Direct and Indirect Effects of Executive Functions, Reading Engagement, and Higher Order Strategic Processes in the Reading Comprehension of Dual Language Learners and English Monolinguals

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Abstract

Given concerns about the reading achievement of Dual Language Learners (DLLs) in comparison to English Monolinguals (EMs), this study examined individual difference variables contributing to English reading comprehension growth in Spanish-speaking DLLs and their EM counterparts in Grades 1-4. The participants, who included 578 DLLs and 412 EMs, were primarily from low-income backgrounds. They were assessed in the fall and spring of one school year on decoding, vocabulary, and oral language comprehension (established predictors of reading comprehension for DLLs and EMs); higher order strategic processes, executive functions, and reading engagement (understudied predictors for DLLs); and reading comprehension. Among the key findings were that each of the three understudied predictors was associated with reading comprehension growth over the school year, over and above the contributions of the established predictors, in both language groups. Additionally, higher order strategic processes partially mediated the relations of executive functioning in the fall with reading comprehension in the spring for both DLLs and EMs. Theoretical and practical implications of the findings for understanding and strengthening the reading achievement of all students are considered.

Direct and Indirect Effects of Executive Functions, Reading Engagement, and Higher Order Strategic Processes in the Reading Comprehension of Dual Language Learners and English Monolinguals

Currently, 77.1% of U.S. Dual Language Learners[1] (DLLs) speak Spanish as their home language (National Center for Education Statistics, 2018), and Spanish-speaking DLLs, in particular, struggle with English reading comprehension (Mancilla-Martinez & Lesaux, 2010; Miller et al., 2006; Proctor, Carlo, August, & Snow, 2005). In fact, 65% of 4th grade and 72% of 8th grade DLLs in the U.S. scored below the basic level in reading on the 2019 National Assessment of Educational Progress (NAEP; National Center for Education Statistics, 2018a). Reading comprehension is central to success across academic content areas in elementary school, contributing to achievement in science (Reed, Petscher, & Truckenmiller, 2016), social studies (Klingner, Vaughan & Schumm, 1998), and mathematics (Grimm, 2008; Vilenius-Tuohimaa, Aunola, & Nurmi, 2008). Not surprisingly, DLL students' achievement in these NAEP areas mirrors their reading comprehension performance, with 41% and 72% of 4th and 8th grade students, respectively, scoring below basic levels in mathematics; 62% and 76%, respectively, scoring below basic levels in history; and 59% and 81%, respectively, scoring below basic levels in science (National Center for Education Statistics, 2018b). Thus, addressing the reading comprehension needs of DLLs is a pressing concern, with implications not just for reading achievement but for overall achievement in school. However, aside from substantial research evidence regarding vocabulary as a key component in DLLs' reading comprehension (August,

[1] We use the term *Dual Language Learner* (DLL) to refer to students who come from households in which a language other than English is spoken, regardless of whether they are denominated as Limited English Proficiency (LEP). DLLs are learning a second language at school while continue to develop their first (or home) language (Administration for Children and Families and U.S. Department of Health and Human Services, 2013).

Carlo, Dressler, & Snow, 2005; Mancilla-Martinez & Lesaux, 2010), little is known about other individual difference variables that may contribute to DLLs' reading comprehension.

The pervasive Simple View of Reading (SVR), which was originally proposed to explain reading disabilities (Gough & Tunmer, 1986), rightly suggested word reading and language comprehension contribute directly to reading comprehension, including that of DLLs (Gough & Tunmer, 1986; Hoover & Gough, 1990). In contrast, contemporary models of reading comprehension focus on skilled (as opposed to disabled) reading comprehension and include a broader array of individual difference variables beyond those articulated in the SVR (Cromley & Azevedo, 2007; Cromley, Snyder-Hogan, & Luciw-Dubas, 2010; Duke & Cartwright, 2019; Francis, Kulesz, & Benoit, 2018; Kim, 2017; RAND Reading Study Group [RRSG], 2002), such as executive function skills, engagement, and higher order strategic processes, which are proposed to interactively generate skilled reading comprehension, at least for English Monolingual (EM) readers. However, we know little about how – and whether – contemporary, complex views of skilled reading comprehension characterize DLLs' reading achievement, which is an important question if DLL students' educational needs are to be met in US schools. Thus, in the current study we sought to examine whether malleable individual difference variables that contribute directly and indirectly to EMs' reading comprehension, and are understudied in DLLs, might also influence DLL students' reading comprehension, with the goal of identifying potential targets for intervention for DLLs' reading comprehension difficulties.

Theoretical Framework

We take as our theoretical framework contemporary perspectives that provide more comprehensive views of skilled reading comprehension than articulated in the SVR (see Hoffman, 2017, for a recent discussion of the need to move beyond the SVR). The RAND

Reading Study Group (RRSG, 2002) offered a widely-cited conceptual model intended to provide an organizing framework for research and development in reading comprehension, "informed by a vision of proficient readers who are…capable of being engaged in the reading process and reflecting on what is being read." (RRSG, 2002, p. xiii). The RRSG framework characterized skilled comprehension as a goal-directed activity that is influenced by characteristics of the reader, the text, and the reading activity, which interact within a particular socio-cultural context. Our study is primarily concerned with individual characteristics of the reader, which include such dimensions as cognitive capacities (e.g., word reading, strategic processes, executive functions); motivation and engagement; and various types of knowledge (e.g., vocabulary, oral language) (RRSG, 2002). We describe the RRSG framework here to contextualize our work and to illustrate the shift in the field from a narrow, disabilities-oriented approach (e.g., SVR) to a more complex focus on attributes of skilled reading comprehension that may point to additional factors important to fostering effective reading and academic achievement for all learners. Yet, we also acknowledge that despite its advances, the RRSG framework did not specify how variables might work together to support reading comprehension.

More recently, scholars have begun to characterize skilled reading comprehension as a complex, goal-directed endeavor – consistent with the RRSG (2002) framework – and have moved beyond the RRSG model by specifying direct and indirect effects of a number of individual difference variables on reading comprehension (e.g., Cromley & Azevedo, 2007; Cromley et al., 2010; Kim, 2017). These models vary in the arrays of individual difference variables they consider, but they all posit similar lower level (e.g., word reading, vocabulary, oral language comprehension) and higher level (e.g., strategic processes, such as inference making and monitoring) contributors, with lower level skills contributing indirectly through higher level skills - and sometimes directly - to reading comprehension. These more complex models, which we call Complex Effects Models (CEMs), have confirmed, for example, that vocabulary contributes indirectly to reading comprehension through higher-order strategic processes in English-speaking high school students (Cromley & Azevedo, 2007), university students (Cromley et al., 2010), and 2nd grade students (Kim, 2017).

However, studies of CEMs have not included samples of DLL students who have been found to be weaker than their English monolingual counterparts on skills known to contribute to reading comprehension in EMs (e.g., Lesaux, 2006). Further, few CEMs have included attention to variables that support goal-directed dimensions of skilled reading comprehension, such as executive functioning and engagement. These dimensions of skilled reading are particularly important for DLLs because they represent potentially malleable proximal influences that can shape children's academic retention, achievement, and resilience (e.g., Skinner, Kindermann & Furrer, 2009; Diamond, 2013). Indeed, a recent review of research on DLLs' reading comprehension (Brown, 2017) found limited research base suggests an array of cognitive, metacognitive, strategic, and affective processes interact to support DLLs' reading comprehension, though much more work is needed in this area. Thus, we adopted the CEM approach to further examine aspects of the goal-directed nature of reading comprehension (executive functioning skills and reading engagement), focusing on whether effects of these might be mediated by higher order strategic processes (e.g., inference, comprehension monitoring) in both EM and DLL students when lower level contributors to reading comprehension are controlled for (e.g., word reading, vocabulary, oral language comprehension). As described below, limited evidence suggests executive functions may contribute to strategic processing for EM students (Gnaedinger, Hund, & Hesson-McInnis, 2016; Kim, 2017), but more work is needed in this area. See Figure 1 for a visual depiction of these predicted relations.

Insert Figure 1 here

Our work will add to the literature by expanding CEM views of reading comprehension to include variables known to support the goal-directed nature of reading comprehension, providing a better understanding of whether these variables impact reading comprehension directly or indirectly when considered in a complex framework. Additionally, we seek to explore whether CEMs of reading comprehension explain contributions to reading comprehension differentially for DLLs and EMs, given that they differ significantly on key contributors to reading comprehension. Exploring these relations allows identifying contributors to DLLs' reading comprehension that could be potentially targeted in future intervention work. We describe lower and higher level predictors next, addressing their prevalence in the study of EMs' and DLLs' reading comprehension, and explaining expected relations between them.

Predictors of Reading Comprehension in EMs and DLLs

Lower level predictors: Word decoding, vocabulary, and oral language comprehension. There is wide consensus that to comprehend a text, a child must be able to decode the individual words in text and to understand that language in spoken form (Cain & Oakhill, 2007). Empirical studies with EM students have repeatedly shown impairments in either skill contribute to difficulties in reading comprehension (e.g., Brady & Shankweiler, 1991; Catts, Adlof, & Weismer, 2006; Hoover & Gough, 1990; Johnston & Kirby, 2006). Word identification or word decoding, in particular, is among the strongest predictors of reading comprehension levels in English in the early years; for example, Juel, Griffith, and Gough (1986) found word decoding was associated with changes in R^2 of .42 and .40 in first and second graders when added after listening comprehension in regression models predicting reading comprehension. However, it is also known that other skills, such as vocabulary and oral language comprehension, become more relevant predictors of comprehension as word reading skills develop over time (e.g., Curtis, 1980; Gough, Hoover, & Peterson, 1996; Lonigan et al., 2018; Saarnio, Oka & Paris, 1990). For instance, the role of vocabulary in comprehension cannot be overemphasized; with the impact of vocabulary increasing in the later grades as reading tasks become more meaning based (i.e., correlations range from .52 to .69 across the elementary and middle grades; Proctor, Daley, Louick, Ledier & Gardner, 2014; Proctor, Dalton & Grisham, 2007; Proctor, Silverman, Harring, & Montecillo, 2012; Taboada, Townsend & Boynton, 2013). Also, the influence of oral language comprehension seems to be best described as being organized around word- and sentence-level processing dimensions (e.g., Lonigan et al., 2018). These findings come primarily from studies of EM students. However, a growing body of literature has examined word decoding, oral language, and vocabulary in DLLs and how these factors contribute to their reading comprehension, with particular attention given to vocabulary.

Research on DLLs has consistently demonstrated that Spanish-speaking DLLs are likely to develop word decoding skills at rates similar to native EM students, but after the third grade tend to fall two to three grade levels below their EM peers and national norms, in both vocabulary and comprehension skills (for review see Lesaux, 2006; Mancilla-Martinez & Lesaux, 2010; Nakamoto, Lindsey & Manis 2007; Proctor el al., 2005). Word recognition, listening comprehension, and vocabulary contribute to DLLs' patterns of growth in reading comprehension (Mancilla-Martinez, Kieffer, Biancarosa, Christodoulu, & Snow, 2011), sometimes alongside more basic reading-related skills that contribute to word reading (e.g., phonological processing, rapid automatized naming; e.g., Farnia & Geva, 2013; Nakamoto et al., 2007). Vocabulary better discriminates between good and poor comprehenders in fourth and fifth grades than working or short-term memory in both DLLs and EMs (Zhang & Shulley, 2017), though recent work has raised questions about contributions of receptive vocabulary beyond word recognition to reading comprehension in the elementary years for Spanish-speaking DLLs (Mancilla-Martinez, Hwang, Oh, & McClain, 2019). Thus, other predictors should be explored.

The need for broader conceptualizations of reading comprehension. While word recognition and vocabulary are critical pillars of reading comprehension, studies of EM student profiles of reading difficulty have consistently identified subsets of students who have reading comprehension difficulties despite adequate word decoding skills (Buly & Valencia, 2002; Hock, et al., 2009; Leach, Scarborough, & Rescorla, 2003; Torppa et al., 2007); these students are said to have specific reading comprehension deficits (S-RCD; Locascio, Mahone, Eason, & Cutting, 2010), and their difficulties mirror those of DLL students who acquire word decoding skills at rates similar to their EM counterparts, but after the third grade tend to fall two to three grade levels below their EM peers and national norms, in both vocabulary and comprehension skills (for review see Lesaux, 2006; Mancilla-Martinez & Lesaux, 2010; Nakamoto et al., 2007; Proctor el al., 2005). Thus, work on EM students with S-RCD may point to additional variables that could inform understanding of DLL students' comprehension difficulties. For example, EM students with S-RCD have deficits in oral language skills (Nation, Cocksey, Taylor, & Bishop, 2010), higher-order strategic processes such as inference-making skills (Cain & Oakhill, 1999; Oakhill, Yuill, & Parkin, 1986) and comprehension monitoring (Helder, van den Broek, Van Leijenhorst, & Beker, & , 2013), and executive functions (Cartwright et al., 2017; Cutting, Materek, Cole, Levine & Mahone, 2009; Locascio et al., 2010). In addition, consistent with contemporary models of reading comprehension, motivation and engagement predict reading achievement in EM students with and without reading comprehension problems after word reading is controlled (Klauda & Guthrie, 2015). These findings suggest executive function skills, reading engagement, and higher-order strategic processes may also be important for the development of reading comprehension in DLLs. The studies of reading comprehension growth in DLLs, however, have examined a limited set of predictors of reading comprehension growth, based primarily in the SVR, with one exception being Farnia and Geva's (2013) inclusion of working memory: a component of executive function. We next consider how such additional variables may predict reading comprehension performance and growth in both DLLs and EMs.

Beyond lower level processes: Executive functions, reading engagement, and higher order strategic processes.

Executive functions. Recent research points to the role of executive function skills (EF) in reading comprehension beyond traditional contributors, such as word reading (Locascio et al., 2010: Sesma ,Mahone, Levine, Eason, & Cutting, 2009). EF involves a set of cognitive skills needed to guide behavior towards a goal or to coordinate performance in complex tasks (Best & Miller, 2010; Davidson, Amso, Anderson, & Diamond, 2006; Diamond, 2013). Although there are multiple conceptualizations of the varied component skills that make up EF (e.g., Barkley, 1994; Denckla, 1994; Goldstein & Naglieri, 2014; Norman & Shallice, 1986), there is wide agreement that there are three core EFs: inhibition, working memory, and shifting or cognitive flexibility (Diamond, 2013; Miyake et al., 2000; Miyake & Friedman, 2012). We follow the unity-by-diversity (tripartite) framework (Friedman & Miyake, 2017; Miyake et al., 2000) that indicates the three core EFs are related but separable components (Diamond, 2013). *Working memory* involves two simultaneous activities: storage or maintenance of information, and active processing or transformation of that stored information, which Miyake and colleagues (2000) call updating. Updating “goes beyond the simple maintenance of task-relevant information in its requirement to dynamically manipulate the contents of working memory” (Miyake et al., p. 57). Both aspects of working memory (storage and active manipulation) play critical roles in integrating information during reading comprehension by helping readers to (a) hold recently processed information in mind for the construction of an overall representation of text (e.g., Cain, Oakhill & Lemmon, 2004), while also (b) updating or changing their mental model of text meaning as they encounter new ideas in text (García-Madruga, Vila, Gomez-Veiga, Duque, & Elosua, 2014; Kintsch, 1988). *Inhibition* involves suppression of irrelevant information or responses and allows readers to forget or suppress information that is not relevant to text meaning, such as irrelevant word meanings when activating the meanings of polysemous words in text (e.g., *bank* as river bank vs. financial institution; Barnes, Faulkner, Wilkinson, & Dennis, 2004; Henderson, Snowling, & Clarke, 2013). The third core EF skill, *cognitive flexibility,* enables readers to switch back and forth between text elements or processes and has been found to be particularly important for reading comprehension, contributing to comprehension beyond decoding skill and language comprehension (Cartwright et al., 2017; Conners, 2009) and beyond other EFs (Georgiou & Das, 2018; Kieffer et al., 2013). EF skills are proposed to be involved in language processing and attention in bilinguals (e.g., Bialystok, 2010, 2015; Hilchey & Klein, 2011), thus making them a viable candidate to be explored in DLLs. Evidence indicates bilingual experience fosters stronger EF skills for bilingual children (Calvo & Bialystok, 2014; Carlson & Meltzoff, 2008; Morales, Calvo, & Bialystok, 2013) in comparison to EM counterparts, suggesting EFs may differentially support DLL students’ reading comprehension development in comparison to EM peers.

EF skills have been found to play important roles in reading comprehension for EMs (e.g., Cutting et al., 2009; Locascio et al., 2010) but the study of EF skills in relation to DLLs' reading comprehension is limited, with Geva and Farnia (2012) showing similar degrees of correlation with working memory for fifth-grade DLLs and EMs. Most of the studies exploring multiple EFs have been with students with reading disabilities, and, to date, only one study has been conducted with DLLs (i.e., Kieffer, Vukovic, & Berry, 2013). Further, to our knowledge, no studies have explored this link longitudinally and across grades, and few have investigated whether EF may play a causal role in reading achievement (Jacob & Parkinson, 2015). Our study is designed to fill these gaps by building on emerging evidence for the potential roles of EF in reading comprehension in EMs, and extending the work to DLLs with the goal of determining whether EFs may offer potential targets for intervention to improve DLLs' reading comprehension.

Reading engagement. Though the RRSG (2002) conceptualization of reading comprehension highlighted the importance of engagement to reading comprehension almost two decades ago, little work has focused on how engagement predicts comprehension alongside other cognitive and language variables. In the reading engagement framework (Guthrie & Wigfield, 2000; Guthrie, Wigfield, & You,. 2012; Guthrie & Klauda, 2016) adopted in this study, reading engagement is conceptualized as a multidimensional construct including behavioral, affective, and cognitive dimensions reflective of active involvement in reading, in accord with domain-general conceptualizations of academic engagement (Fredricks, Blumenfeld, & Paris, 2004; Reeve, 2012). Further, engagement is facilitated by motivation – one's goals, values and beliefs in a given area – and, in turn, fosters achievement (Eccles & Wang, 2012; Guthrie et al., 2012; Research has employed varied, reliable indicators of reading engagement, such as reading amount, print exposure, and teacher ratings based on observed behavior, in showing that reading engagement predicts reading comprehension across Grades K-12 (De Naeghel, Van Keer, Vansteenskiste, & Rosseel, 2012; Guthrie, Klauda, & Ho, 2013; Mol & Bus, 2011; Taboada, Tonks, Wigfield, & Guthrie, 2009). In the current study, teachers rated students on their behavioral, affective, and cognitive engagement based on their observations of such indicators as students' devotion of attention, expressions, and conversations while reading.

There is limited empirical research that explores the role that reading engagement or motivation may play in DLLs' reading comprehension. In the two known studies that have compared their role in predicting DLLs' and EMs' reading comprehension, they equally predicted reading comprehension in middle school DLLs and EMs with disabilities, controlling for language proficiency (Proctor et al., 2014), and in upper elementary DLLs and EMs, controlling for language group, word identification, oral language, and cognitive strategy use (Author, 2019). There are no known studies, however, that have compared engagement's or motivation's role vis á vis other key cognitive variables and EFs on comprehension change in the two language groups. Thus, we explore those relations, given the need to determine variables that contribute to explanations of change in reading comprehension for both EMs and DLLs.

Higher order strategic processes. One understudied aspect of reading comprehension in DLLs is that of higher order strategic processes such as inferencing (van den Broek, 1989) and comprehension monitoring (Oakhill & Cain, 2000). We define strategic processes as "cognitive operations over and above the processes that are a natural consequence of carrying out [a] task…[that] achieve cognitive purposes (e.g., comprehending, memorizing) and are potentially conscious and controllable activities" (Pressley, Forrest-Pressley, Elliott-Faust, & Miller, 1985, p. 4) that can be consciously considered when needed, such as to resolve breakdowns in comprehension. Both metacognitive, higher-order strategies and EFs involve goal-directed actions that facilitate management of behavior and cognition (Myers & Paris, 1978). However, explanations of the nature of relations between EF and higher order strategic processes have varied in the literature. Borkowski, Chan, and Muthukrishna (2000) suggested metacognitive strategy use facilitates the development of EF by providing students opportunities to apply specific goal-directed operations to learning tasks, increasing motivation for and engagement with learning and facilitating application of goal-directed strategies in future learning situations (also see Taboada Barber, Cartwright, & Klauda, in press, and Dinsmore, Alexander, & Loughlin, 2008, for discussions of relations between these constructs). Indeed, multiple studies with college students have indicated links between EF and strategy use. Follmer and Sperling (2016) found metacognitive, strategic processes mediated relations of EF to self-regulated learning, and Garner (2009) found overlap between these constructs, as well. However, little work has investigated links between EF and strategic processes in children.

Longitudinal path analyses have shown *inferencing* and *comprehension monitoring* predicted reading comprehension over and above the autoregressive effect of comprehension (i.e., prediction of comprehension at a later time by comprehension as an earlier time) and verbal ability (vocabulary and verbal IQ; Oakhill & Cain, 2007; Oakhill & Cain, 2012; Perfetti, Landi, & Oakhill, 2005) in EMs aged 7 to 11. Such higher order strategic processes may be a particularly promising target for intervention for students who struggle with reading comprehension (Rapp, van den Broek, McMaster, Kendeou, & Espin, 2007). However, these skills have rarely been explored in relation to DLLs' reading comprehension. We focus on these processes in this study to gain a more nuanced understanding of their role in the reading comprehension of DLLs and to identify potential targets of intervention for these students.

Relations between Strategic Processes and Executive Functions: Two Hypotheses

Based on research exploring the relations between strategic processing and executive functions (Taboada Barber et al., in press; Borkowski et al., 2000; Dinsmore et al., 2008; Follmer & Sperling, 2016; Garner, 2009), we hypothesize that higher order strategic processes such as comprehension monitoring and inferencing (e.g. Cain, Oakhill, & Elbro, 2003; Cain, Oakhill, & Lemmon, 2004) may partially mediate the relations of EF skills and reading comprehension on the one hand, and those between reading engagement and reading comprehension on the other. We have two hypotheses about the mediating role of higher order strategic processes (see Figure 1). First, recent cognitive findings on the direct associations of EF skills with reading comprehension raise the possibility that EF skills play a role in the development of strategic reading (e.g., Borkowski, et al., 2000; Follmer & Sperling, 2016; Garner, 2009; Kieffer et al., 2013), and may facilitate the use of strategic processes and the contributions of those strategic processes to reading comprehension (Gnaedinger et al, 2016). Thus, we hypothesize that the relation of EF skills to reading comprehension may be – at least partially – mediated through their influence on readers' abilities to deploy higher order strategic processes. Second, consistent with Borkowski and colleagues' account (2000), the relation between engagement and higher order strategic processes would respond to an assumption that cognitively demanding, higher order processes (such as inferencing or comprehension monitoring) would tend to be energized or potentiated by the degree of a reader's engagement with text. If that were the case, higher order strategic processes would act as partial mediators, or partially explain the relation between engagement and reading comprehension. Drawing from the motivation literature, a thorough review of the casual directions of motivation/engagement and reading achievement indicated there is a dearth of studies examining the role of cognitive strategies or higher order strategic processes as mediators of the effects of motivation (or engagement) on reading achievement (Schiefele, Schaffner, Moller & Wigfield, 2012); thus, our test of this hypothesis will help expand this literature.

The Current Study

This study addresses limitations that exist in research on predictors of reading comprehension for Spanish-speaking DLLs from low income homes. Specifically, we sought to explore the roles of higher order strategic processes, EF skills, and reading engagement (higher level predictors) while controlling for the roles of word decoding, vocabulary, and oral language (lower level predictors) in reading comprehension for DLLs and their EM classmates from similar socioeconomic backgrounds in Grades 1-4. This study is part of a larger three-year longitudinal study exploring cognitive and motivational growth predictors of reading comprehension over time. The current study is unique in our planned work on the longitudinal study in at least three ways. First, in the current study we focus on individual difference variables that contribute to *change* in reading comprehension *within an academic year*, a time span important for educational practice, as teachers are tasked with ensuring students – in all grades – meet particular learning goals within a single school year. Second, we extend contemporary theories (CEMs) of reading comprehension to DLL students that go beyond the components of the SVR (i.e., word reading and language comprehension) and the exploration of vocabulary as the key predictor of comprehension in DLLs. Third, we extend recent work on the role of EF skills in reading comprehension for EM and DLL students - an understudied individual difference variable for the latter group with respect to reading comprehension difficulties.

We proposed a mediation model to further understand growth in reading comprehension for DLLs, with particular attention to malleable factors that could serve as targets for intervention for reading comprehension difficulties. Given the prominent role that EF skills (e.g., Cutting et al., 2009; Locascio et al., 2010) and reading engagement (e.g., Guthrie, Wigfield, Metsala, & Cox, 1999; Jang, 2008; Orvis, Fisher, & Wasserman, 2009) have played in the reading comprehension of EM students, we also sought to explore their roles as direct or indirect predictors of reading comprehension *chang*e for DLLs from fall to spring within the year. Specifically, we hypothesized that higher order strategic comprehension skills (inferencing and monitoring) would mediate the relation of fall EF skills and fall reading engagement with spring reading comprehension. We tested this hypothesized mediation model via path analyses while controlling for the autoregressive effect of reading comprehension (i.e., controlling for prior reading comprehension) as well as oral language, word decoding, and vocabulary in the fall. The following four research questions guided our study:

1. Do DLLs and EMs in Grades 1 to 4 differ on lower level predictors (i.e., word decoding, vocabulary, and oral language) and on goal-directed and strategic aspects of reading comprehension (i.e., EF skills, reading engagement, higher order strategic processes) as well as on reading comprehension in the fall of the school year? Consistent with past work, we expect DLL students to score lower on these variables than their EM counterparts.
2. How much do DLLs and EMs change in reading comprehension, reading engagement, higher order strategic processes, and EF skills in Grades 1 through 4 from fall to spring within the school year? Does the amount of change vary by language group or by grade? We focus here on change in our key outcome (reading comprehension) and the three, –goal-directed predictors of interest (EF, engagement, and higher order strategic processes).
3. While accounting for the autoregressive effect of reading comprehension: What variables predict change in reading comprehension within each grade from fall to spring within the

school year? Are the predictors similar or different by language group? And, do the predictors vary by whether students are in the early (i.e., 1 and 2) or late elementary grades (i.e., 3 and 4)? To our knowledge, no work has examined this array of predictors of reading comprehension growth for these groups of students, and thus we have no specific hypotheses regarding these exploratory analyses. However, we believe that these analyses will yield insight into whether similar or different arrays of variables predict DLL and EM students' reading comprehension growth across grades and across the school year.

4. Do higher-order strategic processes mediate the relation between EF skills and reading engagement in the fall and reading comprehension in the spring when all other predictors are in the model (i.e., word decoding, oral language, and vocabulary)? Are these relations similar or different across language groups? We expect that higher order strategic processes will serve as a partial mediator and that this mediation will hold for both language groups.

Method

Sample and Setting

Data for the current study come from Year 1 of a larger study, which received Institutional Review Board approval. In all, 1,034 students from three schools in suburban areas in Mid-Atlantic United States were assessed at two time points during the year. Classroom identification was not available for 44 students, so they were not included in these analyses, as our estimation accounts for nested responses within classrooms. Among the remaining 990 students, 236 were in first grade, 247 were in second grade, 270 were in third grade, and 237 were in fourth grade. Across all three schools there were 51 teachers. Parental and teacher consent were obtained before collecting all data. The proportion of DLL students was about the same across grade, ranging from 52 to 64 percent, with a total of 578 DLL students and 412 EM students. Two criteria were used for determining DLL status: the WIDA Access test used by the school district to determine ESOL (English for Speakers of Other Languages) status, and a language questionnaire that determined if a language other than English was used at home and with siblings. Eighty-five percent of DLL students reported speaking Spanish at home. Across all students at the three schools, between 60 to 72% were Hispanic, between 22 to 37% were African American, and on average, 91 to 95% received Free or Reduced-Price Lunch. Students were assessed with cognitive and engagement measures two times during the year; in the Fall (from October to early December), and in the Spring (from February to mid May).

Measures

Reading comprehension. The passage comprehension subtest of the Woodcock Johnson-IV Tests of Achievement (Schrank, Mather, & McGrew, 2014) was used to assess reading comprehension. The items increase in difficulty as the test proceeds, and consist of three types: matching a rebus (picture symbol) with an actual picture, identifying the picture that corresponds to 1-3 written words, and silently reading short passages of one or two sentences and providing a missing word (cloze format). The score on the subtest is the total correct out of 52 items. For the subtest, the publisher reports split-half reliability coefficients for 6-10 year olds ranging from .89-.98 (McGrew, LaForte, & Schrank, 2014). In the present sample, internal consistency (Cronbach's α) was .94 both in the fall and spring.

Word decoding. Students were assessed with the Letter-Word Identification subtest of the WJ-IV (Schrank et al., 2014) that requires students to read a list of letters and real English words presented individually in print. This subtest is scored as total correct out of 78 items. Split-half reliability coefficients from the publisher for ages 6-10 range from .94-.98 (McGrew et al., 2014), and in the present sample, internal consistency was .98 in the fall and .97 in the spring.

Vocabulary. We used the Picture Vocabulary subtest of the WJ-IV (Schrank et al., 2014) to assess lexical knowledge. This test asks students to name pictures using primarily single words, with the task becoming increasingly difficult, as pictures shown are less commonly part of the environment. This subtest is scored as total correct out of 54 items. Split-half reliability coefficients for ages 6-10 from the publisher range from .77-.78 (McGrew et al., 2014). In the present sample internal consistency was .89 in the fall and .85 in the spring.

Oral language comprehension. We assessed language comprehension with the Oral Comprehension subtest of the WJ-IV (Schrank et al., 2014). For this test, students listen to short passages and then supply the missing final word using syntactic and semantic clues (e.g., "Without a doubt, his novels are more complex than the novels of many other contemporary ___."). This test is scored as the total number correct out of 33 items. Split-half reliability coefficients for ages 6-10 range from .78-.83 (McGrew et al., 2014), and in the present sample, internal consistency was .91 in the fall and .89 in the spring.

Higher-order strategic processes. Two measures of higher-order skills involved in reading comprehension were administered: inferencing and comprehension monitoring.

Inferencing. This measure was adapted from Language and Reading Research Consortium (LARRC) and Muijselaar (2018) and the original work by Oakhill and Cain (2012) to be used with Grades 1-5. It assessed two types of inferences, *text connecting inference*s, which are required to integrate information from different parts of the text to establish local coherence, and *gap-filling inferences*, which incorporate general background knowledge with text information to fill in missing details and formulate a globally coherent representation of the text as a whole. Students listened to two recorded stories, each comprised of three paragraphs. Each one was followed by six questions requiring text-connecting inferences and four questions requiring gap-filling inferences. The score was the total number of questions answered correctly. For this measure, internal consistency reliability was calculated by grade level since there was variation across grades in the passages comprising the measure. In the fall, Cronbach's α ranged from .61 (for Grade 3) to .73 (for Grade 1), with an average of .68; in the spring, values ranged from .66 (for Grade 4) to .71 (for both Grades 2 and 3), with an average of .69. These values are consistent with the range of .69-.74 reported for Grades 1-3 by LARRC and Muijselaar (2018).

Comprehension monitoring. This measure was adapted from the *inconsistency detection task* developed by Cain and Oakhill (2007) and Ammi and Cain (2014) to measure comprehension monitoring across Grades 1-5. Students listened to five 5-6 sentence stories, three of which contained internal inconsistency (two lines containing contradictory information; e.g., Oakhill, Hartt, & Samols, 2005). After each story, students were asked if any part of it did not make sense; if they said yes, they were asked "which part does not make sense?" This task has been used previously with large samples of children of primary school age. Reliability of the data (Cronbach's α) ranged between .70 and .84 (e.g., Cain & Oakhill, 2007; Language and Reading Research Consortium & Yeomans-Maldonado, 2017); similarly, internal consistency reliability with the present sample was .84 in the fall and .86 in the spring. Two scores were derived from this task: the number of stories students correctly judged as making sense or not, and the number of legitimate reasons they gave for why the inconsistent stories did not make sense. Our final score for higher-order skills consisted of a composite score created from the sum of the inference and comprehension monitoring raw scores after transforming each to standardized scores.

Executive function skills. Composite measures of EF best fit in models of cognitive development (Lee, Bull, & Ho, 2013; Wiebe, Espy, & Charak, 2008; Wiebe et al., 2011) and reading comprehension (Corso, Cromley, Sperb, & Salles, 2016; Follmer & Sperling, 2018), consistent with the unity-by-diversity (tripartite) framework (Miyake et al., 2000) of EF consisting of related but separable components. Recently, in a cross-national study of the structure of EF across development, Xu and colleagues (2013) found unitary EF structure in 7- to 9-year-old and 10- to 12-year-old children, regardless of language groups (English or Chinese speakers), with differentiation of separate EF skills only emerging in 13- to 15-year-olds. Thus, given the young age of our sample (1st to 4th graders, or 6- to 10-year-old students), we created a composite of the three EF skills we assessed. We converted each of the three skills to Z scores and summed these to create the EF composite. For those participants without responses on all three measures, we created the composite based on the average of the available items.

Working memory. Prior work indicates complex verbal working memory tasks that require both storage, or maintenance of information in memory, as well as active processing that involves manipulation of stored information (i.e., updating; Miyake et al., 2000), are more highly correlated with reading comprehension than simple working memory span (i.e., passive storage) tasks and are lower in students with reading comprehension problems, despite adequate word reading ability (e.g., Seigneuric, Ehrlich, Oakhill, & Yuill, 2000; Sesma et al., 2009; see Cartwright, 2015, for a review). We assessed working memory with the Letters Backward Subtest of the Test of Memory and Learning-2 (TOMAL-2), which entails reading lists of letters that increase in number of items, from two to potentially nine, and asking students to immediately repeat the letters in reverse order. Thus, this task requires mentally storing and transforming the lists. The number of items recalled in correct order across all lists comprised children's working memory scores. TOMAL-2 Letters Backward has good test-retest reliability (r = .67 for ages 5 to 18) and good convergent validity with moderate to strong correlations with measures known to correlate highly with working memory (r = .48 with WISC Full Scale IQ scores and r = .44 with Test of Nonverbal Intelligence-Third Edition; Reynolds & Voress, 2007). In the present sample, internal consistency reliability was .78 in the fall and .84 in the spring.

Inhibition. Given that non-reading-specific measures of inhibition have been related to reading comprehension in EMs and DLLs in past work (e.g., Altemeier, Abbott, & Berninger, 2008; Andersson, 2008; Kieffer et al., 2013), inhibition was measured with the Inhibition subtest from the NEPSY-II. This timed subtest requires students to name objects, such as circles and squares, and then provide the opposite names for the same objects (e.g., "square" for a picture of a circle); that is, it requires the ability to inhibit automatic responses in favor of novel responses and the ability to switch between response types. The manual reported reliability for the total score for this subtest is .72 for ages 7 to 12, and with the present sample internal consistency reliability was .77 in the fall and .85 in the spring. This subtest shows good convergent and discriminant validity, as it correlates strongly with the Delis-Kaplan Executive Functioning System Color-Word Interference subtest and shows strong effects (Cohen's d = .64) in students with ADHD, a condition known to be related to deficiencies in inhibition (Brooks, Sherman, & Strauss, 2010).

Cognitive flexibility. We used both general- and reading-specific trials in our cognitive flexibility task. First, in the general trials, students were asked to sort two sets of 12 pictures of objects based on both color (e.g., red or yellow) and type (e.g., fruit or flower) into a 2 x 2 matrix (Bigler & Liben, 1992; Bock, Gallaway, & Hund, 2015; Cartwright, 2002; Cartwright, Marshall, Dandy, & Isaac, 2010). Then, in the reading-specific Graphophonological-Semantic Flexibility (GSF) trials (Bock et al., 2015; Cartwright, 2002; Cartwright et al., 2010) students sorted two sets of 12 printed words by initial phoneme (e.g., (/b/ or /t/) and word meaning (e.g., vehicle or animal), likewise into a 2 x 2 matrix. The task was scored with a composite of sorting accuracy and sorting speed across the four card sets. The task is highly reliable, with Cronbach's α found to be as high as .86-.90 for first- and second-grade EM students (Cartwright, et al., 2010). In the present sample, internal consistency was .60 in the fall and .77 in the spring; these lower values compared to past studies may reflect the language background and/or other demographic characteristics of the present sample. Additionally, task performance shows good validity, correlating, for instance, .35 with performance on such other measures of cognitive flexibility as the Dimensional Change Card Sort (Bock et al., 2015; see also Cartwright et al., 2010; Cartwright, Lee, DeWyngaert, Lane, & Singleton, 2019; Colé, Duncan, & Blaye, 2014).

Reading engagement. Reading engagement was assessed with teacher reports on student engagement using the Reading Engagement Index (REI) developed by Guthrie et al. (2007). Consistent with Guthrie's and our definition of engaged reading as a multidimensional construct, the REI assesses behavioral, cognitive, and affective dimensions in a teacher rating scheme. After sufficient time for getting to know their students and their reading habits, teachers rated each student in their classrooms on eight items such as *reads often independently* (behavioral), to *thinks deeply about the content of texts* (cognitive) and *enjoys discussing books with peers* (affective). That is, teachers rated each student on their behavior, cognitive involvement, and affect they manifested while reading. The Likert response format is 1 = *not true* to 4 = *very true*. Students could receive a score of 8 to 32 points. The REI is highly reliable with samples of EMs (.92 for Grades 3 and 4; Wigfield et al., 2008) and DLLs (.93, Grade 5; .91, Grade 6; Taboada et al., 2013); similarly, with the present sample, internal consistency was .92 in the fall and spring. The REI was positively correlated with achievement measured by both the Gates-MacGinitie (r =.54) and a science comprehension measure (r =.57), showing criterion related validity (Wigfield et al., 2008). Also, the REI and student self-reports of motivation were moderately correlated (r = .44; Wigfield et al., 2008) showing additional evidence for construct validity.

Procedure

Research assistants (RAs) administered most measures in the fall and spring individually to students in a quiet room in their schools; RAs visited schools in the same order in the fall and spring, so there was a consistent 5-month interval between testing at each site. Assessment sessions lasted 60 minutes. All task instructions were given in English; DLL students had sufficient knowledge of English to understand them. Prior to data collection, RAs completed a rigorous 1-2 day training program and two assessments of their fidelity to administration protocols. Teachers completed the REI for each of their students twice during the school year, after the completion of fall assessments in December and spring assessments in May.

Data Analyses

We obtained answers to the first research question by using *t* tests within a regression framework to compare the means on each of the analysis variables between each language group, and subsequently within grade and language group in the fall of the school year; interaction terms were included to assess within-grade language differences. These tests were conducted in SAS (version 9.4) using the PROC SURVEYREG function to obtain linearized estimates of standard errors, adjusting for the dependency of students within the 51 classrooms, and thus degrees of freedom are a function of the number of classrooms. Additionally, for proper standard error estimation, a domain analysis was conducted across grades instead of treating grades as separate analysis groupings (Heeringa, West, & Berglund, 2017). Cohen's d measures of effect size of the difference in means was calculated using the pooled sampling variances across language groups. For research questions two and three we used multiple regressions with interaction terms, again utilizing PROC SURVEYREG, to investigate the partial regression coefficients in the prediction of reading comprehension or change in reading comprehension during the school year based on language status (i.e., DLLs versus ESs). Given the relatively low amount of missing data, for parsimony, missing data were treated using listwise deletion for the first three research questions. For research question four we used multivariate path analyses implemented in M*plus* (version 8.1; Muthén & Muthén, 2018) to investigate the plausibility of our proposed mediation model wherein higher order strategic processes mediate the effect of baseline executive functions and reading engagement on end-of-year (spring) reading comprehension scores. Specifically, we tested if higher order strategic processes (measured in the spring) mediated the relation between EFs and reading engagement in the fall with change in reading comprehension (i.e., by controlling for the autoregressive effect of reading comprehension and higher order strategic processes). In this model, we included the covariates of oral language comprehension, word decoding, and vocabulary (in the fall of the school year). Auxiliary variables were included to improve the estimation in the face of missing data; these variables included language spoken at home, grade, gender, and measures of vocabulary and English language comprehension. Furthermore, we utilized multiple group modeling (with language status defining the group) and constraints on paths to evaluate whether the model estimates differed across groups. All models were estimated utilizing full information maximum likelihood and TYPE=COMPLEX was used to obtain linearized standard errors and adjusted chi-squared statistics given the dependency of students within classrooms. Tests of the indirect effects were conducted using the confidence limits of the product approach, given that indirect effect estimates cannot be assumed to be normally distributed (MacKinnon, Lockwood, &

Williams, 2004); we used the application provided at https://amplab.shinyapps.io/MEDCI/ (Tofighi & MacKinnon, 2011).

Results

Of the 1,034 assessed children, we were able to use data from 990 children for analyses (although some students have missing data elements as described below). Descriptive statistics along with a pairwise correlation matrix for all analysis variables appear in Table 1 for the full sample (DLLs and EMs combined) and in Table 2 by language group. Missing data rates ranged from 5 to 13 percent in the first wave of data collection, with up to 18% missing in the second wave; missing values for students represented occasions when students were not able to be assessed because of absenteeism and inability to retest them due to school schedules.

Insert Tables 1 & 2 here

To address our first research question, Table 3 presents the mean values on the constructs of interest in the fall wave of data collection by grade level and language group status (DLL vs. ESs). On aggregate, there were significant differences in the means across language status groups on reading comprehension ($t_{(49)}$ =-10.13, d=-0.77), word decoding ($t_{(49)}$ =-7.45, d=-0.61), vocabulary ($t_{(49)}$ =-19.41, d=-1.34), oral language ($t_{(49)}$ =-12.64, d=-0.97), higher order strategic processes ($t_{(49)}$ =-7.87, d=-0.57), EF skills ($t_{(49)}$ =-4.48, d=-0.34), and reading engagement ($t_{(49)}$ =-2.78, d=-0.21). Statistically significant differences at each grade level across language status are symbolized with an * in Table 3, and Cohen's d effect sizes reported for each mean difference. In general, most measures were statistically different across language group within each grade, save for reading engagement at all grade levels and executive function skills at grade 2. Consistent with past work (e.g., Lesaux, 2006; Mancilla-Martinez & Lesaux, 2010; Nakamoto et al., 2007; Mancilla-Martinez et al., 2019) there were large differences between DLLs and EMs in vocabulary and oral language, reflecting DLLs more limited knowledge of English semantics, and medium to large differences in word decoding (which may reflect their limited semantic knowledge, as vocabulary and oral comprehension contribute to word identification skill; Kendeou, van den Broek, White, & Lynch, 2009). For the variables of interest in our study, we found medium to large language group differences in higher order strategic processes, small to medium differences in EF, and small differences in engagement. Thus, despite their limitations with English semantics, DLL students had strategic, EF, and engagement processes that were more similar to their EM counterparts. See Cohen (1988) for a discussion of effect sizes.

Insert Table 3 here

Given these baseline differences, it was then of interest to determine whether change between the fall and spring in reading comprehension, as well as the target predictors of higher order strategic processes, EF skills, and reading engagement, differed for DLL and EM students in Grades 1 to 4 (research question two) and whether any of these baseline measures could predict change in reading comprehension from the fall to the spring of the school year (research question three). Table 4 shows the mean change in our outcome of interest (reading comprehension) and the three target predictors (i.e., higher order strategic processes, executive functions, and reading engagement), by language group within grade. In general, DLL students changed more than their EM student counterparts in reading comprehension (t (49) = 3.88, $p <$ .001); this difference was significant at the overall level as well as in Grades 2 and 3 where the effect sizes were .35 and .23 respectively. These are small effects, but they are of practical significance because they show DLL students exhibit greater growth in reading comprehension than their peers despite having lower oral language, vocabulary, and word reading than their EM counterparts; thus, the growth difference in reading comprehension is worth further investigation. With respect to change in higher order strategic processes, there was no significant difference between DLL and EM students both overall (t (49) = 0.96, p = .340), and within grade. There was little change in EF skills from fall to spring and no overall significant difference in change in EF skills between DLL and EM students (t (49) = -0.96, p = .342). In Grade 2, however, it appears that EM students changed at a greater rate than DLLs (with a Cohen's d effect size of -.31). Similarly, there were no significant differences in changes in reading engagement within the year between the two language groups overall, for all four grades. However, Grade 2 DLLs appeared to have changed at a significantly greater rate than their EM counterparts on reading engagement within the school year (d=.42, a medium effect). These findings regarding growth in our target predictors (higher order strategic processes, EF, and engagement) suggest that despite significant differences in lower level predictors of reading comprehension in the fall, DLL students are not disadvantaged relative to their EM counterparts in development of higher level predictors of reading comprehension across the school year.

Insert Table 4 here

To answer our third research question, we examined predictors of change in reading comprehension from fall to spring within each grade, across language group, and by whether students were in the lower (Grades 1 and 2) or upper (Grades 3 and 4) elementary grades (see Table 4 for means). Table 5 contains the regression parameter estimates based on main effects. The total R^2 was .41. While some skills were expectedly positively related to change (e.g., word decoding, vocabulary, higher order), the level of reading comprehension in the fall was negatively related to change by the spring (β =.-.74, p <.01), suggesting that those who start lower on reading comprehension are catching up (i.e., controlling for the other skills). In terms of EF skills, those with higher levels in the fall experienced greater growth in reading comprehension by spring (β = .66, p <.01). Also, students with higher reading engagement in the fall demonstrated greater positive change in reading comprehension by spring (β = .04, p = .03), again controlling for the other covariates in the model. These findings suggest having higher levels of EF skills and higher engagement promotes greater growth in reading comprehension for all students.

Of interest was whether any of these relations differed across language groups, and thus we added interactions of language status with each of the predictor variables. None of the interactions suggested that the strength of the relations differed across language groups. Specifically, there was no statistically significant interaction between any of the predictors and language group (change in R^2 = .009; change in df = 8, F change = .064; p = .999). We also examined whether there were any interactions with grade level (lower versus upper grades), likewise finding no significant interactions (change in R^2= .005; change in df = 9, F change= .034; p=.999). The new combined R^2 value was .42 when interactions with either language group or grade level were added. These findings suggest the pattern of relations (predictions) of reading comprehension are the same across language groups and grades, despite initial significant differences in lower and higher level predictors between DLLs and their EM peers.

Insert Table 5 here

To answer our fourth research question, a partial mediation model positing that higher order strategic processes in the spring mediated the relation between variables in the fall and reading comprehension in the spring was imposed on the data for DLL and EM students. Because this was a saturated model, fit was perfect for each group separately. The unstandardized path coefficients were then constrained to be equal across the two groups in a multi-group path analysis. These constraints suggested no significant loss of fit (chi-square =

204, *df* = 15, *p* =.16, CFI = 0.998, RMSEA = .027, SRMR = .013), and thus we can conclude that there is no evidence that the unstandardized path values differ across DLLs and ESs. Table 6 presents the standardized path coefficients for each group (note that constraints are placed on unstandardized coefficients and thus the standardized values can differ across groups if variable sample variances differ), and Figure 2 depicts the model graphically.

Controlling for the covariates of oral language comprehension, vocabulary, and word decoding in the fall, we found that EF in the fall was positively related to higher order strategic processes in the spring (path standardized values were .11 for DLLs, and .13 for EMs). As we noted previously, limited work has investigated contributions of EF to higher order strategic processes. Albeit modest, these effects are similar to those found in studies of EFs' contributions to reading comprehension in EM children (Kim, 2017), and in students of diverse language backgrounds (Kieffer et al., 2013);which have ranged from .15 to .21 . Similarly, in studies of EFs' contributions to adults' reading comprehension, path standardized values have ranged from .19 to .32 (Cartwright et al., 2019; Georgiou & Das, 2018). Additionally, higher order strategic processes in the spring were related to reading comprehension in the spring at a standardized value of β = .05 for both groups. This is smaller than the values found by Kim (2017) for inference (-.10) and comprehension monitoring (.17) in a sample of 350 2nd grade students, only of which, 1.8% were DLL students. The total indirect effect was statistically significantly different from zero (the unstandardized indirect effect was 0.49 with a confidence interval of [0.003, 0.106]). There was a significant direct effect of fall EF skills on spring reading comprehension, as well as a significant indirect effect of fall EF skills on spring reading comprehension through spring higher order strategic processes (β = .05), suggesting that higher order strategic processes (spring) partially mediated the effect of EF skills (fall) on reading comprehension (spring), as predicted. In contrast, higher order strategic processes appeared to play no role in the relation of reading engagement in the fall and reading comprehension in the spring, as the indirect effect of .001 was not statistically significantly different from zero (CI = [-0.001, 0.004]. The direct effect of reading engagement in the fall on reading comprehension in the spring was significantly different from zero, at a standardized value of .05 for both language groups. The total R^2 was .82 for DLLs, and .77 for ESs.

Insert Table 6 and Figure 2 here

Discussion

Reading comprehension is critical for success across academic content areas in elementary school and is affected by a number of individual difference variables. This study explored contributions of three of these - executive function (EF), engagement, and higher order strategic processes - beyond lower level predictors (vocabulary, word reading, and oral comprehension) to the English reading comprehension of first to fourth grade Spanish-speaking DLLs from low income homes in direct comparison to their English monolingual peers of similar SES (a first in the literature). Understanding the individual differences that contribute to successful reading comprehension for DLLs is critical to addressing achievement gaps for these students in reading and across academic areas (National Center for Education Statistics, 2019). Four key findings emerged from this study. First, we found DLLs tended to be lower than EMs on lower and higher level predictors in fall of the school year. Specifically, there were large differences (Cohen, 1988) between DLLs and EMs in vocabulary and oral language, as expected, and medium to large differences in word decoding. For the individual difference variables of interest in our study, we found medium to large group differences in strategic processes, and small to medium differences in EF. However, DLLs were comparable to their EM peers in reading engagement. Second, each language group improved significantly in reading comprehension over the school year, with DLLs showing a greater change (though not significantly so) than EMs. Reading engagement remained stable during the school year for both groups. Third, all three target variables (EF skills, strategic processes, and reading engagement) predicted significant change in reading comprehension over the school year, over and above vocabulary, oral language, word decoding, and fall levels of reading comprehension – novel findings for DLLs. Despite lower initial levels of most skills for DLL students, the magnitude of these changes did not differ across language groups and were comparable in size to effects in other studies with EM children (Kieffer et al., 2013; Kim, 2017) and adults (Cartwright et al., 2019; Georgiou & Das, 2018). Further, these findings held for the lower (1 and 2) and upper grades (3 and 4), denoting their importance through different stages of reading comprehension development for both DLLs and EMs. Fourth, as hypothesized and novel in the literature, we found strategic processes (inferencing and comprehension monitoring) mediated the relation between fall EF and spring reading comprehension for both EM and DLL students. However, and somewhat unexpectedly, higher order strategic processes did not mediate the relation between fall reading engagement and spring reading comprehension; rather, reading engagement contributed to reading comprehension directly for both DLLs and EMs. This study is the first, to our knowledge, to examine reading engagement, EF, and strategic processes within the framework of complex effects models (CEM) of reading comprehension for both EMs and DLLs. Next, we discuss four sets of findings and offer theoretical and instructional implications.

DLLs' Performance Patterns: Insights into Development and Intervention

Language and cognitive variables: Differences between DLLs and EMs. Our first set of findings confirmed that Spanish DLLs of performed lower on reading comprehension, word decoding, oral language, and vocabulary than EM peers of comparable SES. These findings are novel because our comparison EM sample was of similar low SES, a confound typical in prior work (e.g., Kieffer et al., 2013). Yet, DLLs' lower word reading skills (DLL *M* = 36.02, *SD* = 14.06; EM *M* = 44.48, *SD* = 13.55, d=-0.61, a medium to large effect) still confirmed prior work (e.g., Mancilla Martinez & Lesaux, 2011; Paez & Rinaldi, 2006). These results suggest explicit and targeted word reading instruction may be warranted for DLLs, especially in the lower grades, when reading instruction is highly dependent on decoding skills. However, we note that decoding instruction alone is not enough to support development of reading comprehension for these students, a point we take up below. Additionally, despite similar SES across groups, DLLs still performed under the average range for English vocabulary (DLL *M* = 21.01, *SD* = 4.28; EM *M* = 26.03, *SD* = 4.29, d=-1.34), which is a very large effect (Cohen, 1988). The fact that DLLs were significantly and substantially lower than their EM counterparts of similar SES, points to the need to attend to explicit instruction on vocabulary and word recognition for all students, but especially those who come from low income Spanish households like the DLLs in this sample.

Additionally, new to this set of findings is DLLs' lower performance on higher order strategic processes (inferencing and comprehension monitoring) – which have been scarcely studied in DLLs – and on EF skills. The former finding is not surprising, given that higher order strategic processes have been found to be consistently weaker in EM students who struggle with reading comprehension, despite having adequate word reading skills (S-RCD, Cain & Oakhill, 1999; Cain, Oakhill, & Bryant, 2004): a group with a similar profile to DLL students (Lesaux, 2006). In particular, EM students with S-RCD have trouble generating knowledge-based inferences that require integration of text elements with background knowledge, even when their background knowledge is comparable to peers with better reading comprehension (Bowyer-

Crain & Snowling, 2005). These types of inferences are causally related to reading comprehension (Cain & Oakhill, 1999). Thus, it is no surprise that DLL students' inference skills are lower than EM peers, given that they have lower levels of reading comprehension and are still developing language proficiency. Because comprehension monitoring and inferencing are amenable to instruction, with facilitative effects on reading comprehension (Hansen & Pearson, 1983; Reis & Spekman, 1983; Yuill & Oakhill, 1988), these strategic processes offer a potential mechanism for improving reading comprehension via intervention with DLL students, from the early stages of literacy development—a direction to consider in future work.

Our results also showed that EF skills were significantly lower for DLLs than for EMs (DLL M = -.12, SD =.75; EM M = .14, SD =.82, d = -0.34, a small effect). This finding needs to be interpreted with caution, given the abundant literature that reveals an advantage on EFs for bilingual over monolingual individuals (e.g., Calvo & Bialystok, 2014; Martin-Rhee & Bialystok, 2008; for review, see Adesope, Lavin, Thompson, & Ungerledier, 2010 and Bialystok, 2015) as well as the more recent work that refutes some of these findings, indicating no evidence of a bilingual advantage for 9- to 10 -year-olds of a nationally representative sample (e.g., Dick et al., 2019). However, we do not claim that our findings are consistent with the latter results (Dick et al., 2019) for three reasons. First, our study focuses on EFs that are consistently related to academic achievement (Best, Miller, & Naglieri, 2011; Diamond, 2013) and in particular to reading comprehension (Potocki, Sanchez, Ecalle, & Magnan, 2017; Sesma, Mahone, Levine, Eason, & Cutting, 2009). Thus, in this study, we did not focus EFs commonly studied in the bilingual advantage literature, such as attentional control (Adesope et al., 2010; Bialystok, 2015), nor do we try to refute the bilingual advantage literature, given that we did not utilize EF tasks commonly employed in those studies. Rather, our interest was to explore whether the three widely-studied core EFs (working memory, inhibition and cognitive flexibility; Diamond, 2013) that have been associated with higher reading comprehension in EMs (Borella, Carretti, & Pelegrina, 2010; Cartwright et al., 2017; Locascio et al., 2010) acted as predictors of reading comprehension in DLLs. Second, DLLs' lower performance on EFs, is, in fact not surprising given the characteristics of our sample. Indeed, longitudinal studies demonstrate that EFs are strongly associated with academic success (Best, Miller & Naglieri, 2011; St. Clair-Thomspon & Gathercole, 2006) and with reading comprehension in particular (Potocki et al., 2017). Therefore, it is not surprising that DLLs who struggle with reading comprehension would show depressed performance on EFs. Third, the three EFs in this study were measured in English, such that performance on them is, somewhat, language-dependent (e.g., our measure of cognitive flexibility required some vocabulary knowledge). Thus, the absence of a bilingual advantage in this sample may have been due to DLLs' weaker language performance. Future studies need to assess EFs with a more restricted "language load" to ensure that EMs are not at an advantage.

Reading engagement: Similarities across DLLs and EMs. In contrast to other variables, reading engagement was not significantly different between the two language groups in the fall of the school year (research question 1) and remained stable across the school year for both groups (research question 2). Further, this finding held up across Grades 1 to 4. As such, it provides empirical evidence for the attention that we ought to give to DLLs' engagement with reading – attention that others have persuasively discussed at conceptual and practical levels (e.g., Cummins, 2011). At its most general level, academic engagement refers to the quality of a student's connections or involvement with school, its people, goals, values and activities (e.g., Skinner, Kindermann, & Furrer, 2009). At a more specific level, reading engagement refers to the dimensions of literacy behaviors (reading and writing extensively, in and out of school), affect (enthusiasm and interest in reading), and depth of cognitive processing (active use of strategies to deepen comprehension) (Guthrie & Wigfield, 2000; Guthrie et al., 2012). In this study we measured engagement across all of these dimensions as they were observed by teachers with regards to at-school reading. The enthusiasm, effort, and investment of time in reading-related activities appear not to differ across these groups based on teachers' judgements. This finding is not trivial, because it may indicate that, on the one hand, teachers are aware of DLLs' positive emotions (i.e., enthusiasm, interest) as well as their constellation of positive behaviors (i.e., devotion of time, persistence with reading activities) about reading. On the other hand, this awareness may also speak of teachers' perception of reading engagement as a malleable proximal influence that can shape students' academic experiences. Indeed, the concept of engagement is attractive to educators because, compared to status indicators like student SES or ethnicity, engagement represents a factor shaping children's academic retention, achievement, and resilience (Skinner et al., 2009; Taboada Barber, Buehl, & Beck, 2017). Thus, the role of reading engagement as a motivation construct cannot be overemphasized and requires attention as a possible target for intervention that may mitigate struggles with reading comprehension.

Predicting Reading Comprehension: Theoretical and Practical Implications across Groups

A key contribution of this study is that higher order strategic processes, EFs, and reading engagement emerged as significant predictors of reading comprehension and reading comprehension growth over the year for both DLLs and EMs of similar SES, while controlling for lower level predictors. In addition, we found that these variables, which are understudied in DLLs, predicted reading comprehension across grades 1 to 4, for both language groups. Importantly, DLL and EM students higher in EF or engagement at the beginning of the year showed greater growth in reading comprehension than their counterparts who were lower on EF or engagement at the beginning of the school year. These findings suggest that tapping into EFs, which are amenable to intervention (Cartwright et al., 2017; Diamond, 2012), and into reading engagement as a malleable, socio-cognitive construct is important throughout the early and late elementary years. Finally, our findings support the need for more encompassing and multidimensional views of reading comprehension as espoused by many literacy researchers in the last decade (e.g., Butterfuss & Kendeou, 2018; Cromley & Azevedo, 2007; Duke & Cartwright, 2019; Kim, 2017) that include language, cognitive, and engagement components. Importantly, these models of reading comprehension should consider implications for instruction, such that multiple components are effectively integrated for both EM and DLL struggling readers. We discuss the implications of each of these findings.

Higher order strategic processes and reading comprehension. We measured two metacognitive comprehension skills, inferencing and comprehension monitoring, following Cain's protocols (Ammi & Cain, 2014; LAARC & Muijselaar, 2018). In the inferencing task, students made local and global inferences. Local inferences are necessary to integrate information from adjacent pieces of text, whereas global inferences require filling in details not explicitly stated in the text (LAARC & Muijselaar; 2018). Both types of inferences, as well as the ability to monitor inconsistencies in texts, are needed to form a coherent mental representation of text (Graesser, Singer, & Trabasso, 1994; Kintsch, 1988). Indeed, most theories of text comprehension agree upon the need for an integrated and coherent representation of text for successful comprehension to take place (see McNamara & Magliano, 2009 for a review). Our findings extend previous work by demonstrating that inferencing and monitoring predicted reading comprehension growth over the school year in both DLLs and EMs, underscoring the importance of strategic processes to the successful development of reading comprehension for

DLLs, a group for whom strategic processes have been understudied. Further, these findings support the notion that these higher order strategic processes are key players in reading comprehension for EMs and DLLs of low SES and should thus receive instructional attention.

Reading engagement and reading comprehension. We found that reading engagement not only correlated moderately with concurrent reading comprehension (*r*s = .36-.42 across the full sample and language subgroups), but also showed a small but significant effect (β = .04) on reading comprehension growth across the school year, over and above language and cognitive predictors, again for both language groups. The strength of the relations appeared generally consistent with the scant past research including DLLs (Author, 2019; Taboada et al., 2013) and that involving elementary-aged EMs (e.g., Guthrie et al., 1999), which overall suggests moderate to strong concurrent relations, and weak to moderate prediction of growth, varying with the particular cognitive, motivation, and demographic variables employed as controls. Our findings further suggest the importance of reading engagement for successful reading comprehension in EMs and DLLs of low SES, groups for whom variables such as motivation and engagement tend to be overlooked, given the premium put on cognitive ones (Taboada et al., 2009, 2013).

EF skills and reading comprehension. EF skills predicted small but significant variance in reading comprehension growth over the school year for both language groups, directly and indirectly, even after word reading, vocabulary, oral comprehension, and initial reading comprehension were controlled. This is a novel finding, particularly for DLL students. Our study is the first, to our knowledge, to examine the role of EF in reading comprehension growth for DLLs. EFs contribute significantly to EMs' (Butterfuss & Kendeou, 2018; Follmer, 2018) and DLLs' concurrent reading comprehension (Kieffer et al., 2013); our findings confirmed this contribution across language groups. Additionally, early EF skills predict later reading achievement longitudinally, including measures of word reading, vocabulary, and reading comprehension (e.g., Ahmed, Tang, Waters, & Davis-Kean, 2018; Morgan, Farkas, Hillemeier, Pun, & Maczuga, 2018), suggesting EF may contribute to the development of reading comprehension over time. However, those studies did not examine reading comprehension separately from other reading skills, nor did they examine EFs' contributions to reading comprehension growth, controlling for initial reading comprehension. In fact, limited evidence has emerged regarding contributions of EF skills to reading growth of any sort. Recently, LARRC, Jiang, and Farquharson (2018) found first grade EFs predicted third grade reading comprehension in EMs, controlling for initial levels of language comprehension and word reading; however, they did not examine reading comprehension growth. Thus, our study provides novel insight into the way EF may contribute to the development of reading comprehension: rather than simply contributing to reading comprehension over time, our data show EF contributes directly to the growth of reading comprehension beyond initial levels of reading comprehension and lower level controls. These findings were more pronounced for children who were lower in initial levels of reading comprehension, as evinced by the negative relation between reading comprehension in the fall and growth in comprehension, such that weaker comprehenders tended to catch up to stronger ones, while other variables were controlled. These findings held across language groups, supporting the significance of EFs to reading comprehension irrespective of English proficiency. Direct contributions of EF to reading comprehension growth make sense: EF skills enable students to manage competing mental processes - such as semantic, syntactic, phonological, and word reading processes - while constructing, maintaining, and updating a mental model of text meaning. EF skills, particularly for children with initially low reading comprehension, would help students handle the coordination of multiple processes necessary for reading comprehension growth to occur.

Higher Order Strategic Processes as Mediators of EFs and Reading Comprehension

One of the most intriguing findings from this study, consistent with CEM models of reading comprehension, is that strategic processes mediated the relation between fall EF skills and spring reading comprehension, indicating a possible explanatory mechanism for the relation between these two variables. Although modest in size (but comparable to prior findings, e.g., Kieffer et al., 2013), our finding suggests instruction in strategic processing may be better served by tapping on EF skills, top-down processes activated in the context of goal-oriented behavior, which may facilitate strategy use in service of reading comprehension. Others have pointed to the association between EFs and cognitive strategies (e.g., García-Madruga et al., 2014; Kieffer et al., 2013; Locascio et al., 2010) to further elucidate associations of EF skills with reading comprehension. Such a hypothesis proposes that the metacognitive work required by higher order strategies, such as inferencing and comprehension monitoring, necessitate the self-regulation afforded by EF skills. These findings are consistent with work with college students that demonstrated significant relations between metacognitive strategies and EFs (Follmer & Sperling, 2016; Garner, 2009). Although strategic metacognition is associated with EF, little research has explored directly this association in children (see Dinsmore et al., 2008 and Roebers & Feurer, 2016 for reviews). Some scholars have suggested self-regulatory strategic processes, such as monitoring, are examples of complex EF, like planning or organization, to which the three core EFs (inhibition, working memory and cognitive flexibility) contribute (Dawson & Guare, 2018; Meltzer, 2018). Other work has suggested overlap in these processes (e.g., Dinsmore et al., 2008; Garner, 2009); and, still other scholars have suggested metacognitive strategy use offers opportunities to apply specific, goal-directed strategies to learning tasks, which strengthen EFs, as well as motivation for, and engagement with learning (Taboada Barber et al., in press; Borkowski et al., 2000). We found EFs contribute directly to metacognitive comprehension strategies (inferencing and comprehension monitoring), which partially mediate the contribution of EFs to change in reading comprehension across the academic year. Importantly, our findings also go beyond existing work by demonstrating the *direct* contributions of EF skills to promoting change in reading comprehension over time. Indeed, as noted above, evidence shows inferencing and comprehension monitoring are not a byproduct of reading comprehension, but rather that efficient inference and monitoring skills are a plausible cause of good reading comprehension (Cain & Oakhill, 1999; Oakhill & Cain, 2007), though additional research is needed on the causal relation between inferencing and reading comprehension (see Follmer, 2018, for a review). In sum, our findings confirm the potentially important role of EFs to the development of strategic reading in DLLs and EMs, in which EFs exert their influence on reading comprehension partially through complex, strategic processes.

Why might EF skills contribute indirectly to reading comprehension through strategic processes? One plausible explanation is that both inferencing and comprehension monitoring require executive skills. For example, studies comparing poor comprehenders to peers whose reading comprehension is on par with their age or grade has shown these students struggle with detecting inconsistencies in text across pairs of sentences (as required in the comprehension monitoring task), both when the inconsistent sentences are adjacent and when they are separated within the text – increasing working memory demands of the task (e.g., Oakhill et al., 2005). Indeed, the inability of elementary school poor comprehenders (9- and 10-year-olds) to detect inconsistencies seems not to just be a simple challenge with integration of information; rather, their success may depend on the working memory demands of the task. Similarly, working memory contributes to inferencing, even compensating for weaknesses in decoding ability, to facilitate reading comprehension (Hamilton, Freed, & Long, 2016). Limited evidence shows the other two core EF skills, inhibition and cognitive flexibility, may contribute to the development of strategic processes as well. For example, inferring appropriate word meanings of polysemous words is essential for reading comprehension, and this inferencing skill requires inhibition (Henderson et al., 2013). With respect to cognitive flexibility, the third core EF, students with greater degrees of cognitive flexibility are more likely to employ metacognitive comprehension strategies, such as inferring and monitoring, and such strategies are more likely to positively impact reading comprehension for students high in cognitive flexibility (Gnaedinger et al., 2016). Scholars have speculated about the critical role of EF skills in supporting the development of higher order, strategic comprehension skills (e.g., see Butterfuss & Kendeou, 2018 and Follmer, 2018, for reviews). Our findings provide an important first step toward understanding how EF supports strategic reading comprehension in EM and DLL students. However, more work is needed to understand precisely how EFs support higher order strategic reading processes.

The Intriguing Relation between Reading Engagement and Strategic Processes

Contrary to expectation, but consistent across language groups, higher order strategic processes did not mediate the relation between fall reading engagement and spring reading comprehension. In fact, fall reading engagement and spring strategic processes were unrelated. This lack of relation may reflect a mismatch between how our measure of reading engagement, the REI, captures students' strategic behaviors in reading and how strategic reading is specified in the present study: as a combination of inferencing and comprehension monitoring. The REI includes only one item pertaining to strategy use, "uses comprehension strategies well", which teachers may interpret in broader and more diverse ways than what our strategy measure entails. We do support, however, the idea, proposed by others (Borkowski, 2000; Guthrie & Klauda, 2016) that the deployment of cognitively demanding, top-down processes, such as cognitive strategies would possibly be facilitated or even potentiated by the degree of a reader's engagement with text. That is, given a complex, challenging text that requires the use of cognitive strategies to facilitate its understanding, an engaged reader would likely be more successful, and possibly more flexible, in the deployment of appropriate strategies to enhance comprehension than a disengaged reader. Future work should consider self-report reading engagement measures to permit exploration of relations to strategic processes more precisely.

Limitations and Future Research

Together, these findings indicate all three focal predictors of reading comprehension examined in the current study, which have been scarcely studied in DLLs before – EF skills, higher order strategic processes, and reading engagement – make significant, unique contributions to the development of reading comprehension across the academic year in first to fourth grade DLLs and EMs beyond other predictors of reading comprehension. One key limitation of this study is that we did not assess EF skills in DLLs' home language, Spanish, in addition to measuring them in English. Given that our focal predictors of reading comprehension were equally important, or of equal weight, for both groups, it would have been informative to learn whether DLLs were of similar performance to their EM peers had their EFs been measured in Spanish as well as in English. A second, related limitation was the absence of a measure of oral language and reading comprehension in Spanish. Given recent findings on the influence of home language on English reading achievement in DLLs in the early grades (Mancilla-Martine et al., 2019), learning about the influence of Spanish language usage on English comprehension would have been helpful to inform targeted literacy interventions – more so in light of the reported advantages of Dual Language Immersion Instruction for DLLs (Bickle, Hakuta, & Billings, 2004; Lindholm-Leary & Genesee, 2010). A third limitation includes the absence of a measure of reading engagement that could better capture its relation with higher-order strategic processing, and thus permit its investigation in a more precise way. A clear direction for future work is to test a model of reading comprehension that includes key higher order predictors (EFs, strategic processes, and engagement) for DLLs in both Spanish and English. Recent work indicates the use of receptive and productive vocabulary measures, including conceptually scored vocabulary measures that allow to DLLs to respond in either language (Mancilla-Martinez et al., 2019). We add and emphasize the need for broader models of the multidimensionality of reading comprehension that include reading engagement, EF skills, and strategic processing. Such models will allow the emergence of a fuller picture of bilingualism and biliteracy.

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Table 1

Correlation Matrix and Descriptive Statistics for Analysis Variables in Combined Sample of DLLs and EMs

	WD-F	RC-F	V-F	OL-F	IM-F	CM-F	HO-F	WM-F	I-F	CF-F	EF-F	RE-F	RC-S	WM-S	I-S	CF-S	EF-S
WD-F	—																
RC-F	.90	—															
V-F	.59	.64	—														
OL-F	.66	.71	.70	—													
IM-F	.56	.60	.56	.67	—												
CM-F	.38	.40	.37	.46	.44	—											
HO-F	.55	.59	.54	.66	.85	.85	—										
WM-F	.46	.48	.34	.39	.38	.27	.38	—									
I-F	.52	.49	.30	.40	.43	.30	.43	.39	—								
CF-F	.55	.56	.41	.51	.49	.36	.50	.33	.47	—							
EF-F	.66	.66	.44	.55	.56	.39	.56	.74	.81	.78	—						
RE-F	.42	.39	.29	.31	.27	.19	.27	.23	.22	.26	.30	—					
RC-S	.87	.86	.62	.68	.58	.42	.59	.45	.50	.56	.65	.41	—				
WM-S	.49	.46	.40	.42	.32	.26	.34	.49	.38	.32	.50	.29	.50	—			
I-S	.50	.49	.32	.38	.39	.30	.41	.45	.69	.48	.69	.24	.48	.40	—		
CF-S	.61	.61	.45	.55	.53	.39	.54	.38	.51	.64	.66	.26	.62	.37	.52	—	
EF-S	.68	.66	.50	.57	.52	.40	.54	.56	.67	.61	.79	.33	.67	.75	.81	.80	—
M	39.51	20.67	23.08	12.28	22.89	6.19	.00	10.43	.78	12.77	.07	27.08	22.98	11.35	.88	8.65	.00
SD	14.46	7.88	4.94	5.10	8.24	2.91	1.70	4.84	.24	11.64	2.32	7.78	7.06	5.03	.26	6.47	2.35

Note. WD = word decoding; RC = reading comprehension; V = vocabulary; OL = oral language comprehension; IM = inference making; CM = comprehension monitoring; HO = higher order strategic processes; WM = working memory; I = Inhibition; CF = cognitive flexibility; EF = executive functions; RE = reading engagement. F = fall; S = spring.

Table 2

Correlation Matrix and Descriptive Statistics for Analysis Variables in DLL and EM Subgroups

	WD-F	RC-F	V-F	OL-F	IM-F	CM-F	HO-F	WM-F	I-F	CF-F	EF-F	RE-F	RC-S	WM-S	I-S	CF-S	EF-S
WD-F	—	.88	.42	.59	.48	.34	.48	.46	.53	.54	.65	.44	.84	.48	.48	.56	.66
RC-F	.90	—	.43	.64	.51	.34	.50	.47	.51	.53	.65	.42	.81	.41	.50	.54	.63
V-F	.62	.66	—	.45	.34	.18	.30	.28	.27	.26	.34	.24	.44	.36	.30	.28	.41
OL-F	.64	.69	.75	—	.57	.37	.55	.38	.42	.45	.53	.30	.58	.35	.38	.48	.53
IM-F	.54	.58	.61	.67	—	.38	.80	.34	.42	.45	.52	.24	.48	.19	.35	.44	.43
CM-F	.36	.39	.43	.47	.44	—	.86	.30	.28	.34	.40	.16	.38	.23	.28	.36	.38
HO-F	.53	.57	.61	.67	.86	.84	—	.38	.41	.47	.55	.23	.51	.26	.38	.48	.48
WM-F	.44	.46	.35	.36	.36	.22	.35	—	.39	.35	.72	.25	.39	.51	.44	.30	.54
IN-F	.52	.49	.33	.40	.43	.31	.44	.39	—	.51	.81	.26	.52	.35	.68	.53	.68
CF-F	.54	.57	.50	.55	.50	.34	.50	.29	.43	—	.82	.24	.52	.26	.48	.63	.59
EF-F	.66	.67	.52	.56	.57	.36	.55	.75	.80	.74	—	.32	.62	.46	.67	.65	.77
RE-F	.39	.36	.31	.29	.27	.19	.27	.19	.18	.25	.27	—	.39	.36	.26	.21	.36
RC-S	.87	.87	.64	.68	.58	.40	.58	.47	.51	.58	.68	.39	—	.48	.46	.57	.65
WM-S	.47	.47	.39	.43	.35	.24	.35	.45	.39	.36	.52	.21	.48	—	.38	.31	.73
IN-S	.52	.50	.37	.39	.42	.30	.43	.45	.69	.47	.70	.21	.50	.41	—	.52	.81
CF-S	.61	.62	.52	.55	.55	.39	.55	.42	.49	.63	.67	.27	.63	.39	.52	—	.79
EF-S	.67	.66	.54	.58	.55	.38	.55	.55	.67	.61	.80	.29	.68	.76	.82	.80	—
DLLs																	
Mean	36.02	18.34	21.01	10.57	20.95	5.76	-.39	9.87	.76	11.28	-.21	26.40	21.27	10.76	.87	7.73	-.29
SD	14.06	7.43	4.28	4.70	8.32	2.78	1.67	4.81	.23	10.54	2.21	7.43	6.82	4.75	.25	6.04	2.26
EMs																	
Mean	44.48	23.99	26.03	14.71	25.64	6.81	.55	11.23	.80	14.85	.45	28.05	25.29	12.13	.90	9.91	.40
SD	13.55	7.29	4.29	4.64	7.29	2.99	1.58	4.79	.24	12.75	2.41	8.15	6.71	5.29	.26	6.83	2.42

Note. Values for DLLs appear below the diagonal; values for EMs appear above the diagonal. WD = word decoding; RC = reading comprehension; V = vocabulary; OL = oral language comprehension; IM = inference making; CM = comprehension monitoring; HO = higher order strategic processes; WM = working memory; I = Inhibition; CF = cognitive flexibility; EF = executive functions; RE = reading engagement. F = fall; S = spring.

Table 3

Mean Values of Variables in Fall by Language Learner Status and Grade

Measure	Language status	Grade 1 (*n* = 236)	Grade 2 (*n* = 247)	Grade 3 (*n* = 270)	Grade 4 (*n* = 237)
Reading comprehension	ES	15.7	22.8	26.9	28.5
	DLL	11.0*	17.2*	22.1*	24.6*
	Cohen's d	-0.78	-1.02	-0.88	-0.87
Word decoding	EM	28.5	43.2	49.3	53.2
	DLL	22.3*	32.9*	43.5*	48.5*
	Cohen's d	-0.59	-0.95	-0.55	-0.64
Vocabulary	EM	23.3	25.8	26.8	28.4
	DLL	18.7*	20.6*	22.3*	23.2*
	Cohen's d	-1.34	-1.62	-1.24	-1.51
Oral language	EM	10.9	14.1	16.3	17.2
	DLL	7.3*	10.2*	12.0*	13.7*
	Cohen's d	-0.93	-1.06	-1.15	-0.93
Higher order strategic processes	EM	-.54	0.2	.99	1.37
	DLL	-1.41*	-.80*	.30*	0.60*
	Cohen's d	-0.64	-0.56	-0.47	-0.54
EF skills	EM	-0.6	-0.1	0.5	0.6
	DLL	-0.7*	-0.3	0.2*	0.4*
	Cohen's d	-0.25	-0.24	-0.36	-0.26
Reading engagement	EM	27.3	28.3	28.5	27.8
	DLL	26.2	25.6	27.6	26.2
	Cohen's d	-0.13	-0.34	-0.14	-0.21

Note. * indicates that mean is significantly different ($p \leq .05$) between DLLs and the mean for EMs (directly above it). All omnibus mean comparisons (combining across grade levels) are significant between DLLs and EMs.

Table 4

Mean Change in Reading Comprehension, Higher Order Strategic Processes, Executive Functions, and Reading Engagement by Grade and Language Status

	Language status	Grade 1	Grade 2	Grade 3	Grade 4
Change in reading comprehension	EM	2.3	1.9	0.8	1.8
(RC-S – RC-F)	DLL	3.9	3.1*	1.7*	2.1
	Cohen's d	0.37	0.35	0.23	0.06
Change in higher order strategic processes	EM	.17	-.20	.09	-.11
(HO-S – HO-F)	DLL	.01	.17	.08	.05
	Cohen's d	-0.12	0.28	0.00	0.13
Change in EF skills	EM	0.05	0.14	-0.01	0.03
(EF-S – EF-F)	DLL	0.01	0.00*	0.02	0.06
	Cohen's d	-0.09	-0.31	0.04	0.04
Change in engagement	EM	1.34	.29	-.10	.20
(Eng-Sp – Eng-F)	DLL	.09	2.74*	-.30	.92
	Cohen's d	-0.20	0.42	-0.04	0.13

Note. RC = reading comprehension; HO = higher order strategic processes; EF = executive functions; F = fall; S = spring. * indicates that mean is significantly different ($p \leq .05$) between DLL and the mean for EM group (directly above it).

Table 5

Estimated Regression Coefficients Predicting Amount of Change in Reading Comprehension from Fall to Spring

	β Coefficient	St. Err.	*p*-value
Intercept	3.87	1.05	<0.01
Fall reading comprehension	-0.74	0.04	<0.01
Word decoding	0.23	0.02	<0.01
Vocabulary	0.15	0.03	<0.01
Higher order strategic processes	0.27	0.80	<0.01
Executive functions	0.66	0.19	<0.01
Reading engagement	0.04	0.02	0.03
Language status	0.23	0.32	0.48

Table 6

Standardized Coefficients of Mediation Model

	DLL		EM	
Fall predictors of spring higher order strategic processes	Coefficient	*SE*	Coefficient	*SE*
Reading comprehension	0.03	0.05	0.03	0.05
Executive functions	0.11**	0.03	0.13**	0.03
Reading engagement	0.03	0.02	0.04	0.02
Oral language	0.21**	0.05	0.20**	0.04
Vocabulary	0.07	0.04	0.06	0.10
Higher order strategic processes	0.46**	0.03	0.46**	0.03
Word decoding	-0.02	0.06	-0.02	0.06
Fall predictors of spring reading comprehension				
Reading comprehension	0.27**	0.04	0.27**	0.04
Executive functions	0.06**	0.02	0.07**	0.03
Reading engagement	0.05**	0.02	0.05**	0.02
Oral language	0.06*	0.03	0.05*	0.02
Vocabulary	0.05**	0.02	0.04**	0.02
Higher order strategic processes	0.04	0.02	0.03	0.02
Word decoding	0.46**	0.04	0.44**	0.04
Spring predictor of spring reading comprehension				
Higher order strategic Processes	0.05*	0.02	0.05*	0.02

* $p \leq .05$; ** $p \leq .01$

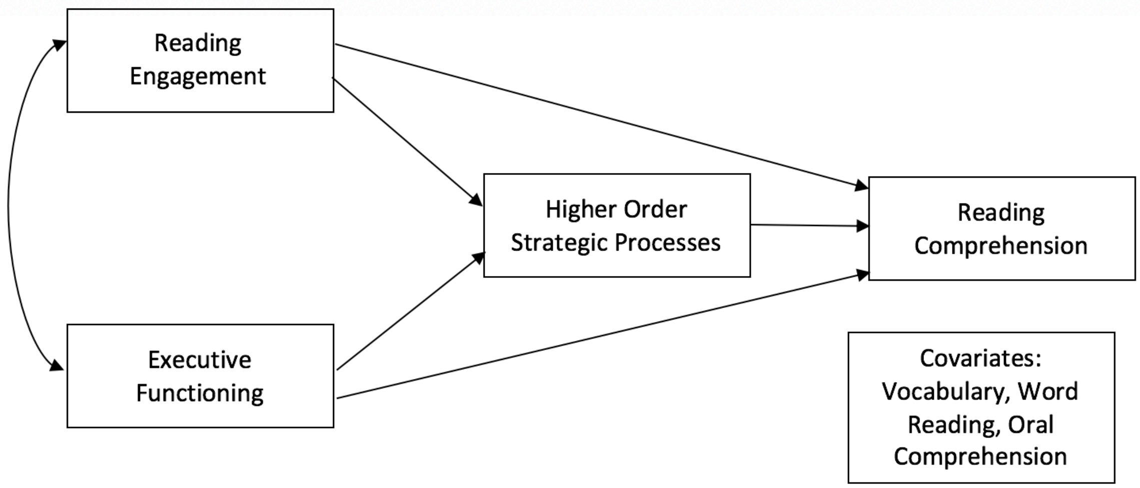

Figure 1. Hypothesized model depicting partial mediation of effects of executive functioning and engagement by spring higher order strategic processes on spring reading comprehension for DLL and EM students (DLL = Dual Language Learners; EM = English Monolinguals).

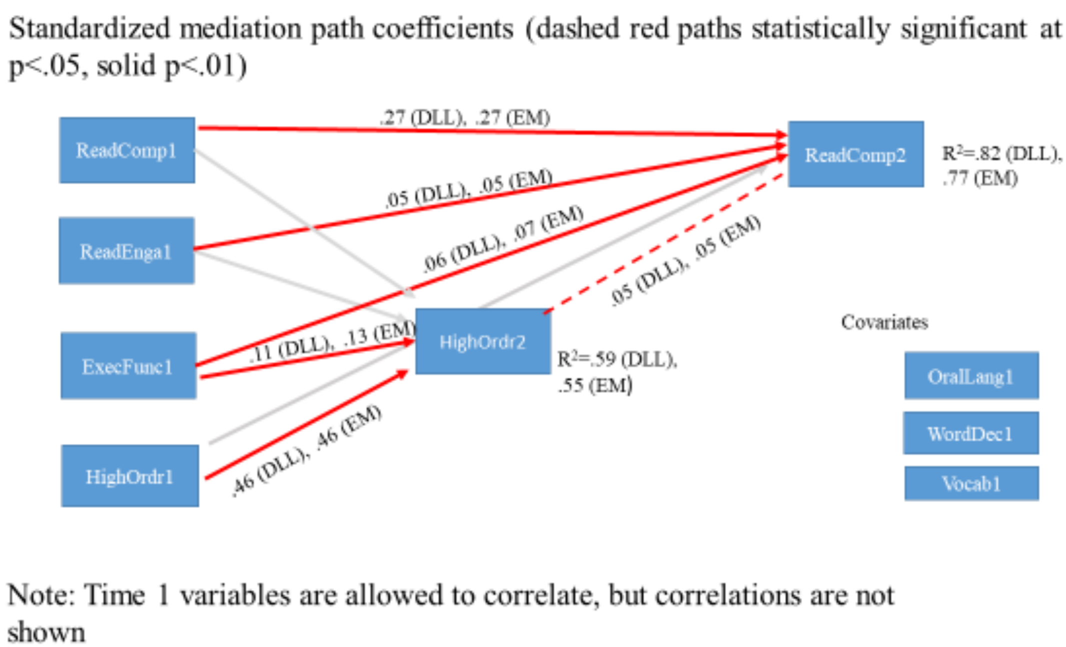

Figure 2. Path analysis model depicting partial mediation effect of spring higher order strategic processes on spring reading comprehension for both language groups (DLL = Dual Language Learners; EM = English Monolinguals).