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The Mesulam Continuous Performance Test (M-CPT): Age-Related and Gender Differences in the Sustained Attention of Elementary School Children

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The present study gathered normative data for the Mesulam Continuous Performance Test (M-CPT; Mesulam, 1985) and illustrates its potential as an efficient assessment of attention in elementary school children. The M-CPT was administered to a convenience sample of 299 6-14 year-old children drawn from a charter elementary school in Northern California. The results of a multiple regression analysis revealed that test performance generally improved with age. Logistic regression modeling indicated that female students had greater odds of committing no errors on at least one section of the M-CPT than male students, suggesting that girls had greater attentional capacity for the task. The amount of time it took each student to complete the M-CPT was investigated and it was found that age had a strong linear relationship with time to completion. The results suggest that time to completion could be a developmentally sensitive marker of sustained attention. M-CPT completion time offers promise in an assessment of attention problems. Implications are discussed.

Keywords: neuropsychological assessment, continuous performance test, attention, ADHD, sustained attention, vigilance

Attention Deficit Hyperactivity Disorder (ADHD) is a chronic condition characterized by abnormally high levels of inattention, hyperactivity, and impulsivity (American Psychiatric Association, 2000). ADHD is estimated to affect as many as 9% of school age children (Pastor & Reuben, 2008). Children with ADHD are at risk for a host of developmental, social, and health problems (Barkley, 2003; Klassen, Miller, & Fine, 2004). Problems with self-regulation, inhibition, and task persistence often impair functioning in school, with inflicted children at great risk for interpersonal difficulties, academic struggles, and school drop outs (DuPaul & Stoner, 2003; Stefanatos & Baron, 2007).

The assessment of ADHD is quite complex, often due to the numerous overlapping behavioral manifestations with other conditions. ADHD shares symptomatic presentation and possible etiological pathways with other disorders, such as oppositional and conduct disorders as well as childhood tic disorders (Stefanatos & Baron, 2008). A broad range of functional and neuropsychological impairments are suggested as potential markers for ADHD including deficits in working memory, sustained attention, inhibition, and impulsivity (Halperin, Trampush, Miller, Marks, & Newcorn, 2008). Furthermore, a wide range of possible comorbid disorders complicates specific and comprehensive ADHD assessment (Stefanatos & Baron, 2008). It is therefore not surprising that no single test exists that consistently detects ADHD (NIH, 1998).

Continuous performance tests (CPT) have been used as part of comprehensive ADHD assessments. CPTs are a collection of tests that measure sustained attention, also called vigilance. During a CPT, participants are presented with a sequence of visual or auditory stimuli, typically letters of the alphabet. The participant is asked to respond when s/he sees or hears a predefined target stimulus and to ignore the non-target stimuli. The target stimulus occurs at a low frequency relative to the non-target or background stimulus events. Thus, the test is intended to be repetitive and to challenge the participant to focus their attention over an extended period of time. Riccio, Reynolds, Lowe, and Moore (2002) reported on the strong validity of CPTs as a group of tests that measure sustained attention/vigilance.

Evidence suggests that CPTs are sensitive to attention disorders but this sensitivity does not translate into clinically useful diagnostic assessment (AACP, 1997). Studies with CPTs generally found that children with ADHD perform significantly worse than controls (Epstein et al. 2003; Halperin, Matier, Bedi, Sharma, & Newcorn, 1992; Losier, McGrath, & Klein, 1996), illuminating the sensitivity of CPTs in identifying ADHD symptomatology. Furthermore, Barkley and Grodizinsky (1994) reported that among nine neuropsychological instruments researched, only CPTs could be considered useful as an assessment tool for ADHD. However, Barkley and Grodizinsky also stated that the false positive and false negative rates are so high that they did not recommend using it. Additionally, Nigg, Hinshaw, and Halperin (1996) questioned the reliability, validity, and clinical significance of CPT performance. The general consensus was that the CPT should not be used as the singular diagnostic assessment instrument but should be relegated to other purposes such as screening, symptom documentation, and research.

The importance of reaction time (RT) in ADHD screening has been seen in recent decades (Castellanos & Tannock, 2002; Halperin & Healey, 2011). Kuntsi, Oosterlaan, and Stevenson (2001) reported that RT variability was able to discriminate children with ADHD from controls. RT was more effective for discriminating between the two populations than measures of inhibition and working memory. Furthermore, neuropsychological theories of executive function weaknesses in children with ADHD offer theoretical support for RT variability (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). In light of these findings, the connection between CPT reaction time and ADHD symptoms reported in the literature (Epstein et al. 2003), and the continued need for scientifically grounded ADHD screening measures (e.g., Nigg et al., 1996), it is worthwhile to revisit the CPT with increased focus on studying performance as a function of time.

The Mesulam Continuous Performance Test (M-CPT; Mesulam, 1985) is an efficient paper and pencil based assessment of visual processing and attention that has been shown to produce robust score differences between students diagnosed with ADHD and typical students (Dumont, Stevens, Dawson, Guare, & Weiler, 2001; Meyer & DeLange, 2005). The M-CPT consists of two pages, each with 300 letters of the alphabet printed in uppercase. Participants are asked to circle certain target letters while ignoring the non-target letters. Performance is usually measured in terms of errors of omission (i.e., the number of target letters that were not circled). The M-CPT takes 15 minutes to administer to individuals or groups, and researchers (Dumont et al., 2001; Meyer & DeLange, 2005) have argued that it may be able to simplify diagnostic assessment of ADHD and other attention-related disorders, or to function as an efficient instrument for research on children's attention.

The present study conducted an investigation of age- and gender-related performance on the M-CPT for a population of students in grades one through eight. Performance was measured by the number of errors committed on the M-CPT and how long a student needed to complete the test. To date, no studies that used the Mesulam to measure attention have examined the relationships between the time students take to complete the M-CPT, age, and number of errors. Thus, this study gathered information about time to completion that examines the question of whether older students tend to take less time on the M-CPT than younger students and the question of whether students who complete the M-CPT faster tend to make more errors. Our investigation of time to completion was expected to add a new dimension to the developmental data on M-CPT performance that, although exploratory in nature, bears directly on the possibility that the M-CPT is sensitive to the RT deficits often found in children with ADHD (Halperin & Healey, 2011). Additionally, gender differences in M-CPT performance have not been addressed in the literature. Therefore the current study aimed to investigate the differences between male and female participants.

The specific research questions are as follows: 1) What is the relationship between M-CPT error scores and age, controlling for time spent on the test, gender, and the order of administration of the two different sections of the M-CPT? 2) What was the relationship between how long it took a student to complete the M-CPT and the student's age, controlling for gender and order of administration? 3) How do the odds of achieving a perfect score on at least one section of the M-CPT change with age, gender, and order of administration?

Method

Participants

The sample consisted of 299 students from a single charter elementary school in a rural city in the Northern California. Parent/caregiver consent was given to allow student participation. The average number of students per grade was 37.4 (SD = 4.57). The minimum class size was 31 and the maximum size was 45. The sample contained 162 females and 137 males. Females were slightly more numerous at all ages with the exception of age six where there were 8 males and 17 females. Ethnicity information was not collected from participants. However, district records showed that ethnically, the school was 73% White, 9% Asian, 7% American Indian or Alaska Native, 6% Hispanic or Latino, and 4% African American. The ethnic composition of the school is representative of the population in the area. Twelve percent of the school was identified as socioeconomically disadvantaged according to California Department of Education guidelines. This charter school sample is representative of the rural Pacific Northwest.

Students with disabilities that were mainstreamed in general education classes for at least half of the day were also included in this sample. Eleven percent of the school population was identified as having a disability. Results were interpreted accordingly with special attention to the effects of statistical outliers and influential observations.

Measure

The Mesulam Continuous Performance Test (Mesulam, 1985) is a neuropsychological measure of executive function that consists of two pages with the letters of the alphabet printed in uppercase (Figure 1a and 1b). On the ordered page, the letters are placed in neat, orderly rows and columns, whereas on the random page, the letters are placed in a haphazard fashion with no apparent order. On both pages, 60 A's are scattered among the other letters. Regardless of the page, the A's are in the same location, dispersed symmetrically, with approximately 15 in each of the 4 quadrants.

Procedure

All participants were tested as groups in their respective classrooms. Each participant was given the first section of the M-CPT face down on his or her classroom desk. The participants were asked to write their age and gender on the back of the test. They were then given complete verbal instructions that included the following statements: "This is a game for you to play and is not for a grade. When I say go, turn over the test, and find all the A's and circle them. Do this as quickly as you can and when you think you have circled all the A's that are on the page, turn your paper over and raise your hand." The instructions were repeated. When the participants were finished, they raised their hand and the first author or an assistant recorded their time to completion on the back of the paper. The procedure was repeated for the second page. Participants were limited to a maximum of seven minutes per section but the full time was rarely needed. The test order of administration was counterbalanced. Each grade level had two classes. One class received the ordered page first and the other class received the random page first.

Variables

M-CPT performance was measured by two variables, errors and time. The variable errors is the total number of errors of omission that the participant made on the M-CPT. The variable was constructed by adding a participant's ordered page errors plus their random page errors. Errors is a continuous variable with a range of 0-36 errors. Time was defined as the number of seconds it took a participant to complete both sections of the M-CPT and was calculated by summing ordered page seconds and random page seconds. The variable time is continuous and has a range of 116 to 879 seconds. Summary statistics for these variables are presented in Table 1.

An exploratory analysis was conducted on errors and time and the results revealed that both these variables were heteroskedastic across the range of student ages. The variables were each transformed with a log10 transformation that homogenized the variances across the age range (Figures 2 and 3). The transformed variables were renamed logerrors and logtime. Prior to transforming the errors variable, 0.5

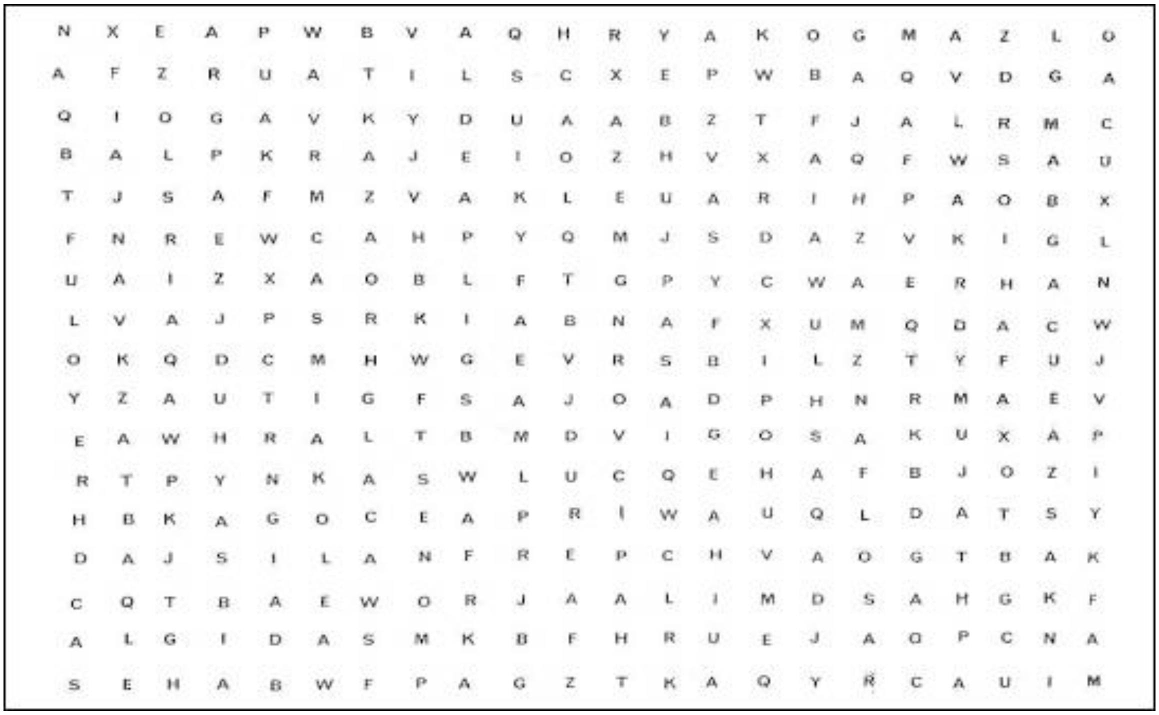

Figure 1a. Ordered page of the M-CPT.

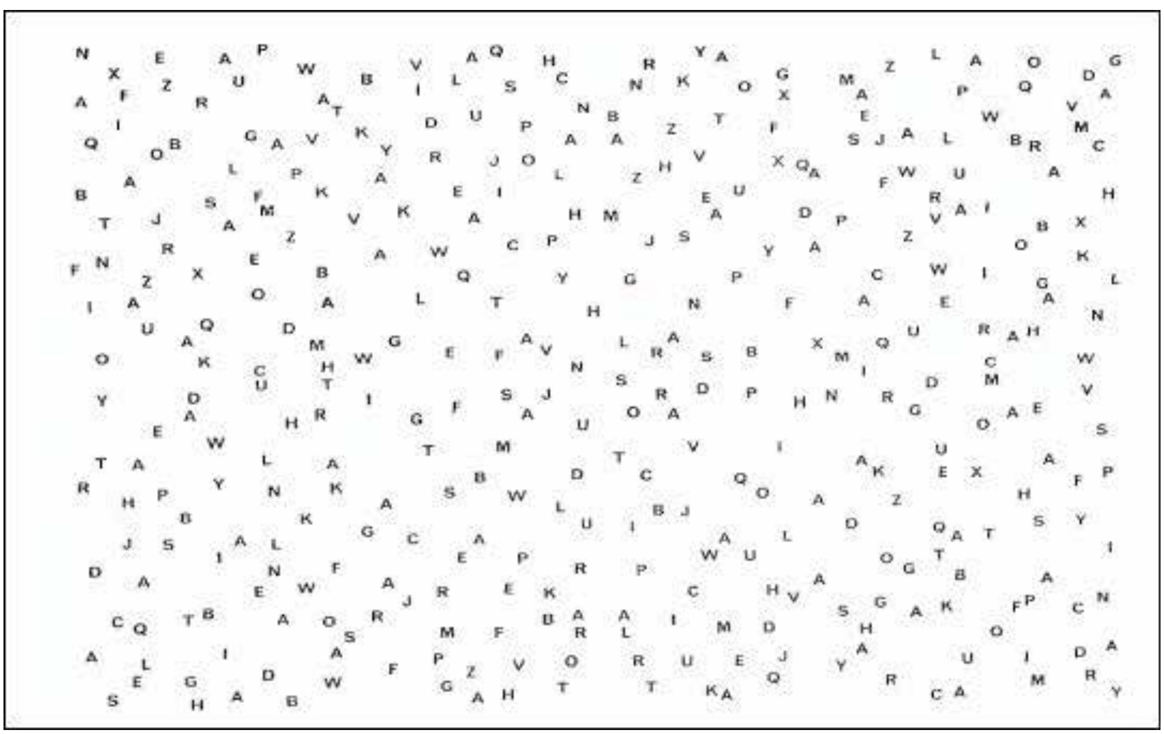

Figure 1b. Random page of the M-CPT.

Table 1

Summary Statistics for Continuous and Transformed Variables

Variable	Obs	Mean	SD	Min	Max
Errors	299	7.27	6.91	0	36
Logerrors	299	.715	0.431	-0.30	1.56
Time (Sec)	299	325	152	116	879
Logtime	299	2.49	0.190	2.06	2.94
Age (Years)	299	9.86	2.31	6	14

was added to each score. This was necessary because the original data contained scores of 0. Summary statistics for the two transformed variables are presented in Table 1.

A continuous interval variable age, was the participant's age in years and has a range of 6-14 years. The gender of the participant was given by the dummy variable female. Accordingly, females were assigned a value of 1 and males were assigned a value of 0. The M-CPT order of administration was coded by the dummy variable ostart, which has a value of 1 if the participant received the ordered page before the random page, and a value 0 if the participant received the random page before the ordered page. The variable oneperfect is the dichotomous response variable in the logistic regression #3. Oneperfect has the value of 1 if the participant obtained a perfect score (0 errors) on at least one section of the M-CPT, and it has a value of 0 if the participant made at least one error on both sections of the M-CPT.

Statistical Analysis

To investigate the relationship between M-CPT error scores and age, controlling for time spent on the test, gender, and the order of administration (research question 1), the transformed M-CPT error score (logerrors) was regressed on student age (age), a dummy variable for being a girl (female), the time it took to complete the test (time), and a dummy variable for having received the ordered page first (ostart). Time was used as an explanatory variable instead of logtime to allow the resulting regression coefficient to be interpreted as the difference in logerrors per second, rather than log errors per logsecond.

The regression coefficient for age is an estimate of the change in M-CPT errors per year increase in student age, controlling for gender, time to completion, and page order of administration. The coefficient for female is an estimate of the difference in M-CPT errors for girls, relative to the boys, after controlling for age, time to completion, and page order. The coefficient for time is the estimated change in M-CPT errors per additional second the student spent taking the M-CPT, controlling for student age, gender, and page order. The coefficient for ostart is the estimated difference in total error scores when the ordered page was administered first compared to when it was administered second, controlling for age, gender, and time to completion. Age X female and time X female interaction effects on the response variable were also analyzed to evaluate if gender interacted with other central variables.

For research question 2 focusing on the relationship between how long it took a student to complete M-CPT and the student's age, controlling for gender and order of administration, transformed time to completion (logtime) was regressed on student age (age), being a girl (female), and if the ordered page was received first (ostart). In this analysis, the regression coefficient for age is an estimate of change in the number of log-seconds spent taking the test for each year increase in student age, controlling for gender and page order of administration. The coefficient for female is an estimate of the difference in time to completion for girls, relative to the boys, after controlling for age and page order of administration. The coefficient for ostart is the difference in time to completion between

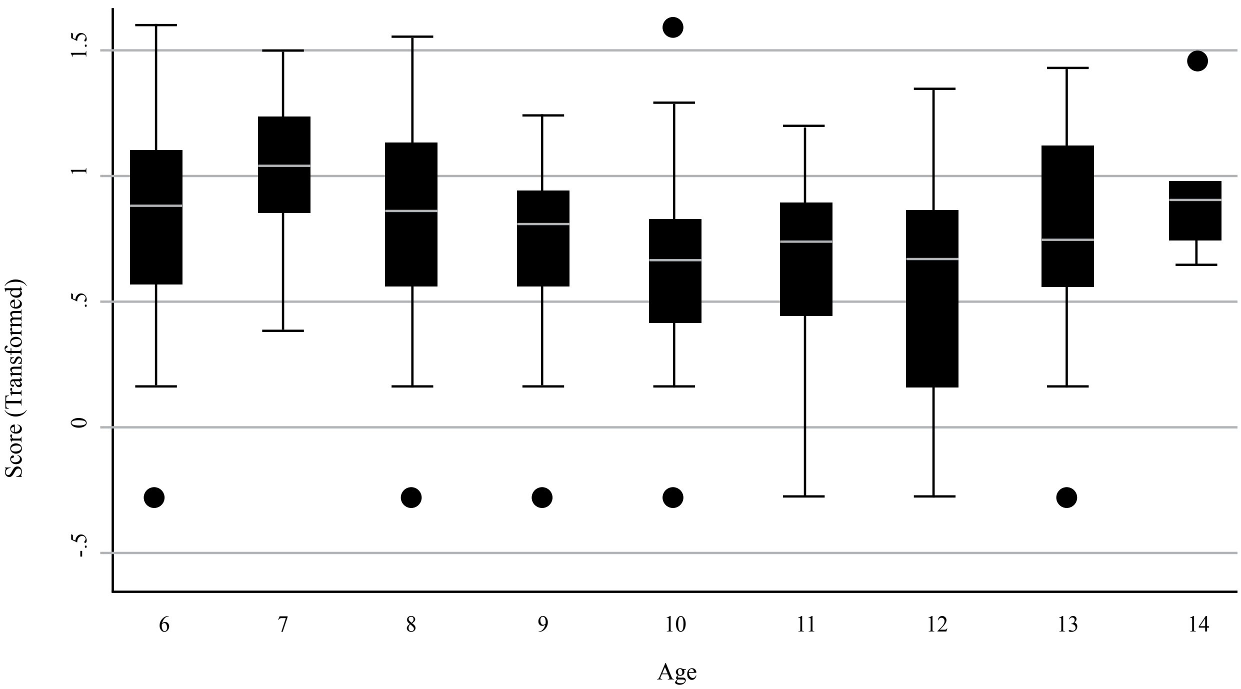

Figure 2. M-CPT error score subject to a Log_{10} transformation

students who received the ordered page first relative to the students who received the random page first, controlling for age and gender.

To assess our third and final question–whether the odds of achieving a perfect score on at least one section of the M-CPT change with age, gender, and order of administration–we employed a logistic regression model to regress the variable oneperfect on student age (age), being a girl (female), and if the ordered page was administered before the random page (ostart). The odds ratio for age is the factor by which the odds of obtaining a perfect score on at least one section of the M-CPT are estimated to change per year increase in age, controlling for gender and page order of administration. The odds ratio for female is the estimated change in odds for females of obtaining a perfect score on one section of the M-CPT, relative to males, controlling for age and page order of administration. The odds ratio for ostart is the estimated change in odds of obtaining a perfect score on one section of the M-CPT for those who received the ordered page before the random page, controlling for age and gender.

Results

Descriptive Analysis

Overall, the sample made 2,173 total errors on 299 completed M-CPTs ($M = 7.3$, $SD = 6.9$). No missing data exists. Although the distributions of the log10 transformed response variables for regressions 1 and 2 were more homoskedastic than the untransformed scores, they still display some inconsistent variance across age. Thus, robust standard errors were used to relax the homoskedactiy assumption of linear regression. Two-way cross tabulations for the categorical variables in the logistic regression analysis showed that there were between 34 and 103 cases per cell and no sparseness problem existed for the logistic regression model.

Regression Analysis

Regression 1: Errors regressed on age, time, gender, and page order. Transformed M-CPT error scores (logerrors) were regressed on time to completion (time), student age (age), a dummy variable for being a girl (female), and a dummy

Table 2
OLS Regression Coefficients for the Transformed M-CPT Errors Response Variable

Variable	Coef. (Rob. Std. Err.)	95% CI
age	-0.5710** (0.0998)	-0.7675, -0.3745
age2	0.0245** (0.0049)	0.0152, 0.0342
time	-0.0011** (0.0002)	-0.0015, -0.0006
female	-0.2267** (0.0462)	-0.3176, -0.1356
ostart	0.1046* (0.0453)	0.0153, 0.1938
_cons	4.2478 (0.5256)	3.213, 5.282
R^2	0.1998	
$F(5, 293)$	15.40**	

Note: *$p < .05$, ** $p < .001$

Table 3
OLS Regression of Transformed M-CPT Time to Completion

Variable	Coef. (Rob. Std. Err.)	95% CI
age	-0.6570** (0.0028)	-0.0712, -0.0602
female	-0.0466** (0.0131)	-0.0725, -0.0208
ostart	-0.2717* (0.0132)	-0.0531, -0.0013
_cons	3.1553 (0.0295)	3.097, 3.213
R^2	0.6515	
$F(3, 295)$	203.84**	

Note: *$p < .05$, ** $p < .001$

Table 4
Logistic Regression of the Oneperfect Response Variable

Variable	Odds Ratio (Rob. Std. Err.)	95% CI
age	1.138* (0.0620)	1.022, 1.266
female	2.540** (0.6525)	1.535, 4.202
ostart	0.8588 (0.2148)	0.526, 1.402
X^2	18.75**	

Note: *$p < .05$, ** $p < .001$

variable for taking the ordered page before the random page (ostart). The estimated coefficients are presented in Table 2. Controlling for time, gender, and page order of administration, age was statistically significant ($t(293) = -5.72$, $p < 0.001$). In order to relax the linearity assumption, polynomial terms were generated for the variable age. Age2 was statistically significant ($t(293) = 4.96$, $p < 0.001$) when included with age and controlled for time, gender, and page order. Thus, it was added to the final model. Age3 was also tested in the model and found to be nonsignificant, so it was removed. For easier interpretation of the model coefficients, Figure 4 displays the estimated relationships between logerrors, age and, age2, controlling for gender, time to completion, and page order. Although older participants were expected to make fewer errors on the M-CPT than younger participants, age-related improvement in M-CPT error scores attenuated at around eleven years of age. For participants ages twelve through fourteen years, older age was associated with a greater number of errors on the M-CPT.

There was a significant gender effect on transformed M-CPT error score ($t(293) = -4.90$, $p < 0.001$. Controlling for age, time, and page order, females were expected to make 0.23 fewer errors (transformed) than males (95% CI [-0.32, -0.14]). The standardized effect size of this estimated difference was -0.52. Time also had a significant effect on transformed errors ($t(293) = -4.45$, $p < 0.001$). Controlling for age, gender, and page order, students were expected to make 0.0011 fewer errors (transformed) for each additional second longer they took to complete the M-CPT (95% CI [0.0015, 0.0006]). Page order of administration also had a significant effect on transformed error score ($t(293) = 2.31$, $p = 0.022$). Controlling for age, gender, and time, students who received the ordered page first were estimated to make an additional 0.1 errors (transformed) on the M-CPT (95% CI [0.015, 0.193]). No significant age X gender and time X gender interactions were found. This model explained 20% of the variance in M-CPT error scores.

Regression 2: Time regressed on age, gender, and page order. The simple correlation between age and transformed time to completion was strong ($r = -0.79$, $p < 0.001$). In the regression model

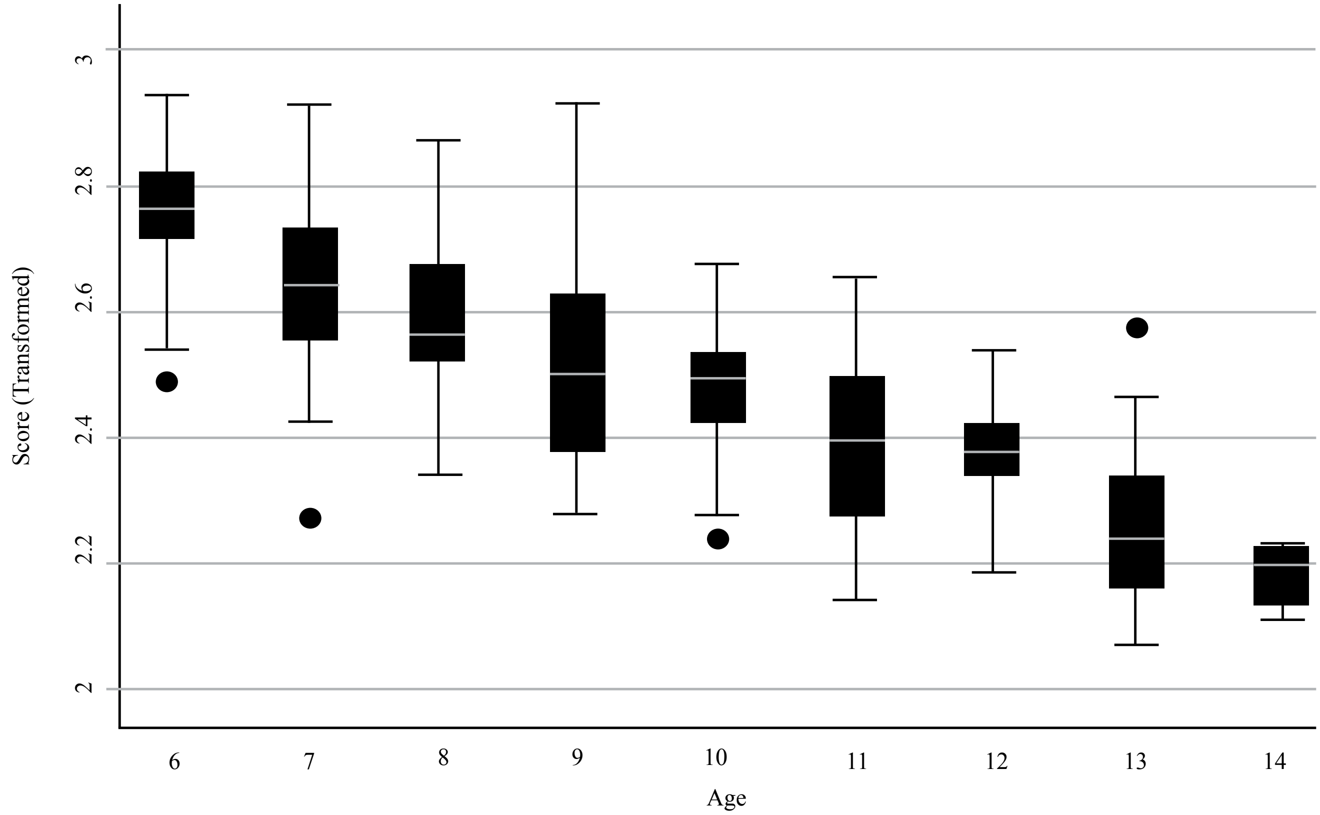

Figure 3. M-CPT time to completion in seconds subject to a Log_{10} transformation

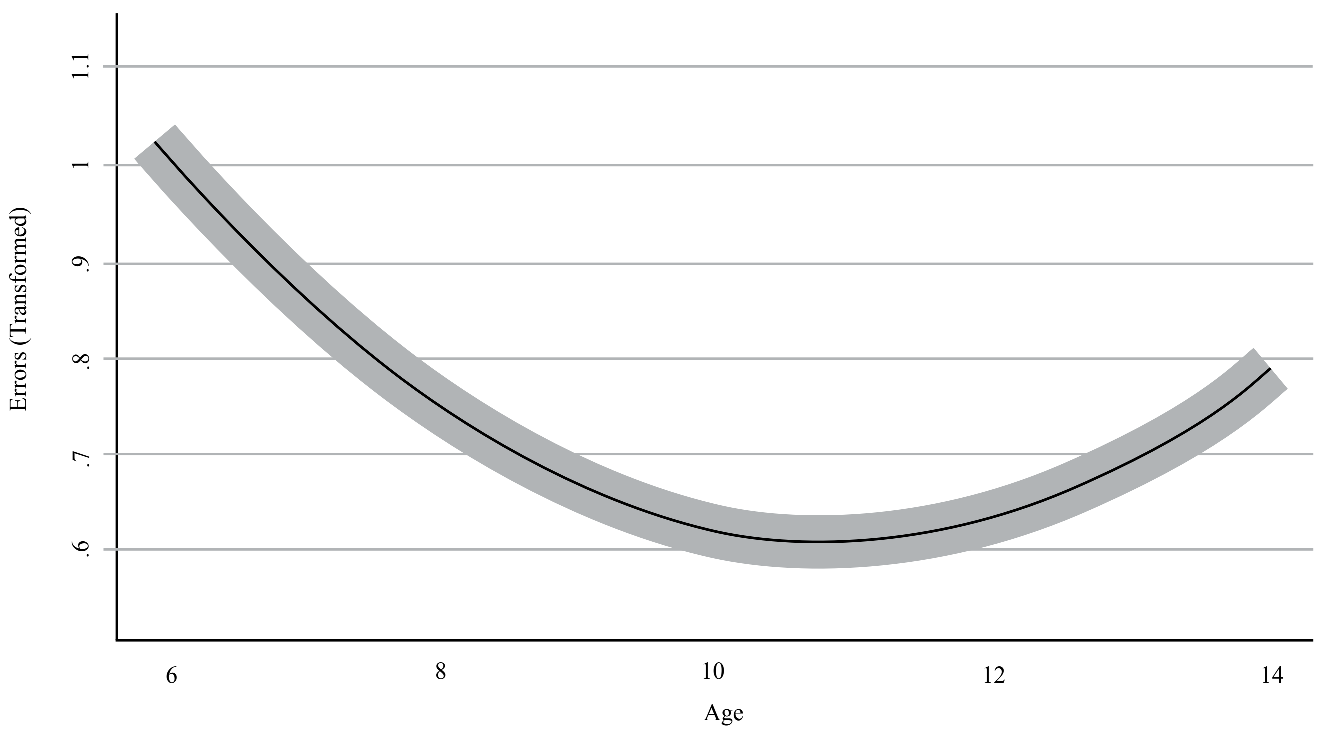

Figure 4. Predicted relationship between transformed M-CPT error scores and student age, controlled for gender, time to completion, and page order tof administration. The 95% confidence interval is shown in grey.

used, transformed time to completion (logtime) was regressed on student age (age), a dummy variable for being a girl (female), and a dummy variable for taking the ordered page before the random page (ostart). The estimated coefficients are presented in Table 3. There were highly significant age effects on transformed time to completion ($t(295) = -23.31$, $p < 0.001$). Controlling for gender and page order of administration, transformed time was estimated to decrease by an average of 0.065 log-seconds per year increase in age (95% CI [-0.071, -0.060]). There was a significant gender effect on transformed time ($t(295) = -3.55$, $p < 0.001$). Controlling for age and page order, females are expected to take 0.047 transformed seconds less than males to complete the M-CPT (95% CI [-0.021, -0.072]). Page order of administration also had a significant effect on transformed time to completion ($t(295) = -2.07$, $p = 0.040$). Controlling for age and gender, students who received the ordered page first were estimated to take 0.027 fewer transformed seconds on the M-CPT (95% CI [-0.053, -0.001]). This model explained 65% of the variance in M-CPT time to completion. To check for nonlinearity the square of age was calculated and added to the model, but the resulting coefficient was nonsignificant and thus the squared term was removed. Relatedly, the strong linear relationship between age and time to completion is also evident in Figure 3, which graphs logtime as a function of age.

Diagnostics were performed to test assumptions of the two linear regression models. To confirm constant residual variance (homoskedasticity), studentized deleted residuals were plotted against fitted values. The normality of the residuals was evaluated using a histogram of residuals. DFBETA statistics and Cook's distances were plotted to identify influential observations. Outliers were evaluated using boxplots. The absence of multicolinearity was tested by calculating variance inflation factors. In general, the diagnostics confirmed that assumptions of the linear regression models were satisfied.

Regression 3 (logistic): One perfect M-CPT section regressed on age, gender, and page order. The estimated odds ratios for achieving at least one perfect M-CPT section are presented in Table 4. In this logistic model, achieving at least one error free section of the M-CPT (oneperfect) was regressed on student age (age), being a girl (female), and if the ordered page was administered before the random page (ostart). Controlling for gender and page order of administration, the estimated odds of achieving at least one perfect section on the M-CPT increase by 13% for each year in age (95% CI [2%, 26%]). A Wald test confirmed that this was a statistically significant effect ($z = 2.37$, $p = 0.018$). Controlling for age and page order, females have 2.5 times the odds as males of achieving at least one perfect section on the M-CPT (95% CI [1.54, 4.20]). Again, a Wald test confirmed that this was a statistically significant effect ($z = 3.63$, $p < 0.001$). Page order of administration does not have a statistically significant effect on the response variable after controlling for age and gender ($z = -0.68$, $p = 0.496$). To check for acceleration or deceleration in the odds ratios as a function of student age, the square of age was calculated and added to the model, but the resulting coefficient was nonsignificant and thus the squared term was removed. Converting odds ratios to probabilities, the predicted probability of a student committing zero errors on at least one section of the M-CPT as a function of age and gender is presented in Figure 5.

Model diagnostics for logistic regression. Assumptions of linearity, a low degree of multicolinearity, and a lack of sparseness were evaluated. The linearity assumption was tested by adding age^2 to the model. However, the Wald test revealed that the variable was nonsignificant and thus it was removed from the model. Muticolinearity was tested by running the logistic regression variables in a linear regression model and calculating the variance inflation factors. All VIF scores were 1.00, suggesting that no multicolinearity existed among the explanatory variables. Cross tabulations showed that there was no issue with sparseness.

Discussion

In this study, we examined the relationship between the M-CPT error scores and age. We found that, in general, younger participants were expected to make more errors than older participants. Next, we explored the relationship between age and time to complete the M-CPT. Time to complete the task was expected to decrease with age. A highly linear relationship existed between age and completion

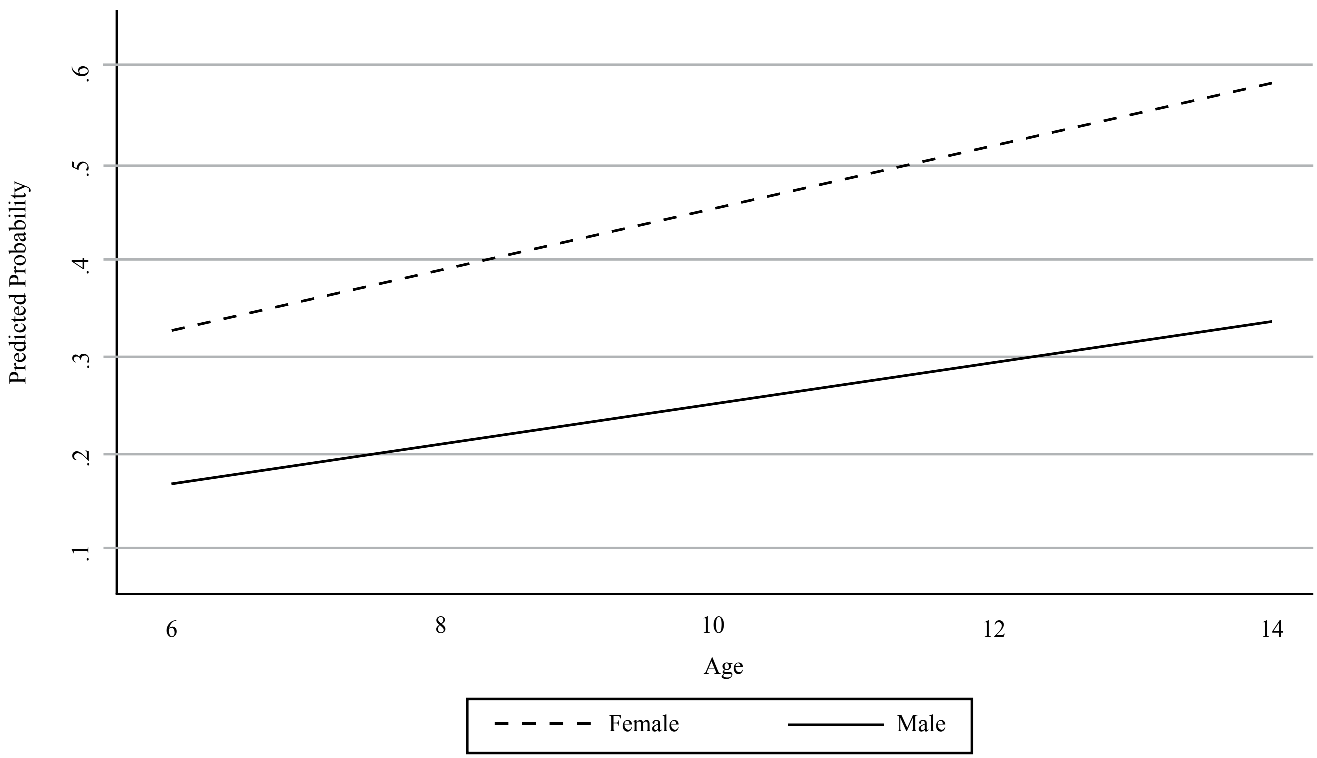

Figure 5. Gender difference in the predicted probability of achieving at least one perfect M-CPT section, controlled for page order of administration

time. Last, we investigated the gender differences in M-CPT performance and found that the girls in the sample outperformed the boys. On average, girls finished the test faster and committed fewer errors than boys. In sum, the results suggest that M-CPT completion time holds promise as a developmentally sensitive indicator of sustained attention. A norm-referenced score for M-CPT completion time might provide useful information about a child's sustained attention as part of a comprehensive assessment for suspected attention problems.

This study conducted a cross-sectional investigation of age- and gender-related changes in M-CPT performance for a population of students in first through eighth grades. Performance on the M-CPT generally improved with age for both genders. Controlling for gender, the time spent on the test, and the test order of administration, older students tended to make fewer errors on the M-CPT, finish the test faster, and had a greater chance of scoring errors on at least one section of the test than younger students. Age-related improvement in M-CPT error scores was estimated to cease at eleven years age. This finding is not altogether surprising, as cognitive and neuropsychological test performance has been shown to decrease during the transition from childhood to early adolescence (Waber et al., 2007).

Our results indicate that girls outperformed boys on the M-CPT. Girls made fewer errors, took less time to complete the test, and had greater odds of achieving a perfect score on at least one of the two sections of the M-CPT, controlling for other variables. These results were consistent with Connors, Epstien, Angold, and Klaric's (2003) study that assessed over 17,000 participants and found that females made significantly fewer CPT errors than males. The gender difference finding is also consistent with the expectation that as children girls have better capacity for attention than boys, as supported by the between-gender disparity in ADHD prevalence. However, it should also be noted that within-gender difference in performance far exceeded the between-gender variation and broad generalizations must be made with caution.

The most striking finding in the data was the robust linear relationship between time to completion and age. Sixty-three percent of the variance in M-CPT time to completion was explained by student age. Speculatively, the data suggest that time to completion might be a more specific and sensitive indicator of attention difficulties than error scores. A child with attention difficulties could present with neuropsychological weaknesses that impair their ability to quickly complete the M-CPT and result in longer time to completion relative to their same age peers. Additionally, the finding that M-CPT time to completion decreases with age has an interesting resemblance to the rapid increase in speed of information processing that occurs during childhood (Kail, 1991; Miller & Vernon, 1997). Examining the correlation between processing speed and M-CPT time to completion has the potential to generate new information about neuropsychological development in children. In sum, this study suggests that completion time is an interesting variable that should be the focus of future studies using the M-CPT.

Limitations

Limitations in the study design were imposed as a requirement to gain access to the population that prevented gathering information about ADHD status and demographic information about individual students. These limitations ruled out the possibility of comparing the performance of students with and without ADHD, and also introduced the possibility that confounding exogenous variables (e.g., psychophysiological deficits) may have influenced the results. Also, the sample size was only minimally adequate to justify investigations of age-related changes in M-CPT performance. When groups were subdivided by age and gender, statistical power was diminished. The sample of 14-year-olds contained only six students, meaning inferences for this age group should be made judiciously. Calculations of effect size should be interpreted with caution. Furthermore, age groups may have been confounded by cluster effects that could not be modeled because of the few classrooms in the study. Lastly, the fact that the sample was a convenience sample in a single charter school confers the possibility that the results are specific to the particular population.

Conclusion

The current findings suggest that the examination of reaction time within attentional research and screening has relevance to the M-CPT and that the M-CPT is developmentally sensitive to performance. This study provisionally suggests that the M-CPT has the potential to provide accurate and useful information about attentional functioning in children relative to their same-age peers. It is possible that when normed on an adequately large representative sample, the M-CPT may be able to reliably identify students with developmental differences in attention using time to completion scores. The M-CPT has the potential to become a valuable source of information for assessment of attention problems in children. With attentional problems firmly linked to a plethora of academic, social, and psychological sequelae, it is imperative that psychological science develops instruments that improve clinical assessment and research. Future studies using the M-CPT should focus on investigating the relationship between age and time to completion in students with typical and atypical attention.

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