Using Neuroscience to Enhance Performance
Avenues for Fundamentally Improving Cognitive Performance

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The Challenges

Complex and diverse programs

• Time and resource costly
• Significant variability
• Challenges in monitoring efficacy
Perceptual Cognitive Benefits

Three distinct advantages

1. Efficacy Enhancement of programs
2. Early measurement of cognitive potential
3. Skill-specific enhancement
NeuroTracker
3D Multiple Object Tracking

- Measures attention
- Rapid learning
- Integrates with other tasks
Efficacy Enhancement of programs

Accelerated Learning

- The science of learning & adaptivity
- Specific versus general
- Optimized cognitive loading
Load Effects
Powerful principles in learning

- Distributed learning
- Progressive loading
- Extended complexity
Evidence of Effect

Changes in brain state

- Transfer to intelligence metrics
- Gains in Attention, WM, Executive Functions
- Improvements in neuroelectric activity

✈ Beta & Gamma
✈ Theta

Parsons & al., Clinical EEG & Neuroscience, 2015
Vartanian et al., Military Psychology, 2016
Early Measurement of Cognitive Potential

Identifying high responders

- Neutral cognitive task
- Steeper learning rate
- Superior adaptivity
Cognitive Profiling
A Practical Methodology

- New and insightful metric
- Simple and useful to administer
- Selective training & identifying leaders
Prediction of performance

Surgical resident study

- Initial NeuroTracker scores significantly associated with laparoscopic surgical abilities
  - Speed
  - Accuracy

- Other factors not significantly associated
  - Age
  - Sleep
  - Caffeine
  - Video game use

NBA study


| Table 1. Qualitative inferences on the magnitude of the relationship between game-related measures of performance, perceptual-cognitive function, and visual-motor reaction time (n = 12).† |
|---------------------------------|-----------------|-----------------|-----------------|
| Visual tracking speed          |                 |                 |                 |
| AST                            | 0.78            | 99.7            | 0.2             | 0.0             | Most likely positive |
| TO                             | 0.49            | 90.1            | 6.9             | 2.9             | Likely positive |
| STL                            | 0.77            | 99.7            | 0.3             | 0.0             | Most likely positive |
| AST/TO                         | 0.78            | 99.8            | 0.2             | 0.0             | Most likely positive |

| Visual reaction time           |                 |                 |                 |
| AST                            | -0.22           | 16.5            | 19.0            | 64.5            | Unclear |
| TO                             | -0.18           | 19.8            | 20.5            | 59.7            | Unclear |
| STL                            | 0.02            | 40.9            | 23.6            | 35.5            | Unclear |
| AST/TO                         | -0.16           | 21.3            | 21.0            | 57.7            | Unclear |

| Motor reaction time            |                 |                 |                 |
| AST                            | 0.04            | 42.5            | 23.5            | 33.9            | Unclear |
| TO                             | 0.29            | 72.2            | 16.1            | 11.7            | Unclear |
| STL                            | 0.19            | 61.4            | 20.0            | 18.6            | Unclear |
| AST/TO                         | -0.07           | 30.5            | 23.2            | 46.4            | Unclear |

| Physical reaction time         |                 |                 |                 |
| AST                            | -0.13           | 24.6            | 22.0            | 53.3            | Unclear |
| TO                             | 0.01            | 39.0            | 23.7            | 37.3            | Unclear |
| STL                            | 0.10            | 50.0            | 22.6            | 27.4            | Unclear |
| AST/TO                         | -0.14           | 23.7            | 21.8            | 54.5            | Unclear |

| Variable region choice reaction reaction |                      |                 |                 |
| AST                            | 0.07            | 46.1            | 23.2            | 30.7            | Unclear |
| TO                             | 0.15            | 55.7            | 21.5            | 22.8            | Unclear |
| STL                            | 0.27            | 69.9            | 17.1            | 13.1            | Unclear |
| AST/TO                         | -0.05           | 32.8            | 23.4            | 43.8            | Unclear |

†AST = assists; TO = turnovers; STL = steals; AST/TO = assists-to-turnovers ratio.

Threshold set to 0.1 for all relationships.
NeuroTracker training shows improved passing % - transfer to the field performance

Objective evaluation
(Standard scoring grid of video by expert blind to the study)

Subjective improvement (% Post-Pre training)

Subjective self evaluation
(VAS measure)

Romeas, et al, Psy of Sport & Exercise, 2016
Skill-specific enhancement of training programs

**Synergistic compatibility**

- Complement training programs
- Additional performance metrics
- Integrate directly with training exercises
NeuroTracker Tactical Awareness

Complementary training

- Flexible to combine with dual-tasks
- Decision-making tests under pressure
- Metrics for guiding cognitive loading
Thank You

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