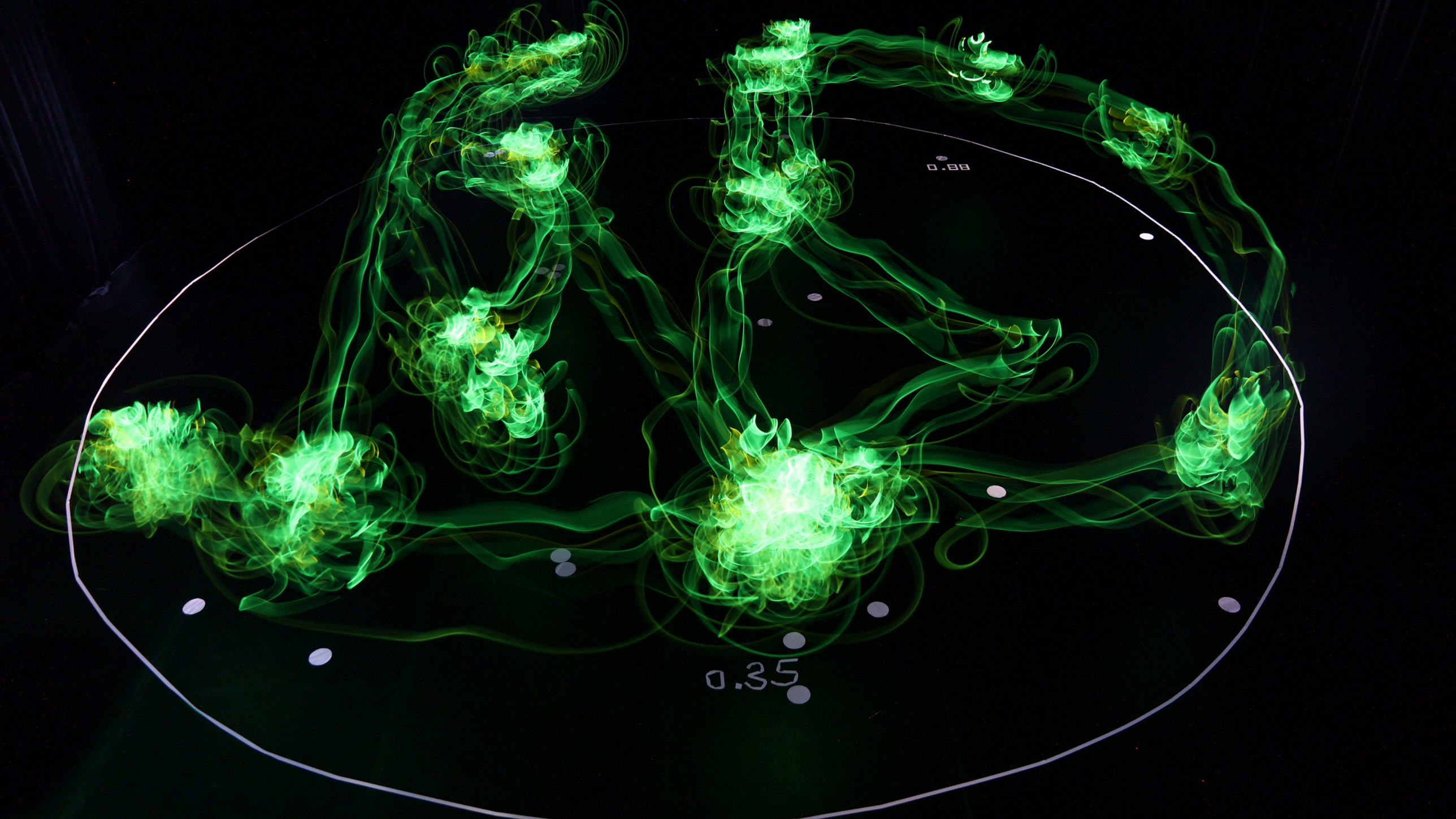
BASED ON EEG OPEN-SOURCE DATA
OF 20 ALZHEIMER'S PATIENTS FROM
OPENNEURO DATASET

"Body as an Archive"
"Beyond Linear Narrative"

Self-authored Entropy

Neurochoreography by Cindy Ren


0.88
0.35

Rationale

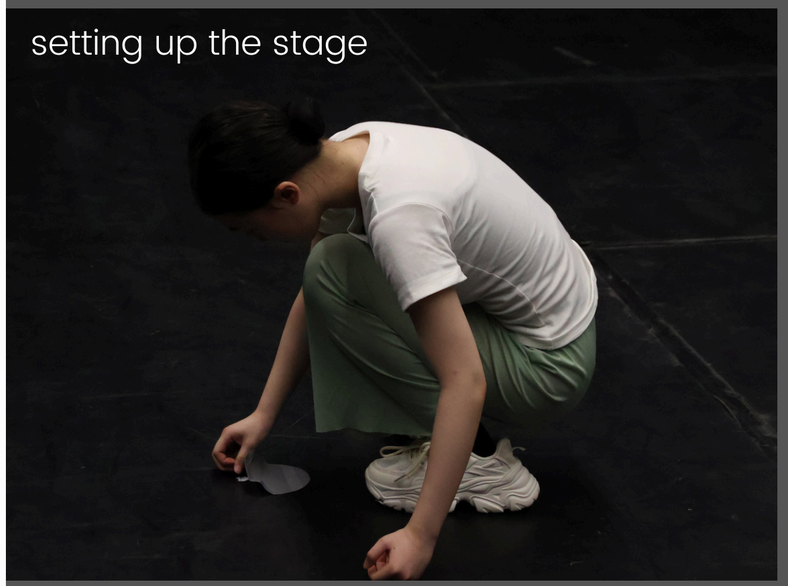
It all came from a dance called *Autobiography* choreographed by Wayne McGregor and performed at Movimentos Festwochen 2018. In that piece, McGregor translated strands of DNA into movement vocabulary—turning genetic code into fluid, living choreography. Before seeing it on YouTube, neuroscience—my rigorously analytical major—and dance—my passionately emotional hobby—ran on separate tracks. However, upon watching *Autobiography*, I realized that it was possible, and would be so cool, to fuse the cold objectivity of data with the visceral expressiveness of dance, to quite literally “dance out” scientific information.

Thus began my journey into this experimental, interdisciplinary project. Having already immersed myself in **Alzheimer’s** research, it naturally became the first subject I envisioned for neuro-choreography.

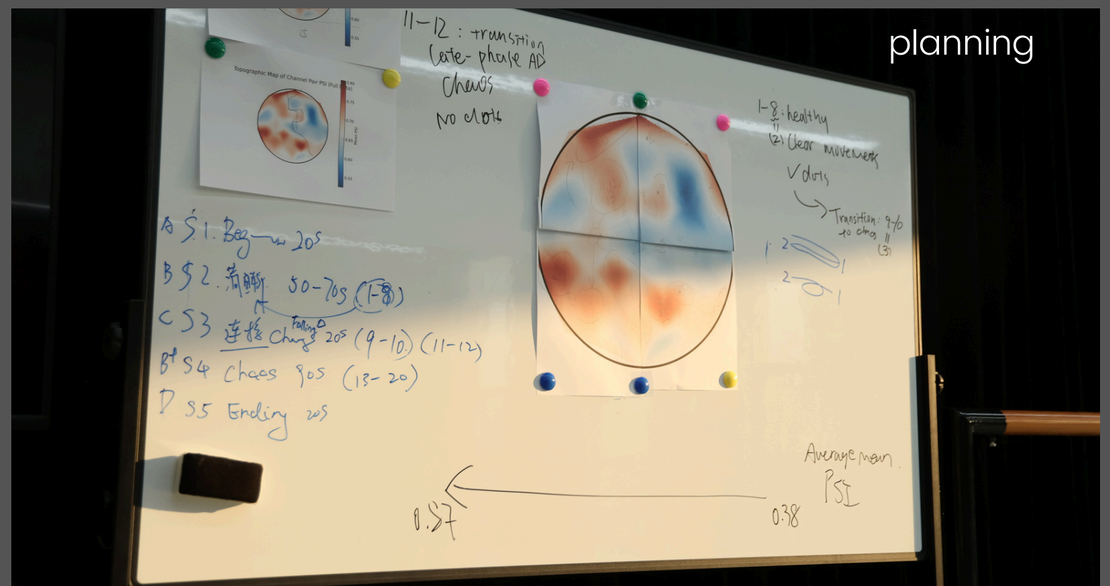
Due to technical limitations, I was restrained to the open-source datasets online. But that didn’t stop me. My goal was ambitious: to translate the neural signatures of 20 Alzheimer’s patients into movement, while simultaneously mapping an “average” Alzheimer’s brain through dance. Keep reading to discover how I brought this vision to life...

performing on stage

experimenting with time-lapse photography and light sticks

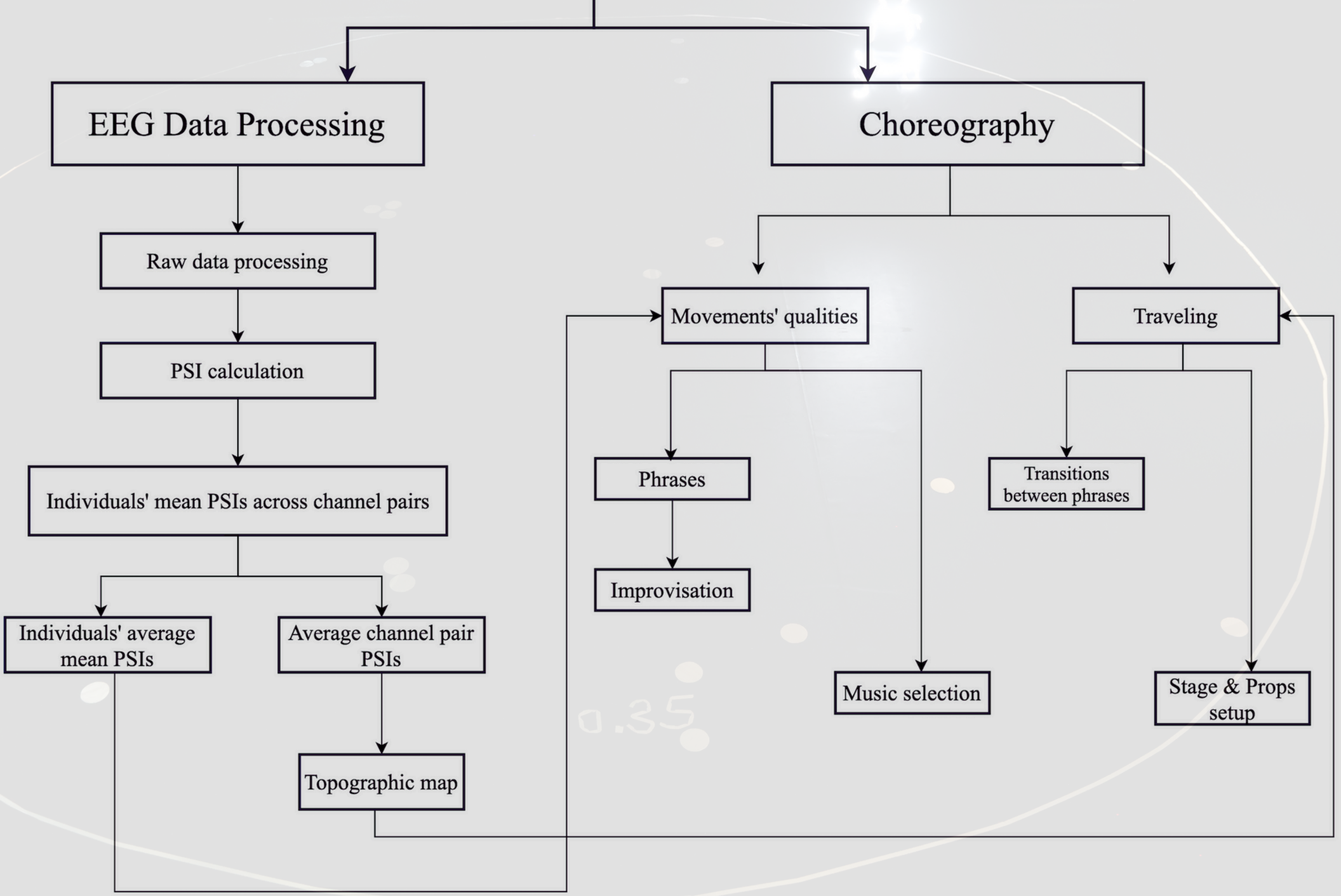


setting up the stage

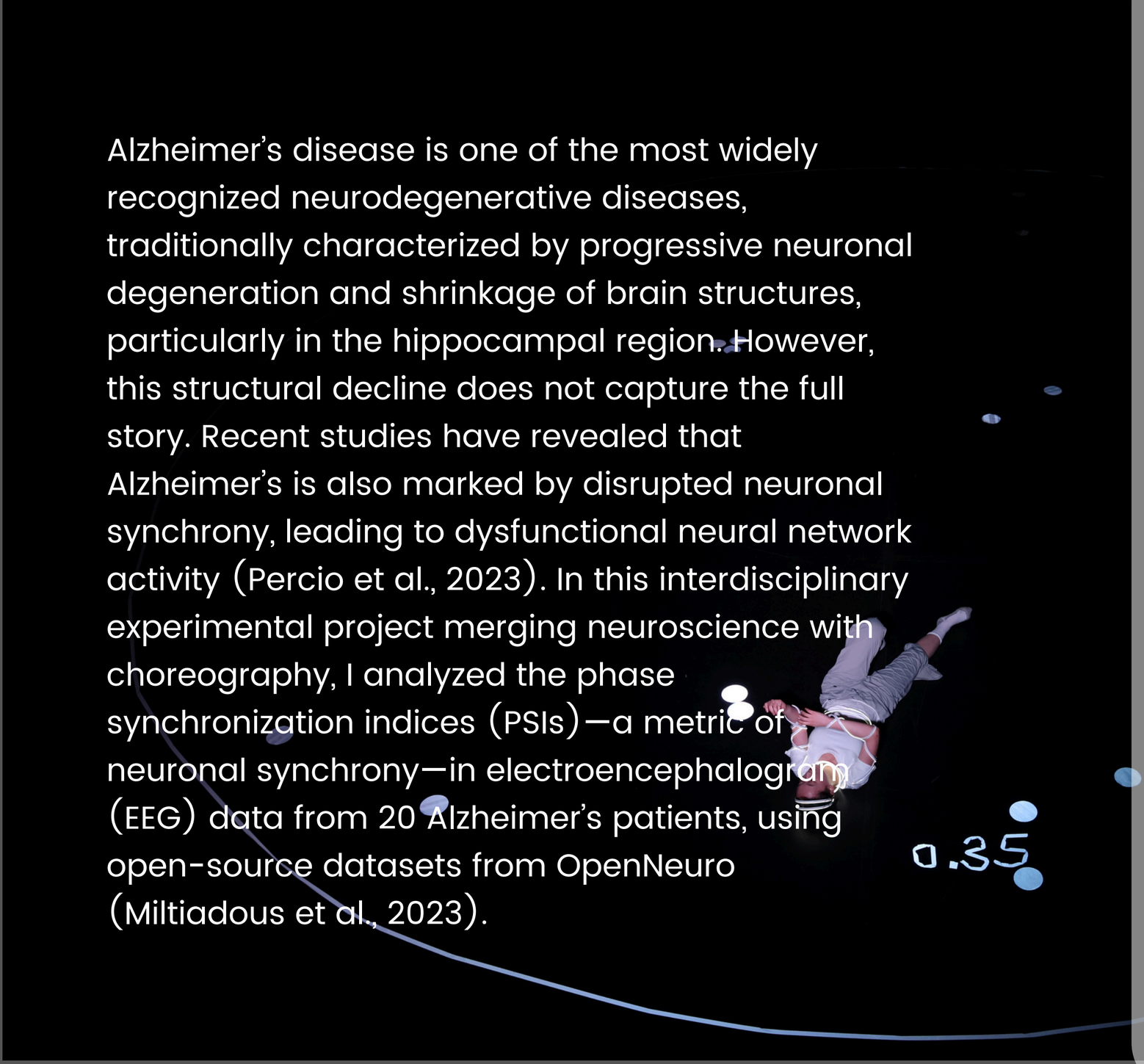


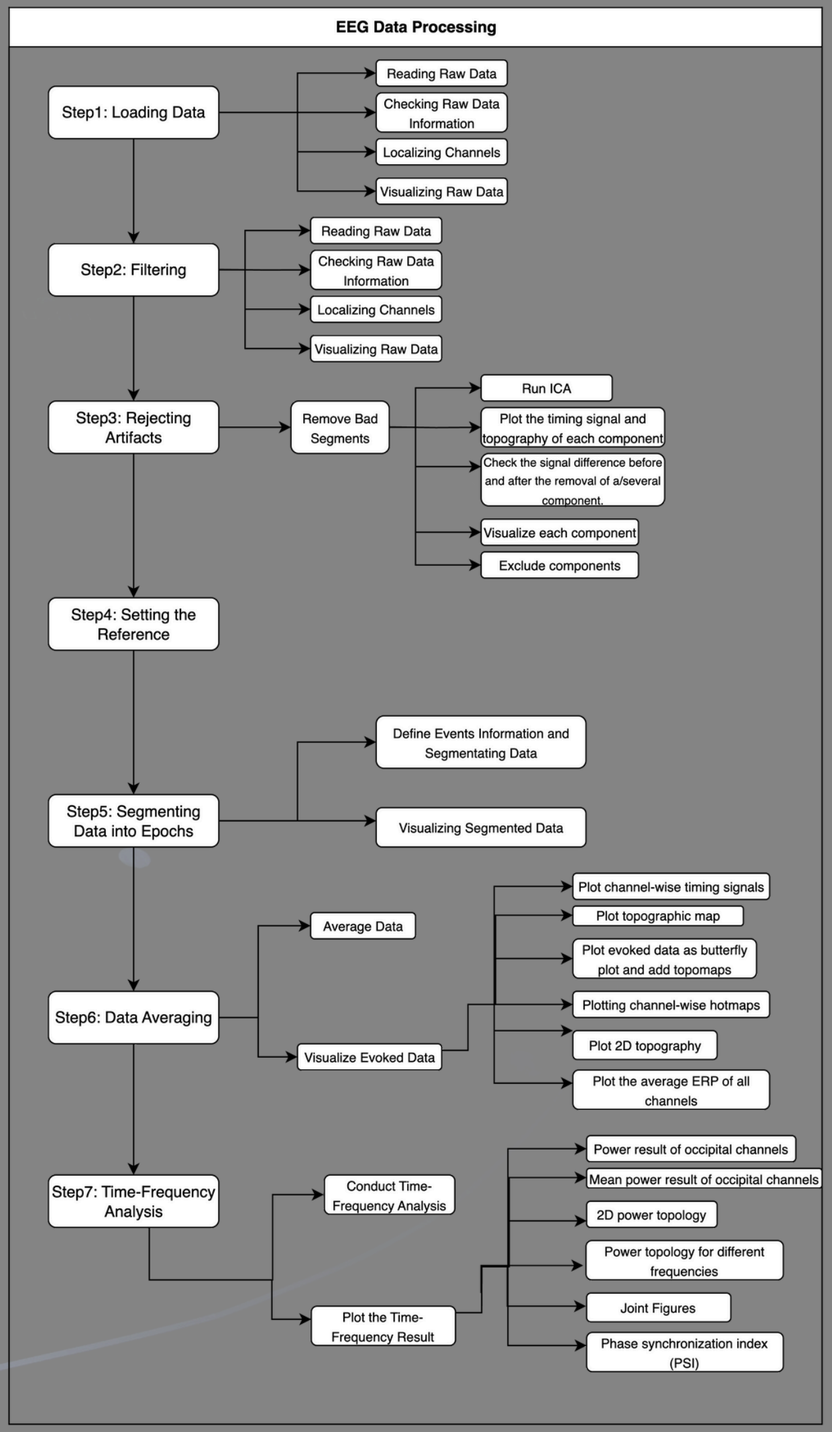
planning

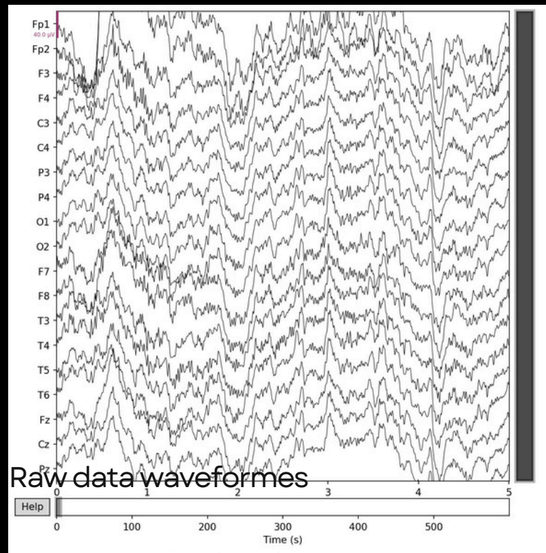
performing on stage


EEG Data Processing
Raw data processing
PSI calculation
Individuals' mean PSIs across channel pairs
Individuals' average mean PSIs
Average channel pair PSIs
Topographic map
Choreography
Movements' qualities
Phrases
Improvisation
Music selection
Traveling
Transitions between phrases
Stage & Props setup

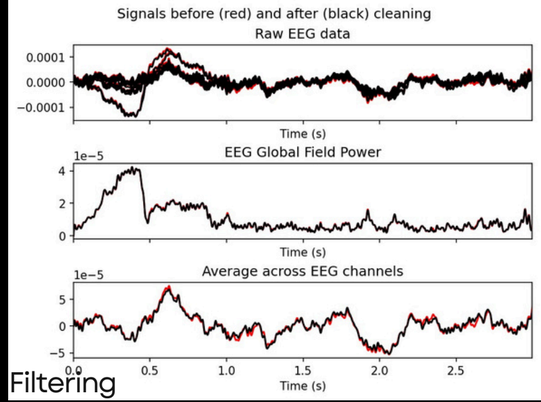
Alzheimer's disease is one of the most widely recognized neurodegenerative diseases, traditionally characterized by progressive neuronal degeneration and shrinkage of brain structures, particularly in the hippocampal region. However, this structural decline does not capture the full story. Recent studies have revealed that Alzheimer's is also marked by disrupted neuronal synchrony, leading to dysfunctional neural network activity (Percio et al., 2023). In this interdisciplinary experimental project merging neuroscience with choreography, I analyzed the phase synchronization indices (PSIs)—a metric of neuronal synchrony—in electroencephalogram (EEG) data from 20 Alzheimer's patients, using open-source datasets from OpenNeuro (Miltiadous et al., 2023).



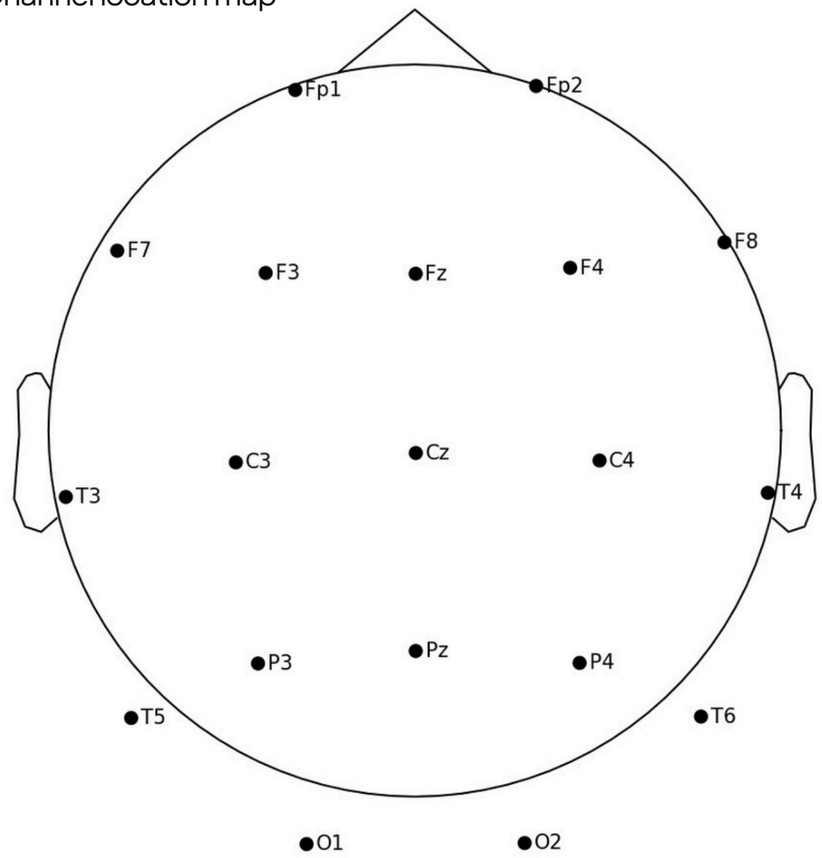




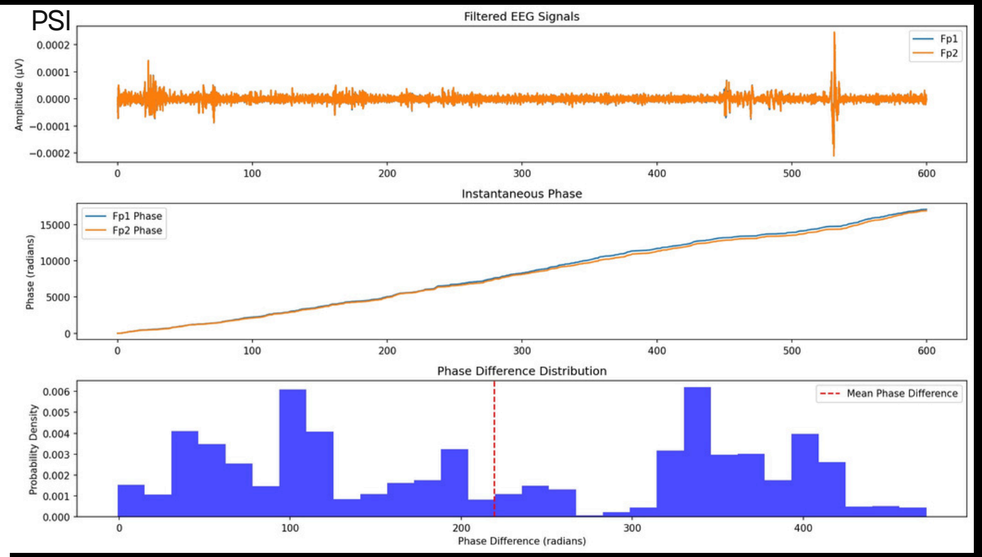
Raw data waveformes



Filtering



PSI



Parts of Processing displayed

The complete work of data processing with python is displayed here. The file for EEG processing is named "EEG_Python_Handbook_Preprocessing": https://github.com/cindyshak0104/EEG-Processing-and-PSI-Calculation/tree/0a5b180c8b12c7c381939808e31dd6bdfaebf8af

Calculated PSI

First, I calculated the mean PSI for each channel pair across the 20 patients (chatGPT used for this calculation). Then, for each patient, I computed the average of these mean PSI values across all channel pairs. A lower average PSI indicates greater neuronal desynchronization, and vice versa. This value served as a metric for determining the quality and coherence of my movements as I "danced out" the neuronal synchrony of these 20 patients.

example of one patient:

		Channel 1	Channel 2	Mean PSI
2	115	P4	Pz	0.518164296
3	121	O1	T5	0.28978445
4	67	C3	P3	0.252300019
5	104	P3	Pz	0.566985078
6	81	C4	P4	0.191394583
7	63	F4	Fz	0.419569923
8	112	P4	T6	0.751211483
9	116	O1	O2	0.176319551
10	91	C4	Cz	0.140273088
11	134	O2	Pz	0.045109548
12	73	C3	T3	0.924384918
13	106	P4	O2	0.104934545
14	78	C3	Cz	0.850622736
15	131	O2	T6	0.468236235
16	94	P3	O1	0.608825448
17	125	O1	Pz	0.517266651
18	92	C4	Pz	0.164161643
19	103	P3	Cz	0.178618256
20	93	P3	P4	0.714467651
21	87	C4	T4	0.113460072

159	5	Fp1	P3	0.177037411
160	31	Fp2	T6	0.372882073
161	22	Fp2	P3	0.161091433
162	23	Fp2	P4	0.095077749
163	14	Fp1	T6	0.173282573
164	6	Fp1	P4	0.29648057
165	34	Fp2	Pz	0.081321551
166	13	Fp1	T5	0.846700708
167	17	Fp1	Pz	0.281299691
168	7	Fp1	O1	0.442125864
169	30	Fp2	T5	0.749971952
170	24	Fp2	O1	0.225517566
171	25	Fp2	O2	0.810811899
172	8	Fp1	O2	0.750943441
173				
174				
175			average	0.488046567

The whole excel sheet named "Calculated PSI" can also be found on github by clicking "view raw": https://github.com/cindyshak0104/EEG-Processing-and-PSI-Calculation/tree/0a5b180c8b12c7c381939808e31dd6bdfaebf8af

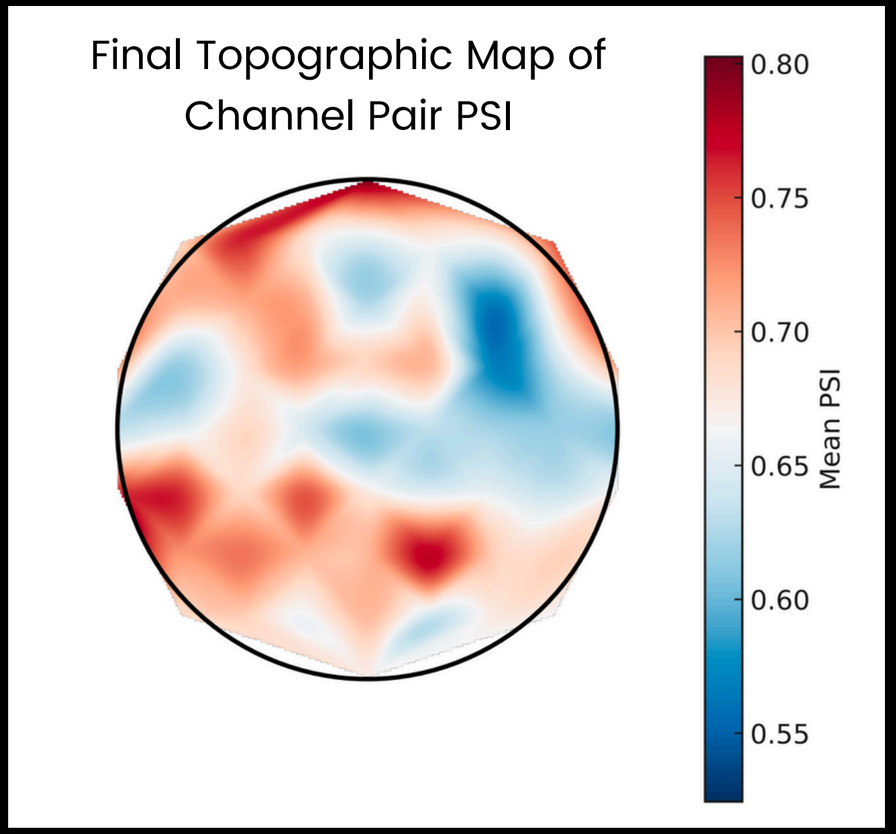
Calculated PSI

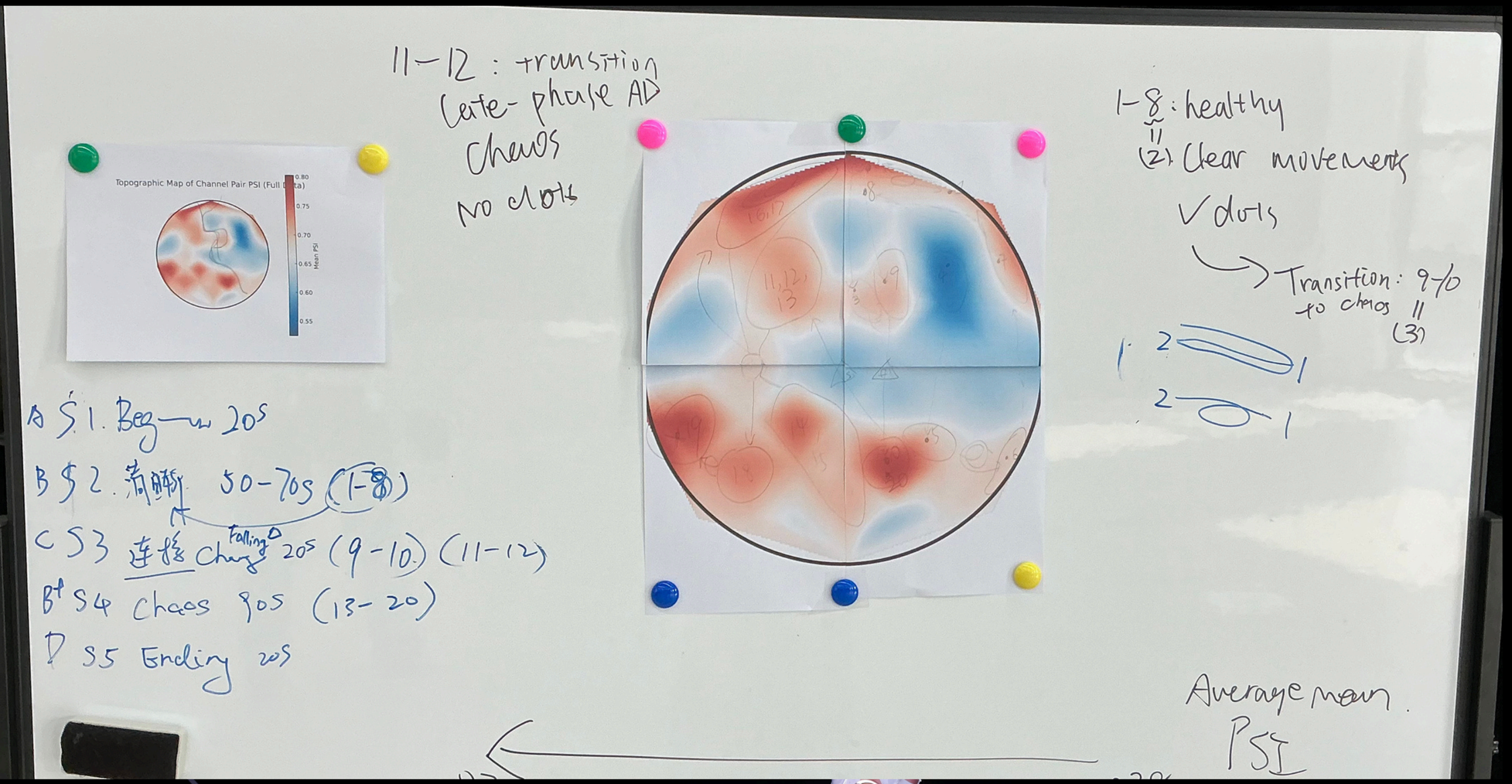
Lastly, I calculated the average mean PSI for each channel pair (chatGPT used here) across the 20 patients (as shown on the final sheet of the Excel file). Using the spatial locations of each channel, I then generated a topographic map to visualize the distribution of these average mean PSI values.

This map guided the trajectory of my dance, as I used light sticks attached to my body to physically "trace" the map—spending more time in the dark red (high synchrony) regions and less in the dark blue (low synchrony) areas.

Example (part of the channels):

Channel Pair	Average Mean PSI
P4-Pz	0.77473081
O1-T5	0.682641128
C3-P3	0.73474264
P3-Pz	0.722664773
C4-P4	0.652730923
F4-Fz	0.696513777
P4-T6	0.692162581
O1-O2	0.671664626
C4-Cz	0.680543729
O2-Pz	0.668440025
C3-T3	0.750443662
P4-O2	0.673054575
C3-Cz	0.773398095
O2-T6	0.65978236
P3-O1	0.694387487
O1-Pz	0.704651537
C4-Pz	0.648224741
P3-Cz	0.700233465
P3-P4	0.707407852





In terms of movement quality, I ranked the 20 PSIs from highest to lowest. The first eight points represent the relatively healthy patients, conveyed through clear, emotionless, and sharp movements. Points 9 and 10 mark the transition from early- to late-stage Alzheimer's, with the choreography gradually shifting from structured to increasingly erratic. Points 11 through 20 embody fully chaotic movement, symbolizing late-stage Alzheimer's and the pronounced desynchronization of neuronal activity. Overall, the choreography follows a progressive increase in disorder, culminating in the 20th point—the most disoriented and chaotic in movement.

Choreography-- Movement Trajectory & Qualities

The central concept of the performance is to physically trace the topographic map while embodying the PSIs of all 20 patients. To realize this, I plotted 20 points across the map and assigned specific durations to each location, reflecting the average neuronal synchrony in that region. The resulting movement path emphasizes prolonged presence in dark red areas—symbolizing high synchrony—and minimal presence in dark blue areas, representing regions of desynchronization.

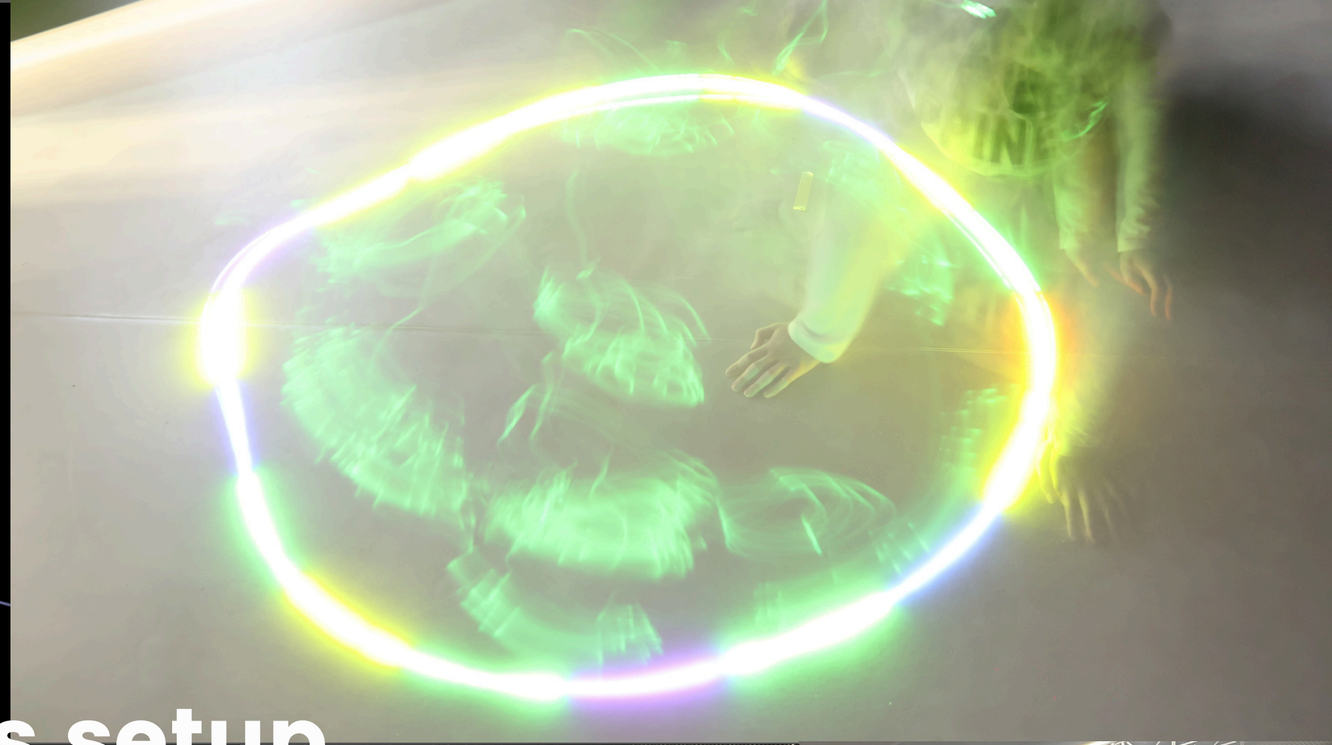
Process of Choreography

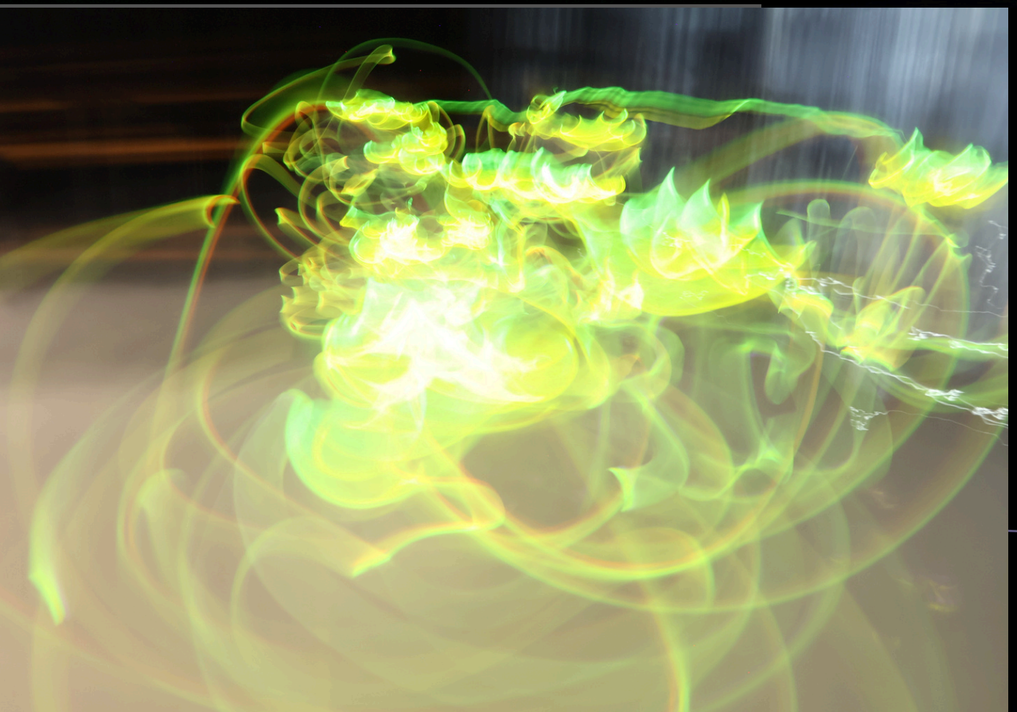
I began by choreographing seven distinct phrases of clear, structured movements to represent the first seven points. Starting with the eighth point, I introduced chaotic distortions of earlier movements—for instance, the eighth point featured a deformed version of the phrase from the second point, as they occupy the same area on the map. The same approach was applied to the ninth and third points. From the tenth point onward, due to the increasing chaos represented, I fully improvised the choreography by repeatedly listening to the chaotic soundtrack and letting it guide my movements.

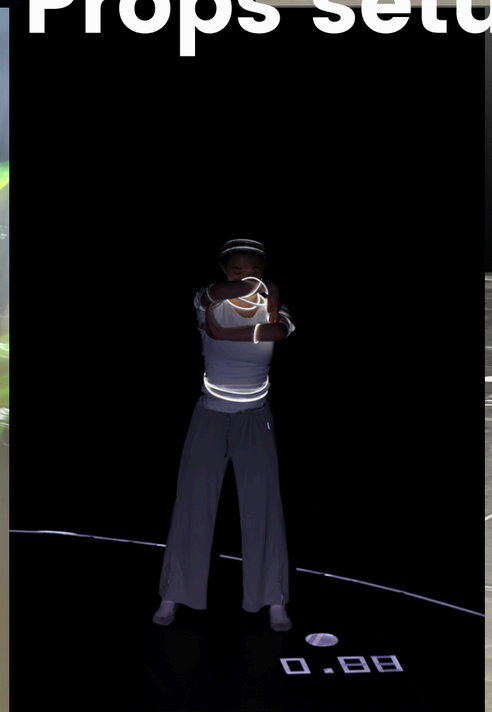
As for transitions between points, the first half of the performance features mostly direct, linear walking. These transitions gradually shift into more erratic and disordered movements, such as rolling, in the second half—mirroring the progression from neural synchrony to desynchronization.

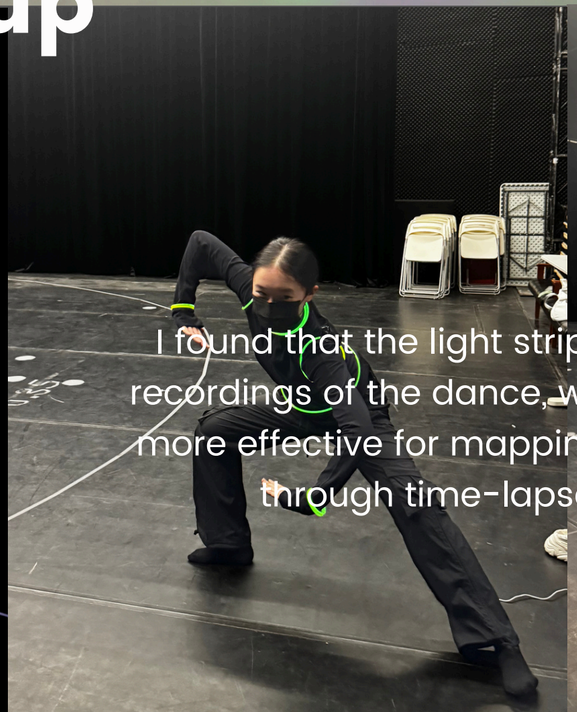
Props setup

To visually capture my trajectory as it traces the topographic map, I chose to use a light source and create a time-lapse photograph. I experimented with both a portable charger-powered light strip and a series of connected light sticks, as shown in the photos documenting these trials.

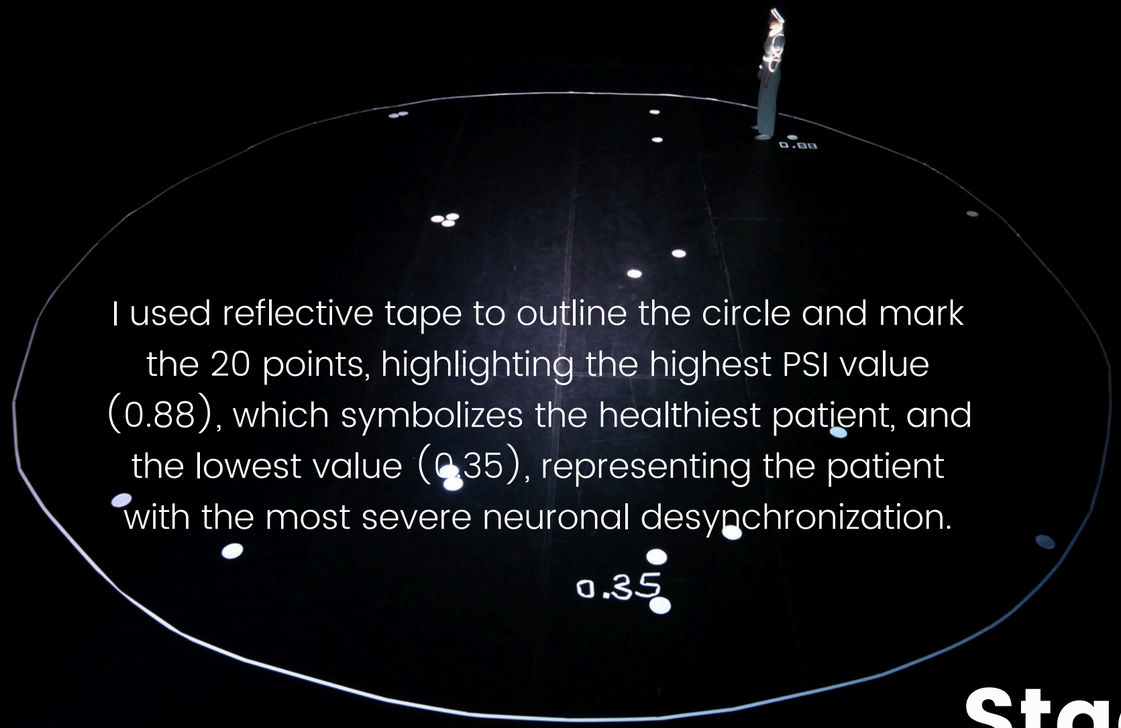




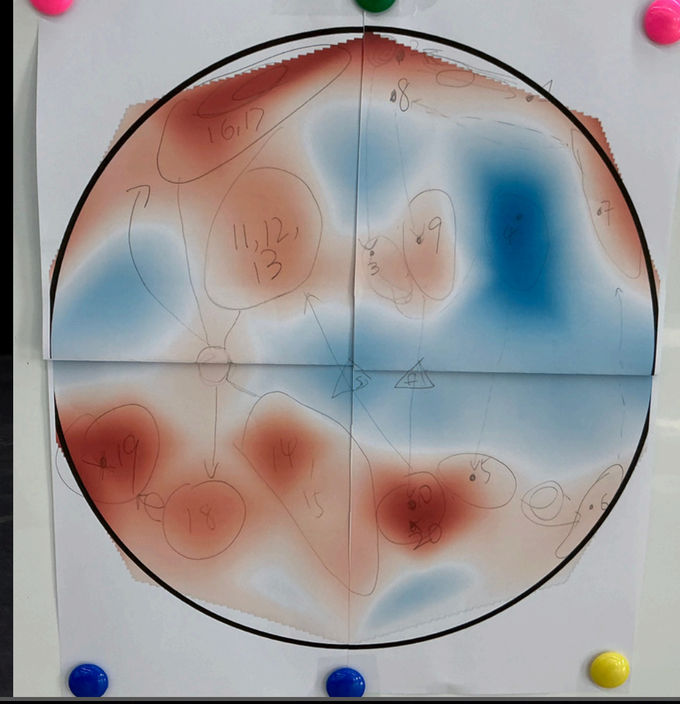




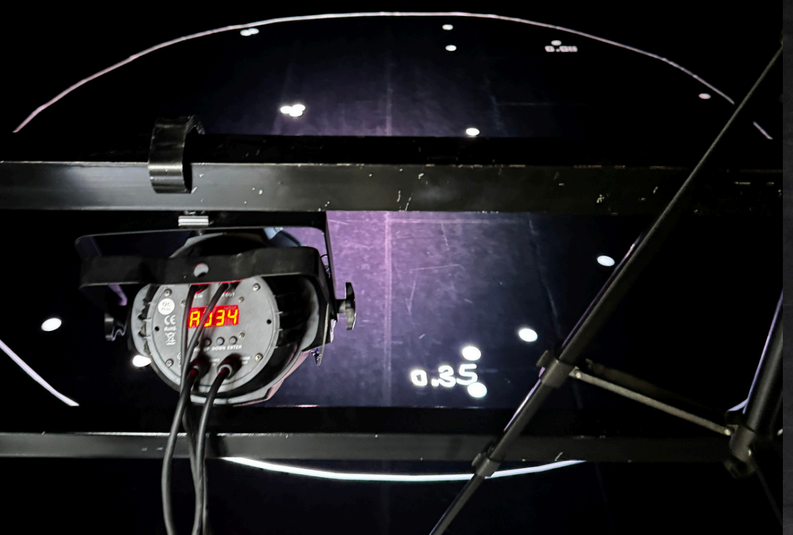
I found that the light strip works best for video recordings of the dance, while the light sticks are more effective for mapping the movement path through time-lapse photography.

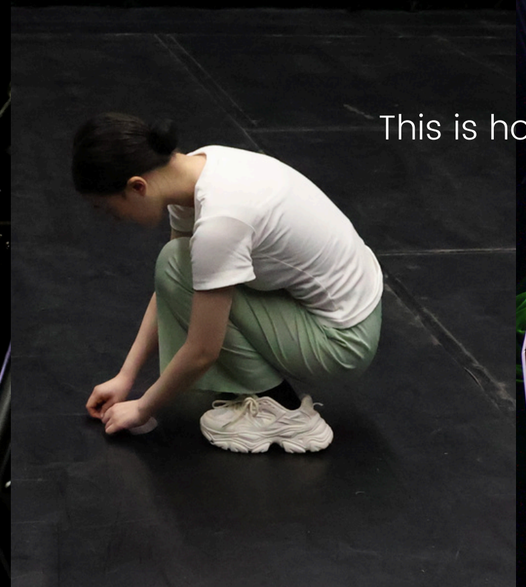


I used reflective tape to outline the circle and mark the 20 points, highlighting the highest PSI value (0.88), which symbolizes the healthiest patient, and the lowest value (0.35), representing the patient with the most severe neuronal desynchronization.



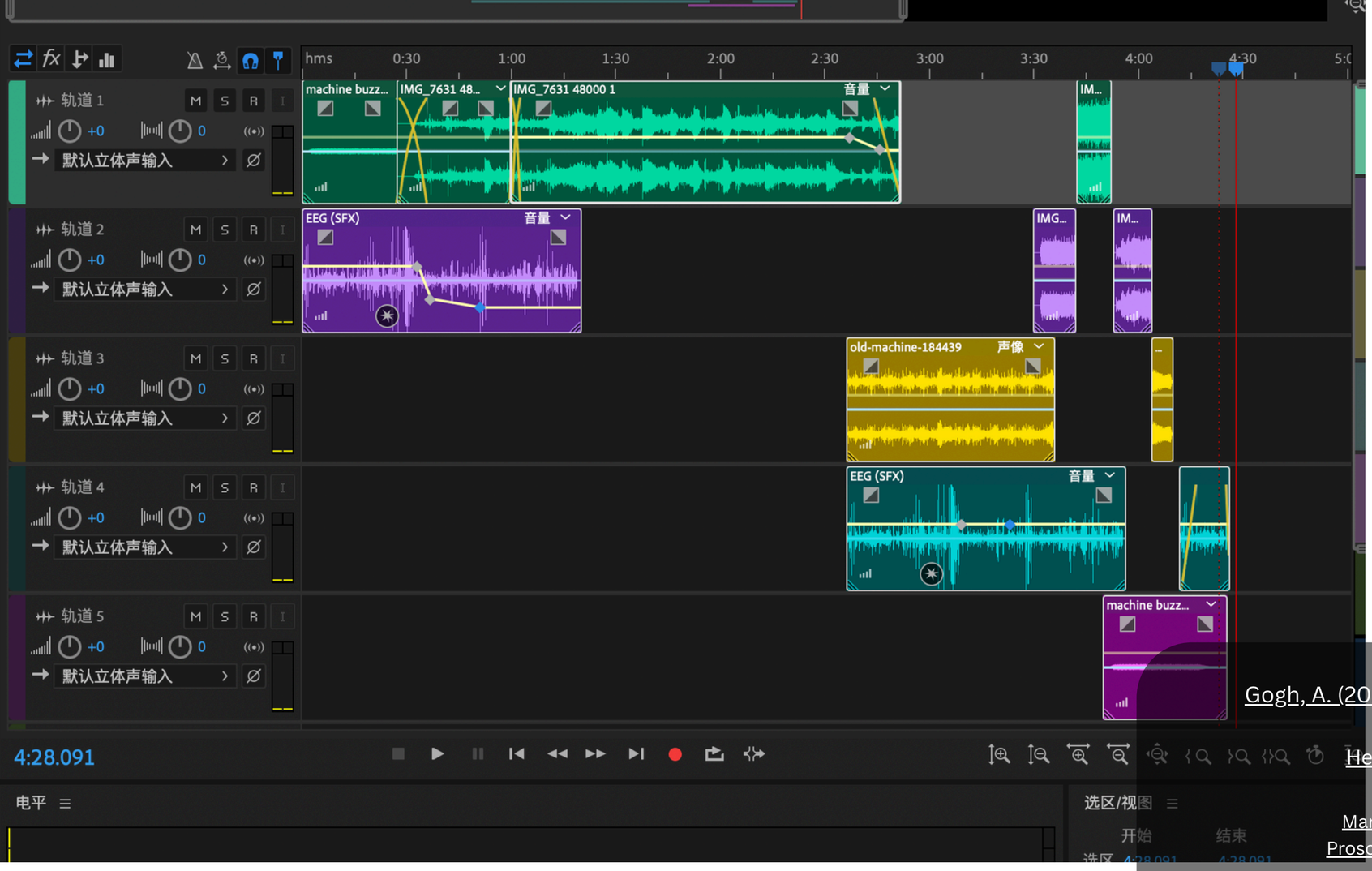
Stage setup





This is how it turned out:

You can see that it did a fair job tracing the contours of the topographic map.



The background soundtrack was edited from the four online sound effects and two songs attached. I chose machine and EEG sound effects to underscore the dance's data-driven origins However, there is still a gradual transition from crisp, structured beats into increasingly fragmented and chaotic textures.

Soundtrack

Gogh, A. (2025). *old machine*. Pixabay.com. https://pixabay.com/sound-effects/search/old%20machine/

Herudek, T. (2025). *machine buzzing ambience*. Uppbeat.io. https://uppbeat.io/sfx/category/mechanical/machine

Mangini, M., & Anderson, R. L. (2025). *Electroencephalogram*. Prosoundeffects.com. https://www.prosoundeffects.com/sound-effects/PSE_OE/NcW2H/Electroencephalograph

Hempel, S. (2024). *Ekg Ecg Medical Unit Beep Signal Heart Beat Flatline*. Depositphotos. https://depositphotos.com/sound-effect/ekg-ecg-medical-unit-beep-signal-heart-beat-flatline-532746646.html

Jilin. (2018a, July 17). The Abyss of Doubt. Spotify. https://open.spotify.com/album/0NdzZwdbmRBKn75Ndw1deE

Jilin. (2018b, September 28). First Overture (Spiritual Atom). Spotify. https://open.spotify.com/track/6gTFMyUfY6zo7iYweAazJM

Photos taken as I was feeling my body and finding inspiration for the choreography

WHY?

On the surface, the choreography may seem to descend into despair--however, that is the last thing I want to leave the audience with. These EEG measurements aren't meant to label or define anyone; rather, they spring from each individual's unique neuronal firings. By transforming these data into movements, I want each move to become a living memory inscribed in the neurons—a choreographic life story of their very essence. As Wayne McGregor put it about *Autobiography*, "the body is a living archive."

Thus, even as mortality looms, through seeing those data being transformed into body movements, I want to restore a sense of autonomy in those twenty patients--and everyone who shares their condition--to leave the world with something beyond simple, linear data report: an immortal archive of movement they have authored and claimed as their own.

References

Gogh, A. (2025). old machine. Pixabay.com. https://pixabay.com/sound-effects/search/old%20machine/

Hempel, S. (2024). Ekg Ecg Medical Unit Beep Signal Heart Beat Flatline. Depositphotos. https://depositphotos.com/sound-effect/ekg-ecg-medical-unit-beep-signal-heart-beat-flatline-532746646.html

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Jilin. (2018b, September 28). First Overture (Spiritual Atom). Spotify. https://open.spotify.com/track/6gTFMyUfY6zo7iYweAazJM

Mangini, M., & Anderson, R. L. (2025). Electroencephalogram. Prosoundeffects.com. https://www.prosoundeffects.com/sound-effects/PSE_OE/NcW2H/Electroencephalograph

Miltiadous, A., Tzimourta, K. D., Afrantou, T., Ioannidis, P., Nikolaos Grigoriadis, Tsalikakis, D. G., Pantelis Angelidis, Tsipouras, M. G., Glavas, E., Nikolaos Giannakeas, & Tzallas, A. T. (2023). A Dataset of Scalp EEG Recordings of Alzheimer's Disease, Frontotemporal Dementia and Healthy Subjects from Routine EEG. OpenNeuro Dataset, 8(6), 95–95. https://doi.org/10.3390/data8060095

Percio, C. D., Lizio, R., Noce, G., Lopez, S., Soricelli, A., Ferri, R., Tucci, F., Bahar Güntekin, Görsev Yener, Frisoni, G. B., & Babiloni, C. (2023). Brain neural synchronization mechanisms are affected by aging in cognitively unimpaired seniors and patients with Alzheimer's disease and mild cognitive impairment. Alzheimer S & Dementia, 19(S2). https://doi.org/10.1002/alz.062176