

**Comparison of Impulsivity Scores Generated
by the MFFT and the TOVA**

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Abstract

The Matching Familiar Figures Test (MFFT) and the Test of Variables of Attention (TOVA) are two popular tests used to determine a person's "impulsivity", especially when screening a child for Attention Deficit Hyperactivity Disorder (ADHD). Sixty third and fourth grade children rated as having average to low levels of impulsivity by their teachers on a subjective scale, were administered both tests to determine if a correlation exists between the standard impulsivity scores generated by each test. After eliminating five subjects which produced unreliable data on the TOVA, the linear correlation coefficient between the two sets of scores demonstrates a predictable negative correlation, however, the correlation is very low ($r = -0.37(p < .01)$). From these results, we learned that the **exact** definition of "impulsivity" as determined by each test must be unique, so that we can in no way reliably predict the impulsivity score of either test based on the results of the other. This study also brings up further questions as to the validity of one test versus the other when clinics or researchers attempt to use these tests to screen children for impulsivity related to ADHD. Further study concerning this correlation in previously diagnosed ADHD students and a closer look at the type of "impulsivity" in children with ADHD would prove useful.

Introduction

"Approximately 3-5% of all American children - up to 3.5 million children - have an Attention Deficit Disorder (ADD).ⁱ People with ADD are characterized by inattention, distractibility, impulsivity, and in many cases hyperactivity.ⁱⁱ Although new objective methods have recently been found to effectively diagnose ADD, the most commonly used methods presently used for screening and diagnosis include subjective tests and teacher/parent evaluations. Two such subjective tests that have the ability to screen subjects for impulsivity include the Matching Familiar Figures Test (MFFT) developed in 1964 by Kagan et. al. and the Test of Variables of Attention (TOVA) developed by Lawrence M. Greenberg.

When introduced in 1964, Kagan et. al., explained that the MFFT can be used as a measure of a cognitive style labeled "reflection-impulsivity."ⁱⁱⁱ For this test the child is required to match a sample picture with one of six variants of the picture. By timing the latency to the child's first response and the number of incorrect responses on each of 12 figures, an impulsivity and efficiency standard score can be calculated. Impulsivity, as tested by the MFFT, describes differences in the way children resolve response uncertainty. Based on the MFFT scores, each student can be labeled into one of four categories. Fast-inaccurates and fast-accurates tend to be more impulsive,

while slow-accurates and slow inaccurates tend to be more reflective.

The TOVA, formerly known as the Minnesota Computer Test, was developed by Greenberg to monitor several characteristics of those people suspected of having ADD, including impulsivity. It is a fixed-interval, visual continuance performance test used in the diagnosis and monitoring of treatment of children and adults with attention deficit disorders.^{iv} The TOVA involves having each subject hit a button each time a particular geometric figure appears on a computer screen for 22.5 minutes. An impulsivity score is determined from the number of errors of commission (responding inappropriately to the nontarget). Greenberg has interpreted this measure of impulsivity as a failure to inhibit responses which suggest a cortical problem in which the individual is not monitoring their responses closely enough.^v

Even though both the TOVA and the MFFT are completely unique in their methods of testing, both generate a standard impulsivity score used in many research situations and in clinical settings to screen children for signs of ADD. Since both tests are being used in this manner, it would prove useful to understand if a correlation exists between their impulsivity scores. If such a correlation did exist between their impulsivity scores, it would prove useful to see if the correlation is strong enough to reliably predict one score based on the other test's score. On the other

hand, if a poor correlation existed, this would help researchers and clinicians realize that they need to take a closer look at which test is most appropriate for their needs. Our study attempts to determine the actual correlation between the impulsivity standard scores of each test in a "normal" population of third and fourth grade students.

Methods

Sixty third and fourth graders, ages 8-10 years old, from two different school districts were administered both the TOVA and MFFT. For inclusion in the study each child's level of impulsivity was rated on a scale of 1 to 5 by their teachers. A rating of 1 indicated a high level of impulsivity and a rating of 5 indicated a very reflective child. Only those children with a rating of 3 or higher and with permission from their parents were considered. Twenty-eight boys and twenty-seven girls were tested at random times during the school day. In all cases, one test was given immediately following the other. For diagnostic purposes it is recommended that the TOVA only be administered in the morning, but for this study this factor should be less critical because each test was given at the same time of day. The order in which the tests was given was randomized by flipping a coin which resulted in the MFFT being given first in 26 of the 60 cases.

Each child completed the tests in a quiet setting separated from other students and identical instructions were given to all other students. The TOVA was presented under standard conditions on an IBM computer with a quick demonstration of the test presented first. Raw scores were used in the calculation of each child's standard score for impulsivity. The 12-sample MFFT was presented from a bound notebook, with the number of errors and latency to first response being recorded. Each child was also shown the two samples provided before testing. Standard impulsivity and efficiency scores were calculated from the raw data.

Results

When analyzing the standard scores from each of the sixty children on both the TOVA and MFFT, five of the children's scores had to be dropped from inclusion in the study due to the large amounts of variability found on the TOVA which indicated that the data was unreliable. The average impulsivity score on the MFFT (n=55) is $+0.01 \pm 1.42$, with the average impulsivity standard score on the TOVA (n=55) being 106.87 ± 10.32 . In order to determine if a correlation existed, the 55 sets of scores were analyzed by computing the linear correlation coefficient and drawing a scatter plot of the points. The scatter plot is shown below and demonstrates a randomized scatter of points that do not distinctly fall in a line. The correlation coefficient is

-0.37 ($p < .01$). The correlation coefficient was also calculated comparing the TOVA impulsivity scores to both the number of total errors found on the MFFT and the raw latency score. These correlations were even lower being -0.34 ($p < .01$) and +0.30 ($p < .05$) respectively. Although in each case, the t-test of the correlation coefficient is significant, this does not demonstrate a strong relationship between the two variables. For example, with the correlational coefficient of the MFFT and TOVA standard impulsivity scores, of -0.37, only 13.7% of the variability of the "y" values on the graph can be accounted for by the linear relationship.

Discussion

The negative correlation found between the TOVA's impulsivity standard score and the MFFT impulsivity score is predictable because negative values on the MFFT indicate a more reflective child as do higher impulsivity scores on the TOVA. The low correlation between the two sets of scores, however, merits some discussion. With the low correlation, it is obvious that one impulsivity score cannot be used to reliably predict the other. Since the impulsivity scores on the MFFT incorporate both the raw number of errors and the raw latency scores, the correlations between these two factors alone versus the TOVA impulsivity standard score were also calculated. As noted earlier, these correlations

were even lower than the that involving the impulsivity standard score on the MFFT.

The question then remains as to why these two tests which each give "impulsivity" scores do not show a strong correlation. Answers to these questions may lie in the following three reasons or a combination of these reasons. The first reason may be the slightly nonstandard procedures used in our study. The TOVA is recommended to be taken during the day, but both our tests were given throughout the school day. The process of determining the "normal" subjects for this study may have also be slightly flawed as noted by the TOVA results, which labeled approximately five children with strong signs of ADD.

The second reason and more probable cause of the low correlation may be due to the varied definition of "impulsivity" given by the creators of each test. According to Kagan et. al., the MFFT's "reflection-impulsivity" dimension was described as "the child's consistent tendency to display slow or fast response time in problem situations with high response uncertainty."^{vi} During this test a child is faced with a difficult task which requires some initial thought and visual discrimination to determine the correct answer. In contrast the TOVA's presentation merely requires quick, almost reflex-like responses for 22.5 minutes which requires very little visual discrimination skill or complex thought processes. Greenberg, therefore, defines impulsivity as measured by the TOVA as a failure to inhibit

responses. Even though both characteristics measured in this study are called "impulsivity" they each have unique definitions.

Thirdly, the low correlation may indicate that one the two tests is a poor indicator of "impulsivity" as a personality trait. "Positive Emission Tomography (PET) scans in adults with ADD now show that ADD is a neurobiological disorder related to a dysfunction of nonadrenergic nuclei in the premotor and prefrontal superior cortex and the corpus striatum. If these nuclei are underactive, they fail to modulate impulsivity and distractibility, causing the driven, inner distractibility that presents clinically as problem behavior."^{vii} This cortical origin supports the definition related to the TOVA as explained by Greenberg as an inability to inhibit responses. The MFFT's ability to be a reliable indicator of a child's impulse behavior, however, has been challenged numerous times. J. Block et. al. for example state that the MFFT latency component has no or trivial behavioral implication in nontest settings.^{viii} In support of the MFFT, however, is the fact that the MFFT may seem to better simulate those type of tasks actually performed in school settings versus the reflex-like like responses required by the TOVA.

The exact reason for the low correlation between the TOVA's impulsivity score and the MFFT's impulsivity score in third and fourth grade children is unknown. But it is evident that the scores are not interchangeable in clinical

settings or research situations to determine if a child is "impulsive". Further research would prove helpful to determine if a better correlation exists in those children with ADHD, rather than "normal" children, taking both the TOVA and MFFT. As well, a more thorough investigation of the type of impulsivity more commonly found in people with ADD would prove beneficial in deciding which test to use in future research or clinical situations.

ⁱ <http://www.chadd.org/fact1.htm>. October 14, 1996, p. 1.

ⁱⁱ Greenberg, L., Dupuy, T. R. (1993) Interpretation Manual for the TOVA. Los Alamitos, CA: Universal Attention Disorders, p. 1.

ⁱⁱⁱ Kagan, J., Fosman, B.L., Day, D., Albert, J., Phillips, W. (1964) "Information processing in the child: Significance of analytic and reflective attitudes." Psychological Monographs. (1, Whole No. 578) p 78.

^{iv} Greenberg, L., p. 9.

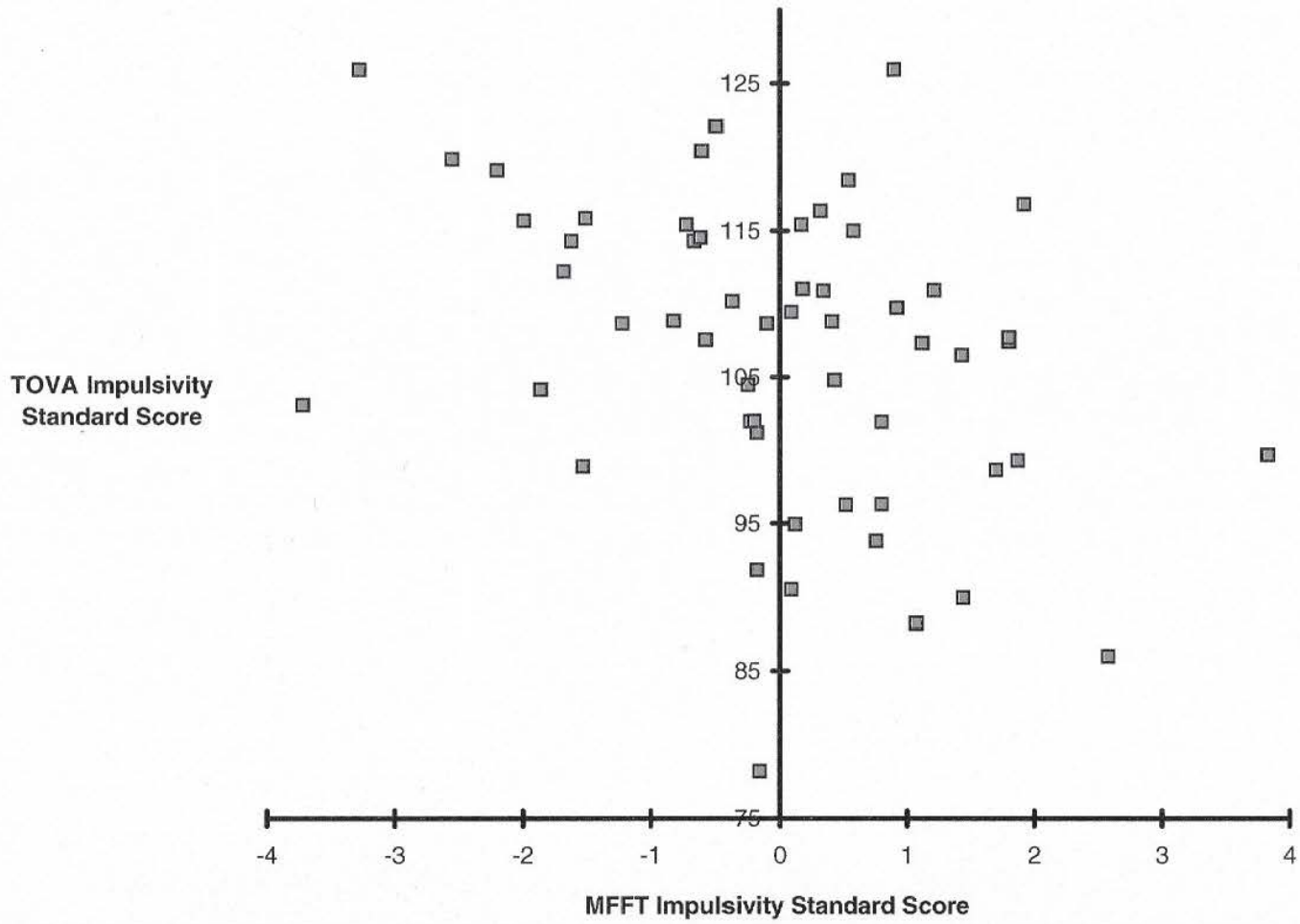
^v Greenberg, L., p. 19.

^{vi} Kagan, J. (1965) "Impulsive and reflective children: Significance of conceptual tempo. Learning and the education process. p. 134.

^{vii} Faigel, H. C. (1995) "Attention Deficit Disorder in College Students: Facts, Fallacies, and Treatment" Journal of American College Health. Vol. 22, No. 6, p. 150.

^{viii} Block, J., Gjerde, P.F., and Block, J.H. "More Misgivings About the Matching Familiar Figures Test As a Measure of Reflection-Impulsivity: Absence of Construct Validity in Preadolescence" Developmental Psychology. Vol. 22, No. 6, p. 828.

Scatter Plot: TOVA vs. MFFT Impulsivity Scores (n=55)



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