



The Impact of Learning Environment Design on the Health and Perception of School-Age Children

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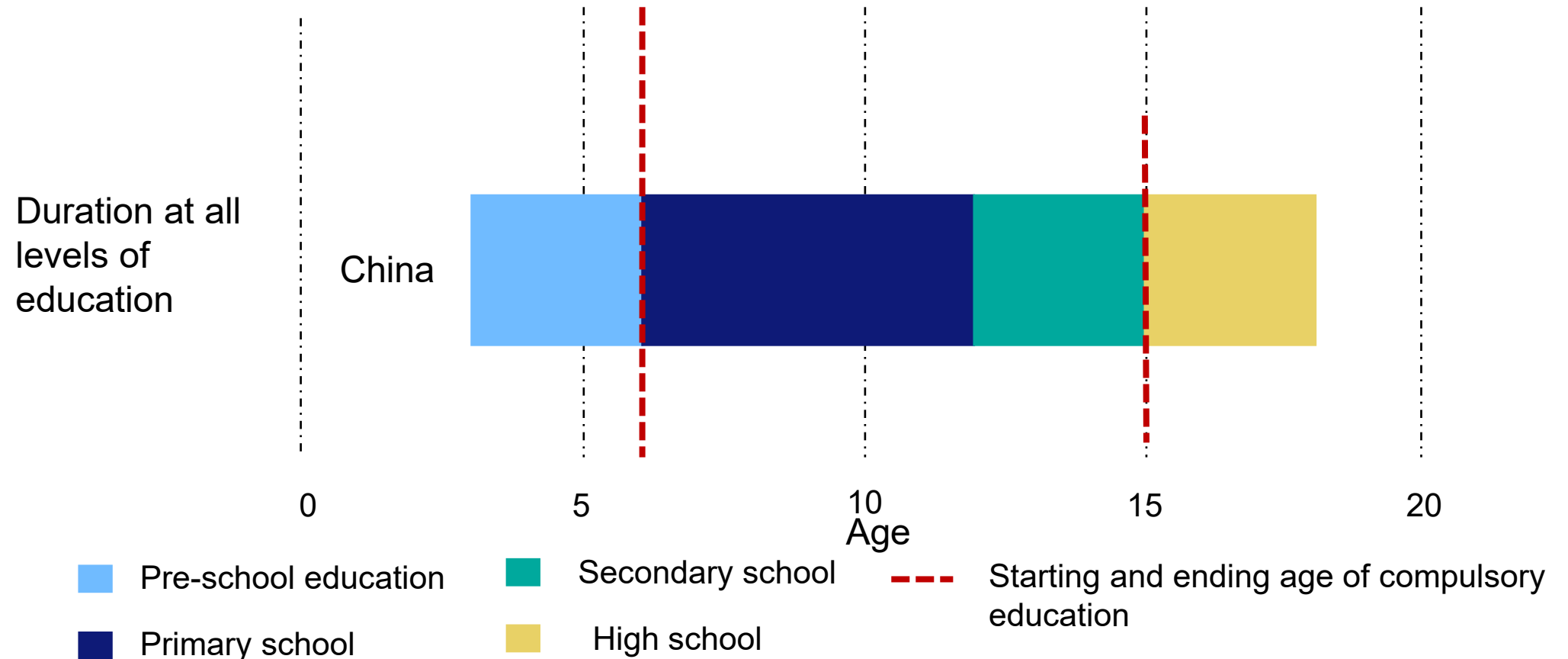
Design Implications

The Chinese Context: Unique Challenges for Children's Health



PART 01

In China, the education system implements a 12-year basic education framework, which includes a 9-year compulsory education structure. The 9-year compulsory education primarily follows a “six-three” system, while some regions adopt a “five-four” system or a nine-year integrated approach .

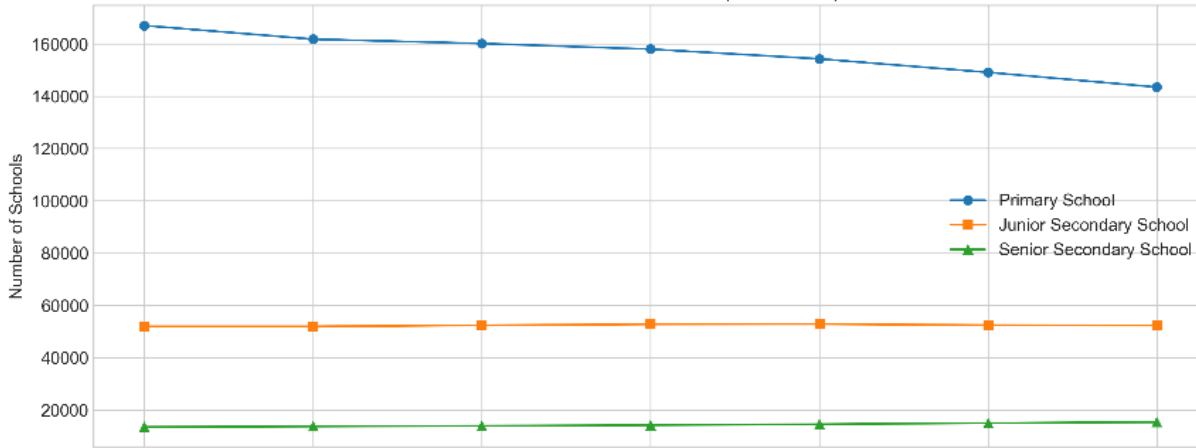


Primary School Weekly Schedule (China)

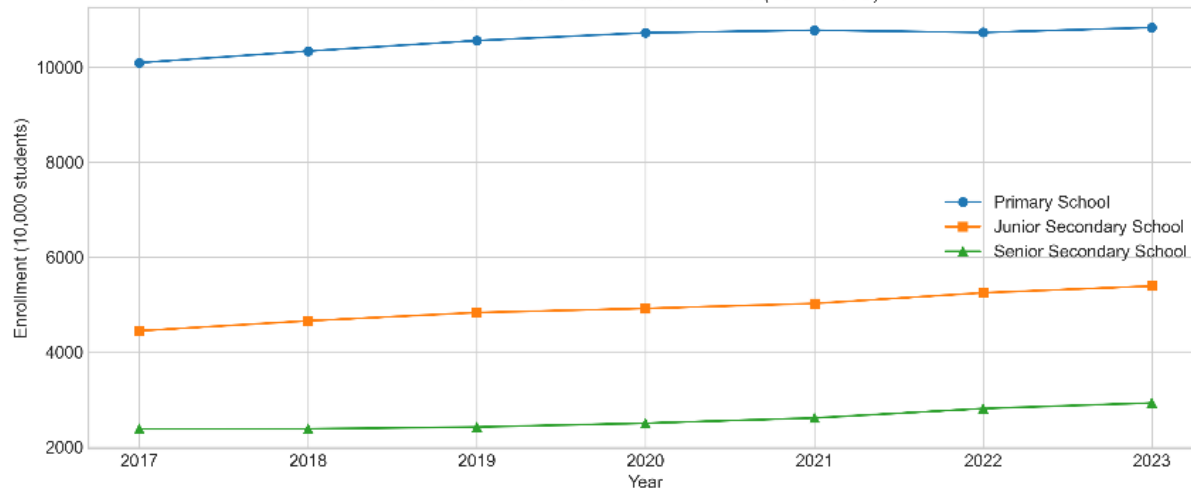
8:20-8:55	English	Math	English	Chinese	Chinese
8:55-9:35		Flag-raising/ Morning Exercises/ Sports Break			
9:35-10:10	IT	Chinese	Chinese	Math	English
10:10-10:20	Break	Break	Break	Break	Break
10:20-10:25	Eye Exercises	Eye Exercises	Eye Exercises	Eye Exercises	Eye Exercises
10:25-11:00	Chinese	Science	PE & Health	Morality & Rule of Law	Math
11:00-11:10	Break	Break	Break	Break	Break
11:10-11:45	Math	English	Math	English	PE & Health
11:45-13:00	Lunch/Noon Break/Noon Meeting	Lunch/Noon Break/Noon Meeting	Lunch/Noon Break/Noon Meeting	Lunch/Noon Break/Noon Meeting	Lunch/Noon Break/Noon Meeting
13:00-13:10	Indoor Exercises	Indoor Exercises	Indoor Exercises	Indoor Exercises	Indoor Exercises
13:10-13:45	School-based Curriculum	AI Basics	Labor Skills	PE & Health	Music
13:45-13:55	Break	Break	Break	Break	Break
13:55-14:00	Eye Exercises	Eye Exercises	Eye Exercises	Eye Exercises	Eye Exercises
14:00-14:35	Science	Morality & Rule of Law	Music	Chinese	Morality & Rule of Law
14:35-14:45	Break	Break	Break	Break	Break
14:45-15:20	PE & Health	PE & Health	Class Team Activity	Art	
15:30-16:30	Session 1	Session 1	Session 1	Session 1	Session 1
16:30-17:30	Session 2	Session 2	Session 2	Session 2	Session 2
17:30-18:00	Extended Service	Extended Service	Extended Service	Extended Service	Extended Service

Note: This schedule reflects a typical day in Chinese primary schools under the "Double Reduction" policy, with extended school hours and after-school services.

Number of Schools in China (2017–2023)

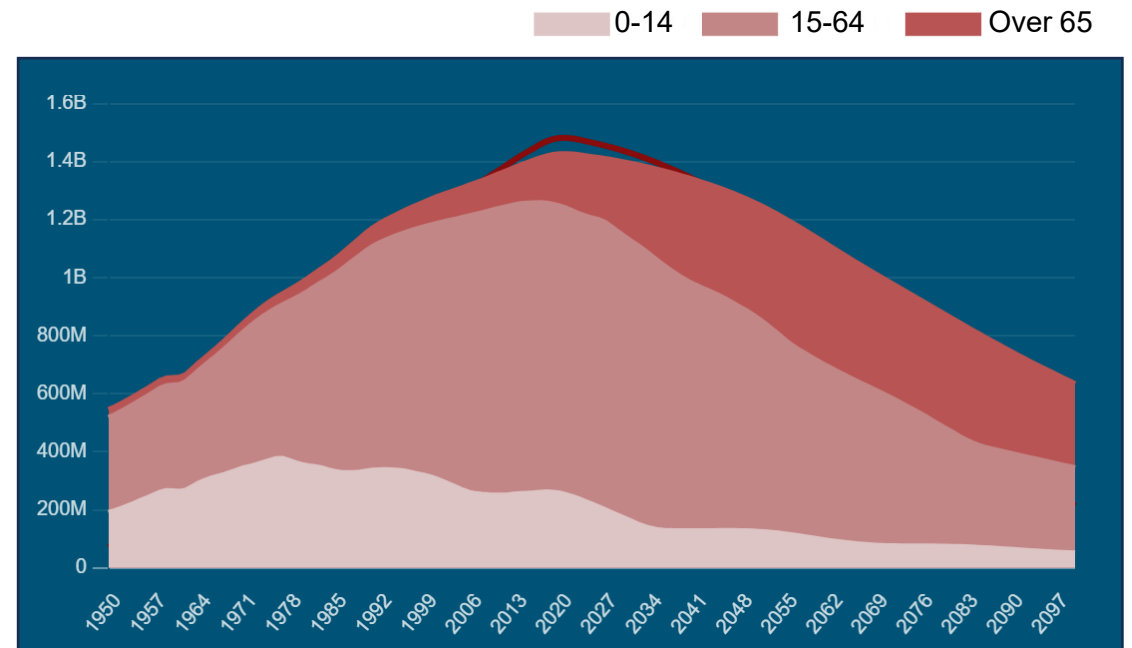


Number of Students Enrolled in China (2017–2023)

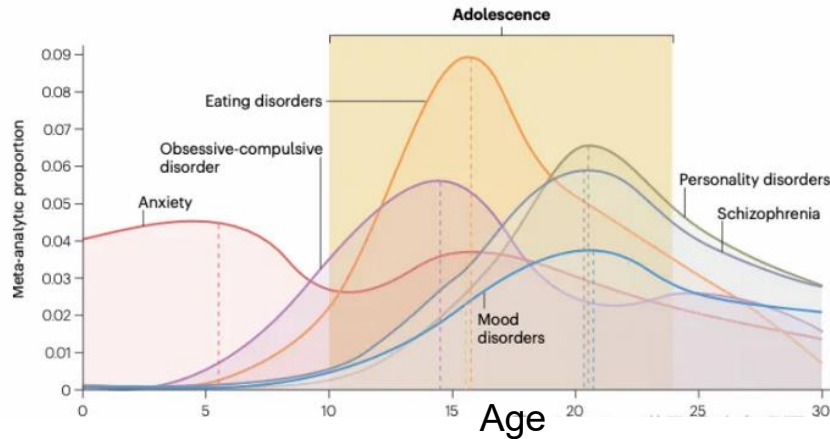


China's "14th Five-Year Plan" includes an education capacity expansion and **quality enhancement** project, proposing the construction or renovation of over 4,000 primary and secondary schools.

Population Age Structure Development Forecasts in China

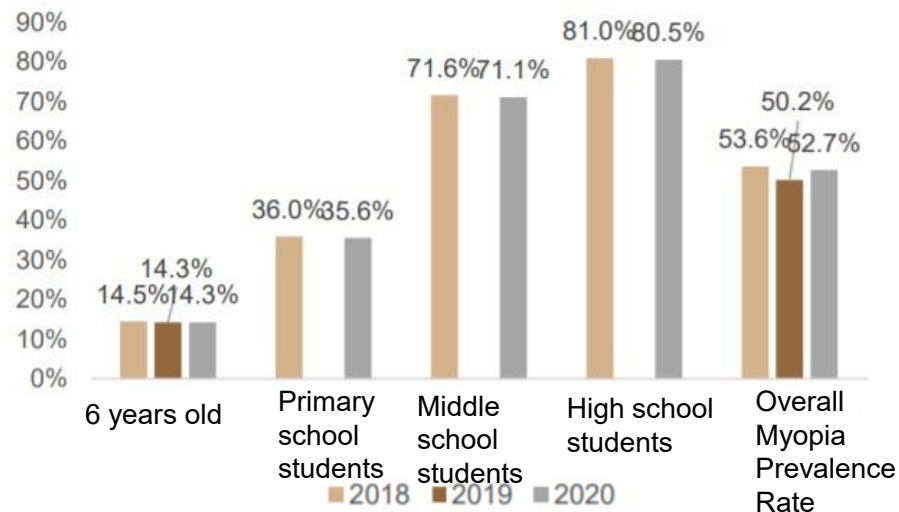


Rising psychological stress (academic anxiety, social pressure)



Prevalence rates of various mental disorders at corresponding ages.

AND a physical inactivity crisis (Myopia, obesity).



The National Health Commission's “Dietary Guidelines for Childhood and Adolescent Obesity (2024 Edition)” indicates that the obesity rate among Chinese children and adolescents aged 6 to 17 is 7.9%. In contrast, the obesity rate for this age group in 1982 was only 0.2%—meaning that over the span of nearly 40 years, the incidence of childhood and adolescent obesity has increased nearly 40-fold.

National Strategy: Policy Framework for Building Healthy Schools

Core Guideline: "Healthy China Action (2019-2030)"

It explicitly promotes health literacy in key areas: Healthy Behaviors & Lifestyles, Disease Prevention, Mental Health, and Growth & Development. It outlines concrete actions for **individuals, families, schools, and governments.**

"Double Reduction" Policy: Extended School Hours

The 2021 policy to reduce homework and off-campus tutoring has significantly lengthened students' time on campus, making the school environment a more dominant factor in their daily lives and well-being.

An Urgent Shift in Design Paradigm

With plans for over 4,000 new and upgraded primary and secondary schools, fundamentally redesign schools from passive containers into active, therapeutic landscapes that promote both physical and mental resilience.

Research Questions



RQ1

How can we measure the impact of environmental design on children's mental health?

RQ2

How can spatial layout design promote children's physical activity?

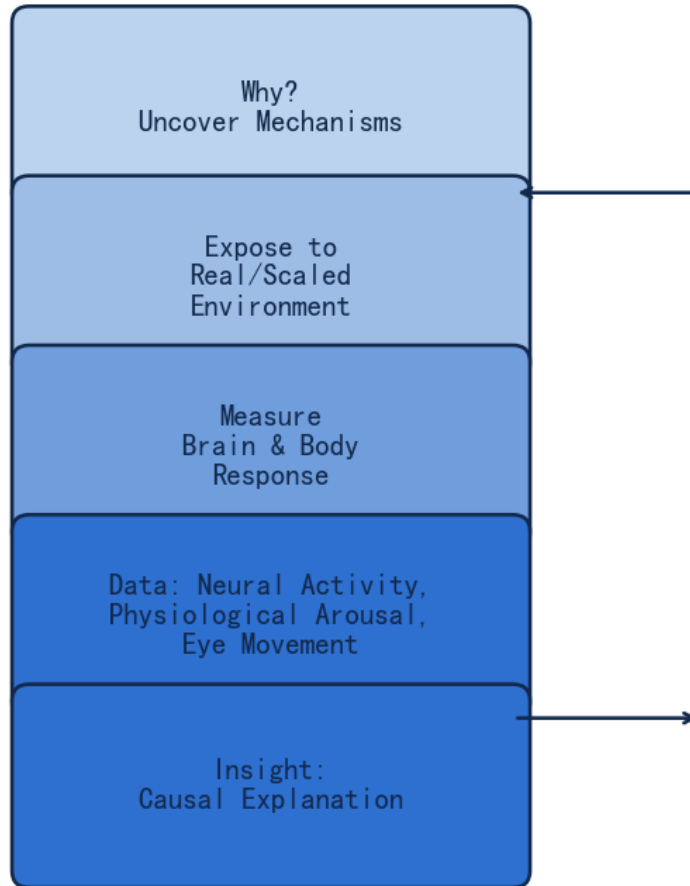


Methodology: Neuroarchitecture & Agent-Based Model

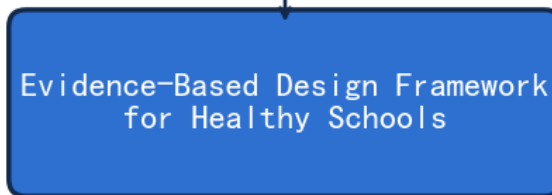
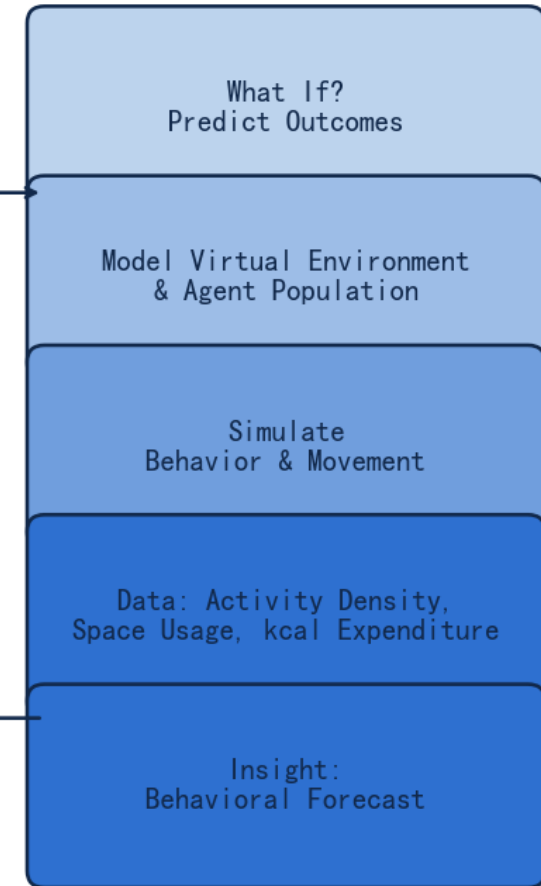


PART 02

Neuroarchitecture Approach

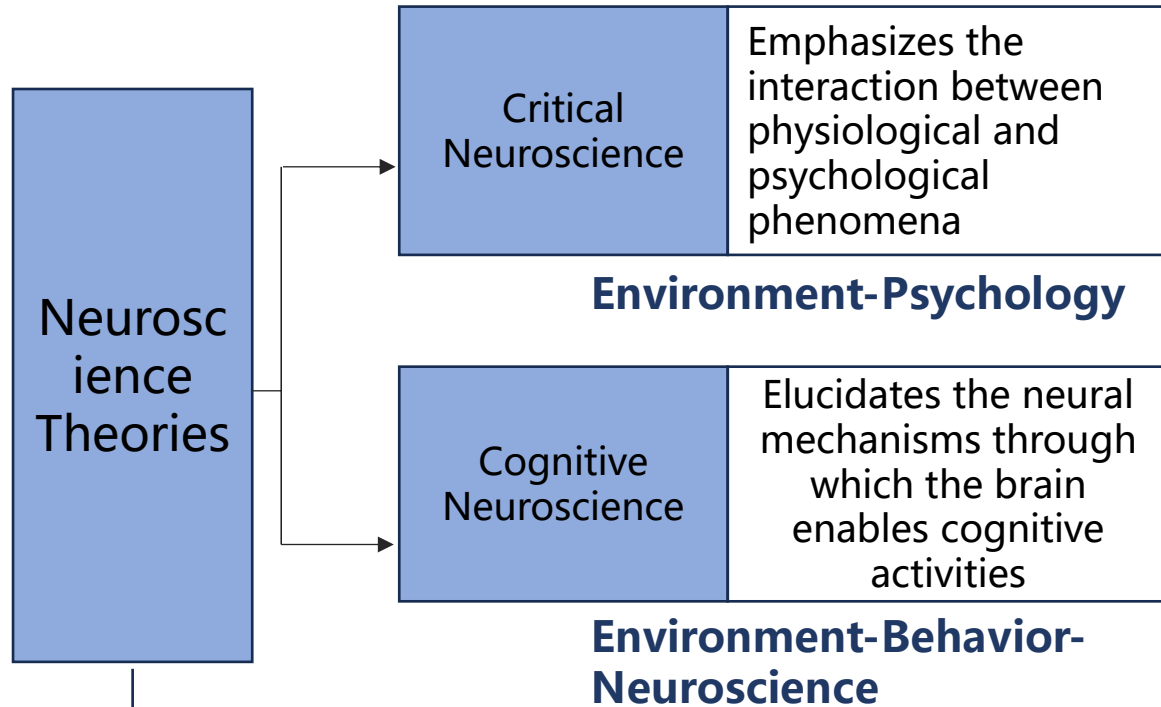


Agent-Based Modeling Approach



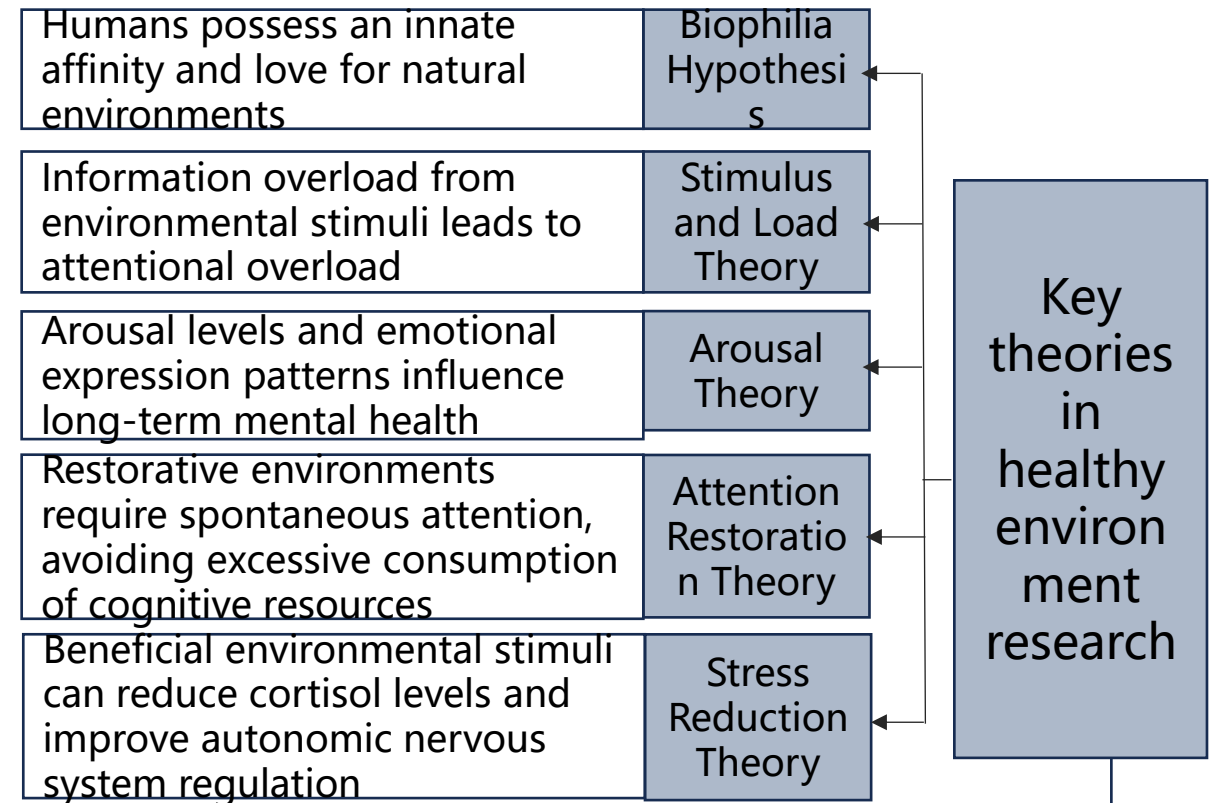
The Neuroarchitecture Approach

Intrinsic Health Mechanisms



Cognitive Foundation

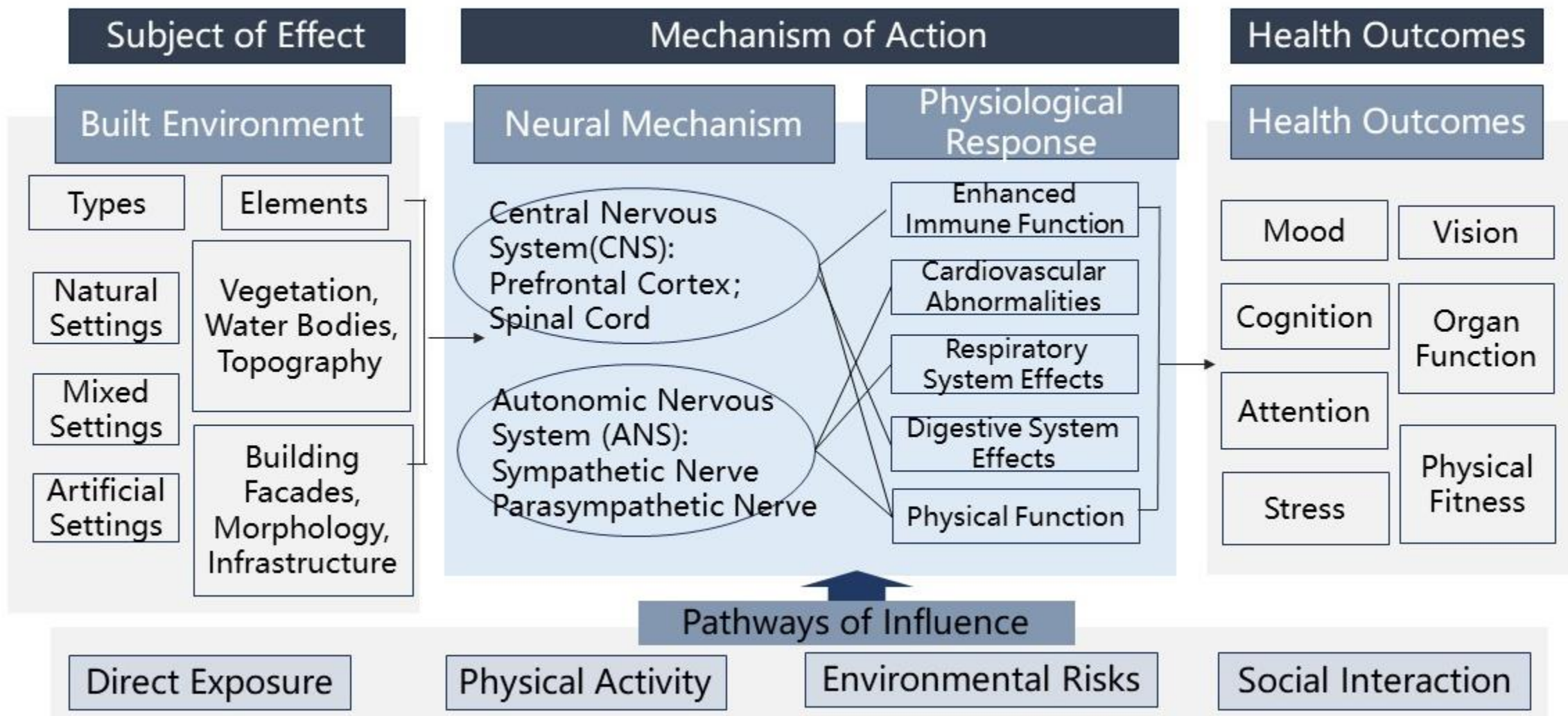
External Environmental Perception



Theoretical Foundation

Neuroarchitecture

Design Framework for 'Environmental Factors -Mental Health Outcomes'



Neuroscientific Methods for Mental Health Assessment



Functional Near-Infrared Spectroscopy (fNIRS)



Eye-tracking

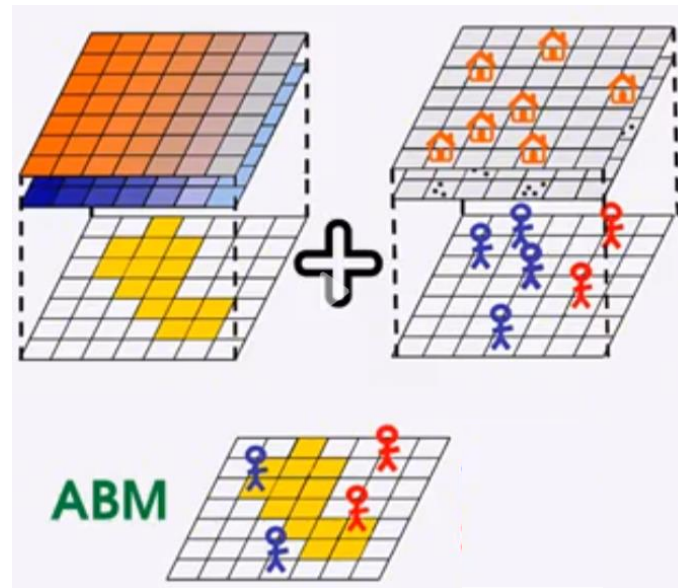
Target	Method	Principle	Data Output	Application
Brain	Computed Tomography (CT/CAT), Magnetic Resonance Imaging (MRI), Functional MRI (fMRI), Functional Near-Infrared Spectroscopy (fNIRS), Electroencephalography (EEG), Event-Related Potential (ERP)	Measures magnetic, electrical, or metabolic changes in the brain under cognitive stimulus.	Brain images, Neural activity time-series data.	Identifies changes in specific brain regions to determine the relationship between environmental stimuli and corresponding brain functions.
Skin	Electrodermal Activity (EDA)	Records electrical currents generated by neural synaptic activity.	Skin conductance response data.	Observes sympathetic nervous system arousal, indicating emotional and cognitive stress.
Heart	Heart Rate (HR), Heart Rate Variability (HRV)	Cardiac contractions and relaxations cause pressure changes in arteries, resulting in vessel wall pulsations.	Heart rate variability data.	Monitors autonomic nervous system balance and emotional fluctuation processes.
Eyes	Eye-tracking	Captures infrared light reflected by the human eye.	Visual metrics, Pupillometry data, Gaze-point trajectories, Heatmaps.	Infers cognitive and emotional changes by observing eye movement processes and visual attention.

Agent -based Model research and applications in children's studies

Agent-Based Modeling (ABM) has matured as an effective solution for space layout problem. By simulating human actions and thoughts, ABM, with its goal-driven agents interacting autonomously with the environment, exhibits high accuracy in predicting collective behaviors. ABM integrates a versatile simulation framework that includes space, time, and social networks.

It can simulate key physical activity measures such as type, spatial distribution, and duration, using agents to model individual behaviors.

Environment



Agent

ABM

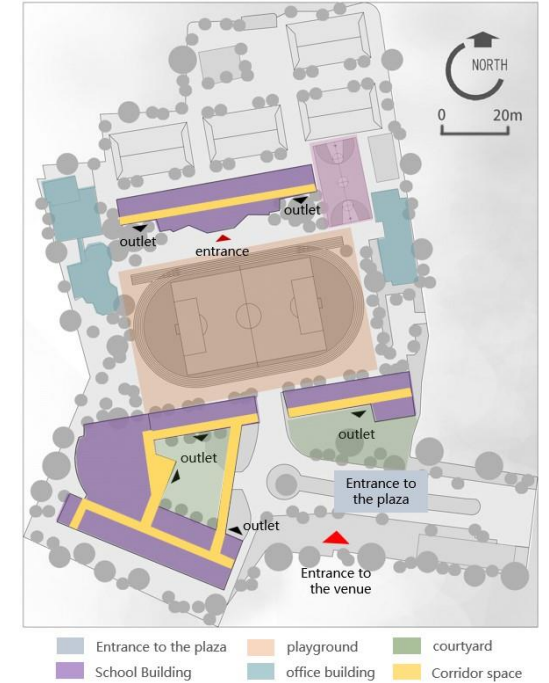
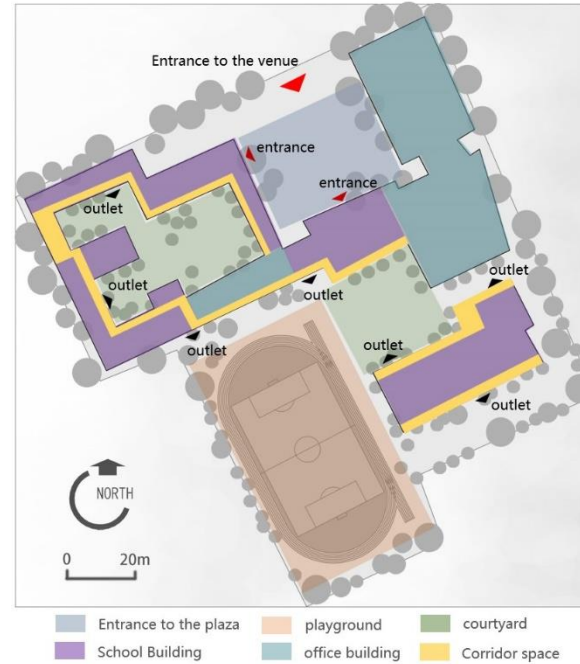
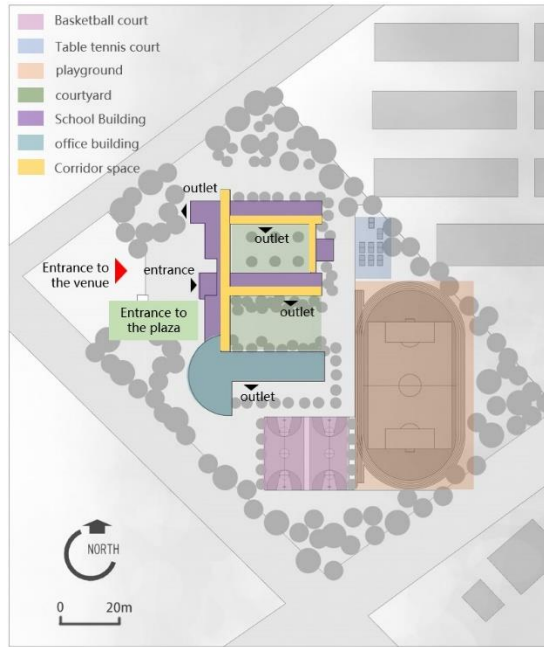
Results



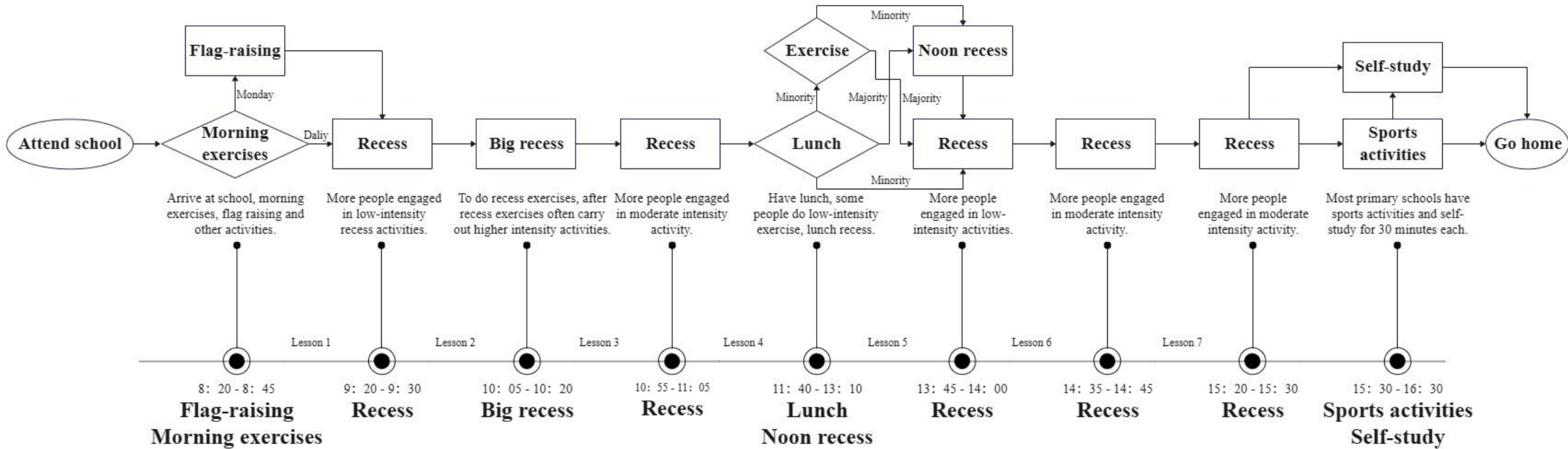
PART 03

Multi-Agent-Based Model of Physical Activity Levels

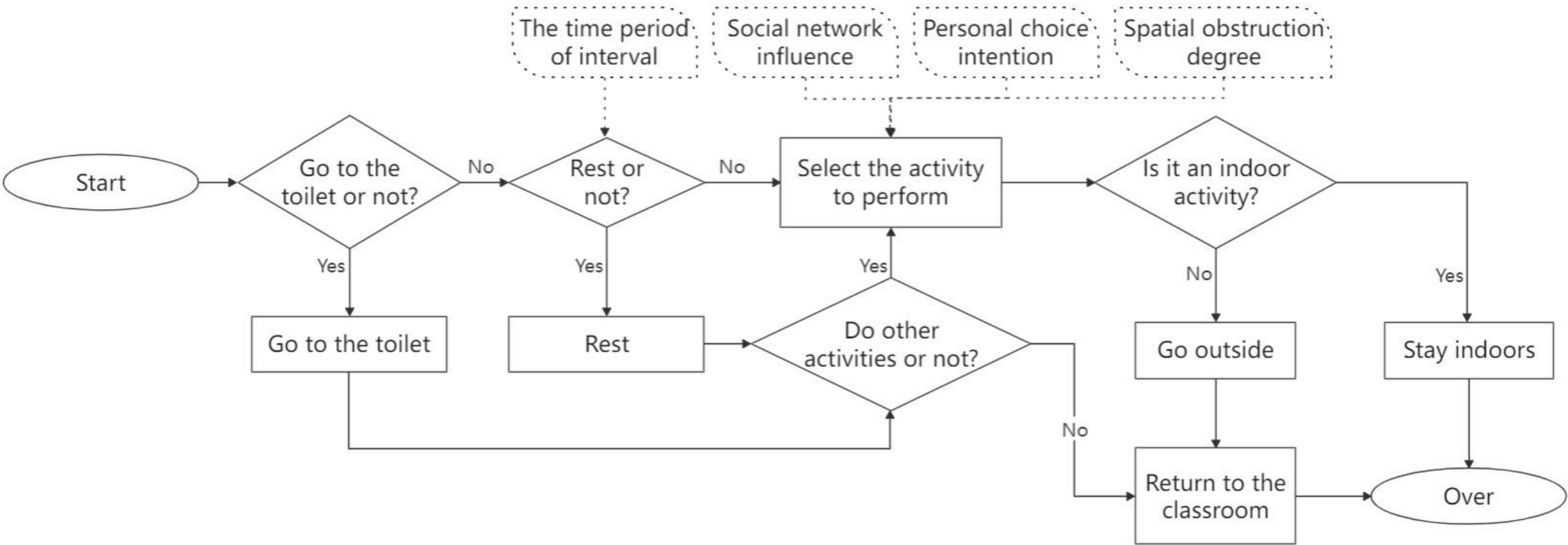
Environment



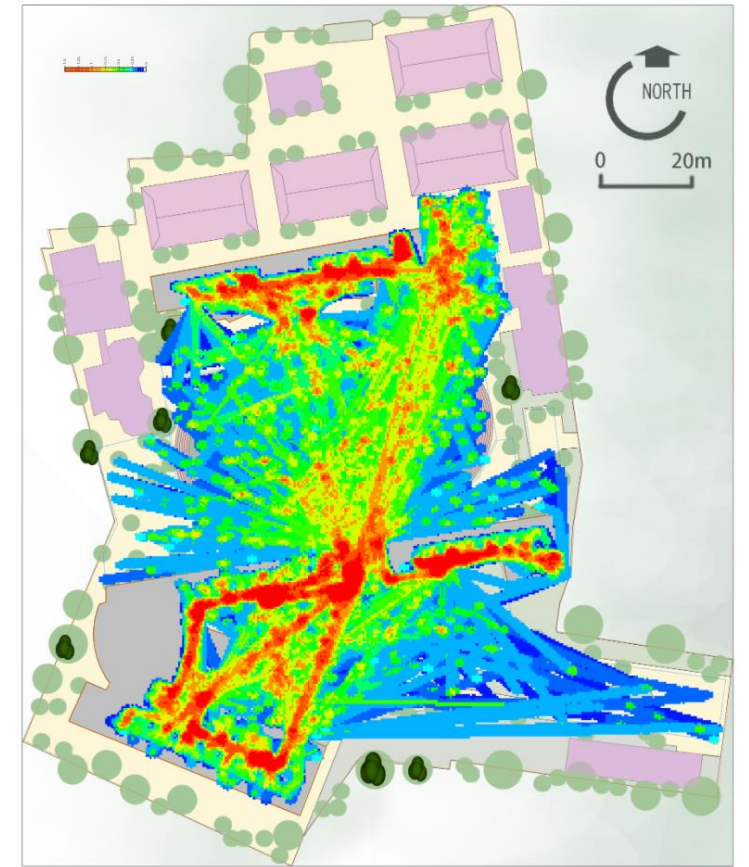
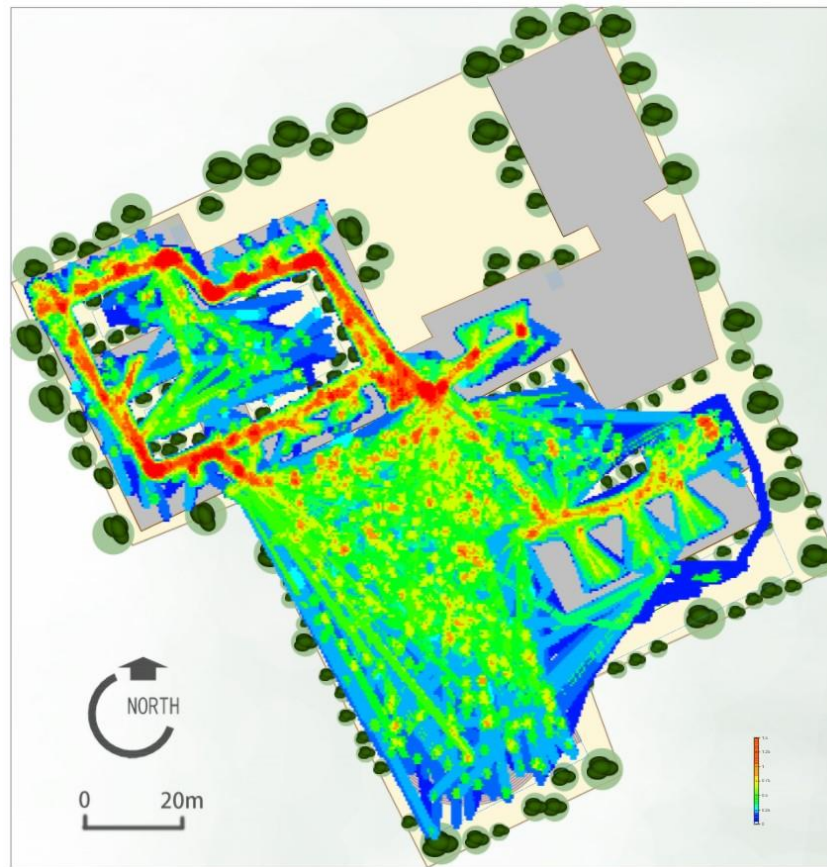
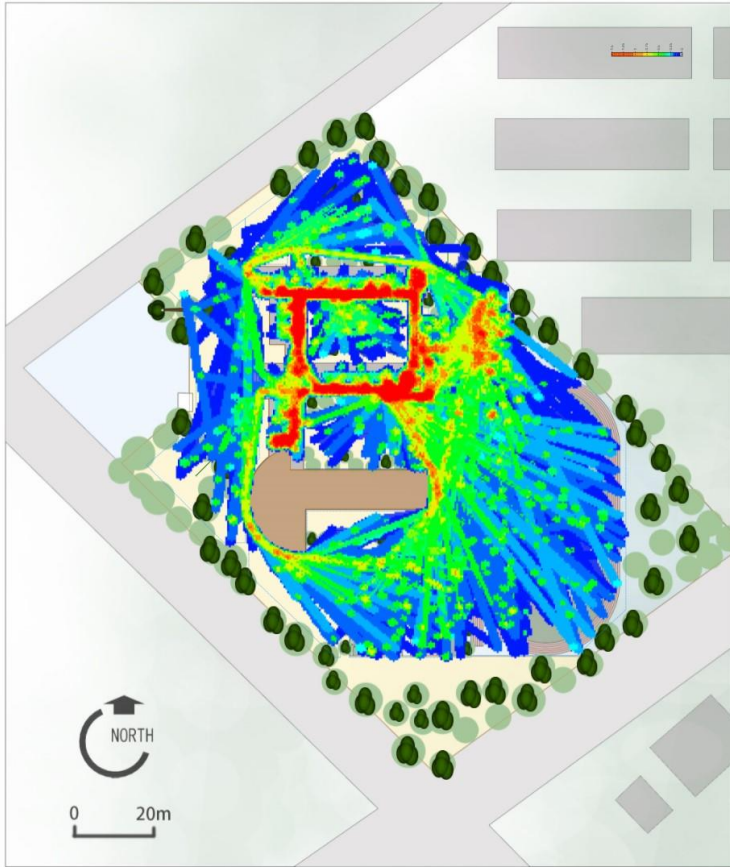
Agent-The schedule of the students during their school time.



Process overview and scheduling .



Physical Activity occupancy density distribution.



Design Implications



PART 04

From Neuroscience to Design: Principles for Mental Resilience

✓ Biophilic Integration

- **Maximize Access to Nature & Daylight**
- Large windows with green views;
- interior plants and gardens;
- use of natural materials (wood, stone);
- biomorphic forms and patterns.



From Neuroscience to Design: Principles for Mental Resilience

✓ Social & Refuge Spaces

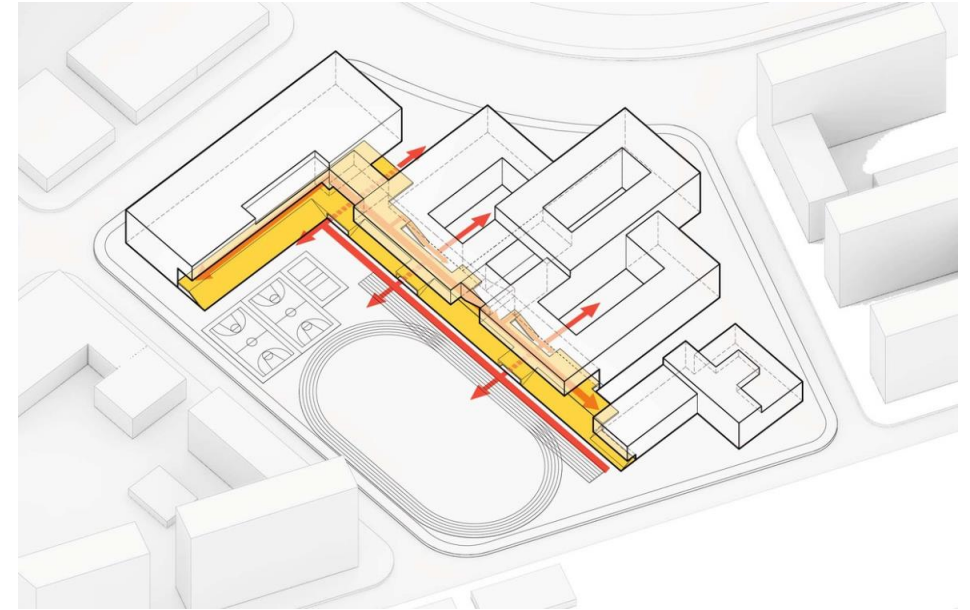
- **Balance 'Prospect' and 'Refuge'**
- Reading nooks overlooking common areas;
- semi-enclosed niches within larger volumes;
- stepped seating allowing for observation and participation.



Design Strategies: For Physical Activity

✓ Accessibility & Flow

- **Prioritize Proximity and Connectivity**
- In high-density cities, L-shaped or linear layouts where the long side of the building faces the playground;
- direct, visible pathways;
- ground-floor connections to outdoors.

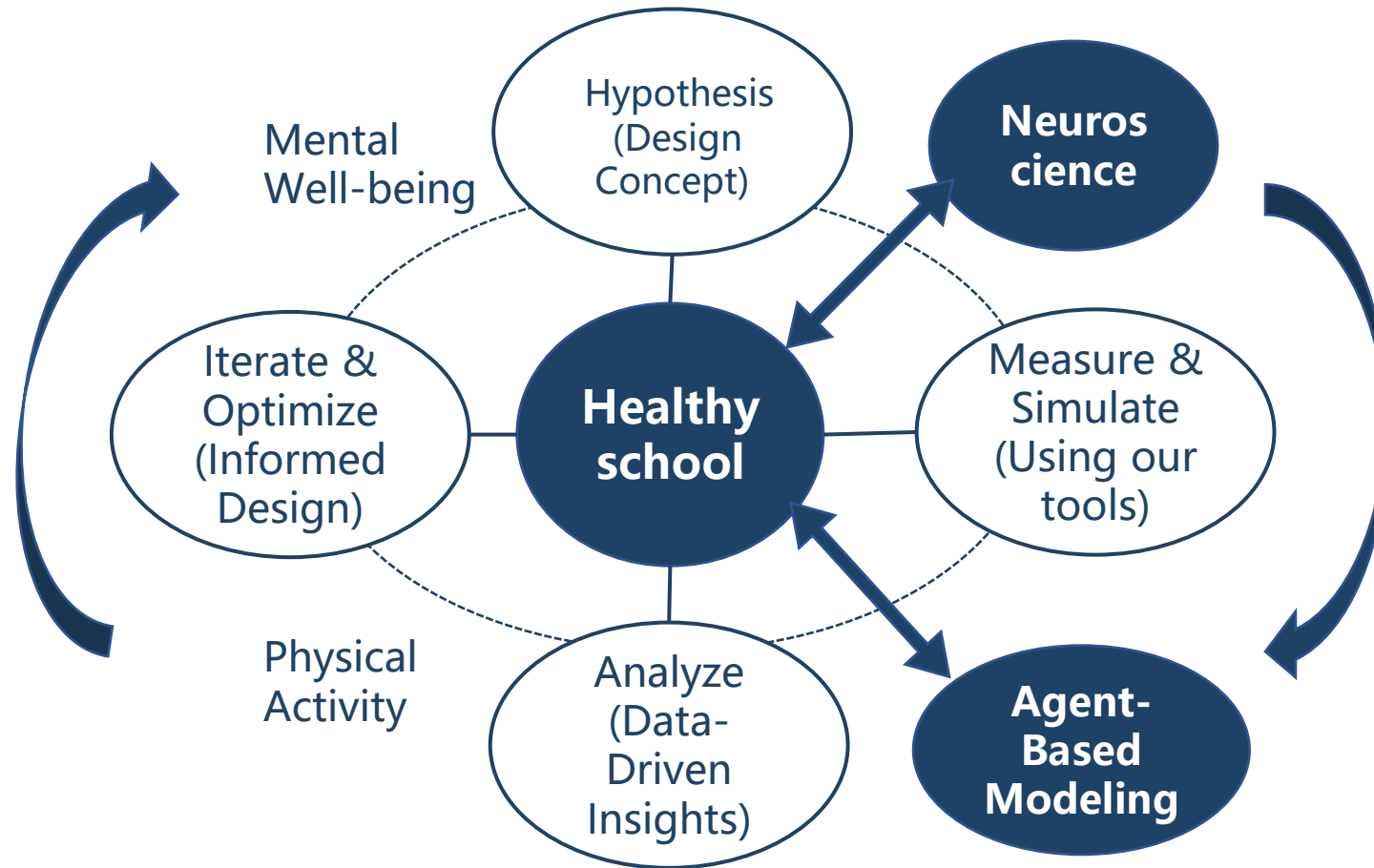


Design Strategies: For Physical Activity

- ✓ **Activating Transitional Spaces**
- **Transform Corridors into Destinations**
- Widen key corridor nodes into "activity bays";
- integrate corridors with semi-outdoor platforms;
- provide movable furniture and flexible space.



Evidence-Based Design Process





THANKS FOR WATCHING

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