

Performance Institute

HUMAN & COGNITIVE PERFORMANCE

Enhancing Cognitive Performance: Insights into Learning, Decision Making & Neuroscience



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#LEADERS19



A modern, multi-story building with a facade of grey panels and large windows. The UFC logo is prominently displayed in red on the upper left side of the building. The building has a unique, angular design with several protruding sections. In the foreground, there is a landscaped area with small trees and plants, and a red curb. The sky is clear and blue.

UFC

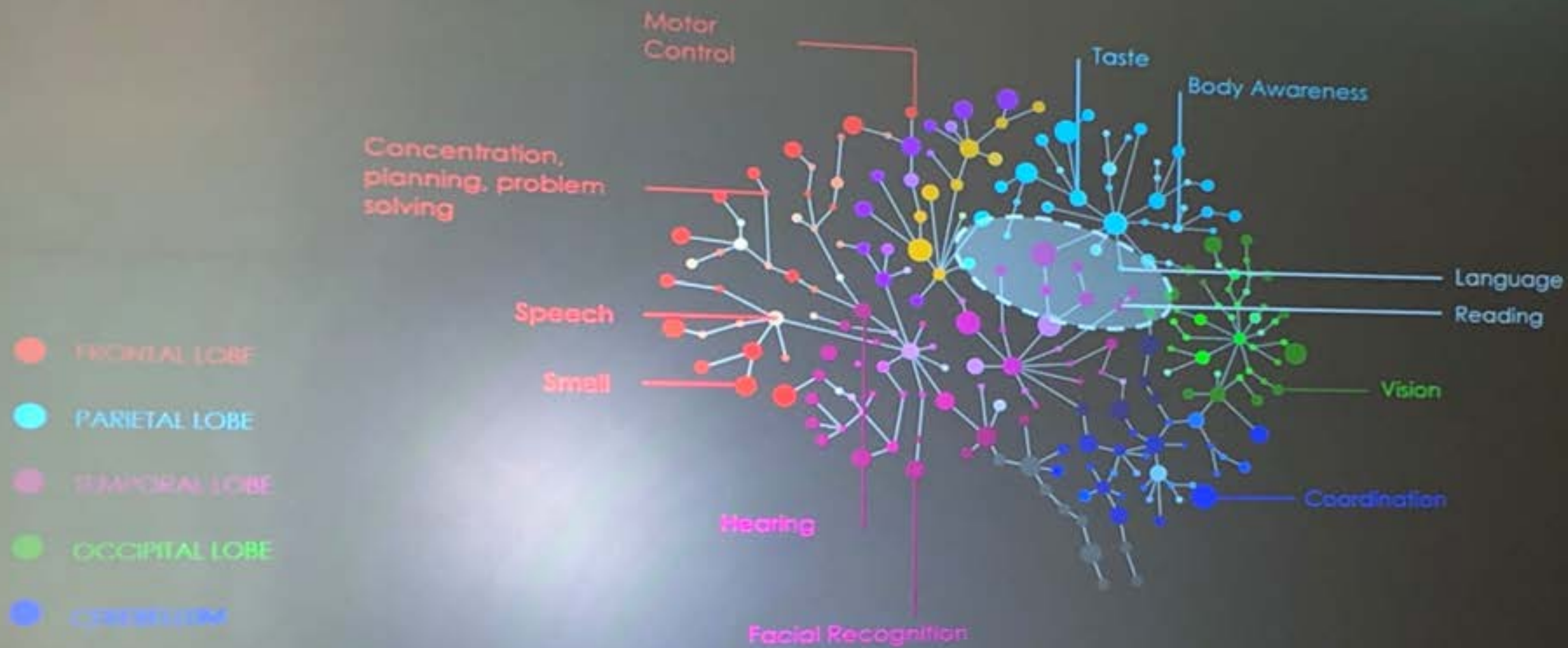
KEY TAKEAWAYS



LEADERS™




BRAIN ANATOMY – FUNCTIONAL ORGANIZATION

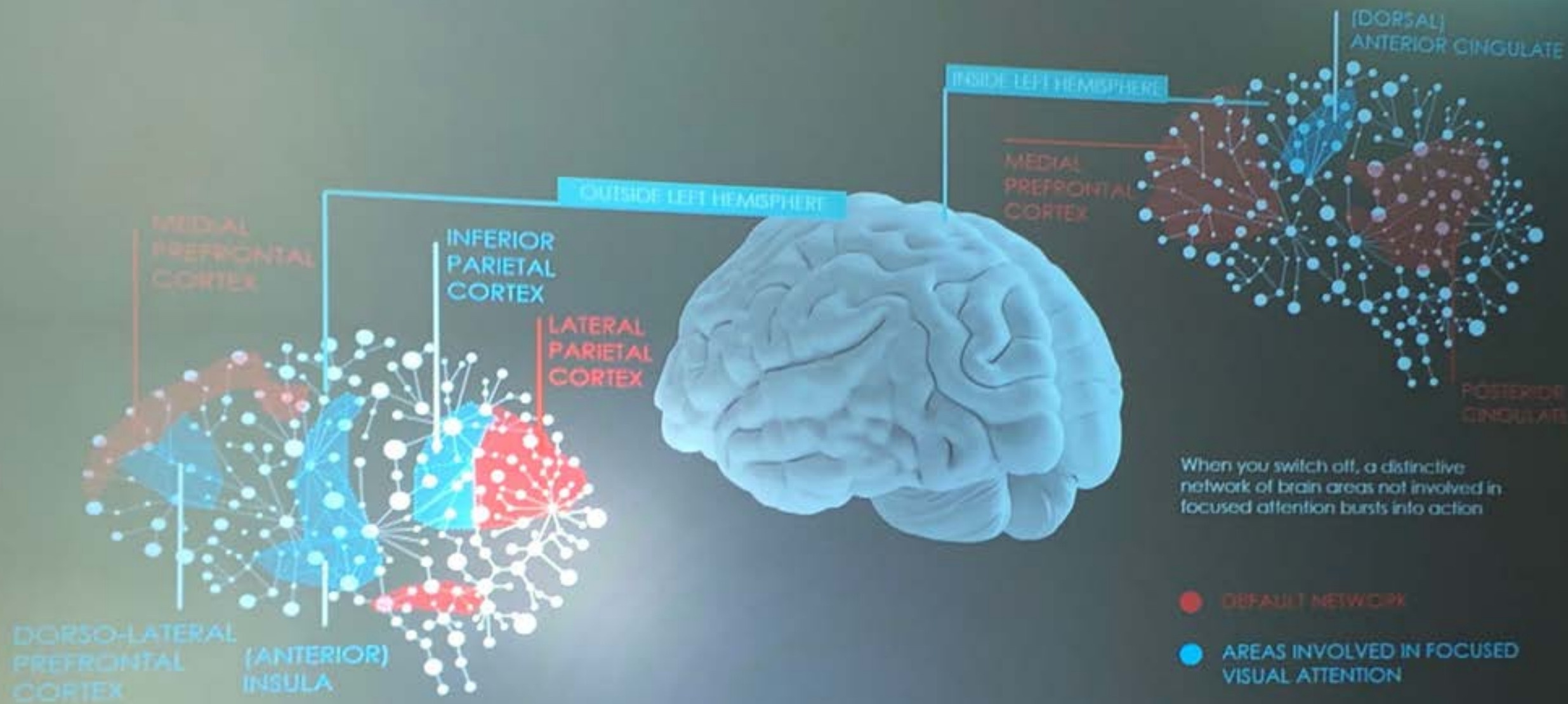


BRAINWAVE FREQUENCIES

HUMAN BRAINWAVES

| | | | FREQUENCY (Hz) | CORRELATES |
|--------------|--|--|----------------|--|
| GAMMA |  | Heightened perception, learning, problem solving tasks, cognitive processing | 30 + | Multi-sensory processing, euphoria, high focus |
| BETA |  | Awake, alert consciousness, thinking, excitement | 13 - 30 | Active cognition, intense, concentration |
| ALPHA |  | Physically and mentally relaxed | 8 - 13 | Relaxation, reflection, closed eyes |
| THETA |  | Creativity, insight, deep states, dreams, deep meditation, reduced consciousness | 3 - 7 | Memory creation, hypnagogia |
| DELTA |  | Deep (dreamless), sleep, loss of bodily awareness, repair | < 3 | Slow-wave sleep |

FUNCTIONAL BRAIN NETWORKS



NEUROPHYSIOLOGY OF EXPERTISE ACROSS TASKS

TRAINING TASK

CHARACTERISTICS OF EXPERTISE:

NOVICE-LEVEL PERFORMANCE:

Known Distance Marksmanship

(n = 200 novices,
100 Marines)

- Pre-shot alpha & theta increase
- Pre-shot HR deceleration
- Low sympathetic activation
- Low EEG Engagement
- Psychophysiological control

- Inconsistent alpha & theta
- No HR deceleration
- High sympathetic activation
- High EEG Engagement
- Limited psychophys control

Combat Marksmanship (n=26)

- Low pre-shot EEG Engagement
- Pre-shot HR deceleration

- Very high EEG Workload
- High HR

Deadly Force Judgement and Decision Making

(n=12 experts,
60 novices)

- **Modulate** physiology to meet task demands

- Limited psychophysiological control
- Inefficient resource allocation

FURTHER THOUGHTS ON EXPERTISE DEVELOPMENT

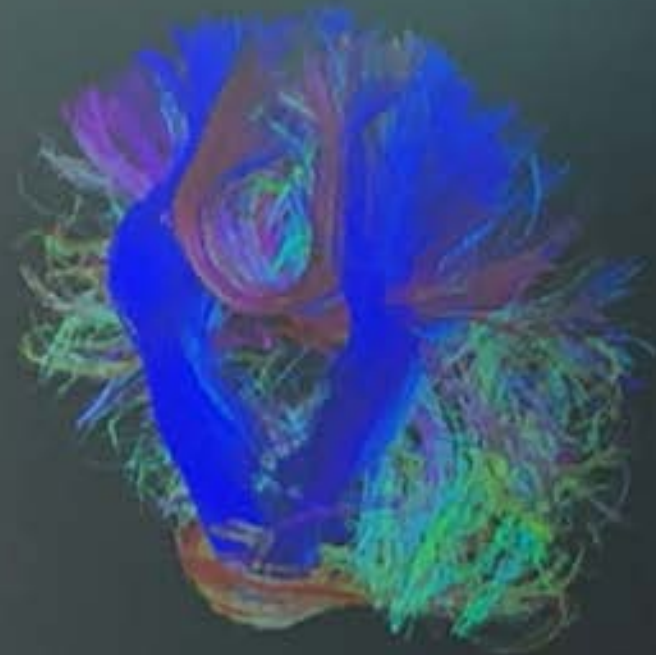
- The expert brain is an **EFFICIENT** brain. The brain spends less energy on tasks it has mastered.
- Expertise does not happen overnight.
- The brain must go through several "stages" before it gets really efficient.
- These brain changes are **enabled by neuroplasticity**
- **Deliberate practice is the key to building the optimal "master" level performance**



THE AMAZING ADULT BRAIN



The brain's relay station, the thalamus, connects to 80 different brain regions



- 100 Billion Neurons
- Each neuron connected to up to 10,000 other neurons
- One thousand trillion synaptic connections

THE MIRACLE OF NEUROPLASTICITY

The adult brain is "plastic."
It can be profoundly re-wired by
experience, learning, and training

THIS IS A BIG DEAL

1960s

Nobel prize winning
research suggests the
brain's architecture is **fixed**

1970s-80s

Scientists begin to
**understand that the brain
can be plastic, but it is
assumed this capacity is
limited**

1990s

Pioneering research
demonstrates that the adult
brain is far more plastic than
previously believed

2000s-Present

Scientists begin learning
how to proactively "rewire"
the brain, e.g., to
accelerate skill acquisition,
enhance language
learning, and delay
cognitive decline

COGNITIVE FUNCTIONS – ESSENTIAL AND IMPROVABLE

VITAL SIGNS – CAPACITY

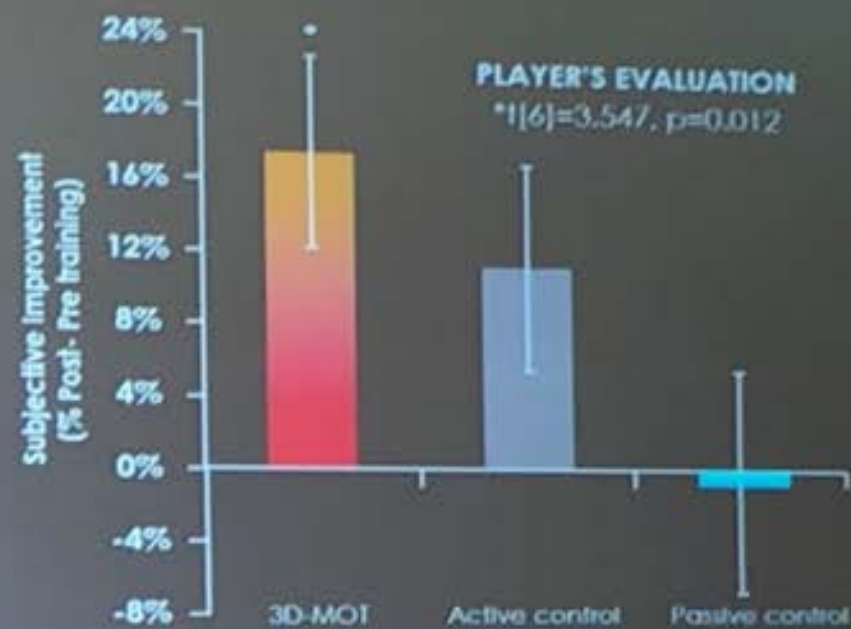
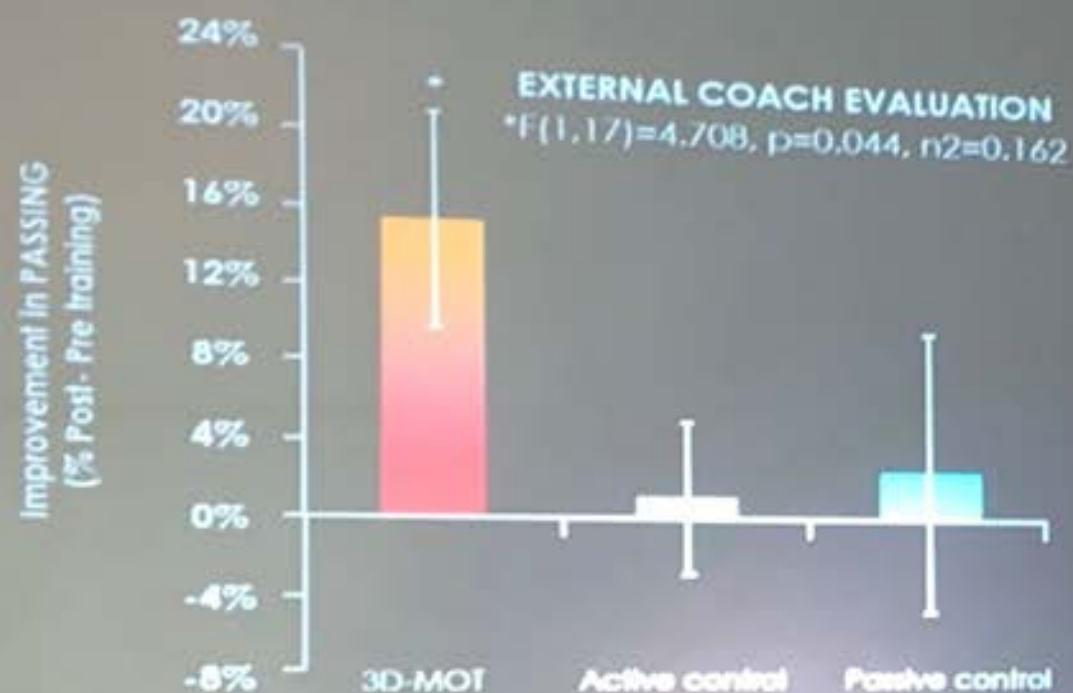
- Brain Speed
- Field of View
- Attention
- Memory Capacity
- Emotional Reactivity
- Resilience
- Adaptability / Cognitive Flexibility
- Grit / Stamina



VITAL SIGNS – STATES

- "Zone" – Motor Performance
- Attention/Arousal
- Cognitive Load
- Stress
- Fatigue
- Group Synchrony
- Flow
- Creativity

TRAINING VISUAL PROCESSING: SOCCER



Soccer players who trained their visual-perceptual skills showed increased passing accuracy and improved decision-making as judged by an independent panel of coaches

MECHANISMS TO INDUCE OR ENHANCE NEUROPLASTICITY



KEY TAKEAWAYS: THE BRAIN AND EXPERTISE

- The brain is functionally organized both anatomically and in networks.
- Different frequencies are associated with different states. We can measure those through EEG in real-time.
- The brain reveals signatures of expertise for different tasks, especially motor tasks.
- We can **accelerate performance** by having individuals learn and produce those expert brain states
- The expert brain is an **EFFICIENT** brain. Deliberate practice is the key to building the right "master" level performance
- Expert teams **demonstrate neural synchrony**. We really can be on the same wavelength.

KEY TAKEAWAYS: NEUROPLASTICITY & COGNITIVE FUNCTION

- The adult brain is amazing, complex and PLASTIC – meaning it can still change and be re-wired.
- Cognitive functions - both capacities and states are essential to optimal sports performance
- One can train to increase these cognitive functions and that results in better performance – qualitatively and quantitatively
- There are many means to addressing increased neuroplasticity – not just one way – however what you are trying to accomplish matters in the selection criteria
- Stress resilience is a challenge – but there are some techniques. Emotional resilience is a “little” easier to get at – aimed at decreasing reactivity.