

Using Neuroscience to Enhance Performance

Avenues for Fundamentally Improving Cognitive Performance



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&
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The Challenges

Complex and diverse programs

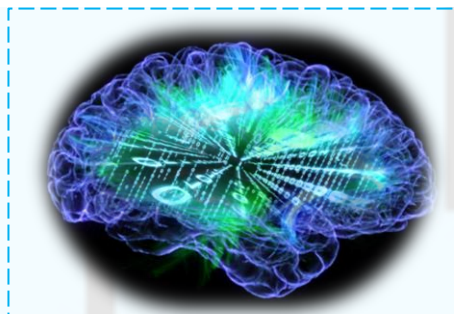
- Time and resource costly
- Significant variability
- Challenges in monitoring efficacy



Perceptual Cognitive Benefits

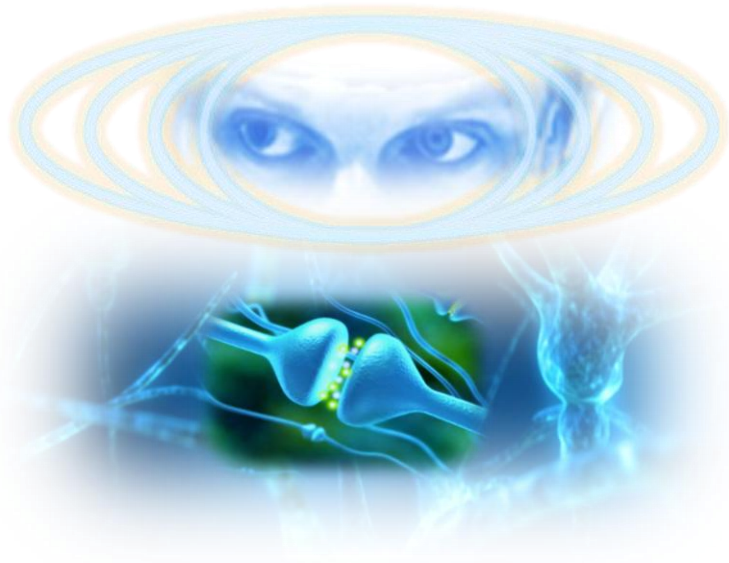
Three distinct advantages

1. Efficacy Enhancement of programs
2. Early measurement of cognitive potential
3. Skill-specific enhancement



NeuroTracker

3D Multiple Object Tracking



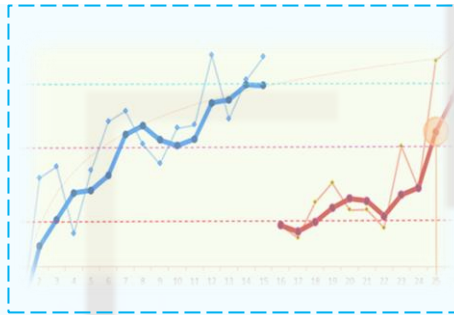
- Measures attention
- Rapid learning
- Integrates with other tasks



Efficacy Enhancement of programs

Accelerated Learning

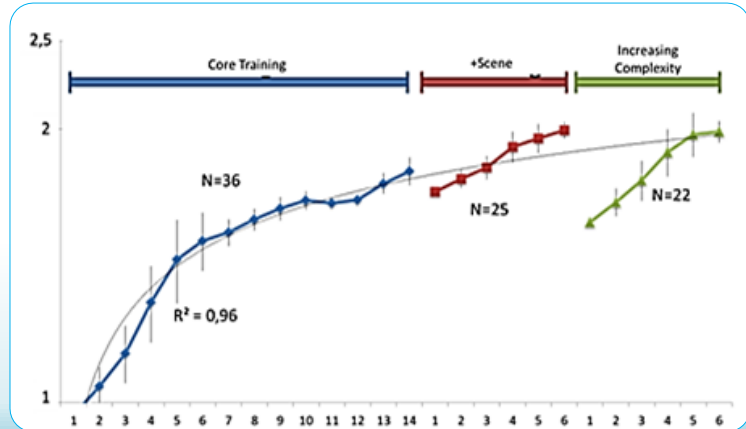
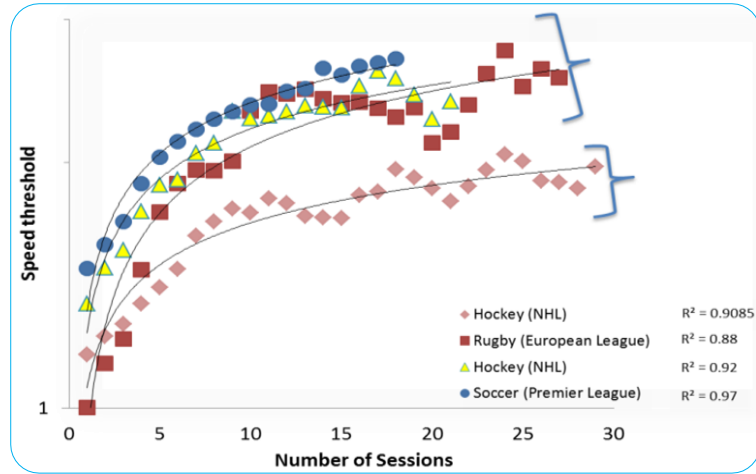
- The science of learning & adaptivity
- Specific versus general
- Optimized cognitive loading



Load Effects

Powerful principles in learning

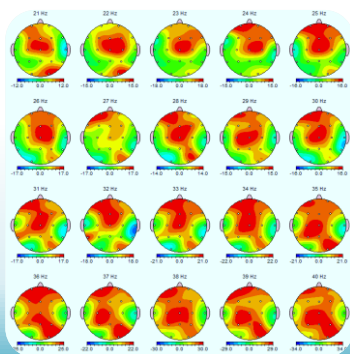
- Distributed learning
- Progressive loading
- Extended complexity



Evidence of Effect

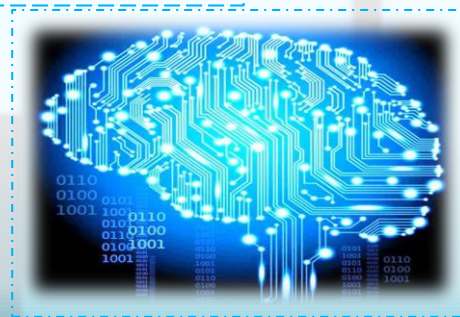
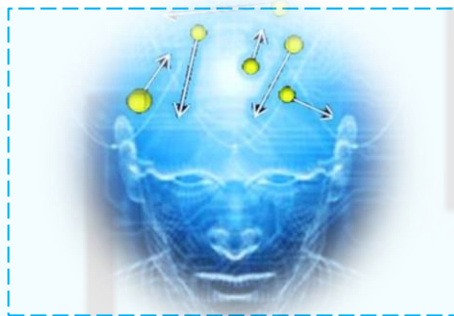
Changes in brain state

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



↑ Beta & Gamma

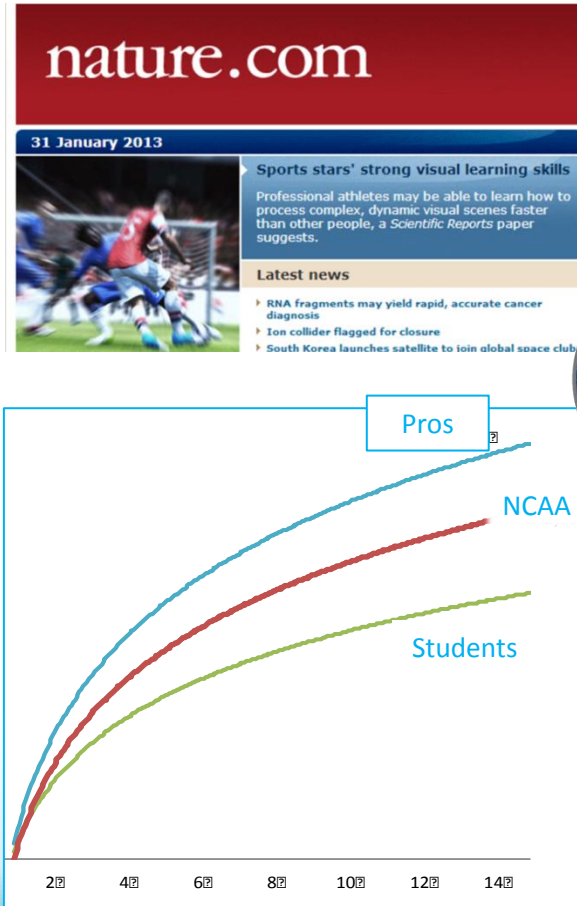
↓ Theta



Early Measurement of Cognitive Potential

Identifying high responders

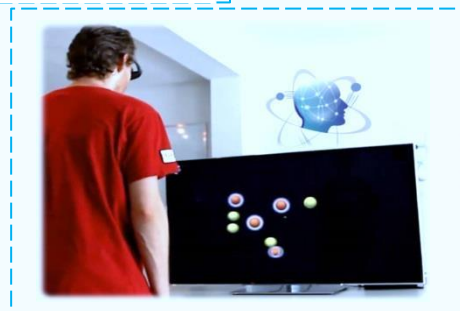
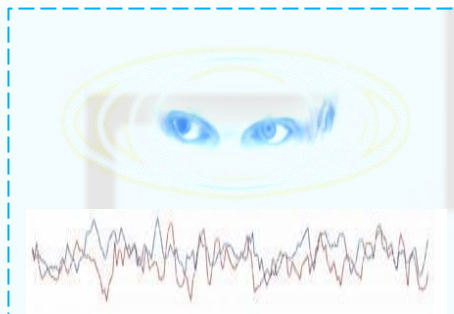
- Neutral cognitive task
- Steeper learning rate
- Superior adaptivity



Cognitive Profiling

A Practical Methodology

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



Prediction of performance

Surgical resident study

- External validation

Harenberg, et al., J of Surgical Education, 2016

- Initial NeuroTracker scores significantly associated with laparoscopic surgical abilities
 - Speed
 - Accuracy
- Other factors not significantly associated
 - Age
 - Sleep
 - Caffeine
 - Video game use

NBA study

Mangine, et al., J Strength & Conditioning Res, 2014

NeuroTracker

TABLE 1. Qualitative inferences on the magnitude of the relationship between game-related measures of performance, perceptual-cognitive function, and visual-motor reaction time ($n = 12$).*

| | <i>r</i> | Positive | Trivial | Negative | Qualitative inference† |
|---------------------------------|----------|----------|---------|----------|------------------------|
| 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 | | | | | |
| 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.

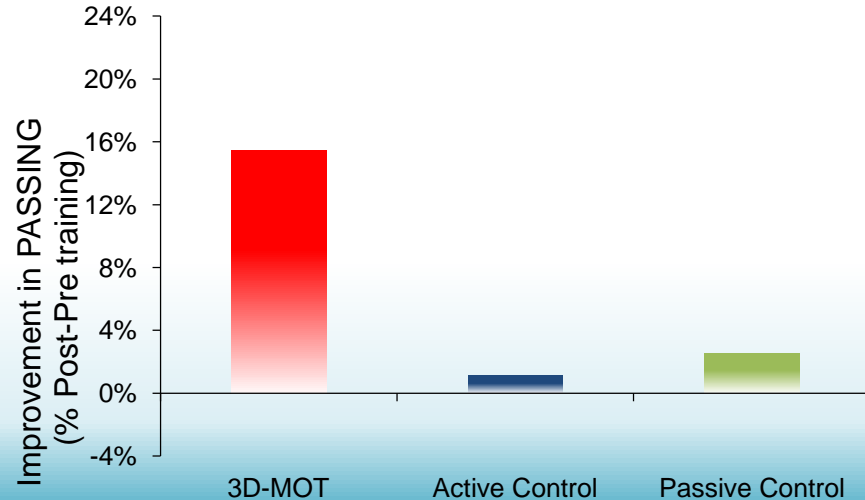
†Threshold set to 0.1 for all relationships.

Far transfer study

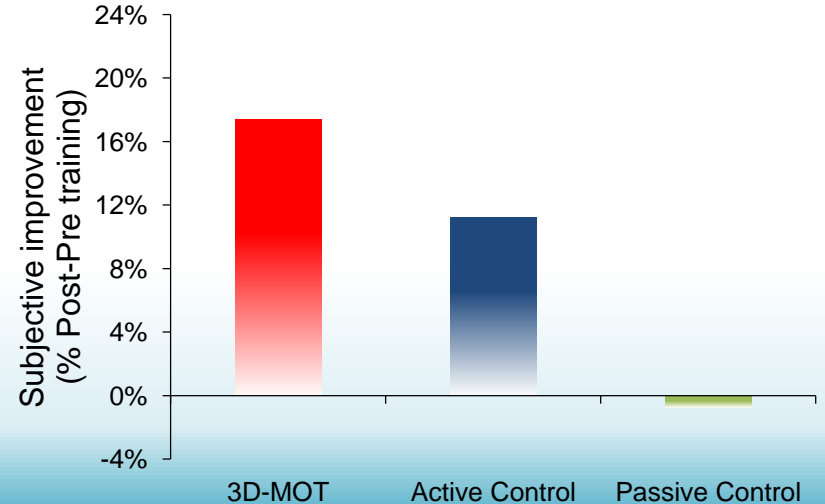
**NeuroTracker training shows improved passing %
- transfer to the field performance**



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



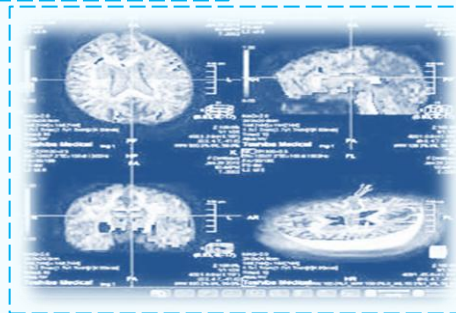
Subjective self evaluation
(VAS measure)



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
Jocelyn Faubert

