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CORE ACADEMIC LANGUAGE SKILLS (CAL S): AN EXPANDED OPERATIONAL CONSTRUCT AND A NOVEL INSTRUMENT TO CHART SCHOOL-RELEVANT LANGUAGE PROFICIENCY IN PRE-ADOLESCENT AND ADOLESCENT LEARNERS

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ABSTRACT

Beyond academic vocabulary, the constellation of skills that comprise academic language proficiency has remained imprecisely defined. This study proposes an expanded operationalization of this construct referred to as 'Core Academic Language Skills' (CAL S). CAL S refers to the knowledge and deployment of a repertoire of language forms and functions that co-occur with school learning tasks across disciplines. Using an innovative instrument, we explored CAL S in a cross-sectional sample of 235 students in grades 4-8. Results revealed between- and within-grade variability in CAL S. Psychometric analyses yielded strong reliability and supported the presence of a single CAL S factor, which was found to be predictive of reading comprehension. Findings suggest that the CAL S construct and instrument appear promising for exploring students' school-relevant language skills.

Introduction

In the educational linguistics literature, school-relevant language proficiency has long been hypothesized to contribute to academic success, specifically to skill in comprehending school texts throughout the upper elementary school years and beyond (Snow & Uccelli, 2009; Bailey, 2007; Biancarosa & Snow, 2004; Chamot & O'Malley, 1994; Cummins, 1981, 2001; Scarcella, 2003; Schleppegrell, 2004, 2012; Shanahan & Shanahan, 2008; Valdés, 2004; Wong-Fillmore & Fillmore, 2012). However, direct empirical evidence of this relationship has remained elusive, in part, because the construct of school-relevant language --or academic language proficiency-- has been either imprecisely delineated or too reductively defined to inform educational research, assessment, or pedagogical practice (Nagy & Townsend, 2012; National Research Council, 2010; Valdés, 2004). Studies exploring reading comprehension in populations of both bilingual and monolingual students suggest that for large proportions of struggling adolescent readers, one source of reading comprehension difficulty is not necessarily or exclusively decoding the words on the page, but understanding the meanings of words and comprehending the syntactic and discourse constructions in which words are embedded (August & Hakuta, 1997; August & Shanahan, 2006; Biancarosa & Snow, 2004; Lesaux, Crosson, Kieffer & Pierce, 2010). Although researchers have often surmised that this comprehension challenge is, in large part, due to the barriers posed by school-relevant lexical, syntactic, and discourse skills, to our knowledge neither a construct to define this wider set of developmental language skills nor an assessment to capture these skills presently exists. In fact, proof of this relationship has resided mostly in indirect evidence (Nagy & Townsend, 2012; National Research Council, 2010; Valdés, 2004). For instance, an insightful line of research has

documented that among students with equal content-area knowledge, English proficient students in the U.S. consistently outperform English language learners¹ (Abedi & Herman, 2010; Martiniello, 2008). These findings have pointed to academic language as an obstacle to students' demonstration of –or access to-- content-area knowledge, but have not yet directly and comprehensively assessed adolescents' academic language skills.

In the absence of such a construct, academic language proficiency has often been narrowly operationalized as knowledge of academic words –and occasionally, word parts-- both in developmental research and in intervention studies focused on the relationship between language proficiency and reading comprehension. Developmental studies have consistently reported robust predictive relations between academic vocabulary knowledge and reading comprehension (Dickinson & Tabors, 2001; Mancilla-Martinez & Lesaux, 2010). In contrast, the results of a majority of research-based vocabulary intervention studies so far have shown improvements in students' vocabulary knowledge but somewhat less satisfactory effects for improving students' reading comprehension (Proctor, Dalton, Uccelli, Biancarosa, Mo, Snow, & Neugebauer, 2011; Deshler, Palincsar, Biancarosa, & Nair, 2007; Lesaux, Kieffer, Faller, & Kelley, 2010). This contrast between developmental and intervention studies, however, might not be that surprising after all. A highly literate person who has developed an extensive and rich repertoire of academic vocabulary has also learned how to use those words in particular ways, (e.g., to pack dense information through subordination and nominalization, to mark conceptual relationships explicitly through precise connectives, and to use various referential strategies to

¹ The English language learner (ELL) designation is used by U.S. schools to identify language minority students who require intervention to support the development of grade-appropriate English skills.

link themes throughout a text). Therefore, in developmental studies, vocabulary knowledge may serve as a proxy indicator of a wider set of language skills that individuals have developed in synchrony. Among other alternatives, we hypothesize that the unsatisfactory outcomes of some intervention studies targeting reading comprehension might be the result of pedagogical practices that miss additional key academic language skills that need to be attended in synchrony with academic vocabulary instruction. In fact, recent definitions of academic language proficiency proposed by different authors support a more comprehensive approach to language and literacy instruction (see for example, Bailey, 2007; Scarcella, 2003; Schleppegrell, 2004; or the *Understanding Language Initiative* website at Stanford University). Yet, to date, few researchers have tried to systematically measure a broader set of academic language skills with the goal of informing language and literacy instruction.

In this pilot study, we propose a broader construct of academic language proficiency that includes many of these key academic language skills and we use a set of innovative tasks to evaluate two hypotheses: that academic language skills are still developing during the adolescence years, and that these skills positively contribute to upper elementary and middle school students' text comprehension. The endeavor to more precisely define the skills that comprise the broad domain of academic language proficiency began in 2010, when the authors of this article embarked on the design of an instrument that could capture growth in school-relevant language skills within- and across-grades 4 to 8. This work is part of a larger, ongoing initiative to investigate the impact of an intervention designed to improve students' reading comprehension, which is one of the fundamental skills that supports the learning of complex content and ideas from texts in upper elementary school and beyond (Kintsch, 2004). One of

the main malleable factors hypothesized to contribute to students' reading comprehension in this intervention is students' academic language skills. Thus, it is in the context of this larger research project that the authors of this paper proposed the *Core Academic Language Skills* construct and designed and piloted the CALS instrument described in this study.¹

We define *Core Academic Language Skills (CALS)* as knowledge and deployment of a repertoire of language forms and functions that co-occur with oral and written school learning tasks across disciplines. While other ongoing research initiatives are investigating the development of discipline-specific academic language skills (e.g., the language of science or history), we focus instead on cross-discipline academic language skills, which we hypothesize to be critical for pre-adolescent and adolescent students' participation in the oral learning exchanges of the classroom, the reading of school texts, and the production of school writing assignments *across content areas* (Bailey, 2007). The CALS instrument (CALS-I) encompasses a set of theoretically grounded tasks designed to measure a subset of CALS believed to support text comprehension in upper elementary and middle school students. Although we believe that CALS might underlie a host of school-based communicative capabilities (classroom talk, classroom listening, academic writing, and reading comprehension), we acknowledge the long-standing hypothesis that links school-relevant language skills with text comprehension (Biancarosa & Snow, 2004; Kintsch, 2004; Schleppegrell, 2004) and focus in this initial study on exploring reading comprehension as our outcome of interest. Following the RAND report (2002) we define reading comprehension as "the process of simultaneously extracting and constructing meaning through interaction and involvement with written language" (RAND, 2002:11). The most recent theoretical models characterize the process of reading

comprehension as complex and multicomponential, with language knowledge as a key contributing factor, among many others, such as reading fluency, world knowledge, or working memory (Kintsch, 2004; Perfetti, Landi, & Oakhill, 2005). In this study, we explore CALS as a particularly relevant subset of language skills hypothesized to be associated with the comprehension of school texts.

An important motivation of our work is to make visible for educators and researchers a repertoire of language skills that might continue to develop throughout adolescence and might play a significant role in academic success. These cross-discipline language skills are particularly relevant because, in contrast to disciplinary academic language, they are rarely considered in instruction (Fang, 2012). Mature users of academic language—such as teachers—see language as a transparent medium of communication; yet students, as relatively inexperienced academic language users, struggle not only with the abstract content they need to learn but also with acquiring a language that they often perceive as obscure (Bailey, Burkett, & Freeman, 2008). It is important to clarify, though, that we are interested in academic language as a tool for precise communication that supports effective school learning. Consequently, we focus on high utility language forms across content areas; not on what some have called *academic gibberish*, i.e., rarely used forms and unnecessarily intricate structures widely acknowledged to obstruct instead of facilitate communication (Krashen, 2013).

Three main questions guided this study:

- 1) Based on 4th-to-8th-grade students' performances in the CALS-I tasks, does the constellation of Core Academic Language Skills function as a unitary or multidimensional construct?

- 2) Do 4th-to-8th-grade students' Core Academic Language Skills—as measured by the CALS-I—vary across- and within-grades?
- 3) Controlling for reading fluency, are 4th-to-8th-grade students' Core Academic Language Skills—as assessed by the CALS-I—predictive of students' reading comprehension levels?

Given the limitations of studying development with cross-sectional samples, we are cautious to report our results as *between-grade variability* instead of referring to *developmental trends or developmental trajectories*. This study can only offer initial findings relevant to inform future longitudinal research. However, to our knowledge, no study has embarked so far on the direct assessment of a sample of upper elementary and middle school students' core academic language skills, thus an initial test of our proposed operational construct seems justified before embarking on more ambitious longitudinal studies.

In the next section, we briefly introduce the sociocultural pragmatics-based view of language that has guided our study. In the subsequent sections, we introduce our operational definition of *CALS* in more detail, and we briefly describe the *CALS* instrument. After the introductory sections, we move on to explain the study design and the results of exploring the *CALS* instrument's reliability, unidimensionality, and validity, focusing on *CALS* as a predictor of reading comprehension in a cross-sectional sample of 4th-to-8th-graders from an urban, public K-8 (kindergarten through grade 8) school located in the Northeastern region of the United States.

A sociocultural pragmatics-based view: Later language development as rhetorical flexibility

A sociocultural pragmatics-based view of language development entails understanding

language as inseparable from social context, and *language learning* as the result of individuals' socialization and enculturation histories (Halliday, 2004; Heath, 1983, 2012; Ninio & Snow 1996; Ochs, 1993; Ravid & Tolchinsky, 2002; Snow & Uccelli, 2009). Two key developmental consequences emerge from this framework. First, language development is not seen as complete after the first few years of life but as continuing throughout adolescence and potentially throughout life as language users develop new skills to navigate an increasing number of social contexts (Berman & Ravid, 2009). Second, this view of language suggests that being a skilled language user in some social contexts does not guarantee adequate language proficiency in other social contexts. In fact, whereas speakers are enculturated at home into the language of face-to-face interaction which typically prepares them well for colloquial conversations in their respective communities (Heath, 1983; Ochs, 1993), participating successfully in academic discourses appears to be challenging for many colloquially fluent students who, inside or outside of school, may not have been granted ample opportunities to be socialized into more academic ways of using language (Cummins, 2000; Schleppegrell, 2004; Snow & Uccelli, 2009)².

Needless to say, the goal of later language development is not restricted to school-relevant language discourses. Instead, during the adolescent years, progress in language development entails developing "rhetorical flexibility," i.e., the ability to use an increasing repertoire of lexico-grammatical and discourse resources appropriately and flexibly in an expanding variety of social contexts (Ferguson, 1994; Ravid & Tolchinsky, 2002). In other words, language learning involves expanding overlapping sets of skills that are deployed to participate in different *registers* across contexts (e.g., family conversations, youth discourses, sportscasts).

A register is defined as the assemblage of lexical, grammatical, and discourse features prevalent in particular uses of language (Biber, 1995; Halliday & Hassan, 1976). In the present study, *CALS* is understood as the knowledge and deployment of language features characteristic of registers that co-occur with learning-related tasks across content areas in the social contexts of school (Bailey, 2007; Chamot & O'Malley, 1994; Halliday, 1980; Scarcella, 2003; Schleppegrell, 2001, 2004, 2012; Snow & Uccelli, 2009).

Despite extensive research on early language acquisition, research on school-relevant adolescent language development has received comparably minimal attention (Berman & Ravid, 2009; Nippold, 2007). A recent and illuminating line of developmental linguistics research, though, points to adolescence as a period of substantial growth in the deployment of register features typically encountered in school texts, for example the use of more complex noun phrases and more academic discourse markers (Berman & Ravid, 2009; Derewianka, 2003; Nippold, 2007; Ravid & Tolchinsky, 2002). The present study seeks to extend this research by focusing not on skilled academic language users, but rather on a diverse group of pre-adolescent and adolescent learners presumed to have varying levels of academic language skills. In addition, in contrast to most research on developmental linguistics, instead of analyzing features of texts produced by adolescents, in this study we identified a comprehensive --yet not exhaustive--repertoire of core academic language skills, and tested them directly to explore the associations between students' *CALS* and their reading comprehension abilities.

Core Academic Language Skills (CALS): An innovative construct

As stated above, CALS refers to the language knowledge and effective deployment of language forms and functions prevalent in school texts and tasks *across content areas*. Following Bailey (2007), we hypothesized the existence of overlapping but distinguishable constructs included under the umbrella term *academic language proficiency*. By ‘proficiency,’ we refer to both knowledge of language forms and skill in deploying these forms. *Discipline-specific academic language skills* refer to the different language forms and functions that highlight the key concepts and reasoning moves of specific disciplines. In contrast, CALS refers to language skills that cut across content areas and are used to fulfill similar language goals, such as communicating or understanding precise meanings, concisely packed information, and explicitly-marked conceptual relations (Bailey, 2007; Hyland, 2009; Schleppegrell, 2004; Uccelli, Dobbs, & Scott, 2013). For the operationalization of the CALS construct proposed in this study, we drew from different research traditions: (1) textual linguistics focused on English academic discourses, (2) educational research focused on the language demands of U.S. classrooms, standards, and assessments; and (3) developmental linguistics focused on adolescents’ skills in text production.

To develop the CALS construct, we first engaged in a comprehensive review of the literature that included different lines of research in textual linguistics, such as empirical studies in contrastive analysis of language corpora (e.g., Biber & Reppen, 2002; Chafe & Danielewicz, 1987; Hyland, 2004), evolutionary analyses of scientific language (e.g., Halliday & Martin, 1993), analysis of performances at different levels of expertise or in different disciplines (Schleppegrell, Achugar, & Oteíza, 2004; Schleppegrell, 2001) or analysis of genres used for specific purposes (Swales, 1990). These extensive linguistic analyses have produced inventories

of common features identified in English texts produced by academic writers across different disciplines. A review and integration of such studies provided an initial map of linguistic expectations and textual features characteristic of experts' academic texts across disciplines. For instance, this literature suggests that academic texts across disciplines are expected to be lexically precise; concise and densely packed; and explicit in the marking of conceptual relations, among other characteristics. These expectations are reflected in texts' specific and diverse academic vocabulary, the prevalence of complex morphologically-derived words (e.g., nominalizations, such as *evaporation*) and syntactically intricate structures (such as embedded clauses or extended noun phrases); and the ubiquity of a range of contrastive and causal connectives used to mark relations among complex ideas (for a synthesis and more detailed inventory of features, please see Snow & Uccelli, 2009). By extension, these are the aspects of text that proficient readers must learn to comprehend if they are to have access to the academic content these texts contain.

As a second step, we reviewed the limited educational research on the language demands of reading and learning during the middle school years in the U.S. Notably, many of the cross-disciplinary linguistic features that characterize academic texts written by experts are also found in the texts written for student readers. Indeed, in keeping with the common features derived from our comprehensive literature review of textual linguistics studies, the more limited research on the language demands of U.S. classroom discourse, textbooks, assessments, and educational standards, has documented so far "remarkable similarities across disciplinary discourses" during the middle school years (Bailey, 2007, p. 10). For instance, across social science and science disciplines, Bailey and colleagues report an overlap of all-purpose

academic vocabulary, clause connectors, and extended noun phrases. Bailey and colleagues also report the ubiquity of certain expository discourses (i.e., definitions, explanations, and argumentation), which they describe as types of texts that draw from a common linguistic repertoire across content areas (Bailey, 2007; Butler, Bailey, Stevens, Huang & Lord, 2004). Given the existence of common features that characterize school texts across disciplines (Schleppegrell, 2001), in developing the CALS tasks presented here, we reasoned that the language skills that constitute the counterpart of such textual features should be relevant to support the comprehension of school texts. For instance, knowledge of connectives would support the comprehension of conceptual relationships marked through connectives in an academic text. In fact, a few studies focused on measuring discrete skills—e.g., knowledge of connectives, syntactic or morphological knowledge—already support the relevance of looking at cross-disciplinary language skills as important contributors to reading comprehension (Crosson, Martiniello, & Lesaux, 2008; Kieffer & Lesaux, 2008; Mokhtari & Thompson, 2006). Yet, instead of looking at discrete skills subsumed under—and divided by-- formal linguistic categories (morphology, syntax), the goal of this study was to explore a set of functionally related language skills hypothesized to be particularly relevant for school reading and learning. On the basis of our literature review, not all types of connective, morphological, or syntactic knowledge seem to be equally relevant for the gradual mastery of academic ways of using language. Thus, we focused instead on a particular subset of school relevant skills, such as knowledge of connectives which are prevalent in academic texts; skills in derivational morphology, particularly skill in nominalizations; and syntactic knowledge of embedded clauses. As discussed below, prior research has identified these skills as particularly relevant in

comprehending the precise, densely packed, explicitly connected ways of using language characteristic of academic texts.

Finally, we reviewed empirical evidence from developmental linguistics focused on adolescent language development (Bailey, 2004; Benelli, Belacchi, Gini, & Lucangeli, 2006; Berman, 2004; Berman & Ravid, 2009; Berman & Verhoeven, 2002; Christie & Derewianka, 2008; Derewianka, 2003; Nippold, 2007; Ravid & Tolchinsky, 2002; Schleppegrell, 2001, 2004; Uccelli, Scott, & Dobbs, 2013). These studies have revealed that adolescence is a period of substantial growth in the production of register features typically encountered in school texts, such as the use of more complex noun phrases and embedded clauses, more academic linking devices, the construction of referential chains, and the gradual learning of the overall organization of expository texts (for a review, see Blum-Kulka, 2008; Berman & Ravid, 2009; Nippold, 2007). However, these studies tend to focus on spontaneously generated texts usually produced by skilled language users from middle class environments. In our study, we do not rely on the spontaneous display of these linguistic skills, but instead focus on directly assessing them in an ethnically and socio-economically diverse sample of students.

The Common Core State Standards (CCSS) --recently adopted by the majority of U.S. states-- also offered an additional resource to corroborate the relevance of the selection of CALS areas. From the upper elementary grades up, the CCSS place special emphasis on the language demands students face and explicitly refer to the need to prepare students to engage in argumentative discourse and, more specifically, in writing and language proficiency. For instance, the CCSS include “use precise language... use words, phrases and clauses to create cohesion and clarify relations among claims... establish a formal style... organize ideas, concepts

and information, using strategies such as definitions” (CCSS, 2010, Writing standards: p. 20, 42); “acquire... general academic... words that signal contrast, addition, and other logical relations,” (CCSS, 2010, Language standards: p. 29), among others.

Below we offer an overview for six CALS areas, which, based on the prior literature reviews, underlie skilled comprehension of academic texts.

1. ***Unpacking complex words.*** Morphological skills, in particular skills in derivational morphology, are essential for understanding and producing complex words used to pack information in academic texts. Recent research has shown that skills in decomposing morphologically complex words (e.g., *contribution*, *cultural*) contribute positively to reading comprehension in upper elementary/middle school students (Carlisle, 2000; Kieffer & Lesaux, 2007, 2008, 2010; Nagy, Berninger, & Abbott, 2006).
2. ***Comprehending complex sentences.*** Even though a few studies have questioned the relationship between syntactic awareness skills and reading comprehension (Cain, 2007; Layton, Robinson, & Lawson, 1998), this area was included because numerous studies have provided evidence of later syntactic skills—such as extended noun phrases and complex sentences—positively contributing to reading comprehension in children, adolescents, and adults (e.g., Mokhtari & Thompson, 2006; Nation & Snowling, 2000; Taylor, Greenberg, Laures-Gore, & Wise, 2011).
3. ***Connecting ideas.*** Academic discourse markers (such as connectives and lexical cue phrases, e.g., *although*, *in other words*) constitute prevalent signaling devices that explicitly mark intra-sentential conceptual relations and text transitions in academic discourse (Hyland, 2004). Several sources—from lexical databases to corpus linguistics studies—

document the most prevalent causal and discourse makers in academic texts at school (Zeno, Ivans, Millard, Duvvuri, 1995; Dale & O'Rourke, 1981) and beyond school, in academic texts exchanged by experts across disciplines (Hyland, 2005; Simpson-Vlach & Ellis, 2010). Although not without some controversy, several studies have provided evidence to suggest that discourse markers affect online processing, text memory, and learning from academic text (Meyer & Rice, 1982; Hyönä & Lorch, 2004; Meyer & Poon, 2001).

4. **Tracking themes.** Anaphors, words or phrases appearing in a text that refer to a prior participant or idea, can be interpreted as instructions to the reader/listener to link a previous idea with an element in the text (Givón, 1992). Whereas concrete anaphoric elements are ubiquitous in colloquial language (e.g., 'she' refers to 'Mary'), one type of anaphor, *conceptual anaphora*, is particularly characteristic of academic text, where it has been estimated to account for approximately 20% of all anaphoric references (Biber, Conrad & Reppen, 1998). Conceptual anaphora consists of a demonstrative determiner (e.g., *this*) with or without a hypernoun, i.e., a noun that encapsulates meanings expressed in prior discourse (e.g., *The evaporation of water occurs to due to rising temperatures. This process...*) (Flowerdew, 2003; Hunston & Francis, 2000). A positive relationship between skill in resolving conceptual anaphora and reading comprehension has been documented recently for upper elementary school students (Sánchez & García, 2009).
5. **Organizing argumentative texts:** Research has described later language development as moving along a continuum at the interface of modality and text type (i.e., genre): from the early mastery of oral narrative to gradual progress in written narrative, followed by

proficiency in oral expository and subsequently, written expository texts (Berman & Ravid, 2009). Previous research suggests that narrative organization is well-achieved by age 9 to 10, whereas knowledge of the global structure of expository discourse progresses gradually and consolidates only around high school age (Berman & Nir-Sagiv, 2007, p. 96). Skills in structuring narratives have been found to contribute to reading comprehension during the primary school years, when children read mostly narrative texts (Oakhill & Cain, 2000).

Among the many prevalent non-narrative text types in school discourses, we selected only the argumentative text to assess knowledge of global discourse structure. Given the argumentative nature of academic language³ (Rex, Thomas & Engel, 2010; Toulmin, 1958), skills in structuring argumentative texts (i.e., thesis, arguments, examples, conclusion) were hypothesized to be associated to school literacy during the middle school years.

6. ***Awareness of academic register:*** Definitions provide an optimal minimal genre to assess identification and production of short texts that display core academic language features, including those used to achieve lexical precision (i.e., the use of less vs. more precise superordinates, *bicycle is a thing vs. bicycle is a vehicle*), and concise information packing (complex grammatical structures, such as nominalizations and center-embedded clauses). Prior research has documented the predictive power of productive definitional skills for later academic success (Benelli, Belacchi, Gini, & Lucangeli, 2006; Kurland & Snow, 1997). We selected this minimal genre to focus not only on production, but also on identification skills, i.e., students' skill in identifying more academic forms of discourse in comparison to more colloquial alternatives.

We conceive of these proposed areas as an initial selection to begin to delineate an operational construct of CALS. Whereas the particular selection is so far supported by extensive research and widely-adopted educational standards, we see this set as only provisional and, most likely, in need of further expansion through future research.

Core academic language skills: An innovative assessment instrument

In order to assess students' CALS, we embarked on the design of a set of tasks to assess the six areas listed above (see Appendix 1). The research-based *CALS Instrument* (CALS-I) was the result of a process that included expert linguists, psychometricians, psychologists, educators, and students. The target words, grammatical structures and discourse structures included in the CALS-I were systematically selected to represent high-utility language forms and functions prevalent in school texts during the upper elementary and middle school years (for more information, see Appendix 1).

Once the construct had been defined, the development of the CALS instrument followed four phases. First, the *Task Design Phase* involved designing items to minimize decoding, vocabulary knowledge, prior knowledge, reading comprehension and productive writing demands.⁴ Also, to overcome the logistical difficulties of individual language assessment (a procedure that schools find enormously disruptive), we designed items that could be group-administered.

In the second phase, the *Pilot Phase*, all tasks and items were first piloted in individual or small-group interviews with a sample of 32 students (grades 4-8). The design of items followed an iterative process of generation, testing, incorporation of students' feedback (obtained through multi-party interviews using a structured

protocol), and retesting that resulted in modifying, recalibrating, or discarding individual items and in improving task instructions. The third phase, *Study 1*, consisted of an initial full battery of 110 items administered in three 45-minute sessions by four native English-speaking research assistants with experience in language testing who used a scripted administration protocol. The data reported in the present study were collected during this phase of data collection. The final set of CALS tasks was the result of selecting 44 items and 4 constructed response definitions identified as tapping developmental differences across grades and individual variability within grade (for a full detailed psychometric report of all items and tasks, please see Uccelli & Barr, 2011). To select the 48 items that best captured variability in students' performance, a Rasch unidimensional measurement model was conducted on students' item-level performances across the larger pool of 110 items. From this model, we obtained both individual item difficulty estimates, as well as item fit information. Items with substantial misfit, e.g., items the model identified as easy but where many high performing students endorsed incorrect responses, were eliminated from further consideration in the final item set. Once we had a set of items that demonstrated good model fit, the items were further reduced by eliminating items that had similar difficulty estimates, because items with similar difficulty estimates provide redundant information about student performance at a given point on the academic language ability continuum. Finally, the test information function (TIF) was examined to determine the number of items that needed to be retained to ensure that student performance on the CALS tasks was a reliable measure of student ability across the

entire targeted ability range (2 *SD* below the 4th grade mean and 2 *SD* above the 8th grade mean). Based on the examination of the TIF and in light of theoretical considerations, the final set of 44 multiple-choice items and 4 constructed response items provided adequate information at all points of the targeted ability range and thus, constituted the final selection for the CALS instrument (See Appendix 1 for a more detailed description of tasks and specific skills measured). The fourth phase consisted of an *Expert Panel Review* solicited to establish content validity. The CALS instrument along with a content validation survey was sent to five experts in the field of academic language for their independent review. Overall, the team of experts gave the CALS instrument a mean score of 3.5 out of 5-point scale, with a median score of 4. Experts' valuable feedback and recommendations were considered and, to the extent possible, incorporated in the assessment. In this discussion, we report the design and results of the Study 1, the third phase in the CALS instrument development.

Methods

Participants A total of 235 4th-to-8th grade students attending one urban K-8 school in the Northeast region of the United States participated in this study (see Table 1). The sample was relatively balanced by gender. Substantial portions of the students came from low-income families, with 80% receiving free or reduced-price lunch. Participants were from a diversity of ethnic backgrounds, with 66% African American or black, 22% Caucasian, and 7% Latino/a students, according to school records. Only 18% of students in the sample were officially classified by the school as English Language Learners (ELLs), but 28% were identified as language minority students with a range of home language

resources. From a total of 66 language minority students, the majority came from families with Cape Verdean Creole as a home language (36), followed by Haitian Creole (14), Spanish (5) Portuguese (4) and Somali (3) as home languages. Other home languages, such as French, Swahili, and Vietnamese, were also represented by single students (for one language minority student, the home language could not be identified). Based on school records, approximately 15% of the sample had a special education designation. The grade-specific socio-demographic distributions closely resembled the distribution of the overall sample for gender, SES, home language, and special education. There was a smaller proportion of ELLs in the higher grades (and no ELLs in 8th grade) due most likely to students being reclassified as English-proficient in the later years. In any case, the number of ELLs was relatively small in the overall sample.

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Measures

Participants were administered the following three assessments:

(1) Reading Comprehension - MASSACHUSETTS COMPREHENSIVE ASSESSMENT

SYSTEM—ENGLISH LANGUAGE ARTS (MCAS–ELA): A criterion-referenced, statewide assessment of English language arts, the MCAS-ELA focused on reading comprehension and contained selected readings followed by multiple-choice and open-response questions. Previous studies have shown the MCAS-ELA to be strongly associated with other standardized measures of reading comprehension (see Proctor, Uccelli, Dalton, & Snow, 2009). Possible scores ranged from 200 to 280. The

MCAS-ELA scores are classified into four performance levels (Advanced: 260-280; Proficient: 240-259; Needs improvement: 220-239; Warning: 200-219).

(2) Reading Fluency - *Test of Silent Word Reading Fluency (TOSWRF)* (Mather, Hammill, Allen, & Roberts, 2004): A group-administered measure of silent fluency. The TOSWRF is designed to measure reading fluency, i.e., the ability to recognize printed words accurately and efficiently, in students in grades 1 and above. On this task, students are asked to draw a dividing lead between words (e.g. ‘inyesgomesees’ should be parsed as ‘in/yes/go/me/see’) and receive one point for each word correctly identified. We used Silent Word Reading Fluency standard scores, based on a mean of 100 with a standard deviation of 15.

(3) Core Academic Language Skills Instrument (CALSI): Researcher-designed group-administered instrument that measures Core Academic Language Skills (see Appendix 1 for a detailed description of tasks and specific skills measured). A total of 44 items and 4 constructed responses comprised the CALSI instrument used in this study. In order to equally weight the items when creating the AL total score, the few items that were not scored dichotomously as correct/incorrect were rescaled to be between 0 and 1. Task-specific and total summative CALSI scores were computed as a percentage metric, i.e., the number of items correct divided by the number of items a given student was administered⁵. Reliability for the CALSI was investigated and found to be robust at .92 as indexed by coefficient alpha and at .82 by split-half reliability of even vs. odd numbered items.

Analytic plan

Descriptive statistics were generated for the CALSI task-specific and total scores, as well as for each administered measure. Subsequently, pairwise correlational analyses were

conducted to explore associations between CALS-I scores, reading fluency (TOSWRF), and reading comprehension (MCAS-ELA). In order to investigate the potential multidimensionality of the CALS construct, factor analyses at the task level were conducted using principal components analysis (PCA). Using the factor score generated for each student, we explored the variability of CALS-I student scores within and across grades. Finally, to assess the predictability of the CALS-I scores, multiple regression analyses were conducted with MCAS-ELA scores as outcome and reading fluency (TOSWRF) as a covariate.

Results

A unitary but multifaceted construct of CALS (Research Question 1)

As displayed in Table 2, pairwise correlational analyses revealed that all of the CALS-I task-specific scores were significantly and positively correlated. Across the first five CALS-I tasks displayed in Table 2, all bivariate correlations ranged from moderate to high. The *Identifying academic register* task was positively correlated to all tasks, but displayed the lowest correlations of all tasks administered. Finally, for the *Producing academic register* task, all within-task dimensions used to score the definition productions were, as expected, highly correlated with each other. In addition, each scoring dimension of this production task displayed mostly positive and moderate correlations with all other CALS-I tasks. Between reading fluency and each CALS-I task, most correlations were moderate. Except for the correlation with *Decomposing words* (morphological skills), correlations did not exceed .36.

-----INSERT TABLE 2 ABOUT HERE-----

In order to further investigate the potential multidimensionality of the CALS construct, a

factor analysis at the task level was conducted using principal components analysis (PCA). The seven CALS task-specific scores (Unpacking Complex Words, Comprehending Complex Sentences, Connecting Ideas, Tracking Themes, Structuring Argumentative Texts, Identifying Academic definitions and Producing Academic Definitions) were entered into the PCA. The results of the PCA indicated that there was one eigenvalue greater than 1. This first principal component (eigenvalue = 3.44) accounted for 49% of the variability in the data (see Table 3). Confirmatory factor analysis results also suggested that the general academic language data supported a single factor solution (CFI=.93, TLI = .92, RMSEA <.05). These findings suggest that aggregate core academic language tasks scores load onto a single factor.

-----INSERT TABLE 3 ABOUT HERE-----

Variability in the development of CALS (Research Question 2)

Operationalized as a unitary construct, we examined total CALS-I scores to gain insight into the developmental variability exhibited by this sample. Table 4 displays students' means and standard deviations for the CALS instrument, the MCAS-ELA, and the reading fluency test (TOSWRF). Total CALS-I scores displayed evidence of variability across grades and within-grade. The mean CALS-I score across grades was .61 with a standard deviation of .19. As displayed in Table 2 and in Figure 1, the mean CALS-I total scores per grade revealed that students exhibited higher performances in the higher grades. The mean total CALS-I score was lowest in 4th grade, with a mean of .44 (*SD* = .14), and progressively higher across grades, with the highest mean of .76 (*SD* = .12) displayed by 8th graders. Interestingly, as displayed in Figure 2, an analogous increasing progression was detected for mean task-specific CALS-I scores per grade, indicating that students in higher grades performed better on average in the CALS-I as a whole, as well as

within each specific task. In addition, total CALS-I scores also revealed considerable individual variability, as illustrated by the normal distribution of scores within grade displayed in the bar graphs in Figure 1. Standard deviations fluctuated from .12 to .19 across grades, displaying approximately normal distributions in each grade with a wide range of scores that progressively moved towards the higher scores in the later grades. A one-way ANOVA indicated that CALS-I scores differed significantly as a function of grade, $F(4, 230) = 40.08$, $MSE = .14$, $p < .0001$. Post-hoc Tukey's HSD tests suggested that students in 4th grade and 5th grade had CALS-I scores that were significantly lower than students in higher grades at the .05 level of significance. However, there was no significant difference observed between the performances of 4th graders when compared to their 5th grade peers. Similarly, there were no statistically significant differences between the CALS performance of students in grades 6, 7 and 8. Yet, it is important to emphasize that CALS-I scores at each grade displayed considerable individual variability.

As shown in Table 4, reading fluency scores were available for 217 students in the sample and the overall mean was 109.07 ($SD = 25.94$), indicating that students tended to perform slightly above average on this measure, with 4th, 5th, and 6th grader typically displaying average performances, and at 7th and 8th graders performing above average (7th grade mean 123, $SD = 28.81$; 8th grade mean 121.46, $SD = 17.74$).⁶

Although MCAS-ELA scores are valuable metrics of within-grade reading performance, this measure was not designed using an equated scale across grades and so cannot be used for cross-grade comparison. Results of MCAS-ELA assessment are reported on a scale (200-280 points) with thresholds that serve to delineate achievement levels. Participants' distribution across performance levels in the MCAS-ELA indicated a larger proportion of low-performing

students in our sample when compared to the overall state distribution: with only 26% of students scoring ‘proficient or advanced,’ (compared to 69% for the state); 54% receiving the designation of ‘needs improvement,’ (compared to 23% for the state); and 20% with scores that placed them in the ‘warning’ range (compared to 8% for the state)⁷. Despite the differences with overall state means, this distribution of MCAS-ELA scores is not atypical of urban public schools in the region.

-----INSERT TABLE 4 ABOUT HERE-----

-----INSERT FIGURE 1 ABOUT HERE-----

Figure 1: Histograms of distribution of CALS total scores by grade

-----INSERT FIGURE 2 ABOUT HERE-----

Figure 2: Mean CALS task-specific scores per grade

CALS as a predictor of reading comprehension (Research Question 3)

Multiple linear regression models were run at each grade level using the CALS-I total score to predict MCAS-ELA scores, controlling for fluency. Prior to conducting regression analyses, the correlations between students’ MCAS-ELA scores and CALS-I scores were examined. In all grades, correlations were moderate to strong and statistically significant ($p < .0001$) (grade 4=.54; grade 5=.61; grade 6=.77; grade 7=.41; grade 8=.65). At each grade level, students’ CALS-I scores were found to be significant predictors of MCAS-ELA scores, even after controlling for reading fluency. As displayed in Table 5, these regression models accounted for an important amount of variability in MCAS-ELA scores, ranging from explaining 25% of the variability in 7th grade MCAS-ELA scores to 61% of the variability for 6th grade students.

To investigate the potential impact of ELL status, the contribution of ELL status was explored within each grade, as was the interaction between ELL and CALS-I scores. No significant contribution of ELL status was detected either as a main effect or an interaction. This is likely a power issue given the small sample of ELLs in this study. In addition, regression analyses were also conducted with a sample that excluded the students classified as ELLs. We compared these results to those for the full sample and found that the findings, with regard to statistical significance, were identical, and the magnitude of the parameter estimates appeared to be quite comparable.⁸

-----INSERT TABLE 5 ABOUT HERE-----

Discussion

Starting with the premise that knowledge of academic vocabulary constitutes a highly relevant developmental and pedagogical domain, yet only a fragment of a wider repertoire of academic language skills, the goal of this study was to identify additional developmental skills involved in mastering academic language throughout the upper elementary and middle school years. Building from Bailey's (2007) data-driven conceptualization of academic language, in this study we offer preliminary evidence to support the construct of *Core Academic Language Skills (CALs)*, defined as knowledge and deployment of an integrated set of prevalent language forms and functions that co-occur with learning-related tasks across content areas at school. On the basis of an extensive integration of different lines of textual, educational, and developmental linguistics research, in this study we measured CALS in the following areas: (1) unpacking complex words; (2) comprehending complex sentences; (3) connecting ideas; (4) tracking themes; (5) organizing argumentative texts; (6a) identifying academic register; and (6b)

producing academic register. We administered the innovative and theoretically-grounded CALS instrument (CALS-I) to 235 4th-to-8th graders in order to answer three main questions: Do CALS-I task-specific performances support a unitary or a multidimensional operational construct of Core Academic Language Skills? Do students' performances in the CALS-I tasks yield evidence of variability within and across the upper elementary and middle school grades? Are students' CALS-I scores predictive of reading comprehension? Results revealed variability within- and across-grades in an expanded—but certainly not exhaustive—set of core academic language skills. Results from the principal component analysis offer initial empirical evidence that supports a unitary construct of CALS, as defined in this study. Regression analyses showed that CALS-I total scores predicted reading comprehension, as measured by the MCAS-ELA, at each grade level from 4th to 8th grade, even after controlling for students' reading fluency levels.

Our results move the field forward by documenting not only a potential developmental progression, but also considerable individual variability in a precise set of CALS that expand our understanding of academic language proficiency. At the level of construct building, this study offers promising initial results that support a construct that is worth exploring in future research. At the level of assessment, the CALS instrument offers a preliminary tool focused on testable cross-discipline academic language skills that can be highly relevant for the design and development of research and pedagogical instruments. We discuss our findings in more detail below and then consider research and educational implications. We close the article by highlighting the limitations of our study and presenting some new questions raised by the current findings.

Core Academic Language Skills as a unitary construct

This study tackled the question of whether CALS --as measured by the CALS instrument—is a unitary or a multidimensional construct. Results offer preliminary evidence pointing to a unitary construct. Scores across the tasks administered revealed positive pairwise associations, and confirmatory factor analyses showed that task-specific scores loaded onto a single factor. These results are in keeping with our view of *language* use as register participation. Within this perspective, language users expand their resources as they participate in different registers, i.e., a constellation of prevalent language features that occur together to serve particular purposes. Thus, adolescent language learning is viewed not as a process of learning discrete individual skills independently, but instead as learning a repertoire of language features in synchrony as they are used in particular contexts and for specific purposes. As students are provided with opportunities to participate in the discourses of school, they would learn linguistic forms and functions as a constellation of features that typically occur together in oral or written school texts in response to the particular goals of academic learning. For instance, the morphologically complex words and academic connectives usually employed when constructing academic argumentative texts would be hypothesized to be learned together as students participate in reading and writing such texts.

On the other hand, caution should be invoked given the novel and exploratory nature of this construct. Certainly, in our CALS construct, the skills assessed represent only a selective repertoire of those involved in reading school texts. In addition, only three highly prevalent school text types are used across the CALS-I tasks: definitions, argumentative text, and fragments of expository texts. The conceptualization of CALS as unitary or multidimensional will depend on how the boundaries of this construct are defined. Thus, more exploration is

necessary to investigate the nature of this construct. Some important questions emerge: are there additional tasks or general cross-content area text types that should be considered as part of this construct? Would the evidence that points to Core Academic Language Skills as unitary hold if the boundaries of the construct were slightly expanded, for example by including additional text types? Only future research can answer these pending questions.

Finally, these results do not imply that the global construct of academic language proficiency entails a single dimension. Given that this larger construct also includes discipline-specific academic language skills, which might not be correlated within individuals (e.g., understanding the structure of a story problem in math vs. that of a literary analysis), we would in fact predict that discipline-specific academic language skills would not be part of a unidimensional construct.

In sum, we interpret the findings pointing towards a unitary construct of CALS as insightful, yet preliminary and of course, as a result of the particular construct investigated in this study. These results align with a pragmatics-based view of language development. Instead of viewing development as progress in fragmented or isolated skills, or as divided by traditional linguistic levels (morphology, syntax, discourse), we view the development of CALS as a synchronous progress that takes place as language users' participate in oral and written school discourses around learning.

Core academic language skills: Development and individual variability

The present results are encouraging as they support an empirically-based construct and instrument that appear promising for capturing change over time and variability across individuals. In line with prior developmental linguistics research on adolescent language

(Berman & Ravid, 2009; Nippold, 2007), the current findings support a view of adolescence as a period of substantial growth, in particular in this case, in a specific subset of language skills – those relevant for school-related learning tasks. Core academic language skills, as measured by the CALS instrument, manifested a general upward trend across both CALS-I total scores and task-specific mean scores. Our findings suggest that repertoires of forms and functions continue to expand throughout development in each of the language-learning areas measured by the CALS instrument. Whereas vocabulary knowledge is widely understood as a potentially ever-expanding domain with thousands of words to be learned in a given language (Stahl & Nagy, 2006), other language domains are sometimes viewed as fully mastered by the end of primary school (e.g., syntactic or morphological skills). Adding to a recently emerging line of research on adolescent language, our findings clearly point to the continuing expansion of school-relevant language knowledge across all our tested tasks. Interestingly, statistically significant differences in performance were only evident when comparing the performance of elementary grade to middle grade students. While it is possible that this intriguing lack of difference is an artifact of the CALS instrument or sampling idiosyncrasies, these results may also suggest some interesting patterns in pre-adolescent and adolescent language development, for example that school-relevant language growth is more subtle in the period from grade 6-8. Further research needs to carefully examine this issue by studying development in longitudinal samples, ideally with larger and more diverse groups of students and by further refining the CALS instrument. Although chronological ages for students were not available to us, future studies may also examine variability in CALS scores not only by grade, but also by age.

Core Academic Language Skills scores revealed considerable variability not only across

grades, but also within grades. The within-grade variability in CALS was considerable, with even a few 4th graders outperforming some 8th graders in this sample. These results might not be surprising in light of prior research that has highlighted considerable individual variability in vocabulary knowledge across and within bilingual and monolingual populations (Biemiller & Slonim, 2001; Graves, 2007; Kieffer & Lesaux, 2007; Stahl & Nagy, 2006). Even if not surprising, these results are revealing. Our findings extend the repertoire of academic language skills that seem to be highly vulnerable to individual variability beyond vocabulary knowledge. In addition, while individual differences in language skills have been documented mostly during the early years (Hart & Risley, 1995; Bowers & Vasilyeva, 2011), our results indicate that even during the middle school years students are differentially equipped to face the language demands of school.

Core Academic Language Skills as predictors of reading comprehension

Our findings suggest that the variability in CALS accounts for a significant variability in students' academic reading comprehension in each of the grades assessed (4th – 8th grade). It should be of no surprise that, analogous to academic vocabulary knowledge, a broader set of general academic language skills would be predictive of reading comprehension. The innovation of this study resides in having identified a precise set of cross-disciplinary academic language skills that offer initial evidence that this proficiency can be measured in a way that captures enough variability associated with advanced literacy skills. Prior research has pointed to academic language as a key predictor in reading comprehension mostly indirectly by comparing skilled vs. unskilled readers, or English proficient vs. English language learners, or by narrowly operationalizing academic language as academic vocabulary. To our knowledge, our study is the

first one to directly assess pre-adolescents and adolescents from grades 4th to 8th with a comprehensive—even if not exhaustive-- set of core academic language tasks.

Limitations of the current study

Adding to other well documented skills (e.g., prior knowledge, motivation, strategy use, vocabulary knowledge), this study expands the range of known contributors to reading comprehension and suggests that core academic language proficiency—understood as a repertoire of skills—is a relevant construct for understanding students’ academic literacy. Our results are promising but require further research in a variety of directions.

First, further research is required to explore if these findings can be replicated with larger groups of diverse students. Caution should be exerted in drawing inferences beyond our sample, which included only 235 students. This is particularly important in light of the fact that our sample comprises a low-performing group of students. Thus, even though our sample’s MCAS-ELA performance is representative of urban public schools in the region, understanding cross-disciplinary academic language development requires the inclusion of a sample with a wider range of academic literacy levels.

Second, this study reports variability across grades in a cross-sectional sample. Developmental research, however, requires longitudinal studies. The next step in this research entails following students from 4th to 8th grade to document individual variability in developmental trajectories. Our finding that students in grades 6, 7 and 8 did not demonstrate a statistically significant difference in CALS performance might suggest also that future versions of this instrument might require further refinement to

include items that present greater challenge to older students who are more adept academic language users.

Furthermore, the CALS construct and instrument need to be refined, possibly expanded, and further explored. It is necessary to consider other potentially relevant areas of proficiency, such as epistemic stance (Uccelli, Dobbs, & Scott, 2013), or the inclusion of a wider variety of text types, such as explanations or school-relevant paragraph patterns (compare-and-contrast, classification, etc.) (Sánchez & García, 2009).

In addition, in order to further understand the contribution of CALS to reading comprehension, future studies may also examine additional covariates, such as academic vocabulary knowledge or listening comprehension skills. As in the case of vocabulary knowledge and reading comprehension, a reciprocal relationship between CALS and reading comprehension should also be considered. Finally, the relationship of CALS to other academic literacy outcomes encompassed in our proposed construct, such as skill in speaking, writing, and comprehending oral language in school contexts should be explored in future studies.

Finally, this study offers evidence of considerable cross-grade and within-grade variation in CALS skills, yet cannot answer the question of what accounts for such variability as this is beyond the scope of the present study. Some researchers have argued that school-relevant language proficiency is acquired mostly in interaction with academic texts (Ravid & Tolchinsky, 2002; Wong-Fillmore and Fillmore, 2012), however there is also evidence to suggest that participation in certain oral exchanges, such as debates and text-based discussions, might support the expansion of school-relevant oral and written language proficiency (Dickinson & Tabors, 2001; Reznistkaya, Anderson, & Kuo, 2007). From a socio-cultural pragmatics-based

perspective, we interpret this range of performances as the result of individuals' histories of socialization and enculturation, i.e., their opportunities to participate in particular forms of language and text interactions. The goal of this research was not to examine the impact of these language experiences or the methods by which CALS is acquired, but rather to examine the impact of having acquired CALS on a fundamentally important element of school literacy—text comprehension. Yet, we acknowledge that examining the social and pedagogical conditions under which academic language skills develop is a crucial area of study that deserves attention. Only future research, though, can shed light on what in-school and out-of-school opportunities—as well as other factors—are associated with school language proficiency.

Implications for educational research, assessment, and pedagogy

This set of CALS tasks constitutes a promising tool that can inform the design of research instruments and, ultimately, a pedagogically informative assessment. This study was designed on the premise that academic vocabulary is only a single component of a constellation of academic language skills and the results provide initial empirical evidence that can help us move beyond the widespread metonymical confusion that equates academic vocabulary knowledge with academic language proficiency.

For research purposes, instruments that directly assess cross-disciplinary academic language skills can further enrich current research programs. For instance, the research conducted by Kintsch (2004), and also by McNamara and colleagues, suggests that text features (i.e., level of cohesion) and readers' characteristics (i.e., background knowledge, comprehension skills) interactively impact reading comprehension. O'Reilly and McNamara (2007) found that skilled comprehenders with high background knowledge benefited from a

highly cohesive text whereas a low cohesion text was beneficial for less skilled readers with high background knowledge. However, in these studies students' proficiency in the linguistic features manipulated in texts—in other words, proficiency in certain aspects of core academic language—is not directly assessed, and is consequently implicitly assumed to be homogenous across students. Measuring students' academic language proficiency as an additional variable in order to explore interactions between textual and reader's characteristics could be illuminating.

For educational purposes, the CALS instrument represents an initial step towards developing a tool that might be useful for making some school-relevant language skills visible to educators, curriculum writers, assessment developers, and students. As stated by Bailey et al. (2008) and Wong-Fillmore and Fillmore (2012), instead of an accessible medium of instruction, the language of school is often opaque to students, while at the same time being often transparent to the teachers. Research that has documented opportunities to learn as significantly contributing to the variability of students' academic achievement (Abedi & Herman, 2010) might expand its focus by investigating classroom discourse (exposure and participation) as an additional dimension relevant for assessing the quality of instructional environments.

We should clarify that we see the CALS construct and instrument as complementary to other ongoing efforts focused on discipline-specific language skills. Bailey and colleagues, for instance, have worked on academic language as embedded in disciplinary learning which subsequently led to the design of assessments used to measure the language skills required to understand typical standardized-assessment questions in 5th-grade math, social studies or science (Butler et al., 2004; Bailey 2007). CALS, in our view, is an essential common

denominator, but certainly not sufficient to participate successfully in the increasing variety of discipline-specific discourses that students encounter at school.

The findings of this study seem to be particularly timely in light of the current climate of the Common Core Standards (CCSS) in the United States. The CCSS call for exposing students to more complex texts, which places academic language at the forefront of the pedagogical conversation about how to best prepare students to be successful readers (and writers). In fact, in the reading and writing competencies outlined in the CCSS, students are called upon to both understand and use 'appropriate transitions' and 'precise words and phrases.' Thus, a potential pedagogical application of the CALS instrument might be to help make the crucial role of students' academic language skills visible to educators and researchers and to support them in (1) identifying language features in the complex texts that students must read at school and (2) in designing lessons that incorporate the expansion of students' academic language skills as an important pedagogical goal. Such cross-disciplinary academic language consciousness might support educators in identifying instructional instances where paraphrasing, unpacking and paying explicit attention to language structures may support students in reading comprehension, written composition or oral discussion always in the service of expanding students' content knowledge and conceptual understandings (see van Lier & Walqui, 2012 and Wong-Fillmore and Fillmore, 2012 for discussion of such pedagogies). The potential malleability of CALS skills and the best ways to scaffold them is an imminent question that emerges from this work. The current

results offer a promising construct and instrument, but constitute only the first step in a journey still filled with numerous questions to be answered.

Appendix 1: Core Academic Language Skills – Instrument (CALs-I)

CALs-I Tasks	Skill measured	Items' Description	Sources for research-based design
1. Unpacking Complex Words <i>Selected items from Kieffer's (2009) adaptation of Carlisle (2000)</i>	Skill in decomposing morphologically-derived words	SAMPLE ITEM: Students are read a set of morphologically derived words followed by an incomplete sentence and are asked to complete the sentence by extracting the base from the derived word: <i>ethnicity. The city had many _____ groups.</i>	This task includes a subset of Kieffer's <i>Morphological Decomposition Task</i> , an adaptation of Carlisle's (2000) measure (Kieffer & Lesaux, 2007, 2008, 2010). Twelve out of the 18 words in Kieffer's assessment were selected. Kieffer's (2009) scoring protocol was followed to score responses as correct or incorrect. Correct responses included phonetically logical versions of the word (e.g., both 'popular' and 'populer' were scored as correct).
2. Comprehending Complex Sentences <i>Selected and adapted items from the TROG-2 (Bishop, 2003)</i>	Skill in understanding complex syntax	SAMPLE ITEM: Administrator reads a sentence and students select the corresponding picture from among four options that accurately represent the lexical and grammatical contrasts conveyed in the sentence, e.g., <i>The sheep the girl looks at is running.</i>	This task consists of a selective adaptation of the <i>Test of Receptive Grammar-2 (TROG-2)</i> (Bishop, 2003), a test suitable for ages 4 to young adulthood. From a total of 80 items, 10 were selected to assess five syntactic structures prevalent in academic texts (e.g., relative clause in object, center-embedded relative clause). In our adaptation, the test items were group administered.
3. Connecting Ideas	Skills in understanding of school-relevant connectives and discourse markers	SAMPLE ITEM A: Students select a missing marker: <i>Kim was sick _____ she stayed home and did not go to school</i> Options: <u>OTHERWISE</u> , <u>YET</u> , <u>IN CONTRAST</u> <u>AS A RESULT</u> SAMPLE ITEM B: Students select the best continuation for an incomplete sentence, from among three options: <i>Most teachers think that homework is important. <u>ON THE OTHER HAND</u> ...</i>	Design informed by researcher-designed assessments used in prior studies (Uccelli, Rosenthal, & Barr, 2011; Sánchez & García, 2009). A selection of frequent academic markers that vary in levels of difficulty was informed by databases of students' word knowledge (Biemiller, 2010; LWV, Dale & O'Rourke, 1981), word frequency in school texts (Zeno et al., 1995) and academic lexical bundles derived from corpus analyses (Biber et al., 2004; Cortes, 2004, 2006; Simpson-Vlach & Ellis, 2010).
4. Tracking themes	Skill in anaphoric resolution	SAMPLE ITEM: Students match the underlined text with its antecedent by selecting among three options: <i>China resisted the move for change. In 1989 students protested to demand changes, but the army opposed these changes. Troops were sent to stop <u>the movement</u>...</i>	Design informed by a prior researcher-designed assessment used in studies of middle-school students' reading comprehension (Sánchez & García, 2009). Widely-used grade-specific school texts were consulted to confirm that the structures included were representative of U.S. middle school textbooks. Fragments were selected from middle school textbooks or grade-appropriate <i>Time for Kids</i> magazine.
5. Organizing argumentative texts	Skill in argumentative text organization	Students order six fragments of a brief essay (each sentence was introduced by conventional markers such as: 'in my opinion,' 'one reason,' 'another reason,' 'in conclusion') to display a conventional argumentative text structure.	Design informed by the story anagram task used by Stein & Glenn (1978), and by Cain, Oakhill and colleagues in their reading comprehension studies (Cain & Oakhill, 2006; Cain, Oakhill & Bryant, 2000). Construction of this task was informed by research on the development of argumentative texts (Crowhurst, 1990; Christie & Derewianka, 2008).
6a. Awareness of Academic Register-Identifying academic definitions	Skill in identifying academic register	This task asks students to identify an academic definition in comparison to two more colloquial alternatives.	This task was inspired by research on children's register awareness (Andersen, 1996; Gibbons, 1998). The specific task design, however, was not modeled after any prior research.

ACADEMIC LANGUAGE DEVELOPMENT

<p>6b. Awareness of Academic Register-Producing written academic definitions</p>	<p>Skill in producing academic register</p>	<p>This task elicits written definitions for a dictionary for adults. Four written definitions were elicited and, subsequently, scored for: (1) superordinate precision; (2) structural density; (3) informativeness: <i>bicycle</i> <i>winter</i> <i>debate</i> <i>anger</i></p>	<p>This task was informed by extensive research on definitions (Benelli, Belacchi, Gini, & Lucangeli, 2006; Kurland & Snow, 1997; Marinellie, 2001; Nippold, Hegel, Sohlberg, & Schwarz, 1999). The goal of this task was not to measure students' understanding of the meaning of words, but to evaluate their deployment of core academic language. Using a research-based and data-driven innovative scoring manual, definitions were scored for superordinate precision, structural density (i.e., morphosyntactic complexity), and informativeness (content features included in the definition). Inter-rater reliability was estimated for all three dimensions with all kappa coefficients reaching .9 or higher.</p>
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TABLES AND FIGURES

Table 1: Student *Demographic Characteristics* (n=235*)

	n (%)
Gender	
Female	114 (52%)
Male	104 (48%)
SES	
Free/reduced lunch	175 (80%)
No free/reduced lunch	43 (20%)
Ethnicity	
Black/African American	143 (66%)
White	48 (22%)
Latino/Hispanic	15 (7%)
Asian	2 (1%)
American Indian/Alaskan Native	1 (.5%)
Two or more races	9 (4%)
Language Status	
Classified as English Language Learners	39 (18%)
Classified as English proficient	179 (82%)
Language minority students	66 (28%)
Special Education Status	
Classified as SPED	34 (15%)
Not classified as SPED	184 (84%)
Grade	
4 th	52 (22%)
5 th	55 (23%)
6 th	39 (17%)
7 th	50 (21%)
8 th	39 (17%)

* Demographic data were unavailable for 17 students.

Table 2. Pairwise correlations between Core Academic Language Skills-Instrument tasks

CALS Subtests	1	2	3	4	5	6	7	8	9	10
1: Unpacking complex words	1									
2: Comprehending complex sentences	.5**	1								
3: Connecting ideas	.61**	.45**	1							
4: Track themes	.4**	.4**	.5**	1						
5: Organizing argumentative texts	.58**	.23**	.54**	.36**	1					
Producing written academic definitions										
6: Definition-Structural density	.36**	.33**	.43**	.29**	.33**	1				
7: Definition-Superordinate precision	.36**	.32**	.44**	.3**	.4**	.69**	1			
8: Definition-Informativeness	.43**	.33**	.46**	.34**	.48**	.63**	.55**	1		
9: Total Definition score	.50**	.32**	.48**	.31**	.46**	.59**	.64**	.55**	1	
10: Identifying academic definitions	.42**	.18**	.29**	.17*	.38**	.25**	.23**	.3**	.23**	1
11: Fluency	.48**	.19**	.34**	.15*	.36**	.24**	.16*	.29**	.32**	.19**

*p < .05, ** < .01, *** < .0001

Table 3. Results from Principal Component Analysis for Core Academic Language Skills - Instrument Tasks

Variable	Eigenvalue	Explained Variation	Loading
Core AL Skills construct	3.44	.49	
Unpacking complex words			0.81417
Comprehending sentences			0.64459
Connecting ideas			0.80623
Tracking themes and participants			0.66574
Organizing argumentative texts			0.72464
Producing academic definitions			0.68314
Identifying academic definitions			0.52233

Table 4: Descriptive statistics for Core Academic Language Skills Instrument (CALIS-I), MCAS-ELA and Fluency scores by grade

<i>Grade</i>	<i>Core Academic Language Skills- Instrument (CALIS-I)</i>		<i>MCAS-ELA Scaled Scores</i>		<i>Reading fluency</i>	
	<i>N</i>	<i>Mean (s.d.)</i>	<i>N</i>	<i>Mean (s.d.)</i>	<i>N</i>	<i>Mean (s.d.)</i>
<i>4th grade</i>	52	.44 (.14)	48	234.54 (14.82)	48	98.36 (26.20)
<i>5th grade</i>	55	.56 (.19)	50	228.72 (10.45)	49	99.36 (22.70)
<i>6th grade</i>	39	.65 (.14)	35	229.09 (12.21)	36	105.88 (22.37)
<i>7th grade</i>	50	.72 (.12)	48	230.29 (14.36)	47	123.00 (28.81)
<i>8th grade</i>	39	.76 (.12)	37	230.59 (12.93)	37	121.46 (17.74)
<i>Total sample</i>	235	.61 (.19)	218	230.72 (13.14)	217	109.07 (25.94)

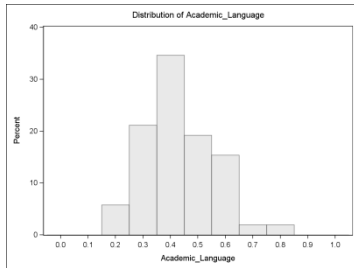
Table 5. Regression models by grade: Contribution of CALS-I scores to MCAS-ELA scores, controlling for reading fluency

<i>Sample</i>	<i>Variable</i>	<i>B (Coefficient)</i>	<i>Standard Error (S.E)</i>	<i>P value</i>	<i>R2</i>
4 th (N=44)	Reading fluency	-.06	.04	.167	.33**
	CALS-I	34.76	8.15	<.0001	
5 th (N=45)	Reading fluency	.094	.05	.065	.47***
	CALS-I	27.36	6.33	<.0001	
6 th (N=33)	Reading fluency	-.010	.04	.818	.56***
	CALS-I	40.91	6.82	<.0001	
7 th (N=45)	Reading fluency	.008	.04	.857	.25**
	CALS-I	37.94	10.04	<.0001	
8 th (N=35)	Reading fluency	.083	.07	.257	.48***
	CALS-I	55.08	10.24	<.0001	

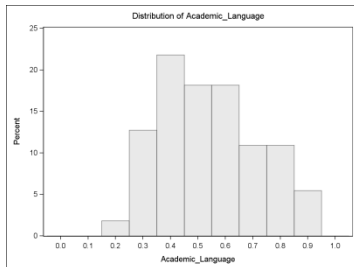
*p < .05, ** < .01, *** < .00

FIGURES

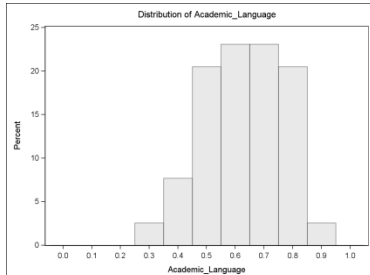
Figure 1: Series of histograms displaying the distribution of total CALS-I scores within grade
Grade 4



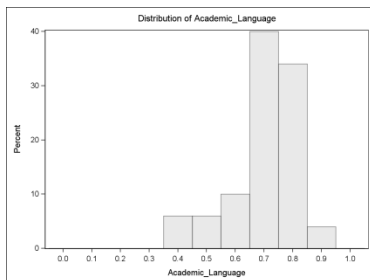
Grade 5



Grade 6



Grade 7



Grade 8

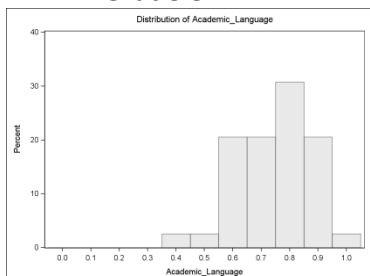
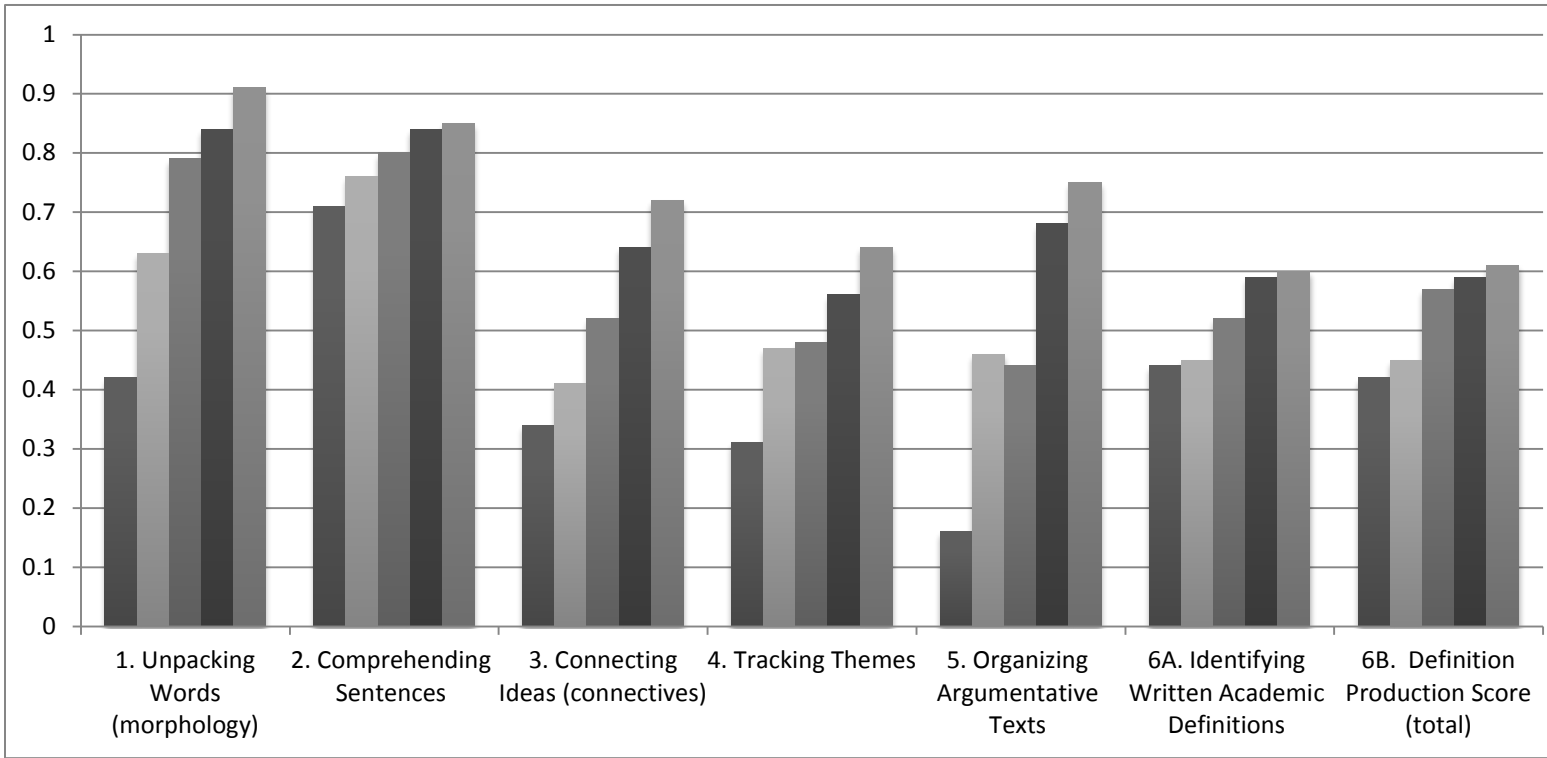


Figure 2: CALS-I task-specific mean scores per grade



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- ¹ The work reported here was part of the project entitled *Catalyzing Comprehension through Discussion and Debate*. This project was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305F100026 awarded to the Strategic Education Research Partnership as part of the Reading for Understanding Research Initiative.
- ² Of course, equally plausible is the case of highly-skilled academic language users who would struggle in other contexts, such as producing effective sportscasts.
- ³ Because academic audiences approach texts from a skeptical orientation, academic writing across disciplines manifests explicitly, through the use of language that conveys certainty or the citing of evidence, or implicitly, through the use of a distant, authoritative voice, a persuasive or argumentative agenda in the writer's rhetorical choices (Rex, Thomas & Engel, 2010; Toulmin, 1958).
- ⁴ To minimize vocabulary knowledge and decoding demands beyond the tested targets, the surrounding vocabulary in the tasks was selected from a pool of words reported to be known by a majority of 4th graders (Dale & O'Rourke, 1981), giving preference to easily decodable words. Whenever possible, the impact of prior knowledge was reduced by selecting simple topics familiar to students from their everyday experiences of being children and going to school (e.g., taking a test, being sick and missing school). Finally, in our effort to measure language proficiency without involving high-inference reading comprehension processes, reading comprehension demands were minimized by first, reducing the length of texts included in the assessment (the longest text includes 5 sentences, but most items involve single sentences); and, second, by including items whose comprehension demands did not go beyond what Kintsch (2004) has dubbed the 'surface level of comprehension' and which, consequently, did not require high-level order processing. Finally, authentic sources (e.g., middle school textbooks, *Time for kids*) were used or adapted, whenever possible.
- ⁵ To avoid invalid inferences on students' CALS, a percentage metric was used instead, because, due to students' absences, not all students were administered all tasks.
- ⁶ The lowest average observed fluency scores were observed for ELLs and Special Education students, but their average fluency scores were still reasonably high with the average fluency for ELLs being 96.9 words per minute (WPM) (112.0 WPM for non ELLs) and the average fluency for Special Education students being 95.9 WPM (111.9 WPM for non Special Education students).
- ⁷ According to the state, students designated as 'needs improvement' manifest a modest reading vocabulary, have a partial understanding of abstract ideas in text, and show partial understanding of genre-specific text organization and produce partially organized compositions. MCAS-ELA thresholds establish proficiency levels (<210=warning, <230=needs improvement, <240 Proficient, >260 advanced).
- ⁸ We also conducted analyses that included the variable, special education status as well as the interaction between special education status and CALS-I score, to predict the MCAS score in each grade. We found no main effect except in grade 8, for which the effect was negative for both special education status and for the interaction between special education status and CALS-I score.