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Studies of Processing Speed in Children with Cerebral Palsy

Adapted Cognitive Assessment Lab (ACAL)

Department of Physical Medicine and Rehabilitation
University of Michigan

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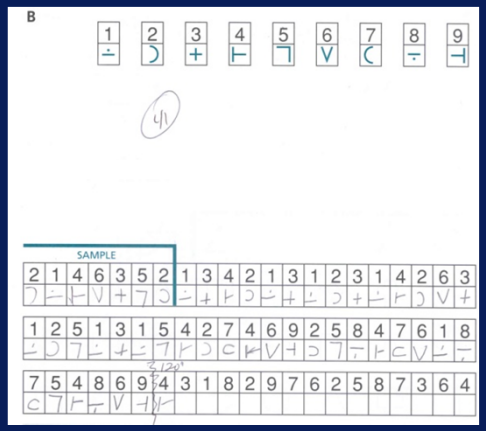
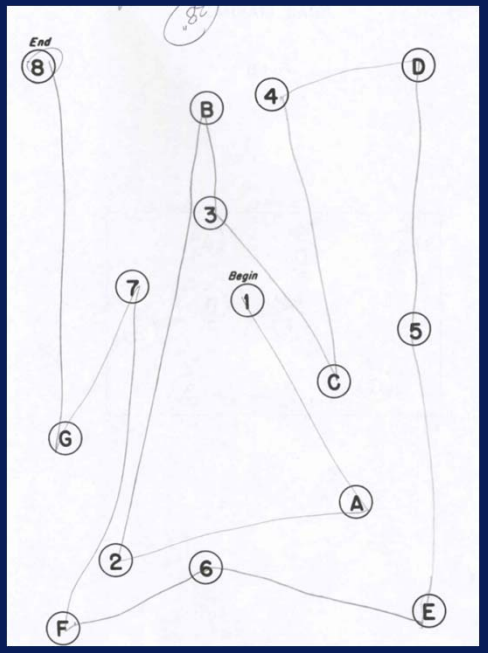
Processing Speed





Results Table (Tabulated Raw data)		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Half 1	Half 2	Total
Omission Errors	%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
(Inattention)	#	0	0	0	0	0	0	0
Commission Errors	%	0.79%	0.00%	22.22%	16.67%	0.40%	19.44%	4.63%
(Impulsivity)	#	1	0	8	6	1	14	15
Response Time	msec	419	471	369	357	445	363	382
RT Variability	msec	73	116	106	85	100	96	103
Correct Responses	#	36	36	124	122	72	246	318
Correct Nonresp.s	#	125	126	28	30	251	58	309
Anticipatory Resp.s	%	0.00%	0.00%	1.23%	2.47%	0.00%	1.85%	0.93%
NonTargets	#	0	0	0	0	0	0	0
Targets	#	0	0	2	4	0	6	6
Multiple Responses	#	0	0	0	0	0	0	0
User Interrupts		0	0	0	0	0	0	0
Hardware Errors		0	0	0	0	0	0	0
Post-Commissions	#	1	0	8	6	1	14	15
Response Time	msec	499	0	443	403	499	426	431
Variability	msec	0	0	157	74	0	130	127
D Prime		6.68	8.53	5.03	5.23	6.92	5.13	5.95

T.O.V.A.(R) Visual Continuous Performance Test
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Factor Model of Processing Speed

O'Connor & Burns (2003)

- **General Speed of Processing – General factor; speed to perform simple and complex tasks.**
- **Perceptual speed – Matching/coding type tasks.**
- **Visualization speed – Length of stimulus exposure required to make decision (IT tasks included, mental rotation included).**
- **Decision time – Time required to make a simple decision based on sensory info (less clear factor).**
- **Movement Time – Comes out of reaction time tasks that attempt to tease movement from decision time.**

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Inspection Time

- Inspection time (IT) is a very simple information processing construct that is measured by an individual's ability to perceive aspects of a stimulus given a very brief time limit.
- IT is generally thought to be associated with a Visualization Speed factor of PS; however, there is some controversy about whether IT is measuring speed of sensory processing versus post-sensory encoding.
- That said, IT measures appear to offer the unique opportunity to look at an aspect of early PS without the confounds of reaction time, paper/pencil or verbal responding.
- IT is associated with many higher level cognitive processes

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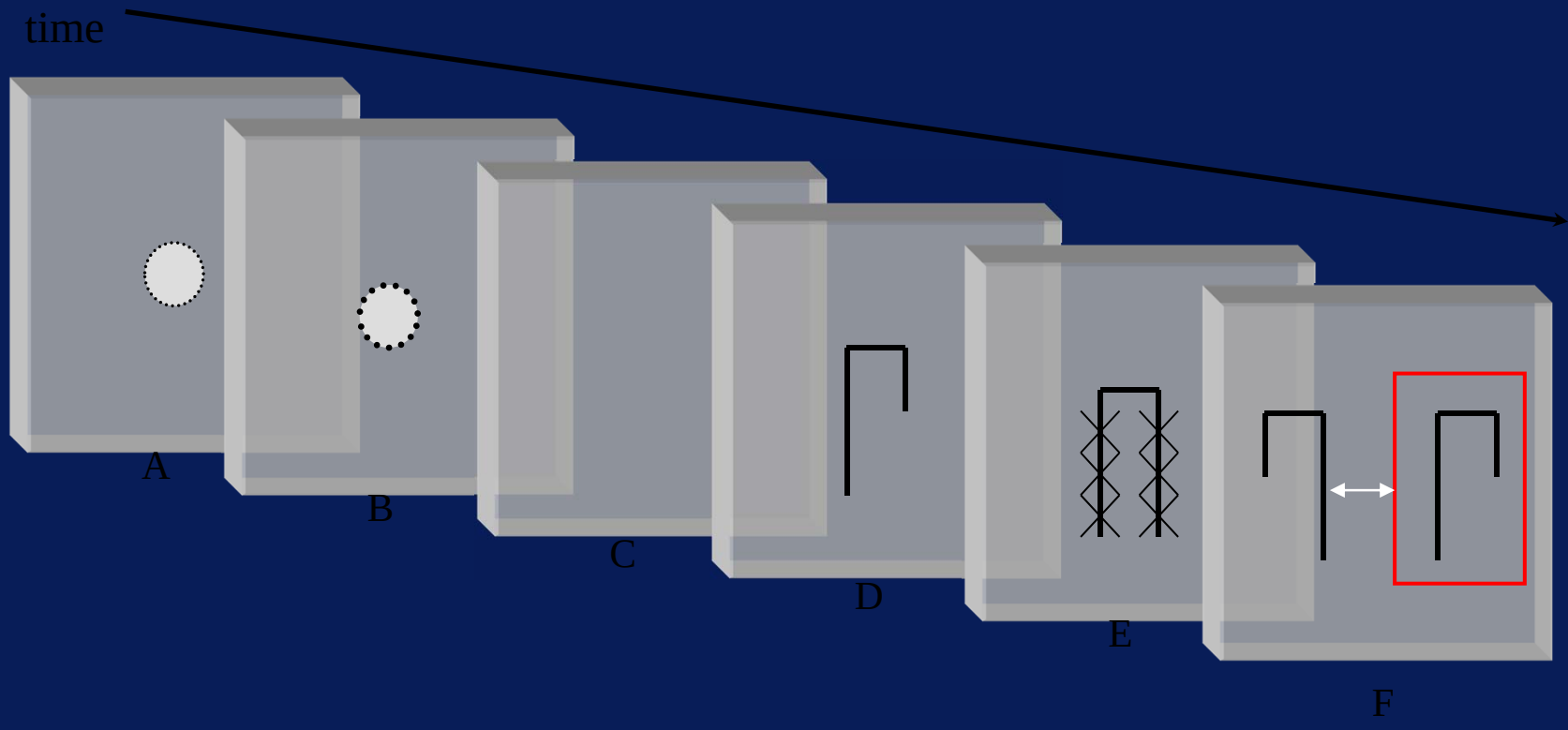
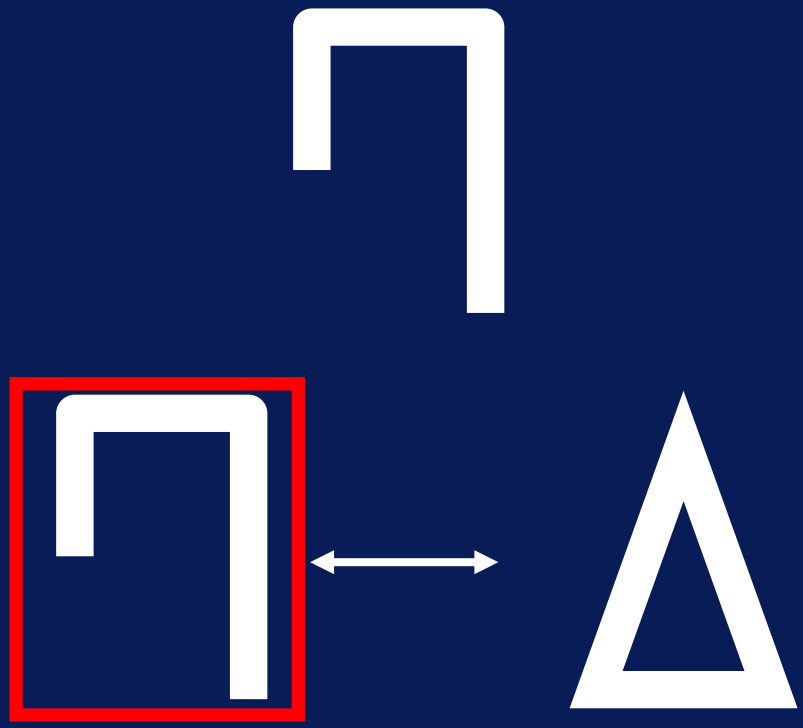
Visual Inspection Time Task



Training for Participation

- The IT task is too complex for some participants to immediately grasp; therefore, a series of training steps have been developed.
- Training steps are conceptual and proceed in a natural progression of cognitive complexity.
- Step-wise training provides data to characterize the performance of children who are not able to complete the formal IT task.



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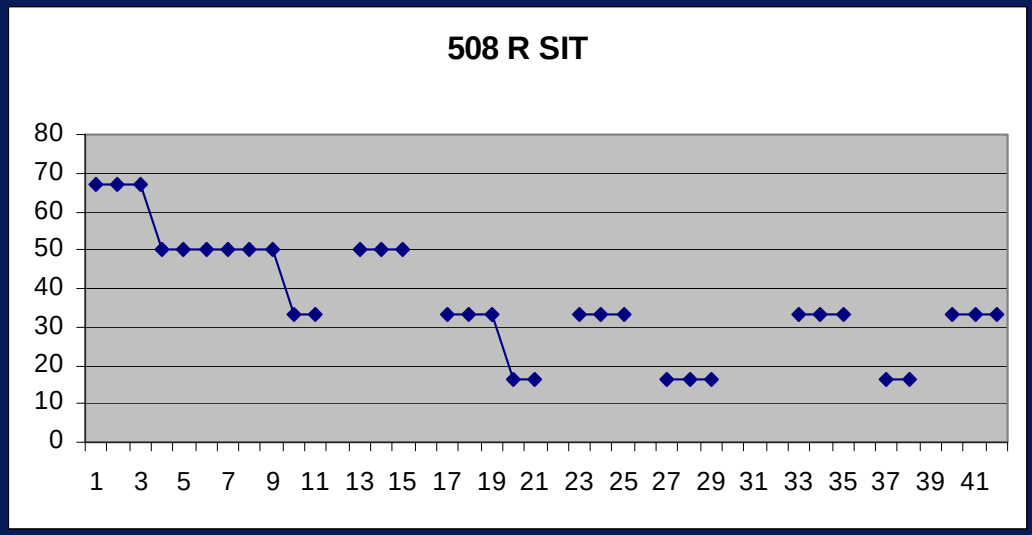
Inspection Time Stepwise Procedure

(Wetherill & Levitt, 1965)



- **Flexibility to determine on-screen duration (OSD) of target stimulus (starting point) for each individual child.**
- **3 correct responses – shorten OSD; 1 incorrect response – lengthen OSD.**
- **Titration of IT is determined by 8 step-wise reversals of on-screen duration.**

Visual Inspection Time and Graphomotor Processing Speed in Children With Cerebral Palsy Kaufman et al. (2010)

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- Previous evidence of slowed PS in children with CP, confounded by motor demands of instruments;
- This study evaluated IT in children with diagnoses of CP relative to typically developing peers, and examined associations between IT and traditional graphomotor measures of PS (WISC-III).

Demographic and developmental characteristics by Group

Variable	CP (n=89)	TD (n=38)
Age (years)	11.5 (2.5)	10.9 (2.6)
Gender (% male)	60.5%	49.4%
PPVT-III	102.1 (16.9)	108.1 (16.1)
Gestation (weeks)	32.8 (5.9)*	37.9 (3.2)
Birth Weight (lbs)	4.6 (2.5)*	7.0 (1.7)
History of seizure	17 %*	1.0 %

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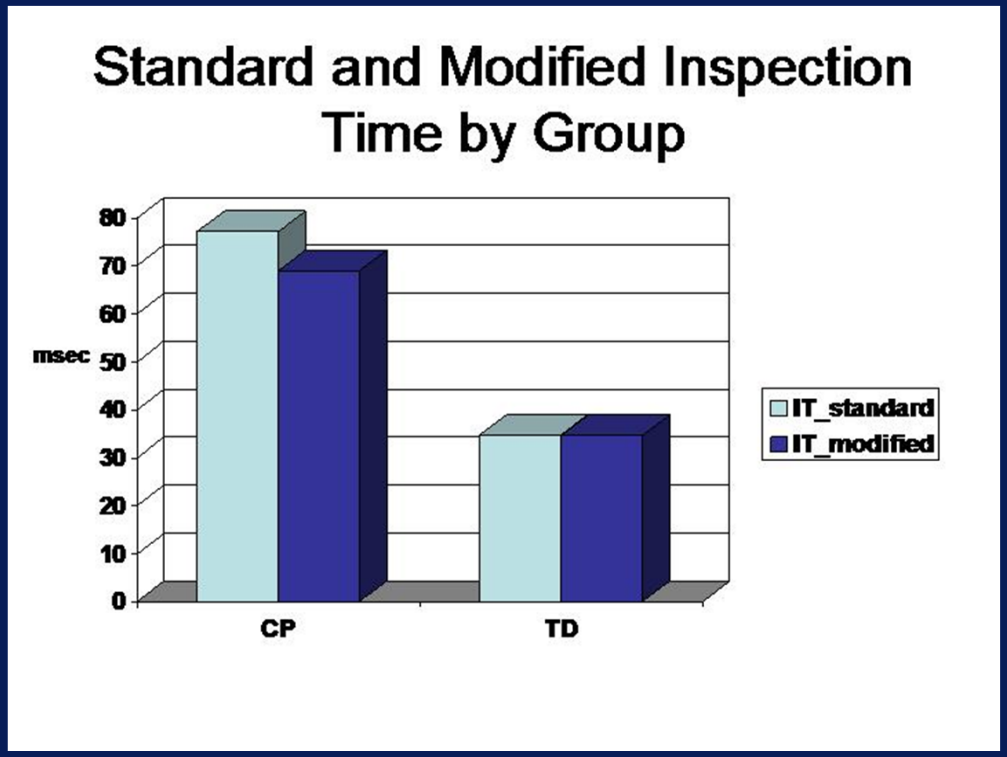
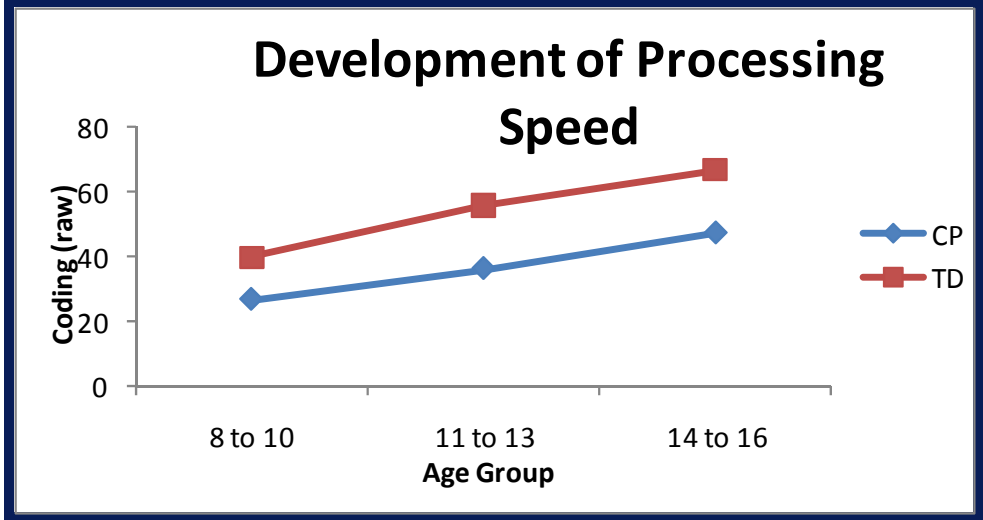
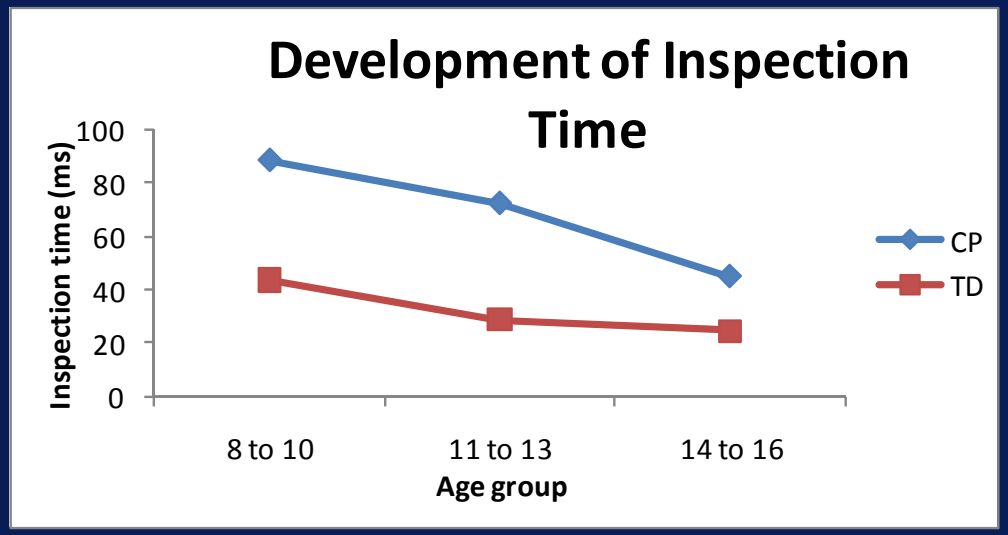
Results



- WISC-III speed task performances were significantly negatively correlated with the IT tasks in the CP group
- WISC-III PS – IT correlations in the TD group were not significant.

Developmental Differences in Inspection Time in Children with and without CP
Shank, Leffard et al. (2010)





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Inspection Time & ADHD Symptoms (Shank et al., 2010)

- **Objective: To examine between-groups differences in the associations processing speed assessed with an inspection time task and ADHD symptoms.**

- **Results**
  - **Children with CP exhibited significantly slower processing speed and more ADHD symptoms than controls.**
  - **Significant associations between inspection time and ADHD symptoms were found only in the control group.**

Table 3
Pearson Bivariate Correlations Between CPRS–R and Inspection Time Variables by Group

Variable	1	2	3
1. Inspection time	—	.09	.16
2. Inattentive	.48**	—	.62**
3. Hyperactive–Impulsive	.44**	.67**	—

Note. CP group correlations are above the diagonal and control correlations are below the diagonal. CPRS–R = Conners' Parent Rating Scale—Revised: Long Version; Inattentive = CPRS–R *DSM–IV* Inattentive subscale; Hyperactive–Impulsive = CPRS–R *DSM–IV* Hyperactive–Impulsive subscale.
** $p < .01$.

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Inspection Time: Summary

- Preliminary evidence that children with cerebral palsy at high GMFCS levels, show evidence of slowed PS, with performance falling approximately a standard deviation below peers;
- Preliminary evidence suggests that modified/accessible visual Inspection Time task yields comparable group level scores;
- Preliminary evidence suggests gains in PS with age
- Evidence that IT and ADHD symptoms, assessed with standard rating scales, dissociate in children with ADHD

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Future Research

- Psychometric studies of IT tasks: Reliability and validity
- Moderators of IT performance on standard versus AT tasks
- Effects of fatigue on IT performance
- Other study populations: Dystrophin-related Muscular Dystrophy
- Medication effects?

ACAL Research Team

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The ACAL Project Website

http://www.med.umich.edu/pmr/acal/index.htm

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