THE DESIGN OF AN AUTISM LEARNING CENTRE in Atteridgeville
Die meisie met mirre in haar hare, en n goue krans.
In memory of dearest
Suzaan
This document is submitted in partial fulfilment of the requirements for the degree MAGISTER TECHNOLOGIAE Architecture (Professional) in the Department of Architecture Faculty of Engineering and the Built Environment, Tshwane University of Technology.

I hereby declare that this is my own original work and has not previously been submitted to any other institution. I further declare that all sources cited or quoted are indicated and acknowledged by means of a comprehensive list of references.

Pantone 12-1011 TCX
The colour used in the group activity space of the combination classroom inspires creativity.
The Design of an Autism Learning Centre in Atteridgeville, Pretoria
Submitted by Riaan Steenkamp.
Submitted in partial fulfillment of the requirements for the degree
MAGISTER TECHNOLOGIAE: ARCHITECTURE: PROFESSIONAL
In the Department of Architecture
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TSHWANE UNIVERSITY OF TECHNOLOGY
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The proposed design is a response to a developmental disorder affecting one in every 68 persons. Autism, or Autism Spectrum Disorder (ASD), is a disorder that is often stigmatised due to a lack of understanding. Those suffering from this disorder require special education in a specific environment. If ASD is not treated from an early age, children with ASD become adults with ASD.

The spatial requirements and design approach accommodating persons with ASD depend on the ASD treatment method. Two main treatment approaches exist, namely, the Sensory Sensitive and the “Neuro typical” method. The Sensory Sensitive method relies on designing spaces sensitively in terms of the senses, while the “Neuro-typical” method relies on typical design conventions. The Sensory Sensitive and “Neuro- typical” methods are underwritten by different theories, the most comprehensive of which are the Sensory Sensitive method, which informed the design process, as well as the final proposal.

Sensory integration is difficult for anyone suffering from ASD. People with ASD experience space from either a hyper- or hyposensitive perspective. The hyper- and hyposensitivity aspects are used as a design generator, and govern the spatial layout, detailing, and material finishes of the design. Specifically, the learning environment provides three types of special layout that accommodate the different sensitivities, namely:

- Hypersensitive classrooms;
- Hyposensitive classrooms; and
- A combination of the two classrooms.

The relationship between the proposed design project and other educational facilities were studied. The project aimed to establish a symbiosis between autistic and non-autistic (“Neuro-typical”) persons through links and shared space, strengthening the idea of integration rather than assimilation.

This design explored the introduction of a large scale programme into an existing environment. The intention of this design was not only to be a school for Autism, but also to become a symbol of hope. Ideally, it should be a space to connect and learn about ASD, ultimately alleviating the stigma attached to those suffering from ASD.

This project identified the need for an ASD educational facility in the western part of Pretoria. Currently, the only ASD facilities exist in the east and south of Pretoria. The site selection will also aid in creating a destination, as well as a symbol of hope for ASD individuals.

Pantone 317c
The colour used in the compartmentalisation space of the hypersensitive classrooms helps with focus.
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By author
Chapter 1

ASD & its place within architecture

1.1 Introduction
1.2 Background
1.3 Sensory processing & hyper- and hyposensitivity
1.4 The importance of designing for ASD

Pantone 317c
According to Gaines et al. (2016), Autism Spectrum Disorder users form part of an ever growing, worldwide population largely ignored in architectural practice. Mostafa (2008:189) argues that official building codes and guidelines exclude these users’ needs. ASD individuals are more sensitive to their physical surroundings than their non-autistic (“Neuro-typical”) counter parts.

Another challenge in designing spatially for ASD is that each diagnosis is unique. It is referred to as a spectrum disorder as each affected person has a different set of symptoms, sensitivities and levels of functioning, which range from mild to severe (Gaines et al, 2016).

Ideally, spaces should be designed to accommodate each unique symptom, thus helping to build a tolerance to environmental stimuli. Environments designed specifically for ASD individuals should prepare them for the challenges of real life instead of protecting them in an ‘other world’ environment, which is referred to as ‘cocooning’. Environments should ideally be realistic with a smooth transition from school life to out of school life (Gaines et al, 2016).

The reason for this sensitivity to the surrounding environment is primarily due to the sensory processing deficits that are associated with ASD. This means that the autistic user is either under-reactive or over-reactive to sensory stimuli. These sensory deficits can make the built environment distracting, and even overwhelming for the ASD user (Gaines et al, 2016).

The proposed design is a response to ASD in a poorly serviced setting. The school aims to serve 150 children from all ranges of the autism spectrum and aims to serve the surrounding suburbs, thus becoming an ASD destination. This design provides a strong public character where “Neuro-typical” individuals can learn more about ASD through shared spaces.

Architecture has the inherent potential to positively affect the daily experience of individuals suffering from ASD. Design factors like colour, sense of enclosure, texture, acoustics, ventilation, and orientation are some of the issues of concern (Mostafa, 2008:189-211). The design approach should thus focus on creating a routine, being consistent and creating a safe environment.
1.2 Background of ASD

ASD is a developmental disorder affecting one in 68 persons worldwide, of which males are five times more susceptible to being diagnosed. Individuals suffering from ASD can be identified as (Gaines et al, 2016):

- Having difficulty with social interaction;
- Having difficulty with communication skills;
- Having a small range of interests;
- Being either hyper- or hyposensitive to sensory stimuli; and
- Displaying repetitive behaviour (Gaines et al, 2016).

Although a variety of treatment forms exist, there is no present cure for ASD (Gaines et al, 2016).
1.3 Sensory processing and hyper- and hyposensitivity

The individual suffering from ASD has abnormal responses to incoming sensory information from his/her immediate surroundings. Typically, people receive information about a space based on the collective, this is known as sensory integration. People with ASD have difficulty with sensory integration due to the inability to process information from several senses at once. This is manifested through being either hypersensitive (over-reactive) or hyposensitive (under-reactive) to stimuli (Gaines et al, 2016).

Individuals with ASD frequently display repetitive and/or compulsive behaviours, which is a way for them to block out complex and confusing sensory stimuli (Gaines et al, 2016).

The following table outlines the hyper- and hyposensitive Symptoms of ASD.

<table>
<thead>
<tr>
<th>Sense</th>
<th>Hypersensitive</th>
<th>Hyposensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditory</td>
<td>• Overly sensitive to loud noises</td>
<td>• Does not respond when name is called</td>
</tr>
<tr>
<td></td>
<td>• Easily distracted by background noise</td>
<td>• Enjoys making loud noise</td>
</tr>
<tr>
<td></td>
<td>• Avoids wearing certain fabrics</td>
<td>• Enjoys touching people and objects of different textures</td>
</tr>
<tr>
<td></td>
<td>• Reacts negatively to being touched</td>
<td>• Abnormally high pain threshold</td>
</tr>
<tr>
<td></td>
<td>• Easily distracted by movement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Easily distracted by bright lights and sunlight</td>
<td>• Responds to outlines of objects</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Likes bright colours and copious amounts of sunlight</td>
</tr>
</tbody>
</table>

Table 1: Hyper- and hyposensitive symptoms of ASD (Gaines et al, 2016)
1.4 The importance of designing for ASD

ASD is a complicated neurological disorder that is usually ignored in architectural design. Designing spaces specifically for ASD users could improve their quality of life, and ensure safety, as well as promote independence (Gaines et al, 2016). Architects should be aware of the sensory dysfunction experienced by ASD individuals in order to create appropriate environments (Mostafa, 2008:191).

This dissertation is based on systemic, empirical research combined with a pragmatic approach to design a building that contributes to the planning and management of environments that enhance organisational effectiveness, and could ideally become a tool for architects.

Environmental design theories pertaining to ASD and design solutions for certain spaces were investigated in this study. The dissertation outlines a variety of design methods for ASD. The spaces proposed include learning, therapeutic and outdoor environments, which is loosely based on the traditional school typology.

The dissertation furthermore explores the idea of integration rather than assimilation as links to conventional schools and public spaces within the scheme area could promote an understanding of ASD.
Chapter 2

Theoretical discourse

2.1 Introduction - A critical analysis of the Sensory Sensitive and “Neuro - typical” method in schools for autism

2.2 Foundational theories for ASD
   2.2.1 Environmental Preference Theory
   2.2.2 Sensory Design Matrix

2.3 Issues of concern

2.4 Limitations & delimitations

2.5 Argument

2.6 Designing for the senses

2.7 The need for an ASD facility in the west of Pretoria

2.8 Outline brief & Accommodation
2.1 Introduction

A critical analysis of the Sensory Sensitive and “Neuro-typical” method in schools for autism

Research on ASD mostly concentrates on the fields of medicine and psychology. There has been limited research on how environments may affect behaviour and be designed to meet the needs of persons with ASD. Magda Mostafa (2008:189) has presented evidence that demonstrates that one’s surroundings can positively contribute to wellbeing, especially with regard to ASD.

To counter the negative effects of ASD, architects tend to subdue the sensory environment (Henry, 2015:53). This approach attempts to address the sensory input abnormalities, i.e. difficulty in sensory integration, which is manifested through hyper- and hyposensitivity. An environment without excessive sensory stimulation should lead to better skill acquisition and less anxiety. This approach could be termed Sensory Sensitive Design, and is the dominant approach when designing for ASD (Henry, 2015:53).

Alternatively, there is a completely different philosophical and practical approach when designing for ASD. The “Neuro-typical” method focuses on the poor generalisation skills prevalent in ASD. Rather than creating environments that are Sensory Sensitive, the “Neuro-typical” approach simulates the ‘real world’ and mimics the features of a mainstream school (Henry, 2015:53).

When spaces for ASD are created, designers have to show an understanding of this disorder. This aids in supporting the learning process, the nature of the development of independence, and preserving the dignity of the user (Gaines et al, 2016). The following two theories are based on the Sensory Sensitive design concept:

- The Environmental Preference Theory; and
- The Sensory design matrix.

These theories focus on creating environments that stimulate and aid the ASD users’ diagnosis. The two Sensory Sensitive design theories referenced have a range of constructs that guide the architect in designing an environment that is sensitive to the needs of ASD individuals. These have been implemented in the new learning centre.

Figure 2: Extensive use of filigree aiding in wayfinding and legibility
By author
The Therapeutic Environment Theory also stems from Sensory Sensitive Design. Cohen and Weismann (1991) developed a conceptual framework for therapeutic environments that assumes that the nature and needs of users (in this case ASD users) define therapeutic goals, which inspires the physical setting indirectly. Their concept, Therapeutic Goals: Focus on Continuing of the self, includes:

1. Maximising safety and security.
2. Maximising awareness and concentration.
3. Supporting functional abilities;
4. Facilitating social context;
5. Providing privacy;
6. Providing opportunities for personal control;
7. Regulating stimulation; and

Thompson et al. (1996:292-314) describe the built environment as having two pillars: a prosthesis (architectural attributes acting as aids, allowing greater autonomy), and diathesis (elements hindering access), as well as how the architect should judge his design accordingly. Examples of prosthesis include:

- Ramps instead of stairs;
- Adequate indirect lighting;
- Clear wayfinding; and
- Acoustic regulation.

Examples of diathesis include:
- Drafts from poor insulation;
- Harsh direct synthetic lighting; and
- Excessive odours.

The latter theory that was researched for this thesis focuses on the social integration of ASD individuals into society. The Integration Rather than Assimilation Theory (Pomana, 2014) means that the ASD individual should not only be conditioned to cope in the real world, but the “Neuro-typical” user should also be equipped with the necessary knowledge to better understand an individual with ASD. The implementation of this theory by means of architecture will be interpreted in an auditorium serving autistic and “Neuro-typical” individuals, and a tangible link will be created via a promenade of trees to a conventional school and park. A cafeteria serving Autistic and “Neuro-typical” persons will be open throughout the week (Pomana, 2014).

The idea here is to analyse the needs of the user in order to create environments that focus on prosthesis and eliminate diathesis.
The Environmental Preference Theory was developed by Rachel and Stephen Kaplan and is based on the idea that people would better respond to environments that are engaging and inviting over environments that are boring and simple (Kaplan, Kaplan & Brown, 1989:509-530). According to Kopec (2006), this theory is appropriate when the aim is to focus on well-being through the development of self-actualisation because it offers a broad practical method for designing engaging environments in terms of its four principles. Preferred environments promote creativity, help sustain talents, and set the background for a calming learning experience free from anxiety; it also increases self-esteem (Gaines et al, 2016).

This theory has several constructs: complexity, coherence, legibility, and mystery (Kaplan, Kaplan, 1982). The four principles of the theory have been incorporated in the new learning centre in Atteridgeville as follows.

1. **Complexity**

Complexity refers to the degree of visual information available in the environment, levels of detail, the diversity of scenes, and the richness of the environment (Scott, 1993:7-16).

Degrees of complexity will vary throughout the new design. The Sensory Design forms the basis of the scheme. The different classrooms allow for complexity in terms of visual, tactile and auditory, which ensures an interesting, comfortable, and stimulating environment for the specific users.
2. **Coherence**

Coherence refers to features in the environment aiding in the organisation and understanding of space, as well as directing attention (Herzog & Leverich, 2003:459-477). Pragmatic examples include using floor patterns to aid in spatial organisation, while directing movement along predetermined routes.

A strong sense of routine is important for ASD users. This predictability is needed because the person with ASD has a weak vestibular and proprioceptive system. This means that some ASD individuals have difficulty orientating themselves in a space. All the classrooms are divided into certain zones, and each zone has a particular function. This spatial sequencing should assist in establishing particular routines and smooth transitions.

Visual and tactile elements are used to differentiate and articulate different spaces.
3. **Legibility**

Spatial design could be described as a space that is easy to understand and remember. This includes ease of finding the way to a desired location and back to the origin. Lynch has identified the following elements that aid in making a city more legible (Lynch, 1960):

- Paths;
- Edges;
- Districts;
- Nodes; and
- Landmarks.

Figure 5: The approach to the hypersensitive classrooms. Elements aiding in wayfinding

By author
4. Mystery

Mystery refers to features in the environment that encourage further exploration (Herzog & Leverich, 2003:459-477). The proposed ASD learning centre uses a method called "previewing" to promote further exploration, i.e. windows are used to provide a view into a space so that the ASD user can get a sense of what to expect upon entering. Intimate spaces will ensure privacy and discovery.

Engaging environments include sensory rooms that reside at the ‘heart’ of the project. It is in the deepest part of the mountain. Within these chambers, hyposensitive users can find sensory stimulation and hypersensitive users can find relief from sensory overload.

Specific sensory rooms were designed to focus on the specific senses, for example, the auditory section of the sensory room plays soft, soothing music. The tactile section houses weighted blankets and hammocks, and the visual section has projectors showing stimulating motion graphics.
2.2.2 Sensory design matrix

Mostafa (2008:189-211) describes the fundamental basis of designing spatially for ASD learners, the fundamentals of which include (and are evident in the new ASD learning centre):

- Compartamentalisation of learning spaces

Figure 7: Asymmetrical approach to compartamentalisation in the hypersensitive classroom
By author

Figure 8: Symmetrical approach to compartamentalisation in the combination classroom
By author
Figure 9: Combination classroom. Indirect mechanical lighting
- Indirect natural lighting

**Figure 10:** Animated facade treatment of the hyposensitive classroom aiding in eliminating harsh direct sunlight
By author

**Figure 11:** Combination classroom. Indirect natural lighting
By author
• Acoustics (elimination of sound pollution and echo)

Figure 12: Wooden perforated paneling in the auditorium eastern interior
By author

Figure 13: Floor finishes throughout the design aiding in acoustic quality
(http://www.megacarpetwarehouse.co.uk/files/52dacec46.jpg)
Mostafa states that these elements are needed for ASD learners to successfully gain necessary skills (2008:189-211).

Mostafa is a pioneer in designing for ASD. Her research has the primary goal of correcting the exclusion that ASD users face in the built environment by developing a preliminary framework of architectural design guidelines for ASD (2008:189). In this project, Mostafa's research findings were translated into a design matrix.

The matrix focuses on the sensory deficits that the users face, thereafter supplying the correct form of architectural attribute and the amount thereof to try and counter these deficits (Mostafa, 2008:208-211).
### Table 2: Sensory Design Matrix

<table>
<thead>
<tr>
<th>Architectural Attribute</th>
<th>Sensory Issues</th>
<th>Auditory</th>
<th>Visual</th>
<th>Tactile</th>
<th>Olfactory</th>
<th>Proprioceptive</th>
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<tbody>
<tr>
<td></td>
<td><strong>Hyper sensitive</strong></td>
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<td></td>
<td><strong>Hypo sensitive</strong></td>
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<tr>
<td><strong>Structure</strong></td>
<td>Neurotypical method</td>
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<tr>
<td>Enclosure</td>
<td>Sensory sensitive approach</td>
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<td>Proportion</td>
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<td>Scale</td>
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<td>Orientation</td>
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<td>Focus</td>
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<td>Symmetry</td>
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<td>Rhythm</td>
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<td>Harmony</td>
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<td>Balance</td>
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<td><strong>Quality</strong></td>
<td>Colour</td>
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<td>Lighting</td>
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<td>Acoustics</td>
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<tr>
<td>Texture</td>
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<td>Ventilation</td>
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<tr>
<td><strong>Dynamic</strong></td>
<td>Sequence</td>
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<td>Proximity</td>
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<td>Routine</td>
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</tbody>
</table>

Legend:
-用和neutral characteristics
-高 enclosure and containment
-低 enclosure and openness
-低 ceilings and moderate proportions
-高 ceilings and exaggerated proportions
-Use of intimate scale
-Use of open scale
-Orientation towards external views and elements of interest
-Use of activity focus to organize space
-Symmetrical organization
-A symmetrical organization
-Use of visual or spatial stimuli
-Visually harmonious spaces without contrast
-Visually harmonious spaces using contrasts
-Use of dynamic and statically balanced spaces
-Use of unbalanced spaces
-Use of bright colours
-Use of neutral colours
-Use of warm colours
-Indirect natural lighting
-Direct natural lighting and views
-Noise and echo proofing
-Use of smooth textures
-Use of rough textures
-Cross ventilation
-Enclosed ventilation
-Organized compartmentalization using visual cues
-Spatial organization according to sensory characteristics
-Use of one-way circulation pattern to capitalize on routine
Lessons learnt from the Sensory Design Matrix

Hypersensitive
Enclosure

Hyposensitive

Combination

Proportion

Orientation

Colour
Focus
Relaxation

Focus

Relaxation

Focus

Relaxation

Figure 14: Lessons learnt from the Sensory Design Matrix
By author
2.3 Issues of concern

This intervention explores certain issues regarding design for ASD. Some of these explorations include:

- The universal lack of sufficient building regulations regarding spatial design for ASD (Mostafa, 2008:189);

- The way certain spatial design techniques can be implemented in a school to counter the hyper- and hyposensitivity aspect of ASD (Autism Spectrum Disorder) in an educational typology (Mostafa, 2008:189-211);

- The way to integrate such an important intervention in a community;

- Mostafa’s theory that a compartmentalised, protected learning environment could raise a child with ASD to become more sociable in the ‘real world’ (2008:189-211); and

- The way relationships can be established between a school for ASD and other mainstream schools to strengthen the above mentioned Theory of Integration Rather Than Assimilation. This is achieved through a visual, tangible link between the schools through a promenade of trees, and a public space where autistic and non-autistic users can interact (Pomana, 2014).
2.4 Limitations & delimitations

Limitations

The lack of sufficient building regulations for ASD individuals was mentioned earlier (Mostafa, 2008:189), however, the aim of this dissertation was not to establish new building codes, but merely to highlight this issue. Research-based theories were thoroughly researched, resulting in choices regarding ASD individual’s comfort being based upon those theories (Environmental Preference Theory and Therapeutic Environment Theory).

Yolandí Kirk, a therapist at the UNICA school for autism, expressed her opinion in an interview about the degree of separation between autistic and non-autistic children, which contradicted Panama’s views (2016). The dissertation has lead, however, to the further exploration of Panama’s Theory of Integration Rather Than Assimilation (Pomana, 2014).

Delimitations

As discussed previously, there are two methods of designing for individuals with ASD: the Sensory Sensitive method and the “Neuro-typical” method (Henry, 2015:53). Both these methods have positive elements, however, only the Sensory Sensitive method was referenced for this dissertation as the Sensory Sensitive method proved to be more successful in practise (a method that uses a sensitive approach with regard to sensory sensitivity). As previously mentioned, this argument was influenced by the Sensory Sensitive method, which will be discussed in the design development chapter (Chapter 5).
According to Gaines et al. (2016), anyone suffering from the developmental disorder ASD experiences space from either a hyper- or hyposensitive perspective. This means that an ASD individual will either respond positively in a hypersensitive room, or in a hyposensitive room (Gaines et al, 2016).

As a result, ASD users’ diagnoses are unique as each users’ response to environmental sensory stimuli differs (Gaines et al, 2016).

The idea is to create three types of classrooms, each type catering to a sensory sensitivity level, namely:

- Hyper sensitive classrooms;
- Hyposensitive classrooms; and
- Combination classrooms.

The user can then choose the most suitable environment for their specific deficit diagnosis.

Elements of these different classrooms will be explained in more detail in the design development chapter (Chapter 5).
2.6 Designing for the senses

It can be argued that life is an intense sensory event and that people understand the world through their senses. It is a simultaneous integration of touch, movement, sound, visuals and smell. As mentioned earlier, life can be chaotic for ASD users because of their deficits in sensory integration, which was explained in Chapter 1.

The idea of making an environment that is sensitive to sensory needs is very important for the ASD user. When this is the case, we speak of a Sensory Sensitive approach to design. This concept is also true for the “Neuro-typical” user, as they also have certain sensitivities to sensory stimuli, which affects their creativity and mood differently, thus making them who they are. This sensory processing pattern becomes part of any person’s (autistic or “Neuro-typical”) character.

Architects can plan environments and spaces that are respectful of these sensory needs.

It is important to mention Mostafa’s Sensory Design Matrix, which was explained in Chapter 2 (2008:208-211), as this was used extensively in this project. The matrix focuses on the sensory deficits that ASD users face, and then supplies the correct form of architectural attribute and the amount thereof to counter these deficits (2008:208-211).
2.7 The need for an ASD facility in the west of Tshwane

In Pretoria, there are two centres and four schools that cater to the needs of ASD diagnosed individuals (Google maps, 2014). These facilities are currently situated in the south-eastern suburbs of Pretoria. This means that learners residing in the north-western parts of Pretoria are marginalised in terms of their lack of accessibility to ASD facilities.

The focus of this dissertation was on introducing a new architectural intervention that has the potential to become an important node in Pretoria West by becoming the only ASD facility. This node could address the sparse distribution of ASD centres around Pretoria, and in particular, in Atteridgeville.

A mainstream education solution in terms of spatial layout, technical solutions and material use is not plausible for this specific intervention (Mostafa, 2008:189-211). The typology of a traditional learning facility will thus meet reform in this thesis.

The following map shows the greater Tshwane and the distribution of facilities catering to ASD and how they are situated in the eastern and western parts leaving the western part of Tshwane with a need for an ASD school (Google maps, 2014).
Figure 16: Arial view of the Autism Learning Centre in Atteridgeville
By author
The aim of this dissertation is to investigate Sensory Sensitive design techniques and theories for an ASD learning centre.

The proposal focusses on the hyper- and hyposensitive aspects of ASD. These are used as design generators for specific classroom typologies with certain similarities, i.e. compartmentalization and spatial sequencing aim to create user comfort for specific sensory deficits.

The resultant design is a ASD learning facility becoming a beacon of hope, that focus on integration rather than assimilation and environmental preference theories to create a sensitive environment for individuals with ASD in the western part of Tshwane.

The design questions the existing isolated school of autism models by implementing modern theories whilst still retaining elements that works. I believe that architecture should establish a meaningful relationship between the site, micro context and community. The proposed centre should become a refuge for users with ASD acting as a catalyst that enforces positive space in its immediate urban context.

Building programme

Space
Public domain
Auditorium
Admin office space
Cafeteria
Supporting functions
Entrance hall
Psychiatrist & speech therapist offices
Staff kitchen and staff area

School
Hypersensitive classrooms
Hyposensitive classrooms
Combination classrooms
Outside playgrounds
Sensory rooms

Equipment

Seating for 100 people, speaking podium
Office desks for 10 staff members, chairs, Toilets
Small kitchen (microwave, stove, refrigerator)
Front desk, waiting area (Seating, coffe tables)
Desks, chars, printers, computers
Table, chairs, refrigerator, WHB, coffee machine, microwave

Round table, chairs, compartmentalization, WC, WHB, sink, selves, cupboards
Round table, chairs, compartmentalization, WC, WHB, sink, selves, cupboards
Round table, chairs, compartmentalization, WC, WHB, sink, selves, cupboards
Dynamic play apparatus, sand pit, Hammocks, sofas, plush toys, sensory walls, digital projectors, sound systems
Chapter 3

ASD success proven in architectural practice

3.1 Precedents
   3.1.1 Acland Burghley School
   3.1.2 Niemenranta Elementary school
   3.1.3 The North Brother Island School for Autistic children

3.2 Case study
   3.2.1 UNICA School
3.1 Precedent studies
3.1.1 Acland Burghley School

Architects: GA Architects
Location: London, United Kingdom
Area: 2000 sqm
Project year: 2006

Designed for 20 children, the facility is in an unused part of an existing mainstream school. Specific features include the following and will be implemented in the proposed intervention in Atteridgeville (Gaines et al, 2016).

- Lighting came from an indirect source as to be of minimal disturbance to users. LED lights were used as opposed to the conventional fluorescent light bulbs as the on and off flickering has proven to be very disturbing for ASD users.

- Double glazing of all fenestration with views orientated as to avoid views to the playground and glare from the sun.

- Colours of vertical planes were selected based on research done by the firm upon consultation with the children. For example bright colours in the entrance space and subdued colours in the classroom space.

- The classroom is designed with a single member of staff having the ability to observe the entire classroom from a single point.

Figure 17: Main entrance of the Acland Burghley school (https://www.google.co.za/search?q=acland+burghley+school)

Figure 18: View from the cafeteria (https://www.google.co.za/search?q=acland+burghley+school&hl=sa&biw=1778)
3.1.2 Niemenranta Elementary school

Architects: ALT Architects + Architecture Office Karsikas
Location: Oulunsalo, Finland
Area: 3670.0 sqm
Project Year: 2012

Figure 19: Niemenranta elementary school (http://www.archdaily.com/279413/niemenranta-elementary-school-alt)
The Niemenranta Elementary school is located in a new residential area in the Oulunsala Municipality. The project finished in 2012 and is surrounded by small scale houses, most of which are still in the construction phase. The school has become the central focus point by being the only public building in the area.

**Lessons learnt from the Niemenranta Elementary school in Finland**

The Niemenranta Elementary school is divided into 3 parts:

- The elementary school for 300 students (the project at hand)
- The kindergarten
- The junior high school

This concept of one school for all ages is similarly implemented at the school in Atteridgeville. ASD education does not focus on age, but rather on where the individual lies on the spectrum and the level of functioning, regardless of age. Thus, the ages in such schools range from preteen to young adult. The degree of separation focuses on the sensory sensitivity of the user.
The free-formed brick wall interact with the public, while the rectangular wooded façade defines the school yard and ensures a humane perception.

The curved brick wall becomes a prominent feature; it creates a strong public feel (Niemrranta Elementary School, 2012).

A great wall reclaims part of the Magalies Mountain range as this wall responds to crevasses in the mountain. Like in the Niemrranta School, the wall at the new learning Centre in Atteridgeville becomes an ordering element, and establishes a datum from which spaces are organised. It also becomes a retaining wall (Niemrranta Elementary School, 2012).

Figure 22: Niemrranta elementary school ground floor plan and free forming brick wall
(http://www.archdaily.com/279413/niemrranta-elementary-school-alt)

Figure 23: Proposed design in Atteridgeville showing the retaining wall
By author
Figure 24: Niemenranta elementary school brickwork
(http://www.archdaily.com)
Figure 25: Niemenranta brick wall
(http://www.archdaily.com)

Figure 26: Zen view at Niemenranta elementary school
(http://www.archdaily.com)
Figure 27: The free forming brick wall follows the contours of the site at the swimming pool

By author
The materiality of the school at Atteridgeville is sensitive to its context. The public domain establishes a sense of hierarchy. Brick work has been used extensively in many forms to aid in wayfinding. The brick work also animates the façade, inspiring movement and demonstrates focal points.

Figure 28: Animation of brick work aids in spatial organization in the combination classrooms
By author
3.1.3 The North Brother Island School for Autistic children

Architects: Ian M. Ellis and Frances Peterson
Location: North Brother Island, New York
Area: 3000 sqm
Project Year: 2012

Figure 29: The North Brother School for Autistic Children library interior (http://www.archdaily.com/314629)
The North Brother Island School for Autistic children was designed by Ian M. Ellis and Frances Peterson. The schools’ aim is to provide the Bronx with a necessary resource as it lacks such a school in the close proximity. The project is also thought to do away with the negative stigma of the island, reestablish the island’s importance for the nesting birds and introduce research and education programs to provide a healthy new learning environment for public, parents and children. They played with the idea of 2 or more functions which does not have a direct relationship with each other yet designing the spaces so that these functions gain a symbiotic relationship.

The unusual mix of program, site and clients reinforce and enable the successful growth of each other. The building attributes responds to the various different needs of the hypersensitive and hyposensitive occupants being human or bird (North Brother Island School for Autistic Children, 2013).

**Lessons learnt from the North Brother School for autistic children**

The designed landscapes and spaces are unique and crafted for a multitude of different users, just as Autism isn’t a predictable disorder. Hypersensitive users need routine, control and similarity. Hyposensitive users need discovery, sound, texture and sensory abundance. The school responds to this with three clusters of classrooms each catering for the specific needs of each of the sensory groups. The three clusters look onto unique courtyards.

- The Western courtyard is for users which is characterized as both hypo and hyper sensitive. It is safe yet adventurous, a good balance. There is an existing structure within this courtyard which has been stabilized to act as a play area.

- The central cluster is designed for the hypersensitive users, as it is most protected. The courtyard has a symmetrical garden and surface materials focusing on safety, ease of use, transition and a low sensory phenomena. Gardening is encouraged and self-exploration of textures, smells, sounds and colours.

- The hyposensitive children finds home in the eastern cluster as these classrooms are totally open to the outside world- the public realm of the island. The vegetation here retain their wildness as they are allowed to grow freely as they have since the island’s abandonment (North Brother Island School for Autistic Children, 2013).
Figure 30: Ground floor plan of the North Brother School for Autistic Children showing the different classrooms
(http://www.archdaily.com/314629/)
Figure 31: Elements of the hyper- and hyposensitive gardens of the North Broher school (http://www.archdaily.com/314629)
Figure 32: The spatial organization of the proposed design
By author
The classrooms are identical for ease of construction. Isolated and group learning spaces are provided, as well as escape spaces for the children. Escape spaces provide a refuge when the ASD individual experiences sensory overload. The roof construction is made up of an upside down scissor truss. It is designed with members fabricated to maximize the capture and redirection of natural light throughout the year. This technique allows for indirect natural lighting. Electrochromic glass is used, which can be electrically switched from clear to opaque to determine the amount of light present in the room. This lighting system in the North Brother school classrooms reduces glare and the flicker of fluorescent lights, which are not ideal in an autistic environment.

Winding paths entice visitors to explore the island without disturbing the children or the birds. There are also spaces where the public can engage with the children. This is very necessary in terms of the Theory of Integretion Rather than Assimilation (North Brother Island School for Autistic Children, 2013).

The new school in Atteridgeville aims to provide an important resource to an area that had a need for a school of this scope. The organisational layout of this new school will follow the same principles as that of the North Brother School for Autistic Children. The new school in Atteridgeville uses similar spatial separation of the different sensory deficit levels, but has only one large play area with elements of each deficit. This encourages mystery and tolerance.

Figure 33: Typical classroom plan at the North brother school for autistic children (http://www.archdaily.com/314629/)

Figure 34: The 3 different classroom plans of the proposed ASD learning centre in Atteridgeville

By author
3.1.4 UNICA School classroom

Location: Lynnwood, Pretoria, South Africa
Area: 3670.0 sqm
Project year: 1997

The classrooms are intimate. The ratio is one Teacher for every nine children. Artificial light is the main source of light as blinds cover the windows, allowing for little penetration of natural light. The classroom is adapted for group learning in the form of a circular table in the centre, as well as individual compartmental learning. This is where sensory distraction is minimised by use of 'compartmentalised stations' where the children do their learning. Individual learning is accentuated by means of a strong sense of routine. Walls are kept mostly bare and pastel colours are used to minimise distractions for the hypersensitive learners.

Figure 35. The typical classroom plan of the UNICA school
By author
Chapter 4

Analysis and appraisal of context

4.1 Regional analysis and need
4.2 Contextual study
  4.2.1 Important nodes
  4.2.2 Main & secondary traffic arteries
  4.2.3 Pedestrian routes
  4.2.4 Context materiality
4.3 Site elements
  4.3.1 Site section
  4.3.2 Panoramic view of site
  4.3.3 Sun response

150 Semenya Street
Atteridgeville
Pretoria
0006
-25.777613, 28.088963
4.1 Regional analysis & need

The following map shows the greater Tshwane and the distribution of facilities catering for ASD and how they are situated in the eastern and western parts leaving the western part of Tshwane with a need for a school for ASD. The legend used gives insight to the scale of each existing ASD facility in terms of number of teachers and pupils and age spectrum.

Legend

- ASD facilities without learning centre
- 1 person = 10 children
- teachers & assistants
- age spectrum
Figure 36: A map showing all of the ASD facilities in Tshwane and giving insight to the scale of each facility (www.googlemaps.com)
4.2.2 Main & secondary traffic arteries

Figure 38: Main traffic arteries (Google Earth)

Figure 39: Secondary traffic arteries (Google Earth)
4.2.3 Pedestrian routes

Figure 41: Taxi stops
By author
4.2.4 Context materiality

Visual context surveyed to establish a sensitivity to the materiality of Atteridgeville. Wall treatments, streetscape and floor finishes have been studied in terms of material use and detailing.

Figure 42: Typical Atteridgeville sidewalk
By author
Figure 43-44: Animation of walls
By author
Figure 45-46. Extensive use of brick
By author
Figure 47-48: Typical sidewalk in Atteridgeville
By author
4.3 Site elements

4.3.1 Panoramic view of site

Figure 50: View from Semenya street panoramic
By author
4.4.2 Site section

Figure 51: Site showing contours
By author

Figure 52: Section through site
By author
Figure 53: Site boundary
By author
4.4.3 Sun response

Figure 54: Site response to the sun throughout the year
By author
Chapter 5: Analysis and appraisal of context

150 Semenya Street
Atteridgeville
Pretoria
0006
-25.777613, 28.088963

Regional analysis and need
Contextual study
Site elements
Weather tracks
Sensory detail in prosthesis

Using different elements aiding in characterization and wayfinding. Prosthesis is architectural attributes acting as aids and allowing greater autonomy.

Figure 55: Sensory detail aiding in prosthesis. Different elements forming part of the design
By author
Figure 56: Parti diagram. "Neuro-typical" (manmade) meets and merges with Sensory Sensitive (natural).
By author
Figure 57: Conceptual study of plan

By author
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By author

Figure 59: The design responds to Serobatse street establishing a reference datum
By author
Figure 60: The design responds to crevasses in the Magaliesberg mountain
By author
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By author
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By author
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Figure 73: A colour gradient showing private to more public. By author.
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By author
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By author

1 Hyposensitive classrooms
2 Hypersensitive classrooms
3 Combination classrooms
4 Sensory rooms

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By author
Figure 80: The auditorium
By author

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By author

Figure 82: The swimming pool
By author

Figure 83: Nodes throughout the proposed design
By author
Figure 64: The entrance of the proposed design will become a monument
By author
Auditorium analysis

Cohere

Figure 85: Light entering and showing movement
By author

Figure 86: Focus in the auditorium
By author

Figure 87: Auditorium plan
By author
Legibility

Figure 88: Circulation
By author

Figure 89: Entrance
By author

Figure 90-91: How hierarchy was established in the public domain
By author
Combination classroom analysis

Spatial sequencing

- Reading space
- Toilet
- Group activity space
- Break away space
- Compartmentalisation
- Storage space
- Circulation

Figure 93: Combination classroom plan
By author

Figure 94: Degree of enclosure
By author
Sensory detail

Figure 99: Combination classroom plan
By author
Figure 100: Section through combination classroom
By author
Hypersensitive classroom analysis

Spatial sequencing

Figure 101: Hypersensitive classroom plan
By author

Figure 102: Degree of enclosure
By author

Reading space
Storage space
Group activity space
Compartmentalisation
Toilet

High enclosure
Degree of seclusion

High degree of seclusion

Medium degree of seclusion

Low degree of seclusion

Figure 103: Colour gradients showing seclusion on plan
By author

Figure 104-106: Diagrams showing degree of seclusion
By author
Sensory detail

Figure 107: Hypersensitive classroom plan
By author
Figure 108: Hypersensitive classroom
By author
Hyposensitive classroom analysis

Spatial sequencing

Figure 109: Hyposensitive classroom plan
By author

Low enclosure

Figure 110: Degree of enclosure
By author
Degree of spatial seclusion

Figure 111: Colour gradients showing seclusion on plan
By author

Medium degree of seclusion
Low degree of seclusion
Figure 112: Hyposensitive classroom plan
By author

Sensory detail
Figure 113: Section through Hyposensitive classroom
By author
Sensory rooms analysis

Cocoons

Figure 114: Sensory rooms
By author

Figure 115: Colour gradient showing degree of seclusion
By author

Visual

Tactile

Auditory

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By author
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By author
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By author
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By author
Chapter 7 Technical review
Chapter 8

Conclusion

8.1 Conclusion
8.2 List of references
8.1 Conclusion

As explained earlier, there needs to be a more inclusive approach when designing environments, especially in regards to ASD. Architecture has the potential to bridge the gap between autistic and “Neuro-typical” by providing spaces accommodating skill acquisition which will lead to integration.

The site proved to be an interesting topology as it gave room for creating spaces cutting into the creating different enclosures needed in order for the design to function properly.

A challenging aspect of this design was the fact that ASD is a spectrum disorder and no two diagnosis are unique. The design challenge was to create spaces that would accommodate for a range of sensory deficits while still leaving room for adaptation.

Further exploration and design regarding spaces and techniques of using architecture in the narrative process and the detailed design of the landscape on site would have been enjoyed.

In essence, this dissertation has afforded me the opportunity to study a field in which I have a personal interest in and the research conducted and insight uncovered through the process of the dissertation are far from final as there is still much to be discovered and explored regarding the topic of architecture and ASD.
8.2 List of references


HENRY, C. 2015. Design for all. Many perspectives: Design for autism spectrum disorder, 10(13), December:53-65


