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Working Memory Measurements and ADHD?

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Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by high levels of inattention, hyperactivity, and impulsiveness. It is in many ways an exaggeration of normal behavior, and children with ADHD may exhibit either too much or not enough of what is expected in a given setting [1]. While widely agreed upon that ADHD is a valid and impairing disorder [2], the delineation between normal behavior and pathological variation, along with the underlying cause, is still controversial [3,4].

Endophenotypes, (i.e., measurable biological or cognitive markers) may be useful for understanding and identifying core features of ADHD [5] because they could lead to more objective neurocognitive diagnostic procedures and greater predictive power [6]. Recently, working memory (WM) has gained attention as an endophenotype of ADHD in the field [7]. Based on Baddely and Hitch's multiple component model, WM is conceptualized as a three-component system comprised of the central executive control system (CE) and two subsidiary systems, the phonological (PH) loop, also known as verbal WM (VWM) and the visuospatial (VS) sketchpad, also known as visuospatial WM (VSWM) [8]. Later, Rapport proposed a functional WM model of ADHD suggesting that WM plays a significant role in organizing behavior through recognition and recall processes. In particular, behavioral response is dependent on WM capacity to create, maintain, and match representations of input stimuli and access and maintain representations of behavioral responses suitable to input stimuli [9]. Attention can be operationally defined as WM representations, and impaired WM processes (e.g., rapid fading representations in WM) lead to disorganized behavior and stimulation seeking, which independently or concurrently result in hyperactive and impulsive symptoms of ADHD [9]. Therefore, based on the basic components of WM [8] and the role of WM in recognition processes, Rapport and colleagues (2001) argue that WM is a core deficit of ADHD that explains upstream of phenotypic features like hyperactivity, impulsivity, and inattention.

If WM processes result in phenotypic expression of ADHD, incorporating WM measurement into ADHD assessment may lead to advances in diagnosis, treatment, and outcomes. However, metanalytic reviews yield discrepant findings in regard to the relationship between WM subsystems and ADHD [10-12].One reason for discrepant findings may be task differences in WM measurement. There are a variety of tasks utilized in clinical and experimental settings to measure WM, with associated strengths and weaknesses, and it is possible that these tasks are engaging different processes. No single approach is guaranteed to engage the neural circuitry of WM [13], instead a multitrait-multimenthod assessment of ADHD should be the "gold standard," as this allows for examination of similar and dissimilar traits through a variety of methods [14].

Conceptually, it seems that the tasks commonly used in clinical psychology may not be measuring the same construct identified in cognitive literature [15]. Span tasks provide a good example of discrepancies in WM measurement between clinical psychology and cognitive or experimental research. In clinical neuropsychology, span tasks are often one of the most common methods for assessing WM capacity [16]. For example, WM measurement built into instruments commonly used in clinical psychology (e.g., Wechsler Intelligence Scale for Children, Fourth Edition) [17], heavily relies on span tasks, and often combines simple and complex tasks. Simple span tasks are viewed as a measure of short-term memory, the ability to hold information for a limited time [13], rather than WM capacity [18]. In contrast to simple span tasks, complex span tasks require both storage and processing of information, engage the CE, and so are theoretically a more accurate measure of WM processes [16].

Methodologically, although complex span tasks are often considered to be a reliable and valid measure of WM capacity, misuse of span tasks, including inconsistent administration, hinders their reliability clinically [19]. Available evidence also reveals that digit span backwards tasks (such as the task utilized on the WISC-IV WMI) load on the same dimension as digit forward tasks, suggesting both forward and backward tasks are measures of short term memory [20-22]. In addition, higher-order chunking is also a problem inherent in span tasks. This refers to the possibility that individuals “chunk” or combine information into meaningful units such as familiar association or patterns, rather than remembering stimuli as single items, as assumed by span tasks.

One method to reduce potential for higher-order chunking is to overload the processing system when stimuli are presented, so more information is in time-limited stores than possible to rehearse or encode before the time-limit ends [23], such as in match-to-sample, or change detection tasks [24]. Currently, match-to-sample or change-detection tasks are common in experimental settings, and these often provide the foundation for understanding the relationship between cognitive constructs (such as WM) and clinical disorders (such as ADHD). Therefore, although these tasks may provide a more accurate understanding of WM functioning, and measure a construct different from that elicited by span tasks, these tasks are not often utilized in clinical settings, and normative data for clinical use is not yet available.

Overall, it is paramount that researchers and clinicians alike recognize that the tasks utilized in experimental research and clinical assessment to measure WM may not be eliciting the same construct. An effort to understand which construct or WM subsystem is likely to be elicited by specific tasks and assessment tools as well as recognition of the similarities and differences among measures is necessary. This would allow both clinicians and researcher to choose and appropriately use and interpret WM measures. Moreover, researchers should consider the feasibility of utilizing experimental measures in clinical settings, and an effort to provide normative data for commonly utilized experimental tasks (e.g., change-detection paradigms) in order to enhance clinical interpretation is paramount. Clinicians should recognize the importance of being familiar with the experimental measures, on which understanding of the relationship between ADHD and WM is based, and attempt to utilize similar measures clinically, rather than relying solely on common clinical standards that may elicit different constructs (e.g., WMI). Overall, further research on WM measurement in clinical psychology, including its similarity to WM constructs in cognitive and experimental research, as well as potential adaptation of current paradigms is warranted.

References

1 Goldstein S, Naglieri JA (2008) The school neuropsychology of ADHD: Theory, assessment, and intervention. Psychol Schools 45: 859-874.

2 Barkley RA, Cook EH, Diamond A, Zametkin A, Thapar A, Teeter A et al. (2002) International consensus statement on ADHD. January 2002. Clin Child Fam Psychol Rev 5: 89-111.

3 Pliszka S (2007) Practice parameter for the assessment and treatment of children and adolescents with attention-deficit/hyperactivity disorder. J Am Acad Child Adolesc Psychiatry 46: 894-921.

4 Wolraich ML (1999) Attention deficit hyperactivity disorder: the most studied and yet most controversial diagnosis. Ment Retard Dev D R 5: 163-168.

5 Gottesman II, Gould TD (2003) The endophenotype concept in psychiatry: Etymology and strategic intentions. Am J Psychiatry. 160: 636-645.

6 Crosbie J, Perusse D, Barr CL, Schachar RJ (2008) Validating psychiatric endophenotypes: Inhibitory control and attention deficit hyperactivity disorder. Neurosci Biobehav Rev 32: 40-55.

7 Rapport MD, Alderson RM, Kofler MJ, Sarver DE, Bolden J, Sims V et al. (2008) Working memory deficits in boys with Attention-Deficit/ Hyperactivity Disorder (ADHD): The contribution of central executive and subsystem processes. J Abnorm Child Psychol 36: 825-837.

8 Baddeley A (2003) Working memory: Looking back and looking forward. Nat Neurosci 4: 829-839.

9 Rapport MD, Chung K, Shore G, Isaacs P (2001) A conceptual model of child psychopathology: Implications for understanding attention deficit hyperactivity disorder and treatment efficacy. J Clin Child Psychol 30: 48-58.

10 Kasper LJ, Alderson RM, Hudec KL (2012) Moderators of working memory deficits in children with attention-deficit/hyperactivity disorder (ADHD): A meta-analytic review. Clin Psychol Rev 32: 605-617.

11 Willcutt EG, Doyle AE, Nigg JT, Faraone SV, Pennington BF (2005) Validity of the executive function theory of Attention-Deficit/ Hyperactivity Disorder: A meta-analytic review. Biol Psychiatry 57: 1336-1346.

12 Martinussen R, Hayden J, Hogg-Johnson S, Tannock R (2005) A meta-analysis of working memory impairments in children with attention-deficit/hyperactivity disorder. J Am Acad Child Adolesc Psychiatry, 44: 377-384.

13 Jarrold C, Towse JN (2006) Individual differences in working memory. *Nat Neurosci*, *139*: 39-50.

14 Campbell DT, Fiske DW (1959) Convergent and discriminant validation by the multitrait-multimethod matrix. Psychol Bull 56: 81-105.

15 Shelton JT, Elliott EM, Hill BD, Calamia MR, Gouvier WD et al. (2009) A comparison of laboratory and clinical working memory tests and their prediction of fluid intelligence. Intelligence 3: 283-293.

16 Beblo T, Macek C, Brinkers I, Hartje W, Klaver P (2004) A new approach in clinical neuropsychology to the assessment of spatial working memory: The block suppression test. J Clin Exp Neuropsychol 26: 105-114.

17 Wechsler D (2003) WISC-IV: Wechsler Intelligence Scale for Children – Fourth Edition. San Antonio, TX: Psychological Corporation.

18 Vock M, Holling H, (2008) The measurement of visuo–spatial and verbal–numerical working memory: Development of IRT-based scales. Intelligence 36: 161-182.

19 Conway ARA, Kane MJ, Bunting MF, Hambrick DZ, Wilhelm O, Engle RW (2005) Working memory span tasks: A methodological review and user's guide. Psychon B Rev 12: 769-786.

20 Colom R, Flores-Mendoza C, Quiroga MÁ, Privado J (2005) Working memory and general intelligence: The role of short-term *storage.* Pers Indiv Differ 39: 1005-1014.

21 Engel PMJ, Santos FH, Gathercole SE (2008) Are working memory measures free of socioeconomic influence?. J Speech Lang Hear Res 51: 1580-1587.

22 Swanson L, Kim K (2007) Working memory, short-term memory, and naming speed as predictors of children's mathematical performance. Intelligence 35: 151-168.

23 Cowan N (2000) The magical number 4 in short-term memory: A reconsideration of mental storage capacity. Behav Brain Sci, 24: 87-114.

24 Luck SJ, Vogel EK (1997) The capacity of visual working memory for features and conjunctions. Nature 390: 279–281.