



Title Registration for a Systematic Review: School-Based Executive Functioning Interventions for Improving Executive Functions, Academic, Social-Emotional, and Behavioral Outcomes in School-Age Children and Adolescents: A Systematic Review and Meta-Analysis

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TITLE OF THE REVIEW

School-Based Executive Functioning Interventions for Improving Executive Functions, Academic, Social-Emotional, and Behavioral Outcomes in School-Age Children and Adolescents: A Systematic Review and Meta-Analysis

BACKGROUND

Introduction

Executive function is an umbrella term for a collection of cognitive or behavioural functions such as switching focus, planning, organizing, sustaining attention, and controlling inappropriate speech or behaviour. Similar terms include cognitive control, executive control, and everyday cognitive skills. Although there is still no unanimous theoretical and operational definition of executive functions, it is now commonly believed that executive functions are essential for purposeful, goal-directed, problem-solving behaviours and actions (Gioia, Isquith, Guy, & Kenworthy, 2000). Some researchers have characterized attention deficit hyperactivity disorder (ADHD) as executive functioning deficits and dysfunction (e.g., Barkley, 1997, 2012). Deficits or disorders of executive functions can greatly affect a person's ability to perform in school or work environments, function independently, or maintain appropriate social relationships (Best, Miller, & Naglieri, 2011; Bull & Lee, 2014). Executive functions have attracted interest from researchers across several fields, including medicine, neuroscience, psychiatry, neuropsychology, psychology, and education.

Executive function skills have been linked to many important aspects of child and adolescent functioning, such as academic achievement, self-regulated learning, social-emotional development, physical well-being, and behavioural problems. For example, a number of longitudinal studies and studies with national representative samples have reported that early executive function skills predict growth in academic achievement over time (e.g., Best, Miller, & Naglieri, 2011; Fuhs, Nesbitt, Farran, & Dong, 2014). Also, improved general executive functioning ability is found to be associated with fewer behavioural problems, and vice versa (Young et al., 2009). Planning and organization, two key executive functions, are found to be the most important predictors of school grades for middle school students with ADHD (Langberg, Dvorsky, & Evans, 2013). Recently, some researchers have advocated increasing the use of executive functioning assessments in school environments, as they add to students' intellectual profile, lead to better understanding of their academic and social-emotional status, and provide useful information for intervention when necessary (Bracken & Brown, 2006).

Four Core Executive Function Components

This proposed systematic review and meta-analysis will focus on four core components of executive functions: inhibition (also called inhibitory control), working memory (or

updating), cognitive flexibility (or shifting, task-switching), and planning. We will choose to focus on these four executive function components for three reasons. First, there is a strong literature base for them. Best, Miller, and Jones (2009) identified these four components as the most important executive function components based on the frequency of their appearances in literature. Second, results from factor analyses of various measures of executive functions on different populations have typically identified inhibition, working memory, cognitive flexibility, and planning as core or important constituents of executive function (e.g., Donder, DenBraber, & Vos, 2010; Egeland & Fallmyr, 2010; Gioia, Isquith, Retzlaff, & Espy, 2002; Lazzman & Markon, 2010; Miyake et al., 2000). Lastly, we intend to take a developmental perspective on executive function skills during the period of childhood to adolescence. Our previous narrative review of executive function literature (i.e., Steenbergen-Hu, Olszewski-Kubilius, & Calvert, 2014) found that studies on executive function of early childhood predominantly focused on inhibition, working memory, and cognitive flexibility (e.g., the Center on the Developing Child at Harvard University, 2011) and studies on executive function with adolescents often included planning as an important dimension (e.g., Jurado & Rosselli, 2007). Thus, the selection of these four components will allow us to take a developmental perspective on executive function in this review.

Common Executive Function Assessments

Both performance-based tests and rating scales of executive function skills have been used in clinical and research settings (Toplak, West, & Stanovich, 2013). Performance-based executive function measures involve highly standardized procedures that are often administered on a one-on-one basis to assess an individual's accuracy or response time on specific tasks. For example, the Wisconsin Card Sorting Test (WCST; Heaton, Chelune, Talley, Kay, & Curtis, 1993) assesses a subject's ability to be flexible in response to feedback, avoid perseverative tendencies, and inhibit a prior response that is no longer appropriate in a new situation (Salthouse, Atkinson, & Berish, 2003). The most commonly used performance-based EF measures include the WCST, the Halstead Category Test (Halstead, 1947), Trail Making Test (Lewis & Rennick, 1979), the Delis–Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001) and Stroop Test (Jensen & Rohwer, 1996). Performance-based executive function assessments are the foremost measurement tools in clinical- or laboratory-based settings.

Rating scales assess executive function in complex, daily, problem-solving situations through either informants (e.g., parents and/or teachers) or the examinees themselves (Roth, Isquith, & Gioia, 2005). The most frequently used rating scales of executive function include the Behavior Rating Inventory of Executive Function (BRIEF; Gioia et al., 2000), the Childhood Executive Functioning Inventory (CHEXI; Thorell, Eninger, Brocki, & Bohlin, 2010; Thorell & Nyberg, 2008), the Behavioral Assessment of the Dysexecutive Syndrome (BADS; Wilson, Alderman, Burgess, Emslie, & Evans, 1996), the Current Behaviors Scales (CBS; Barkley, 1997), and the Deficits in Executive Function Scale (Barkley & Murphy, 2010). Rating scales of executive function have increasingly gained popularity in education

and psychology. Recently, some researchers have recommended the use of data from multiple and different executive function measures, such as both performance-based and rating scales, and consideration of other relevant factors, such as health problems, age, and economic and cultural influences when diagnosing EF deficits (Randolph & Chaytor, 2013).

Why the Proposed Systematic Review is Important

The rising public awareness of the importance of executive function has led to a wealth of interventions designed to promote and enhance executive function skills in children and adolescents. Commonly used executive function interventions comprise two categories: pharmacological (e.g., stimulants used to treat ADHD patients) and non-pharmacological (e.g., computerized training, cognitive behavior therapy, and adds-on school curricula). A number of systematic reviews or meta-analyses have been conducted to address how effective the interventions are and if these results show reliable and convincing evidence. Our review of such systematic reviews and meta-analyses leads to four noteworthy findings:

1. Many of the existing reviews were conducted on clinical samples in clinical- or laboratory-based settings by researchers in the fields of medicine, neuroscience, neuropsychology, psychiatry, and psychology. Such reviews are not the most useful and informative resources for policy makers, practitioners, or researchers in education;
2. Although a number of reviews of the effects of executive function interventions on normal children and adolescents in school-based settings have been conducted or are currently in progress, these reviews often examine only one or two specific types of EF interventions or programs (e.g., Maynard, Solis, & Miller, 2014; Randolph, Rosentein, & Michaels, 2014). There exists no reviews to date that include multiple types of school-based executive function interventions;
3. Most reviews of school-based executive function interventions concentrate on indirect outcomes such as academic achievement, social-emotional or behavioural performance. Only a few focuses on direct executive function outcomes, such as general executive function or specific components of executive function like working memory, cognitive flexibility, or inhibition (e.g., Smith et al., 2010).

Taken together, our survey of existing and ongoing executive function interventions reviews suggests there are no systematic reviews that have all of the following three features: (a) integration of the executive function intervention research from fields like neuroscience, neuropsychology, and psychology with research in education, with a primary focus on serving and informing policy makers, educators and researchers in education; (b) inclusion of multiple types of school-based interventions, such as teaching training or add-on curricula, for typically developing children and adolescents; (c) examination of both direct (e.g., general or specific components of executive function) and indirect intervention outcomes (e.g., academic achievement, social-emotional and behavioural performance). We

thus propose to conduct a systematic review and meta-analysis that will have all three features. We will thereafter refer it as “the proposed systematic review” or “the proposed review” for brevity.

This proposed review will be beneficial and important on at least three fronts:

1. It will integrate executive function intervention research across multiple disciplines and include multiple types of school-based interventions on typically developing school children and adolescents. It will examine the effects of executive function interventions not only on some indirect outcomes, such as academic achievement, social-emotional, or behavioral performance, but also on direct outcomes, such as EF in general or inhibition, working memory, cognitive flexibility, and planning.
2. It will examine not only whether executive function interventions work but also which components work and how they work, for whom they work, and in what circumstances they work. It will achieve this goal through the following three activities: (a) conducting a meta-analysis on eligible quantitative executive function efficacy studies and providing the estimates of overall effect sizes for executive function interventions; (b) performing moderator analyses in the meta-analysis through either an analysis of variance (ANOVA) or meta-regression to identify factors that significantly moderate the efficacy of interventions; and (c) conducting an in-depth investigation of issues or factors relevant to the efficacy interventions such as the implementation process or strategies that help or hamper the expected outcomes from the interventions. The findings from these three activities will shed light on issues of great practical importance.
3. It will employ advanced meta-analysis techniques to deal with study results that are from sophisticated statistical analyses, such as multiple regression, factor analysis, structural equation modeling (SEM), and hierarchical linear modeling (HLM). Some EF intervention studies do use these complex statistical analyses (see Barnett et al., 2008 for an example of studies that reported results from both multiple regression and HLM). Examples of advanced meta-analysis techniques include methods to deal with multiple regression results (see Becker & Wu, 2007; Mavridis & Salanti, 2013; Wu & Becker, 2012), and model-based meta-analysis (Becker, 2009), also called meta-analytic structural equation modeling or two-stage structural equation modeling (Cheung & Chan, 2005; Furlow & Beretvas, 2005). These techniques will be critical tools to tap into the increasingly growing research that uses advanced statistical methods and to help address important questions regarding the efficacy of interventions, which might involve complex interplays among sets of factors.

OBJECTIVES

The proposed systematic review aims to comprehensively synthesize the efficacy of school-based executive function interventions on typically developing children and adolescents. Specifically, this review will address the following six key questions:

1. Do school-based executive function interventions help improve children and adolescents' executive function skills, such as their overall skills, or specifically inhibition, working memory, cognitive flexibility, and planning?
2. Do school-based executive function interventions help improve the academic achievement, social-emotional and behavioral performance of children and adolescents?
3. Across many different types of school-based executive function interventions, is one type (e.g., exercise) more effective than the other (e.g., cognitive behavioral therapy)?
4. What kinds of evidence are available? Is the evidence from randomized controlled trials (RCTs) or from less rigorous research designs? Is the evidence sufficient, reliable, or convincing?
5. How do executive function interventions work, specifically, for whom, and in what circumstances?
6. What are the common features underlying the most effective executive function interventions? What are the most effective implementation process and strategies that maximize the benefits of interventions?

EXISTING REVIEWS

The vast majority of existing or ongoing systematic reviews or meta-analyses on executive function interventions are conducted on studies using clinical samples or in laboratory-based settings. These reviews fall into two broad categories: one group concentrating on pharmacological interventions (e.g., the use of stimulants for patients with ADHD or brain injury), and the other focusing on non-pharmacological executive function interventions. Examples of non-pharmacological interventions include dietary (e.g., free fatty acid supplementation), psychological and cognitive training programs (e.g., neurofeedback training, and cognitive behavioural therapy), computerized training programs (e.g., computerized working memory training programs), and Tai Chi (e.g., Karch, Albers, Renner, Lichtenauer, & von Kries, 2013; Melby-Lervåg & Hulme, 2013; Sonuga-Barke et al., 2013; Wayne et al., 2014).

In addition, there are a number of reviews on the effects of school- or home-based executive function interventions and they vary greatly in scope and outcome types. Only a few focus primarily on the direct outcomes of interventions, such as executive function in general, inhibition, working memory, cognitive flexibility, and planning. One example of such a review is by Smith et al. (2010), a meta-analysis of randomized controlled trials on the impact of aerobic exercise on attention and processing speed, executive function, and memory performance of adults over 18 years of age. Most of the reviews examine only indirect outcomes of interventions, such as academic achievement, social-emotional development, or behavioral performance, rather than the direct outcomes. For example, Jacob and Parkinson (2015) conducted a systematic review on the association between executive function and student academic achievement in reading and math. Randolph et al. (2014) are currently developing a Campbell Collaboration (C2) systematic review protocol on the effects of Montessori education on academic and behavioral improvements among 5-12 years old elementary students. Similarly, Maynard et al. (2014) are developing a C2 review protocol on mindfulness-based interventions for improving academic achievement, behavioral and socio-emotional functioning of primary and secondary students.

Some executive function interventions have also been reviewed by the What Works Clearinghouse (WWC). For example, the WWC (2008) reviewed research evidence for Tools of the Mind, an early childhood curriculum for preschool and kindergarten children. They found that one study (Barnett et al., 2008) met their evidence standards, three studies did not meet their evidence standards, and seven other studies did not meet their eligibility screens. Similarly, the WWC (2011) reviewed the research evidence of the Incredible Years program (see Webster-Stratton, 2011; Webster-Stratton, Reid, & Hammond, 2004).

A brief introduction of the Tools of the Mind and the Montessori education, as well as the two other exemplary interventions, are described in the Intervention section below. It is noteworthy that the WWC reviews are different from the Campbell systematic reviews. Specifically, the WWC reviews aim to identify the best available evidence on an educational intervention, rather than the general effectiveness of an intervention or the potential moderators of the effects.

There also exist a number of reviews of studies that do not focus on executive functions but broadly investigate the effects of school- or home-based social, emotional, or behavioural interventions on normal or disadvantaged young children and adolescents. Such interventions include self-monitoring interventions (e.g., Thompson, Maynard, Bowen, & Pelts, 2013), group-based parent trainings (Barlow & Parsons, 2005), social competence interventions (e.g., Kennedy & Pigott, 2012), instructional strategies (e.g., Spivak, Lipsey, Farran, & Polanin, 2013), school-based universal interventions (e.g., Durlak et al., 2011), and after-school programs (e.g., Durlak, Weissberg, & Pachan, 2010). These reviews typically concentrate on outcomes such as reducing challenging behaviors, developing prosocial behaviours, social competence and performance, improving academic achievement in children, adolescents, or young adults.

In summary, the proposed systematic review will make a unique contribution to executive function research and practice as it will focus on the efficacy of multiple school-based interventions on typically developing children and adolescents. It will include both direct and indirect outcomes of the interventions and it will utilize advanced meta-analysis techniques for sophisticated statistical analysis results. Finally, it will explicate issues of practical importance surrounding the efficacy of EF interventions.

INTERVENTION

Intervention Inclusion Criteria

Studies of executive function interventions need to meet four criteria to be eligible for this review, as follows:

First, interventions must be designed primarily to focus on promoting children and adolescents' executive function skills (direct outcomes) and/or other indirect outcomes such as academic achievement, social-emotional and behavioural performance. For interventions that are designed to promote a broad range of non-academic outcomes, we will determine whether their outcomes are conceptually or operationally related executive function in general or related to the four core components (i.e., inhibition, working memory, cognitive flexibility, and planning).

Second, interventions must be existing and widely implemented in school-based educational settings for at least 5 years. During such a time period, a sufficient number of evaluation studies might have been generated on the interventions yet the efficacy of the interventions may not be clearly established. Furthermore, the length of an intervention in individual evaluation studies has to be in place for at least two weeks, as research shows that executive function interventions need to be repeated over a sustained period of time to be effective (Barkley, 2012).

Third, interventions must be implemented on a group or individual basis within school-based environments, such as early childhood settings (e.g., preschool, Head Start), public, private, or charter schools. Interventions implemented in clinical- or laboratory-based settings will be excluded. Interventions implemented in home- or community-based settings, such as parent training, community prevention programs, will also be excluded.

Lastly, the efficacy of the interventions has to be empirically evaluated with a quasi-experimental design or randomized controlled trials. We describe the specific research design inclusion criteria in more detail below.

Examples of eligible interventions include, but are not limited to, school add-on curricula, physical activities (e.g., exercise, yoga), teacher training, and cognitive behaviour therapy conducted in school environments. We briefly describe four exemplary eligible interventions below.

- 1. Tools of the Mind.** Tools of the Mind, first implemented in 1993, is an early childhood curriculum for preschool and kindergarten children, based on the Vygotskian approach (Bodrova & Leong, 2006). It consists of 40 activities implemented over a two-year period designed to foster children's executive functions such as self-regulation, working memory, and cognitive flexibility, as well as their academic skills. Dramatic play is a key component of the curriculum, which requires teachers to engage in intensive professional development. It is active in more than 450 full- and half-day classrooms in six states in the United States during the 2008/09 school year (WWC, 2008). The efficacy of Tools of the Mind has been evaluated through a randomized controlled trial (e.g., Barnett et al., 2008).
- 2. Montessori Education.** Montessori education is an education approach originally developed by Italian physician and educator Maria Montessori. The essential elements of Montessori education include multiage classrooms, specialized materials, uninterrupted block of work time (ideally three hours) on student-chosen of activity from available options, a constructivist or discovery learning model, freedom of movement in the classroom, and a trained Montessori teacher (American Montessori Society, 2015; Association Montessori Internationale, 2014). Classroom is designed to promote concentration and a sense of order. It is estimated that there are at least 5,000 Montessori programs in the United States (Lillard & Else-Quest, 2006). Of those, more than 400 are public Montessori schools (American Montessori Society, 2015). Some Montessori schools provide all levels of learning, from infant & toddler through the high school level. The effects of the Montessori have been widely evaluated and often compared with traditional classroom education with various types of research designs (e.g., Lillard, & Else-Quest, 2006; Rathunde & Csikszentmihalyi, 2005a, Rathunde & Csikszentmihalyi, 2005b).
- 3. Head Start REDI.** Head Start REDI (REsearch-based, Developmentally Informed) is a federally-funded randomized intervention and control group study, developed in partnership with Head Start Program in 2003. It aims to promote school readiness skills such as prosocial skills, emotional understanding, self-regulation, aggression control, language and emergent literacy skills. The intervention is implemented through conducting professional development and mentoring with teachers to help them improve the quality of their language use, emotional support, and positive-management (e.g., Bierman et al., 2008; Domitrovich, Gest, Gill, Bierman, Welsh, & Jones, 2009).
- 4. Promoting Alternative Thinking Skills (PATHS) Curriculum.** The PATHS curriculum, established in 2000, is designed based on neurocognitive science on brain development and executive functioning to be used by educators and counselors for promoting social and emotional competencies and reducing aggression and behavior problems in children in preschool through grade 6 (Riggs et al., 2006). It is typically taught two or more times per week for approximately 20-30 minutes per

day. The current version of the PATHS curriculum consists of grade-specific classroom kits for Pre-K/Kindergarten, Grade 1-4, and Grade 5/6. The efficacy of PATHS curriculum has been evaluated with some randomized controlled trials (e.g., Domitrovich, Cortes, & Greenberg, 2007; Kam, Greenberg, & Kusché, 2004).

Comparison Inclusion Criteria

Eligible comparison conditions will include traditional school curricula, placebos, treatments as usual, or any other conditions set up as a contrast to the intervention conditions that allow the efficacy of interventions to be revealed.

POPULATION

The proposed review will include studies with populations of typically developing children and adolescents from ages 3 to 18. There are three reasons for selecting early childhood through adolescence as the developmental period of focus in this review. First, this age range is the key developmental period during which foundational executive functions, such as inhibition, working memory, and cognitive flexibility, rapidly progress (Best & Miller, 2010; Best et al., 2009). The executive function of planning appears relatively late in development, but it reaches adult-like levels around age 15 (Asato, Sweeney, & Luna, 2006). Second, evidence supports that early childhood and adolescence are significant periods during which to intervene for executive function development through the intentional teaching and support due to brain plasticity (Cramer et al., 2011). Lastly, selecting this age range corresponds to the main objective of this review, which is to provide evidence-based information regarding the effects of executive function interventions that can guide educational practices for children and adolescents to enhance outcomes. Age will be examined as a key moderator of the effects of interventions in the meta-analysis of this review. There will be no exclusion criteria based on study participants' demographic characteristics. Eligible studies may have been conducted on participants of any country but must be reported in English.

This review will not include studies that primarily focus on special populations with biological, neurological, behavioural, or learning disability diagnoses or those who work with such populations. Examples of such special populations include children and adolescents diagnosed with ADHD or attention deficit disorder (ADD), autism spectrum, oppositional defiant disorder (ODD), conduct disorder (CD), disruptive behaviour disorders (DBD), and brain injury. Many existing systematic reviews or meta-analyses have been conducted to synthesize the effects of EF interventions on such special populations (e.g., Cortese et al., 2015). In addition, research shows that the effects of executive function interventions might also be confounded by other factors such as health, or other comorbid conditions (Riccio & Gomes, 2013).

OUTCOMES

Primary Outcomes

Two primary outcomes will be examined in this proposed systematic review. The first one will be outcomes directly related to general executive function skills, or four specific components: inhibition, working memory, cognitive flexibility and planning. The second primary outcomes will be academic achievement (e.g., scores of standardized achievement tests, school grades, or school readiness) and social-emotional and/or behavioural performance (e.g., self-regulation, social-emotional competence, peer relations, and attentional performance). These outcomes will be assessed with a variety of measures, including performance-based measures, rating scales, academic achievement tests (e.g., standardized tests or teacher-made tests), observations, interviews, or other data collection methods.

This review will exclude studies that are primarily concerned with relatively severe social-emotional or behavioural outcomes, such as antisocial behaviour, aggressive behaviour, violence prevention, depressive symptoms, mental health, risks for substance use, and delinquency.

Secondary Outcomes

The secondary outcomes in this proposed review will be data relevant to intervention implementation logistics, quality of implementation and administrative support. This will be of great practical importance for education policy-making and practices.

STUDY DESIGNS

Quantitative Studies

Eligible quantitative studies that will be analysed meta-analytically need to employ strong empirical research designs, such as randomized controlled trials (RCTs) or quasi-experimental designs (QEDs). Randomized controlled trials (RCTs) include, but are not limited to, parallel group trials, cross-over trials, cluster-randomized trials, and factorial trials. Quasi-experimental studies need to employ appropriate comparison groups, which ought to resemble the main characteristics of the intervention groups in terms of the baseline measures, age, grade levels, or other demographical factors. Separate meta-analyses will be conducted on studies of RCTs and QEDs. Studies with a single-subject design will be excluded.

Mixed-Methods Studies

For eligible studies that employ mixed-methods, we will code and analyse the quantitative and section of the studies.

All eligible studies have to be conducted during the period from January 1985, when most of the school-based executive function interventions began to be prevalent, to the time of literature search conclusion (approximately December, 2015) and their full texts have to be available in English.

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ROLES AND RESPONSIBILITIES

Content: Saiying Steenbergen-Hu, Paula Olszewski-Kubilius, & Eric Calvert

Systematic review methods: Saiying Steenbergen-Hu & Paula Olszewski-Kubilius

Statistical analysis: Saiying Steenbergen-Hu & Eric Calvert

Information retrieval: Saiying Steenbergen-Hu & Eric Calvert

Saiying Steenbergen-Hu, PhD, will be the lead author of the proposed systematic review and meta-analysis. Steenbergen-Hu is a research assistant professor and the research director of the Center for Talent Development of the School of Education and Social Policy at Northwestern University. As the lead author, Steenbergen-Hu will take responsibility for review design, literature search, information retrieval, study coding, data-analysis, finding reporting, and research disseminations. She has knowledge and expertise on executive functions research. She and Eric Calvert received the 2014 American Psychological Foundation’s (APF) Esther Katz Rosen Grant (\$43,500) to conduct a study on executive

functioning skills of gifted students identified through above-grade-level standardized achievement tests. In addition, she and her co-authors of this proposed review have been working on a systematic narrative review of executive functions focusing on EF assessments, interventions, and the relationships between EF and intelligence and academic achievement (e.g., Steenbergen-Hu, Olszewski-Kubilius, & Calvert, 2014).

Steenbergen-Hu also has extensive knowledge and experience in conducting systematic reviews and meta-analyses. Her meta-analysis on the effects of acceleration on high-ability learners (i.e., Steenbergen-Hu & Moon, 2011) won the *Gifted Child Quarterly* (GCQ) (the no.1 research journal in the field of gifted education) *Paper of the Year Award*. She was a Co-Investigator of a systematic review project funded by the Smith Richard Foundation (\$100,000). In this project, she led and completed two meta-analyses on the effects of intelligent tutoring systems on K-12 students' mathematical learning and college students' academic learning, respectively. She played a leading role in designing the meta-analyses, conducting the literature search and information retrieval, coding studies, conducting data-analyses, and disseminating research findings. These two meta-analyses have both been published in the *Journal of Educational Psychology* (i.e., Steenbergen-Hu & Cooper, 2013, 2014). She has been a methodological referee for the *Campbell Collaboration (C2)* since 2010 to present and has successfully reviewed at least 6 C2 full reviews. She and Professor Olszewski-Kubilius recently completed a methodological brief on how to conduct a good meta-analysis in gifted education for the *Gifted Child Quarterly*. She also conducted and played a leading role in several other systematic reviews on the effects of classroom teacher questioning and ability grouping and acceleration (e.g., Steenbergen-Hu & Zhang, 2010; Steenbergen-Hu, Makel, & Olszewski-Kubilius, 2014).

Lastly, Steenbergen-Hu also has qualitative research experience. She was a Co-Investigator for a project investigating early college entrants' lived experiences and effects of enrollment in a math and science program in China, funded (\$25,000) by the Institute for Research and Policy on Acceleration, University of Iowa. In this project, she participated in research design, selecting and interviewing 38 early-college entrants, data-analysis, and research disseminations. This project has been successfully completed and yielded two peer-reviewed journal articles, which are currently in press on the *Gifted Child Quarterly* and the *Roeper Review*, respectively (i.e., Dai, Steenbergen-Hu, & Zhou, 2015; Dai, & Steenbergen-Hu, 2015).

Dr. Paula Olszewski-Kubilius is currently the director of the Center for Talent Development at Northwestern University and a professor in the School of Education and Social Policy. She has spent the past 30 years designing, implementing and evaluating supplemental educational programs for all kinds of gifted learners including traditionally underserved gifted children. She has authored over 120 articles and book chapters about talent development, outside of school programs, gifted education, and best practices for under-represented gifted students. She has served as editor of *Gifted Child Quarterly*, co-editor of the *Journal of Secondary Gifted Education* and on the editorial review boards of

The Roeper Review, *The Journal of Advanced Academics*, and *Gifted Child Today*. She is currently on the board of trustees of the Illinois Mathematics and Science Academy, a member of the board of directors of the Illinois Association for the Gifted, and serves on the advisory boards of the Center for Gifted Education at the College of William and Mary and the Robinson Center for Young Scholars at the University of Washington. She is the immediate past-president of the National Association for Gifted Children from whom she received the Early Scholar Award in 1987, the Distinguished Scholar Award in 2009, and the GCQ Paper of the Year Award in 2011. Her paper, *Rethinking Giftedness and Gifted Education: A Proposed Direction Forward Based on Psychological Science*, published in *Psychological Science in the Public Interest* received an Award for Excellence in Research in 2013 from the Mensa Education and Research Foundation of Mensa International. Dr. Olszewski-Kubilius will serve as a content expert and systematic review methods expert for this project.

Dr. Eric Calvert has extensive experience researching, designing, and evaluating school-based intervention and support strategies to improve outcomes for exceptional students. In particular, his work has focused on creating structures and support systems that enhance student access to and success in flexible educational structures and non-traditional learning environments, including accelerated, online, field-based, and hybrid settings. His interest in executive functions stems from the recognition that success in these environments is significantly contingent upon developing acquiring skills and support systems that allow them to benefit opportunities for increased choice, flexibility, and independence in learning options that are less rigidly structured and teacher directed. His work in this area has included designing professional development related to scaffolding independent study experiences for gifted students, developing research-based models for facilitating successful academic acceleration, supporting schools serving predominately minority and low income populations in implementing project-based learning and student-led research, and using technology-based tools to augment cognition and metacognition.

Calvert also brings significant research and practical experience related to assessment to the proposed project. At the Ohio Department of Education, Calvert led a review of assessment practices related to determining academically accelerated educational placements, designed and managed a technical review process for approving assessments for use in identifying gifted students, and managed a research grant program to evaluate the appropriateness of published assessments of cognitive ability and academic achievement for use with diverse subpopulations of students. Currently, Calvert co-chairs Center for Talent Development's Assessment Committee and oversees selection and development of resources to help non-technical users such as classroom educators and parents make appropriate use of standardized assessments. He has also served as a methodological reviewer for quantitative research papers for *Gifted Child Quarterly* and the *Journal of Secondary Gifted Education* focused on evaluating the efficacy of educational interventions, has designed and taught graduate courses on educational research methods, and frequently consults with school districts and state education agencies on evaluation research and design projects.

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POTENTIAL CONFLICTS OF INTEREST

None.

PRELIMINARY TIMEFRAME

Estimated project period: **July, 2015 --- June, 2017**

- Date to submit a draft protocol: **1st September, 2015**
- Date to submit a draft review: **1st September, 2016**

AUTHOR DECLARATION

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