EFFECTS OF SPATIAL NAVIGATION ON VISUO-SPATIAL WORKING MEMORY IN CHILDREN WITH AUTISM:
A Study on 'Special Units' from Primary Schools in Negombo, Sri Lanka

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Abstract: Wayfinding is an important feature that has a substantial impact on autistic children's cognitive and spatial abilities in educational settings, yet it is typically overlooked in inclusive educational design. The study investigates the impact of wayfinding on visuo-spatial working memory (VSWM) of autistic children in two school settings with 'Special Unit's' in Negombo, Sri Lanka. Using a mixed-method approach, the research evaluates the effects of architectural wayfinding on cognitive performance through pre and post intervention VSWM assessments using the Corsi-block tapping tasks across both Assisted Wayfinding Tasks (guided navigation) and Unassisted Wayfinding Tasks (independent navigation) across a sample of 23 autistic students and navigational impairments using wayfinding questionnaires. The research further studies the wayfinding patterns through a series of behavioral mapping exercises and parametric observation done through a photographic study. The study found that post-task accuracy declined in both navigation contexts, with unassisted tasks exhibiting lesser losses (Case 01: -25.5%; Case 02: -33.48%). Recall times increased in supported activities (Case 01: +43.22%; Case 02: +32.2%) while improving in unassisted tasks (Case 01: -8.62%; Case 02: +4.95%). Error rates dropped somewhat (-8.33% in unsupported tasks). Case 02 demonstrated severe spatial anxiety (≥31), chronic distance estimate deficits, and a modest decrease in navigation orientation. Behavioral observations revealed that autistic children prefer straightforward routes, shaded green settings, and enclosed spaces for sensory modulation. However, both investigated environments lacked critical wayfinding aids for reducing cognitive strain. Recommendations can help architects, designers, and educators create autism-friendly spaces that enhance navigation and cognitive outcomes. Future research should look into long-term cognitive effects and wayfinding in unfamiliar environments in order to improve navigation tactics and assistance for various sensory needs.

Keywords: *Spatial Navigation, Wayfinding, Visuo-Spatial Working Memory, Autism Spectrum Disorder.*

1.1 Introduction

Autistic individuals experience differences in sensory processing, often showing heightened sensitivity that impacts their interaction with space and the built environment (Munshaw, 2015; Donohue et al., 2012). Difficulties in processing sensory stimuli are linked to increased anxiety and depression (Tavassoli et al., 2014). While egocentric navigation may remain intact, research suggests autistic individuals often struggle with allocentric navigation due to deficits in relational memory (Bowler et al., 2011).

Enhanced visual memory in children with autism supports navigation when aided by clear, structured visual cues (Schmidt et al., 2011). Visuo-spatial working memory (VSWM)—vital for spatial understanding—is often impaired in autism and associated with core symptoms such as communication difficulties and repetitive behaviors (Schuh et al., 2016). Despite its importance, limited research explores how spatial navigation in architecture affects VSWM in autistic individuals, marking a key gap this study aims to address.

1.2 RESEARCH PROBLEM

Most of the available literature evaluating the effect of the built environment on sensory sensitivities of autistic users has only focused on the impact of color, lighting levels, materiality etc. (Munshaw, E.K. 2015). Lesser approaches or studies were focused on wayfinding, and even lesser studies pertaining to autistic students.

1.3 OBJECTIVES

The main purpose of this study is to contribute to an understanding of the effects of wayfinding on Visuo-Spatial Working Memory of Autistic children and to assess the contribution of it towards the wellbeing of 'Autistic kids' and parameters defining built environment.

- To identify the built environment, factors affecting Spatial Navigation and its effects on Autistic individuals.
- To identify how Spatial Navigation affects the Visuo-Spatial Working Memory of the Autistic individuals.
- To examine the effects of spatial navigation (wayfinding) tasks on the visuo-spatial working memory (VSWM) of autistic students in selected special schools.

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1.4 METHODOLOGY

This research adopts a mixed-method approach, combining quantitative and qualitative data collection and analysis. The quantitative component involves a wayfinding task assessed using pre- and post-tests of Visuo-Spatial Working Memory (VSWM) to measure its correlation with wayfinding ability. A standardized Wayfinding Questionnaire (WQ) is also used to evaluate spatial navigation impairments.

- Independent variable: Wayfinding/Spatial Navigation
- Dependent variable: Visuo-Spatial Working Memory

The study focuses on selected 'Special Units' within primary schools due to access limitations. A pilot study was conducted to define the route, followed by assisted and unassisted wayfinding tasks, each paired with pre- and post-VSWM assessments. Recall sequences were recorded using structured tables.

The qualitative analysis includes behavioral mapping by observers, teachers, and students, and a photographic parameter study to identify environmental features that support wayfinding. Data were analyzed using ANOVA and manual coding to extract key findings and inform design recommendations for autism-friendly school environments that support the development of VSWM.

1.5 SCOPE AND LIMITATIONS

The original study intended to include special schools, but the limitations of access led to a focus on 'Special Units' within primary schools. Participant numbers were reduced due to these constraints, and schools were selected from a single geographical area. However, since the research was conducted during school vacations, daily school activity and full environmental context were limited. Moreover, the structured nature of the tasks and small sample size limits the generalizability and do not fully replicate the complexity of real-world wayfinding scenarios.

2.1 Literature Review

The built environment plays a critical role in shaping the quality of life for individuals with Autism. A mismatch between spatial needs and architectural design is compromised due to the inability of people with Autism to independently interact with their surroundings as stated by Terzi (as cited in Tola et al., 2021), this view is also supported by Imrie and Kullman (as cited in Tola et al., 2021).

Autistic individuals experience differences in neurological processing, particularly in how they perceive and respond to sensory stimuli (Munshaw, 2015; Donohue et al., 2012). These sensory challenges, such as hyper- or hypo-reactivity, can result in adverse responses to textures, sounds, and light, as outlined in the DSM-5 (APA, 2013), which often constrict their behavior and movement in typical spaces.

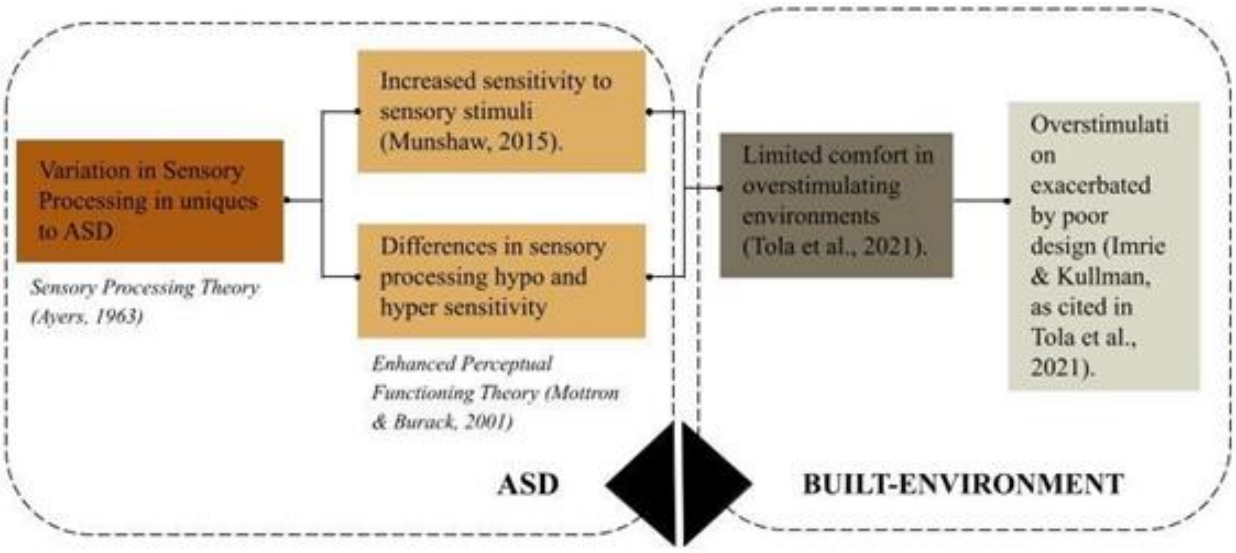

Figure 1 : Relationship Diagram between ASD and Built Environment
Source: Author

2.2 AUTISM AND WAYFINDING INCLINATIONS

Research highlights that individuals with Autism may possess strengths in wayfinding due to cognitive traits such as strong short- and long-term memory (Siegel & White, 1975), enhanced visual perception aiding landmark recognition (Mottron et

al., 2006), and adaptive problem-solving abilities (Golledge & Stimson, 1997). However, Smith (2015) notes that despite these strengths, many individuals with Autism face difficulties in real-world navigation.

2.3 ARCHITECTURAL PARAMETERS FOR WAYFINDING THAT AID ASD

The built environment significantly influences the wayfinding abilities of individuals with autism, highlighting the need for architectural interventions that support spatial navigation. Several key design factors have been identified:

- Clear visual cues help reduce confusion and anxiety due to difficulty interpreting abstract signage (Michaels et al., 2018).
- Predictable layouts support cognitive mapping and spatial understanding (Alves et al., 2020).
- Sensory-friendly environments reduce overload that can impair navigation.
- Personalized pathways enhance comfort and engagement (Hodgetts & Nussbaum, 2018).
- Lighting and color sensitivity can affect orientation, requiring careful design (Liddiard et al., 2019).
- Quiet retreat spaces aid in emotional regulation (Smith et al., 2021).
- Flexible spaces support autonomy and reduce stress (Stewart et al., 2016).

2.4 ASSESSMENT TOOLS FOR WAYFINDING

Wayfinding performance is often assessed through task-based measures such as completion time, distance traveled, and error frequency (Bowman et al., 2001; Elvins et al., 2001; Zhai et al., 1999; Ruddle & Jones, 2001; Witmer et al., 1996).

Behavioral mapping, developed by Sanoff and Coates (1971), documents user movement and interactions within spaces, offering insights into spatial usage, sensory challenges, and user needs—making it valuable in educational, healthcare, and urban design to enhance accessibility and experience.

2.5 VISUO-SPATIAL WORKING MEMORY (VSWM)

Lohman (1996) defines visuo-spatial abilities as the capacity to generate, retain, retrieve, and transform structured visual images. According to Yang et al. (2014), visuo-spatial memory involves recalling object relationships and spatial locations which is crucial.

Logie (1995) proposed that spatial memory is a multi-component system, comprising spatial sequential memory, simultaneous memory, memory for location, and spatial working memory, aiding in complex spatial processing. Hegarty & Waller (2005) further emphasized VSWM's role in supporting spatial thinking. Visuo-spatial working memory (VSWM) in wayfinding is assessed using tasks that capture different components, such as sequential versus simultaneous processing and active versus passive engagement.

2.6 ASSESSMENT TOOLS FOR VISUO-SPATIAL WORKING MEMORY (VSWM)

Studies reveal a range of VSWM tasks - The Mental Rotation Task evaluates active simultaneous VSWM which assesses object orientation, the Copying Tasks assesses the simultaneous processing of static layouts, Spatial Problem Task involves active engagement in efficient navigation. The Corsi Block Task assesses sequential VSWM through passive spatial recall, which is crucial for remembering route steps. Together, these tasks highlight how sequential processes support route continuity and simultaneous processes aid adaptability. The Corsi Block task with a slight adjustment of a tapping task supports in using children for the study.

2.7 WAYFINDING, VISUO-SPATIAL WORKING MEMORY AND ASD

Wayfinding involves the integration of spatial information, memory retention, and problem-solving, requiring active and simultaneous cognitive processing. While individuals with autism may show strengths in some visuospatial tasks, research indicates deficits in visuo-spatial working memory (VSWM) and visual perception that hinder navigation (Logie, 1995, 2003). Wayfinding tasks rely heavily on spatial orientation and planning, engaging the spatial rehearsal component of VSWM.

Studies show that individuals with autism often perform worse in spatial working memory (Zhang et al., 2020), leading to difficulties in encoding and manipulating spatial layouts. Many theories such as ‘Weak Central Coherence Model’ explains a focus on local details at the expense of global understanding (Sheppard et al., 2009), while ‘Executive Function Deficit Theory’ links challenges in memory, flexibility, and planning to impaired wayfinding (Happé & Frith, 2006). These theories highlight the cognitive and sensory barriers autism individuals face in navigation.

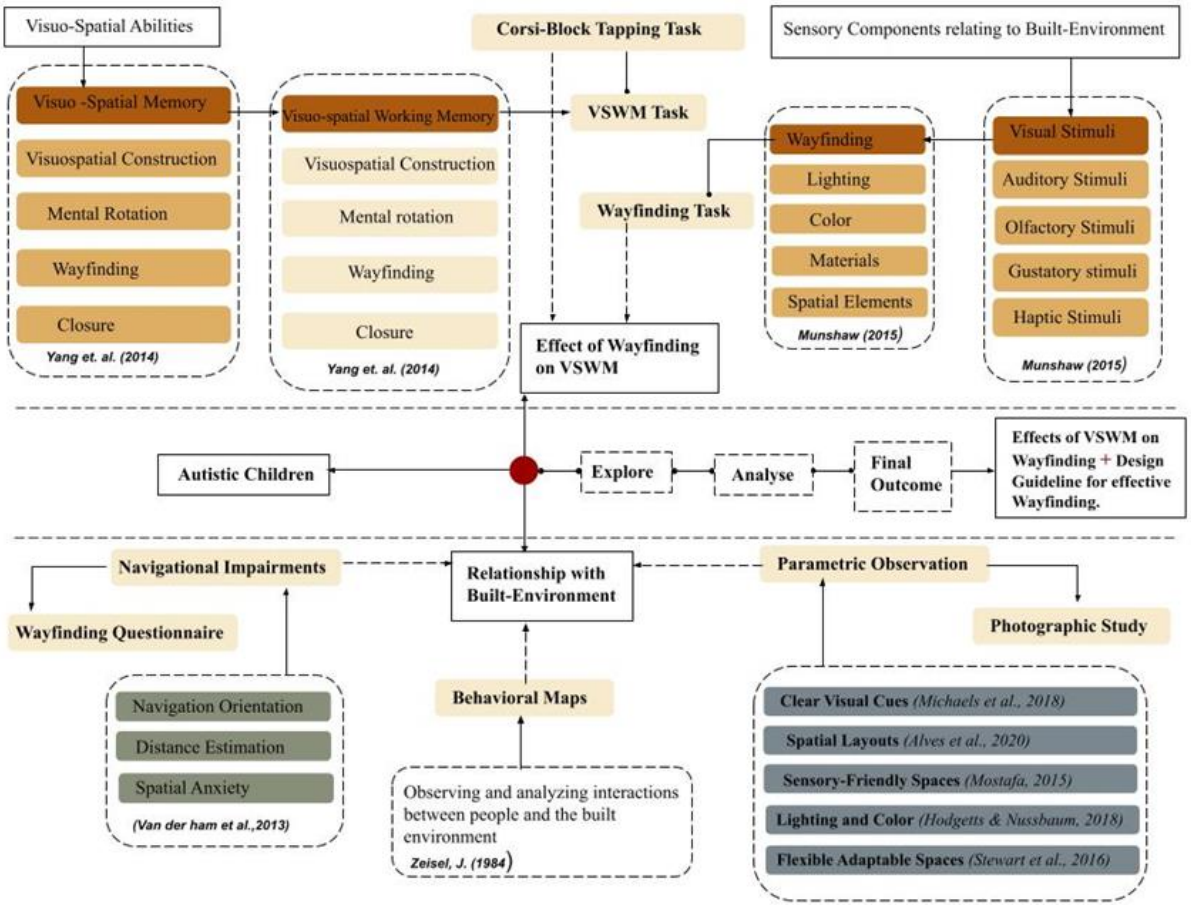

Figure 2 : Relationship between factors affecting Human Spatial Navigation
Source: Author

3.1 Research Design

This investigation is on how wayfinding and architectural parameters within school environments influence the visuo-spatial working memory (VSWM) of autistic children in 'Special Units'. Grounded in literature and prior research, the study incorporates wayfinding tasks, standardized questionnaires, observations, and mapping to assess outcomes.

The study uses a mixed-method approach. The quantitative method uses the Corsi Block-Tapping Task to assess VSWM. The qualitative method involves behavioral mapping and photometric observation study.

For the quantitative method, the tasks were administered across two main scenarios:

- Scenario 1: Assisted wayfinding with pre- and post-VSWM tasks.
- Scenario 2: Unassisted wayfinding with pre- and post-VSWM tasks, observed by teachers.

One scenario was conducted per day to minimize cognitive strain. Behavioral mapping was performed from three perspectives: researcher, teacher, and student. A photographic observation map was done by the researcher, while a Wayfinding Questionnaire looked at identifying navigation difficulties.

Finally, quantitative data from pre/post-tests and qualitative records were analyzed to compare assisted vs. unassisted performance. The qualitative data analysis hints at improvements for environments.

3.2 ETHICAL ASPECTS OF THE STUDY

As the study concerned inclusion of children with 'Autism'; according to the ethical guidelines set forth by the University, permission and ethical clearance was obtained for the study. Prior to collection of data, approval was obtained by the Ethical Clearance Board of University of Moratuwa (Ethics Declaration Number: EDN/2025/009, dated 02nd June 2025). Participants of the study, their legal guardians and the teacher in charge of the unit were informed about the purpose, the risks and the benefits of the study and 'Informed Consent' forms were obtained. The study was done with minimal intervention of the researcher, where the teacher was the primary person handling and performing the activities with the students, time sets for different activities were set to reduce cognitive strain upon the participants and the level of difficulty

in activities were reduced by considering the environments they are used to. The questionnaire was also reduced from a '7 point Likert scale' to a '5 point Likert scale' to reduce the cognitive load upon participants.

3.3 PARTICIPANTS OF THE STUDY
From two selected schools, a sample of 20 clinically diagnosed autistic students (male and female) were selected with the assistance of the teachers. All the participants were formally diagnosed by consultant psychiatrists based on the SCGC-confirmed with mild to moderate ranges of autism and were suitable for mainstream placement. This ensured the participants capability to cognitively and behaviorally engage in structured learning activities, in line with eligibility criteria commonly used in previous ASD related research.

3.4 CHOICE OF APPROPRIATE CASE STUDIES
Schools with 'Special Units' were selected for this study, based on minimizing variables affecting outcomes, with criticality on participant availability. Due to higher attendance in 'Special Units' at the primary level, District-level schools were selected. Both selected primary schools had mixed-gender student populations, with gender considered as a relevant factor.

3.5 DATA COLLECTION TOOLS
This study employs both quantitative and qualitative data collection tools. The primary quantitative measure is the VSWM task assessment, analyzing pre- and post-wayfinding effects. Secondary instruments include wayfinding questionnaires evaluating wayfinding ability in familiar contexts, behavioral mapping and photographic studies assess user behavior and environmental parameters pertaining to the study.

Table 1 : Quantitative Data Collection Methods

Parameter	**Investigative Parameter**	**Method of Investigation**
Visuo-Spatial Working Memory (VSWM)	Investigate the effects of 'Wayfinding' on 'VSWM'	Pre and Post VSWM tasks (Task Implemented - 'Corsi Block Tapping Task')
Wayfinding	Investigate and measure wayfinding using three subscales (Navigation & Orientation, Distance Estimation and Spatial Anxiety)	Wayfinding Questionnaire (WQ) Standard Questionnaire (Likert scale reduced from 7 to 5 considering the subjects ability to respond)

Table 2 : Qualitative Data Collection Methods

Parameter	**Investigative Parameter**	**Method of Investigation**
Wayfinding	Investigate the behavioral patterns of wayfinding.	Behavioral Maps (Observer/Teacher/Students)
	Investigate and identify parameters of Wayfinding that aid in effective Wayfinding.	Parametric Observation through Photographic Study

3.6 DATA COLLECTION
Physical -Manual Data collection, with close observation by teachers in each 'Special Unit.' Pre- and post-wayfinding tasks presented asfour scenarios tested over four sessions over four days. Each session included three steps: introduction to the Corsi Block-Tapping task (VSWM test), performing the wayfinding task, and then repeating the VSWM task to assess the impact of wayfinding. For both Assisted and Unassisted wayfinding each scenario was repeated on two consecutive days. In addition, students participated in behavioral mapping with teachers to identify spaces supporting wayfinding.

4.1 Data Presentation and Analysis

4.2 CASE STUDY 01 - WP/NG/SEEDUWA METHODIST PRIMARY SCHOOL, SEEDUWA
Discussion

- The 'Behavioral Mapping' reveals all students primarily used a defined route from the entrance to the classroom, their secondary spatial preferences varied—some gravitated toward shaded, green areas, while others preferred

quieter, enclosed spaces. Active students (e.g., Students 1 and 2) engaged more with open, semi-structured environments and less active students sought refuge in quieter, more isolated settings.

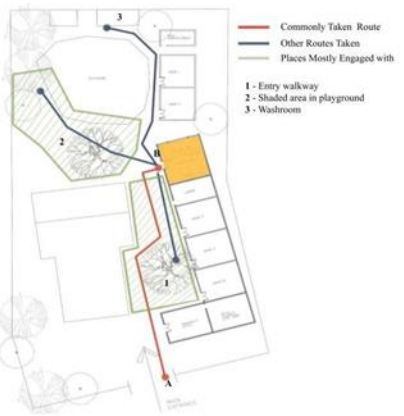

Figure 3 : Behavioral Mapping - Investigator's Perspective (Case Study 01)

Figure 4 : Behavioral Mapping - Teacher's Perspective (Case Study 01)

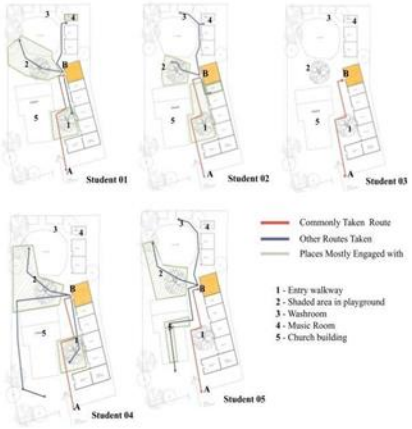

Figure 5 : Behavioral Mapping – Student's Perspective(Case Study 01)

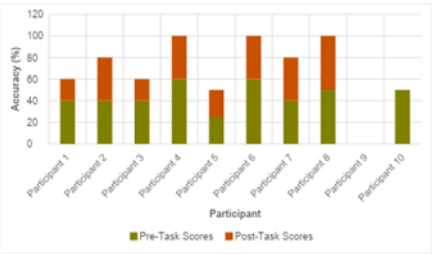

Figure 6 : Participant Accuracy – Assisted (Case Study 01)

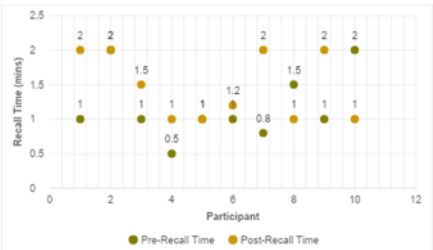

Figure 7 : Pre vs Post Recall Times - Assisted (Case Study 01)

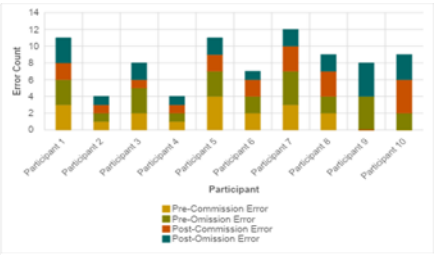

Figure 8 : Omission and Commission Errors -Assisted (Case Study 01)

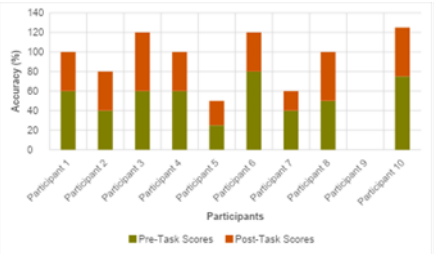

Figure 9 : Participant Accuracy - Unassisted (Case Study 01)

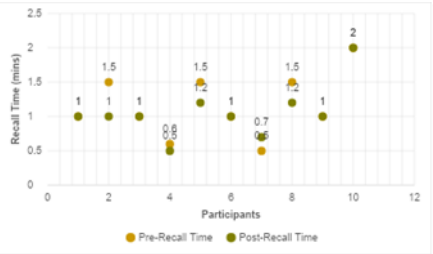

Figure 10 : Pre vs Post Recall Times - Unassisted (Case Study 01)

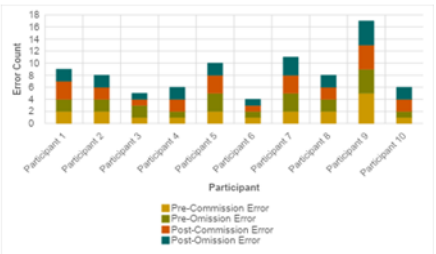

Figure 11 : Omission and Commission Errors -Unassisted (Case Study 01)

- The 'Parametric Observation' reveals the following findings. The school provides some basic spatial support, such as a clearly defined path from entry to the classroom. However, visual cues are minimal, sensory design is lacking—bright blue tones and concrete floors may cause discomfort, and sound control is minimal and a huge lack in personalized zones or quiet escape spaces.
- The 'Wayfinding Questionnaire' revealed significant wayfinding challenges among autistic students. While 30% fell within the navigational impairment threshold, where 70% were impaired, demonstrating difficulty with route recognition and spatial representation. In the spatial anxiety subscale, 100% of participants scored above the critical threshold. In distance estimation, 80% were impaired, showing struggles with spatial reasoning.
- Assisted Wayfinding Task
    1. Pre vs Post Accuracy:
       Participants began with a moderate pre-intervention mean accuracy (55.7%), but post-intervention accuracy declined by 18.46 points on average, indicating a negative effect of assisted wayfinding on VSWM. The median dropped from 60% to 40%, and the performance range narrowed to 80%.
    2. Recall Time Changes:

Longer recall times post-intervention in most, implying increased cognitive load. Stability in times were observed but did not indicate performance change.

3. Omission & Commission Errors:
   Common errors of Omission which increased post-intervention. Commission errors were less frequent and varied inconsistently. Higher omission rates correlated with lower accuracy, showing retention difficulty.
4. Accuracy vs Recall Time Trends:
   Study reveals no significant reduction in recall time post-intervention, nor did longer times generally didn't enhance accuracy. For some, extended time improved performance, but for others, it did not.
5. Performance Index vs Recall:
   Pre-intervention showed efficient performance for some; while it declined post-intervention, especially with increased recall time.

- Unassisted Wayfinding Task
  1. Pre vs Post Accuracy:
     Participants began with a moderate mean accuracy of 49%, and showed high variability in scores. Post-intervention, performance declined significantly to a mean of 36.5%, with no improvements noted across the group.
  2. Recall Times:
     Pre-intervention recall times mostly ranged between 0.5 -- 3 minutes, with quicker responses; post-intervention recalls times generally increased, suggesting heightened cognitive load.
  3. Omission and Commission Errors:
     Varied errors pre-intervention. Post-intervention, omission and commission errors largely remained consistent or worsened. Participants with lower baseline errors had stability in performance.
  4. Accuracy and Recall Time Trends:
     Accuracy varied across participants in the study. Some had maintained or slightly improved scores, but most showed declines. Changes in recall time were inconsistent as per the study.
  5. Performance Index vs Recall Time:
     Shorter recall times pre-intervention often correlated with moderate performance, while longer times explained for low performance indices. Post-intervention, speed tasking did not translate into accuracy gains. Few participants improved both recall time and performance slightly.

4.3 CASE STUDY 02- ST. FRANCIS DE SALES PRIMARY SCHOOL - KATTUWA

Figure 12 : Behavioral Mapping - Investigator's Perspective (Case Study 02)

Figure 13 : Behavioral Mapping - Teacher's Perspective (Case Study 02)

Figure 14 : Behavioral Mapping - Students Perspective (Case Study 02)

Figure 15 : Participant Accuracy – Assisted (Case Study 02)

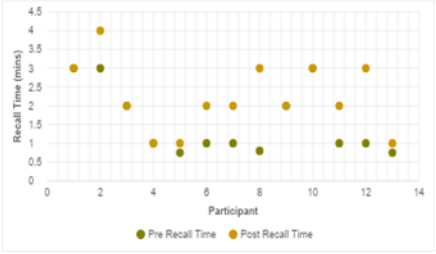

Figure 16 : Pre vs Post Recall Times - Assisted (Case Study 02)

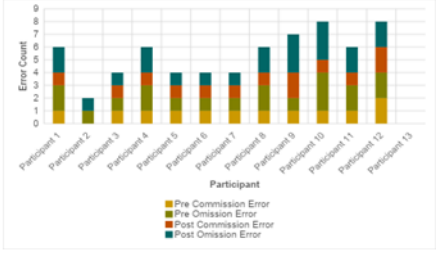

Figure 17 : Omission and Commission Errors -Assisted (Case Study 02)

Figure 18 : Participant Accuracy - Unassisted (Case Study 02)

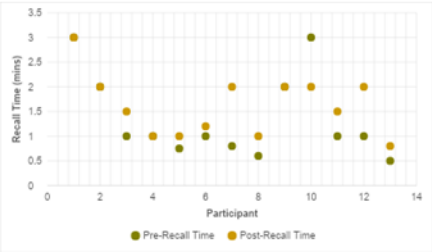

Figure 19 : Pre vs Post Recall Times - Unassisted (Case Study 02)

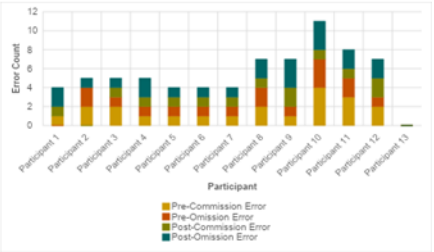

Figure 20: Omission and Commission Errors -Unassisted (Case Study 02)

Discussion

- The Behavioral Mapping reveals that Autistic students primarily followed a consistent route (A-B) from the entrance to the special unit, establishing an informal main circulation path. Minimal movement outside the classroom. The study reveals preferred spaces to reflect a need for calm, enclosed, and familiar environments. Teacher observations confirmed that students gravitated toward quiet, bounded spaces. Student interviews supported this, with many showings' likeness to quiet spaces. Overall, spatial familiarity, enclosure, and natural elements that provide sensory safety and predictability which is benefitting.
- The Parametric Observation reveals the following findings. The school provides minimal support with spatial design and wayfinding. With only a linear path directing to the unit, which lacks clarity and intuitiveness. Students' navigation based on familiarity without any clear visual aids. Little to no effort was demonstrated in making spaces 'autistic friendly' classroom interior bright (sensory challenges), artificial lighting leading to glare, lack of spaces for de-escalation and standard furniture limiting mobility and flexibility.
- The Wayfinding Questionnaire revealed that all participants exhibited impairments in navigation orientation (NA), scoring below the threshold (≤ 23). Spatial anxiety (SA) was expectantly high, with scores between 80% -92.5%, demonstrating emotional stress due to navigation. Distance estimation (DE) responses varied, showing a general difficulty in route planning.
- Assisted Wayfinding Task
    1. Pre vs Post Accuracy Analysis
       The mean accuracy declined from 55.77% to 37.31% post-intervention, indicating a general performance drop. High performers struggled with increased cognitive demands. The reduced post-task score range (max 80%) signals fewer high achievers.
    2. Recall Time
       Increased Recall durations post-intervention, moving from a 1–2-minute range to 2–3 minutes, implying greater cognitive load. Increase recall time in Participant 8 (0.8 to 3 minutes), where it denotes correlation between time and accuracy. Showing accuracy came at the cost of speed.
    3. Omission and Commission Errors
       More frequent omission errors than commission errors, reflecting retrieval struggles. Persistent errors or increased errors post-intervention. Some participants demonstrated accuracy drops due to commission errors post-task (e.g., Participants 7 and 8
    4. Performance Index
       Overall decline in performance efficiency. Most participants struggled to balance speed and accuracy posed by the intervention, indicating a negative effect on performance.

- Unassisted Wayfinding Task
    1. Pre vs Post Accuracy Analysis
       Baseline variability was high pre-intervention (scores ranged 0–80). A drop of 49 to 36.5 in mean score denoting an overall performance regression. Mean change in accuracy was negligible (-0.01), indicating minimal effects. Accordingly, high performers had no improvement; low performers had no gains
    2. Recall Time Analysis
       Shorter times linked to better performance Pre-task ranging from 0.5 -- 2 mins, with. Post-task recall times remained within 0.5 -- 2 mins and many indicated improved efficiency. The study reveals that the intervention benefited those with moderate pre-performance.
    3. Omission and Commission Errors
       High pre-task omission and commission errors, showing recall and attention difficulties. Post-task, although some improvements were seen, most showed error increases.
    4. Accuracy and Recall Time Change
       High performers-maintained stability (1.0), while low performers (7, 9) saw no progress. Recall time decreased for some, while others stayed unchanged or worsened.
    5. Performance Index vs Recall Time
       The study revealed a negative correlation existed between recall time and performance both pre- and post-task. Participants with shorter recall times had higher performance indexes.

4.4 COMBINED ANALYSIS OF BOTH CASES

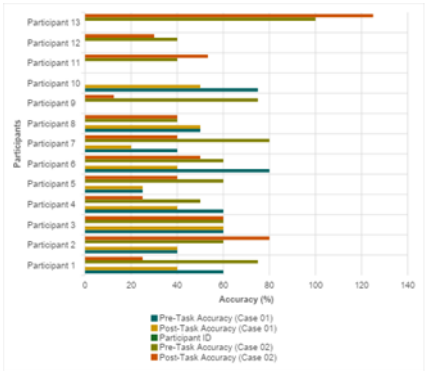

Figure 21 : Accuracy across both cases Assisted

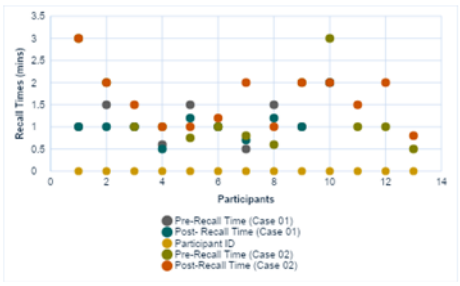

Figure 22 : Recall Times across both cases Assisted

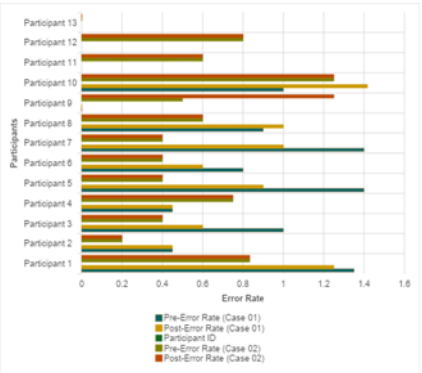

Figure 23 : Error rates across both cases Assisted

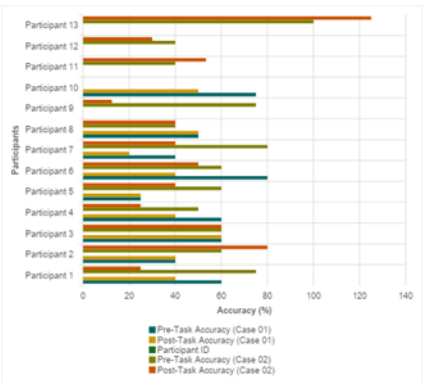

Figure 24 : Accuracy across both cases Unassisted

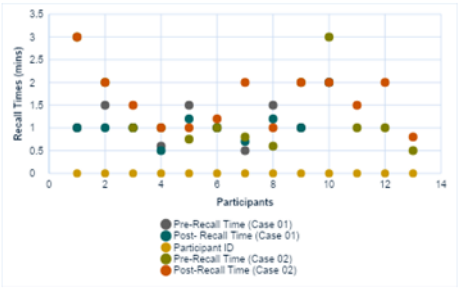

Figure 25 : Recall Times across both cases Unassisted

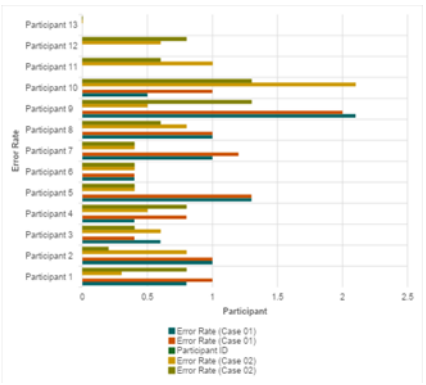

Figure 26 : Error rates across both cases Unassisted

The combined Analysis of both the cases 01 and 02 reveal certain findings;

- Behavioral Mapping
  In both cases, children depended heavily on a single, central route from the school entrance to the classroom, preferring predictable, straightforward paths. Secondary routes were rarely used and were made for specific activities and children favored shaded, green spaces which mostly provided them sensory comfort and emotional stability. Classrooms were consistently the most occupied and preferred spaces, with some children also drawn to creative, calm areas like music rooms and libraries. Minimal to low social interaction.
- Parametric Observation Study
  Both environments lacked sufficient visual aids and landmarks in supporting navigation, where students relied on their habitational dependencies rather than clear cues. Sensory-friendly features were minimal in both; although environments were less visually intense, they still lacked soundproofing or quiet spaces. Neither case provided personalized or flexible spatial zones tailored to autistic children's needs.
- Wayfinding Questionnaire
  The study revealed no severe navigational orientation impairments, both cases revealed consistently high spatial anxiety (probably due to emotional stress in navigation) and distance estimation impairments varied individually.
- Assisted Wayfinding Tasks
  In both cases the 'Assisted wayfinding' task revealed significant accuracy declines; with Case 2 denoting a steeper drop (although they started with high accuracy). Recallability of tasks increased post-task in both the cases reflecting on the heightened cognitive load and decreased efficiency. Improved and stable Error rates were recorded in Case 1 but stayed unchanged in Case 2.
- Unassisted Wayfinding Tasks
  The study reveals higher baseline accuracy especially in Case 2, but both groups experienced post-task declines. Improved recall times were recorded post-task in Case Study 1, while Case Study 2 had slight increases. Stable error rates in Case 1 slight improvements in Case 2.
- Comparison of Assisted vs. Unassisted Wayfinding

Stable recall times and reduced error rates were recorded in unassisted participants compared to assisted participants. Assisted participants exhibited slower recall times and error improvements were more evident among unassisted participants, highlighting greater adaptability.

5.1 Conclusions

This study explored how wayfinding impacts Visuo-Spatial Working Memory (VSWM) in autistic children, using two school case studies in Negombo. It combined behavioral mapping, parametric observation, and questionnaire data to understand how architectural elements influence cognitive and emotional responses.

Key Findings:

- Autistic children preferred simple, predictable navigation using central routes, minimizing secondary pathways. Shaded, green areas and classrooms were most favored, with limited social interaction observed—indicating the need for sensory-sensitive and emotionally secure spaces.
- Built Environment Limitations: Both schools lacked adequate wayfinding aids (e.g., color-coded paths, visual cues, landmarks), while overwhelming sensory elements like bright colors and noise were present. These findings align with literature emphasizing structured layouts, calming sensory inputs, and spatial orientation support.
- Assisted vs. Unassisted Wayfinding Tasks: Across both methods, accuracy declined post-task, particularly with assistance. Unassisted navigation showed slightly better outcomes in accuracy and recall, suggesting that autonomy in familiar settings may support performance. Increased recall time post-task highlighted cognitive fatigue—confirming VSWM strain during navigational challenges.
- Error Rates: While Case 01 showed stability, Case 02 (unassisted) showed slight improvement, indicating possible memory adaptation through repeated spatial exposure.

5.2 RECOMMENDATIONS

To foster inclusive environments for autistic learners, the study proposes design guidelines for future school settings:

Table 3 : Proposed Recommendations along with Findings

Element	Recommendation
Simplified Navigation	Use straightforward layouts that are predictable, with clear primary pathways. Incorporate color-coded or high-contrast visual cues for navigation.
Incorporate Landmarks	Use of recognizable landmarks such as Trees, murals or any distinguishable marker to support the autistic students in establishing spatial identity as they often remember space through distinctive visual cues.
Sensory-friendly Environments	Use muted colors, natural lighting, and soundproofing to improve environments to adjust to the user's needs. Include sensory-regulating elements like textured walls or adjustable lighting so that users can effectively use environments.
Personalized and Flexible Spaces	Design personalized zones (e.g. sensory gardens and quiet corners) to which the children can move to regulate themselves or need a space to calm down. Use of flexible layouts and furniture for varied activities.
De-escalation Spaces	This is a design consideration that is not currently implemented which is considered to be an important consideration for autism. Provision of quiet, enclosed spaces for sensory regulation is necessary while providing calming visuals and tools (e.g., weighted blankets, noise-canceling headphones).

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