NeuroTracker Published Studies & Research

Evidence of Relevance in Measurement, Learning and Transfer for Learning and Learning Related Conditions

NeuroTracker evolved out of a pure science approach through years of research at Prof. Faubert's Visual Psychophysics & Perception Laboratory. Designed to uniquely measure and enhance high-level cognitive function, it has become established as a valuable research tool for understanding human performance. The not-for-profit CogniSens Applied Research Centre (ARC) supports an increasing number of NeuroTracker research projects across a variety of scientific disciplines. To date, published studies have discovered important neuroscience findings in in the following areas.

Measurement

NeuroTracker provides objective cognitive metrics on brain functions fundamental to learning, and also relevant in cognitive impairments in learning. NeuroTracker speed threshold measures have been found to differentiate development of attentional resources with young age and identify cognitive impairments in learning related disorders.

Learning

NeuroTracker is a simple training exercise to do, with virtually no technique or practice required within the task itself. However, performing NeuroTracker evokes powerful responses in brain activity, becoming both a stimulant of neuroplasticity, and a valuable reference of it. NeuroTracker learning rates have been found to be strong even in individuals with severe learning disorders where learning capacities are expected to be diminished. Mapping of neuroelectric brain function suggests neuroplasticity levels may be increased with NeuroTracking.

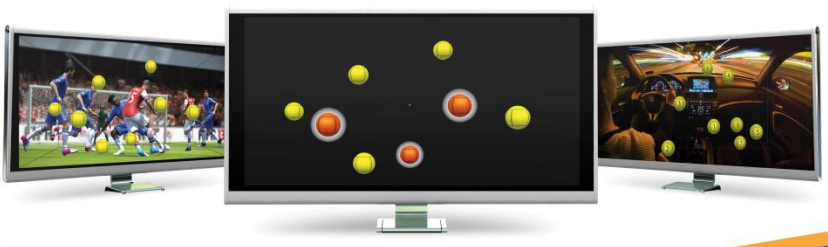
Transfer

Ultimately, it's measureable improvement in intellectual capacities that are sought after, known to be difficult to attain with contemporary interventions. Robust near transfer has been demonstrated with NeuroTracker training, revealing significant improvements with different populations in many high-level cognitive faculties, such as executive function, attention and working memory. These are known to be essential to learning abilities, and also to be critically impaired across a range of cognitive related conditions. Gains in abilities to read and interpret human body motion have also been shown.

This document contains summaries of research and studies completed to date, with references to the research.

To inquire for further details or interpretations of the research, please contact: info@cognisens.com

To inquire about conducting research projects with NeuroTracker, please contact: info@c-arc.org



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NeuroTracker
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NeuroTracker Studies Index

These symbols denote research evidence of NeuroTracker's relevance in,

- **Measurement** – measurement of human performance capacities or impairments
- **Learning** – understanding the characteristics or enhancement of cognitive learning
- **Transfer** – enhancement of human performance or recovery of cognitive impairments

1. **Enhancing Cognitive Function** ← click to view
   NeuroTracker training robustly transfers to high-level cognitive gains, with boosts in brain wave activity.
2. **Attention Training of Students with Learning Disability** ← click to view
   NeuroTracker training provides robust gains in cognitive functions critical to learning abilities.
3. **Attention Training of Students with Autism** ← click to view
   Evidence of NeuroTracker training providing transfer to fundamental cognitive and learning abilities in Autism.
4. **Attention Deficit Training** ← click to view
   NeuroTracker training improves in attention related deficits in young students with ADHD characteristics.
5. **Learning Effects of Feedback** ← click to view
   Transfer effects of NeuroTracker training are improved with feedback, reducing attention test errors.
6. **Biological Motion Perception** ← click to view
   NeuroTracker training reverses age related cognitive decline for reading human movement simulations.
7. **Development of Attentional Resources** ← click to view
   NeuroTracker baselines and learning rates differentiate developments in age related cognitive function.

This document of study synopses is provided by CogniSens, it is requested that inquiries are directed to CogniSens and not the researchers or authors of the studies.

NeuroTracker Study on Enhancing Cognitive Function

'Enhancing Cognitive Function Using Perceptual-Cognitive Training'

Clinical EEG and Neuroscience 1–11, 2016, DOI: 10.1177/1550059414563746

Aim

To examine the effects of NeuroTracker training on standardised measures of attention, working memory, and visual information processing speed using standardized neuropsychological tests. Additionally to measure changes in brain state using functional brain imaging.

Method

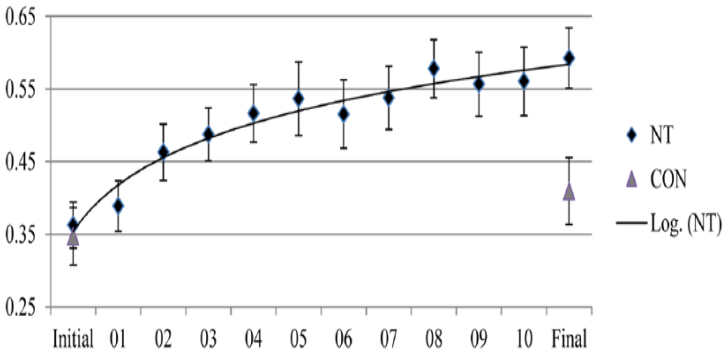
20 university-aged students were recruited and divided into an NT training group (30 sessions of NeuroTracker) and a non-active control group. Cognitive functions were assessed using standardized neuropsychological tests (IVA+Plus, WAIS-III, D-KEFS), and correlates of brain functions were assessed using quantitative electroencephalography (qEEG).

Findings

The trained group showed strong and consistent improvements in NeuroTracker speed thresholds throughout the training period. The NT group demonstrated significantly higher scores on the IVA+Plus Auditory, WAIS Symbol Search, WAIS Code, WAIS Block Design, WAIS Letter-Number Sequence, d2 Test of Attention, and D-KEFS Color Naming, Inhibition and Inhibition/Switching subtests ($P < .01$).

For qEEG measures the NT group demonstrated significant relative power increases in a range of frequencies within the beta bandwidth, with both eyes open and closed resting states. These changes were observed across frontal regions of the brain (executive function) and represented increases in brain wave speed associated with heightened brain activity and neuroplasticity.

Overall results indicated that NeuroTracker training can enhance attention, information processing speed, and working memory, and also lead to positive changes in neuroelectric brain function.



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NeuroTracker Training of Students with Learning Disability

'Using a three-dimensional multiple object tracking paradigm to train attention in students with a learning disability'

Perceptual Neuroscience Laboratory for Autism and Development. McGill University. Université de Montréal.

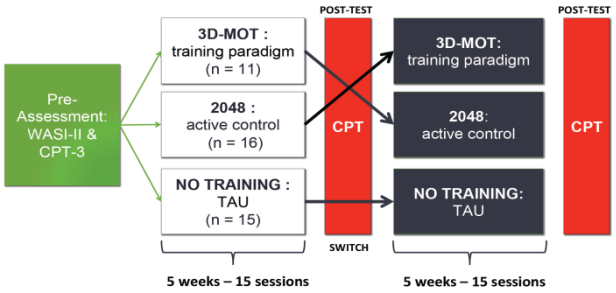
Status: Poster release, study waiting to be published

Aim

Students are vulnerable to overstimulation and distractions that often affect their ability to attend to relevant information in the classroom. Attention moderates the relationship between intelligence and academic performance. The researchers sought to investigate the efficacy of NeuroTracker as an adaptive training task for improving attention in a large population of 129 individuals with Learning Disabilities and specific learning disorders, including ASD, ADHD, or Intellectual Delay. The students (special needs school) were measured as having an overall IQ between 1 and 2 standard deviations below the population average (Wechsler Abbreviated Scale of Intelligence II).

Method

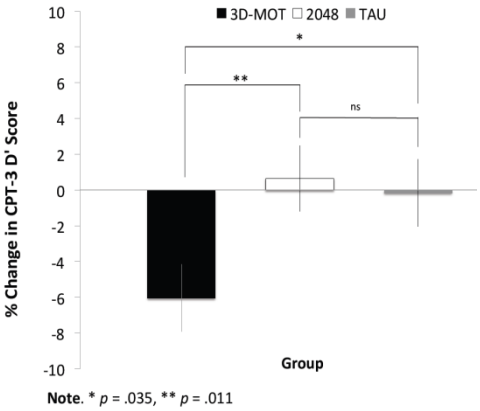
A 15 session NeuroTracker training program was carried out over 5 weeks, with pre and post standardized neuropsychological assessments (CPT-3), in combination with an active control placebo training task using a simple math like puzzle game (2048), and a non-training group.



Findings

Near-Transfer: there were significant differences in the pre-post CPT-3 percentage change scores in the NeuroTracker trained group, who differed significantly from the control and non-trained groups, who in turn had no significant difference from each other. Additionally there was a correlation between initial NeuroTracker scores and IQ measure (WASI-II), as well as CPT-3 scores. The study suggests that NeuroTracker is an effective way to train attention in these clinical populations.

NeuroTracker Learning: comparisons of NeuroTracker scores between day 1 and 15 revealed a mean improvement on the task of 43% (strong significance). There was no significant improvement in 2048 scores from day 1 to day 15. This suggests NeuroTracker to be an accessible and adaptable training approach for adolescents with Learning Disability.



Note. * $p = .035$, ** $p = .011$

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NeuroTracker Attention Training Study of Students with Autism

'Training attention in students with ASD using a multiple object tracking paradigm: A pilot study'

Perceptual Neuroscience Laboratory for Autism and Development. McGill University. Université de Montréal.

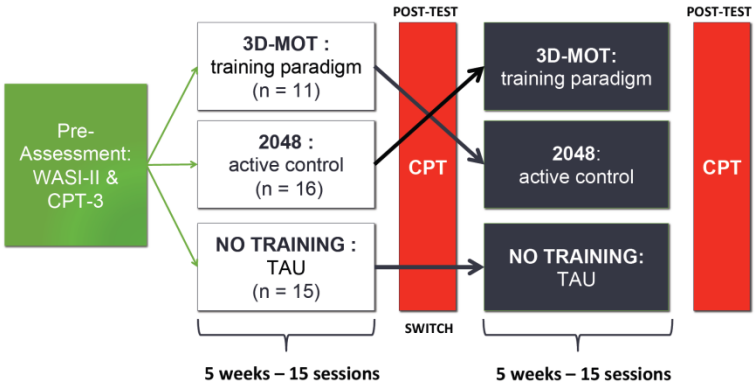
Status: Poster release, study waiting to be published

Aim

A deficiency in the subcomponents of selective and sustained attention is characteristic of atypically developing populations, particularly in children diagnosed with Autism Spectrum Disorder (ASD). Using a large population of 42 students with ASD with a mean age of 13 years, the researchers aimed to assess if the participants could improve significantly in the NeuroTracker task, and if training effects could achieve near transfer. The students had an overall IQ between 1 and 2 standard deviations below the population average.

Method

A 15 NeuroTracker session training program was carried out over 5 weeks, with pre and post standardized neuropsychological assessments (CPT-3), in combination with an active control placebo training task using a simple math like puzzle game (2048), and a non-training group.



Findings

Near-Transfer: there were significant improvements in pre-post CPT-3 scores in the NeuroTracker trained group, and no significant difference in the control group or placebo group.

NeuroTracker Learning: comparisons of NeuroTracker scores between session 1 and 15 revealed a mean improvement on the task of 64%. There was no significant improvement in 2048 scores from week 1 to week 5 15. This suggests NeuroTracker to be an accessible and adaptable training approach for adolescents with ASD, and that they are able to improve attention on a non-verbal task similar to typically developing adults.

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NeuroTracker Elementary School Study on Attention Deficit

Attention and Perceptual-Cognitive Training:
Preliminary evidence for training attention-deficit populations

Pilot Study by CogniSens Inc. and Neurodezign

Aim

This was a pilot study with a selection of children based on test measures showing severe attention deficits and impulse control typical of ADHD symptoms, but not clinically diagnosed as ADHD. The purpose of this pilot study was to see if NeuroTracker has the potential be an efficacious short-term intervention for young students with severe attention impairments, based on changes in standardised neuropsychological assessments.

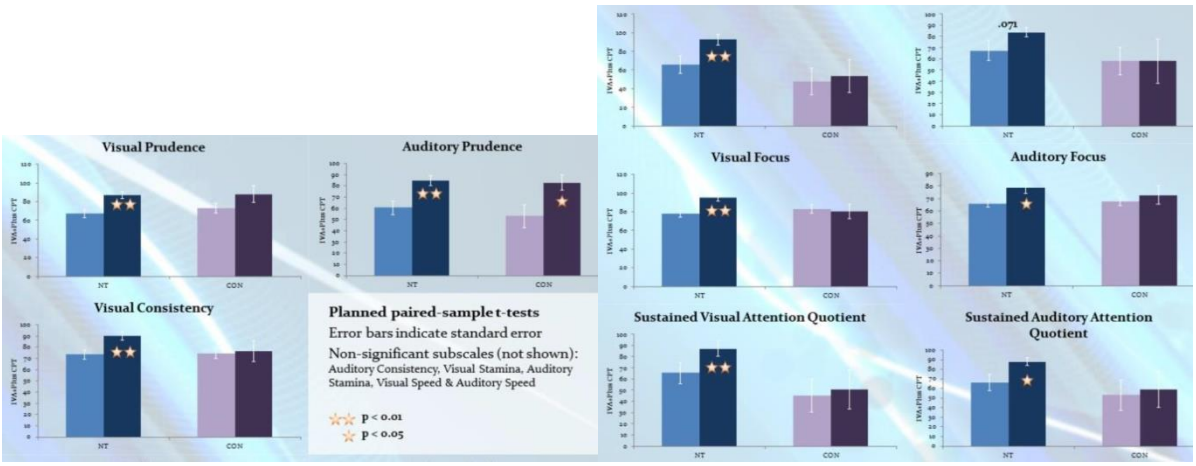
Method

A test and control group of 5 Elementary school students each were included in the study, selected based on severely impaired rating on the IVA+PlusTM Continuous Performance Test. Both groups produced NeuroTracker initial baselines with statistically insignificant differences. The test group completed 21 five-minute NeuroTracker training sessions distributed over 3.5 weeks, the control group did no training. Both groups were then retested on the neuropsychological assessments.

Findings

The Test Group improved NeuroTracker speed thresholds by an average of 61% over the course of the training. The control group showed negligible difference in pre-post neuropsychological assessments scores, whereas the trained group showed variable but significant improvements across a range of visual and auditory measures. Gains were most pronounced in Prudence, Consistency and Focus in both visual and auditory domains, matching previous findings, and suggesting cross-modal performance transfer.

In general the improvement ratios suggested that a short-term NeuroTracker training intervention can improve severe attention deficits towards moderate attention deficits in this population, with potential to positively impact learning outcomes at a young age.



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NeuroTracker Study on Effects of Feedback

'The effect of feedback on 3D multiple object tracking performance and its transferability to other attentional tasks'

Poster in Journal of Vision 14(10):357-357

Aim

Attention and feedback are known to play critical roles in learning. This preliminary study sought to assess the benefits of instant feedback within NeuroTracker task performance.

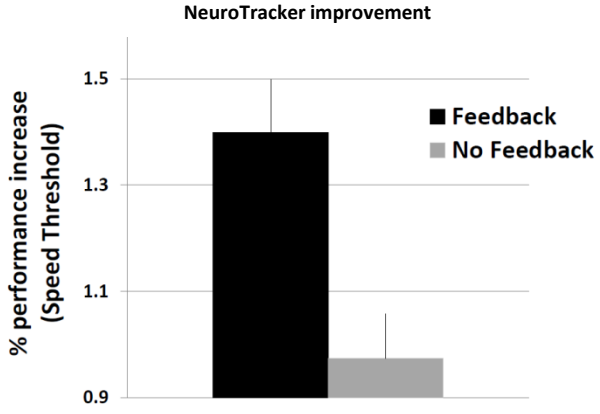
Method

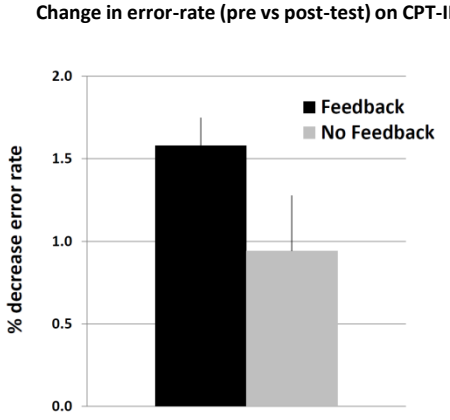
38 young adults (mean 23yrs old) completed 4 NeuroTracker sessions over two days. 19 participants were assisted with feedback on test performance throughout the sessions, and 19 were given no feedback. Pre and post training assessments were completed using the Continuous Performance Test II to measure cognitive function.

Findings

The participants assisted with feedback demonstrated greater improvement in NeuroTracker scores over the 4 sessions. The feedback group also demonstrated better transferability effects to the CPT-II task, reflected by a significantly decreased pre/post mean error rate.

The results indicate that feedback has a positive effect on performance and may be an important aspect of transfer to cognitive functions.





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NeuroTracker Study on Biological Motion Perception

'Training 3D-MOT improves biological motion perception in aging: evidence for transferability of training'

NeuroReport 23:469-473
http://vision.opto.umontreal.ca/publications/bdd/pdf/2012/Legault_Faubert_Neuroreport2012.pdf

Aim

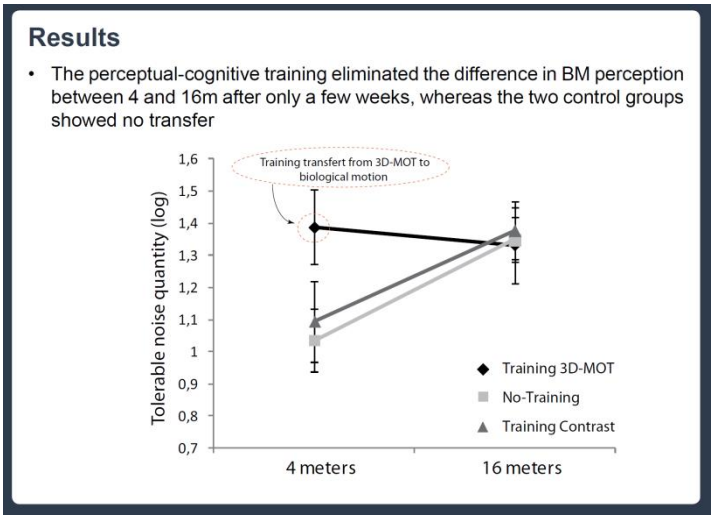
To investigate if age related cognitive decline in functional capacities can be reversed with a short cognitive intervention (NeuroTracker training). Biological Motion Perception (BMP) involves complex interpretations of human-based movement and body language, essential for interpreting social stimuli and managing complex scenes such as in crowds or sports activities. Young adults cannot read BMP at less than 1 meter, whereas with healthy older people it is typically lost at 4m (a critical risk for collision avoidance). This research focused on testing if the capacities of young adults could be regained.

Method

41 older adults with mean age of 68yrs old were divided into trained, active control (placebo), and passive control (no training) groups. They were measured on a standardised BMP post training, which consisted of 15 NeuroTracker sessions distributed over 5 weeks.

Findings

Only the NeuroTracker trained group showed transfer to BMP, who demonstrated substantial improvements in processing BMP at 4m. The conclusion was a clear and positive transfer of perceptual-cognitive training onto a socially relevant ability in the elderly.



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NeuroTracker Study on Developmental Attentional Resources

'The limitations of attentional resources across developmental groups: A three-dimensional multiple object tracking study'

Journal of Vision September 2015, Vol.15, 463. doi:10.1167/15.12.463

Aim

This study sought to investigate the resource limits for dynamic visual attention across age development using NeuroTracker speed thresholds as a measure of attentional capacity.

Method

21 participants were grouped by age.

- School-aged (6-12 years)
- Adolescent (13-18 years)
- Adult (19-30 years)

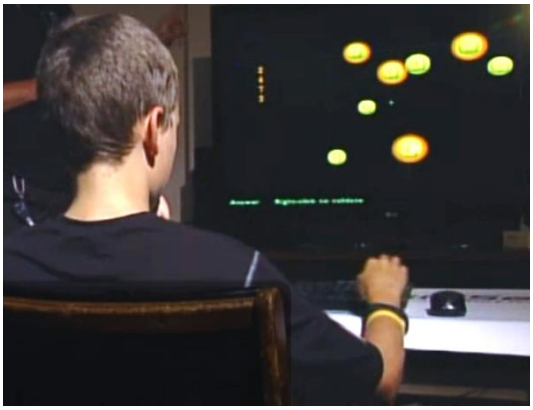
Each group completed NeuroTracker baselines using speed threshold measurements at progressively increasing number of targets.

Findings

For all groups, speed thresholds changed in logarithmic way consistent with the relative increase in multiple object tracking demands. Attentional capacities for NeuroTracker were determined by age, with significantly lower multiple object tracking limits for school-aged individuals.

The findings also suggested that the 3D stereo component of NeuroTracker is a critical enabling factor for processing greater attentional loads: school-aged individuals could track numbers of targets beyond the limits of 2D non-stereo (as established in previous studies).

These findings suggest that NeuroTracker can be used for characterizing the development of resource allocation in attentional processes through the use of a measure that best approximates real-world conditions.



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