

PsiNet

A Wearable Brain-to-Brain Interface
for Increasing Inter-Brain Synchrony

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INTRODUCTION

What is Inter-Brain Synchrony?

Inter-Brain Synchrony (IBS)- The "Connected" Brain

IBS describes the synchronization of neural oscillations (brain waves) between people during social interaction.



Inter-brain synchrony supports:

- Positive emotions
- Better decision making
- Relationship bonding
- Team Work
- Empathy



The Research Gap

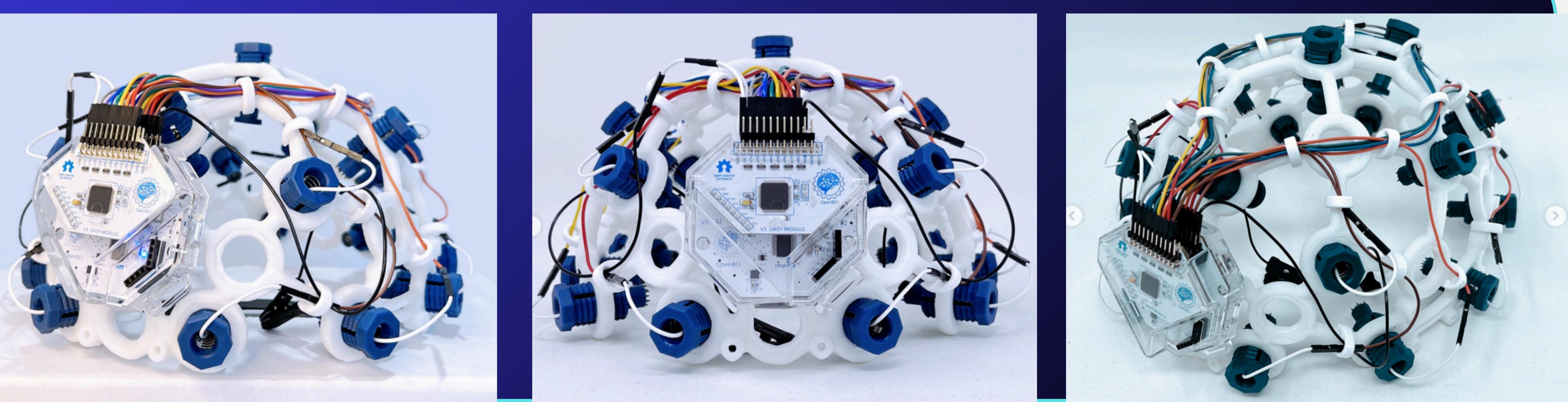


Current systems are -

- Lab-bound and task-focused.
- Only did simple “binary” brain communication(1/0 phosphenes)
- Not wearable
- Focused on data, not user experience
- No system designed to boost synchrony in real life

There is a critical lack of knowledge in deploying these systems "**in-the-wild**"
to understand the user experience of augmented connection.

**How can we design a
real-world, usable Brain-
to-Brain Interface (BBI) to
support inter-brain
synchrony?**



Introducing PsiNet

The first wearable, networked, brain-to-brain system that :

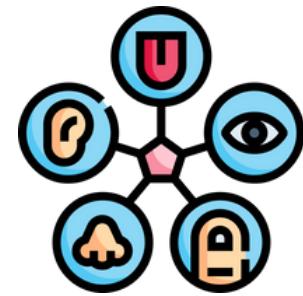
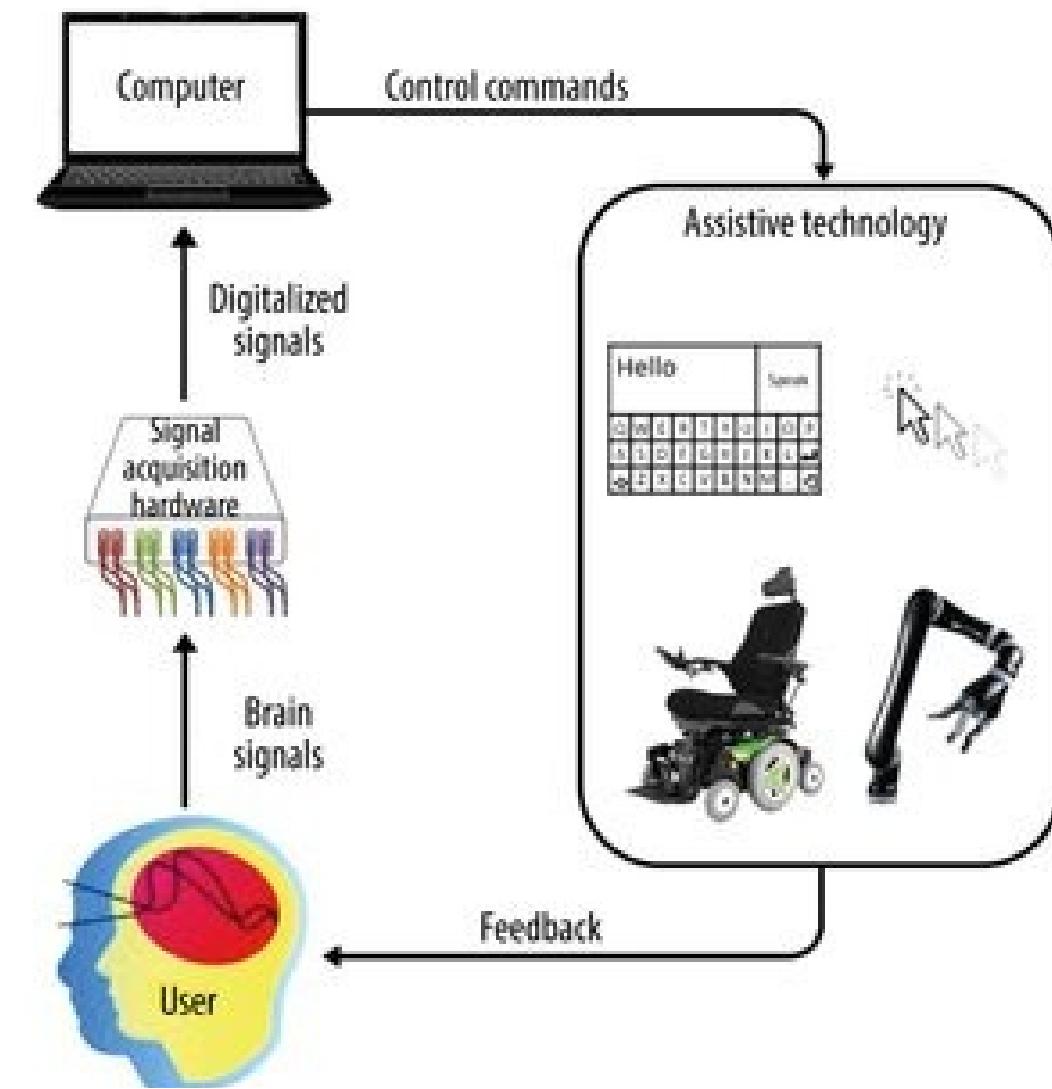
- Reads your brain activity with EEG
- Stimulates your brain with tES
- Uses AI reinforcement learning
- Aims to increase synchrony between people

System Architecture

The Loop

1. EEG → detects mental states
2. AI → decides who needs stimulation
3. tES → gives targeted brain stimulation
4. Synchrony increases → AI learns what works

A continuous feedback loop.



Sense: Detects brain states (Concentration, Relaxation, Motor Activity) via Event-Related Desynchronization.



Decide: A Reinforcement Learning agent selects a stimulation based on group state.



Stimulate: Delivers signals (e.g., Phosphenes, Motor) to other group members to encourage synchrony.

HOW PSINET WORKS

HARDWARE SETUP

- OpenBCI Ultracortex EEG headset
- 16 EEG electrodes
- 4 tES sponge electrodes (for stimulation)
- Raspberry Pi for processing
- Wi-Fi link to central AI server



EEG reads brain waves



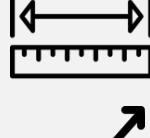
System detects mental states



AI decides who needs stimulation



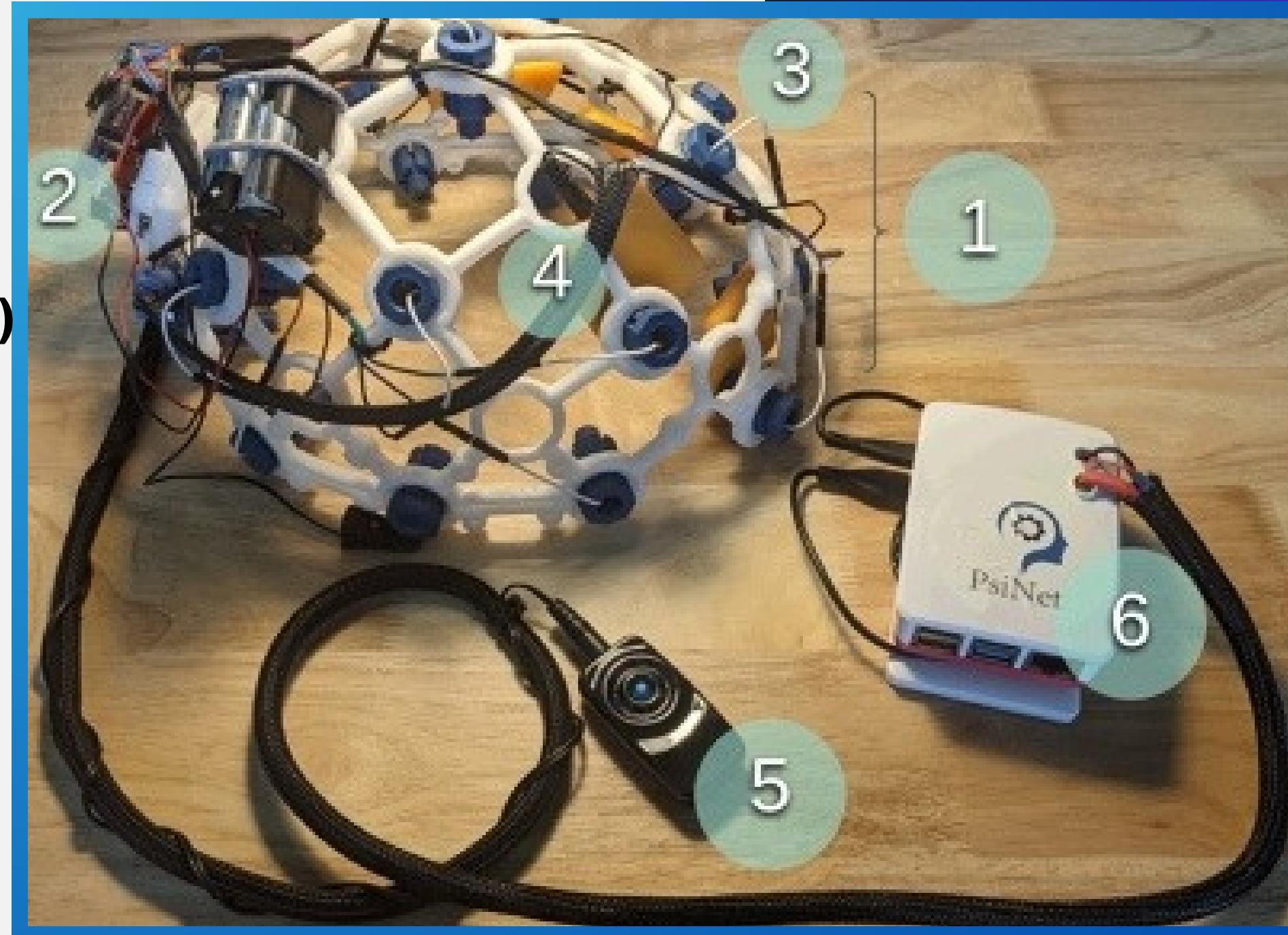
tES stimulates brain areas



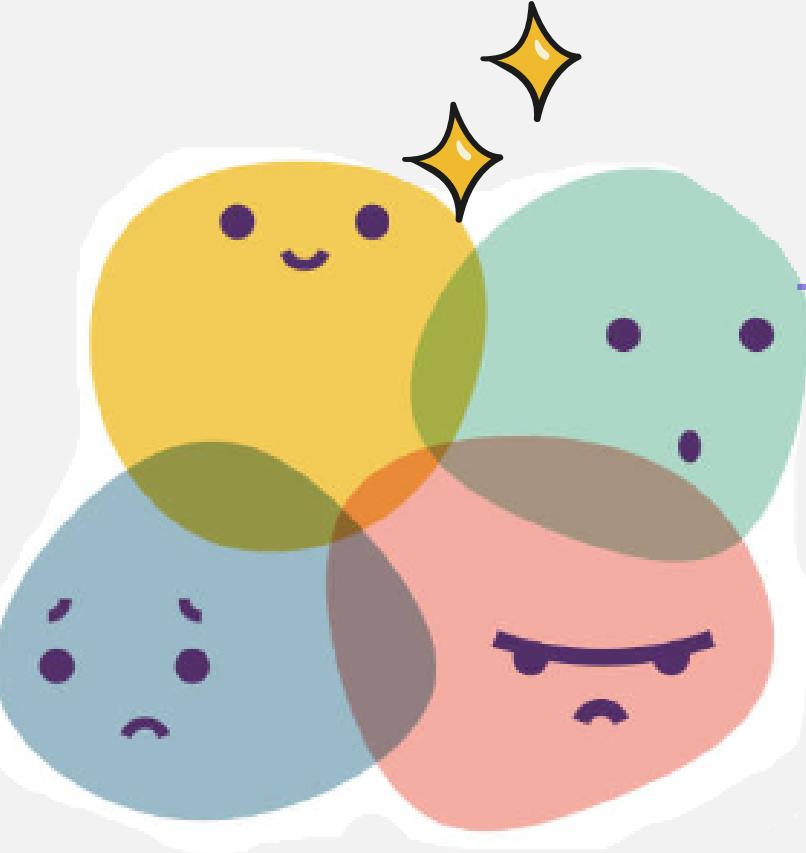
After stimulation → system measures synchrony



AI learns and improves next time



Mental States Detection:



PsiNet Detects -

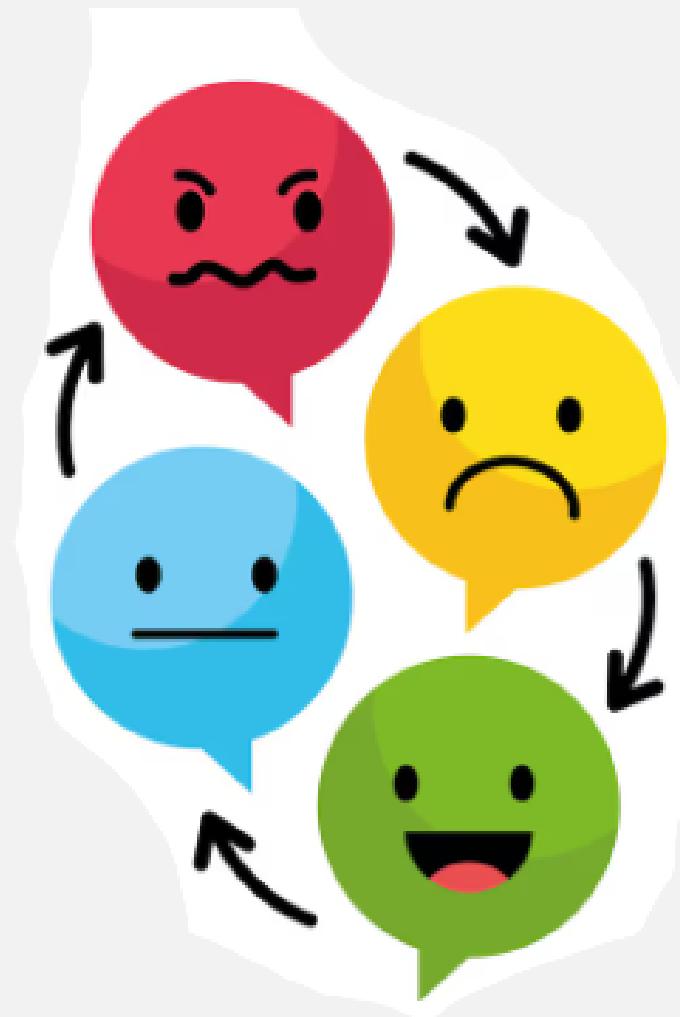
Excitement,
Relaxation,
Boredom,

Concentration,
Focus,
Stress,

- The AI Decision System creates a “state matrix” of everyone’s mental states
- Multiplies with a “weight matrix”
- Chooses best stimulation to increase group synchrony

If synchrony ↑ → system strengthens that decision

If synchrony ↓ → system weakens it



In-The-Wild Study

Methodology

Participants: 3 Groups of 3 (Housemates/Families).

Duration: 3 Days of open-ended use at home.

Context: Natural activities (Working, Gaming, Watching TV).

Data: Qualitative (Interviews/Diaries) + Quantitative (EEG Logs).



Quantitative Results

Did it work? The system significantly increased Inter-Brain Synchrony

Before Stimulation

0.88 (CCorr)

After Stimulation

0.92 (CCorr)

Wilcaxon signed-rank test: Z=794.00, p=0.035

Inter-brain synchrony significantly increased after stimulation

48 measurements

Average increase: +3.78%

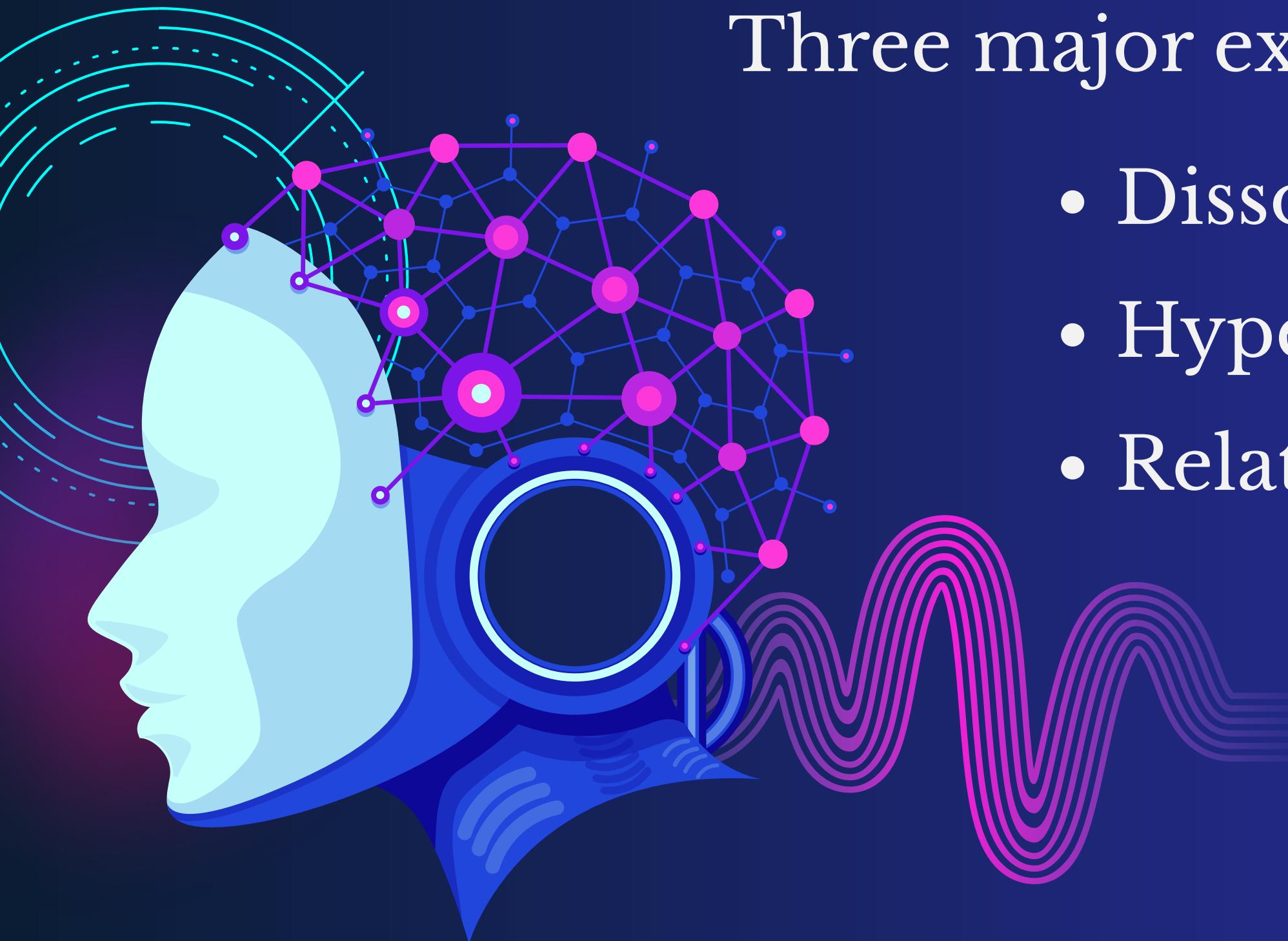
Statistical significance: p = 0.035

This shows PsiNet actually influences neural synchrony.

Qualitative Results

Three major experience themes emerged:

- Dissolution of Self
- Hyper-Awareness
- Relational Interaction



THEME 1: DISSOLUTION OF SELF

Felt “merged” with others couldn’t separate their thoughts from group influence sense of shared agency described as “mind blending”.

This was the most powerful emotional effect.





THEME 2: HYPER-AWARENESS

The system created a feedback loop of awareness.

They became very aware of:

- ✓ Their own mental state
- ✓ Others' possible feelings
- ✓ Group atmosphere
- ✓ Their own bodily states.

PsiNet made emotions feel amplified.

⟳ A social feedback loop.

THEME 3: RELATIONAL INTERACTION



PsiNet changed group interactions:

- ✓ Gaming became more coordinated
- ✓ Conversations felt deeper
- ✓ Even silent activities felt “shared”
- ✓ Solitude/Work: Felt like a "silent motivation" or background presence.

Participants played with influencing each other
PsiNet became a social medium, not just a device.

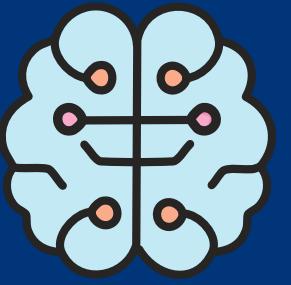


Limitations

- Small sample size (n=9)
- Short usage time (avg 3.8 hrs)
- Only household participants
- Hardware discomfort
- No long-term study
- Lacks long-term longitudinal results

Design Implications

For future Brain-to-Brain Interfaces:



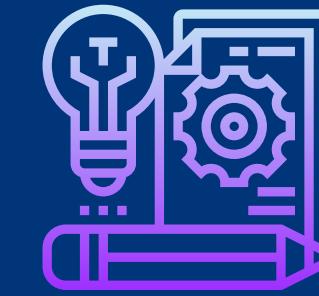
Implicit Interaction

- Strengthen social connection
- Support group connection
- Encourage ambiguity
- Enable playful environment



Seamless Integration

- wearable
- Light-weight
- comfortable



Adaptability

- Support individual & group states
- Respect emotional & ethical boundaries

Conclusion

PsiNet shows a new future:

Technology that connects brains— not just devices.

It opens possibilities for:

- ✓ Team collaboration
- ✓ Therapy
- ✓ Social bonding
- ✓ Creative experiences

PsiNet isn't science fiction –
it's a real step toward connected cognition.

Thank You.

