




MAHAN RYKIEL
LANDSCAPE ARCHITECTURE
URBAN DESIGN & PLANNING

MEGAN OLIVER, AICP + WELLAP

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NEUROURBANISM

How an Understanding of Our Brains & Bodies Can Help Us Design Happier Cities

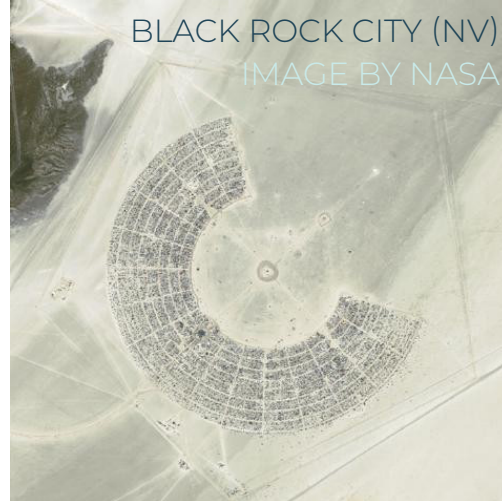
Keynote | 2023 APA Washington Chapter Annual
Conference October 11-13 | Spokane, WA



PIKES PLACE, SEATTLE (WA)
PHOTO BY AUTHOR



BLACK ROCK CITY (NV)
IMAGE BY NASA



NYHAVN, COPENHAGEN (DENMARK)
PHOTO BY AUTHOR



MOUNT SUTRO OPEN SPACE RESERVE, SAN FRANCISCO (CA)
PHOTO BY AUTHOR

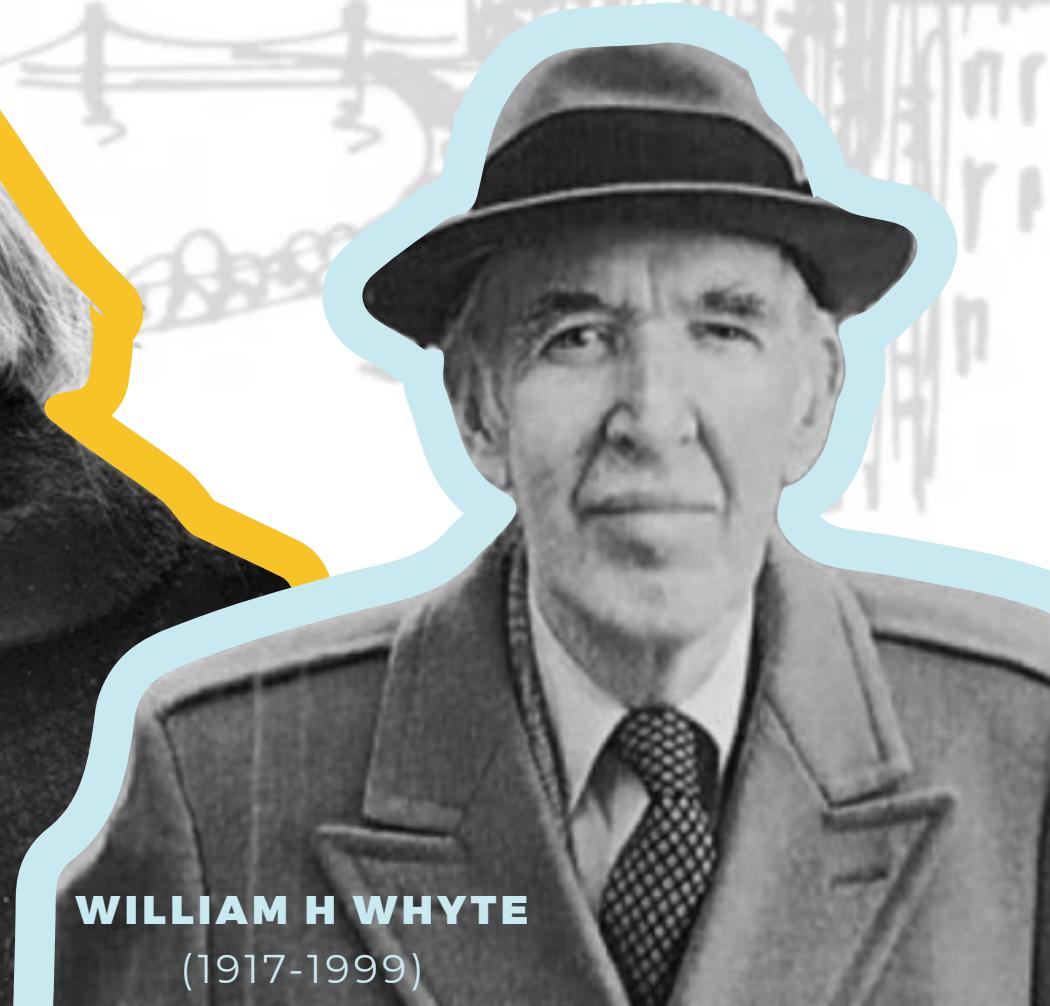
A CENTURY OF PROFESSIONAL WISDOM



KEVIN LYNCH
(1918-1984)



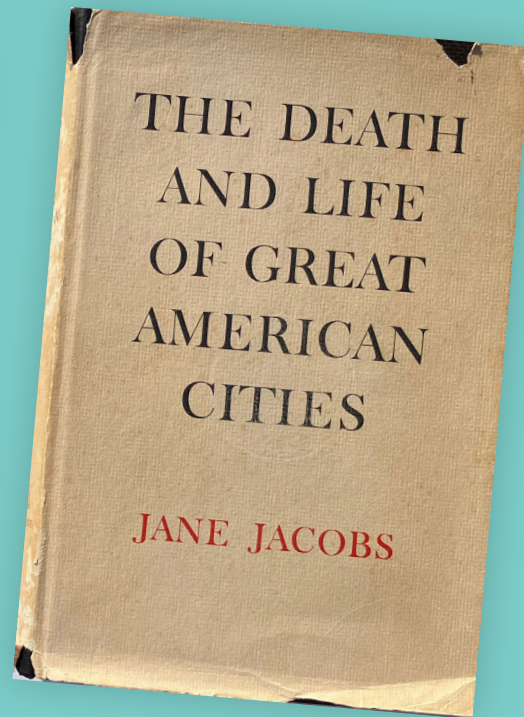
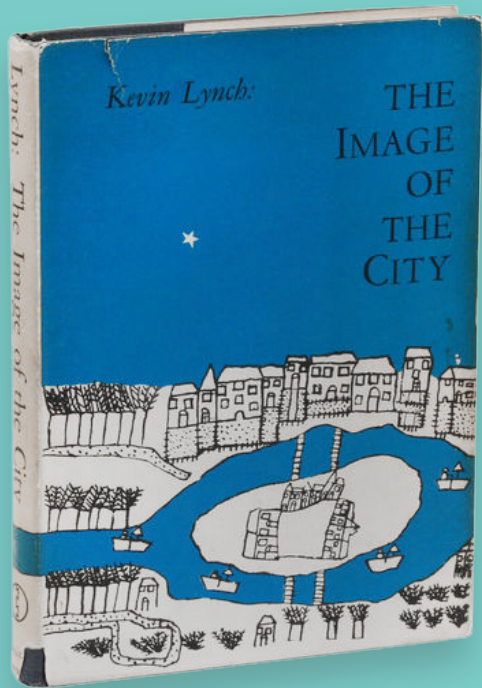
JANE JACOBS
(1916-2006)



WILLIAM H WHYTE
(1917-1999)

TWO PROFESSIONS ADVANCING IN TANDEM

As Lynch and Jacobs were publishing their works on imageability and city life, the neurosciences were being born



Neuourbanism is “predicated on understanding and managing the effects of urban living on neurological processes, viewing urban planning primarily as an instrumental means of improving health”

Mondschein & Moga, 2019
[citing Adli et al., 2017]

"Arguably, most planning history has not even been human centered, but in recent decades, there's been a growing interest in designing places through the lens of the human experience."

Dr. Justin Hollander

OUR PREFERENCES HAVE AN EVOLUTIONARY BASIS

THE FIRST HOMO SAPIENS APPEARED BETWEEN 200,000 AND 300,000 YEARS AGO

150,000 BCE

100,000 BCE

50,000 BCE

Mesopotamia (1st Cities)
7,500 BCE

Common Era

1st Gas-Powered Car & 1st High-Rise
1880s CE

World Wide Web
1991 CE

iPhone Invented
2007 CE

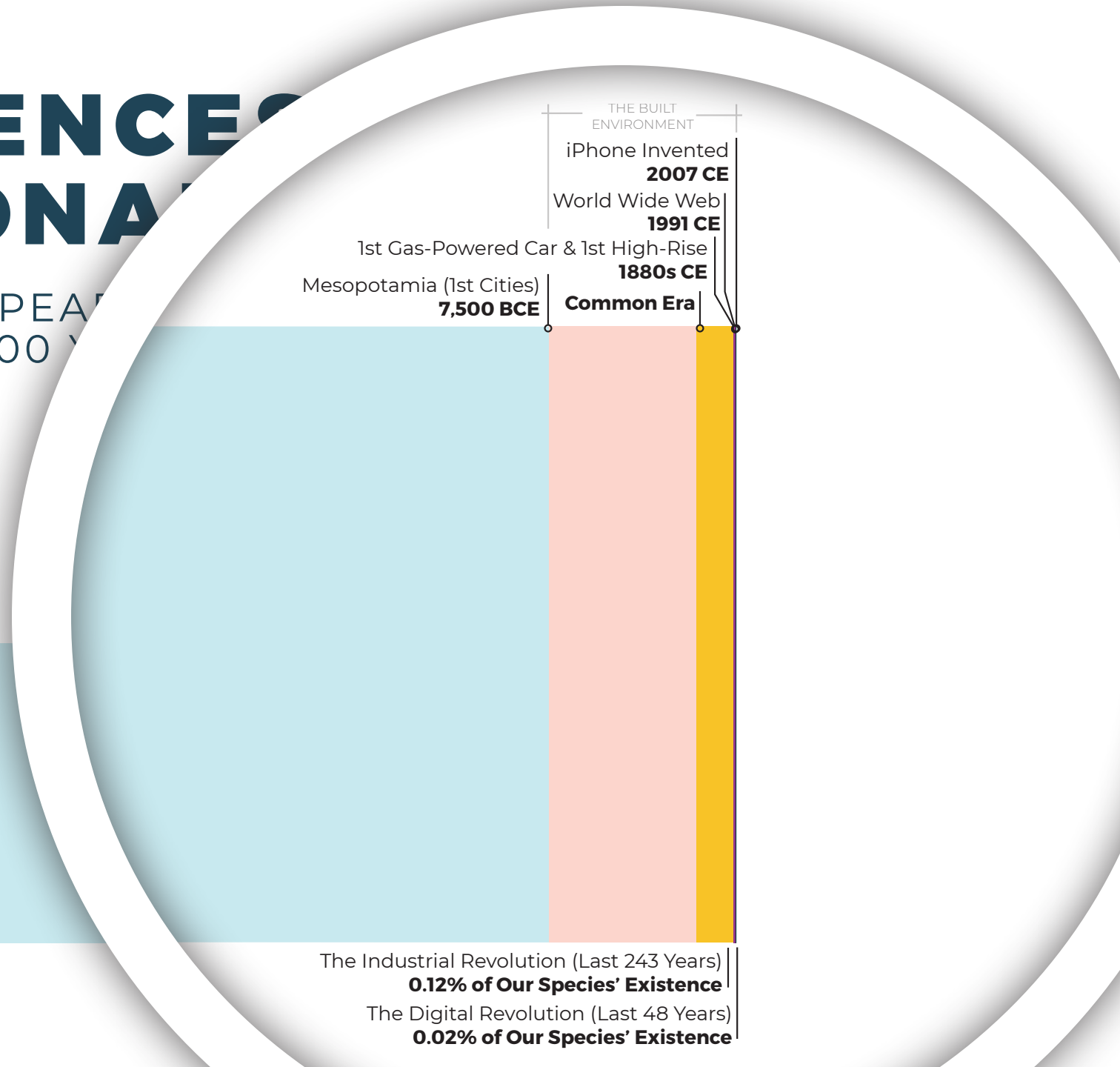
THE BUILT ENVIRONMENT

The Industrial Revolution (Last 243 Years)
0.12% of Our Species' Existence
The Digital Revolution (Last 48 Years)
0.02% of Our Species' Existence

OUR PREFERENCES AN EVOLUTIONARY

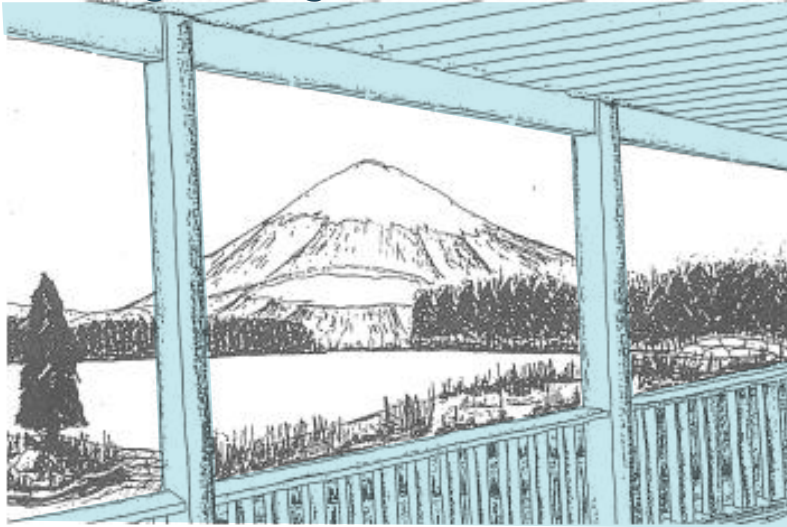
THE FIRST HOMO SAPIENS APPEARED
BETWEEN 200,000 AND 300,000 YEARS AGO

150,000 BCE



INNATE ENVIRONMENTAL PREFERENCES

Strong Refuge



Prospect Refuge Balanced



Strong Prospect



SOURCE: CONRAD 1993, UNPUBLISHED MASTER-THESIS

FUNDAMENTAL & PERVASIVE HUMAN MOTIVES

- 1 Social acceptance
- 2 Belonging
- 3 Influencing others
- 4 Protecting ourselves from harm
- 5 Intimate relationships



Leary, M. (2013). Understanding the Mysteries of Human Behavior [Recording]. The Great Courses.

SANDLOT [MARYLAND]
Mahan Rykiel Associates

**"Tracing back to the beginning,
architecture was born out of our primal
instincts, or rather, our behavior patterns:
a strong desire to survive, to be shielded
from foes and predators when we are
most vulnerable, and to provide shelter
as the environment changes."**

Shin Thant Htet

95% OF OUR THINKING HAPPENS AT THE SUBCONSCIOUS LEVEL

WHAT WE
PERCEIVE



WHAT THE BRAIN
FILTERS OUT

STRUCTURE OF THE BRAIN

CEREBRUM, CEREBELLUM, AND BRAIN STEM

FRONTAL LOBE

conscious thought, decision-making, planning/future action, personality, movement, smell recognition (typically), speech [*Broca's area*]

TEMPORAL LOBE

home of limbic system, complex visual stimuli, short-term memory recall, speech, musical rhythm, some degree of smell recognition,

SOMATOSENSORY CORTEX

PARIETAL LOBE

spatial relationships, sensory information, body awareness, object identification, understanding interpreting pain and touch, understanding spoken language [*Wernicke's area*]

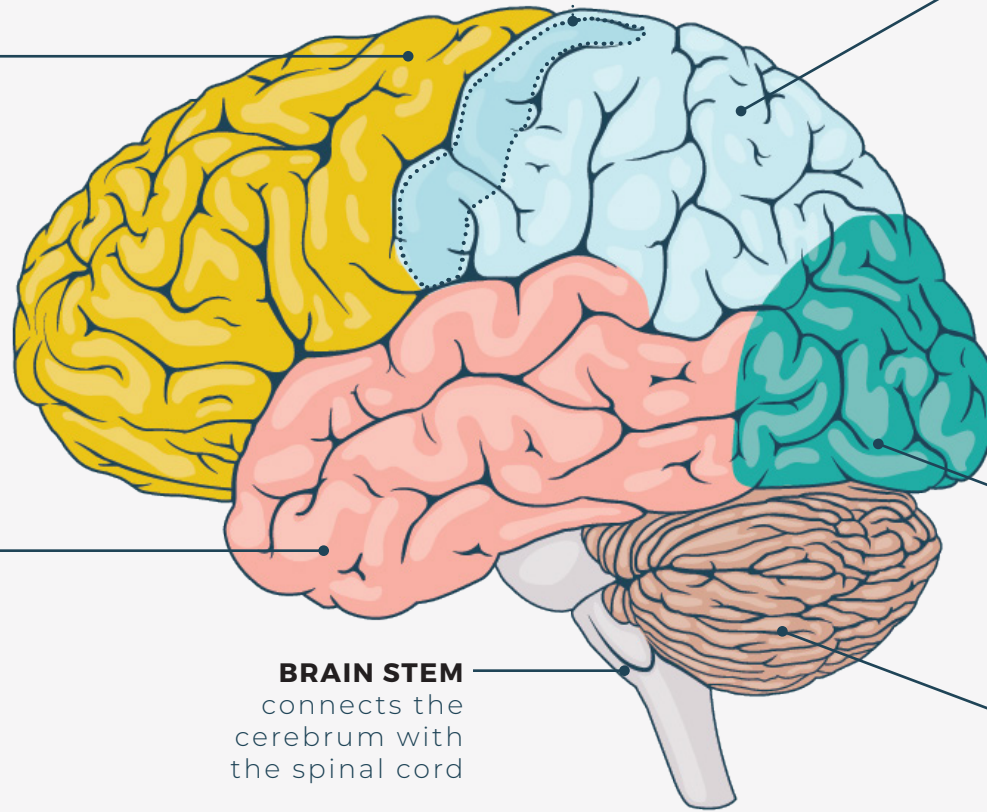
OCCIPITAL LOBE

visual processing

BRAIN STEM

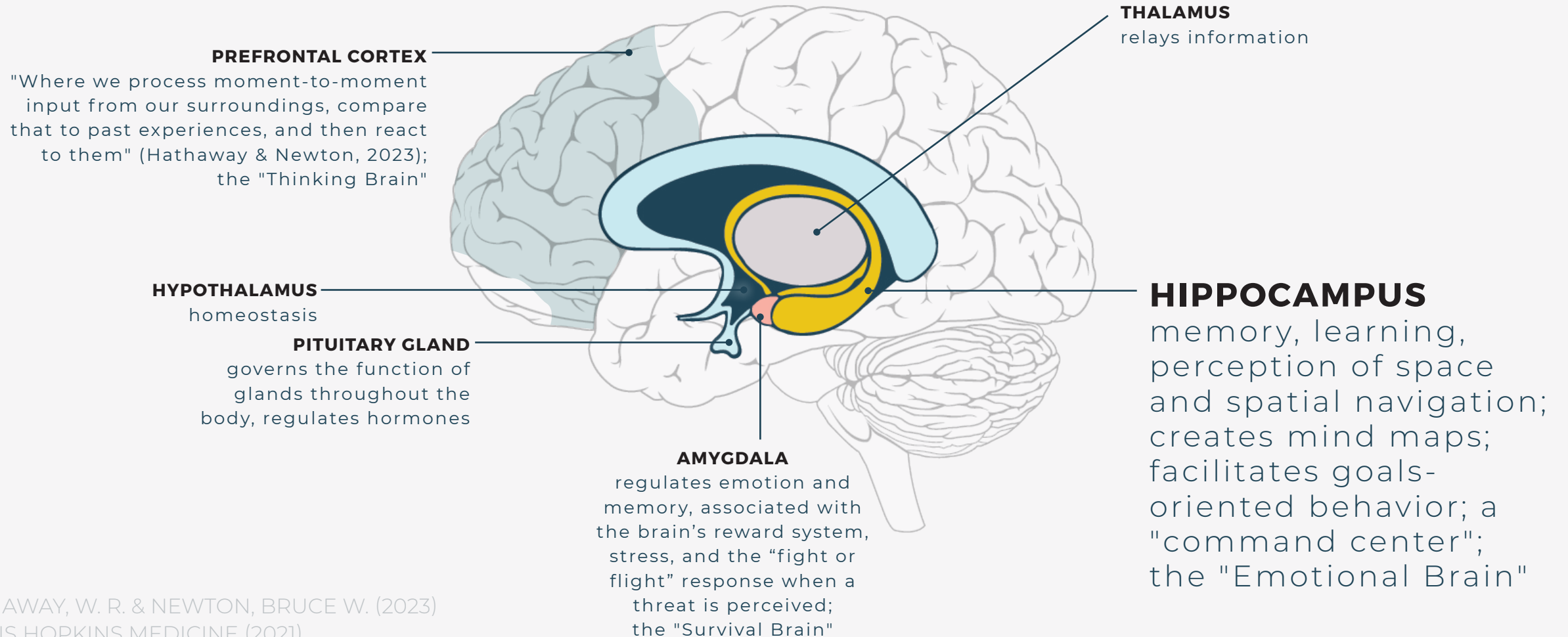
connects the cerebrum with the spinal cord

CEREBELLUM ["LITTLE BRAIN"]



THE HIPPOCAMPUS

& THE LIMBIC SYSTEM [SIMPLIFIED]



HATHAWAY, W. R. & NEWTON, BRUCE W. (2023)

JOHNS HOPKINS MEDICINE (2021)

THANT HTET (2023)

COGNITIVE MAPPING

CELLS INVOLVED IN OUR SPATIAL MAP-MAKING

These cells are *allocentric*, meaning they respond to what's outside our bodies



PLACE CELLS

fire when features of a specific place are sensed; thought to play a role in episodic memory

BOUNDARY CELLS

respond to environmental boundaries at a distance and direction from us; provide the first critical spatial input to hippocampal place cells



GRID CELLS

arranged in a map-like configuration; fire sequentially as we move through space



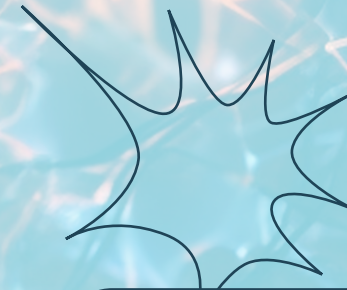
HEAD DIRECTION CELLS

discharge in relation to one's directional heading by using the surrounding environment as a reference



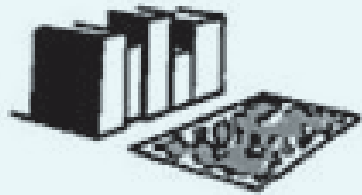
SPEED CELLS

firing rates depend on speed through the environment





PATHS



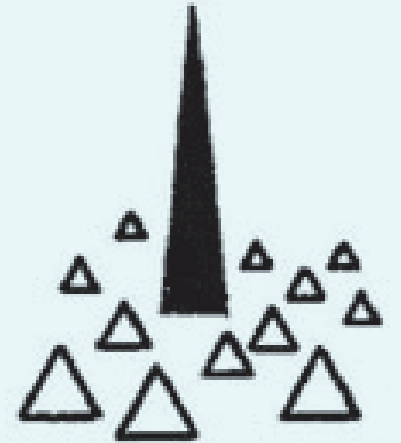
EDGES



DISTRICTS



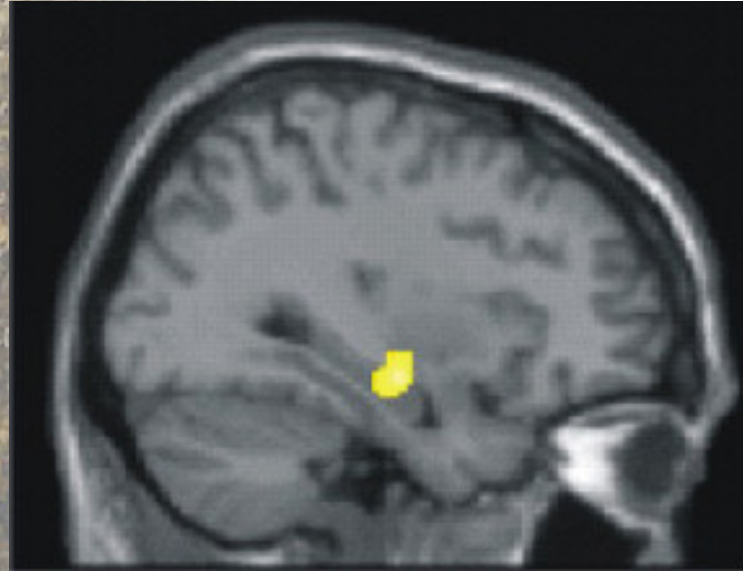
NODES



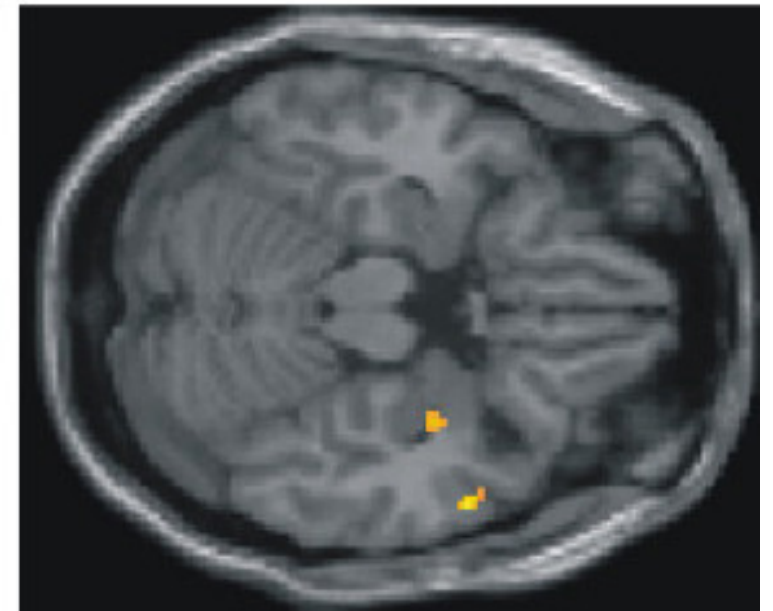
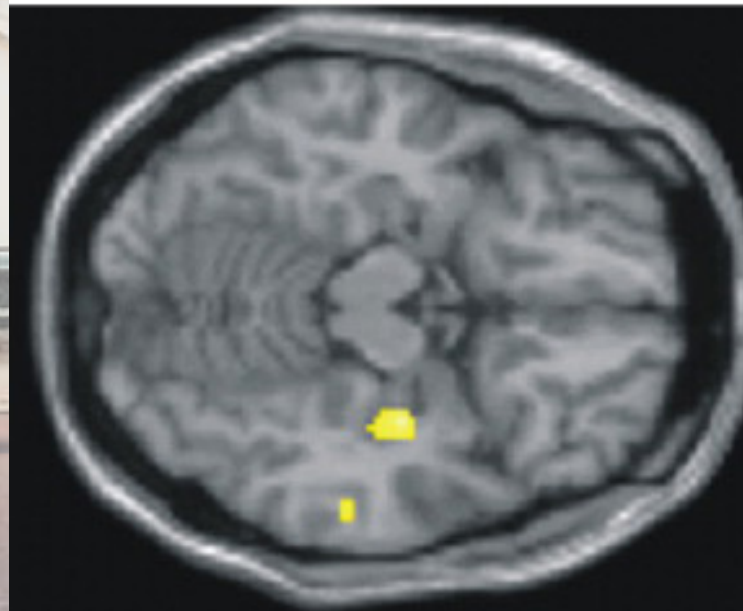
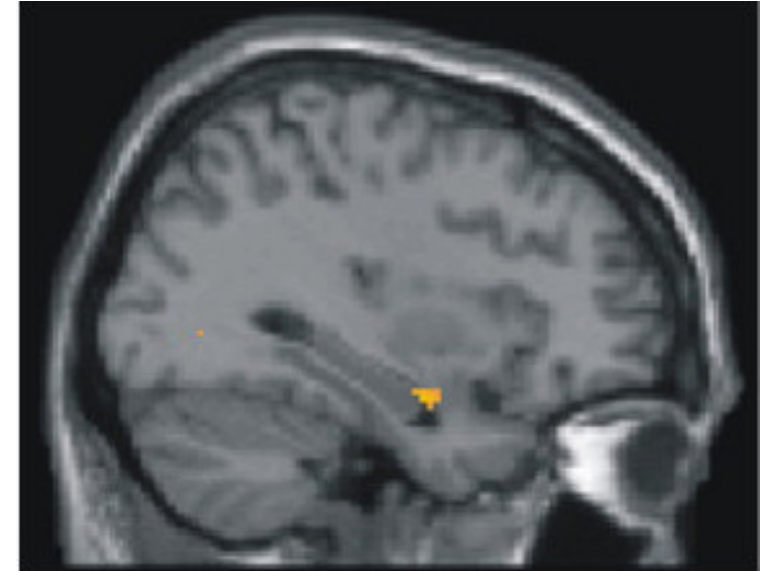
LANDMARKS

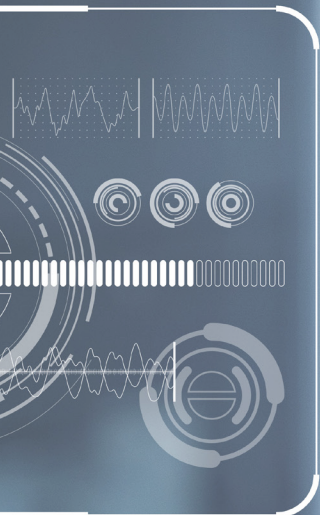
LONDON CAB DRIVERS DEVELOP LARGER HIPPOCAMPI

LONDON TAXI DRIVERS



CONTROL GROUP





- /Administrati
- /Human Resour
- /Legal
- /Accounting
- /Finance
- /Marketing
- /Publicity
- /Promotion
- /Research
- /Business
- /Development
- /Engineering
- /Manufacturing
- /Planning



BIOFEEDBACK

& THE DESIGN OF CITIES



A FEW BIOMARKERS USED IN URBAN STUDIES

SKIN CONDUCTANCE

FACIAL EXPRESSIONS

EYE MOVEMENT

HEART RATE VARIABILITY (HRV)

ELECTRICAL BRAIN ACTIVITY

BIOMARKERS

BIOMARKER (Physiological [P] or Neural [N])...

...IS AN INDICATION OF...

...WHICH WE MEASURE BY...

SKIN CONDUCTANCE

P (a.k.a. "electrodermal response" or "galvanic skin response/resistance"[GSR])

Stimulus-response/arousal;
intensity of emotions

Finger electrodes; GSR
sensors

P FACIAL EXPRESSIONS

EYE MOVEMENT

P (e.g., gaze path, fixation, saccades,
pupil reactivity)

HEART RATE VARIABILITY (HRV)

P (fluctuations in the time between
heartbeats)

ELECTRICAL BRAIN ACTIVITY

N (e.g., Brainwaves)

MEASURING STRESS IN CYCLISTS

- Car passing events, parked vehicles, and roads with dashed centerline markings increased cyclists' stress.
- Separate bike facilities were associated with less cyclist stress than shared streets



EMPATICA E4 WRISTBAND



Venkatachalapathy, A., et al. (2022). A naturalistic study assessing the impact of daytime running lights and vehicle passing events on cyclist's physiological stress

PROVING NATURE IS RESTORATIVE

- Restorative spaces act as medicine, helping us heal and lifting our spirits



UPPER CHESAPEAKE CANCER CENTER [MARYLAND]
Mahan Rykiel Associates



KAISER PERMANENTE



tranquility trail 

There are 1440 minutes in every day. Schedule 30 of them for physical activity.



KAISER PERMANENTE MEDICAL OFFICE BUILDINGS [MARYLAND]
Mahan Rykiel Associates

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P FACIAL EXPRESSIONS

Emotion

Facial electromyogram (fEMG, or facial EMG)

EYE MOVEMENT

P (e.g., gaze path, fixation, saccades, pupil reactivity)

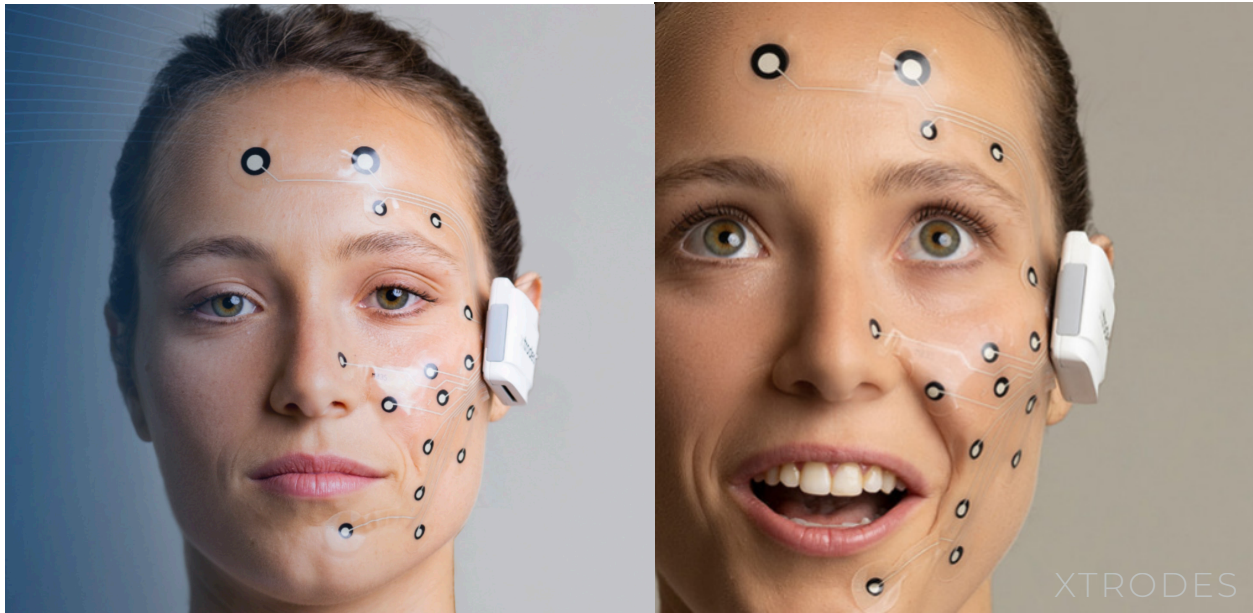
HEART RATE VARIABILITY (HRV)

P (fluctuations in the time between heartbeats)

ELECTRICAL BRAIN ACTIVITY

N (e.g., Brainwaves)

FACIAL EXPRESSIONS SUGGEST LANDSCAPE PREFERENCES



Petružálek. (2021). Viewing Natural vs. Urban Images and Emotional Facial Expressions: An Exploratory Study

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Attention/Interest

Eye tracking devices

HEART RATE VARIABILITY (HRV)

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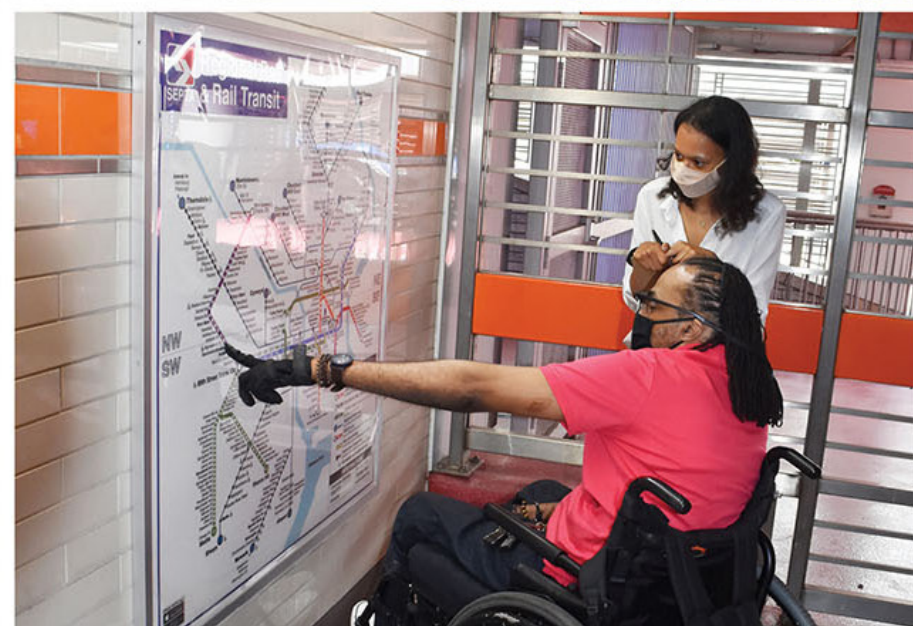
ELECTRICAL BRAIN ACTIVITY

N (e.g., Brainwaves)

EYE-TRACKING REVEALS TRANSIT "PAIN-POINTS"



PHILADELPHIA INQUIRER, 2021, Eye-tracking glasses could help SEPTA tackle its wayfinding woes



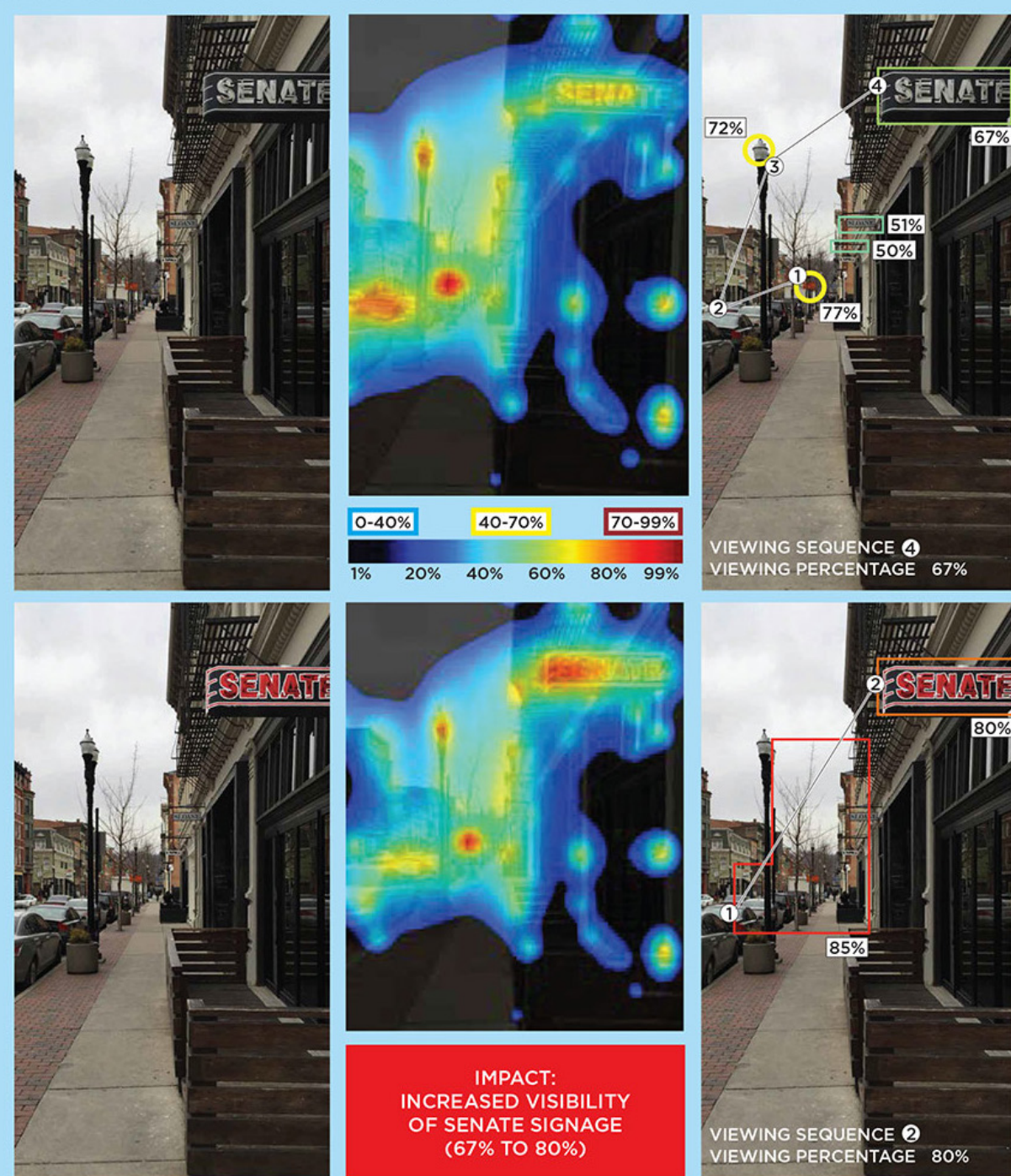
IMAGES OF THE SEPTA BRANDING AND WAYFINDING MASTER PLAN, 2023 MERID AWARD [FROM SEGD.COM]

WAYFINDING CAN BE BETTER

"Eye-tracking helps
signage designers and
planners understand the
effectiveness of signs
and implications for
sign codes."

CHRISTOPHER AUFFREY
ASSOCIATE PROFESSOR OF PLANNING AT
THE UNIVERSITY OF CINCINNATI

SUSSMAN & WARD
(2016). Planning for
the Subconscious



DATA SOURCE: UNIVERSITY OF CINCINNATI AND 3M/VAS

ARTIFICIAL INTELLIGENCE

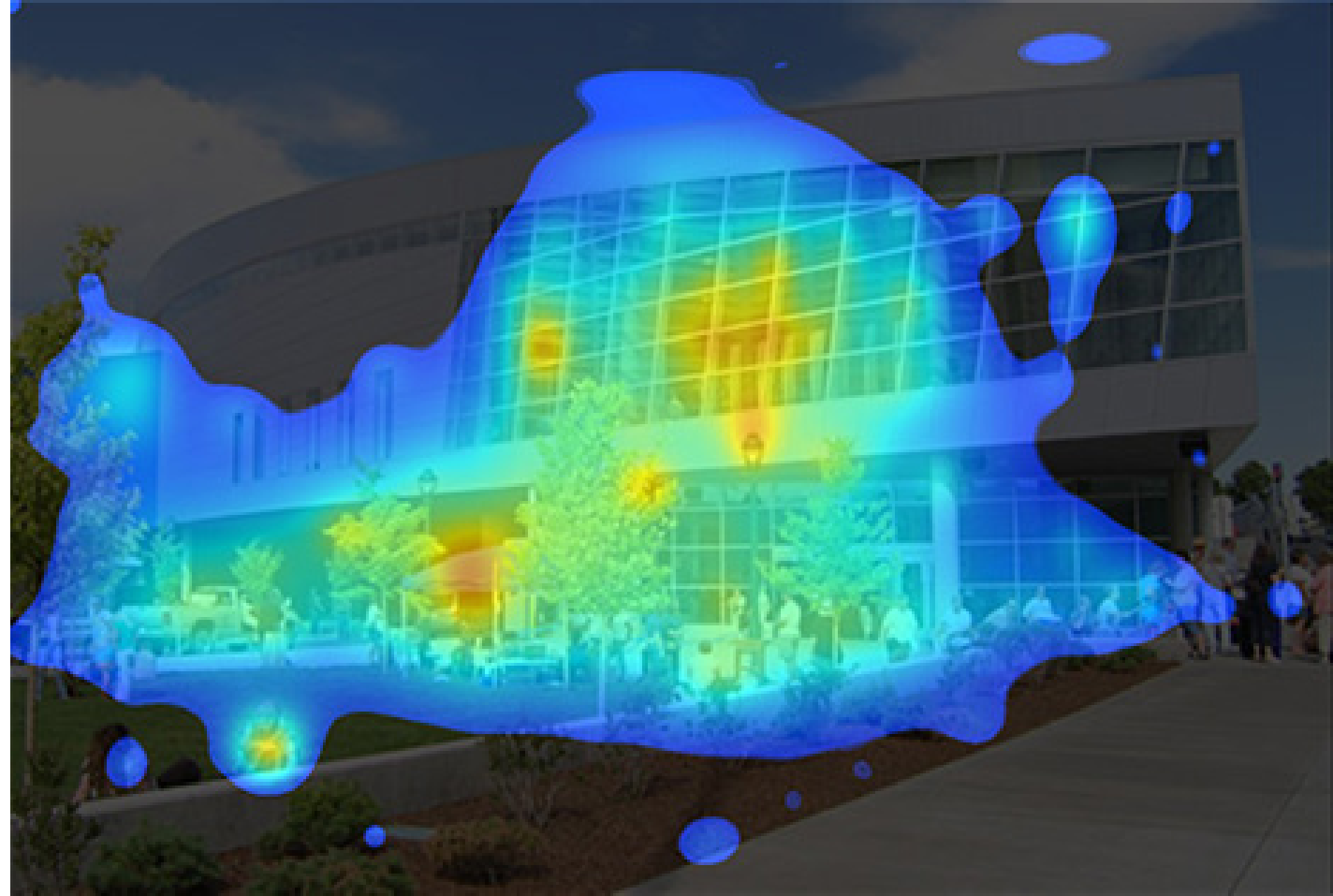
INTELLIGENCE

& PREDICTIVE EYE TRACKING
WITH 3M™ VISUAL ATTENTION
SOFTWARE



IMAGE FROM WASA-OLY.ORG/

3M VAS HEATMAP, HOTSPOTS, AND
GAZE PATH ANALYSIS BY AUTHOR



IMMERSIVE VIRTUAL REALITY

- Controlled environments
- A/B Scenarios (potential futures)
- Can combine with biofeedback devices
- Recognizes that humans are inherently spatial actors with a strong visual bias



VR IN PRACTICE

"It helped us translate otherwise complex ideas that the public could see, literally walk through, and react to, which was especially useful in building public understanding."

ROBBY GUTHART, AICP
PROJECT TRANSPORTATION PLANNER



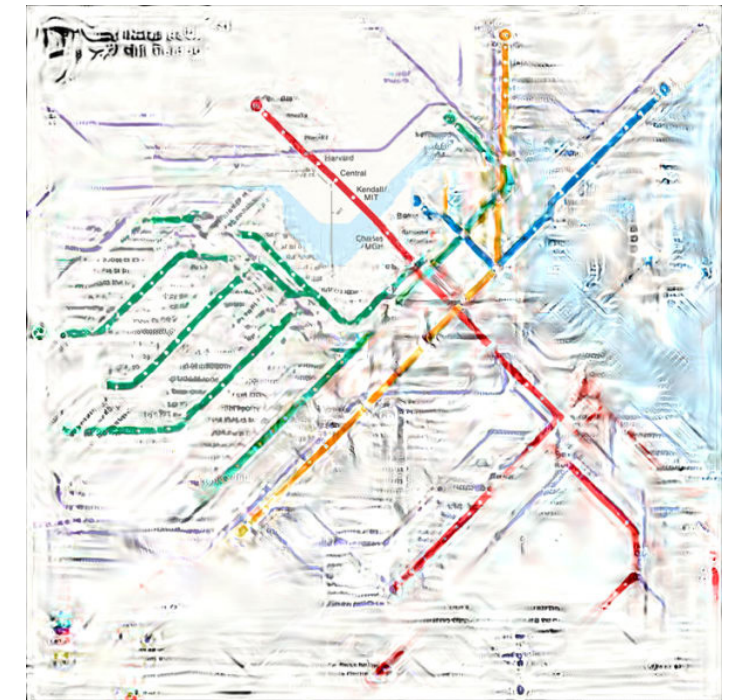
U.S. 67 Corridor Master Plan project (CDM Smith for Texas Department of Transportation)

MAPS CAN BE CLEARER

- Our brains have limited capacity to absorb information quickly
- Our peripheral vision pools info outside the direct line of sight, sacrificing detail in favor of an overall impression

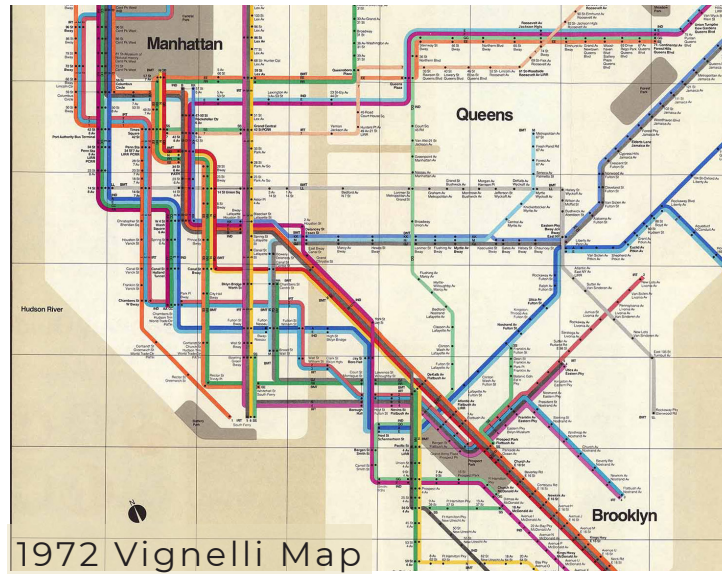
(Rosenholtz, 2011; Jaffe, 2013; Smithsonian Magazine, 2023)

MBTA Maps with "Mongrels" (on right) computed for someone looking at the Kendall/MIT stop
 JAFFE, 2013, The Science of a Great Subway Map



"Vignelli's modernist design stressed visual clarity over geographical precision; all the lines ran vertical or horizontal . . . and rectangular Central Park was rendered as a square."

ERIC JAFFE



New York City Subway Map



HILLERY (2019). Making the NYC subway user-friendly through effective visuals.
 JAFFE (2013). The Science of a Great Subway Map

"The daily map, geographically inclined just as the public wanted back in the 1970s, is a mess. The diagrammatic Vignelli weekend map, meanwhile, hardly looks like a mongrel at all—a sign of the designer's preternatural understanding of visual processing. **Intuition confirmed."**

ERIC JAFFE

Current Daily Map



Current Vignelli Weekend Map



The current NYC Subway Daily Map (left) and the Vignelli-designed weekend map (right), compared with their "mongrels" (below)

JAFFE, 2013, *The Science of a Great Subway Map*

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Finger electrodes; GSR sensors

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P (e.g., gaze path, fixation, saccades, pupil reactivity)

Emotion

Facial electromyogram (fEMG, or facial EMG)

EYE MOVEMENT

P (e.g., gaze path, fixation, saccades, pupil reactivity)

Attention/Interest

Eye tracking devices

HEART RATE VARIABILITY (HRV)

P (fluctuations in the time between heartbeats)

Stress

Heart rate sensors, electrocardiogram (ECG)

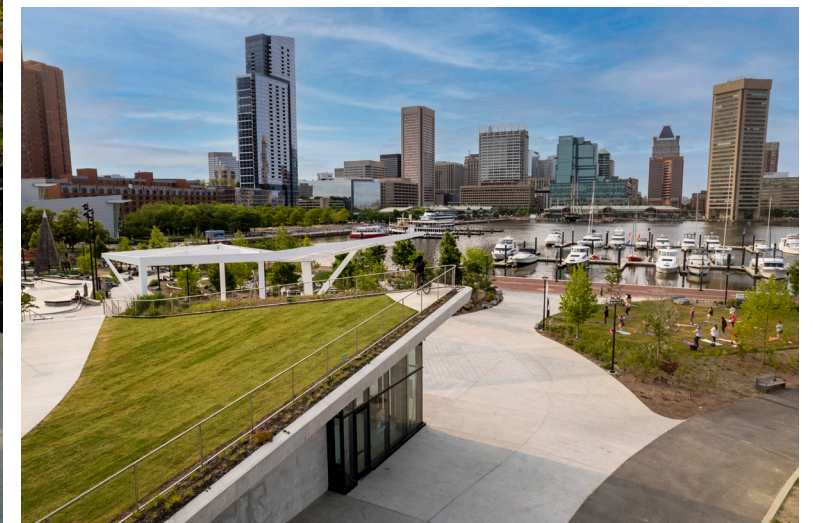
ELECTRICAL BRAIN ACTIVITY

N (e.g., Brainwaves)

HEART RATE CHANGES DURING CITY WALKS



PROSPECT-REFUGE: RASH FIELD PARK



RASH FIELD PARK, BALTIMORE, MD | DESIGN BY MAHAN RYKIEL ASSOCIATES

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Heart rate sensors, electrocardiogram (ECG)

ELECTRICAL BRAIN ACTIVITY

N (e.g., Brainwaves)

Activation of different regions of the brain, the effects of environments on emotional states; motivation & memory

electroencephalogram (EEG); functional near infrared spectroscopy (fNIRS)

BRAIN ACTIVITY IN CITIES



Neale et al. (2019). The impact of walking in different urban environments on brain activity in older people



Mavros et al. (2016). Geo-EEG: Towards the Use of EEG in the Study of Urban Behaviour

ENRICHED ENVIRONMENTS (EE)

- Mary Diamond, 1960s
- Proved that our environs have the potential to alter our brains
- Thanks to Diamond, **"we know that our brains have the capacity to physically rewire and create new pathways in response to environmental stimulation throughout our lives"** (Magsamen, 2023)
- 2 important factors: Choice and Autonomy



LIBERTY SQUARE [MARYLAND]
Mahan Rykiel Associates



MOSAIC DISTRICT [VIRGINIA]
Mahan Rykiel Associates



PARK(ING) DAY 2016
Mahan Rykiel Associates



LANCASTER SQUARE ("EWELL PLAZA") [PENNSYLVANIA]
Mahan Rykiel Associates



PIG TOWN MAIN STREET [MARYLAND]
Mahan Rykiel Associates



CORDOVA VILLAGE PLAN [MARYLAND]
RK&K



REIMAGINE MIDDLE BRANCH [BALTIMORE]
Mahan Rykiel Associates



LANCASTER SQUARE [PENNSYLVANIA]
Mahan Rykiel Associates

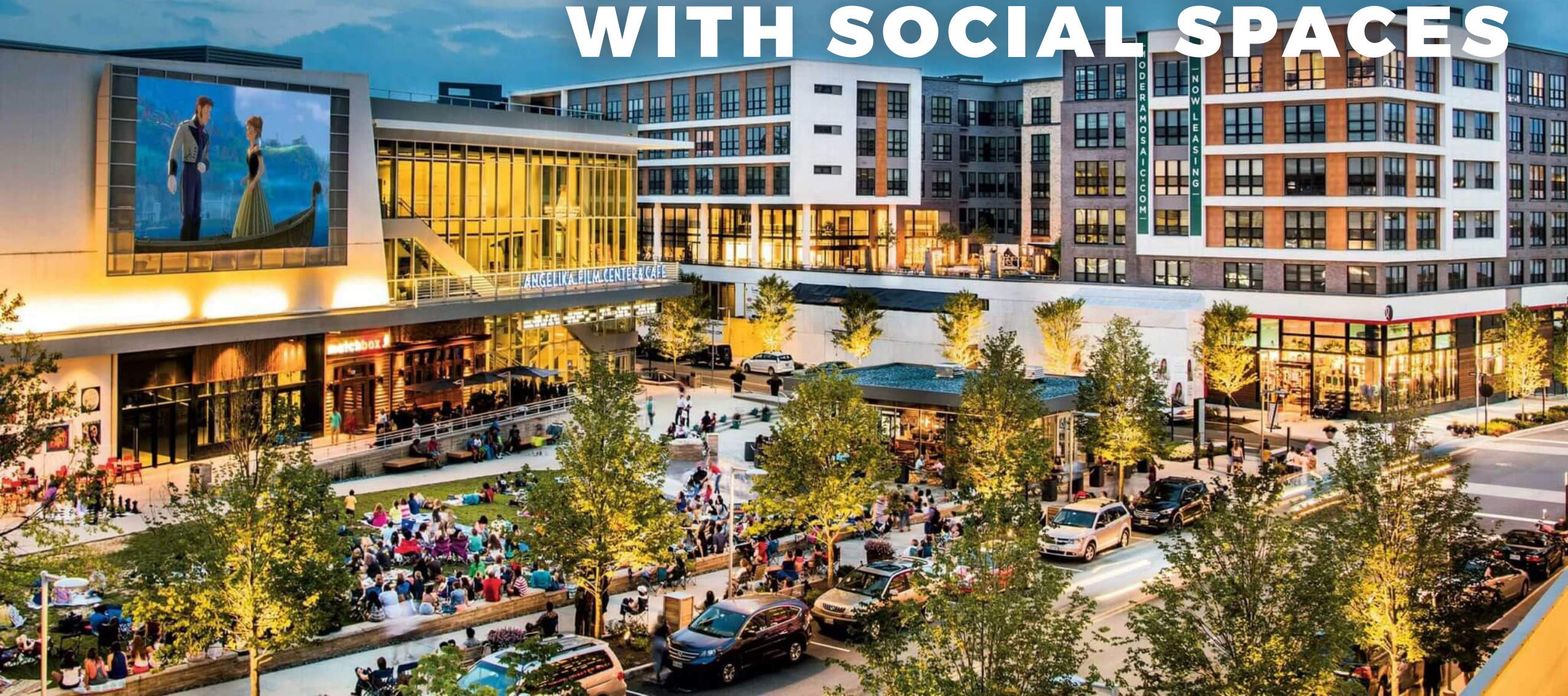


CORDOVA VILLAGE PLAN [MARYLAND]
RK&K

**How might the future look
if human factors informed
development of our cities?**

The NeuroCity of the Future ...

FIGHTS LONELINESS WITH SOCIAL SPACES



The NeuroCity of the Future ...

**INCREASES IMAGEABILITY
WITH FLEXIBILITY**

The NeuroCity of the Future ...

CREATES MORE COMFORTABLE AND INVITING SPACES

The NeuroCity of the Future ...

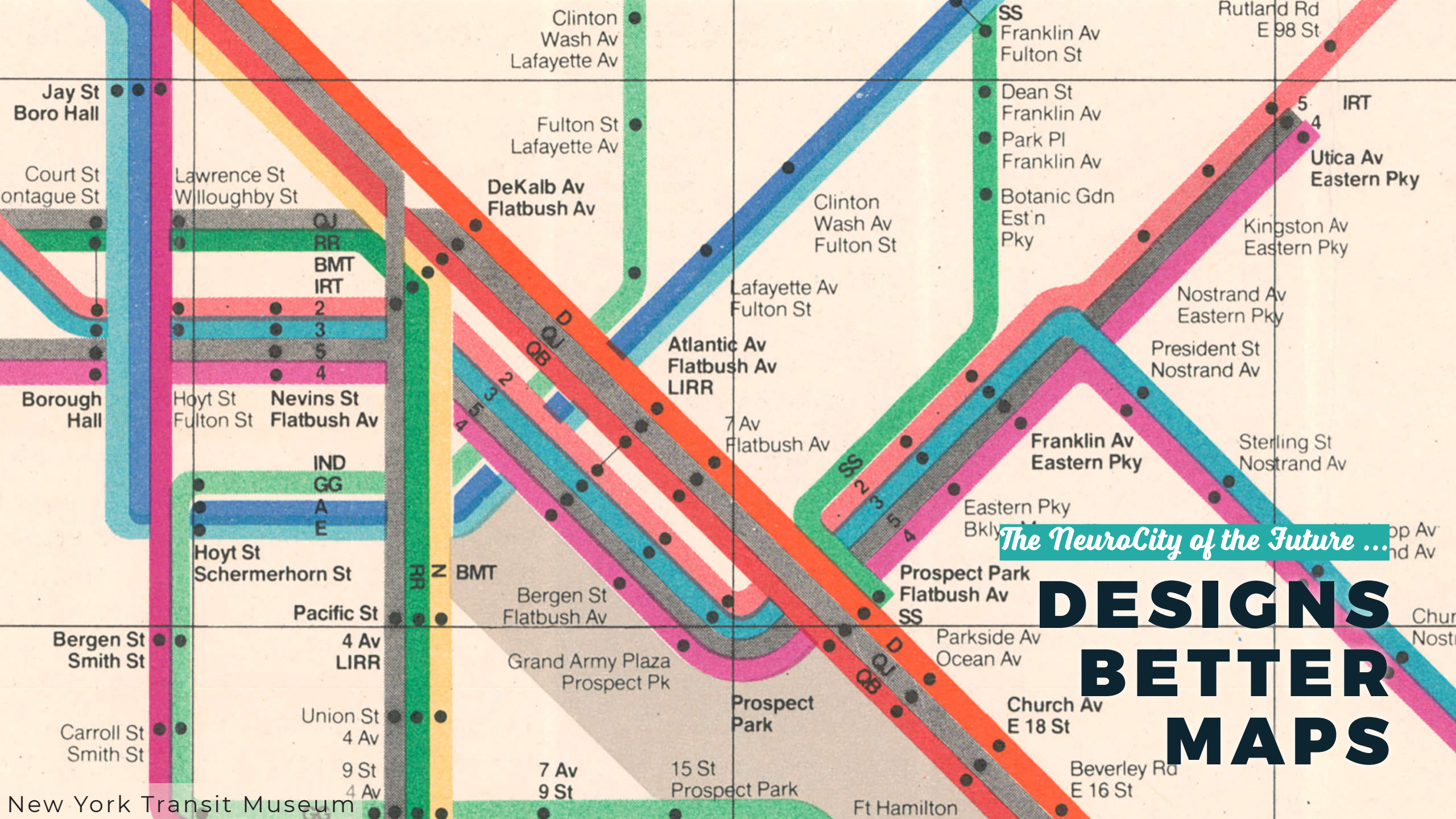
RECONNECTS PEOPLE WITH NATURE





The NeuroCity of the Future ...

OFFERS RESTORATIVE ENVIRONMENTS

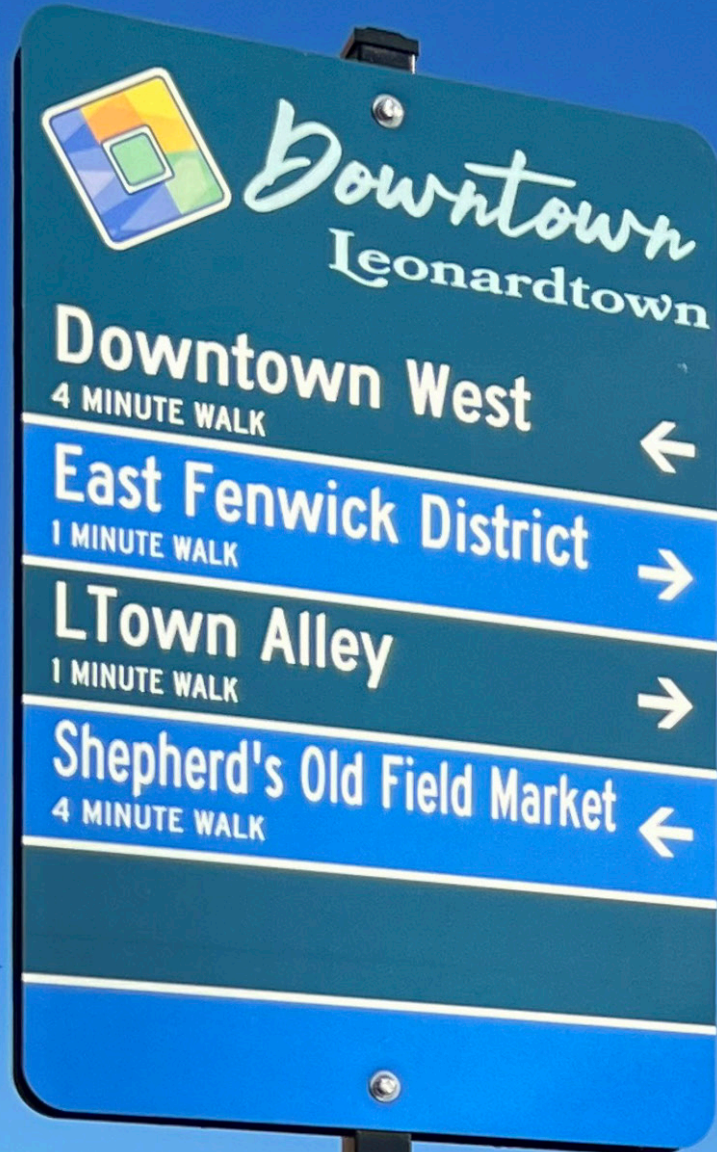


The NeuroCity of the Future ...

DESIGNS BETTER MAPS

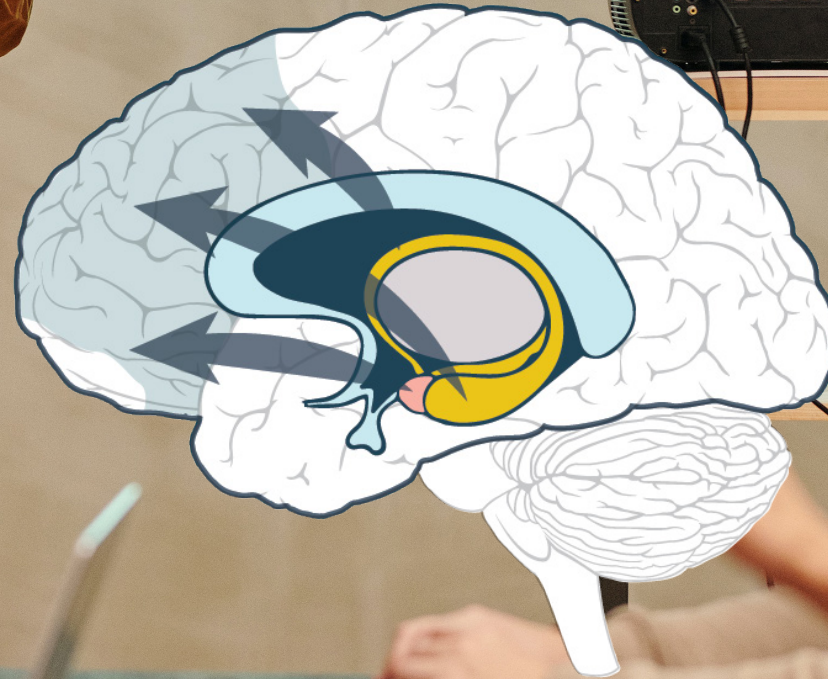
The NeuroCity of the Future ...

FACILITATES WAYFINDING



The NeuroCity of the Future ...

IS FILLED WITH EFFECTIVE COMMUNICATORS



The NeuroCity of the Future ...

EASILY CONVEYS COMPLEX IDEAS





The NeuroCity of the Future ...

PROMOTES ENRICHED ENVIRONMENTS (EE)



The NeuroCity of the Future ...

**UNDERSTANDS OUR
DIFFERING NEEDS**

**In tomorrow's NeuroCities,
we can create more human
sensitive places that are
better for our bodies and
our brains.**

**“When a flower doesn’t bloom you
fix the environment in which it
grows, not the flower.”**

Alexander Den Heijer

DUTCH SPEAKER & WRITER

When a **goldfish** doesn't **grow**
you **fix the bowl in which it grows,**
not the fish.





MAHAN RYKIEL
LANDSCAPE ARCHITECTURE
URBAN DESIGN & PLANNING

Thank you!

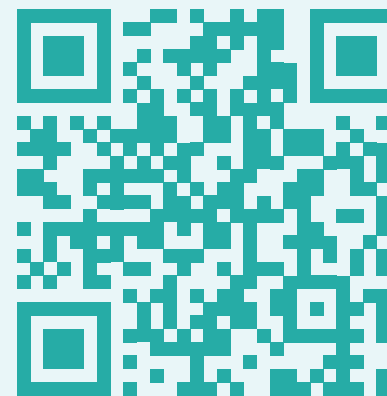
MEGAN OLIVER, AICP + WELLAP

 [http:// hellohappy.design](http://hellohappy.design)

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 @hellohappy_dsgn

 megan@hellohappy.design



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