Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy

of

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MSc (University of British Columbia, 2013)
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“Towards a Multivariate Assessment of Executive Functions”

Department of Psychology

July 24, 2017
1:00 p.m.
David Turpin Building
A144

Supervisory Committee:
Dr. Mauricio Garcia-Barrera, Department of Psychology, University of Victoria (Supervisor)
Dr. Scott M. Hofer, Department of Psychology, UVic (Member)
Dr. Grant L. Iverson, Department of Physical Medicine and Rehabilitation, Harvard Medical School
(Outside Member)

External Examiner:
Dr. Brandon Gavett, Department of Psychology, University of Colorado

Chair of Oral Examination:
Dr. Janet Storch, School of Nursing, UVic
Objective: This work consisted of three research projects bridged by their focus on a multivariate assessment of executive functions in research and practice: (a) a systematic review and re-analysis of latent variable studies on executive function test batteries, (b) a confirmatory factor analysis (CFA) of the Delis-Kaplan Executive Function System (DKEFS), the most commonly administered executive function test battery in clinical practice, and (c) the derivation of multivariate base rates for the D-KEFS, offering a psychometric resource with direct applications to clinical practice.

Method: Systematic review. The systematic review identified 45 eligible samples (N=9,498 participants, mean age range: 3.01-74.40 years-old) and 21 correlation matrices eligible for re-analysis, comparing seven competing models including the most commonly evaluated factors: updating/working memory, inhibition, and shifting. Model results were summarized based on the mean percent accepted (i.e., mean rate at which models both properly converged and met fit thresholds: CFI≥.90/RMSEA≤.08). CFA. Using adults from the DKEFS normative sample (N=425; 20-49 years-old), eight alternative measurement models were evaluated for a subset of D-KEFS tests. Factors from the accepted measurement model predicted three tests measuring constructs less often evaluated in the executive function literature: abstraction, reasoning, and problem solving. Base rates. The iv frequency of low scores occurring among the D-KEFS normative sample (N=1,050; 16-89 years-old) was calculated for the full D-KEFS and two brief batteries using stratifications for age, education, and intelligence.

Results: Systematic review. The most often accepted models varied by age (preschool=one/two-factor; school-age=two/three-factor; adolescent/adult=three/nested-factor; older adult=two/three-factor), and most frequently included updating/working memory, inhibition, and shifting factors. The nested-factor and three-factor models were accepted most often and at similar rates among adult samples: 33-34% and 25-32%, respectively. No model was accepted most often for child/adolescent samples, but those with shifting differentiated garnered less support. CFA. A three-factor model including inhibition, shifting, and fluency fit the data well (CFI=0.938; RMSEA=0.047), although a two-factor model merging shifting/fluency fit similarly well (CFI=0.929; RMSEA=0.048). A bifactor model fit best (CFI=0.977; RMSEA=0.032), but rarely converged. Shifting best predicted tests of reasoning, abstraction, and problem solving (p<0.05; R2=0.246-0.408). Base rates. Low scores, based on commonly used clinical cutoffs, occurred frequently among healthy adults. For a three-test, four-test, and full D-KEFS battery, 62.8%, 71.8%, and 82.6% obtained ≥1 score(s) ≤16th percentile, respectively, and 36.1%, 42.0%, 50.7%, obtained ≥1 score(s) ≤5th percentile, respectively. The frequency of low scores increased with lower intelligence and fewer years of education.

Discussion: The systematic review effort did not identify a definitive model of executive functions for either adults or children/adolescents, demonstrating the continued need to re-evaluate the conceptualization and measurement of this construct in future research. The D-KEFS CFA offers some evidence of clinical measures capturing theoretical constructs, but is not directly translatable into clinical practice; while the multivariate base rates are useful to clinicians, but do not bridge theory and assessment. This research reaffirms the elusive nature of executive functions in both research and clinical spheres, and represents a step forward in an enduring scientific process towards a true understanding of this mysterious construct.