can sometimes have trouble understanding social interactions, expressions and emotional responses, which affects the ability to play, engage with others; and may involve in restricted, obsessive, or repetitive behaviours. Those higher on the spectrum may have mild sensory issues and difficulties socially interacting with others. The more severe may have debilitating neurological abilities to function in mainstream environments.

Figure 1: Three primary areas of development that can be affected.

ASD is also a developmental condition and looks different at different ages. Processing everyday sensory information can be different for people with autism. Alongside the five usual senses, a person on the autism spectrum may also process two other senses differently (Figure 2). These have been categorised as vestibular (balance) and proprioception (body awareness).

Figure 2: The five primary senses and the two hidden ones.

Reactions to these can be hypersensitive; this is when a response is heightened, and a person can become overwhelmed. Or the reaction could be hyposensitive. This is when the reaction is seemingly very low or underwhelming. This can include receptors to pain.

A person can have a combination of both these sensitivity conditions. They could also be hypersensitive to one sense but hyposensitive to another sense. McNally Morris Architects (2013) identified that *"Adding to these difficulties, people with autism can also experience sensory mixing or "jumbling" resulting in a confused reading of the world through a disordered mixture of several senses. All of these factors have an impact on their ability to negotiate comfortably in the built environment".*

Rospa (2021) identified that hyper or hypo sensitivity to sights and sounds could pose a risk on the road. A child could panic in reaction to particular noises or sights, because they experience over-sensitivity, or have a lack of awareness of dangers such as approaching traffic if a child experiences under sensitivity.

The National Autistic Society in the UK consider the effects of these responses, and some are shown

below (**Table 1 – The impacts of under and over sensitivity to different stimuli.**Table 1). When it comes to the built environment, all senses have the potential to be more heightened.

Table 1 – The impacts of under and over sensitivity to different stimuli.

	Under-sensitive	Over-sensitive
Sight	Objects appear dark or lose some features.	Distorted vision - objects and bright lights can appear to jump around.
	Central vision may be blurred but the peripheral vision is quite sharp or vice-versa.	Images may fragment.
	Poor depth perception, difficulties throwing and catching.	Easier and more pleasurable for individuals to focus on a detail rather than the whole object.
Sound	Only hearing sounds in one ear, the other ear having only partial hearing or none at all.	Noise can be magnified, and sounds become distorted and muddled.
	May not acknowledge particular sounds	May be able to hear conversations in the distance.
	Might enjoy crowded, noisy places or bang doors and objects.	Inability to cut out sounds – notably background noise - leading to difficulties concentrating.
Smell	No sense of smell and failure to notice extreme odours.	Intense and overpowering smells. This can cause toileting problems.
	Some people may lick things to get a better sense of what they are.	Dislike of people with distinctive perfumes, shampoos, etc.
Taste	Eating or putting non-edible items such as stones, dirt, soil, grass, metal, faeces in mouths. This is known as pica.	Finding some flavours and foods too strong and overpowering because of very sensitive taste buds. Certain textures cause discomfort.
Touch	Holding others tightly - needing to do so before there is a sensation of having applied any pressure.	Touch can be painful and uncomfortable.
	High tolerance to pain and injury.	Dislike of having anything on hands or feet.
	Enjoying heavy objects (eg weighted blankets) on top of them.	Only tolerating certain types of clothing or textures.
Balance	Needing to rock, swing or spin to get some sensory input.	Difficulties stopping quickly or during an activity.
		Difficulties with activities where the head is not upright, or feet are off the ground.
Body awareness	Standing too close to others, cannot measure their proximity to other people and judge personal space.	Difficulties with fine motor skills, eg. manipulating small objects.
	Finding it hard to navigate and avoid obstructions. May bump into people.	Moving whole body to look at something.

Sensory overload occurs when there is a bombardment of sensory stimuli. This can cause either a combination of, or, both stress and anxiety. Urban streets and spaces can be an overwhelming sensory situation for children with ASD. The busy street activity, noise and confusion, creates over-stimulation. Each autistic person is unique in many ways, including these sensitivities. No two people with autism are the same, meaning that each individual comes with their own set of challenges that need to be navigated and supported.

The draft Publicly Available Specification (PAS) 6463 *Design for the mind - Neurodiversity and the built environment,* produced by the British Standards Institution, states that the spectrum of conditions and impact of environments can vary significantly from one individual to another. Numerous elements of the built environment have the potential to contribute to sensory overload or "shut down". These include;

1) audible sounds, of various types, including intermittent or continuous, from loud to very quiet and particularly when unexpected;
2) visual "noise" which may be caused by lighting, colours, patterns, technology or clutter;
3) spatial and layout considerations;
4) unwanted or extreme sensory feedback through smell, touch, or taste.

A survey conducted by the National Autistic Society in the UK revealed that 64% of those with ASD do not visit shops because they find the experience' too much' (Scott, 2017). Therefore, it is imperative that we find ways to facilitate the rights of all by developing our urban spaces to make these spaces more accessible. As, by not doing so, we are potentially neglecting the child's rights.

The UN Convention of the Rights of the Child (UNCRC) sets out 42 internationally developed and recognised rights (and three optional protocols) for all people below the age of 18. It was ratified in New Zealand in 1993 (Ministry of Social Development). It provides a framework for bringing about the 'three Ps', protection, provision, and participation for all. These are explored through a range of interrelated and mutually reinforcing articles. Three key human rights are; the right to participate in decision-making (Article 12); to gather in public space (Article 15); and to play, rest leisure, and access cultural life (Article 31). As per the Child-Friendly City model (Unicef 2019), a child-friendly city is where children:

- are protected from exploitation, violence and abuse;
- have a good start in life and grow up healthy and cared for;
- have access to quality social services;
- experience quality, inclusive and participatory education and skills development.
- express their opinions and influence decisions that affect them;
- participate in family, cultural, city/community and social life.;
- live in a safe secure and clean environment with access to green spaces;
- meet friends and have places to play and enjoy themselves; and
- have a fair chance in life regardless of their ethnic origin, religion, income, gender or ability.

By adapting our spaces to become more inclusive, we are working towards a greater opportunity for a large proportion of our society with neurodiversity to be recognised and respected as a social category, similar to ethnicity, religion, income or gender.

METHOD

Engagement with families of children and young adults with autism has revealed that many things could be done to make our streets friendlier, safer, convenient and more inclusive to children with autism. Despite a significant lack of data and recording of ASD within the New Zealand population, international figures are as high as 1:69 in the USA (Centers for Disease Control and Prevention, 2014) and 1:100 in the UK (British Medical Association, 2020). These figures are under-represented of the true proportion of individuals on the spectrum within our cities (Bowden et al., 2020). The range of capabilities and ability to function equally well will be extremely diverse. To gain insight into the potential needs of those with ASD and the struggles faced by their families or carers, the authors reached out to five UK families, including one of the authors of this piece, who have a family member with ASD. The authors knew these families through local support groups and educational settings. The purpose of conducting these discussions was to identify the difficulties they face in urban areas and the key changes they believe would make such spaces more ASD friendly and more manageable.

Family members were simply asked;
"*What does your family member with ASD struggle with most when in urban areas?"*

And;

"What are the main difficulties you face as a carer for a person with ASD in an urban area, and what alterations would you recommend?"

The capabilities of the family members with autism were broad and included a 30-year-old man with the developmental age of a two-year-old, a non-verbal eleven-year-old with hyposensitivity disorder, a female six-year-old with sensory difficulties and was a flight risk, a nine-year-old male with sensory difficulties, which included an inability to orally consume food and required the use of a wheelchair, and a fifteen-year-old male with sensory and communication difficulties. These families were approached individually and provided a unique insight into the challenges that they face daily.

Given the sample size, there are obvious limitations to our findings particularly given the very diverse

range of needs and reactions of people across the spectrum. A larger sample size would provide further insight to engagement of the urban environment from ranges across the spectrum (extreme to high functioning) and varying ages of children. In addition, further discussions could take place in both the UK and New Zealand to understand if there are any specific location or context sensitive design issues. This could be supported through the use of sensory audits (Mostafa, 2021) of our urban spaces, and Design Thinking Methodology/Autism Friendly Design Audits to guide designers through complex solutions for spaces.

FINDINGS

When asked the question;
"*What does your family member with ASD struggle with most when in urban areas?"*

The most common response by all participants was unsurprisingly the business of the environment. This was identified as a combination of sounds, colours and congestion with traffic and people. The families commented that taking a set, familiar route was important for their urban experience. Deviating from these set routes often caused their ASD family member a great deal of distress, leading to a meltdown, taking flight, or self-harm. This becomes significantly more difficult as the family member becomes older and stronger.

When asked the question;
"What are the main difficulties you face as a carer for a person with ASD when in an urban area, and what alterations would you recommend?"

The responses to this question were broad and reflective of the individual needs of the autistic person in each family. One of the shared difficulties was the signposting to quiet spaces. Families regarded this as essential for times when their autistic family member was having a meltdown or sensory processing difficulties and needed to find a safe and calming place. These are generally green and open places with little to no traffic and a reduced number of people. Mostafa (2021), suggests that escape spaces can "*take on many forms and scales and may include small scale natural environments, seating around water features, quiet seating arrangements, sensory area, and free-standing micro-environments within larger spaces*". Outdoor spaces which have integrated sensory areas developed to specifically engage with neurodiverse citizens can involving movement and sound. Examples of this can be seen below in Figure 3 and Figure 4.

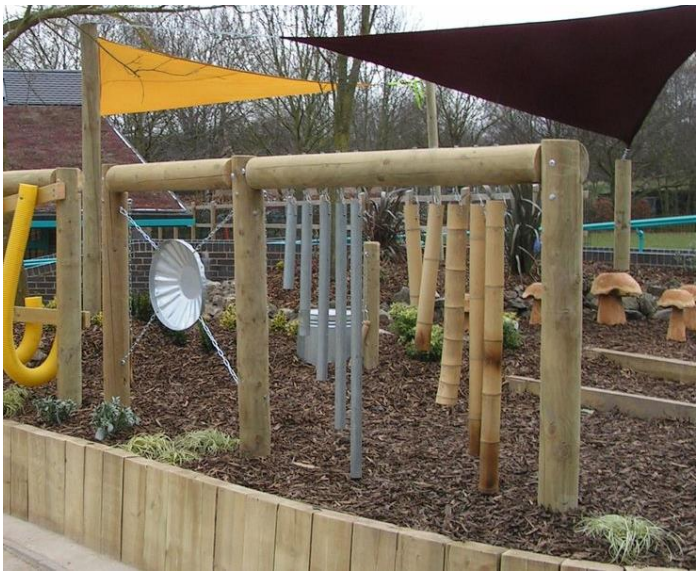

Figure 3: Interactive elements that could be incorporated into the street scene (courtesy of Sensory Gardens for Schools, retrieved from www.celebratethechildren.org).

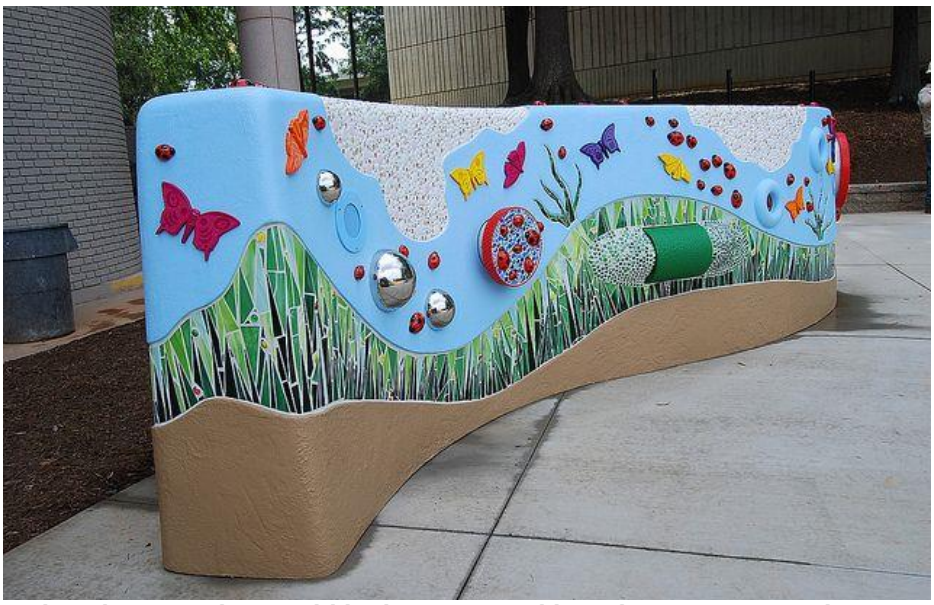

Figure 4: Interactive elements that could be incorporated into the street scene (courtesy of Lexington Designs, retrieved from Sensory Wall | Lexington Design + Fabrication | Flickr).

Three out of the five families raised the issue of changing facilities in urban spaces. Existing provisions are for those with babies make no consideration for people with disabilities who need diapers/nappies changing. By creating these facilities and clearly signposting them, families would feel more confident in visiting, and positively experiencing, urban spaces.

Families also mentioned the importance of knowing where there are autism-friendly restaurants, cafes and spaces accessible for wheelchairs, supportive of those requiring feeding tubes, and considerate layouts and sensory triggers such as décor, sounds, and lighting.

The families reported going to places with staff who had knowledge and awareness of ASD as a significant benefit to their city experiences. Knowing where there are places and people they could speak to for directions and information is invaluable.

DISCUSSION

Creating mindful and intuitive environments requires an awareness of the variations in people's perception, processing and organisation of sensory information taking into account the two hidden senses (Figure 2). In some cases, a design intervention to improve something for one type of sensory difference can be to the detriment to another.

The 'Six Feelings Framework' (Knowlton School of Architecture, 2019) provides advice on increasing the inclusivity of design. Considering those with ASDs needs, planning and design implementations in the public realm should make adults with autism:

1. **Feel connected** - because they are easily reached, entered, and/or lead to destinations.
2. **Feel free** - because they offer relative autonomy and the desired spectrum of independence.
3. **Feel clear** - because they make sense and do not confuse.
4. **Feel private** - because they offer boundaries and provide sanctuary.
5. **Feel safe** - because they diminish the risk of being injured.
6. **Feel calm** - because they mitigate physical, sensory issues associated with autism.

Despite the assumption that it is not useful to plan for one group of people, planning through the lens of autism can benefit everyone.

Using our findings from the family member questions, a range of research documents, including the PAS, and informal discussions with Christchurch based Landscape Architects, Table 2 and Table 3 have been compiled. Using these tables when designing streets and spaces at a spatial level followed by more detailed considerations for neighbourhood level, could allow inclusive environments for neurodivergent individuals. Specific characteristics and processes which connect urban spaces to

health remain unknown and Holt-Damant (2013) recognises that the lack of research poses a challenge:

"What remains a challenge, however, is for urban designers to be more certain about which elements and attributes of the urban environment trigger positive interactions, and for health researchers to locate these triggers and the types of interactions that improve well-being. If we understand what makes our spaces safer, healthier and inclusive, then we can predict and plan for them in the future."

Applying building design guidelines to the streets and spaces network could be a weakness or limitation. To ignite discussion around this subject, we considered this a helpful starting point.

Table 2: Spatial level considerations for city design

Spatial level	Requirement	Suggested development
Great neighbourhoods	Good urban planning where children and caregivers can access facilities locally.	• Mixed-use development. • Range of local facilities that can be easily accessed.
Green neighbourhoods	Children and caregivers have access to nature daily. There are so many benefits (cognitive, mental and physical health and social and emotional) for children with ASD to have contact with nature.	• A network of public/private gardens. • Accessible and adaptable public spaces. • Mix of spaces that provide opportunity for physical challenge, structured and imaginative play, and solitary observation can help facilitate positive peer interactions in autistic children (ASLA). • Therapeutic engagement with gardening and garden-based activities (Kids Gardening). • Consider the underlying natural environment & landscape character – can those stories / elements be revealed within the streetscape?
Peaceful & Playful neighbourhoods	A network of quiet streets and spaces for children and caregivers to seek respite or play.	• Play spaces can facilitate mental and physical activity and connection. • Green spaces can allow connection with nature that can be calm and be areas for escape. • Network of quiet streets for psychophysiological recovery and restoration (Gidllow et al, 2016).
Walkable neighbourhoods	Children are more likely to have localised travel so they should have the opportunity to move around safely and actively.	• Slow speed zones & low traffic neighbourhoods. • Adopting a Healthy Streets Approach (TfL). • Good crossings that are consistently designed. • Places that are easy to navigate and have visible signs to quiet, sensory calming spaces where families can go can be vital when a child is experiencing sensory overload.
Mobility choice	Children and caregivers have access to safe and reliable public transport.	• Trips may occur outside of peak times and people should still be able to access to critical services. Unreliable and/or unwelcoming transport could lead to people not taking a trip.
Access to choice	Children and caregivers have access to shops and facilities at quiet times.	• Include an annual Autism Hour in which shops and businesses reduce their music, dim their lights and spread awareness about ASD has been incredibly successful in the UK. Before COVID-19 in 2020, which resulted in the Autism Hour being cancelled, there was a 220% increase in the number of participating shops and businesses (UK).

Table 3: Detail considerations for city design

Detail level	Requirement	Suggested development
Transport hubs	Children and caregivers should be able to access public transport hubs to be able to move around the places where they live to access services.	• Provide larger personal boundary proxemics. • Advertise crowded times so places can be avoided alongside well-signposted quiet spaces.

Legible networks	Children and caregivers are provided with familiar routes.	• Create streets with regular rhythm & repetition where design cues and features have the same design language (not unexpected / fits with a routine).
Streetscapes	Need for compartmentalisation to optimize autistic use (Mostafa, 2021)	• Currently most streetscapes have mixed uses (footpaths with scooters etc). Fluid streetscapes with no sense of boundary can cause unnecessary stress for autistic users. • Use various levels of boundaries between users and in particularly traffic. • Consider transition zones between building setbacks and the public space with sensory zones and escape space.
Shared spaces and paths	Shared spaces that feature in the public space network should be easy to navigate for Children and caregivers.	• Shared use surfaces might be difficult to navigate for some people with sensory processing differences due to difficulties in judging distance, space and speed of approaching cyclists. • These spaces should only be designed via in depth consultation and engagement with a wide range of stakeholders and users through the whole process.
	Where possible designers should lessen confusion, anxiety, and stress in the public realm.	• Wider multi-use trails with separated uses (pedestrians and cyclists), making it easier for adults with autism because it lessens conflicts and potential collisions.
Walking	Children should be able to feel confident and safe to be able to walk with family or caregiver.	• Crowded sidewalks can cause anxiety. Wider pavements and walkways allow people to walk side by side, but also to distance themselves from traffic with more space to accommodate busy times.
	Create calming footpaths for oversensitivity.	• Design paths that flow naturally rather than always linear so they feel more natural and unobtrusive.
	Provide temporary havens from the bustle of busy streets (traffic, lights etc).	• Use of modal filters and cul-de-sacs with connecting pathways to provide a haven.
	Provide moments to pause.	• Create pocket parks and parklets with room for personal space for moments of contemplation and play. Could include introduce scented plants to orientate and create a sensory experience. • Inclusion of sensory interactive pieces.
	Provide shade from bright lights.	• Street trees make the urban environment attractive and provide shade.
Wayfinding	Children and families moving around should be able to move around confidently with clearly identifiable wayfinding.	• The ability to touch features such as walls, to provide reassurance and familiarity. • Transitioning between different ground surfaces should be avoided where possible, as this is a challenge for some people.
	Wayfinding should allow for ease of navigation.	• Visible sign postings, colour coded symbols in shop windows, street signs or on the pavements.
	Wayfinding should be inclusive and in suitable locations	• Wayfinding systems should be designed to be clear and inclusive. • Information should be provided based on the principle of at least two senses, since information is interpreted via visual, audible, or tactile methods • Where people might naturally converge and make decisions, should be taken into account.
Crossings	Be able to cross the road safely.	• There are several pedestrian road crossings, including zebra, puffin, pelican and toucan, not all of which are readily understood by members of the public. The black and white lines on the road surface are, however, familiar to the majority of people and varying the appearance of a pedestrian crossing (such as colourful crossing surface designs which are unique to each crossing and often incorporate blocks of vivid colours (see Figure 6) can lead to misinterpretation of the feature, hesitation and

		anxiety. This particularly affects people with sensory impairments such as sight or hearing loss, people with sensory processing conditions or heightened sensitivity to visual noise.
Play Spaces	The local street network provides the opportunity for informal play particularly when there may be a lack of open green space close by.	• Incorporate natural elements into the streetscape with small areas such as berms or changing parking spaces to parklets for play elements that could alternate between spaces for over-sensitive or under-sensitive children or create zones within bigger areas.
Seating	A mix of furniture styles should be used to meet a variety of user needs.	• Furniture that is soft to touch and the use of natural materials, such as timber, should be included for therapeutic and calming value.
	Do not underestimate the power of a bench/ seat/ stopping place	• Create small, detailed spaces for focus/ quiet time – don't necessarily need to be screened off – perhaps a place where someone can be in their own heads e.g. artwork, pattern, vegetation moving in the breeze etc.
	Think creatively around seating for quieter spaces	• Consider bench seating integral with planter boxes, forms that indicate enclosure like semicircles or ½ octagons (or curving natural forms) – see my note about stopping places above. Could also think about build outs or parklets – spaces that are still part of the streetscape – but not busy.
Materials	Be careful with choices of materials	• Large areas of reflective materials, such as some metals or glazing, should be avoided as this can cause discomfort or disability glare.
	Be mindful of shapes and include ranges of options for play	• Naturalistic design with organic forms with shapes, connection with nature through the use of forms and textures that occur naturally. • Include sensory play equipment.
	People who experience sensory overload are likely to seek out spaces that are quieter but appropriate lighting and sight lines for personal safety should be taken into account	• Ideally, green spaces should provide a mix of sensory experiences, with opportunities for visual and speech privacy, and to hear, see and touch the natural environment. • Include natural features that provide sensory feedback, e.g., running water, scented planting, and nature sounds are found to be therapeutic.
	Be mindful of choice of surfacing material	• Soft and/or smooth surfaces should be used; soft grass or smooth surfaces with limited tactile feedback underfoot. To enhance feelings of security, larger areas should use an orientation map at the point of entry and seating.
	Be mindful of the use of patterns and transitions	• The amount of contrast within a pattern, particularly on a large area such as walls or floors, should be taken into account, as it can influence the level of discomfort and visual overload some people experience. • Transitioning between different ground surfaces should be avoided where possible, as this is a challenge for some people.
Colours	Be considerate of colours being applied in the streetspace.	• Muted colours are typically more calming and cause less sensory overload than vivid tones, which should be taken into account. A mixture of environments with neutral and visually stimulating backgrounds should be possible spaces to offer variety and choice to accommodate different sensory requirements.
Sound	Incorporate sympathetic sound in street elements	• Figure 5 illustrates an option for incorporating a visually stimulating environment complete with musical instruments and chimes.

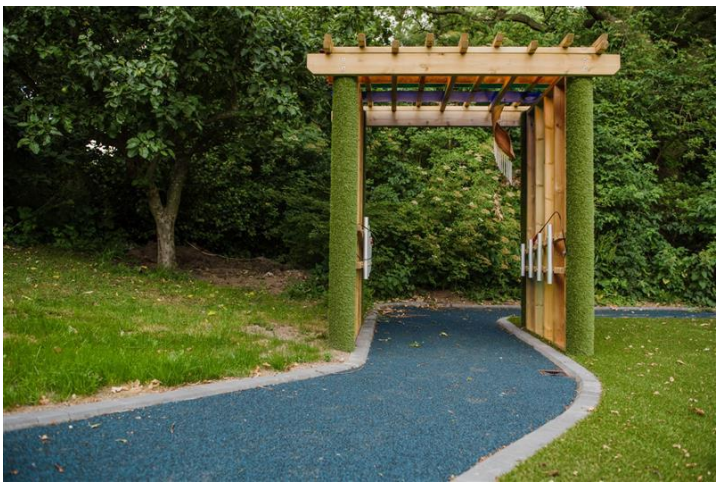

Figure 5: Incorporating sensory arbour on walkways (courtesy of Pentagon Play (https://www.pentagonplay.co.uk/news-and-info/play-equipment-sensory-processing-disorder).

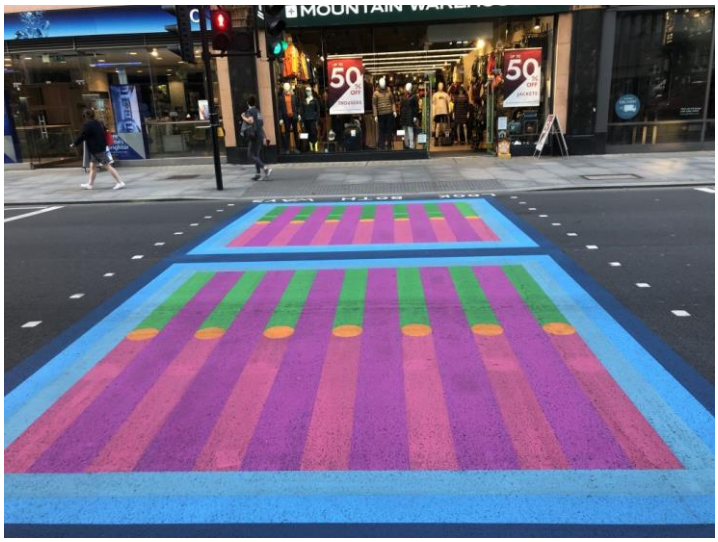

Figure 6: Installation of Colourful Crossings has temporarily been suspended in London (Courtesy of Transport for All https://www.transportforall.org.uk/campaign/colourful-crossings/).

CONCLUSIONS & RECOMMENDATIONS

The investigations and discussion presented in this paper is only the beginning in trying to understand changes that could be made to make our streets and places more inclusive to children with ASD and more accessible for families or caregivers. Due to the spectrum of responses to sensitivities, it could appear challenging in being able to offer solutions to everything. However, the paper has identified that there are certain street elements or features that could provide consistency.

Making small key adjustments to our urban environments can make a significant difference to those with and the families of those with ASD. This can aid in building the confidence of those with ASD and thus allow them to grow up into confident, healthy, and psychologically supported adults.

It is recommended that this paper be the basis for more cross-disciplinary approaches to the design of streets and spaces with inputs from families and caregivers that are likely to use routes and places frequently and understand their children's needs. An increase in the use of Sensory and Autism Friendly Design audits is supported to guide designers through complex solutions for urban spaces.

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