ABSTRACT

Title of Dissertation	SPEECH-LANGUAGE PATHOLOGISTS' SERVICES FOR CHILDREN WITH CO-OCCURRING LANGUAGE AND EXECUTIVE FUNCTION DEFICITS
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There is a well-documented association between developmental language disorder (DLD) and executive function (EF) deficits. These co-occurring deficits pose risks to students' short- and long-term academic and social outcomes. In the United States, school-based speech-language pathologists (SLPs) are tasked to ensure that students with DLD are able to achieve academic success, and though EF generally lies within their scope of practice, it remains unclear the extent to which SLPs are equipped to address these deficits. This dissertation consists of three related studies, the sum of which shall provide insight into the SLPs' services. The first of these studies, Chapter 2, offers a systematic literature review of the evidence supporting intervention for children with co-occurring deficits, as well as a synthesis of the guidance for SLPs addressing EF deficits in their services. I found a dearth of empirical studies for interventions targeting this population, though a relative abundance of practitioner papers provides a foundation of best practices for direct and indirect services. Chapter 3 presents the second study, an exploratory latent profile analysis of 167 Kindergarteners' receptive language, expressive language, and working memory (WM), as well as follow-up analyses of variance which examine children's average behavior ratings by profile. I identified a suitably-fitted three-profile model of language and WM, and I found that low-performing children, on average, were rated lower in social

competence. Finally, Chapter 4 contains a mixed-methods analysis of school-based SLPs' interventions for children with EF deficits. Following an explanatory sequential design, I first surveyed 350 SLPs, then followed up with eight interviews designed to explain and contextualize the survey results. I found that most SLPs support EF deficits through indirect services or embedded strategies, though fewer provide direct intervention. However, direct intervention is feasible, and SLPs' knowledge and confidence about EFs influence their service provision. Overall, the findings of this dissertation support the notion that SLPs can be active and involved service providers, addressing EF deficits that are abundant in children with DLD, and which may otherwise hinder students' education. However, to optimize these services, the field of SLP requires further empirical intervention research and improved SLP preparation to ensure that SLPs can meet all the needs of students with co-occurring deficits.

SPEECH-LANGUAGE PATHOLOGISTS' SERVICES FOR CHILDREN WITH CO-OCCURRING LANGUAGE AND EXECUTIVE FUNCTION DEFICITS

by

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Dissertation submitted to the Faculty of the Graduate School of the
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Dedication

I dedicate this dissertation to my son, Oliver, who presently can neither read nor understand a single word I've written.

But I can hear you babbling "Dada dada dada" outside my office door, and I can't wait to submit this manuscript and go play with you.

I love you, Ollie.

Acknowledgements

First and foremost, I must thank my wife Mandy, without whom this dissertation would likely have been an abandoned dream. This is as much your accomplishment as it is mine, and I can't help but be amazed at all of the hard work you've put in over the last few years. You gave me unending encouragement, support, and motivation, all of which were 100% necessary for me to make it through my doctoral studies. You also gave me a son, who did *not* help me finish my doctoral studies. But wow, he sure is cute! Anyway, I'm proud of you, I appreciate all of the support you've given me, and I can't wait to spend the rest of my life trying to repay the debt I owe you for patiently tolerating this wild journey.

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Dr. Christine Bae, Dr. Jing Liu, and Dr. Jade Wexler: Thank you immeasurably for your service on my dissertation committee! Looking back on my doctoral experience, my main regret is that I wasn't able to work more closely with each of you. I would have liked to take your courses, collaborate on research, and pick up all sorts of lessons along the way. Alas, between the relative brevity of my program, my decision to transfer between universities, and the global pandemic that turned me into a recluse, I've not yet had the chance to get to know you half as

well as I would have liked. Nevertheless, you agreed to serve on my dissertation committee, and for that I am forever grateful. I hope that my dissertation marks the beginning of our collaboration, not the end!

As I alluded to above, partway through my studies, I transferred from Virginia Commonwealth University to the University of Maryland, College Park. On one hand, I never had the chance to establish deep roots at either school, but on the other hand, I was blessed with two sets of faculty, two sets of colleagues, and two sets of administrative staff to support me through my studies, and I never once felt like any of them treated me any lesser for my lack of roots. This acknowledgement is for my families at VCU and UMD, each of whom have treated me like their own. A special shout-out to Dr. Kevin Sutherland, who wrote letters of reference even after I transferred out of VCU; Christine Powell, who will forever be my cohort "bestie," and Carol Scott, who has never met me but has patiently answered hundreds of my questions about UMD's program, policies, and requirements.

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List of Key Terms and Abbreviations

To aid readers, I present the following list of key terms and abbreviations used throughout the dissertation, paired with definitions of these terms as I have used them. They are presented alphabetically, except for abbreviations of the assessments used in Chapter 4, which are found under the term "Assessments."

American Speech-language-hearing Association (ASHA): A professional association of speech-language pathologists in the United States and internationally. It acts as the national professional, scientific, and credentialing association.

Assessments: The School Social Behavior Scale (2nd edition; SSBS) is a teacher-reported measure of children's behavior. The Test of Auditory Comprehension of Language (4th edition; TACL) is a direct measure of children's receptive morphology, vocabulary, and syntax. The Test of Expressive Language (TEXL) is a direct measure of children's expressive morphology, vocabulary, and syntax. The Wechsler Intelligence Scale for Children (5th edition; WISC-V) is a direct measure of children's intellectual ability.

SSBS AB: The Antisocial Behavior scale of the SSBS; a composite score of Peer Relations, Self-management/Compliance, and Academic Behaviors.

SSBS SC: The Social Competence scale of the SSBS; a composite score of Hostile/Irritable, Antisocial/Aggressive, and Defiant/Disruptive.

TACL RLI: The Receptive Language Index of the TACL; a composite score of the Vocabulary, Grammar, and Elaborated Phrases and Sentences subtests.

TEXL ELI: The Expressive Language Index of the TEXL; a composite score of the Vocabulary, Grammar, and Elaborated Phrases and Sentences subtests.

WISC-V DS: The Digit Span subtest of the WISC-V, which measures working memory.

Attention-deficit/hyperactivity disorder (ADHD): A neurodevelopmental disorder which impacts attention, hyperactivity, and impulsiveness. Executive function deficits are a ubiquitous characteristic of ADHD.

Computerized Working Memory Training (CWMT): A type of intervention which purports to use adaptive training techniques to improve working memory function and capacity.

Developmental Language Disorder (DLD): A neurodevelopmental disorder characterized by deficits in using or understanding language. It is diagnosed in the absence of other associated conditions, such as Autism Spectrum Disorder or Intellectual Disability (Bishop et al., 2017).

Direct Services: A term used to describe services, typically intervention, provided by the speech-language pathologist directly to the student. I use this term to describe pull-out, push-in, or integrated intervention services.

Executive Function (EF): The cognitive skills used to plan and perform goal-directed behaviors. Though various researchers dispute the precise mechanics of EF, this definition includes the traditional components of response inhibition, working memory, and shifting/flexibility, as well as more complex skills such as planning, problem-solving, and organization (Jones et al., 2016).

Implementation Science: The study of methods used to promote the systematic uptake of research into routine clinical practice, and to improve patient outcomes and services quality. (Eccles & Mittman, 2006).

Indirect Services: A term used to describe services that the speech-language pathologist provides to improve student outcomes without direct contact with the student. Examples include collaboration and consultation with parents and other educators, as well as the implementation of

environmental modifications (e.g., visual supports, organizers) or instructional modifications (e.g., repetition, chunking).

Individuals with Disabilities Education Act (IDEA): A piece of American legislation that ensures students with disabilities receive individualized Free and Appropriate Public Education; this dictates aspects of special education such as eligibility criteria. Children eligible for special education under the criteria of Speech-Language Impairment will often receive services from the speech-language pathologist if their disability otherwise prevents them from accessing their classroom curriculum.

Intervention: A service provided by the speech-language pathologist or another educator/service provider, which aims to improve student deficits or to mitigate the effect these deficits have on the student's education.

Latent Profile Analysis (LPA): A categorical latent variable approach that focuses on identifying latent subgroups within a sample, based on a certain set of variables (Spurk et al., 2020).

Speech-language Pathologist (SLP): A service provider specialized in identifying and/or remediating deficits of articulation, fluency, voice and resonance, receptive and expressive language, hearing, swallowing, cognitive communication, social communication, and communication modalities. This dissertation focuses on SLPs who serve children with receptive and expressive language deficits, particularly within a school-based setting in the United States.

Specific Language Impairment (SLI): A common term for language disorders which preceded the term Developmental Language Disorder; unlike DLD, SLI applies only to individuals whose intelligence falls at or above the average range.

Working Memory (WM): One of the primary components of EF, which is most closely associated with language acquisition and ability. WM refers to the ability to retain information in short-term cognitive stores long enough to complete a task or to process the information into a longer-term store. Much like EF, there is little consensus on the specific mechanisms of WM, though researchers generally agree that verbal (/phonological) and nonverbal (/visuospatial) WM are separate but related skills.

Chapter 1: Introduction

Developmental language disorder (DLD) is a common but "hidden" condition which impacts individuals' ability to communicate and understand others (Bishop et al., 2017). Despite the inherent importance of communication, DLD remains underserved and under-researched (McGregor, 2020). It is a neurodevelopmental impairment of language acquisition, prevalent in an estimated 7.58% of children, which occurs in the absence of an explanatory or causal condition (Bishop et al., 2017; Norbury et al., 2016). DLD may impact the production or comprehension of a variety of domains of language (i.e., phonology, morphology, syntax, semantics, or pragmatics), which limits the school-age child's ability to understand or demonstrate their understanding of the classroom curriculum.

Children's language ability is inextricably linked with academic success, including the domains of reading (Dickinson et al., 2010), writing (Dockrell et al., 2009), and mathematics (Chow & Jacobs, 2016). They are also linked to social behavior and friendships (Durkin & Conti-Ramsden, 2007); and even general life outcomes such as employment (Law et al., 2009). As such, students with DLD are at risk for poorer outcomes in education and in other aspects of their life. Per the Individuals with Disabilities Education Act (IDEA; 2004), speech-language pathologists (SLPs) provide services to children with speech or language impairments who require specialized instruction to fully access their education.

Whereas communication deficits are a characteristic symptom of DLD, a growing body of research demonstrates that children with DLD may often present with other developmental deficits as well. Among these are deficits in executive functions (EFs), which are the cognitive processes used to facilitate goal-directed behavior (Jones et al., 2016). Traditional models of EF describe three components: working memory (WM), which stores small sets of information for

immediate use; response inhibition, which suppresses interfering impulses; and shifting, also known as flexibility, which allows for smooth transitions between tasks. Each of these domains of EF are commonly impaired in children with DLD, who on average present with phonological WM deficits of 1.27 standard deviations below their language-typical peers, visuospatial WM deficits of 0.63 standard deviations, inhibitory control deficits of 0.56 standard deviations, and cognitive flexibility deficits of 0.27 standard deviations (Graf Estes et al., 2007; Pauls & Archibald, 2017; Vugs et al., 2013). Though there is a notable association between EF and language ability, and though deficits in these domains often co-occur, the interactions between their developmental trajectories are not yet fully understood. In a longitudinal study of children ages four through seven, Gooch and colleagues (2016) observed a strong concurrent association at each time point, but cross-lagged analyses were weak and non-significant. These findings suggest that language and EF may share a common mechanism or factor (e.g. processing speed; Im-Bolter et al., 2006) influencing the development of both, or perhaps that there may be a directional association in early childhood. Indeed, Spaulding and colleagues (2008) observed that early childhood attention skills may influence language learning.

Various complementary models have been developed to describe how these foundational components directly relate to complex skills, including planning, problem solving, organization, and more (Jones et al., 2016). Like language, EF is another strong and significant predictor of academic achievement in areas such as mathematics, reading, and science (Morgan et al., 2019; Samuels et al., 2016). For this reason, it is particularly worrisome that children with DLD often present with EF deficits, because it is reasonable to suspect that a child with co-occurring deficits of language and EF is at even higher risk for academic difficulties.

From a therapeutic perspective, EF is a notable consideration in the remediation of children with DLD, because one skill may impact the success of the intervention and the development of the other skill. In one example, Kapa and Mettler (2021) examined self-directed speech in children with DLD. They found that self-directed speech was positively associated with EF performance, but the development of this skill was delayed in children with DLD. Thus, by supporting the acquisition and use of self-directed speech in children on their caseload, SLPs may be able to improve functional EF performance. In another example, Montgomery and colleagues (2021) recognized that WM, which is perhaps the discrete EF skill most closely associated with language (Pauls & Archibald, 2016) acts as a conduit for language comprehension in children with DLD. Whereas language-typical children acquire language without the added influence of WM, children with DLD require WM to retain linguistic input long enough to convert it to long-term knowledge. Therefore, it appears likely that receptive language deficits may be mitigated in children by teaching them strategies to circumvent their poor WM, such as rehearsal and repetition.

SLP Services for Children with EF Deficits

Given (1) the established prevalence of EF deficits in children with DLD, (2) the contribution of EF to positive academic and communication outcomes, and (3) the SLPs' responsibility to support students with DLD in meeting curricular demands, it is therefore imperative to ensure that SLPs are properly equipped to address EF deficits which co-occur in children on the SLPs' caseload, particularly those with DLD. However, at present, EF represents a small niche in the field of speech-language pathology, and there are several gaps in the literature which prevent further progress in this area. First, the best practices for intervention for children with co-occurring DLD and EF deficits remain unclear. Whereas there is an abundance

of research conducted on separate populations (i.e., children with DLD, or children with EF deficits attributed to another condition such as attention-deficit/hyperactivity disorder), the interaction between DLD and EF suggests that intervention practices should be validated for students with co-occurring deficits. In the absence of empirically-validated interventions, we must look to the literature for the best available guidance.

A second gap is the present lack of understanding of how language and WM present in children. WM is particularly important because, of all of the various discrete EF skills, it is the most closely intertwined with language (Graf Estes et al., 2007), and it serves an important role in vocabulary acquisition, expressive and receptive language, and reading (Gathercole & Baddeley, 2014). However, despite the abundance of variable-centered research of language and WM, there is a dearth of person-centered research, which can be readily applied to clinical practice (Logan & Pentimonti, 2016). Person-centered research offers a glimpse into clinical profiles of children with various strengths and weaknesses, and a better understanding of children's profiles may help inform SLPs' intervention approaches.

A third gap is that current SLP services for children with EF deficits are not clearly understood. Whereas other related areas of SLP practice have been explored through the lens of implementation science (e.g., SLP practices for adults with traumatic brain injury; Riedeman & Turkstra, 2018), no studies to date have explored how SLPs serve children with EF deficits, nor the barriers or facilitating factors which influence their service provision. Without knowledge of SLPs' current practices or obstacles, it would be difficult to offer helpful and relevant guidance in the area.

Overall Dissertation Purpose

The purpose of this dissertation is to address these gaps so that we may better understand the present state of SLP services for children with co-occurring DLD and EF deficits. In doing so, we may illuminate the path forward to a better foundation of SLP research, preparation, and practice. To that end, I pose the following three research questions, each of which are expanded upon in the chapters to come:

1) What are the effects of interventions provided for children with co-occurring DLD and EF deficits, and what practices are generally recommended by the SLP literature?
2) What latent profiles, if any, emerge based on young children's language and WM? How are these profiles associated with visible and recognizable child characteristics (i.e., behavior)?
3) How do school-based SLPs address EF deficits in their services, and what factors affect the provision of these services?

Outline of the Dissertation

My dissertation consists of three related studies, each centered on one of the questions above. It is organized into five chapters: Introduction, Research Synthesis, Mixed-method Study, Latent Profile Analysis, and Conclusion. The current chapter (Chapter 1: Introduction) introduces the problem and the significance of this research, and provides a general outline of the remainder of the dissertation.

Chapter 2 presents a systematic literature review which aimed to answer the first research question above. It shares the results of two concurrent literature searches: the first of which identified empirical intervention studies of children with co-occurring DLD and EF deficits, and

the second of which identified non-empirical articles which offered guidance to SLPs on how to provide EF intervention. Chapter 2 contains a synthesis of the best available practices as identified through the literature review.

Chapter 3 addresses the second research question above by presenting the results of an exploratory latent profile analysis of 167 Kindergarten students' expressive language, receptive language, and WM. I identified a well-fitted model based around three profiles, a *Low-performing* group, an *Average* group, and a *High-performing* group. I then conducted follow-up analyses to determine whether there was a difference in the behavioral characteristics of children in these groups. Chapter 3 contains the results and discussion of these analyses, and also includes implications for how SLPs and educators can apply these findings to improve the identification and services provided to students with language and WM deficits.

Chapter 4 addresses the third research question by presenting the results of a sequential explanatory study of a quantitative survey and qualitative interviews. I surveyed 350 school-based SLPs about their knowledge of EF, their current intervention practices, and any barriers or factors which influence their provision of EF services. I used the results of this survey to inform interviews of eight SLPs, selected to be representative of the survey respondents, which explored each of these topics in greater detail. Chapter 4 contains a thorough description of current SLP practices, as well as implications for SLP preparation, practice, research, and policy.

I conclude with Chapter 5, which contains a summary of the findings of the three studies contained within this dissertation, a critical synthesis of how the sum of these studies impacts the field of speech-language pathology, and brief recommendations for practitioners and researchers.

Chapter 2: Research Synthesis

Abstract

Purpose: The purpose of this synthesis was to systematically review the research and guidance for school-based speech-language pathologists (SLPs) who provide intervention to children with developmental executive function deficits, particularly those children with co-occurring language disorders.

Method: We conducted a structured search of four major electronic databases that yielded 27 articles for analysis. We categorized these studies by type of publication and synthesized their contents to assess the evidence base for executive function interventions in children with Developmental Language Disorder, and to evaluate the guidance for SLP-implemented direct and indirect interventions.

Results: A small body of research explores the efficacy of SLPs' intervention for children with co-occurring language disorders and executive function deficits, generally finding modest but inconsistent effects of cognitive interventions and strategy training to improve language outcomes. Guidance suggests that SLPs can support students with executive function deficits by ensuring appropriate accommodations are provided, including visual aids and modified instructional practices. Further, SLPs may provide direct intervention by teaching discrete skills or generalizable strategies.

Conclusions: A robust body of literature equips SLPs with the principles and strategies of executive function intervention. Many of these papers are sourced from literature about children with executive function deficits or ADHD, but few empirical studies explicitly measure the efficacy of these interventions for children with co-occurring language disorders.

Speech-language Pathology Interventions in Children with Executive Function Deficits: A Systematic Literature Review

Executive function deficits, often associated with medical conditions (e.g., acquired brain injury) or neurodevelopmental disorders (e.g., Attention-Deficit Hyperactive Disorder [ADHD]), may be more prevalent among children in a school-based speech-language pathologist's (SLP) caseload than previously realized. Executive function (EF) deficits commonly co-occur with language disorders in children (see Graf Estes et al., 2007; Pauls & Archibald, 2016; Vugs et al., 2013). Since about 90% of school-based SLPs serve children with language disorders (ASHA, 2020), it is essential that SLPs be equipped to provide services that are sensitive to the needs of children with co-occurring language disorders and EF deficits.

Evidence-based practice is the cornerstone of speech-language services, so SLPs must be mindful of the research supporting their interventions. Certainly, SLPs strive to provide language interventions grounded in evidence-based practice. However, it is unclear the extent to which these interventions are effective in children with co-occurring deficits. Cognitive limitations may lead to poorer outcomes in language intervention, which suggests the need for evidence to support the efficacy of interventions specifically for children with co-occurring DLD and EF deficits (Montgomery et al., 2010). Further, the efficacy of EF interventions may be limited in children with DLD, as many of the most common interventions rely on verbal mediation. There is also a need to explore the SLPs' role in intervention for children with EF deficits, as only half of SLPs report providing cognitive communication therapy (ASHA, 2020).

Executive Functions

EFs are the cognitive skills necessary to plan, organize, and engage in goal-directed behaviors (Miyake et al., 2000). Various models take different approaches to defining and

describing the components of EF. Most models agree on three domain-general ("simple") skills: working memory (WM), shifting attention, and inhibiting competing thoughts (Diamond, 2013; Miyake et al., 2000). In contrast, other models include domain-specific ("complex") skills such as sustained attention, goal-directed persistence, metacognition, organization, emotional regulation, and more (Brown, 2005; Dawson & Guare, 2009; Jones et al., 2016). These complex, functional skills are understood to interact and build upon the foundations of other EFs.

Regardless of the model of EF, these skills are linked to notable child developmental outcomes such as academic achievement (Best et al., 2011), behavior and social competency (Nigg et al., 1998), and social-emotional development (Hughes et al., 2000). Further, EFs have implications for interventions as an outcome (e.g., Diamond & Ling, 2019), mediating mechanism (Raver et al., 2011), or as an intervention component (Bierman et al., 2011).

Developmental Language Disorder

Developmental Language Disorder (DLD) is the term used to describe a naturally-occurring impairment of one or more language components, including phonology, morphology, syntax, semantics, and pragmatics. It is estimated to occur in about one in 13 children (7.58%; Norbury et al., 2016) and is found in the absence of a differentiating condition such as a genetic or neurological etiology (Bishop et al., 2017).[1]

Executive Functions in Speech-Language Pathology

DLD is associated with a host of academic outcomes, including reading disabilities, spelling problems, and math difficulties (McGregor, 2020; Young et al., 2002). While the

[1] Language disorders are described by a wide variety of terms, including Specific Language Impairment (SLI), Primary Language Impairment (PLI), and Developmental Language Disorder (DLD). Of these, DLD is the most inclusive. In accordance with Bishop et al. (2017), this systematic review will use the term "DLD" to describe all language disorders that occur in the absence of a known differentiating condition, even when the original authors of the included texts used SLI, PLI, or similar terms in their text.

academic risks of DLD have been long-understood, an emerging body of research explores the risks of co-occurring EF deficits. Much of this research addresses WM in children with DLD, including meta-analyses finding that children with DLD perform, on average, 1.27 standard deviations below their peers for phonological short-term memory (Graf Estes et al., 2007), .63 standard deviations below their peers in visuospatial working memory tasks (Vugs et al., 2013) .56 standard deviations below their peers tasks of inhibition, and .27 standard deviations below their peers in tasks of cognitive flexibility (Pauls & Archibald, 2016).

Based on these findings of EF deficits in children with DLD, it should come as no surprise that Attention-Deficit/Hyperactivity Disorder (ADHD) frequently occurs as a comorbid disorder in children with language impairments. ADHD has an estimated co-occurrence rate of 22.3% in children with DLD, and though reports do not indicate that ADHD exacerbates language impairment, this high rate of co-occurrence may impact the way that SLPs conduct assessment and intervention for children in this population (Redmond 2016; 2020).

Despite the prevalence of EF impairments and disorders in children with DLD, the field of speech-language pathology research has seemingly devoted more attention to EF deficits in other populations, such as individuals with acquired brain injuries. One indicator of this effort is reflected in the abundance of research on assessment practices (e.g., Constantinidou et al., 2012; Salis et al., 2018), intervention (e.g., Dachtyl et al., 2017), and the role of the SLP in treatment (e.g., Haarbauer-Krupa, 2012). Only one in eight school-based SLPs serve children with acquired brain injury, with an average of 2-3 children per caseload (ASHA, 2020). The resources for clients with acquired brain injury may be useful in other settings of SLP practice, but this body of literature does little to support school-based SLPs who are more likely to encounter executive function deficits occurring alongside DLD or other neurodevelopmental disorders.

The growing awareness of EF impairments developing alongside DLD is reflected in the expanding body of research in this area, but much of this research focuses on descriptive information (e.g., Pauls & Archibald, 2016; Redmond, 2020) or assessment practices (e.g., Fahy, 2014). While there is intervention research for children with EF impairments, much of it focuses on interventions for social communication (e.g., Timler et al., 2015) rather than academic outcomes. The prevalence of EF deficits in children with DLD, coupled with the heightened risk of negative academic outcomes, justify the SLP's role in the identification and remediation of EF deficits. However, interventions for this population are underexplored.

Research Aims

Because there is a dearth of research about interventions to support developmental EF deficits in children with DLD, SLPs are at risk to be insufficiently equipped to serve these children on their caseloads. This paper aims to systematically review the literature which informs school-based SLP's practice for children with EF deficits, including the research which constitutes the evidence base as well as the practitioner papers which provide information about the implementation of these interventions. To that end, this paper will:

1) Identify research which reports the results of interventions for children with co-occurring EF deficits and DLD
2) Synthesize the current guidance for SLPs to provide intervention (including guidance for accommodations, principles and strategies of intervention, and intervention frameworks) to children with developmental deficits of EF

Method

This systematic review follows the reporting guidelines and criteria set forth in Preferred Reporting for Systematic Reviews (PRISMA; Page et al., 2021). For the purposes of this review,

we examined direct and indirect interventions for EF deficits prevalent in school-age children with DLD. Articles of interest include empirical studies evaluating the efficacy of EF interventions for children with DLD, as well as practitioner papers providing guidance for how SLPs can provide support for children with EF deficits.

Operational Definitions and Search Strategy

This systematic review operationalizes EFs based on their description in the Executive Function Mapping Project (Jones et al., 2016). This model includes three components: response inhibition, set shifting, and WM, as well as numerous complex (proximal and distal) skills. Search terms pertaining to EF were drawn from this model. Further, because ADHD is a well-known and well-studied disorder of EF, and because much of the literature in the field of speech-language pathology discusses EFs within the context of children with ADHD, the search was also extended to include terms related to ADHD based on the premise that there is meaningful overlap between interventions for ADHD and other EF deficits.

Our search included terms related to DLD and related terms which fall under the umbrella of DLD (e.g., Specific Language Impairment, Primary Language Impairment). We expanded the search terms to include "speech-language pathology" and related terms to ensure the inclusion of literature that is relevant to this population. Interventions were operationalized as direct or indirect services that could be feasibly implemented by a school-based SLP.

Inclusion Criteria

The study inclusion criteria were as follows:

1) Original, peer-reviewed journal articles; theses and dissertations. No date restrictions.

2) Included articles must feature intervention for children with EF deficits. This broadly describes direct and indirect therapy, accommodations, and related strategies. Studies focused on descriptive associations or assessment were excluded.
3) This review focuses on developmental EF deficits, such as those found in Attention Deficit Hyperactivity Disorder. Deficits occurring secondary to acquired brain injuries (ABI), such as strokes or concussions, were not included.
4) Preference was given to publications addressing the population of school-age children (i.e., K-12) with DLD. Closely-related articles (e.g., tutorials for pediatric SLPs) were included on a case-by-case basis dependent upon whether their guidance could be feasibly applied to school-based SLPs' practice.

Data Extraction

Article Screening

The search and selection process is reported following the PRISMA 2020 standards for reporting systematic reviews (Page et al., 2021; see Figure 2.1). The initial search yielded 6,362 articles that were screened for inclusion. Search results were imported into Rayyan, a free web application published by the Qatar Computing Research Institute (Ouzzani et al., 2016). Following the removal of 1,795 duplicates, 4,567 articles remained. The first author screened each article's title and abstract to assess eligibility for inclusion, and an undergraduate research assistant screened 1,100 titles and abstracts (approximately 25% of the total). Reliability between the screeners was 98.6%, and the authors reviewed discrepancies to ensure accurate decisions about inclusion.

The initial screening yielded 32 articles for which the full-texts were further reviewed for inclusion. The reference lists of these articles were hand-searched, leading to the identification of

two additional articles, and we reviewed special issues of journals to find an additional two articles. After full-text review, 27 articles met the inclusion criteria.

Article Coding

For each included publication, we extracted key information necessary to synthesize the overall findings or guidance, and entered into one of two spreadsheets, dependent upon whether the publication was an empirical design (Table 2.1) or a practitioner paper (Table 2.2).

For each included empirical study, we extracted the following information: name of author(s), date of publication, research design, population (e.g, DLD, ADHD, or co-occurring DLD and ADHD), EF construct (e.g., ADHD, working memory), number of participants, interventionist (e.g., SLP, multidisciplinary team), intervention category (e.g., direct [language], direct [EF], indirect, or principles of intervention), and outcome variables.

For each practitioner paper, we extracted the following: name of author(s), date of publication, population, EF construct, DLD focus (coded as "Yes" or "No" depending on the scope of the article), interventionist, intervention category, and the targeted outcome variables.

The first author of this review coded each article, and the third author served as a second coder to demonstrate reliability. We randomly selected eight articles (30%) to double-code; four empirical and four non-empirical papers. Reliability across the empirical studies was 87.5%, and the coders resolved all discrepancies. Reliability across the non-empirical papers failed to meet our standards (78%), so we adjusted our coding scheme for clarity, resolved differences, and selected four new articles to double-code. Our reliability across the second set of non-empirical papers was 96%, and we updated previously-coded articles based on the revised coding scheme.

Results

Twenty-seven articles met the criteria for inclusion. They represented a diverse array of formats, both empirical (*n* = 10, 37%) and non-empirical (*n* = 17, 63%). Three of the ten empirical studies used single subject designs, three used quasi-experimental designs, and four were case studies (i.e., non-experimental designs). The non-empirical articles contained an assortment of narrative reviews, conceptual papers, tutorials, and two instances of research summaries containing implications for practice. The dates of publication ranged from 1994-2021, and most (*n* = 21, 78%) were published in peer-reviewed journals of speech-language pathology, communication disorders, or language disorders.

The first aim of this systematic review is to identify the evidence for interventions in children with co-occurring EF deficits and DLD. The findings pertaining to empirical designs are reported below, containing summaries of quasi-experimental designs, single case designs, and case studies (which, though empirical, are non-experimental in nature). The results pertaining to the second aim of this review, to synthesize the current guidance for SLP intervention into developmental EF deficits, are reported below as guidance. These results contain a variety of tutorials and narrative reviews.

Empirical Designs

Quasi-experimental Designs

Gill and colleagues (2013) conducted a quasi-experimental study, the results of which provide some evidence for rehearsal and visualization strategies to improve memory in children with DLD. Children who received explicit instruction in these strategies performed significantly better on recall tasks than their peers who received traditional speech-language therapy alone, and the effects persisted through a follow-up eight months later.

Holmes and colleagues (2015) conducted a quasi-experimental study of the computerized working memory training (CWMT) program "Cogmed Working Memory Training RM," which is intended to improve cognitive skills such as verbal short term memory through a series of progressively difficult computer-based tasks (Klingberg, 2001). They found that children with low language ability showed similar benefits from Cogmed as language-typical peers. However, their study did not address criticisms that CWMT may not produce generalizable or durable effects (see Gillam et al., 2018; Melby-Lervåg & Hulme, 2013).

Stanford and colleagues (2019) conducted a similar quasi-experimental study of Magic Memory, another type of CWMT. Their study, conducted on French-speaking children aged 5-12 years, found that WM training resulted in significant improvement to both WM performance and 3rd person accusative clitics (i.e., a morphosyntactic structure referring to the unstressed portion of contractions) in children with DLD. A control group receiving scholastic intervention showed no significant changes. This study provides some evidence that WM training may improve not just working memory, but also far-reaching outcomes such as language ability in children with DLD. However, durability and generalizability are still questionable due to the absence of a later follow-up and the narrow scope of linguistic outcomes.

Single Case Designs

Ebert and Kohnert (2009) conducted a multiple-baseline across participants design with two children diagnosed with DLD to determine the efficacy of auditory memory training and visual processing speed training to improve language and cognitive function. The results lend some support to the notion that cognitive training can improve linguistic outcomes, as both participants improved their performance on rapid naming tasks, and both showed significant improvements in standardized language assessments administered pre- and post-test. However,

these findings must be interpreted cautiously due to limitations of internal validity (e.g., limited opportunity to demonstrate experimental effects, the rehearsal effect on standardized assessment, and the absence of a control intervention or task). Finally, the data from the repeated measures tasks cautiously provided only modest support for the efficacy of intervention on linguistic measures, due to high levels of overlap between phases and significant variability within individual phases in both participants.

Ebert (2014) conducted a multiple-baselines across participants design with three children diagnosed with DLD, two of whom had also been diagnosed with ADHD. The purpose was to determine whether conventional language treatment (i.e., therapy targeting relational vocabulary, morphosyntax, and auditory comprehension) is effective for improving cognitive skills. Ebert concluded that the two participants with ADHD showed mild improvement in WM and processing speed post-intervention, but there was substantial within-child variability both pre- and post-intervention, as well as inter-phase overlap and variability.

Shahmahmood and colleagues (2018) conducted a phased single subject design (A-B-A-C) evaluating the effectiveness of WM training and traditional language therapy on WM and grammar in ten Persian-speaking children with DLD. In contrast to Ebert and Kohnert (2009), this article found that WM training resulted only in improvements to WM tasks, while improvements to language were inconsistent. Dedicated language therapy resulted in improvements to non-word repetition and sentence completion tasks.

Intervention Case Studies

Clegg and Hartshorne reported two case studies of children with co-occurring DLD and ADHD (2004). Within these case studies, multidisciplinary educational teams including an SLP implemented a variety of strategies including curricular modifications, reduced distractions,

increased structure, visual support, and support in social communication. In the first case study, the authors reported benefits for learning, language, and communication, and the second case study demonstrated the feasibility of coaching teachers to accommodate learners with co-occurring disorders.

Dunaway (2004) contributes a narrative case study describing a school-based SLP's role in supporting a child with ADHD. This SLP collaborated with educators to implement contextual and instructional modification, as well as direct writing interventions. Through this collaboration, the educators and SLP were able to negotiate mediating opportunities such as service across settings.

In a similar vein, Singer and Bashir (1999) used a case study of a sixteen-year-old boy with DLD to supplement a conceptual description of executive functions and the SLP's role in remediation. The authors emphasize the interaction between cognition and language, noting that speech-language treatment can include metacognitive strategies such as self-talk and thinking maps. The authors note the importance of using dialogic and interactive approaches, teaching the flexible use of strategies, addressing the linguistic underpinnings of metacognition, and developing the student's self-efficacy and motivation. They encouraged SLPs to provide context for strategies by teaching the student where, when, why, and how to use them.

Datchuk and colleagues (2020) reported a case study of a specific intervention for a child with co-occurring DLD and ADHD. In this instance, the interventionist was a special educator using a combined approach of sentence instruction and frequency building to a performance criterion. The intervention targeted the accuracy and speed of sentence writing, and the child demonstrated immediate improvement in both regards following intervention.

Non-empirical papers: Guidance for Intervention

The majority of publications selected for inclusion were practitioner papers intended to explain the role of SLPs in the treatment of children with EF deficits. The contents of these papers ranged from principles of intervention to intervention categories to explicit descriptions and examples of intervention.

Principles of Intervention

In a tutorial for school-based speech-language pathologists, Drazinski (2014) described the principles of intervention for children with EF deficits, both developmental and acquired. Drazinski encouraged SLPs to select an intervention plan based on the child's individualized strengths and needs, using "repetitive routines with contextualized [and meaningful] activities resulting in positive outcomes" in order to establish a pattern of successful habits. Drazinski also noted that SLPs can use elements of restorative and compensatory approaches within their intervention context.

R. Gillam (1997) provided a summary of principles for incorporating memory into language intervention. Based on the premise that success in language intervention depends heavily on memory processes, Gillam stated the importance of promoting attention through salient intervention targets and limiting distractions, providing emphasis and speaking clearly and slowly, promoting phonological coding to enhance listening skills, planning activities around familiar content, helping learners organize new knowledge, and teaching retention cues. Gillam described these principles to address both working and long-term memory, suitable for children and adults. Gillam acknowledged that the evidence behind some of these principles was sparse, singling out phonological coding as "promising" if not yet empirically validated.

S. Gillam and colleagues (2018b) echo many of the same principles espoused by R. Gillam in 1997: the value of an organizational framework, and the importance of developing phonological awareness to reduce the innate WM demands of listening comprehension. This article also discusses self-esteem as a correlate of performance in WM tasks (Autin & Croizet, 2012). Though DLD did not seem to be a consideration in Autin and Croizet's article, Gillam and colleagues noted that this research has meaningful implications for individuals with DLD, many of whom experience lower self-esteem than their typically-developing peers (Durkin et al., 2017). Despite this article's support for different principles and types of interventions to support children with WM deficits, one overarching message is a caution against WM training intended to improve WM capacity. Citing a number of meta-analyses (Au et al., 2015; Karbach & Verhaeghen, 2014; Melby-Lervåg & Hulme, 2013; Melby-Lervåg et al., 2016; Randall & Tyldesley, 2016; Sala & Gobet, 2017; Schwaighofer et al., 2015), Gillam and colleagues observed consistent findings that WM training rarely produces far transfer effects into skills such as language and reading, and cautioned against their use in therapy.

Interventions for Children with DLD

Montgomery (2006) and Montgomery et al. (2010) promote the use of phonological awareness training alongside verbal rehearsal and paraphrasing as viable WM interventions for children with DLD. Montgomery (2006) refers to this as a "dual language-memory approach," intended to resolve the co-occurring deficits attributed to a bidirectional association between language and memory. Montgomery and colleagues (2010) also suggest working memory capacity training as an intervention option, in contrast to later work by Gillam et al. (2018), along with a program called Fast ForWord, intended to improve processing speed.

Fahy and Browning (2021) also provided a functional guide for intervention supported by numerous ready-to-implement examples of activities. Their article addresses adolescent therapy for children with co-occurring DLD and EF deficits, and their intervention approach suggests that the adolescents work in teams to create and follow linguistically-complex instructions. This activity is intended to exercise participants' expressive and receptive language, as well as their planning and reasoning skills in a meaningful and engaging context.

Meltzer and colleagues (2021) published a clinical tutorial describing how SLPs can provide direct intervention to teach explicit strategy use to improve various EFs. The authors noted that these skills are valuable for all children, but especially for children with language deficits. They emphasized the importance of helping students recognize their own strengths and weaknesses, and teaching strategies that the students themselves can implement and self-monitor. They also introduced their "SMARTS program," consisting of explicit strategies to target specific EF deficits directly, which they described as a research-based program to support EF across various educational settings.

Singer and Bashir (2018) summarized and synthesized the existing literature describing verbal WM limitations in children with DLD, which they used to provide a clinical framework to guide WM interventions. As a narrative review, many of the principles in this article echo those of other authors included in this systematic review. Singer and Bashir cautioned against WM training due to the lack of evidence to improve far outcomes. Instead, they advised SLPs to improve language efficiency and automaticity. Their rationale is that improving children's language will reduce linguistic demands on WM, allowing them to repurpose their cognitive capacity towards the content of the message. They also advise the use of visual anchors, including rehearsal, visualization, advance organizers, and graphic organizers, which may

complement the child's efforts to store a verbal message in their memory. Likewise, the authors noted that WM demands can be supported through heightened linguistic structure and reduced demands, which include various internal and external factors. Finally, they stated the need for SLPs to collaborate with other professionals to help address students' needs across contexts.

Gillam and colleagues (2019) and Montgomery and colleagues (2021) bridged the gap between practitioner-focused intervention articles and empirical research in these research summaries. They reported previous results from a large-scale study of children with DLD and their propensity-matched typically-developing peers (Evans et al., 2018), and provided insight into the implications for assessment and treatment based on their findings. Their study found that WM mediated the association between other cognitive functions (i.e., fluid reasoning, controlled attention, and long-term memory for language knowledge) and sentence comprehension. In the former article, Gillam and colleagues (2019) suggested a functional approach to language intervention which promotes "strategic organization of information," similar to the recommendations for organizational framework discussed in Gillam (1997) and Gillam et al. (2018). They promoted a narrative-based approach called "Supporting Knowledge in Language and Literacy" (SKILL: Gillam et al., 2018a) to target language in children with co-occurring cognitive and language deficits. In a follow-up article (Montgomery et al., 2021), the authors encouraged interventionists to address underlying language skills of syntax and sentence comprehension directly, rather than attempting to improve WM through training. They suggested methods for implicit and explicit interventions, to reduce WM demands and improve language respectively.

Interventions for Children with ADHD

Several articles (incl. Damico et al., 1999; Damico & Armstrong, 1996) provided intervention strategies for SLPs to use with children with ADHD. Aligned with the prevailing literature of ADHD interventions (Barkley, 2018, DuPaul & Stoner, 2014), the intervention strategies described within these publications were categorized as pharmacological, behavior management, cognitive-behavioral therapy, direct communication intervention, or classroom academic management strategies. These broad categories of ADHD intervention align with the strategies and interventions presented in other papers included in this review.

Dunaway (2004) builds on the literature of strategies for SLPs to use with children with ADHD. This article provided insight into the classroom academic management strategies introduced by Damico and colleagues, including contextual and instructional modifications. Dunaway encouraged SLPs to collaborate with other educators and explore services across setting and service delivery models.

Similarly, Jansen and colleagues (2010) shared strategies and materials that SLPs can use with children with ADHD. The authors promoted sensory strategies to improve students' motivation and academic performance, particularly those utilizing "stimulating, novel, active, meaningful, and interesting" stimuli; examples of tactile, visual, and auditory strategies are provided, as are examples of strategies to optimize peer interaction and meaningful intervention. This article is a functional resource for clinicians, and includes sample activities to address pragmatics, WM, and reading comprehension.

Westby and Cutler (1994) authored a review of language ability in children with ADHD, noting the prevalence of DLD in children with ADHD, as well as the associations with pragmatic and metacognitive deficits. They advised clinicians to develop children's planning skills and

social-emotional cognition in order to ameliorate these deficits. Specifically, they propose cognitive-behavioral intervention consisting of cognitive modeling and verbal mediation to ensure that children with ADHD can understand and describe the strategies they are asked to implement. They also encouraged explicit instruction in problem-solving techniques, particularly those consisting of a self-questioning script. These three strategies meet children with ADHD at the intersection of language and cognition, allowing the clinician to address both domains, but Westby and Cutler noted that the linguistic limitations of many children with co-occurring ADHD and language disorders present a barrier to effective strategy use.

Nelson and Hawley (2004) provided SLPs with a guide to address inner control in children with ADHD. This article advocated for literacy interventions as a way to develop inner control following the premise that reading relies on inner control to focus on the text, to interpret the orthography, to employ comprehension strategies, and ultimately to find meaning. Citing Cambourne (1988), the authors outlined key principles to literacy intervention: immersion into a literacy-rich environment, sufficient demonstrations, mediated opportunities to participate, significant opportunities to practice independently, and opportunities to "perform" their reading for others. This progression allows readers to develop independence.

Interventions for Children with General and Specific EF Deficits

While the publications above provided SLP with intervention approaches for the broad deficits associated with ADHD, Boudreau and Constanza-Smith (2010) had a more narrow focus on WM. They suggested that SLPs may implement computerized WM training to improve discrete skills, but also provide strategies leading to more generalizable academic success. The latter strategies include working with teachers to reduce WM demands, and working with

students to improve skills and teach strategies that will result in improved performance on tasks that require WM.

Gathercole and Alloway's tutorial and narrative review (2006) addressed a broader audience of practitioners treating children with neurodevelopmental disorders. It was selected for inclusion due to its explicit mentions of specific language impairment as a neurodevelopmental disorder associated with WM deficits. The strategies within this article focused on improving the outcomes of children with WM deficits, but are not differentiated between children with DLD or other neurodevelopmental disorders such as Autism Spectrum Disorder or ADHD. The authors described strategies to accommodate poor verbal short-term memory and WM.

Discussion

The purpose of this systematic review was to identify the speech-language pathologist's role and capacity to support students with deficits of EF, and to review the current state of the evidence for EF interventions for this population. The results of this review support the notion that SLPs are well-positioned to support children with EF deficits. There are three central findings of the present review. First, there appears to be little research exploring interventions at the intersection of DLD and EF deficits, and the findings of these studies fail to provide overwhelming evidence in support of the interventions' efficacy in improving cross-domain or functional outcomes. Second, despite the lack of empirical support in favor of interventions, SLPs are encouraged to draw from literature outside the realm of communication disorders research to provide direct intervention addressing the functional deficits of children with EF impairments. Third, SLPs can be valuable team members by collaborating with other educators to ensure that children with co-occurring deficits can access their academic curriculum. The following discussion will elaborate on each of these central findings, describe the limitations of

this systematic review with consideration of the article selection and scope of this research, and explore the implications of these findings for SLPs and researchers.

Evidence for EF Interventions in Children with DLD

The primary aim of this review was to identify studies of EF interventions for children with DLD. To the author's best knowledge, few such studies exist; this review identified two quasi-experimental studies, three single case design studies, and three case studies. The American Speech-Language-Hearing Association offers guidance to assist readers in the determination of a study's level of evidence, based on several hierarchies from related fields of study (ASHA, n.d.; Robey, 2004). Using ASHA's guidelines for evidence, quasi-experimental studies fall under the second level of evidence, behind meta-analyses, systematic reviews, and randomized controlled trials. Single case studies fall behind quasi-experimental studies on the hierarchy of evidence, and case studies (which are regarded as non-experimental) fall even lower, ahead of only expert opinion when ranking the level of evidence. This guidance should be considered when evaluating the research behind executive function interventions. While the efficacy of interventions may have been evaluated at a high level in other populations (e.g., ADHD trials without controlling for language ability, or studies of individuals with acquired brain injury), clinicians should be cautious about assuming that interventions have been validated in the populations of children they serve.

Despite small sample sizes, single-case research designs have a strong potential for experimental control, allowing them to provide valuable insight into intervention efficacy (Horner et al., 2005). This is particularly valuable for researchers of children with disabilities (Ledford et al., 2019). Ebert's (2014) multiple baselines study of three children with DLD examined whether conventional language therapy (including relational vocabulary,

morphosyntax, and auditory comprehension of directions) can improve task-based measures of WM, sustained attention, and processing speed. Since many aspects of EF are tied to linguistic ability (e.g., using self-talk scripts to make plans and follow through, or using verbal rehearsal to improve WM), it is important to conduct research such as Ebert's, to determine whether speech-language therapy alone can improve the EF of children with co-occurring language and EF deficits. The findings of this study were not particularly strong, but it sets the stage for future research. Due to the documented flaws of task-based measurement of EF, future studies may consider using parent- and teacher-reported behavior scales to identify functional changes to children's EF skills.

A primary finding of this review is that the field has barely begun to explore the efficacy of EF interventions in children with DLD, and this remains a vital area of research for future study. Language and EF are deeply intertwined, so it should not be a surprise that so many of the EF interventions directed toward SLPs and other educators are structured around linguistic ability. Some of the approaches to EF intervention appear to circumvent language deficits (e.g., visual supports, external memory aids) while other approaches appear dependent upon language ability (e.g., self-talk, rehearsal, organizational frameworks). The function of language in the efficacy of these interventions is unclear. Does language ability moderate the child's success with EF interventions which are heavily rooted in language? If so, then children with DLD may not receive the same benefits as their language-typical peers. Alternatively, perhaps explicit instruction in language-based interventions such as self-talk will yield more substantial results as children's language improves alongside their executive skills. SLPs must consider the interdependency between language and EF, and tailor their intervention accordingly.

Guidance for Direct Intervention

Though the evidence for intervention in children with co-occurring EF deficits and DLD is sparse, this review found an abundance of articles which encourage and inform SLPs in the provision of direct intervention to teach the skills necessary for academic success. The articles in this review used research from related fields (e.g., ADHD research in developmental psychology), and claimed that direct intervention may take a narrow approach by addressing discrete linguistic skills necessary to perform tasks, or a broader approach by equipping the student with strategies that can be applied to various situations. Examples of the narrow approach include teaching relevant knowledge and skills to build automaticity, thus reducing cognitive demand; teaching relational vocabulary and morphosyntax to better understand complex instructions and retain them in memory; and teaching memory-assisting techniques such as rehearsal and visualization (Boudreau & Costanza-Smith, 2010; Gathercole & Alloway, 2006; Gill et al., 2003; Gillam et al., 2019). The broader approach can include strategies that empower the student, such as emphasizing the meaning and relevance of curricular content and teaching interactional strategies (Damico & Armstrong, 1996), teaching self-talk and problem-solving strategies (Dunaway, 2004), and teaching children how to implement organizational frameworks such as visual organizers and concept maps (Gillam et al., 2018). SLPs must be mindful to select an intervention focus (narrow, broad, or a combination) based on the child's individualized needs.

Computerized Interventions

While the research and literature supports the use of strategy instruction and cognitive and cognitive-behavioral interventions, the findings of this review suggest approaching computerized interventions with caution. Though the findings of Gathercole and Alloway (2006)

support the use of CWMT, these findings must be considered within the context of Gillam and colleagues' (2018) rebuttal, and the findings of associated meta-analyses (e.g., Melby-Lervåg & Hulme, 2013; Melby-Lervåg et al., 2016). These articles concluded that while CWMT may improve task performance following intervention, these improvements show limited evidence of durability (i.e., sustained improvement at later follow-up) or generalizability (i.e., providing benefits in functional or related contexts outside of discrete tasks). Likewise, while Montgomery and colleagues (2010) promoted the use of a computerized training called Fast ForWord to improve processing speed, subsequent research disputes the efficacy of this program (Strong et al., 2011). When providing services to children with EF deficits, school-based SLPs would do well to select interventions that offer meaningful improvement to functional tasks, rather than narrow benefits to discrete tasks identified by studies of CWMT.

Guidance for Collaboration and Accommodations

A recurring theme throughout the included articles posited that interventions for EF provide notable benefits when they are meaningful and contextualized, thus suggesting the need for SLPs to ensure that students receive educational support in the classroom. To accomplish this, SLPs must work with teachers across several fronts: implementing contextual modifications, adjusting instructional practices, and balancing curricular demands. Such collaboration may yield benefits for teachers and SLPs alike, resulting in improved services for students (Wallace et al., 2021).

This review identified contextual accommodations recommended to improve the learning outcomes of children with EF deficits, including tangible supports such as visual aids. Visual aids may be used to supplement learning (e.g., graphic organizers, concept maps, organizational frameworks) and executive processes (e.g., visual activity schedules, timers, calendars, planners,

checklists). While visual aids are reported to be effective for children with EF deficits, educators may implement verbal modifications to accomplish many of the same goals. Examples include verbally redundant instruction, mental imagery, advanced notice of transitions, etc. (Dunaway et al., 2004; Gillam et al, 2018).

The literature within this review emphasized the importance of ensuring that children with EF deficits can access their academic curriculum, particularly when their EF deficits are accompanied by language disorder. SLPs should work with educators to promote supportive discourse strategies (e.g., repetition, examples, reduced rate of instruction, allowing time for processing, emphasizing key words, pairing auditory cues with visuals), and to pre-teach key concepts and topical language. Likewise, educators may break tasks and instruction into smaller chunks to reduce cognitive demands, and may deliver short and specific instructions (Boudreau & Costanza-Smith, 2010; Jansen et al., 2010).

This review found that balancing curricular demands against executive demands is essential for children's classroom success, for reasons which trace back to the cognitive load theory that humans have limited capacity to acquire new information (Kennedy & Romig, 2021). Academically challenging tasks should be paired with higher levels of support for EF deficits in order to allow students to focus on learning material, and tasks with higher levels of executive requirements should be paired with less-demanding academic material, so that children may devote more of their cognitive efforts to the planning, organization, and completion of the assignment (Gathercole & Alloway, 2006). Likewise, educators must strike a careful balance between cognitive and linguistic demands. Like curricular content, complex linguistic input can strain cognitive mechanisms such as working memory as children parse through the meaning of unfamiliar vocabulary or morphosyntactic structures. This is particularly true for children with

DLD, whose comprehension is moderated by WM capacity (Montgomery et al., 2021). Boudreau and Constanza-Smith (2010) cited previous research of working memory demands in the classroom (Gathercole et al., 2006) to encourage SLPs to remain aware of linguistic and cognitive demands in discourse and text, and to collaborate with teachers to strike a balance between competing demands between content and EF. They note that while executive demands are not exclusive to linguistic contexts (i.e., discourse and text), SLPs are particularly well-suited to address these domains.

Limitations

This systematic literature review aimed to compile and synthesize the research and guidance for speech-language pathologists' EF interventions, particularly for children with DLD. However, the methodology presents a number of limitations, mostly centered around the vulnerability to errors of omission. First, the search criteria and abstract screening were crafted to include EF interventions that reported results for children with DLD, but this review may have inadvertently omitted relevant articles that failed to mention language measures in their abstracts. For instance, in a study of interventions for children with ADHD or other impairments of EF, language scores or DLD diagnosis may have been collected as covariates even if language ability was not central to the study's aims or research questions. Further, the search was limited to peer-reviewed scholarly publications, thus excluding relevant articles published in non-peer reviewed journals such as the ASHA Leader (e.g., Prath, 2019).

Second, this review sought to compile articles offering guidance directed to SLPs based on the premise that this guidance would be relevant to children on the SLP's caseload. To that end, the author included publications that did not include specific mentions of DLD, so long as the publications discussed developmental EF deficits that might be expected in children with

DLD. While this advances the understanding of an SLP's role in EF interventions, the review may have overidentified articles offering guidance for children with typical language ability. Conversely, this review does not include articles containing general research and guidance for children with EF deficits unless they contained a direct mention of speech-language pathologists or language disorders, so readers should be aware that this review is not an exhaustive compilation of EF interventions that an SLP may choose to implement.

Third, the scope of this review is limited to interventions with outcomes related to academic achievement, EF, or language ability. A growing body of research documents the role of an SLP in addressing social communication deficits in children with ADHD (see Brien et al., 2021; Timler & White, 2015), but these studies fall outside the scope of this review. Nevertheless, SLPs must remain aware of the prevalence of social communication deficits in this population to ensure that their students receive the services they need.

To mitigate the risks associated with article inclusions and exclusions, this review implemented a second screener to establish reliability, and reviewed the references of included studies to search for relevant articles not included within the initial abstract screening. The limitations above are worth noting, but they do not devalue this review's effort to inform practitioners and researchers of the present state of the literature.

Implications for Practice

Executive functions, categorized as a cognitive aspect of communication, appear on the "Big Nine" list of domains served by speech-language pathologists across the lifespan (American Speech-Language-Hearing Association, n.d.). Their inclusion on this list signals the need for SLPs to be proficient in the treatment of children with EF deficits, and the findings of this systematic literature review hold meaningful implications for practitioners and researchers alike.

Practicing SLPs should be mindful of their role in both direct and indirect services for children with EF deficits. Based on previous meta-analyses of EF performance in children with DLD (see Graf Estes et al., 2007; Pauls & Archibald, 2016; Vugs et al., 2013), it is reasonable to assume that most children with DLD will also present with deficits in at least one component of EF. Therefore, SLPs would do well to incorporate contextual modifications and modified instructional practices into their therapy. Depending on the child's educational needs, an SLP may target EF deficits directly through their intervention goals. Functional approaches, such as teaching and rehearsing graphic organizers or self-talk scripts, appear to be particularly favorable approaches for intervention in this population. Interventions should be selected to provide meaningful, functional, and contextualized benefits for children.

SLPs must also be mindful of the need to provide indirect services as necessary to support the child's ability to access their classroom curriculum. To that end, they must collaborate with classroom teachers to ensure the implementation of appropriate modifications, whether contextual or instructional. Classroom observation or push-in therapy provide the SLP the opportunity to take note of the child's instructional needs, and to identify systemic barriers to their learning. The classroom teacher may benefit from an SLP's perspective and coaching, while the SLP may benefit from the opportunity to further individualize their services by using classroom content and tailoring their services to the observed needs.

Implications for Future Research

The findings of this systematic review suggest that the evidence base for EF interventions for children with DLD is underwhelming. Randomized control trials, which are the gold standard of experimental research, were conspicuously absent. The majority of the included publications were not experimental; they offered guidance for practitioners, but their claims were often

supported by research on samples for which DLD was not a requisite (e.g., samples of children with ADHD, whose language abilities likely varied between average and below-average). Whereas research using DLD samples likely accounts for the below-average EF performance common among this population, the reverse is not necessarily true; EF interventions are not necessarily validated for children with DLD. Language ability may play a mediating role in the efficacy of EF interventions, particularly those centered around self-talk and rehearsal. Further research may aim to replicate interventions in a sample of children with co-occurring DLD and EF deficits, as well as assess the efficacy of SLP-implemented interventions such as Ward and Jacobsen's "Get Ready*Do*Done" model (2014).

Further research may be necessary to evaluate the SLP's comfort and competence in the remediation of developmental EF deficits. Salis et al. (2018) conducted similar research regarding the assessment of memory deficits in clients with Aphasia, finding that SLPs often used unreliable evaluation instruments, and that their attitudes about memory varied. Surveys of acute care SLPs indicate a lack of confidence and preparation in the treatment of clients with cognitive-communication disorders (Morrow et al., 2021), so it is not unreasonable to suspect that school-based SLPs are similarly under-equipped to deal with cognitive deficits (namely, EF) in children on their caseload. Despite growing awareness of the prevalence of EF deficits in children with DLD, and of language disorders co-occurring in children with ADHD, EFs remain on the fringe of pediatric speech-language pathology, especially when compared to speech sound disorders, language disorders, and fluency disorders. At this time, the author is unaware of studies which explore pediatric SLPs' perspectives and experiences remediating developmental EF deficits with (or without) co-occurring DLD, nor any studies which explore their confidence and competency in this area.

Conclusion

To the author's best knowledge, this review is the first to systematically identify the principles, strategies, and approaches to EF intervention intended for SLPs' implementation, as well as the evidence validating the efficacy of EF interventions for children with DLD. As such, this review can serve as a resource for practicing clinicians seeking to learn about EF interventions and evidence-based practices that they can use in their therapy. Likewise, this review can be used as a map for researchers to establish what has and has not been explored. While other professions have charged ahead in pursuit of effective EF interventions, we must cautiously ensure that children with co-occurring DLD also benefit from these approaches. If not, we must balance children's linguistic and cognitive demands to facilitate their academic success. Finally, we must bridge the research-to-practice gap by determining clinicians' readiness and willingness to remediate EF deficits, and by identifying opportunities to improve SLPs' clinical skills in this domain.

Figure 2.1

PRISMA Flow Diagram

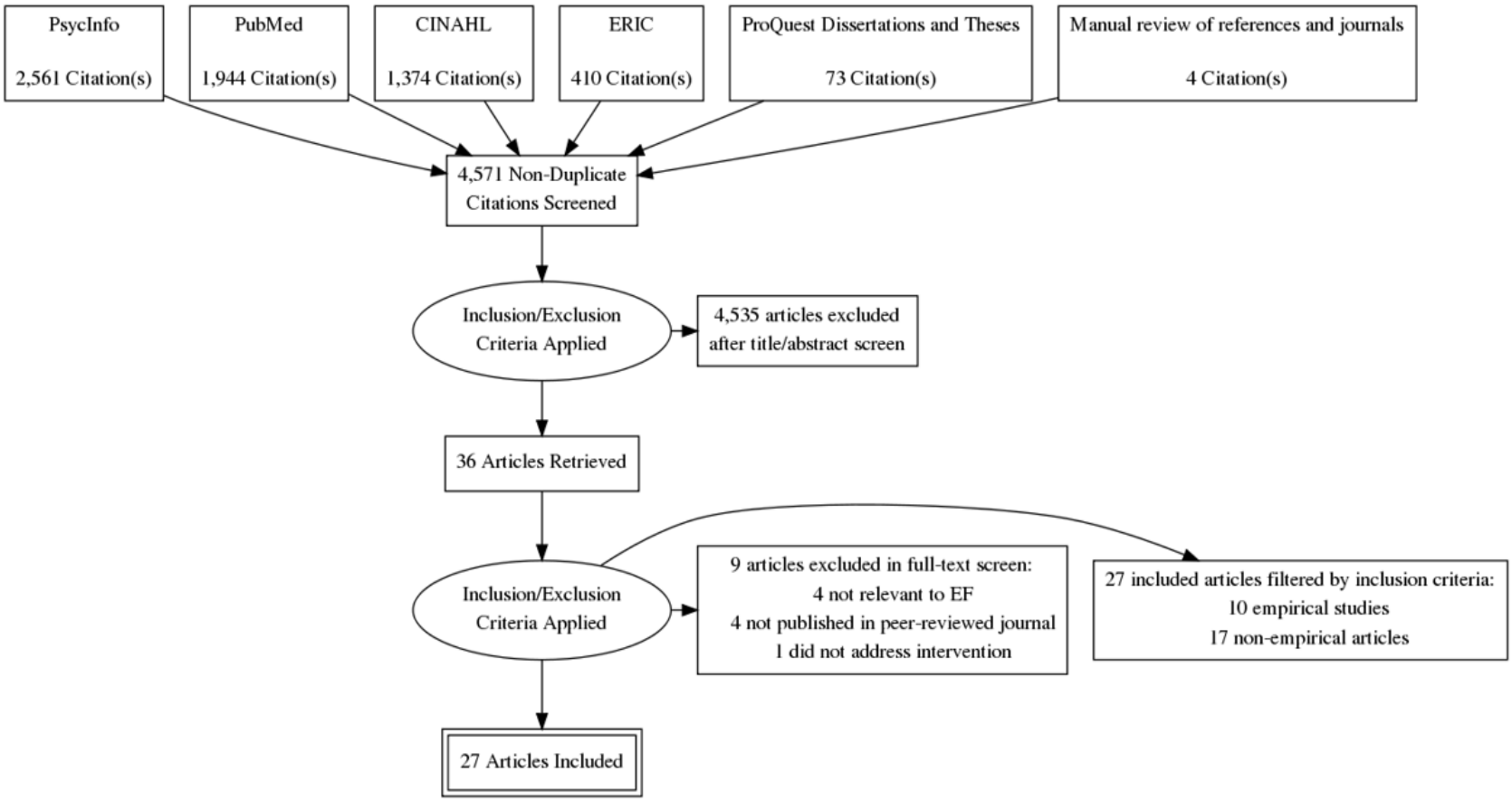


Table 2.1

Description of Included Empirical Studies: Case Studies, Single Case Designs, Quasi-experimental Designs

Author(s)	Date	Research Design	Population	EF Construct	*N*	Interventionist	Intervention	Outcome Variable
Clegg & Hartshorne	2004	Case studies	DLD + ADHD	ADHD/ Hyperactivity	2	School-based multidisciplinary (incl. SLP)	Indirect	Learning, language & communication
Datchuk et al.	2020	Single baseline design (Case study)	SLI + ADHD (hyper- activity and impulsivity)	ADHD	1	Researcher	Direct (language)	Correct writing sequences
Dunaway	2004	Narrative case study	ADHD	ADHD	1	SLP	Indirect	Not specified
Ebert	2014	Multiple-baselines design	DLD (2/3 w/ co-occurring ADHD)	WM, processing speed, sustained selective attention	3	SLP	Direct (language)	Task-based EF measures
Ebert & Kohnert	2009	Multiple-baselines design	PLI	Auditory memory	2	Not specified	Direct (EF)	Language and cognitive tasks
Gill et al.	2003	Quasi-experimental	DLD	Memory (following verbal instructions)	30	SLP	Direct (EF, language)	Oral Directions subtest score

Holmes et al.	2015	Quasi-experimental	DLD	Verbal memory	179	Cogmed trainer	Direct (EF)	Cognitive skills (e.g. verbal STM)
Shahmah-mood et al.	2018	Phased SCD	PLI	WM	10	SLP	Direct (EF, language)	WM, grammar
Singer & Bashir	1999	Case study	DLD	EF, SR	1	SLP	Direct (EF, language)	Academic achievement, communication
Stanford et al.	2019	Quasi-experimental	DLD	WM	42	Not specified	Direct (EF)	WM, language

Note. DLD = Developmental Language Disorder, EF = Executive function, PLI = Primary Language Impairment, SCD = Single Case Design, SLP = Speech-language pathologist, SR = Self-regulation, STM = Short-term memory, WM = Working memory

Table 2.2

Description of Included Practitioner Papers: Tutorials, Narrative Reviews, Research Summaries

Author(s)	Date	Population	EF Construct	DLD Focus	Interventionist	Intervention	Outcome Variables
Boudreau & Costanza-Smith	2010	WM-impaired	WM	No	SLP	Direct (EF, language) and indirect	WM in the classroom
Damico et al.	1999	ADHD	ADHD/ Hyperactivity	No	SLP	Direct (EF, language) and indirect	Not specified
Damico & Armstrong	1996	ADHD	ADHD/ Hyperactivity	No	SLP	Direct (unspecified) and indirect	Not specified
Drazinski	2014	EF-impaired	Developmental EF deficits, TBI	No	SLP	Principles of intervention	Not specified
Fahy & Browning	2021	DLD + EF	Reasoning, planning	Yes	SLP	Direct (EF, language)	Planning, reasoning

Gathercole & Alloway	2006	Neuro-developmental disorders (incl. SLI, ADHD)	WM	No	Not specified	Direct (EF) and indirect	WM
Gillam	1997	DLD	Memory	Yes	SLP	Principles of intervention	Not specified
Gillam et al.	2018	DLD, WM-impaired	Long-term memory retrieval	Yes	SLP	Direct (EF)	WM
Gillam et al.	2019	DLD	Cognitive processing	Yes	SLP	Direct (language)	Language
Jansen et al.	2010	DLD + ADHD	ADHD	Yes	SLPs and educators	Direct (EF, language)	Language and learning
Meltzer et al.	2021	DLD + EF	Various EFs	Yes	SLP	Direct (EF)	Student success
Montgomery	2003	SLI	WM	Yes	Clinician	Direct (EF, language)	Language and learning
Montgomery et al.	2010	SLI	WM	Yes	Not specified	Direct (EF)	WM, cognitive processes

Montgomery et al.	2021	DLD	WM	Yes	Not specified	Direct (language)	Learning and Language
Nelson & Hawley	2004	ADHD	Inner control	No	SLP	Direct (language)	Inner control
Singer & Bashir	2018	Low WM	Verbal WM	Yes	SLP	Principles of intervention	Not specified
Westby & Cutler	1994	ADHD	ADHD	No	Not specified	Direct (EF)	Academics, social interactions, self-regulation

Note. CWMT = Computerized working memory training, DLD = Developmental Language Disorder, EF = Executive function, SLI = Specific Language Impairment, SLP = Speech-language pathologist, WM = Working memory

Chapter 3: Latent Profile Analysis

Abstract

Purpose: The purpose of this exploratory study was to determine whether latent profiles emerged based on children's expressive language, receptive language, and working memory, and to determine whether profile membership was associated with children's behavioral characteristics in the classroom.

Method: I conducted a latent profile analysis of 167 Kindergarteners' scores on the Test of Auditory Comprehension of Language, Test of Expressive Language, and Wechsler Intelligence Scale for Children: Digit Span subtest. I analyzed a variety of fit statistics to identify and evaluate the best-fitting model. Finally, I conducted two one-way analyses of variance to determine whether there were mean differences between the emergent profiles on teachers' ratings of the School Social Behavior Scale: Social Competence and Antisocial Behavior scales.

Results: A three-profile solution emerged as the best-fitting model for these data, which I labeled as the *Low-performing* group, the *Average* group, and the *High-performing* group, based on the relatively level means of each groups' expressive language, receptive language, and working memory. The *Low-performing* group was rated, on average, significantly lower in Social Competence than their *Average* or *High-performing* peers. The differences in ratings of Antisocial Behavior were not significant.

Conclusion: Educators may consider whether children with visibly poor prosocial behaviors warrant referral for speech-language or special education evaluation, and speech-language pathologists and educators alike may be thoughtful in their application of cognitive support for children presenting with characteristics of the *Low-performing* group.

A Latent Profile Analysis of Young Children's Language and Working Memory

Language ability shares a well-established association with working memory (WM; Archibald, 2017; Gathercole & Baddeley, 2014). WM is implicated in central aspects of language processing, including vocabulary acquisition, expressive and receptive language, and reading (Gathercole & Baddeley, 2014). The nature of the association between these two skills has not yet been satisfactorily explained, and there are various models of WM which present contrasting theories of how the mechanisms of WM may interact with language. One such theory hypothesizes that WM, operating through a "phonological loop," is used as a short-term store for language input. By retaining the auditory and verbal stimuli, WM facilitates the conversion of language knowledge into long-term memory (Baddeley et al., 2017). Another theory hypothesizes that WM is a set of embedded processes drawn from attention and long-term memory, and that these processes (which include familiar linguistic concepts such as encoding, representation, and retrieval) explain the path from attention to learning (Cowan, 2014). Indeed, while the predominant models of WM are each grounded in supporting empirical evidence, each is also contra-indicated by some degree of "difficult evidence," and proponents of each model have experienced varying degrees of success in fitting their model to current theory and evidence (Cowan, 2022).

While the nuances between various models of WM carry subtle-yet-meaningful implications for language learning to the researchers who study them (Baddeley, 2003), the theoretical differences between models do not inherently explain the functional relation between language and WM. As a result, questions about the developmental trajectory and interactions of language and WM remain unanswered, despite a relative abundance of research on the topic. One fact is clear: children with developmental language disorder (DLD), which is marked by

clinically-significant deficits of expressive or receptive language (Bishop et al., 2017), often present with co-occurring deficits in WM as well (Graf Estes et al., 2007; Vugs et al., 2013). Three possible explanations emerge: (1) Language impairments contribute to domain-general deficits including WM, (2) Domain-general deficits contribute to language impairments, or (3) Language impairments and domain-general deficits are likely to co-occur due to other factors (Kapa & Plante, 2015; Smolak et al., 2020).

The first possible explanation relies on the potential role of language in directing and focusing attention; children with poor language skills may have difficulty attending to linguistic stimuli, or may have more difficulty encoding and storing information. The second possible explanation supposes that deficits in WM may prevent children from storing novel and complex linguistic input, and converting it into long-term memory and knowledge stores; this view has been supported by several studies documenting the role of attention in language learning (Spaulding et al., 2008), though evidence supports this phenomenon primarily in preschool-age children, and causal pathways become less clear later in development. The third possible explanation opens the door for an overabundance of theories related to shared causes or mediators (see Kapa & Plante [2015] for thorough discussion of contrasting theories of developmental interactions between language and executive functions including WM).

In all likelihood, the association between language and WM is dynamic over the course of development (Archibald, 2017); whereas studies of early childhood suggest that attention plays an important role in early language acquisition, the presence of concurrent (but not predictive) relations between WM and language in later childhood and adolescence may suggest either that the developmental trajectories have become disentangled as each domain develops

separately, or that both domains are susceptible to greater external influences in these later childhood years (Gooch et al., 2016).

Person-centered Research

To date, most of the research in this area has followed a variable-centered approach, which is used to explore the relations among variables (Bergman & Magnusson, 1997); in this case, the associations between language, WM, and perhaps other related domains (see meta-analyses by Graf Estes and colleagues [2007] and Vugs and colleagues [2013] for examples). The findings of these meta-analyses are conclusive; children with specific language impairment, on average, present with very large impairments in phonological WM and large impairments in visuospatial WM. Using this information, it may be safe for an SLP or a teacher to assume that a child with a language impairment is likely to present with poor WM, even without explicitly testing the students' WM ability. Beyond that, the application of these variable-centered findings is limited, and many important questions remain unanswered. Is there a subset of children with poor language but typical WM, or vice versa? How do these characteristics relate to other characteristics of children, such as behavior? Do children typically fall neatly into categories based on these characteristics, or is there significant interpersonal variation? How can our knowledge of the association between language and WM contribute to functional and meaningful classroom applications such as identification and intervention for deficits?

All of these questions and more can be answered through person-centered research, which provides a way to categorize individual profiles through empirical methods such as latent profile analysis (LPA; Logan & Pentimonti, 2016). A person-centered approach allows the researcher to identify underlying groups (or "profiles") of children who share common characteristics, namely patterns of strengths and weaknesses across various domains. The

findings of person-centered research facilitate a broader, multidimensional understanding of people and groups, and therefore the results and implications of person-centered research may be more readily applied to individuals rather than variables. There are several benefits to such an approach described below; however, despite these advantages, there persists a relative dearth of person-centered research in this area.

One advantage is the practicality of translating person-centered findings into clinical practice. For example, profiles could be used to aid earlier identification of cross-domain deficits (Logan & Pentimonti, 2016; Murphy et al., 2016). In this case, a speech-language pathologists' (SLPs') knowledge of profiles of language and WM could theoretically be applied to recognize domain-general deficits in WM and potentially other EFs. A second advantage is the ability to account for students with non-normative characteristics (Sjogren et al., 2021). In this case, though previous research has established a concurrent association between language and WM in children of this age, the person-centered approach accounts for children with relative strengths in one domain compared to the other. Another advantage is the versatility of the approach; even once profiles have been established using one set of variables, further analysis can be used to determine whether profile membership is predicted, associated with, or predictive of other variables, which can be used both to validate profiles and to extend the clinical and research applications of profiles (Spurk et al., 2020). In this case, due to the documented association between language and behavior problems (Chow & Wehby, 2018), I can explore the association between profile membership and behavior. One final advantage worth noting is the ease with which fit statistics can be used to interpret the validity of groupings (Samuelsen & Dayton, 2018). Validity is bolstered by within-group similarities and between-group contrasts; in other words, children who belong to the same group should resemble one another rather closely with

regard to the sorting variables, but members of each group should be clearly distinct based on those same characteristics. Techniques such as LPA generate fit statistics, which are used to determine which model (e.g., a 2-profile solution, a 3-profile solution, etc.) best fits the data provided in order to select the most valid model.

Profiles of Language and WM

Though there are several examples of LPAs to be found in the literature of communication sciences and disorders (e.g., Murphy et al., 2016), profiles of language and WM have been previously studied in limited contexts. Marton and colleagues (2012) used analyses of variance to compare EF profiles between children with diagnosed language impairment, children with typical language development, and language- and age-matched control groups. Their findings suggested that children with language impairments perform more poorly than their peers in tasks of WM, noting that this deficit was not universal across all domains of EF, but rather more pronounced in children's WM. This finding was consistent with meta-analytic findings of WM in children with language disorder (Graf Estes et al., 2007; Vugs et al., 2013).

Gray and colleagues (2019) used latent class analysis to examine the WM of 2nd graders with DLD, dyslexia, DLD and dyslexia combined, or typical development, as measured by a battery of WM and other EF tasks. They identified four distinct groups: those with low overall WM, those with high overall WM, those with average WM but low number updating (used to measure the function of the central executive), and those with average WM but high number updating. These findings are notable in that children from each disability group, as well as children from the typically-developing group, were present in each class, suggesting that the WM profiles of children with DLD are not homogenous.

Houwen and colleagues (2019) conducted an LPA to examine profiles of preschool children's verbal language and EF, along with motor performance. They identified a three-profile model; whereas the first profile was mostly comprised of children with average to slightly-below average performance across all domains, the second and third profiles diverged as parents reported elevated levels of WM problems in both profiles, yet the second profile was marked by below-average verbal ability and the third profile was marked by slightly above-average verbal ability. Motor ability likely influenced group assignments, meaning that while this study supports the use of LPA to identify unique groups of children based on language and WM, the results likely do not represent purely cognitive profiles based on those two variables.

The Role of Behavior

While the discussion thus far has centered around language and WM, there are also noteworthy associations between behavior and each of these domains that have important educational implications. Language and behavior share a significant correlation, and poor language also serves as a predictor for future problem behaviors (Chow & Wehby, 2018). These problem behaviors manifest in the classroom (Hollo, 2012) and in speech-language therapy, as well (Chow & Wallace, 2019; Chow et al., 2022). The association between language and behavior extends even beyond the school setting; youth with language disorders are disproportionately represented in the juvenile justice system (Chow et al., 2022). Likewise, at least one study has identified an association between WM and self-regulatory behavior (Hofmann et al., 2008).

DLD has been referred to as a "hidden" disorder due to the way symptoms may be subtle and go unrecognized (McGregor, 2020). Unlike disorders with clear and obvious physical or behavioral phenotypes, DLD can be difficult to for teachers to recognize (Antoniazzi et al., 2009;

Jessup et al., 2008), and even students with identified behavioral disorders present with undiagnosed DLD (Hollo et al., 2014). Likewise, even though SLPs are the experts in the assessment and intervention of DLD, there is little assurance that they would recognize WM deficits in children on their caseload. Very few SLPs reported assessing for executive functions such as WM, and while some SLPs reported gleaning the results of executive function assessments from other professionals such as school psychologists, other SLPs reported that they relied on their own personal judgment (see Chapter 4 of this dissertation).

Given the challenges inherent to the identification of DLD and WM deficits, the outward and recognizable manifestation of classroom behavior may serve a practical use. If children with profiles of language deficits were to present with unique behavioral characteristics recognizable by teachers, then those behaviors might serve as a canary in a coal mine, signaling the presence of deficits that might not otherwise be detectable to the untrained eye.

The Present Study

Language and WM have been examined extensively through variable-centered techniques, but no study to date has isolated measures of language and WM to create person-centered profiles. Since there is a strong association between language and WM, the next logical step is to use these variables to identify latent profiles of children, which may be more readily applied to practitioners' identification and remediation of deficits than normative data. Further, follow-up analyses can serve dual purposes in LPAs: first, they may validate the emergent profiles, and second, they can extend the application of the study's findings. By analyzing the behavioral characteristics of emergent profiles, I hypothesize that these findings may improve the identification of hidden deficits. Through the present study, I aim to address these gaps in the literature by conducting an LPA of Kindergarteners' expressive language, receptive language,

and WM, as well as follow-up analyses of the behavioral characteristics of members of these profiles. To this end, I posed the following research questions:

1) What latent profiles, if any, emerge based on children's expressive language, receptive language, and WM?
2) If profiles emerge, is there a difference between these profiles' average teacher ratings of social competence or antisocial behavior?

Method

The data for this study comes from a multi-year longitudinal study investigating language and behavior in elementary-aged children. The initial study protocol was approved by Virginia Commonwealth University's Institutional Review Board, and further data collection and analysis was approved by the University of Maryland, College Park's Institutional Review Board.

Participants

Participants were students across four schools in a mixed urban-suburban school district outside a large mid-Atlantic city. The study initially included 436 students, of which 182 were selected to participate in longitudinal assessments based on the study's language and behavior screening procedure. Language was screened using the Clinical Evaluation of Language Fundamentals Screening Test (CELF-4 Screener; Semel et al., 2003), which is a norm-referenced measure used to identify students at risk for language disorder. Behavior screening occurred through teacher reports, as teachers were asked to nominate and rank three to five students from their classrooms who closely matched externalizing behavior profiles (i.e., behavior problems directed outwardly by the student toward the external social environment, and considered inappropriate by the teacher and other school personnel). Students were selected based on the results of these screening procedures, and sorted into one of four groups: At-risk for language,

at-risk for behavior, at-risk for language and behavior, or no risk (typical). Children were screened in the Fall semester of their Kindergarten year, and the data used in this study were collected in the Spring semester of participants' Kindergarten year.

Measures

Language

As a part of the original study, language was assessed with a pair of standardized, norm-referenced assessments, the Test for Auditory Comprehension of Language- Fourth Edition (TACL; Carrow-Woolfolk, 2014) and the Test of Expressive Language (TEXL; Carrow-Woolfolk & Allen, 2014). The TACL measures receptive vocabulary, morphology, and syntax across three independent subtests. To administer the TACL, the examiner is instructed to read a brief statement and present the child with three pictures. The child indicates the picture which best matches the examiner's statement, thus demonstrating their understanding without relying upon expressive language skills to do so. The TEXL measures expressive vocabulary, morphology, and syntax across three independent subtests. The examiner is instructed to show a picture to the child, accompanied by a prompt to name the picture, describe the picture, or to complete the examiner's statement by filling in one or more words.

The TACL and TEXL each yield composite scores derived from their respective subtests, the Receptive Language Index (RLI) and Expressive Language Index (ELI) respectively, each with a standardized, norm-referenced mean of 100 and standard deviation of 15. I used these standardized scores from the RLI and ELI to represent receptive and expressive language ability. The TACL manual reports coefficient alphas between .94 and .96 for the subtests, and .97 for the RLI. Studies of diagnostic accuracy report a median sensitivity of .77, median specificity of .84, and classification accuracy of .80. Meanwhile, the TEXL manual reports coefficient alphas

between .93 and .95 for subtests, and .97 for the ELI. The reported median sensitivity is .79, median specificity is .91, and median classification accuracy is .86.

Working Memory

WM was assessed with the Digit Span (DS) subtest of the Wechsler Intelligence Scale for Children, Fifth Edition (WISC-V; Wechsler, 2014). The WISC-V is a standardized, norm-referenced intelligence test that measures a child's intellectual ability, as well as five cognitive domains which impact performance. To administer the DS subtest, the examiner reads a series of increasingly-long strings of numbers, and the child is asked to recite those numbers in order. The DS has historically been used as a task-based measure to isolate an individual's WM capacity (Baddeley, 1992), and primarily draws from verbal or phonological WM as opposed to nonverbal or visuospatial WM.

The DS subtest yields a standardized score with a standardized, norm-referenced mean of 10 and standard deviation of 3. I used scores from the DS to represent participants' WM. Per the WISC-V Technical and Interpretive Manual, test-retest reliability of WISC-V subtest scores ranged from .71 to .90, and interscorer agreement for subtests ranged from .98 to .99.

Behavior

Behavior was assessed using the School Social Behavior Scale, Second Edition (SSBS; Merrell, 2002). The SSBS is a standardized, norm-referenced questionnaire. There are two primary subscales of the SSBS: Social Competence (SSBS SC) and Antisocial Behavior (SSBS AB), each of which were included in the present data analysis. SSBS SC is a composite of questions related to interpersonal skills, self-management skills, and academic skills, while SSBS AB is a composite of questions related to hostile-irritable, antisocial-aggressive, and demanding-disruptive traits. The SSBS can be completed by an adult familiar with the child, including

teachers, parents, or related service providers. In the present study, the SSBS was completed by the children's Kindergarten teacher in the Spring semester, after having taught the child for about six months.

Each of the composite scores are reported as *T*-scores, with a standardized and norm-referenced mean of 50 and standard deviation of 10. Higher SSBS SC scores represent higher ratings of positive behavioral characteristics in children, whereas higher SSBS AB scores represent a higher proportion of negative behavioral characteristics. Per the SSBS manual, alpha coefficients for each scale were estimated at .98, and each of the six subscales ranged from .94 to .96. Test-retest reliability estimates ranged from .60 to .82, and interrater reliability (established between teachers and classroom aides) ranged from .53 to .83.

Procedures

The TACL-4, TEXL, and WISC-V are intended to be administered by a trained examiner. In this study, examiners included undergraduate and graduate research assistants who had been trained to proficiency, had demonstrated that they could conduct the evaluation with fidelity, demonstrated understanding of procedures for ceilings, basals, and prompts, and committed no errors during a mock assessment that would result in an incorrect score. During child testing, examiners removed children to separate one-on-one settings and conducted evaluations across two sessions per child per semester, usually within the same week, with each session typically lasting 30 minutes or less.

Data Analysis

I cleaned the data, conducted descriptive analysis, examined outliers (calculated from Tukey's [1977] method), examined missingness, and estimated correlations between variables using IBM SPSS Statistics (Version 28; IBM, 2019) predictive analytics software. I exported the

data into RStudio (RStudio Team, 2020), and conducted Little's Missing Completely At Random test (MCAR; Little, 1988). I also used RStudio to convert the TACL RLI, TEXL ELI, and WISC-V DS scores into *z*-scores ($M = 0$, $SD = 1$) to facilitate interpretation and data visualization. Next, I conducted an LPA using the MPlus statistical analysis software (Version 8; Muthén & Muthén, 2017) through RStudio using the packages tidyLPA (Rosenberg et al., 2018) and MplusAutomation (Hallquist & Wiley, 2018). These packages used single imputation to account for missing data during the LPA. Finally, I conducted analyses of variance (ANOVAs) using SPSS.

Results

Sample Characteristics

The sample consisted of 167 Kindergarteners. From the initial 182 children in the original sample, I removed 15 from this analysis due to missing data; 11 were missing all assessments at this time point, and four were missing both language assessments, leaving the 167 children whose data are present in this analysis. Overall missingness was at or below 6.59% for all variables, and the results of Little's MCAR test were nonsignficant, $\chi 2(85, n = 167) = 84.92$, $p = 0.48$, which indicates that data were missing completely at random.

The sample included 88 boys (52.7%) and 79 girls. Participants' ages ranged from 5;6 through 7;7 at the time of assessment (M = 6;1, SD = 4 months). Most participants were White (61.1%; $n = 102$), followed by African American (15.0%; $n = 25$), Latinx/Hispanic (9.0%; $n = 15$), or mixed race or other (10.8%; $n = 18$; see Table 3.1).

This sample size is smaller than the median sample size of 494 observed by Spurk and colleagues' (2020) review of latent profile analyses, though comfortably within the observed range of their included studies (131 to 16,280).

Emergent Profiles of Language and WM

My first research question asked whether profiles emerged based on children's expressive language, receptive language, and WM. To answer this question, I conducted an LPA using the Expressive Language Index of the TEXL and the Receptive Language Index of the TACL to represent children's expressive and receptive language respectively, and their performance on the WISC-V Digit Span subtest to represent their WM (see Table 3.2 for descriptive statistics of assessment measures, Table 3.3 for a correlation matrix between TACL and TEXL subscales, and Table 3.4 for a correlation matrix between the assessments used in the main analyses). The correlations between participants' language and WM scores were mostly linear; see Figures 3.1 and 3.2 for scatterplots of WM by expressive and receptive language. Based on visual examination of these scatterplots, the emergence of subgroups of students with poor language and strong WM (or vice versa) seemed unlikely.

I tested possible solutions featuring between two and six profiles, and analyzed the results using a variety of fit statistics (see Table 3.5). First, I considered the Log likelihood (LL), which allows for comparison between competing models. Larger values (i.e., closer to zero) indicate a better fit, particularly when there is a larger change from one model to the next (Pastor et al., 2007). The six-profile solution featured the strongest LL, though the largest change was found between the two- and three-profile models.

The Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Sample size-adjusted BIC (SABIC) are three additional fit statistics used to compare models. In all cases, smaller numbers indicate a better fit, and much like LL, larger changes in AIC, BIC, and SABIC are particularly well-regarded (Nylund et al., 2007). The four-profile solution featured the lowest AIC, and SABIC, but the difference between two- and three-profile solutions

were much more pronounced in all cases. The three model solution also featured the strongest BIC value.

Entropy measures the distinction between profiles within a model; values closer to 1.00 indicate that profiles are highly distinct, whereas values closer to 0.00 indicate very little difference between profiles. Values greater than 0.80 are typically considered a good fit (Clark & Muthén, 2009). None of the five solutions tested produced an entropy within the target range, though the five-profile solution came very close with an entropy of .785. This was followed by the six- and four-profile solutions, featuring entropies of .738 and .735 respectively.

The Bootstrapped Likelihood Ratio Test (BLRT) determines whether one model is a better fit than the model with one less profile. A significant *p*-value suggests a good fit (Spurk et al., 2020). Both the two- and the three-profile solutions featured highly significant BLRT values, $p<.001$. Lagging behind was the four-profile solution, $p=.070$, and other solutions failed to approach significance.

By most fit statistics, the three-profile solution represents the best-fitting solution. Of the five solutions tested, the three-profile solution ranked at or near the top in terms of AIC, BIC, SABIC, and BLRT, and even its LL was respectable due to the dramatic change between the two- and three-profile solutions. Further, a three-profile solution would be desirable from a theoretical perspective; there is a precedent based on the findings of Houwen and colleagues (2019), and the model is appealing in its simplicity. However, the entropy found in the three-profile solution, .712, is below the target threshold of .800 or greater. That said, entropy is viewed as a somewhat flawed measure for the selection of LPA solutions (Spurk et al., 2020). Henson and colleagues' comparison of relative model fit indices (2007) observed that entropy was the worst of the classification-based statistics when comparing two- and three-component

models, as is the case here. Further, it was highly inaccurate for small samples, which again is the case in this analysis. Therefore, while the relatively low entropy statistic may suggest similarity between groups, it should not be weighted as heavily as others.

Due to these considerations, I selected the three-profile solution as the best-fitting solution; see Figure 3.3 for a boxplot of the three profiles' performances on the assessments used to create the profiles. The three profiles are stratified into a "*Low-performing*" group representing 18.0% of the sample ($n = 30$); an "*Average*" group representing 57.5% of the sample ($n = 96$), and a "*High-performing*" group, representing 24.5% of the sample ($n = 41$). True to their names, children in the *Low-performing* group scored, on average, more than one standard deviation below the mean with a relative strength in expressive language; children in the *Average* group scored, on average, within one-tenth of a standard deviation of the mean; and children in the *High-performing* group scored roughly one standard deviation above the mean with a relative strength in expressive language (see Table 3.6).

Though the three-profile solution was the most likely candidate based on the fit statistics, the four-profile solution also presented fit statistics worth examination. The results of the four-profile solution are presented as a boxplot in Figure 3.4, and the average performance of children in each of the four profiles can be found in Table 3.7. As with the three-profile solution, the four-profile solution identified a *Low-performing* group with scores approximately one standard deviation below the mean, and an *Average* group of students with scores around the mean. Unlike the three-profile solution, the four-profile solution split the *High-performing* group into two separate profiles based on strengths: first, a "*Mostly High-performing"* group which resembled the *High-performing* group from the three-profile solution, albeit with relatively weak expressive language compared to receptive language and working memory; and second, an

"*Exceptional Expressive Language*" group, comprised of 11 students whose average scores on the TEXL ELI ranked them more than two standard deviations above the sample mean, despite receptive language and WM scores which were in line with the other *High-performing* or *Mostly High-performing* groups from the three- and four-profile solutions respectively. I rejected this solution largely due to the lack of conceptual merit. Expressive and receptive language are typically highly correlated in individual children (Mashburn et al., 2009), and the presence of a child profile with such dramatic differences between the two skills seems anomalous.

Association between Profile Membership and Behavior

My second research question asked whether there was a difference in the average behavior ratings of different profiles' members. To answer this question, I conducted two separate analyses of variance (ANOVAs), each of which used profile membership as factors. The first ANOVA used the SSBS Social Competence scale as the dependent variable, while the second ANOVA used the SSBS Antisocial Behavior scale as the dependent variable. Results of the Shapiro-Wilk test were significant, indicating a violation of the assumption of normal distribution in behavior ratings. Further, the results of the Levene's test were not significant, indicating a violation of the assumption of homogeneity of variances. To account for these violations of assumptions, I conducted Welch ANOVAs and selected the Games-Howell test as my post hoc analysis.

The results of the first Welch's ANOVA showed a significant difference in ratings of Social Competence between members of different profiles, $F(2, 153) = 7.36$, $p < .001$. The ratings of children in the low-performing group ($M = 48.11$, $SD = 10.68$) were significantly lower ($p < .05$) than the ratings of children in the average group ($M = 54.62$, $SD = 9.18$), and also significantly lower ($p < .001$) than children in the high-performing group ($M = 57.92$, $SD = 9.61$).

The behavioral ratings between the average and high-performing groups were not significant. See Table 3.8 for average behavior ratings of children in each of the three profiles, Table 3.9 for results of the initial ANOVAs, Table 3.10 for results of the Welch Test, and Table 3.11 for post hoc analyses of group differences.

The results of the second Welch's ANOVA failed to show a significant difference in ratings of Antisocial Behavior between members of different profiles, $F(2, 153) = 1.80$, $p = .175$. Practically speaking, the antisocial behavior ratings of the low-performing group ($M = 52.36$, $SD = 11.82$) were, on average, nearly half a standard deviation higher (i.e., higher ratings of antisocial behavior) than those of the average ($M = 47.81$, $SD = 9.45$) and high-performing ($M = 47.68$, $SD = 11.40$) groups.

Discussion

The present study aimed to determine whether latent profiles can be identified from Kindergarteners' language and WM ability, and whether these profiles are associated with teachers' ratings of behavior.

Emergent Profiles

The primary purpose of this study was to determine whether latent profiles emerged from the analysis of children's expressive language, receptive language, and WM. Of the five models tested, the three-profile solution emerged as the best-fitting solution. It was not a perfect solution due to a relatively low rating of entropy, which suggests that the distinctions between profiles is small, and therefore children on the "borderline" between profiles may not clearly fall into one group or the other. As mentioned in the Results section, this is a known risk associated with two- and three-profile solutions, and thus entropy ratings are a notoriously poor fit statistic to use in the selection of low-profile solutions (Henson et al., 2007; Spurk et al., 2020). That said, we

must keep these "borderline" children in mind when interpreting our solution, particularly since our data is completely stratified across all variables. In that sense, the profiles reflect normal distributions; more than half of our participants were placed into the *Average* group, whose mean scores hovered near the normative mean; the remainder of the participants were split relatively evenly between the *High-performing* group (roughly 1 SD above the mean on all measures) and the *Low-performing* group (roughly 1 SD or more below the mean on all measures). Provided that language impairment can be considered clinically significant (e.g., DLD) at or below a cutoff of one standard deviation below the mean, and since children in the *Low-performing* group, on average, presented by deficits greater than one standard deviation below the mean (see Table 3.6), it stands to reason that many of the children in the *Low-performing* group likely present with DLD, and that many more may be considered at-risk due to language skills in the low average range. This is in line with the general prevalence of language disorders estimated by Norbury and colleagues (2016), who found DLD to be prevalent in approximately 7.58% of a community sample, and the prevalence of all language disorders combined to be approximately 9.92%. Eighteen percent of our sample was sorted into the *Low-performing* group, so it makes sense that roughly half of that group might fall under the umbrella of DLD.

Though the broad interpretation of profiles may not yield much more information than a normal distribution, there are two key findings from these profiles. First, the *Low-performing* group, on average, showed a relative strength in expressive language compared to receptive language and WM. Whereas the average expressive language of children in the *Low-performing* group was approximately one standard deviation below the mean, the deficits associated with their receptive language and WM were even more pronounced, both of which were more than 1.2 standard deviations below the mean. This finding aligns with conceptual theories of WM

which suggest that it plays a key role in comprehension and processing (Baddeley et al., 2017; Cowan, 2022; Montgomery et al., 2021). Whereas expressive language may not be as taxing on WM demands, these theories suggest that WM plays a key role in retaining linguistic input while the brain processes and stores the information, thereby implicating WM as an important skill tied to the development and growth of receptive language.. Montgomery and colleagues' (2021) large scale study found that WM serves as an important conduit between cognition and sentence comprehension in children with DLD. The findings of the present study reinforce this conclusion, since the *Low-performing* group presented with deficits in receptive language and WM well beyond their deficits in expressive language. Meanwhile, the expressive language, receptive language, and WM scores were relatively level in both the *Average* and *High-performing* groups, suggesting that WM does not serve a distinct function in the receptive language of children without DLD, which further reinforces Montgomery and colleagues' findings (2021).

The second key finding of the LPA is the extent to which WM is intertwined with language. This would not be a novel finding for a variable-centered study, and the strong correlations between the TACL RLI, TEXL ELI, and WISC-V DS (see Table 3.4) should be no surprise. However, the novelty of this study is the person-centered approach. I tested models with up to six possible profiles, allowing for the opportunity for such profile combinations such as low-language-low-WM, low-language-average-WM, high-language-high-WM, high-language-average-WM, and so forth. However, profiles such as those failed to emerge, and the best-fitting solution offered only normative profiles in which receptive language was balanced with WM. In essence, this validates previous variable-centered research, and supports assessment and intervention practices which account for co-occurring deficits. Granted, there is variability

within each profile, and the relatively low entropy score indicates that some children's scores are not perfect fits within their profile; for example, a child with poor language but average WM would contribute to a lower entropy rating, due to their shared characteristics between the *Low-performing* and *Average* groups. That said, the overarching purpose of an LPA is to find a well-fitted solution which makes theoretical sense, and which allows for further applications in research or in practice. The three-profile solution in this LPA meets all of those criteria, and allows for meaningful applications such as those described below.

The Association between Profiles and Behavior

The secondary purpose of this study was to determine whether children's profile membership was associated with teacher ratings of their social competence or antisocial behavior. There were no significant differences between the *Low-performing*, *Average*, and *High-performing* groups in terms of antisocial behavior, though the mean rating of antisocial behavior was about half of a standard deviation higher in the *Low-performing* group than the other two groups. This is particularly surprising due to the previously-established associations between language ability and behavior, which document higher rates of conduct problems in children with DLD (Yew & O'Kearney, 2013). Within this study, student's expressive language was significantly correlated with ratings of antisocial behavior, but not receptive language (see Table 3.3).

However, there was a significant difference in ratings of prosocial behavior between the *Low-performing* group and their peers; they were rating about two-thirds of a standard deviation below their peers in the *Average* group, and about one full standard deviation below their peers in the *High-performing* group (see Tables 7 and 10). This implies that children with poor language and WM ability are generally less adept at prosocial behaviors (including peer

relations, self-management/compliance, and academic behaviors, per the labeled subscales of the SSBS SC), and perhaps more importantly, these results demonstrate that the behavioral differences within this group of children are tangible and measurable to their teachers.

The association between language and problem behavior was already well documented through previous robust meta-analytic findings (Curtis et al., 2019; Chow et al., 2018; Chow & Wehby, 2018; Yew & O'Kearney, 2013). Their findings suggest higher rates of problem behavior in children with low language ability, such as those in the *Low-performing* profile of this study. Specifically, they identified a heightened risk of externalizing problems (i.e., those that manifest outwardly, such as disruptive behavior or aggression) and internalizing problems (i.e., those that manifest inwardly, such as anxiety or depression). In the context of this study, the teachers' ratings of antisocial behavior for children in the *Low-performing* group were higher than the other groups, though not statistically significant; this may be attributed to the relatively low sample size of this study, especially in comparison to the comprehensive coverage and the statistical power offered by the previously-conducted meta-analyses.

The novel finding of the present study is that teachers rated children in the *Low-performing* group lower in social competence, not merely higher in antisocial behavior. Teachers' perceptions of these children were not solely formed by the problems caused by the externalizing symptoms of antisocial behavior, but teachers were also able to recognize the absence of prosocial behaviors in these children. This aligns with previous research of children with (or at risk for) DLD, as each of the skills associated with each of the SSBS SC (i.e., peer relations, self-management/compliance, and academic behaviors) have previously been explored individually. Children with (or at risk for) DLD are, on average, are less central to their classroom friendship networks (Chow et al., 2021), often struggle with self-regulation (Hofmann

et al., 2012), and are much more likely than their peers to have challenges in one or more areas of academics (Young et al., 2002). The present study supports those findings, and extends them in two ways: first, by recognizing that these deficits are associated with an entire profile of low-performing children, including those who may not be diagnosed with DLD, and second, by demonstrating that deficits in these skills are visible and recognizable by teachers.

Implications for Practice

The primary application of these findings is to inform educators, including teachers and SLPs, of possible warning signs and co-occurring deficits of which they may be unaware. In doing so, they may be able to improve their identification and support of children's deficits.

Teachers should be particularly mindful of the association between weak social competence and membership in the *Low-performing* profile characterized by language and WM deficits. DLD may be difficult for teachers to recognize due to its status as a "hidden" disorder (McGregor, 2020), the symptoms of which may not be apparent without expertise in language development and disorders. Indeed, prior studies of teacher's judgment of language ability have demonstrated that teachers lack sensitivity and specificity when determining which children may require language assessment or intervention (Antoniazzi et al., 2009; Jessup et al., 2008). However, the results of this study may be used to assist teachers in this regard. Since children in the *Low-performing* profile were rated, on average, significantly lower in prosocial behavior than their peers, teachers can use the skills associated with social competence (i.e., peer relations, self-management/compliance, and academic behavior) as indicators of risk for DLD. Certainly, there is enough variability that not all children lacking in social competence have DLD, and not all children with DLD are lacking in social competence, but at very least, deficits in social

competence may serve as a red flag to teachers to further consider whether they suspect the child may have a speech or language impairment.

Likewise, SLPs may use the findings of this study to better inform their recognition of deficits as well. Whether due to their expertise in language disorders, the availability of language assessments, or the nature of their position, SLPs ought to have at least a general awareness of whether the children on their caseload have DLD. However, SLPs are less likely to recognize or assess WM deficits (see Chapter 4 of this dissertation), and therefore WM deficits may go unrecognized or unaccounted for in speech-language therapy. However, the finding of this present study suggests that there are not distinct profiles between children with low-language-low-WM and low-language-average-WM. While that finding does not guarantee the presence of WM deficits in children with DLD, it suggests the strong likelihood thereof. As such, when working with children with DLD, SLPs might be wise to assess WM either directly or indirectly, or at very least they may proactively implement strategies to support WM in children for whom these deficits are suspected.

Along those lines, both teachers and SLPs alike would do well to provide instructional and environmental supports to children suspected of having WM deficits. Examples of such strategies are abundant elsewhere in the literature. For instance, Gathercole (2008) examined children with WM deficits in the classroom, and observed that they may have added difficulties compared to their peers, particularly with lengthy or novel instructions, completing activities with heavy processing demands, and writing. Boudreau and Costanza-Smith (2011) discussed these findings in the context of identifying and simplifying classroom demands, also addressed how to reduce textual demands in the classroom, and further offered examples of environmental supports (e.g., visual schedules) and teaching modifications (simplified discourse, preteaching)

can be useful for supporting children with WM deficits. They also shared examples of skills and strategies that can be taught directly, either in a classroom or therapeutic setting, such as rehearsal, visualization, and metacognitive strategy use. Likewise, Singer and Bashir (2018) explained guiding principles for providing intervention to children with WM deficits. Like the suggestions offered by Boudreau and Costanza-Smith, these principles are relevant in classroom and therapeutic settings alike. Among these principles are practical suggestions such as offloading verbal and cognitive demands via recall strategies or organizers, and adjusting instructional language and delivery to facilitate processing and improve salience.

Limitations and Implications for Future Research

The use of LPA to explore linguistic and cognitive profiles of children with communication disorders is growing, and rightfully so; person-centered research provides ample opportunity to improve the identification and remediation of DLD and other impairments. This study provides an exploratory "proof of concept" to demonstrate the emergence and validation of profiles based on linguistic and cognitive skills, and to provide a basic and easily-digestible set of profiles to demonstrate the relative strengths and weaknesses based on expressive language, receptive language, and WM. However, this study was limited in several regards, and future research would do well to expand on these general findings.

The first major limitation of this study was the relatively small sample size. Nylund and colleagues (2007) suggest that a sample size of about 500 should be sufficient to identify accurate profiles, which roughly aligns with the median value (n = 494) of 46 LPAs reviewed by Spurk and colleagues (2020). However, there is recent precedent from within the field of communication sciences and disorders to demonstrate that LPAs with sample sizes at or below 200 may still be suitable, especially in an exploratory context (see Halpin et al., 2021; Sansavini

et al., 2021). Even outside of the field of communication sciences and disorders, Spurk and colleagues identified LPAs with sample sizes as low as 131. Certainly, the 167 children within this sample fall on the lower end of the range of sample sizes. That is no reason to disregard these results entirely, since I was able to identify a model with adequate fit statistics, but it provides the opportunity for a larger-scale follow-up study to validate and expand on these results.

The second major limitation of this study is the relative shallowness of the profiles, which were formed solely on the inputs of the TACL RLI, TEXL ELI, and WISC-V DS scores. To some extent, this was a purposeful decision; my dataset included subtest scores for both the TACL and TEXL, including Vocabulary, Grammar, and Elaborated Phrases and Sentences. However, I chose to use index scores instead for two reasons. First, nearly all of the subtest scores were highly and significantly correlated (see Table 3.3), and I did not want the sheer number of language inputs to dilute the contribution of WM (i.e., the WISC-V DS) towards the models. Second, as I intended this LPA to be exploratory in nature, I desired a straightforward and easily-interpretable model that would make theoretical sense despite the limitations of a small sample. The result delivered on this premise; it is functional for researchers who may be interested to see the relative weakness in receptive language and WM in the *Low-performing* group, it is practical for SLPs who can make broad inferences about the WM of children on their caseload, and it is useful for teachers who might use these profiles to improve their referrals to special education or implement teaching strategies to support children with these deficits. However, future LPAs may build on this study by using more (and different) measures of skills to generate profiles. For instance, a model which includes linguistic inputs such as morphology, syntax, and semantics, along with WM inputs including both verbal and nonverbal WM, and

perhaps other cognitive or executive skills, may be able to recognize rich and detailed profiles that would be better-suited to inform intervention practices.

A final major limitation of this study is the narrow application of follow-up analysis. The findings related to prosocial and antisocial behavior serve multiple purposes, first to validate the results of these profiles, and second to further elucidate the association between language and behavior in children. However, this is merely the tip of the iceberg. There are a whole slew of theoretically-grounded follow-up analyses that may prove useful to researchers and practitioners alike, including whether profile membership is associated with other concurrent academic challenges, or whether profile membership is predictive of future outcomes such as academic achievement or delinquency.

Conclusion

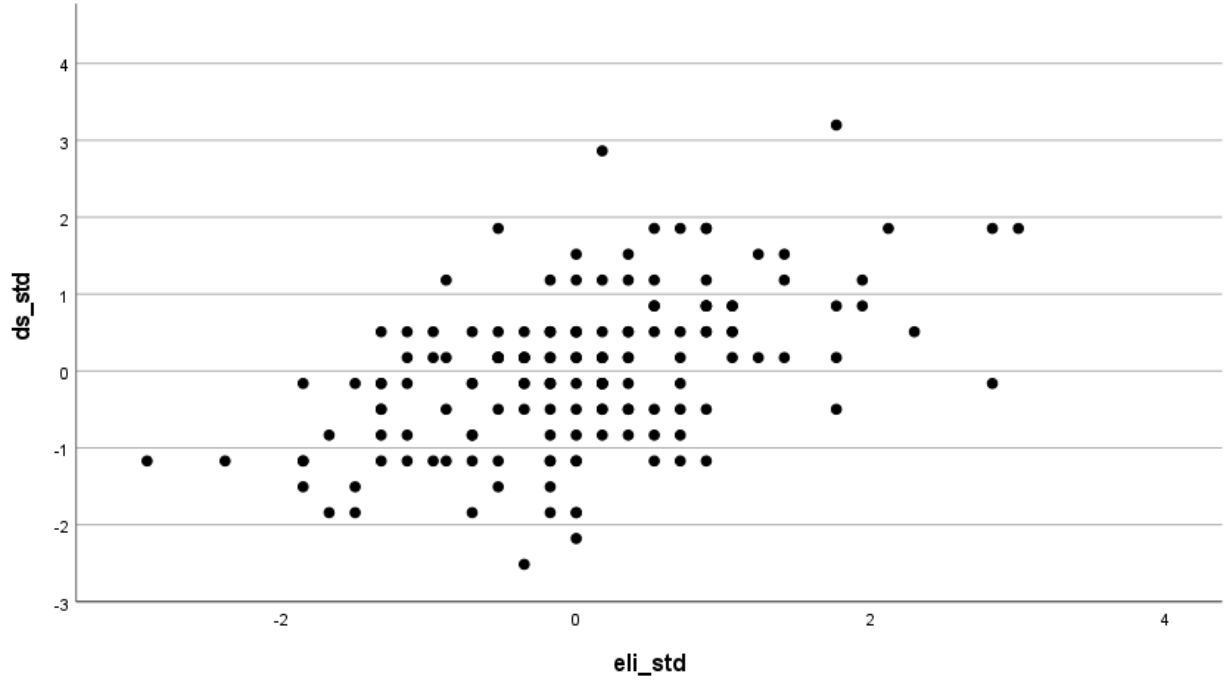
In this exploratory study, I aimed to identify whether latent profiles emerged across a sample of 167 Kindergarteners. The results of an LPA suggest that a three-profile solution produces an acceptably-fitted model. The first profile is a *Low-performing* group of children, comprising 18% of the sample, whose average language and WM scores were more than one standard deviation below their peers. The second profile is an *Average* group of children, comprising 57.5% of the sample, whose average scores hovered around the sample mean. The third profile is a group of *High-performing* children, comprising 24.5% of the sample, whose language and WM scores were (on average) one standard deviation above their peers. The results of an ANOVA demonstrated that children in the *Low-performing* group, on average, displayed significantly fewer prosocial classroom behaviors than their *Average* or *High-performing* peers, based on their teachers' reports.

Based on these results, teachers and SLPs should be vigilant in their awareness of hidden deficits. Teachers may be mindful of children who have poorer peer relations, self-management, compliance, or academic behaviors than their peers, and carefully consider whether these children fit the profile of one who may need to be referred for speech-language or special education assessment. SLPs may be mindful that generally-speaking, children with poor language (e.g., DLD) often have poor WM as well, and may require additional support. To that end, educators across all disciplines should strive to implement appropriate supports for children who struggle with language and WM. Examples of such supports include environmental modifications (e.g., visual supports, organizers, written prompts and instructions) and instructional modifications (e.g., repetition, altered prosody/intonation/pauses for emphasis, chunking assignments).

Though this exploratory study was limited in several regards, the findings and methodology pave the way for further research in this area. Future studies with larger sample sizes and richer "input" variables can be used to identify more complexity between profiles, and novel application of follow-up analyses can be used to measure the relation between profile membership and a nearly boundless variety of variables, including academic, social, behavioral, and functional skills and outcomes.

Figure 3.1

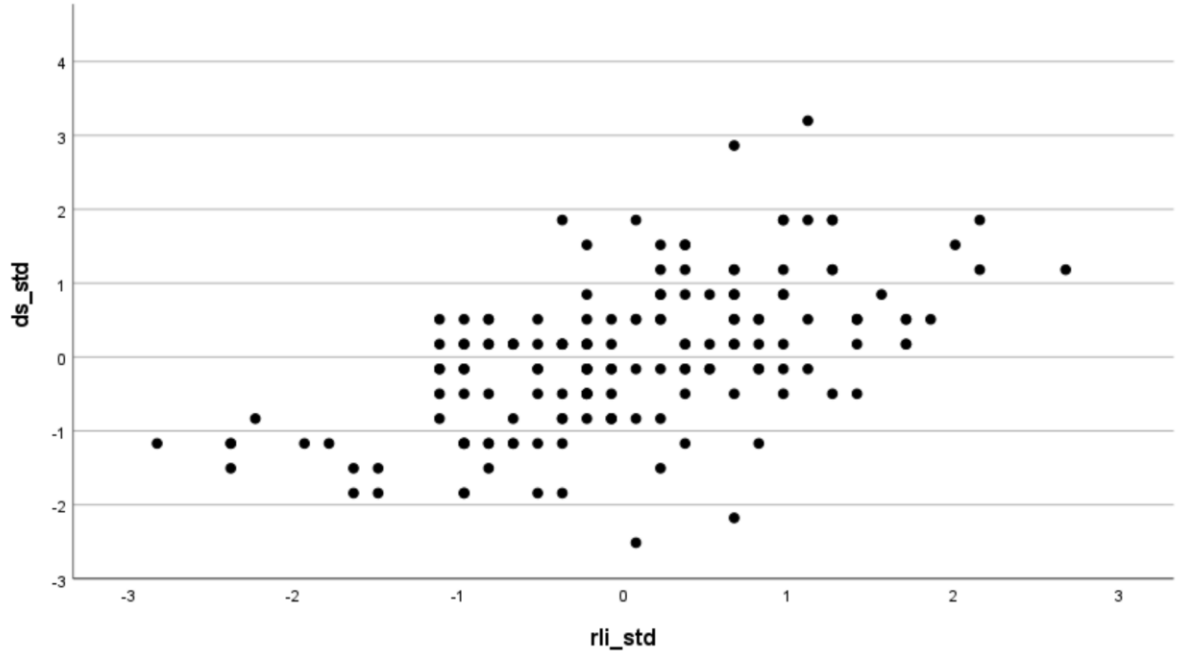
Scatterplot of WM by Expressive Language



Note. eli_std = Standardized scores of the TEXL Expressive Language Index, ds_std = Standardized scores of the WISC-V Digit Span subtest

Figure 3.2

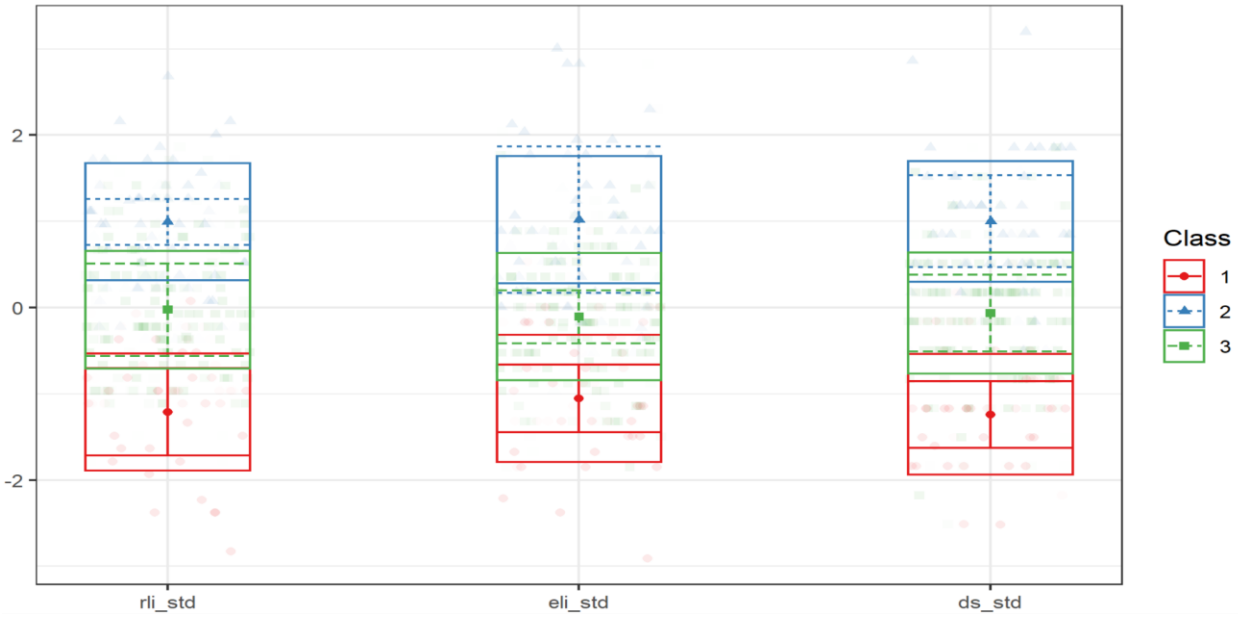
Scatterplot of WM by Receptive Language



Note. rli_std = Standardized scores of the TACL Receptive Language Index, ds_std = Standardized scores of the WISC-V Digit Span subtest

Figure 3.3

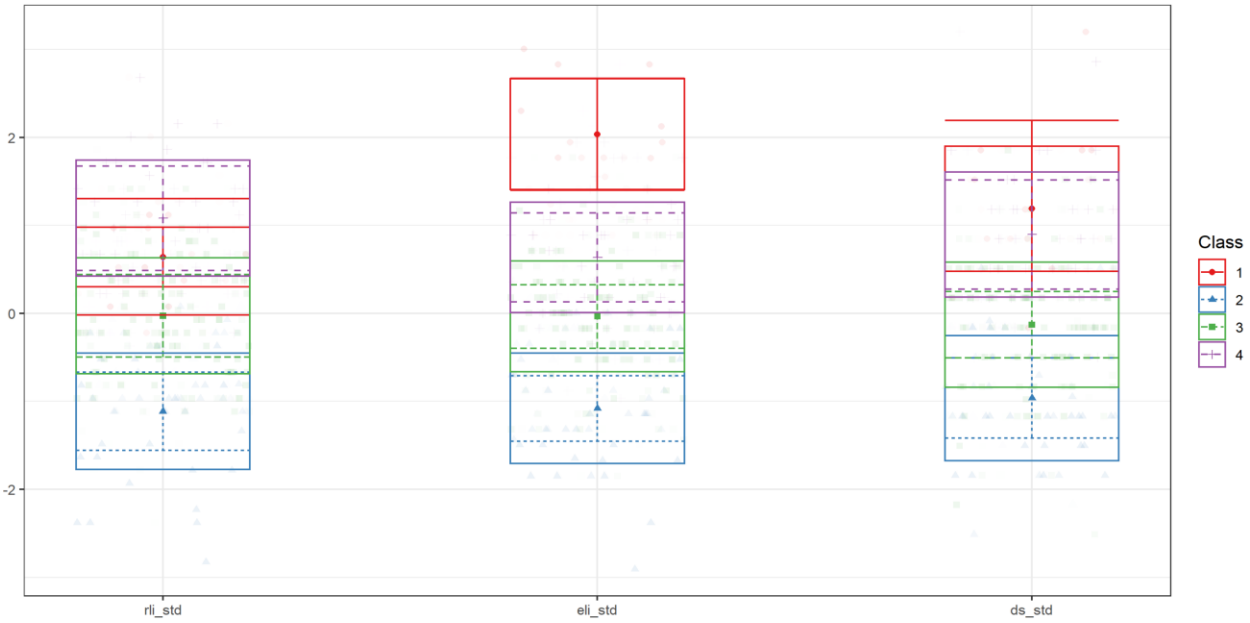
Plot of the Three-profile Solution



Note. rli_std = Standardized scores of the TACL Receptive Language Index, eli_std = Standardized scores of the TEXL Expressive Language Index, ds_std = Standardized scores of the WISC-V Digit Span subtest, Class 1 = *Low-performing* group, Class 2 = *High-performing* group, Class 3 = *Average* group

Figure 3.4

Plot of the Four-profile Solution



Note. rli_std = Standardized scores of the TACL Receptive Language Index, eli_std = Standardized scores of the TEXL Expressive Language Index, ds_std = Standardized scores of the WISC-V Digit Span subtest, Class 1 = *Low-performing* group, Class 2 = *High-performing* group, Class 3 = *Average* group

Table 3.1

Participant Demographics

	n	%
Gender		
Male	88	52.7
Female	79	47.3
Race		
White	102	61.1
Black	25	15.0
Latinx/Hispanic	15	9.0
Mixed/other	18	10.8
Not reported	7	4.2
	Mean (SD)	Range
Age	6;1 (4 months)	5;6 - 7;7

Table 3.2

Descriptive Statistics for Assessment Measures

	Mean	Standard Deviation
TACL-4		
Vocabulary	9.73	2.64
Grammar	9.85	2.96
Elaborated Phrases and Sentences	9.97	3.01
Receptive Language Index	98.98	13.44
TEXL		
Vocabulary	9.04	2.70
Grammar	8.35	2.65
Elaborated Phrases and Sentences	9.50	2.32
Expressive Language Index	93.94	11.33
WISC-V		
Digit Span	8.48	2.98
SSBS-2		
Social Competence	54.26	10.03
Antisocial Behavior	48.60	10.48

Note. TACL-4 = Test of Auditory Comprehension of Language, 4th edition; TEXL = Test of Expressive Language; WISC-V = Wechsler Intelligence Scale for Children, 5th edition; SSBS-2 = School Social Behavior Scale, 2nd edition

TACL-4 and TEXL Vocabulary, Grammar, and Elaborated Phrases and Sentences denote subtests; normative scores have a mean of 10 and a standard deviation of 3. The Receptive and Expressive Language Indices denote composite scores; normative scores have a mean of 100 and a standard deviation of 15. The WISC-V Digit Span is a subtest; normative scores have a mean of 10 and a standard deviation of 3. The SSBS-2 scales represent *T*-scores, with a normative means of 50 and standard deviations of 10.

Table 3.3

Pearson Correlations between Language Subscales

	1	2	3	4	5	6
1. TACL Vocab	1					
2. TACL Grammar	.413**	1				
3. TACL Elab	.317**	.431**	1			
4. TEXL Vocab	.381**	.404**	.321**	1		
5. TEXL Grammar	.214**	.332**	.150	.319**	1	
6. TEXL Elab	.347**	.374**	.362**	.440**	.311**	1

** Correlation is significant at the 0.01 level (2-tailed)

Note. Vocab = Vocabulary subtest, Elab = Elaborated Phrases and Sentences subtest

Table 3.4

Pearson Correlations between Assessments

	1	2	3	4	5
1. TACL RLI	1				
2. TEXL ELI	.537**	1			
3. WISC DS	.558**	.495**	1		
4. SSBS SC	.183*	.348**	.347**	1	
5. SSBS AB	-.021	-.187*	-.226**	-.835**	1

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Note. TACL RLI = Test of Auditory Comprehension of Language, Receptive Language Index; TEXL ELI = Test of Expressive Language, Expressive Language Index; WISC DS = Wechsler Intelligence Scales for Children, Digit Span subtest; SSBS SC = School Social Behavior Scale, Social Competence scale; SSBS AB = School Social Behavior Scale, Antisocial Behavior scale

Table 3.5

Latent Profile Analysis of Expressive Language, Receptive Language, and WM

# Profiles	LL	AIC	BIC	SABIC	Entropy	BLRT
2	-660.536	1341.072	1372.252	1340.590	.692	<0.001
3	-644.909	1317.818	1361.470	1317.144	.712	<0.001
4	-639.198	1314.396	1370.520	1313.529	.735	.070
5	-635.820	1315.640	1384.236	1314.581	.785	.667
6	-632.304	1316.608	1397.676	1315.356	.738	.667

Note. LL = Log Likelihood, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, SABIC = Sample size-adjusted Bayesian Information Criterion, BLRT = *p*-value of the Bootstrapped Likelihood Ratio Test.

Table 3.6

Group Descriptions of the Three-profile Solution

	n (%)	RLI	ELI	DS
Low-performing	30 (18.0%)	-1.211 (.258)	-1.054 (.201)	-1.239 (.197)
Average	96 (57.5%)	-.025 (.274)	-.106 (.157)	-.064 (.226)
High-performing	41 (24.5%)	.994 (.136)	1.018 (.433)	1.000 (.272)

Note. RLI = Mean standardized performance on TACL Receptive Language Index (standard error), ELI = Mean standardized performance on TEXL Expressive Language Index (standard error), DS = Mean standardized performance on WISC-V Digit Span subtest (standard error)

Table 3.7

Group Descriptions of the Four-profile Solution

	n (%)	RLI	ELI	DS
Low-performing	38 (23.0%)	-1.131 (.708)	-1.097 (.673)	-1.066 (.666)
Average	83 (50.3%)	-.036 (.611)	-.028 (.551)	-.084 (.650)
Mostly High-performing	33 (20.0%)	1.206 (.610)	.645 (.549)	.959 (.660)
Exceptional Expressive Language	11 (6.7%)	.563 (.457)	2.230 (.487)	1.244 (.948)

Note. RLI = Mean standardized performance on TACL Receptive Language Index (standard error), ELI = Mean standardized performance on TEXL Expressive Language Index (standard error), DS = Mean standardized performance on WISC-V Digit Span subtest (standard error)

Table 3.8

Behavior Ratings of Children in Various Profiles

	Group	*n*	Mean	Standard Deviation	Standard Error
SSBS Social Competence	Low-performing	28	48.11	10.68	2.02
	Average	90	54.62	9.18	.97
	High-performing	38	57.92	9.61	1.56
SSBS Antisocial Behavior	Low-performing	28	52.36	11.82	2.23
	Average	90	47.81	9.45	1.00
	High-performing	38	47.68	11.40	1.85

Table 3.9

ANOVA Results

		Sum of Squares	df	Mean Sq	*F*	*p*
SSBS Social Competence	Between Groups	1581.15	2	790.57	8.64	<.001
	Within Groups	14998.60	153	91.49		
	Total	15579.74	155			
SSBS Antisocial Behavior	Between Groups	483.13	2	241.57	2.24	.110
	Within Groups	16526.43	153	108.02		
	Total	17009.56	155			

Table 3.10

Welch Test Results

	Statistic	df1	df2	*p*
SSBS Social Competence	7.36	2	59.89	<.001
SSBS Antisocial Behavior	1.80	2	57.29	.175

Table 3.11

Games-Howell Post Hoc Analysis

	Group	Comparison Group	Mean Difference	Standard Error	*p*
SSBS Peer Relations	Low	High	-9.81*	2.50	<.001
		Avg	-6.52*	2.24	.016
	High	Low	9.81*	2.50	<.001
		Avg	3.30	1.79	.178
	Avg	Low	6.52*	2.24	.016
		High	-3.30	1.79	.178

* = The mean difference is significant at the 0.05 level.

Note. Low = Low-performing profile, Avg = Average profile, High-a = High-performing profile

Chapter 4: Mixed-methods Analysis

Abstract

Purpose: The purpose of this study was to examine school-based speech-language pathologists' (SLPs') implementation of services to address students' executive function (EF) deficits, with particular emphasis on the prevalence and characteristics of EF interventions, and the factors and barriers which influence service provision for students with EF deficits.

Method: I applied an explanatory sequential mixed methods research design, beginning with a quantitative survey followed by a series of qualitative interviews. Descriptive data analysis of the survey yielded information about the relative prevalence of various types of direct and indirect services to address EF deficits, as well as the relative prevalence of specific barriers and facilitating factors. I used binary logistic regressions to explore the contribution of various participant characteristics towards the likelihood of survey provision. I used qualitative data analysis to explore detailed descriptions of EF interventions and barriers.

Results: Most SLPs reported that they addressed their students' EF deficits through some sort of direct or indirect intervention. Direct interventions varied by targeted domain, service delivery setting, and teaching techniques, though most SLPs favored strategy instruction and highly contextualized services. Indirect services included accommodations and consultation. SLPs commonly reported the lack of collaborative support, time, and knowledge as barriers, and most reported that professional development would be helpful to improve their services.

Conclusions: SLP graduate programs and providers of professional development should be mindful of their role in preparing SLPs to address executive function deficits, while SLPs may use these results to inform their own practice. Further guidance and research are necessary to elucidate the SLPs' role in mitigating the negative impact of EF deficits on students' education.

This *Is* My Lane: A Mixed-methods Analysis of Speech-language Pathologists' Executive Function Services

Executive functions (EFs) are the cognitive processes used to plan and perform goal-directed behavior (Jones et al., 2016). Accordingly, they play a major role in academic success in students of all ages, ranging from early elementary years (Morgan et al., 2019a, b), middle school (Samuels et al., 2016) to adolescence (Biederman et al., 2004). This is notable for school-based educators and service providers due to the frequency with which children with disabilities present with EF deficits. Speech-language pathologists (SLPs) must be particularly mindful of EF deficits in children on their caseload; while these deficits are a predictable feature of some disorders that may appear on an SLP's caseload such as attention deficit/hyperactive disorder (ADHD; Martel et al., 2007) and acquired brain injury (ABI; Perna et al., 2012), EF deficits are also lesser-known comorbidities among disorders that likely constitute a larger portion of the school-based SLP's caseload, including developmental language disorder (DLD; Graf Estes et al., 2007; Pauls & Archibald, 2016; Vugs et al., 2013) and autism spectrum disorder (Demetriou et al., 2018). Indeed, children with DLD perform, on average, more poorly on various measures of EF compared to both age-matched and language-matched peers (Marton et al., 2012), suggesting that EF deficits go hand in hand with language deficits in children with DLD.

A growing body of literature offers support to SLPs providing EF intervention to children. Some of this literature offers guidance towards principles of intervention (see Drazinski, 2014; Gillam, 1997; Singer & Bashir, 2018), others offer case studies of such interventions being implemented (see Clegg & Hartshorne, 2004; Dunaway, 2004; Singer & Bashir, 1999), and still others provide detailed tutorials for specific intervention approaches (see Jansen et al., 2010; Ward & Jacobsen, 2014; Westby & Cutler, 1994). The sum of these

resources establishes that SLPs are well-equipped to provide direct and indirect services to support children with EF deficits. However, while these resources exist, it is unclear the extent to which school-based SLPs actively contribute to the treatment and intervention of EFs. The American Speech-Language-Hearing Association (ASHA) has taken the stance that EFs are within the trained SLP's scope of practice; "The Big Nine," which lists and describes the nine domains of speech-language pathology, includes "cognitive aspects of communication" and elaborates to include "attention, memory, sequencing, problem-solving, and executive functioning" (ASHA, n.d.) Provided that SLPs are within their scope of practice to offer these services, why does it remain unclear what SLPs are doing to support EFs in practice? The nature of SLPs' services can be explored using empirical methods through the lens of implementation science.

Implementation science is "the examination of methods that promote use of well-researched interventions in 'real-world' settings" (Douglas & Burshnic, 2018). Implementation science frameworks can be categorized into three central applications, including the study of translating research into practice, understanding the factors that influence implementation, and evaluating implementation efforts (Douglas & Burshnic, 2018). With these applications, implementation science provides the perfect lens to examine the real-world practices of school-based SLPs providing intervention. Similar studies have been conducted in the field of communication sciences and disorders, albeit examining interventions for different populations. In one example, Riedeman and Turkstra (2018) surveyed SLPs in healthcare settings to assess their knowledge, confidence, and practice patterns when working with adults with traumatic brain injuries, finding that while some SLPs practiced competently, others lacked confidence or knowledge in that area. This is particularly relevant since EF deficits are a common

characteristic in individuals with traumatic brain injury, and the authors' findings may serve as a warning of inconsistent application of evidence based practices in other settings such as schools. To the best of my knowledge, no similar studies exist to demonstrate whether school-based SLPs have adequate training, confidence, and competence to provide services for students with executive function deficits.

The Present Study

In order to fill the gap in our current understanding of school-based SLPs' EF intervention practices, this study uses an explanatory sequential mixed methods design to gather both quantitative and qualitative data documenting current practices. An initial quantitative survey allows for a relatively large sample of SLPs in order to document national trends in practice, and qualitative follow-up interviews allow for an in-depth exploration of implementation, and help to contextualize and explain the initial results of the survey (Cresswell & Plano Clark, 2017). The combination of these methods should yield a rich source of knowledge by maximizing both the breadth and the depth of this research.

The goal of the present study is to determine the extent to which school-based SLPs provide services to address EF deficits, and to determine the factors that influence these services. To that end, I posed the following research questions:

1) How prevalent are SLP-implemented EF interventions in the school setting?
2) What types of interventions do school-based SLPs use to address executive function deficits?
3) What factors or barriers affect the SLP's service provision?

I hypothesize that this study will identify an intersection of various frameworks found throughout the current literature. Specifically, I predict that some SLPs provide direct

intervention for EF deficits, the components of which align with Denman and colleagues' (2021) framework of intervention components. Likewise, I predict that some SLPs will provide indirect services through accommodations, such as the instructional and contextual (or 'environmental') modifications described by Dunaway (2004), and some will provide indirect services through the consultative approaches suggested by Boudreau and Constanza-Smith (2010) and Clegg and Hartshorne (2004), among others. Finally, I predict that the provision of these services will be impacted by factors and barriers such as those described by Michie and colleagues' (2005) conceptualization of implementation science (see Figure 4.1).

Method

I used an explanatory sequential mixed methods design (Cresswell & Plano Clark, 2017) in which I used a quantitative survey to collect data to demonstrate the trends of school-based SLPs' services for children with EF deficits, followed by a series of qualitative interviews which supplemented the survey by aiming to explain and contextualize the results (see Figure 4.2). I integrated the results of the survey and interviews in order to draw general conclusions about the overall prevalence of various types of services, identify commonly-reported barriers, and further explore specific characteristics of these services and the factors which influence them. The Institutional Review Board at the University of Maryland, College Park approved all procedures for this study.

Participants and Recruitment

Quantitative Strand

Survey participants included 350 school-based SLPs, currently practicing in the United States, while the interview participants included eight SLPs semi-randomly selected from survey participants who volunteered for a follow-up interview. I recruited survey participants through

ASHA community forums, the Speech-Language-Hearing Association of Virginia, professional connections and social media. I encouraged participants and professional connections to share the survey with their networks as well, allowing the survey sample to snowball. A description of participant demographics can be found in Table 4.1, and additional survey responses can be found in Table 4.2.

Qualitative Strand

I selected interview participants from the pool of survey participants who volunteered for a follow-up opportunity. The qualitative power analysis tool proposed by Fugard and Potts (2015) predicted the need for eight interview participants; this sample size would provide an 80% likelihood of encountering at least two instances of each theme, based on a conservative thematic prevalence that 35% of the overall population of SLPs would provide services and/or encounter specific barriers to services provision. I set a stopping criterion wherein I would discontinue interviews after two consecutive interviews failed to introduce new themes or ideas (Francis et al., 2010). I was prepared to recruit additional participants beyond the initial batch of eight interviews, but that was not necessary; I reached my stopping criterion after the 7th interview, so I discontinued after the eighth and final interview of the initial batch yielded no new thematic material.

I stratified my selection of interviewees based on their responses to selected survey items, so that the interview sample would generally reflect the survey sample with regards to key variables which might impact service delivery. The intention behind this stratification was to ensure that SLPs with a variety of settings, experience, and self-reported knowledge would be represented in the interviews, since these three variables would be reasonably expected to influence service provision. I strived to select interview participants that would generally reflect

the survey sample in these areas, but not at the expense of a balanced representation of SLPs in any of these categories.

To that end, the first stratification was based on work setting; I aimed to recruit four SLPs serving elementary schools, one SLP serving preschools, one SLP serving middle schools, one SLP serving high schools, and a final SLP from either a middle or high school setting. The result if this stratification was that elementary school was under-represented compared to the survey sample (50% as opposed to 67.7%), but that I was able to explore the experiences of SLPs serving secondary settings in greater depth while still interviewing a relatively large number of SLPs serving elementary schools. The second stratification was based on years of experience; I aimed to recruit one SLPs with 0-3 years of experience, three SLPs with 4-10 years of experience, three SLPs with 11-20 years of experience, and one SLP with 21 or more years of experience. The final stratification was based on self-reported knowledge of EFs; I aimed to recruit roughly even numbers of SLPs who reported minimal understanding (1 or 2 out of 5), average understanding (3 out of 5), and strong understanding (4 or 5 out of 5). The result of this stratification was that SLPs with low self-reported knowledge were relatively over-represented compared to the survey sample (37.5% compared to 20.3%), whereas SLPs with average self-reported knowledge were relatively under-represented (37.5% compared to 52%); however, this allows for a more thorough understanding of SLPs across the entire range of proficiency. I sorted volunteers based on these criteria, and used a random number generator to select a total of eight volunteers that ensured all of my criteria for representative sampling were met. See Table 4.3 for a comparison of survey and interview participants along these stratified variables, and Table 4.4 for interview participants' settings, experience, and self-reported knowledge of EFs.

Data Collection

Quantitative Strand

The survey used in this study was a 12-item instrument, designed specifically for this research. It was hosted on Qualtrics (2005), an online survey software, and made available for one month between January 19th and February 19th, 2022. Prior to distribution, three SLPs with experience in school-based settings piloted the survey and provided feedback to help validate and streamline the survey's questions and response options. The first three questions of the survey inquired about the participants' demographics, and the next three questions assessed participants' knowledge about executive functions and the SLPs' role in intervention. Following this section, I provided a brief definition and description of EFs in order to establish common terminology with participants. The subsequent six items explored the implementation of services, inquiring about SLPs' self-rated knowledge, direct and indirect services, and any barriers or facilitating factors to intervention. The survey concluded by offering participants the chance to volunteer for a follow-up interview.

My survey design was influenced by similar research within the field of communication sciences and disorders. Examples include Volkmer and colleagues' surveys of SLPs' practices (2019) and barriers (2020) when treating primary progressive aphasia as well as Riedman and Turkstra's (2019) survey of SLPs' treatment of adults with traumatic brain injury. These examples served as models for this survey's structure, sections, formatting, and approach to constructs such as knowledge, confidence, and practice patterns. Further, Michie and colleagues (2005) described human factors which influence implementation (e.g., skills, social role and identity, etc.) which I adapted to explore barriers and facilitating factors. See Appendix 4B for the survey protocol.

Qualitative Strand

I designed the interview protocol to delve deeper into the questions posed by the survey, following a similar structure. I used a semi-structured approach featuring a protocol which outlined the general topics for discussion, though I allowed follow-up questions and tangents as appropriate. I designed this interview protocol to further explore the patterns and themes of survey responses. I conducted interviews virtually through Zoom, which lasted between 30-45 minutes. I recorded all interviews and manually transcribed each interview using www.oTranscribe.com, a free online transcription tool. I validated the transcripts with each respective participant.

In each interview, I encouraged participants to first provide a clearer description of their position, role, and caseload. I also asked participants to describe EFs as they understand them, in order to informally assess their understanding and to reach a consensus definition between the interviewer and participants. Participants then described their services, including relevant components such as population, service provider, setting, dosage, domains, approach, and contextualization (see Denman et al., 2021 for terminology to describe intervention components), along with examples and descriptions of their direct and indirect services. Finally, using the lens of implementation science (per Douglas & Burshnic, 2019), I inquired about barriers and facilitating factors, prompting for possible examples of barriers and factors. See Appendix 4C for the interview protocol.

Data Analysis

I analyzed survey data using IBM SPSS Statistics (Version 28) predictive analytics software. I answered the first two research questions through descriptive statistics, and the third research question through two binomial logistic regressions along with a descriptive analysis. I

coded interview transcripts using Dedoose, a qualitative and mixed method data analysis application (Salmona et al., 2019). I created a codebook (see Appendix 4D) using broad thematic codes (e.g., direct intervention, implementation) and narrower content-specific subcodes (e.g., the domain, form, and delivery of direct intervention; confidence and knowledge/skills as factors of implementation) that were informed by my theoretical framework and refined by survey responses; most of the qualitative data aligned with the initial codebook, though several codes were generated dynamically during the coding process. I assigned codes and subcodes to each distinct statement (e.g., phrase, sentence, or paragraph) from each transcript, and analyzed the themes and patterns which arose from the interviews.

Results

The survey received a total of 488 responses. After I removed 138 incomplete responses which did not respond to questions about intervention practices, 350 responses remained. Of these, the majority of respondents (67.7%; n = 237) reported that their primary setting was Elementary School, while 11.4% (n = 40) listed Preschool, 12.6% (n = 44) listed Middle School, and 8.3% (n = 29) listed High School. Participants reported a range of 0-47 years of experience as an SLP, and an average of 12.5 years (M = 12.59, SD = 9.74). On average, participants reported a "moderate" understanding of EF, with a mean rating of 3.07/5 on a Likert-style scale (SD = .847). Most SLPs were able to select an accurate definition of EF out of four options (76%; n = 266) but fewer (39.4%; n = 138) were able to identify which one of four options was not a core component of EF. About half of SLPs (52%; n = 182) knew that EFs are explicitly listed within their scope of practice by ASHA, while the remainder thought that the SLP's role was less clearly defined, and a few (4.29%; n = 15) did not realize that EFs are within the SLP's

scope of practice at all. The mean score on this three-question knowledge assessment was 1.68/3 (*SD* = .926). See Table 4.1 for an overview of participant's demographics and scores.

Prevalence of EF Interventions

In the first research question, I asked about the prevalence of SLP-implemented EF interventions in the school setting, and was answered through descriptive analysis of the survey data. For the purposes of the survey and data analysis, I characterized interventions as either direct (i.e., the SLP works directly with a student and delivers a targeted intervention, also including interventions embedded within their regular speech/language therapy) or indirect (i.e., the SLP either implements environmental or teaching modifications in their own services, writes these modifications into students' IEPs, or collaborates with teachers to facilitate the classroom use of these modifications). While more than half of SLPs (61.7%, *n* = 216) reported providing EF services to children who were already on their caseload for a communication disorder, only 15.4% of SLPs (*n* = 54) reported providing services to *all* children with EF deficits that impacted their learning. In contrast, 22.9% of SLPs (*n* = 80) reported that they do not provide any EF services at all. In total, 80.6% of SLPs (*n* = 282) reported providing some sort of direct intervention. Most SLPs (84.3%, *n* = 295) reported implementing either environmental or instructional modifications within their own services, while fewer (60.6%, *n* = 212) ensured that these modifications were implemented in their students' classrooms by way of writing them into students' IEPs or training teachers on the implementation of these modifications. See Table 4.2 for more information about participants' services.

Types of EF Interventions

In the second research question, I asked about the types of services SLPs provide to students with EF deficits, which was answered through both quantitative and qualitative analysis.

The quantitative strand relied on descriptive analysis of the survey results, while I derived the qualitative analysis from interview participants' depictions of their direct and indirect services.

Direct Intervention

Survey and interview participants described two approaches to treating EF via direct intervention: through goals and services explicitly intended to address student's EF deficits, or by embedding EF strategies into speech and language goals. An example of the latter may include an SLP who aims to improve listening comprehension by teaching the student strategies to offload their cognitive and working memory demands. Of the survey participants who provide some sort of direct intervention to support EF, the most commonly used approach was to address these deficits implicitly, embedded in their regular speech or language therapy, as reported by 50.9% of SLPs (n = 178). As one SLP described, "I weave a lot of the skills and strategies into everyday therapy, whatever I'm targeting." Other SLPs report a more explicit approach to EF intervention: 29.7% of SLPs (n = 104) explicitly targeted EF deficits with intervention in the pull-out setting (e.g., speech therapy room), and 22% of SLPs (n = 77) did the same in a push-in (e.g., classroom) setting.

Domain. While the surveys explored whether SLPs provide direct services, the interviews explored *how* these services were delivered. My qualitative data analysis revealed that SLPs' direct intervention for EF deficits generally aligns with the intervention components proposed by Denman and colleagues (2021), as I hypothesized within my theoretical framework. Participants described a wide range of EF domains addressed through direct services, including working memory, shifting/flexibility, response inhibition, organization, time management, planning/prioritization, and problem solving. It was rare that any SLP addressed each of these domains through direct intervention, but most SLPs addressed at least one.

Purpose. The purpose of participants' direct services gravitated towards strategy use rather than skill development. One participant noted that "It's a lot of strategies and tools that get put into place, as opposed to trials." When asked about skill development, particularly related to working memory, another participant firmly established that "I don't do that. My understanding is that, per the research, you can do that and maybe they can say a longer strand of numbers, but it's not going to translate into anything that matters in their lives particularly well."

Delivery. As with the survey responses, interview participants reported service delivery through a variety of modalities, including 1-on-1, small-group, and both push-in and pull-out services. Frequently, SLPs used several different forms of delivery in their direct services, even for the same student. As one participant stated:

> There are some strategies where I would initiate learning in my therapy room in a 1-to-1 setting, but once they get it… I would try to shift it into the classroom with other communication partners when I can. The classroom is a distracting environment, so that's why I try to start as much as I can with a 1-on-1 thing so they can get set up. But as fast as I can, I like to transition into a classroom. Because they've got to generalize, you know?

Form. With regards to the form of the intervention, participants stressed the importance of teaching and establishing skills through decontextualized therapy, before shifting to contextualized or activity-focused therapy in order to maximize the functional benefit to the student. In the words of one SLP, "I would say it starts with decontextualized to train the skill… but it moves to contextualized pretty quick." Other SLPs were willing to spend more time on decontextualized therapy, including one who stated "I think the services go across that whole range there, but I think there probably is a lot of decontextualized work where it's just activities,

situations for the students." However, that same SLP emphasized the importance of eventually shifting to a more functional form of therapy, including integration into Community-Based Instruction and preparation for mock interviews. The form of intervention was frequently tied to the delivery of services. As one SLP stated, "I would prefer to be more collaborative, because I don't want to pull these students and teach them some decontextualized skill with some worksheet that I pull off the shelf… I want to go into their classroom and help them out."

Teaching Techniques. Numerous teaching techniques were reported by interview participants. The most prominent prompting technique was the use of questioning, as SLPs encouraged students to think through a problem to find their own solution. One participant reported that the use of questions encourages self-reflection, analysis, and ownership of techniques:

> I think they do have to take ownership of it, so we don't really want to come in there and say "Well this is how you're going to do it," … You are guiding people to their own self-discovery, really, but you've got to let them figure it out.

Participants also used linguistic techniques such as thinking aloud, such as one who reported:

> Another thing I do is think aloud my own emotional regulation strategies. Like, if I'm trying to glue something but my glue is broken–it happened this week–like, "Wow, I'm finding myself very frustrated that the glue is broken! I don't know what to do! Maybe I can take a deep breath, or maybe I can try to choose a different glue, or… I don't know, what do you guys think?"

Finally, with regards to regulatory techniques, participants relied heavily on visuals to support their instruction, albeit a variety of visuals for a variety of purposes, including "Visuals, graphs, or different visual charts that we've used to work on problem solving or describing or retaining

information." While each of the interview participants reported a unique combination of teaching techniques, one common thread is that the techniques were typically adapted based on the child's needs:

> It might be pictures, depending on the age. It might be jotting down key words. It might be repeating what they heard. It just depends on what works for them. I think it's individual to the age, it's individual to the student. It will just depend.

Indirect Services

Accommodations. Based on survey responses, most SLPs implement some sort of accommodations or modifications to their own services in order to mitigate students' EF deficits. Instructional modifications (e.g., repetition, reduced rate of speech, chunking, pairing auditory cues with visuals) are frequently implemented, used by 72% (n = 252) of SLPs. Environmental modifications (e.g., visual activity schedules, checklists, timers, calendars/planners) are also frequently implemented, used by 69.7% (n = 244) of SLPs. However, fewer SLPs ensured that these modifications were generalized to the classroom, as only 53.4% (n = 187) of SLPs reported writing instructional modifications into students' IEPs or providing training to parents or teachers, and only 54.3% (n = 160) of SLPs did the same for environmental modifications. Interview participants tended to report an active role in collaborating with educators to implement accommodations and modifications, both instructional and environmental in nature. Examples of such modifications include multimodal instructions and directions, extra time for assignments, frequent checks for understanding, permission to take pictures of instructional materials, breaking assignments into smaller chunks, repetition of instructions, note-taking support, cued listening, preferential seating, adaptive seating and other sensory supports, and visual supports for schedules, transitions, timers, and instruction. As one participant said,

"Indirect [service] is really changing the classroom environment, and getting teachers to understand that this is how they [students] learn. And I heard a quote the other day, 'What's beneficial for one can be beneficial for all,' so we try to get them to adapt their teaching methods for the kids."

Consultation. Consultation is another prominent form of indirect service, and several interview participants discussed their consultative services. Some reported consulting with parents to ensure the carryover of skills developed at school: "So where I end up having the bulk of these conversations is with parents, saying 'This is what I'm seeing with your kid, here are some things you can do.' Sending them over some resources, those kinds of things." More commonly, SLPs reported providing consultation to teachers and other educators. Consultation was described as one way to ensure the appropriate implementation of the accommodations and modifications described above:

> Working with the teachers, teaching them some of the strategies that they can in turn teach the students… making recommendations like placement in a classroom, or making sure to also involve the paraprofessionals that support the students, and helping them learn "These are different coping strategies,'" or "These are the different strategies that the student can implement to then use this skill.

In some cases, consultation was described as a proactive way for SLPs to influence their students' education, and in other cases, it was described as a reactive way for educators to seek support from the SLP to address a specific problem. As one participant described:

> There's a few students that I'm offered as consult [services]. Most of these students have me as a service, so it's sort of all-in-one. Most of the case managers at my schools know that if they have a question about an accommodation about a specific student, I'm

available. Even for students that don't have me as a consult, I'm there to support the team.

Factors Influencing Service Provision

My third research question was centered around factors that influence service provision, and I answered this using both quantitative and qualitative methods. In the quantitative strand, I analyzed survey responses to determine whether primary setting, work experience, demonstrated EF knowledge, or self-reported EF knowledge were significant predictors of the provision of direct interventions or indirect services. Further, using descriptive analysis of survey results, I identified reported barriers to service provision and factors that would help support the SLP's service provision. My qualitative analysis was derived from interview participants' descriptions of these factors.

SLP Characteristics

I fit a logistic regression model to determine the predictive value of primary setting, work experience, demonstrated EF knowledge, or self-reported EF knowledge on participant's provision of direct services (see Table 4.5). The logistic regression model was statistically significant, $\chi^2(6) = 60.102$, $p < .001$. The model explained 26.0% (Nagelkerke R^2) of the variance of direct service provision, and correctly predicted 83.3% of cases. Higher ratings of self-reported EF knowledge ($p < .001$) and employment in the Elementary School setting ($p < .05$) were each associated with a significantly higher likelihood of providing direct services to address EF deficits. The results of the Box-Tidwell test (1962) were nonsignificant for all continuous variables, $p > .10$, which verifies that the assumption of a linear relation between predictors and their logit has been met.

I fit a second logistic regression model to determine the effects of primary setting, work experience, demonstrated EF knowledge, or self-reported EF knowledge on participant's provision of indirect services, classified as the use or coaching of environmental and instructional modifications (see Table 4.6). The logistic regression model was statistically significant, $\chi^2(6) = 31.966$, $p < .001$. The model explained 20.3% (Nagelkerke R^2) of the variance of indirect service provision, and correctly predicted 91.8% of cases. Higher ratings of self-reported EF knowledge ($p < .001$) was the only significant predictor associated with the likelihood of providing indirect services. The results of the Box-Tidwell test (1962) were nonsignificant for all continuous variables, $p > .10$, which verifies that the assumption of a linear relation between predictors and their logit has been met.

Barriers

I used descriptive analysis of survey responses to identify the most commonly reported barriers to effective service provision (see Table 4.2). From most to least frequent, SLPs reported that their services were negatively impacted by difficulties associated with collaboration (reported by 35.7% of respondents), a lack of time (31.7%), a lack of general knowledge of EF (28.6%), a lack of specific knowledge of EF interventions (25.1%), a lack of materials or resources (22.3%), or their professional role (18.3%). In the "Other" free response option, six additional participants (1.7%) reported issues with students' special education eligibility requirements.

I further examined the themes of the quantitative data results using thematic analysis of the qualitative interviews. With regards to collaboration, interview participants reported varied experiences; some worked in truly multidisciplinary settings which fostered a collaborative environment, while other participants' experiences with collaboration were mixed:

> The teacher for the resource class, she was super collaborative and very open, and we learned from each other. And there were other teachers who were like, "I just don't want to hear from speech, just go to your room and do your thing."

Though survey respondents rated professional role to be a less impactful barrier, this theme arose repeatedly in interviews, and it frequently intersected with the theme of collaboration. The participant above continued their statement, saying:

> I feel like I hear the words "Stay in your lane" all the time. Like, what? Okay, but we also talk about collaboration, so how are we supposed to stay in our lane and also collaborate?

In other cases, the barriers stemming from professional roles were not social in nature, but rather codified into district or state policy. Another participant elaborated, saying

> I think it's filtering out "Well here's ASHA's scope of practice" versus what you do in your school when you've got your State Ed[ucation] Code, you've got your district policies… It's like a separate realm… So the barrier for us is that it [EF] is not really in the Ed Code.

Time was another barrier cited by survey and interview participants alike, and intersected with the themes of caseload and workload; the more students an SLP must serve, the less time they have available to dedicate to any one student. This was observed by one participant, who noted "Of course it would be easier if you have fewer children on your caseload, and you can do more 1-on-1 services and have a lot of time to dig into this [EF] stuff." Another participant commented that EF services might be a lower priority given time constraints, saying "You have a short amount of time, picking and choosing what's gonna be worked on can be challenging."

Knowledge and comfort with EFs were meaningful factors which shaped participants' service provision. Interview participants most frequently cited professional development (e.g., speakers, workshops) as sources of knowledge, while the only SLP who cited graduate school as a major source of knowledge noted that they had studied under experts in that domain. Other sources of knowledge included colleagues (i.e., other SLPs, special education teachers, occupational therapists, behavior specialists, and school psychologists), personal experiences (i.e., with students on their caseload, or with their own children's diagnoses), books, and SLP influencers on social media. While knowledge and comfort were associated with strong descriptions of appropriate service provision, the lack thereof proved to be a barrier to some participants: "I don't [provide EF services], but I wish I did, and I wish I knew how." Similarly, another participant noted that they did not have "much access to training," and that they did not know where to find resources to support their EF interventions.

Assessment. Though my survey protocol centered around intervention and did not include questions about assessment, interview participants offered valuable insight about their assessment practices, and this emerged as a possible barrier to service provision. None of the SLPs interviewed conducted their own EF assessments; sources of data included assessments conducted by school psychologists or educators, informal measures (including interviews and observations), and SLPs' clinical judgment. However, some interview participants' responses suggested that even if other professionals evaluated EF, the information was not always conveyed. One SLP said "I don't think I've heard it [data about EF] directly from the psychologist that I work with during our preschool assessments," while another said that EF was "not really an area that gets its own evaluation section."

Facilitating Factors

Conversely, descriptive analysis also identified factors which SLPs reported would be (or would have been) helpful to facilitate effective service provision (see Table 4.2). From most to least frequent, participants reported professional development (71.1%), better materials or resources (52.3%), more training in graduate school (47.4%), and better collaboration (43.7%). In the "Other" free response option, 14 participants (4%) mentioned improved district support (e.g., more time, lower caseload), and seven (2%) alluded to a clarification or change of their role in district or state policy.

Interview participants' responses echoed those from the survey, particularly in voicing a strong desire for free or accessible professional development. Several participants noted the convenience of online professional development, citing webinars, the ASHA Learning Pass, www.speechpathology.com, and The Informed SLP as various preferred platforms. Elaborating on the desire for professional development, one participant clarified the importance of functional and practical training: "I know ASHA probably has some information on it. But what would be helpful is best-practice, 'Here's what to do, here's what to do, here's what to do when…' So those tangible strategies [would be helpful]."

Though just under half of survey respondents cited graduate school as a facilitating factor, some interview participants felt strongly about the importance of teaching EF content to SLP students:

> This is such a huge, underlying area that is challenging for so many different kinds of people. And I think it really should be part of our training as SLPs… to think about "How do we support this?" Because it's so foundational, and I had to stumble upon it.

Discussion

The present study explored SLPs' services for children with EF deficits using a quantitative survey and qualitative interviews. The integration of this data yielded three key findings: (1) Most SLPs support EF deficits for students on their caseload through indirect services or through strategies embedded in their standard speech/language therapy, though fewer provide explicit, direct intervention to remediate these deficits; (2) SLPs can provide direct therapy under a traditional intervention framework to remediate a variety of EF deficits in a variety of formats, and they can also support students by providing environmental and instructional modifications and by consulting with other educators to facilitate the implementation of these strategies; and (3) SLPs' knowledge and confidence are significant gateways to service delivery; while most SLPs desired more training, those who had already acquired knowledge in this area were more likely to provide services to students in need. The implications of these findings extend to those involved in SLP preparation, SLPs themselves, and policymakers.

It is encouraging that such a large number of SLPs reported providing services for students with EF deficits, though the interviews suggest that the survey results must be interpreted with context. One such instance is centered around the prevalence of services to address EF deficits. An encouraging number of survey respondents reported that they provided services to address EF deficits, though a closer examination of interview data suggests that this might be a misleading statistic. While some interview participants reported interventions to support proximal or distal EF skills (e.g., working memory and organization, respectively), others focused on pragmatic and social communication skills for children for EF deficits. This is certainly an area of need related to EFs, since children with poor EFs frequently present with

social communication deficits and require SLP intervention (Timler & White, 2014). However, pragmatic and social communication lie tangential to EF deficits, and therefore the survey results for SLPs who provide EF intervention may be inflated by SLPs who conflated EF and pragmatics.

Another instance where the interviews helped contextualize survey responses is in the understanding of how SLPs acquire knowledge about EF interventions. Certainly, some of the interviewees demonstrated a stronger understanding of best practices for EF interventions (see Chapter 2 of this dissertation) than others. The SLPs with the strongest understanding each had a story or experience; some had children with EF deficits, others had attended professional development sessions with EF experts, and one studied under a professor who was passionate and knowledgeable about EFs. Meanwhile, the SLPs with comparatively poorer understanding of EFs shared no such experiences. This is a logical trend, and it adds weight to the importance of SLP preparation and continuing education. Since better-informed SLPs generally reported higher-quality interventions, the scientific community must ensure that their research and guidance is translated to practitioners in accessible outlets (see Harold, 2019).

One additional instance of contextualization provided by the interviews is the impact of state and local education policies on service provision. Whereas SLPs working in private practice or clinical settings may have more flexibility in their determination of who may receive services, school-based SLPs are bound by stricter regulations for students' eligibility and the services they may provide. Though many of the interview participants felt free and comfortable to practice within their areas of competency (including EF), others perceived either a *de facto* or *de jure* barrier in which EF fell outside of their scope. In some cases, the expectation was that another professional was responsible for EFs, but in other cases, the SLP was unclear who–if anyone–

provided support for EF. This raises two central questions about these findings: first, how have local policies influenced the results of this survey? Namely, of the SLPs who do not provide EF services, how many were restricted by local policies? Approximately 18% of SLPs reported "professional role" as a barrier to service provision, and the interviews suggest that for some SLPs, "professional role" is a legal barrier (i.e., State Educational Code), whereas for others it may be a result of school culture (e.g., "Stay in your lane!"). Future research may include document analyses to determine the suitability of SLP-implemented EF services in different states and local education agencies, and closer scrutiny of specific barriers to service provision. The second question raised by the finding is whether SLPs in private practice or clinical settings show similar patterns of EF service delivery, and whether they are influenced by similar barriers or facilitating factors. If private practice SLPs provide EF services at a higher frequency than their school-based colleagues, it suggests that many of the barriers may be endemic to the school setting; however, if they do not, then it suggests that this may be a larger problem related to SLP preparation and continuing education. This latter possibility bodes poorly for clients who would benefit from SLP-implemented EF interventions.

Implications for SLP Preparation

Though it was perhaps a predictable finding, the association between SLPs' self-reported knowledge and the implementation of services establishes the importance of ensuring that all SLPs are prepared to address EF as part of their role. Indeed, only half (52%) of survey participants correctly realized that EF is explicitly listed by ASHA as within our scope of practice, so it should be of little surprise that the implementation of direct and indirect services varied. Most interview participants reported minimal instruction about EF in graduate school, so the central findings of this study suggest that SLP preparation programs must do a better job of

establishing the SLPs' role in the remediation of EF deficits. ASHA's required competencies are a major driving force behind university curricula, and while EF competency is required by ASHA's standards (Standard IV-C; ASHA, 2020), interview participants largely reported that EF instruction was relegated to a small, forgettable segment of their curriculum. Even if specific coursework in EF may be an unreasonable expectation for graduate programs, SLP faculty must ensure that their students understand the basic principles of EF and EF intervention, recognize populations of children that may be prone to EF deficits (e.g., those with DLD, ADHD, TBI, or ASD), and that they grasp their role and responsibility in remediation. An audit of university syllabi may be a worthwhile endeavor to ensure that programs remain in compliance with ASHA's educational requirements, and to determine the extent to which SLP students are prepared to address EF deficits in their future clinical services.

Perhaps just as importantly, SLP educators must work to ensure the availability of professional development in the area of EF. This was the most common request by survey respondents, and interview participants reiterated that request while also explaining how important professional development had been to their own knowledge and understanding. Possible outlets for professional development include webinars, conferences, workshops, learning communities, and district-provided in-service training. Previous research on modalities of professional development suggest that SLPs benefit most from workshops and peer coaching models (Lowman, 2016), so these models may be given extra consideration. Conference organizers and other groups offering professional development would do well to note the interest in EF. Notably, though the 2022 ASHA Convention Call for Papers welcomes submissions across 31 explicit topic areas, none of these topic areas are explicitly inclusive of developmental cognitive impairments (i.e., the EF deficits commonly found in children with DLD, ADHD, or

ASD; ASHA, 2022). If SLPs are to be well-prepared and effective service providers in this under-emphasized niche of practice, then they must be given convenient and accessible opportunities to develop their foundational knowledge.

Implications for SLPs

SLPs' intervention practices vary widely, and at least part of that variance may be attributed to factors out of their control, such as district policy. However, the key takeaway for SLPs is that EF is indeed within their scope of practice, and that many of their colleagues can–and do–successfully implement both direct and indirect services within the school-based setting. Direct intervention may be designed and structured through a traditional intervention framework, with consideration to (1) The domain selected for intervention, (2) The purpose of intervention, whether to develop skills or teach strategies, (3) The delivery of services, including considerations of service provider and location, (4) The form of services, whether decontextualized, contextualized, or activity-focused, and (5) The chosen teaching techniques, including prompting, linguistic, and regulatory techniques used to elicit and shape responses. Examples of SLPs' practices for each of these intervention components can be found in the Results section, and may serve as inspiration for readers' own practices. Likewise, SLPs would do well to review the indirect services described in the Results section to determine if any of those strategies may be relevant for students on their own caseload, whether applied in the speech therapy setting or implemented in the classroom through collaboration with the teacher and IEP team.

Collaboration is a vital consideration for supporting both communication and academic outcomes for students (Chow, 2021), and effective collaborative practices may be useful for promoting both the generalization of skills acquired through direct therapy, but also the

implementation of modifications and strategies to support students throughout their day. A recent survey (Pfeiffer et al., 2019) found that fewer than one in four SLPs collaborated with special education teachers, and fewer still collaborated with general education teachers, but SLPs may overcome the barriers to collaboration in order to improve student outcomes in several key areas related to their expertise (Archibald, 2017; Wallace et al., 2021).

Aside from intervention purposes, SLPs must keep collaboration in mind throughout assessment and eligibility discussions as well. Since the interview participants noted that they did not conduct their own EF assessments, it is essential that they work with educators, school psychologists, and other related service providers to ensure that children's EF is assessed as needed, and that the SLPs receive and understand the results of those assessments. Otherwise, SLPs are forced to rely on their own clinical judgment to recognize students' EF deficits, and there is no research to demonstrate that they can do so with accuracy. This is a potential barrier to services that warrants future investigation.

Implications for Policymakers

Among the expected barriers to effective service provision, one surprise was SLPs' concerns about district and state policy. Several interview participants shared that they could only treat deficits which were explicitly codified into their education code, including domains such as speech sound production and language, but not EF. To elaborate, one SLP clarified that they were concerned about potential legal ramifications of providing treatment outside of their education code's scope of practice (Participant 1, February 2022), while another SLP indicated that they recognized it as a gray area, and provided services "under the table" (Participant 5, February 2022). Another SLP reported uncertainty about whether they are permitted to provide

this service, saying that "There's been discussion within the district about 'Whose role is it,' and there have been no answers" (Participant 7, February 2022).

To be clear, any ASHA-credentialed SLP, or any graduate of an ASHA-accredited program, is required to be competent in cognitive domains including EF. By preventing SLPs from addressing students' EF deficits, policymakers are excluding a possible source of clinical expertise. If the district has delegated this responsibility to another professional, the harm may be minimal; however, if there is no one else as qualified as the SLP, then this policy may be a *de facto* violation of students' rights to a free and appropriate public education under the Individuals with Disabilities Education Act (IDEA, 2004). Instead, policymakers must make it clear that EFs are within SLPs' scope of practice, and they would do well to offer professional development in the area of EF to ensure that SLPs and other educators are capable of implementing best practice.

Limitations

One notable limitation of this study is the failure to account for state and local policies in the survey component. The survey did not ask for respondents' state, though the subsequent interviews established that the SLPs' state and local policies influenced their provision of services. Ideally, the respondents' state would have been included as an independent variable in the quantitative analyses of factors which predict service provision, and even more ideally, the survey would have featured a large enough sample size from different states to grant sufficient power for such an analysis. As it stands, the interviews suggest that location may be a significant predictor of service provision, but that cannot be verified through quantitative analysis.

Another limitation of this study is that while the findings report how SLPs can and do address EF deficits through their services, they bring us no closer to identifying what SLPs *should* do. In particular, though the interview data may be used as a model of different ways that

SLPs can approach EF through a traditional framework, this is neither an endorsement of those interventions, nor evidence of their efficacy. SLPs must continue to be mindful of the evidence supporting their chosen interventions.

Directions for Future Research

While this study explores the SLPs' role and practices to address EF deficits, future research may take a broader view by expanding the method and lens of this study to other educators and service providers. Several SLPs emphasized the importance of an interdisciplinary approach to treating EF, and their interactions with other professions (e.g., teachers, school psychologists) proved to be a fruitful facilitating factor for some, and a barrier for others, depending on the quality of their collaboration. Therefore, to gain a fuller understanding of EF interventions in the school setting, follow-up studies must connect with teachers and special educators at a minimum, and possibly professionals from other disciplines as well. Interview participants implicated teachers' knowledge of EF, perception of students with EF deficits, implementation of environmental and instructional modifications, and collaborative habits as possible areas of interest.

Future researchers must also be mindful to address the limited empirical evidence of SLP-implemented interventions for children with developmental EF deficits. At present, there is a dearth of evidence supporting these interventions, and this study merely describes SLPs' practices without validating them. Further study is needed to evaluate whether these practices are effective.

Conclusion

This article presented the results of a sequential explanatory mixed-methods design, in which a quantitative survey of SLPs' services for children with EF deficits was contextualized by

a series of qualitative interviews. Most SLPs reported supporting students' EFs in some capacity; though less than one in three provided explicit EF services in a pull-out or push-in setting, half of SLPs embed support within their direct speech/language therapy, and nearly three in four SLPs reported using some sort instructional or environmental modifications to support EFs. Closer examination suggests that the quality and consistency of SLP's interventions varies, largely due to differences in education and training. Indeed, most (71.1%) SLPs reported that professional development would be helpful to teach them how to support EF deficits.

The present research has applied the lens of implementation science to school-based SLPs' provisions of EF interventions, in order to identify the present state of implementation of both direct and indirect services, and to identify factors and barriers which influence the provision of those services. In doing so, this research paves the way for improved SLP preparation and training, well-informed SLP intervention practices, and a call for clarity in the role of the SLP within each local education agency.

Appendix 4A

Figures and Tables

Figure 4.1

Theoretical Framework

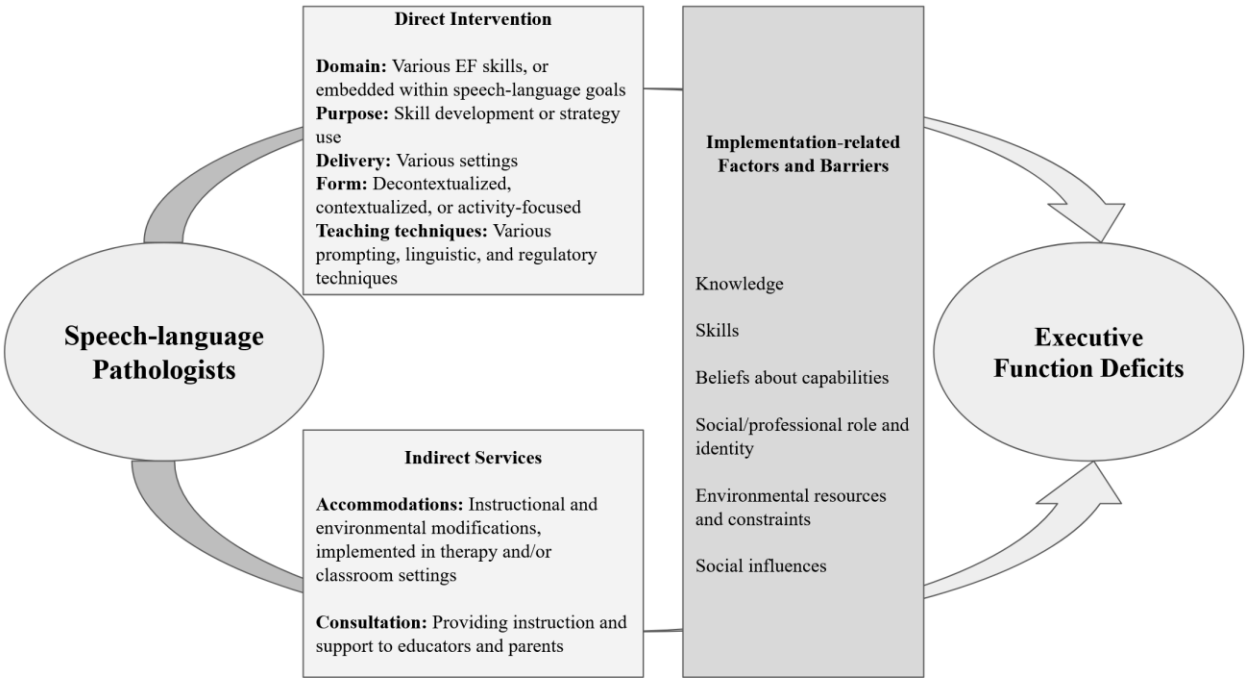
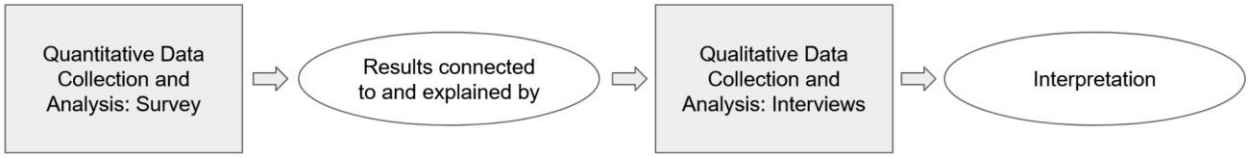


Figure 4.2

Mixed Method Research Design



Adapted from Cresswell & Plano Clark (2017)

Table 4.1

Survey Demographics

Sample characteristics (n = 350)	*n*	%
Primary Setting		
Preschool	40	11.4
Elementary School	237	67.7
Middle School	44	12.6
High School	29	8.3
Secondary Setting		
Preschool	99	28.3
Elementary School	82	23.4
Middle School	96	27.4
High School	63	18.0
Q1: Accurately defined EF	266	76.0
Q2: Accurately selected EF components	138	39.4
Q3: Accurately described SLP's role	182	52.0
Total score of knowledge assessment (out of 3)		
0	40	11.5
1	104	29.8
2	134	38.4
3	71	20.3
	M (SD)	Range
Years of experience	12.59 (9.74)	0-47
Self-rated EF knowledge (out of a 5-point scale)	3.07 (.85)	1-5
Total score of knowledge assessment (out of 3)	1.68 (.93)	0-3

Table 4.2

Survey Intervention Responses

	n	%
Service provision		
Provide intervention to all students who need it	54	15.4
Provide intervention if and only if student is already on caseload	216	61.7
Does not provide EF services	80	22.9
Direct services		
Provides pull-out EF services	104	29.7
Provides push-in EF services	77	22.0
Provides EF services embedded with speech/language therapy	178	50.9
Does not provide direct services	68	19.4
Indirect services		
Uses instructional modifications	252	72.0
Writes instructional modifications into IEP, provides training	187	53.4
Uses environmental modifications	244	69.7
Writes environmental modifications into IEP, provides training	160	54.3
Does not provide indirect services	32	9.1
Barriers		
Collaborative support	125	35.7
Time	111	31.7
EF knowledge	100	28.6
Intervention knowledge	85	25.1
Materials	78	22.3
Professional role	50	18.3
Other		
Issues with IEP eligibility	6	1.7
What would (or would have) helped		
Professional development	249	71.1
Better materials	183	52.3
More training in graduate school	166	47.4
Better collaboration	153	43.7
Other		
District support (incl. more time, lower caseload)	14	4.0
Clarification of role in district or state policy	7	2.0

Table 4.3

Matched Stratification Variables between Survey and Interview

		Survey Participants	Planned Interview Participants	Actual Interview Participants
Setting	PS	11.4%	12.5%	12.5%
	ES	67.7%	50%	50%
	MS	12.6%	12.5-25%	25%
	HS	8.3%	12.5-25%	12.5%
Experience (years)	0-3	19.1%	12.5%	12.5%
	4-10	34.9%	37.5%	37.5%
	11-20	24.3%	37.5%	37.5%
	21+	21.7%	12.5%	12.5%
Self-reported Knowledge	1-2	20.3%	25-37.5%	37.5%
	3	52.0%	25-37.5%	37.5%
	4-5	27.7%	25-37.5%	25.0%

Note. PS = Preschool, ES = Elementary School, MS = Middle School, HS = High School. Scores for "Self-reported Knowledge" represent ratings of 1 ("Minimal knowledge") through 5 ("Area of expertise") on a Likert-style scale.

Table 4.4

Interview Participants

	Primary Setting	Years of experience	Self-reported Knowledge
Participant 1	Elementary School	13	4/5
Participant 2	Middle School	9	4/5
Participant 3	Elementary School	22	3/5
Participant 4	Preschool	9	3/5
Participant 5	High School	17	3/5
Participant 6	Middle School	18	2/5
Participant 7	Elementary School	2	1/5
Participant 8	Elementary School	9	2/5

Table 4.5

Results of Logistic Regression for Direct Services

							95% C.I. for Exp(B)	
	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Preschool setting			4.200	3	.241			
Elementary school setting	.881	.440	4.021	1	.045*	2.415	1.020	5.715
Middle school setting	.776	.617	1.582	1	.208	2.172	.648	7.278
High school setting	.487	.680	.513	1	.474	1.627	.429	6.163
Experience	.007	.017	.181	1	.671	1.007	.975	1.041
Demonstrated knowledge	-.065	.180	.130	1	.719	.937	.659	1.334
Self-rated knowledge	-1.469	.231	40.416	1	<.001**	.230	.146	.362
Constant	5.691	1.018	31.283	1	<.001	296.244		

* Significant at $p < .05$

** Significant at $p < .001$

Table 4.6

Results of Logistic Regression for Indirect Services

							95% C.I. for Exp(B)	
	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Preschool setting			3.489	3	.322			
Elementary school setting	-.437	.632	.477	1	.490	.646	.187	2.231
Middle school setting	.635	.762	.694	1	.405	1.887	.424	8.394
High school setting	-.194	.975	.040	1	.842	.824	.122	5.563
Experience	-.037	.025	2.256	1	.133	.963	.917	1.011
Demonstrated knowledge	.046	.243	.036	1	.849	1.047	.651	1.685
Self-rated knowledge	1.292	.283	20.911	1	<.001**	3.640	2.092	6.333
Constant	-6.264	1.357	21.304	1	<.001	.002		

** Significant at $p < .001$

Appendix 4B

Survey Protocol

1) What is your primary work setting? (Select 1)
    - Preschool
    - Elementary School
    - Middle School
    - High School
2) What are your secondary work setting(s)? (Select all that apply)
    - Preschool
    - Elementary School
    - Middle School
    - High School
3) How many years have you worked as a speech-language pathologist? (Enter a number)
    - _____
4) Which of the following is an accurate description of executive functions?
    - **They are a set of mental processes used to plan and perform goal-directed behavior**
    - They facilitate the cognitive process of converting new knowledge and skills into long-term memory storage
    - They are cognitive skills which manage autonomic responses
    - They direct mental processing in terms of processing speed, accuracy, and storage
5) Which of the following is NOT a core component of executive function?

- Cognitive flexibility
- **Mental processing**
- Response inhibition
- Working memory

6) Which of the following describes the SLP's role in executive function intervention, per the American Speech-Language-Hearing Association (ASHA)?
    - Executive functions are not within the SLP's scope of practice
    - Executive functions are not directly within the SLP's scope of practice, though SLPs may serve on interdisciplinary teams to address these deficits
    - Executive functions may be within the SLP's scope of practice only when deficits occur in individuals who also have speech/language/swallowing deficits (e.g., clients with Acquired Brain Injury)
    - **Executive functions are explicitly listed within the SLP's scope of practice**

Establishing common terminology

For the purpose of this survey, executive functions are defined as "The cognitive skills used to plan and perform goal-directed behaviors" (Jones et al., 2016). This definition includes the components of response inhibition, working memory, shifting/flexibility, and extends to more complex skills such as planning, problem-solving, and organization.

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7) On a scale of 1-5, how would you rate your knowledge in the area of executive functions?
    - 5: This is an area of expertise for me
    - 4: I am knowledgeable about executive functions and their interventions
    - 3: I am moderately familiar with executive functions
    - 2: I am not confident in my knowledge of executive functions
    - 1: I have minimal knowledge of executive functions
8) Do you provide services to address executive function deficits?
    - I provide services to all students whose executive function deficits impede their learning
    - I provide services for executive functions *if and only if* the student is already on my caseload for a communication disorders
    - I do not provide services for executive functions
9) What type of direct services do you provide to address executive function deficits? (Select all that apply)
    - I provide direct intervention for executive function deficits in a pull-out setting (e.g., speech room)
    - I provide direct intervention for executive function deficits in a push-in setting (e.g., classroom)
    - I address executive function deficits within my speech/language therapy, but I do not provide dedicated intervention for these deficits
    - I do not provide direct intervention for executive function deficits

10) What type of indirect services do you provide to address executive function deficits? (Select all that apply)

- I use instructional modifications in my services (e.g., I repeat myself, I use a reduced rate of speech, I break tasks into smaller chunks, I pair auditory cues with visuals)
- I write instructional modifications (see above) into students' IEPs, and train parents/teachers as necessary
- I use environmental modifications in my services (e.g., visual activity schedules, checklists, timers, calendars/planners)
- I write environmental modifications (see above) into students' IEPs, and train parents/teachers as necessary
- I do not provide indirect services for executive function deficits

11) What barriers, if any, prevent you from providing effective services for executive functions? (Select all that apply)

- I do not know enough about executive functions in general
- I do not know how to provide intervention for executive functions
- It is not my role to provide services for executive function deficits
- I don't have materials to provide services for executive functions
- I don't have time to provide services for executive functions
- I don't have enough collaborative support from parents/teachers to provide effective services
- Other: _____

12) What would help (or would have helped) you provide more effective services for executive function deficits? (Select all that apply)

- More training in graduate school
- Professional development
- Better materials for executive function services
- Better collaboration with parents/teachers
- Other: _____

Appendix 4C

Interview Protocol

Interview procedures

- *Reminder to avoid identifying information*
- *Explanation of how transcript will be used*
- *Obtain consent to participate in interview, record session*
- *Arrange to send the gift card payment*
- *Start recording*

Background information

- *Introduce myself*
- Where do you live/practice?
- How long have you been practicing as an SLP?
- Tell me about your school(s) and your caseload.

EF Knowledge and Expertise

- Do you feel like you understand executive functions and what they do? If so, do you feel comfortable describing your understanding to me?
- *Interviewer and participant reach an agreed-upon description of EFs*
- How have you come by your knowledge of EFs? *(Prompt for graduate school, professional development, mentorship/coaching, colleagues, books, journal articles…)*

EF Intervention

- Do you feel comfortable evaluating EFs?
  - How do you do it?

- Do you provide direct intervention for EFs?
    - What kinds of students do you provide EF intervention to? (Students with SLI vs. all students, students with ADHD, etc.)
        - How do you decide this?
    - What setting(s) do you provide intervention in?
    - What is the frequency and duration of your direct EF intervention?
        - How do you decide this?
    - What domains of EF do you target in your intervention? *(Prompt for working memory, response inhibition, shifting/flexibility, organization, task initiation, time management, sustained attention, planning/prioritization.)*
    - Does your intervention target discrete EF skills, compensatory strategies, or both?
    - Is your intervention decontextualized (i.e., structured tasks) or contextualized (i.e., integrated into child's work and activities)?
    - Describe your EF interventions to me. What kinds of goals do you set, and what does your intervention look like?
    - How do you decide what kind of intervention to provide?
- Do you provide indirect services for students with EF deficits?
    - What do your indirect services include?

Implementation

- Do you feel like there are limitations to your ability to provide services for EFs? Please describe these.

o *Prompt for knowledge (do they know what EFs are, and what the best practices for EF interventions are?) skills (do they know how to provide intervention?), professional role, beliefs about capabilities, confidence in anticipated outcomes, their motivation, their goal in therapy, their resources, their colleagues, their supervisor, their caseload/workload, their time, their group size….*

· What has helped you provide services to children with EF deficits?

· What would be helpful for you to provide more services (or higher quality services)?

Appendix 4D

Qualitative Codebook

Participant and caseload characteristics: *Contains statements describing the participant's role, setting, caseload, experience, or background.*

Assessment and eligibility*: *Contains statements describing how SLPs (or other educators/service providers/interdisciplinary IEP team members) assess EF, and the process by which they determine eligibility for services.*

Direct intervention: *Contains statements discussing the participant's provision of direct intervention, i.e., services that the SLP provides directly to the students in order to improve the student's EF or performance on EF tasks.*

> **Goals*:** *Contains statements describing the goals that the SLP (or other educational/service providers) set for students.*
>
> **Domain:** *Contains statements describing the EF domains which the SLP might target through direct intervention, including core EF components (i.e., working memory, shifting, response inhibition), proximal and distal EF skills (e.g., planning, organization), and domains and skills which the SLP associates with EF (e.g., sequencing, self-regulation).*
>
> **Purpose:** *Contains statements which allude to the primary purpose of the intervention, i.e., skill development or strategy use.*
>
> **Delivery:** *Contains statements which describe the SLP's delivery of direct interventions, such as 1-on-1 or small-group settings, push-in or pull-out services.*
>
> **Form:** *Contains statements describing the extent to which intervention is decontextualized, contextualized, or activity-focused.*

Teaching techniques: *Contains statements which describe the prompts, models, instructions, explanations, and feedback provided by the SLP during direct services.*

Indirect intervention: *Contains statements describing services by which the SLP addresses a student's EF deficits without the direct provision of SLP-to-student therapy.*

Accommodations: *Contains statements describing IEP accommodations which the SLP (or another IEP team member) have implemented to address EF deficits.*

Consultation: *Contains statements describing the SLP's provision of consultation services to teachers, parents, and other educators/service providers.*

Instructional modifications: *Contains statements describing strategies that SLPs use to modify their own instruction, or such strategies that the SLP shares with other educators/service providers (e.g., repetition, slowed rate of speech, frequent comprehension checks).*

Environmental modifications: *Contains statements describing ways in which the SLP modifies the student's environment, or such strategies that the SLP shares with other educators/service providers (e.g., visual supports, timers, checklists).*

Implementation: *Contains statements which describe factors which influence the provision of services for EF deficits, whether these factors are barriers to service, or whether they may support service provision.*

Knowledge/skills: *Contains statements which describe the SLP's knowledge and skills of EF intervention, and the sources by which this knowledge may be acquired.*

Professional roles and boundaries: *Contains statements which describe how the SLP's professional roles and boundaries, both broadly and within the participant's specific setting.*

Confidence: *Contains statements which describe the SLP's confidence in their ability to deliver intervention, as well as their confidence in the intervention's efficacy and projected outcomes.*

Social influences: *Contains statements which describe the influence of the SLP's peers, colleagues, networks, and other stakeholders on their service delivery.*

Environmental resources and constraints: *Contains statements which describe the materials and resources available to the SLP, and how their availability (or lack thereof) influence service provision.*

Behavior*: *Contains statements which describe the association (or perceived association) between a student's EF and their behavior.*

* Indicates that the code was not included in the original codebook, but was derived dynamically from participant responses.

Chapter 5: Conclusion

Through the present dissertation, I aimed to expand the knowledge of the current state of SLPs' interventions for children with co-occurring DLD and EF deficits. While EF is within the scope of practice of SLPs, I found scant empirical research of language and academic outcomes of intervention targeted for children with co-occurring DLD and EF deficits, no person-centered analyses of the characteristics of children with these deficits, nor any research exploring SLPs' implementation of interventions for these children. Since children with DLD and EF deficits are at risk for poor academic and social outcomes compared to their typically-developing peers, it is of the utmost importance to ensure that SLPs are knowledgeable about their role in supporting positive outcomes.

To achieve this overarching aim, I conducted three related and targeted studies: a systematic literature review of the empirical studies of interventions for children with co-occurring DLD and EF deficits, and of the guidance offered to SLPs; a latent profile analysis of Kindergarteners' expressive language, receptive language, and WM; and a mixed-methods analysis of school-based SLPs' intervention practices for children with EF deficits. I first will provide a summary of the three studies in this dissertation followed by a critical synthesis of their findings, taken together, relative to the current state of the field of speech-language pathology.

Speech-language Pathology Interventions in Children with Executive Function Deficits: A Systematic Literature Review

In Chapter 2, I applied systematic searching and screening procedures to identify 27 articles meeting my inclusion criteria: 10 empirical studies of interventions for children with DLD and EF deficits, and 17 practitioner papers offering guidance to SLPs for providing intervention for children with EF deficits. Among the empirical studies were three quasi-

experimental designs, three single-case research designs, and four case studies. Some studies measured the effects of language intervention on students' EF performance, while others approached the topic by measuring the effects of EF intervention on students' language ability. Broadly speaking, the evidence provided by these studies offered a hopeful outlook for future research in the area, but was generally marred by imperfect designs and inconsistent results. There is a real and important need for rigorous experimental research. It is not enough to rely on "one-sided" experimental results, such as research on EF interventions for language-typical children, or research on language interventions for children whose EF lies within normal limits. Previous research suggests that language and EF interact with one another, even in the therapeutic context (Kapa & Mettler, 2021; Montgomery et al., 2021), and thus experimental research must validate interventions for children with co-occurring deficits.

Despite the limited body of empirical evidence for interventions for children with DLD and EF deficits, a relative abundance of literature offers guidance for SLPs providing intervention to children with EF deficits. I identified 17 such articles, and synthesized their findings in Chapter 2 of this dissertation. Broadly speaking, these articles support the notion that SLPs can proactively support children with EF deficits through direct and indirect services. Direct therapy can be provided in a therapeutic (e.g., "pull-out") setting or in the classroom or other functional environments (i.e., "push-in" or integrated services). Either language or EF domains provide acceptable targets for direct intervention; guidance for language targets centered around skill development, such as explicit instruction in vocabulary or syntax, whereas guidance for EF targets centered around strategy use. Most guidance generally favored contextualized or activity-focused interventions featuring teaching techniques including questions, prompts, repetition, and explicit instructions and explanations. In addition to this

guidance for direct services, the included articles also offered suggestions for SLPs to provide indirect services. One such example of an indirect service was consultation, which could be offered to educators and other service providers from related disciplines, or to parents. The purpose of this consultation was generally to suggest instructional modifications, including repetition, chunking, and other teaching strategies which support children with poor EF. Other indirect services included the guided implementation of accommodations and environmental modifications, such as visual supports, organizers, and written instructions.

A Latent Profile Analysis of Young Children's Language and Working Memory

In Chapter 3, I presented the results of an exploratory LPA of 167 Kindergarteners' expressive language, receptive language, and WM. A three-profile solution emerged as the most suitable model, supported by all fit statistics except for entropy, which is often flawed in analyses with small sample sizes or few profiles (Hanson et al., 2007). Based on the average scores of these three groups, which were generally balanced across all domains, I named them the *Low-performing* group, comprised of 18% of the sample, and on average more than one standard deviation below the mean in language and WM; the *Average* group, comprised of 57.5% of the sample, and on average centered around the mean; and the *High-performing* group, comprised of 24.5% of the sample, and on average one standard deviation above the mean. Next, I conducted analyses of variance to determine whether there was an association between group membership and teacher ratings of behavior. Members of the *Low-performing* group, on average, were significantly lower rated on Social Competence than their *Average* and *High-performing* peers, with a mean difference of about one standard deviation.

Based on the findings of this exploratory study, I believe that teachers may use their judgment of social competence (i.e., peer relations, self-management/compliance, and academic

behavior) to consider whether students may meet the profile of a *Low-performing* student with deficits in language and WM. This may be useful to improve the sensitivity of teachers' referrals for special education, specifically speech-language impairment. Further, SLPs may consider the emergent profiles to consider that students with poor language, particularly receptive language, likely present with co-occurring WM deficits. This may help SLPs and teachers alike mindfully consider the necessity of environmental and instructional modifications to support students with WM deficits.

This *Is* My Lane:

A Mixed-methods Analysis of Speech-language Pathologists' Executive Function Services

In Chapter 4, I presented the findings of a sequential explanatory mixed-methods study of school-based SLPs' implementation of EF interventions. First, I surveyed 350 SLPs to assess their understanding of EFs, explore their intervention practices, and identify any barriers or factors which influenced their provision of those services. Then, I conducted eight follow-up interviews to explain and provide context to the findings of the survey.

On average, most SLPs understood EF on a general level, though only half of SLPs knew that EF is explicitly listed within their scope of practice by ASHA. Roughly half of SLPs reported addressing EF embedded within their typical speech/language therapy, while about 30% of SLPs provided direct pull-out EF services, and about 20% reported providing no direct EF services at all. Most SLPs used instructional and environmental modifications to support students with EF deficits, though markedly fewer wrote those modifications into IEPs or trained other educators in their implementation. Interview participants' services varied, and they each explained their direct and indirect services with regards to domain, purpose, delivery, form, and teaching techniques (see Chapter 4 for more information).

Notable barriers to service delivery included a lack of collaborative support (35.7%), time (31.7%), and EF knowledge (28.6%). To expand on this, several interview participants commented that teachers and administration rejected EF support, and instead encouraged these SLPs to "stay in their lane." This prompted one SLP to retort "this *is* my lane!" Most SLPs (71.1%) reported that professional development would be helpful to improve their EF service. The broad patterns of survey and interview results suggest that education in EF is vitally important to SLPs' provision of services, and that most SLPs are interested in (and receptive to) easily accessible professional development in the area.

The Synergistic Contribution of this Dissertation

The overall contribution of this dissertation is greater than the mere sum of the three papers within. Taken together, the findings of these related studies provide new insights for SLP practitioners and researchers alike. One example of the interaction between these studies is the joint contribution of my LPA and systematic literature review to better inform a pair of problems identified by participants in my mixed-methods study. Participants reported first that they frequently lacked data or intuition to identify EF deficits, and thus secondly, they were not sure how to proceed with intervention services in a manner suitable for children with EF deficits. However, the findings of my other two studies may help mitigate these problems.

The findings of my LPA suggest that most students with poor language ability also present with WM deficits, which may suggest that SLPs can, to some extent, predict EF deficits in children with DLD. Beyond that, further application of person-centered research may lead to the design and validation of quick and easy screening tools. For instance, my results showed that children with low language ability typically belonged to the profile that was likewise marked by low WM, and that children in this profile displayed significantly lower rates of prosocial

behavior compared to their peers. Future research may evaluate whether easily visible characteristics (e.g., behavioral) or easily measurable characteristics (e.g., language) can be used to reliably screen for EF deficits, and therefore improve identification of children with poor EF.

Once SLPs have identified EF deficits in the children on their caseload, they may use the synthesis within my systematic literature review to select appropriate direct or indirect services, using the best available guidance and evidence based on the deficits that they may more readily recognize due to the findings of my LPA. The practitioner papers included within my review provide guidance for a variety of needs, including children with broad EF deficits or narrow WM deficits, strategies for providing language intervention to children with EF deficits, strategies for providing intervention to children with EF impairments, and more. Once SLPs understand the latent profiles of their student's language and EF ability, they can select strategies which make sense for that individual.

In a similar display of synergy, my systematic literature review also identified problems which the findings of my LPA and mixed-method study may help to resolve, namely the lack of evidence for the efficacy of interventions for children with co-occurring DLD and EF deficits. My LPA, though exploratory, serves as evidence that latent profiles of language and EF exist and may be applied to serve a functional purpose. This finding sets the stage for a more comprehensive LPA which includes multiple domains of language and EF. Such an LPA may prove useful for future intervention research, which (as established by my systematic literature review) is presently under-explored. Indeed, one of the challenges in synthesizing the practices of SLPs participating in my mixed-methods study was that my systematic literature review identified general principles deemed "best practice" by experts in the field, but little empirical evidence to support those interventions for children with co-occurring DLD and EF deficits.

Future research must be designed with this population in mind; my other two studies demonstrate how person-centered research (e.g., my LPA) may be used to select intervention components, and implementation science (e.g., my mixed-methods study) may be used to evaluate the implementation. Specifically, by identifying patterns of domain-specific deficits found in children, researchers may glean insight into which domains would be ideal to target in intervention studies, thus optimizing the impact of the scarce resources dedicated to intervention in children with co-occurring DLD and EF deficits. Meanwhile, the results of my mixed-methods study can be interpreted to better understand the current implementation of the practices identified within my systematic literature review, but also to identify barriers and facilitating factors which must be considered in future intervention research in order to optimize the implementation (and thus the impact) of this research.

Future Directions

The findings of these three related studies pave the way for important work in the areas of practice and research. With regards to practice, I have found that SLPs have the opportunity to provide vital services for children with co-occurring DLD and EF deficits. Though the empirical evidence is scarce, the wealth of practitioner papers I found in my systematic literature review provides a clear model for the best practices available under current conditions. I synthesized these findings in Chapter 2, and practitioners may use them as a model for their own intervention. Further, my mixed-methods study identified current SLP intervention practices, which may also provide a useful model for SLPs looking to expand their repertoire of services. Through the course of my mixed-methods study, I noted that one key barrier to service provision is a lack of understanding of EF, and how it presents in children with DLD. Thus, my exploratory LPA provides a person-centered analysis of characteristics of language and EF

(specifically WM), and practitioners can use these findings to improve their own identification and support of students' deficits. Overall, this dissertation provides helpful insight into SLPs' intervention practices, but the results of the mixed-methods analysis demonstrate that there is still work to be done in terms of translating research into practice in a clear and accessible manner.

Likewise, there is still work to be done to improve the current state of research for children with co-occurring DLD and EF deficits. As I noted in my research synthesis, there is a dearth of empirical evidence for interventions for children with co-occurring deficits, and due to the possibility that cross-domain deficits may impact the efficacy of interventions, I believe that interventions must be validated for this specific population. This research may be aligned with the needs of my mixed-methods study: Whereas I explored the current practices of SLPs working with children with EF deficits, it would be beneficial to explore the current practices of educators as well, and to follow these studies with a rigorous empirical measurement of the efficacy of SLPs' and educators' practices. Finally, while my LPA proved to be a valid exploratory "proof-of-concept" for the use of person-centered analysis to explore the characteristics of language and WM, this study can be expanded in several key areas: first by expanding the sample size, second by using more specific measures of discrete language and EF skills, and third by conducting a more expansive array of follow-up analyses. This too may be used to improve SLPs' services, as a better understanding of the relative strengths and weaknesses between domains of language and EF will be useful for intervention design.

Final Thoughts

The three studies contained within this dissertation provide valuable insight for practitioners by summarizing and synthesizing current guidance and practice. Further, this

dissertation serves as an incremental step towards understanding and improving SLPs' services for children with DLD and EF deficits. Most importantly, I hope that this dissertation serves as a call to action, so that SLPs may recognize the importance of providing informed and evidence-based services for children in an under-recognized and underserved niche, and so that researchers may turn their attention to the task of equipping SLPs with the evidence and guidance they need.

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