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NeuroTracker Cognitive Function and its Relationship to GPA in College Students

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NeuroTracker Cognitive Function and its Relationship to GPA in College Students

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Abstract

Introduction: The NeuroTracker system is a training tool used to enhance one's cognitive abilities. It has been previously tested to improve athletic performance and core cognitive abilities in a variety of populations, but it has yet to be used as a cognitive test to examine its ability to distinguish academic ability in college students. The purpose of this study was to examine the relationships between a student's grade point average (GPA), major, minutes exercised, and visual tracking speed utilizing the NeuroTracker System.

Methods: Forty-five students volunteered for the study (20 male and 25 female, 20.2±1.09years, ht=170.44±9.48cm, wt=70.98±15.66kg) and were tested with the NeuroTracker system to obtain a baseline visual tracking speed. Each participant performed 1 session of 20, 8-second trials where they had to track 4 of 8 balls in a 3-dimensional queue. If they succeeded, the speed would increase, and if they failed, the speed would decrease. Their final score was calculated by averaging variable trial successes and failures dependent on performance throughout the session.

Results: There was no correlation found between tracking speed and GPA, major, and minutes exercised. Moderate correlations were found between age and tracking speed ($r=0.378$; $p=0.011$), sex and tracking speed ($r=-0.448$; $p=0.002$).

Discussion: The results suggests that there was no correlation between GPA, college major, minutes exercised, and cognitive tracking speed, but older students did better and men had faster tracking scores. Additional testing is warranted to determine if cognitive tracking speed is related to athletic ability and academic success.

Key Words: NeuroTracker, cognition, GPA

Introduction

The NeuroTracker system is a training tool used to enhance one's cognitive abilities. It has been previously tested to increase brainwave speeds, associated with heightened alertness and learning capacity. Research shows that NeuroTracker training significantly enhances attention, executive function, working memory and processing speed ("Perceptual-Cognitive Training Solution." 2017). It is a common testing and training technique for athletes in the sports sciences. It uses the idea of Multiple Object Training (MOT), where the subject has to simultaneously track multiple moving balls or objects amongst other objects in a virtual space (Mangine et. al. 2014). This ability to track objects is directly correlated to the rapid decision making and anticipatory response time in an athlete. A quick tracking speed is extremely important in almost all sports that involve complex situations for the individual athlete (Beauchamp et. al. 2011). In a game, athletes need to have an increased ability to quickly recognize the in-game situation, effectively anticipate future events, and make the best possible decision while avoiding costly mistakes (Mangine et. al. 2014). Elite athletes are able to make more efficient eye movements and performed better on measures of attention and processing speed when compared to non-athletes or less accomplished athletes (Appelbaum and Erickson, 2016). When one trains with this cognitive tool, the Neurotracker stimulates higher brain functions such as dynamic and sustained attention processing, working memory, and complex motion integration (Romeas 2016).

Other current research has analyzed the variation in academic achievement with cognitive abilities. A study by Rohde et. al. looked at the prediction of academic achievement with cognitive ability. Each participant went through a series of cognitive tests to look at working memory, processing speed, and spatial ability to understand if this was a good predictor of academic success. General cognitive ability significantly correlated with academic achievement and these three specific cognitive factors were seen as good candidates in influencing academic performance (Rohde et. al. 2007). Other studies have shown that GPA is not correlated with cognitive ability, specifically when testing the level of emotional intelligence (O'Connor Jr, et. al. 2003). There is currently no consensus of the correlation between academic success and cognitive ability, so the purpose of this study is to use the NeuroTracker as a cognitive tool to better view this relationship. This study will also analyze different variables in college-aged athletes and non-athletes to further examine the NeuroTracker and its potential use in the college population.

Methods

Forty-five college students volunteered for the study (20 male and 25 female, 20.2±1.09years). This investigation was approved by the University Institutional Review Board and all participants signed an informed consent prior to testing. Participants reported to the Applied Physiology Lab for one testing session. Participants were asked a series of question including their major, grade point average, amount of exercise they performed each week, and if they were a division 1 athlete. Visual tracking speed (VTS) was assessed by the completion of 1 core session on the Neurotracker (NT; CogniSens Athletic, Inc., Montreal, Quebec, Canada) 3D Multiple Object Tracking (MOT) device by each subject. A core session consists of 20 individual, 8 second trials used to quantify spatial awareness by determining the participant's threshold speed for effective perception and processing of visual information sources. For each trial, players were instructed to sit upright on a stool placed 2.1m in front of a 1.65m 3D display, which makes the size of the 3D volume space being 46° of visual angle at the level of the screen. All players wore 3D glasses to make the objects appear 3D. Before each trial, a 3D transparent cube containing 8 identical yellow balls, measuring 14 cm in diameter, will be presented on the screen. Four of these balls will be randomly illuminated for 2 seconds before returning to the baseline yellow color. The player was then instructed to track these 4 balls for the duration of the individual trial.

During the trial, all 8 yellow balls moved simultaneously and individually throughout all regions of the cube for 8 seconds. The random, continuous movement patterns of each ball are affected by collisions (impact and bounce) with the wall of the cube and the other balls. At the conclusion of 8 seconds, the balls froze in place and are each assigned a display number, 1 through 8, by the computer. The player were instructed to identify, by number, the 4 balls that were originally illuminated at the start of the trial. The speed at which the balls will move on the next trial is dependent on the correct identification of the illuminated balls and will be adjusted between trials in a staircase (1 up 1 down) fashion, which has been previously demonstrated to be an efficient and reliable psychometric estimator (greater than maximum likelihood) in small experiments (less than 30 trials). If the player correctly selects all 4 balls, the speed of the balls will increase. Otherwise, the speed of the balls will be reduced in the next trial.

The subject's final score was calculated by averaging variable trial successes and failures dependent on performance throughout the session. For the first trial, the speed in which the balls move will be standardized at 68 cm/s. To avoid a training effect confound, all players will begin their core session completely unfamiliar to the NT device.

Results

Visual tracking speeds ranged from 0.37 to 2.66 in 45 test subjects. There was no correlation or significant difference found between tracking speed and GPA (r=0.043, p=0.78), tracking speed and athletic status (r=-0.16, p=0.295), and tracking speed and minutes exercised (r=-0.152, p=0.317). Moderate correlations and statistical differences were found between age and tracking speed (r=0.378; *p*=0.011), and sex and tracking speed (r=-0.448; *p*=0.002). The descriptive statistics and correlation tables are found in Table 1 and Table 2 respectively. A scatter plot to determine the correlation between Neurotracker score vs. age and GPA vs. Neurotracker score are found in Figure 1 and Figure 2 respectively.

Discussion

Although there was no correlation between tracking speed and GPA, the main finding of this visual-tracking speed experiment was the significant relationship between NeuroTracking speed and age. As age increased, the test subjects generally had better visual-tracking speeds. The positive correlation between age and tracking speed may be due to the age range of this study's population: 18 to 24 years. Studies have shown that the brain development is not completed until around the age of 25 (Sowell et. al. 1999). The parts of the brain that are last to develop are the frontal lobes, which is responsible for higher executive functions, such as planning, impulse control, and most importantly, working memory. Since the brain is still developing during college, older subjects that have a more developed brain should score higher on the NeuroTracker test.

The other significant relationship was tracking speed was moderately correlated to the sex of the subject. Differences in the cognitive abilities across genders are correlated to anatomical (brain structure) and biochemical (hormone levels) differences (Speck et. al. 2000). Females have more active limbic and prefrontal structures, while males' parietal networks are more involved. Males generally have higher levels of visual-spatial ability, working memory, and mathematical abilities, while females show advantages in verbal reasoning, accuracy, and fine motor skills (Speck et. al. 2000). It can be concluded that males and females could possibly have different neural pathways for problem solving and decision making, which caused this statistical difference in tracking speed.

This study is limited by several factors. A larger variation of grade point averages would strengthen the significance of the data. This study provided a range of GPAs from 2.4-4.0, with the majority of subjects above a 3.0. A larger subject pool with a wider range of exercise levels is also necessary to produce more accurate results. Our NeuroTracker score consisted of one initial test, whereas multiple measurements could increase the accuracy of this test. Another factor that was not accounted for in this study was the amount of time playing video or computer games. This factor could influence the ability to successfully complete the Neurotracker test, and should be reported in further studies.

Conclusion

This data suggests that there is no correlation between GPA and tracking speed. Men and older participants in college have a better tracking speed, and therefore better visual-spatial awareness. Further testing with a larger cohort and a wider GPA, age, and exercise range is necessary to understand if there is a correlation between GPA, minutes exercise, athletic status, and tracking speed.

References

Appelbaum, L. G., & Erickson, G. (2016). Sports vision training: A review of the state-of-the-art in digital training techniques. *International Review of Sport and Exercise Psychology*, 1-30.

Beauchamp, P., & Faubert, J. (2011). Visual Perception Training: Cutting Edge Psychophysics and 3D Technology Applied to Sport Science. High Performance CIRCuit-e-Journal, 1(3), 12-16.

Faubert, J. (2013). Professional athletes have extraordinary skills for rapidly learning complex and neutral dynamic visual scenes. *Scientific reports*, *3*, 1154.

Mangine, G. T., Hoffman, J. R., Wells, A. J., Gonzalez, A. M., Rogowski, J. P., Townsend, J. R., ... & Fragala, M. S. (2014). Visual tracking speed is related to basketball-specific measures of performance in NBA players. *The Journal of Strength & Conditioning Research*, *28*(9), 2406-2414.

O'Connor Jr, R. M., & Little, I. S. (2003). Revisiting the predictive validity of emotional intelligence: Self-report versus ability-based measures. *Personality and Individual differences*, *35*(8), 1893-1902.

“Perceptual-Cognitive Training Solution.”. (n.d.). Retrieved August 12, 2017, from https://neurotracker.net/about/

Rohde, T. E., & Thompson, L. A. (2007). Predicting academic achievement with cognitive ability. *Intelligence*, *35*(1), 83-92.

Romeas, T., Guldner, A., & Faubert, J. (2016). 3D-Multiple Object Tracking training task improves passing

decision-making accuracy in soccer players. *Psychology of Sport and Exercise*, *22*, 1-9.

Sowell, E. R., Thompson, P. M., Holmes, C. J., Jernigan, T. L., & Toga, A. W. (1999). In vivo evidence for post-adolescent brain maturation in frontal and striatal regions. *Nature neuroscience*, *2*(10), 859.

Speck, O., Ernst, T., Braun, J., Koch, C., Miller, E., & Chang, L. (2000). Gender differences in the functional organization of the brain for working memory. *Neuroreport*, *11*(11), 2581-2585.

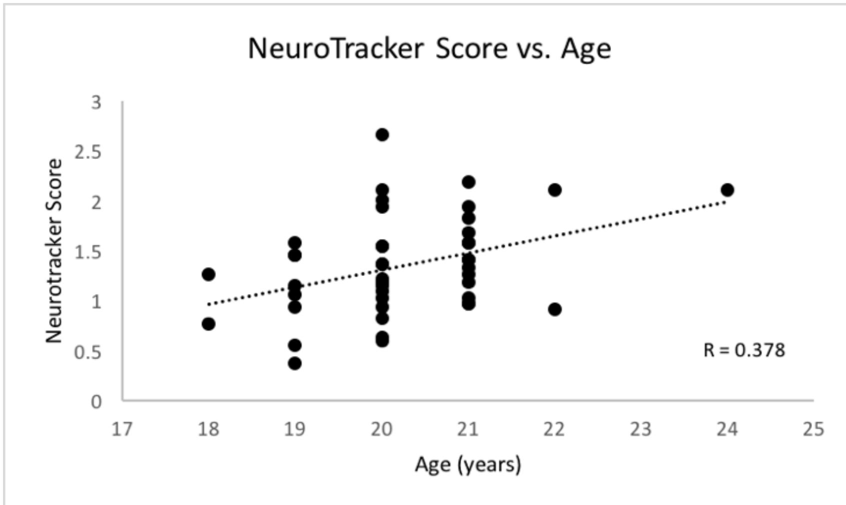

Figure 1: Scatter Plot of the subject's NeuroTracker score and their age.

Correlations			
Type of Correlation	Pearson Correlation	Significance	N
Speed vs Age	0.378	0.011	45
Speed vs Sex	-0.448	0.002	45
Speed vs Min Exercised	-0.152	0.317	45
Speed vs Athlete	-0.16	0.295	45

Table 1: Statistical data between the subjects NeuroTracker score and age, sex, minutes exercised per week, and if they were a collegiate athlete or not.

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Speed	45	.37	2.66	1.3438	.48870
GPA	45	2.43	3.93	3.4478	.35169
Age	45	18.00	24.00	20.2222	1.08479
Height	45	151.50	191.60	170.4378	9.47680
Weight	45	51.20	111.20	70.9800	15.65966
MinExer	45	0.00	240.00	59.0000	51.85864

Table 2: Descriptive information about the subjects in this study.

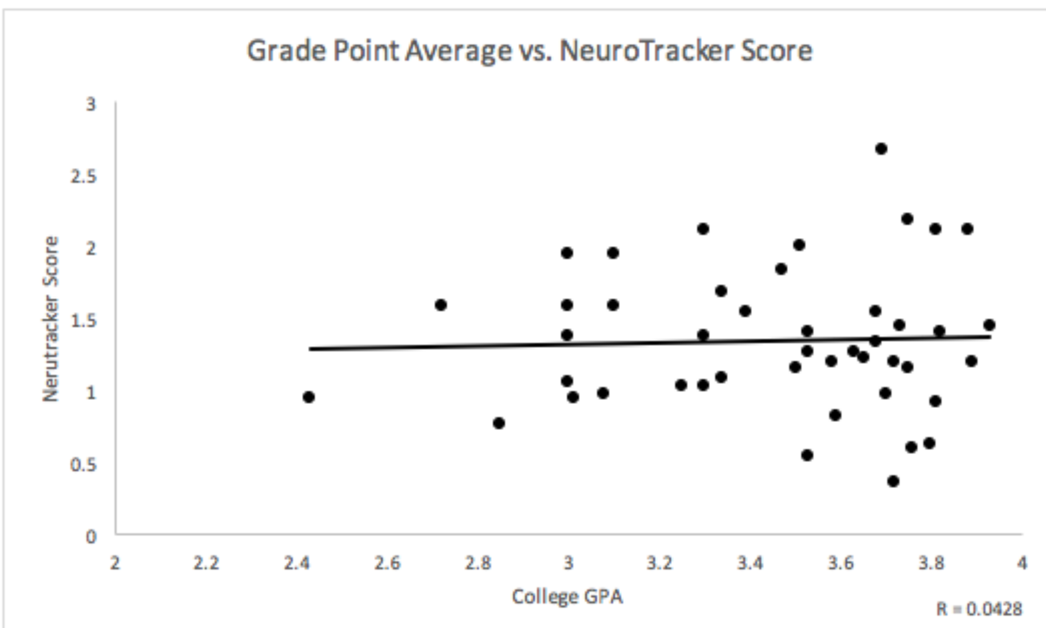

Figure 2: Scatter Plot of subjects NeuroTracker score and their grade point average (GPA).