

Depth of academic vocabulary knowledge: Investigating depth of academic vocabulary knowledge among language-minority community college students

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ABSTRACT

Little is known about language minority community college students' depth of L2 academic vocabulary knowledge, including how it relates to their breadth of L2 academic vocabulary knowledge and the relationship to their L1 skills. This exploratory study was carried out with a sample of 10 language minority students enrolled in either advanced ESL language classes or introductory content courses at a U.S. urban community college. Students completed several language assessment tasks, including: the University Word Levels Test (Beglar & Hunt, 1999) to assess breadth of academic word knowledge; a modified Depth of Vocabulary Knowledge Task, based on Paribakht and Wesche (1993) and Wesche and Paribakht (1996), to assess depth of academic word; and a native language (L1) academic writing task to assess L1 academic proficiency. Data indicate that students with greater breadth of academic word knowledge also demonstrated greater depth of academic words. Students' L1 academic proficiency was also related to variation in the students' academic vocabulary knowledge, with those students exhibiting weak academic skills in both the L1 and English demonstrating particularly weak academic vocabulary knowledge.

KEYWORDS: *academic language, community college students, English as Second Language Learning, language minority, lexicon, vocabulary learning*

Introduction

Language-minority students¹ make up an increasingly substantial proportion of the U.S. community college enrolment, enriching the linguistic and ethnic diversity on these campuses (Grubb, 1999; Laanan, 2000). According to the United States Institute of International Education², students from Asian countries accounted for roughly 60% of the overall international student population at U.S. colleges and universities in 2009. Recent research also suggests that the Asian-Pacific American student population enrolled at U.S. community colleges,

¹ The term "language minority students" refers to students enrolled in U.S. schools who speak another language besides English at home, including foreign-born students and those born in the U.S. (Crawford, 1997).

² Source: <http://opendoors.iienetwork.org/page/CommunityCollegeData/>

in particular, are relatively recent immigrants (Wang, Chang, & Lew, 2009). These trends reflect in part improved access to higher education in Asian countries, such as Nepal and Vietnam, where in years past only the privileged could obtain a college degree or study abroad.

Many U.S. community colleges are able to provide students with a cost-effective alternative to four-year institutions, as well as a relatively more supportive context to ease into U.S. college life (e.g., due to the availability of smaller classes and access to instructors). These trends prompt a few overarching questions which guide the research to be presented here: What are the learning needs of those language-minority students who enter U.S. college life via the community college system? What do we know about the students' academic readiness for college work? In contrast to the preponderance of studies of the academic skills of students enrolled at four-year institutions, research on students in the community college system is scant. In an effort to fill this research gap, I present the following study which focuses on the acquisition of academic English and literacy skills, which, for learners seeking a college degree, represents one of the most important challenges—one that will shape their level of participation and success in the post-secondary environment (Reder, 2000; Santos, 2009; Wiley, 1993). Although this exploratory study does not focus on the learning needs of students from Asian countries per se, my hope is that the findings will provide the reader with some insights into the educational needs and profiles of their ESL students who are bound for U.S. community colleges.

One factor that often distinguishes academically well-prepared from under-prepared college students from all backgrounds is *knowledge of academic vocabulary* (Kuehn, 1996), those words such as *however* and *average* that occur with relatively high frequency across academic disciplines (Coxhead, 2000; Nation, 1990). Academic words often have multiple meanings, both common and specialized (Nation, 2001; Santos, 2000), as illustrated by the examples in Table 1. This kind of polysemy can be a source of difficulty for language-minority speakers who may not be familiar with the range of meanings associated with a particular academic word.

In a study of typical community college textbooks, one out of every six words, or roughly 16%, were academic words (Santos, 2000), a notable finding given that readers often struggle when only about 2% of words in a text are unknown (Carver, 1994). Academic words may be especially difficult to learn because of their relatively infrequent occurrence in everyday speech and in non-academic

Table 1
Examples of words with common and academic meanings

Word	Everyday usage	Academic usage
Stem	<i>stem</i> of plant	<i>stems</i> from the belief
Point	don't <i>point</i> your finger	the author's <i>point</i> was clear
Exercise	<i>exercise</i> daily	<i>exercise</i> your stock options

texts (Cummins, 2000; Nation, 1990). At the same time, language minority community college students with advanced L1 literacy may be able to overcome limitations in their L2 academic lexicon and readily acquire L2 grammatical, semantic, and pragmatic features of new words (Jiang, 2004; Scarcella, 2002).

While prior research has typically conceptualized L2 vocabulary knowledge in terms of breadth of vocabulary knowledge (how many words learners know), depth of vocabulary knowledge (how well learners know words) is now an increasingly valued domain of L2 acquisition research (Ordóñez, Carlo, Snow, & McLaughlin, 2002; Nassaji, 2004; Qian & Schedl, 2004; Read, 1998; Verhallen & Schoonen, 1993, 1998; Vermeer, 2001; Wesche & Paribakht, 1996).³ As Ordóñez et al. (2002) succinctly describe, depth of word knowledge has several components:

- (a) quality of the representation of the phonology of the word in question, which in turn is often related to its orthographic representation (Snow & Locke, 2001);
- (b) knowledge of the array of syntactic structures into which the word enters, its word class(es), and its possibilities for collocation;
- (c) knowledge of the word's morphological structure and its susceptibility to derivational processes;
- (d) richness of the semantic representation of the word, including information about its core meaning, its connotations, its potential for polysemy; and
- (e) knowledge of the pragmatic rules for using the word, including its sociolinguistic register, its degree of formality, and its appropriateness to various contexts (p. 719).

Studies have shown that L2 learners demonstrate partial knowledge on several of these components. For example, in a study of Indonesian university EFL students, Nurweni and Read (1999) found that students could identify less than half of the possible meanings for high-frequency polysemous words. Cohen, Glasman, Rosenbaum-Cohen, Ferrara, and Fine (1988) observed that advanced EFL university students did not recognize when academic words took on specialized meanings in their academic texts. For example, EFL students in a university genetics course thought that the word *specific* meant "precisely stated" and failed to notice that the word was being used to describe a characteristic of enzymes, *specificity*. Other studies have found that students will demonstrate knowledge of words in terms of similarly-spelled or similarly-sounding words (e.g., *convert/convey*), adhering to faulty associations even when available contextual cues suggest other meanings (Huckin & Jin, 1987; Marshall & Gilmour, 1993; Meara, 1982; Santos, 2003). In studies of young L2 learners of Dutch, Verhallen and Schoonen (1993, 1998) found that learners possess less lexical richness of relatively familiar words than their native speaking peers.

Interview protocols are a commonly used approach for assessing depth of word knowledge as the one-on-one format facilitates extensive probing of a learner's network of meanings related to a particular word (Joe, 1995, 1998; Nagy,

³ Although relatively new in L2 vocabulary research, scholarship on depth of L1 vocabulary knowledge dates back to Thorndike (1924).

Herman, & Anderson, 1985; Nurweni & Read, 1999; Ordóñez et al., 2002; Read, 1987; Verhallen & Schoonen, 1998). Studies by Joe (1998), Read (1987), and Nurweni and Read (1999) employed an interview format for assessing depth of word knowledge based on a written protocol, the Vocabulary Knowledge Scale (VKS), created by Wesche and Paribakht (1996), in which students are prompted to talk about any meanings and contexts of use that they know for a set of words. The students' responses are evaluated holistically on a scale which rates two features: (1) the learners' familiarity with a word (from no familiarity, through some degree of partial knowledge, to adequate knowledge) and (2) the students' level of productive control (ability to use the word in a grammatically and semantically appropriate sentence) (Wesche & Paribakht, 1996). One limitation of the VKS of particular relevance in this study is its inability to systematically account for polysemy, i.e., that learners will sometimes provide multiple meanings for a single word (Read, 2000).

Present Study

Swain and Carroll (1987) observed of L2 vocabulary acquisition in general that the task facing L2 learners is "incremental, potentially limitless, and heavily constrained by the individual's experience" (p. 193, as cited in Sanaoui, 1995). However, many L2 learners could make productive gains in their L2 vocabulary development if they deepened their understanding of words they already knew (Lewis, 2000). To promote both breadth and depth of academic word knowledge, we first need basic research documenting the nature and scope of language-minority students' academic lexicon. This study addressed this need by investigating the breadth and depth of academic vocabulary knowledge among language-minority community college students. Specifically, it examined whether variation in the students' depth of academic word knowledge would be reflective of differences in the language-minority students' breadth of academic word knowledge and L1 academic skills.

Methodology

This exploratory study, based on 10 language-minority community college students enrolled at an urban New England community college, was conducted as part of a larger study that compared the academic vocabulary skills of language-minority and native-English speaking community college students (Santos, 2009) (see Table 2). The students were a sub-sample of 104 language minority students who were enrolled in either advanced ESL or introductory psychology courses, which marked two key points in the transitional process: just prior to the completion of ESL coursework, and immediately after entrance into regular introductory content courses.

The students were recruited based on their performance on the University Word Levels Test (UWLT) (Beglar & Hunt, 1999, based on work by Nation, 1990), a 54-item multiple-choice test of academic vocabulary knowledge. Four of the students scored in the top 25th percentile of the UWLT distribution of language-

Table 2
Summary of background characteristics of language minority community college students ($n = 10$)

Group	Student	Age	Gender	Country of origin	L1	Years in US	Prior schooling	Educational goals
ESL	Jorge	35	M	Colombia	Spanish	0.7	M.A. in Management from Colombian university	Undecided; may consider applying to graduate school
ESL	Marta	25	F	Colombia	Spanish	2	Professional degree in tourism from Colombian post-secondary institute	Graduate degree in tourism in US
ESL	Anna	20	F	Ukraine/ Germany	Ukrainian; German	0.2	Graduated high school; professional certificate in economics in Germany	AA General Concentration and BA Management
ESL	Mei	34	F	China	Chinese	9	Graduated high school in China	AA Accounting
ESL	Lily	37	F	China (Hong Kong)	Chinese	10	Graduated high school in China	Accounting Certificate
Psych	Paolo	29	M	Brazil	Portuguese	5	Graduated high school in Brazil	AA Criminal Justice
Psych	Suzie	20	F	Haiti	Haitian Creole; French	6	Completed middle school in Haiti; U.S. high school graduate	AA Nursing
Psych	Isabel	30	F	El Salvador	Spanish	6	Graduated high school and completed two years of university in El Salvador	AA Nursing
Psych	Tai	20	M	Vietnam	Vietnamese	10	Completed elementary school in Vietnam; U.S. high school graduate	AA Education; may apply to police academy or art school
Psych	Chelenco	24	M	El Salvador	Spanish	6	Dropped out of high school in El Salvador; completed Spanish GED in US	Transfer to four-year college, BS Engineering

minority student scores in the larger study, including two native speakers of Spanish, one native speaker of (Brazilian) Portuguese; and one native speaker of Haitian Creole. Two students (one native speaker of German, and one native speaker of Spanish) scored at the 50th percentile of the UWLT distribution. An additional four students scored in the bottom 25th percentile of the UWLT distribution and included one native speaker of Spanish, one native speaker of Vietnamese, and two native speakers of Chinese.

As shown in Table 2, the students' length of residence in the U.S. ranged from two months to ten years. Four students had completed some form of post-secondary training in their home countries. The remaining six students possessed high school credentials, achieved by diverse routes: three were graduates from high schools in their home countries; two were U.S. high school graduates; and one a recipient of a General Educational Development (GED) credential (taken in Spanish). All ten students aspired to some form of post-secondary credential, with most students actively pursuing an associate's degree at the time of the study.

Data

Table 3 summarizes the assessment tasks administered to the students, in addition to the UWLT.

Building on previous research (Dale, 1965; Joe, 1995, 1998; Nagy, Herman, & Anderson, 1985; Nurweni & Read, 1999; Ordóñez et al., 2002; Verhallen & Schoonen, 1998), this study used an interview format for assessing depth of word knowledge. The students' interview responses were evaluated holistically on a scale which rated two features: (1) the learners' familiarity with a word (from no familiarity, through some degree of partial knowledge, to adequate knowledge) and (2) the students' level of productive control (ability to use the word in a grammatically and semantically appropriate sentence) (see Wesche & Paribakht, 1996). To improve on limitations in previous studies, this study's

Table 3

Summary table of language assessment tasks administered to language minority community college students ($n = 10$)

Language assessment task	Nature of task	Purpose
University Word Levels Test (UWLT) (Beglar & Hunt, 1999)	Multiple choice test	To assess breadth of academic vocabulary knowledge
Depth of Vocabulary Knowledge (DVK) task	Semi-structured interview	To assess depth of vocabulary knowledge of ten words with common and academic meanings
Native language academic writing task	Essay writing task in response to prompt, "What makes a good employer?"	To assess academic literacy skills in native language

scoring took polysemy into account, i.e., that learners will sometimes provide multiple meanings for a single word (Read, 2000).

The interview task in this study, hereafter referred to as the depth of vocabulary knowledge (DVK) task, was designed to probe the students' knowledge of ten words. DVK items (*average, bond, direct, field, rate, shape*) were drawn from academic word lists (Coxhead, 2000; Farrell, 1990) or a textual analysis of academic word use (*body, bright, key, right*) of typical community college textbooks (Santos, 2000).

One important criterion for word selection was its polysemous nature. Moreover, it was important that these different meanings could be expected to occur in academic textbooks. To estimate the variety of contexts in which the ten target words were used in academic texts, a search for each word was conducted in a text sample drawn from five typical community college academic textbooks (see Santos, 2000). While the range of word meanings found in the textbooks do not catalogue the full array of possible word meanings, they provide a gauge of what specific meanings a student might encounter across various academic disciplines. The DVK task was piloted on two advanced ESL students to ensure the appropriateness of the word selection and procedural clarity.

Similar to other studies (Joe, 1995; Nurweni & Read, 1999; Wesche & Paribakht, 1996), the DVK task was conducted entirely in English, although students were encouraged to rely on their L1 (thinking aloud, taking notes) if they felt it would facilitate their thinking process. The students were presented each target word in written form and instructed to say the word aloud. The students were then asked a series of questions to probe their depth of word knowledge: "Have you seen this word before?", "Do you know what it means?", "Can you tell me more about the word?" For each meaning provided, the student was also asked to use the word in a sentence. The students were presented with the response scale in Table 4 and encouraged to rely on these statements to articulate their responses. The interviews were taped and transcribed in their entirety.

To explore relationships between performance on the academic vocabulary tasks and L1 academic proficiency, the students' academic skill level in the native language was assessed via an L1 academic writing task. In response to the question "What makes a good employer?", students were given 30 minutes to compose an academic essay in the L1. The essays were evaluated by native speakers with

Table 4

Student response scale used in the Depth of Vocabulary Knowledge Task (Paribakht & Wesche, 1993; Wesche & Paribakht, 1996)

1	I haven't seen this word before.
2	I haven't seen this word before, but I think I know what it means.
3	I have seen this word before, but I don't know what it means.
4	I haven't seen this word before and I think (it means)
5	I know this word. It means
6	I can use this word in a sentence.

expertise in L2 education/research in three areas of writing quality and lexical sophistication: topic development, vocabulary use, and type/token ratios (the ratio of different words to total number of words), an adaptation of the scoring system used in the Michigan English Language Battery (Hamp-Lyons, 1993). Two raters independently scored each essay; scores used in the analysis represented the average of the two ratings, which did not differ by more than a point on any single essay. Raters were instructed to evaluate the essays relative to what might constitute a strong academic essay at the senior high school or first year college level. The student essays varied in length so the calculation of type/token ratios was based on the first 150 words of each essay.

DVK Task—Coding and scoring

The language-minority students' responses to the DVK task were coded in two domains, in accordance with Ordóñez et al. (2002) and Wesche and Paribakht (1996).

- (1) *Knowledge of word meanings*: Extent to which a learner knows the target word, from zero familiarity, through partial knowledge to adequate and precise knowledge.
- (2) *Productive control of word knowledge*: Ability to demonstrate productive control of target word in a sentence.

These domains were scored on a numerical scale, although as noted earlier, this scale does not assume that "vocabulary acquisition is essentially linear" (Wesche & Paribakht, 1996, p. 29). The first domain, depth of word knowledge, was assessed by assigning a score of 0 to 5 to the most communicatively adequate meaning (see Snow, Cancino, de Temple, & Schley, 1991) provided by the student for each word. As shown in Table 5, a score of 0 to 5 was assigned to the students' responses, which carried the following interpretations: 0 = fully incorrect meaning; 1 = word recognized as unfamiliar; 2 = word recognized as familiar but no meaning provided; 3 = word is familiar but meaning is misleading/too general; 4 = adequate but imprecise meaning; 5 = fully adequate meaning, one that "makes it perfectly possible to identify the [word] solely on the basis of given information" (Ordóñez, et al., 2002, p. 721).

Previous depth of knowledge protocols were unable to account for learner's knowledge of multiple meanings (Read, 2000; Wesche & Paribakht, 1996). To improve on this limitation, scores of 1 to 4 were assigned to each additional meaning, with the following interpretations: 1 = student recognizes there are other possible meanings but cannot recall any; 2 = meaning is misleading/too general; 3 = adequate but imprecise meaning; 4 = fully adequate meaning. Table 5 presents sample student responses for the scoring system.

In addition, as illustrated in Table 5, the students' sentences—indicative of their productive word knowledge—were each scored from 0 to 2 depending on the level of semantic and grammatical accuracy: 0 = fully incorrect use in sentence;

⁴ A sentence still received two points if there were grammatical errors in the sentence that did not directly involve the target word (see Wesche & Paribakht, 1996).

Table 5

Examples of responses provided by language minority community college students and the Depth of Vocabulary Knowledge scores awarded

Score	Category	Examples for word shape
1	The word is not familiar at all.	"I don't know this word."
2	The word is familiar but its meaning is not known. The learner may recall seeing or hearing the word before but has no idea of the word's meaning.	"I remember seeing this word in my textbook but I can't remember what it means."
3	The word is familiar. The learner provides <i>at least</i> one meaning that is somewhat misleading or too general, and thus inadequate. (The learner provides a meaning that does not permit the word to be clearly identified based on the information provided.)	"shape means the shape of a triangle or circle" "if uh depends on the environment that a child grows up, means the way that he will be shaped up"
4	The word is familiar. The learner provides <i>at least</i> one meaning that is true but some ambiguity remains about the word's precise meaning.	"shape means, that means look different, ... form, like different form"
5	The word is familiar. The learner provides <i>at least</i> one adequate meaning, one that makes it perfectly possible to identify the target word based solely on information provided.	"shape means the form, the format of something" "it also means physical condition"
For scoring additional meanings (polysemy):		
+1	The learner may recall seeing or hearing other possible meanings for target word but has no idea of these other meanings.	"I know there are other meanings but I don't know."
+2	For every additional meaning of the word provided by the learner that is correct but somewhat misleading or too general	See examples for score level 3 above.
+3	For every additional meaning of the word that is true but somewhat ambiguous, lacking precision	See examples for score level 4 above.
+4	For every additional meaning that is adequate, one that makes it perfectly possible to identify the newly proposed meaning based solely on the information provided	See examples for score level 5 above.
Scoring sentence quality:		
+0	For any sentence that uses the word fully incorrectly	"That person is very bond with the people who doesn't have anything to eat."
+1	For every sentence which uses the target word with semantic appropriateness	"If you go to the gym, you can get a really good shape."
+2	For every sentence which uses the target word with semantic appropriateness and grammatical accuracy	"You're in good shape, you look really great!"

1 = semantically appropriately use; 2 = semantically appropriate and grammatical accurate use.⁴

A student's Depth of Vocabulary Knowledge (DVK) score for each word is the total number of points assigned to his/her word meanings and sentences. The students were not penalized for fully incorrect meanings, but three types of lexical errors were coded for analytic purposes: errors stemming from confusion with another similar-sounding or -looking word; errors based on misperceptions of the relationship between L1 and English (e.g., false cognates); and errors based on confusion about the syntactic function of a word.

Two of the 10 depth of word knowledge transcripts were coded by the researcher and a trained external rater. Inter-rater reliability was evaluated using Cohen's kappa (.74, $p < .001$).

Results and discussion

Estimates of academic vocabulary size

The test items on the UWLT are intended to represent roughly 6.7% of the total number of words, or one in 15 words, on the University Word List (Nation, 1990). The students' raw UWLT scores were multiplied by 15 to estimate how many of the 800 words on the list the students knew. The estimates, listed in Table 6, indicate considerable variation in the students' academic vocabulary knowledge, ranging from knowledge of nearly all of the academic words to knowledge of only about a third of the words. The distribution was slightly skewed with greater variability in the estimates below the mean estimate of 579 ($SD = 189.0$).

Table 6

Estimates of academic vocabulary breadth for ten language minority community college students

Student	Group*	Native language	UWLT raw score (Total possible = 54)	UWLT estimates (Total possible = 800)
Paolo	Psych	Portuguese	53	795
Jorge	ESL	Spanish	52	780
Marta	ESL	Spanish	51	765
Suzie	Psych	Haitian Creole	48	720
Isabel	Psych	Spanish	43	645
Anna	ESL	German	36	540
Chelenco	Psych	Spanish	31	465
Tai	Psych	Vietnamese	30	450
Mei	ESL	Chinese	25	375
Lily	ESL	Chinese	17	255
Overall mean			38.6 ($SD = 12.6$)	579 ($SD = 189.0$)

* ESL = enrolled in advanced ESL; Psych = enrolled in mainstream introductory psychology

The mean UWLT estimate for introductory psychology students ($M = 615$, $SD = 153.4$) was slightly higher than the mean estimate for advanced ESL students ($M = 543$, $SD = 232.7$), with greater variation around the mean within the ESL sub-group. However, this difference in mean estimates between groups was not significant ($t = .57$, $df = 8$, $p = .58$), suggesting that differences in vocabulary skills may not be restricted to program enrolment (Santos, 2009).

UWLT words that appeared difficult to most students included *inherent*, *trend*, and *inspect*. Certain cognate words such as *accumulate* were known to students who spoke a Latin-based native language but not by native speakers of Chinese. This is not surprising given that many academic words translate into high-frequency cognates in Latin-based languages, like Spanish (see Freeman, Freeman, & Mercuri, 2002). However, the two Spanish speakers in the lower scoring UWLT range, Isabel and Chelenco, were unable to correctly identify cognate words, such as *anomaly*, *instance*, and *configuration*, reminding us that cognate recognition cannot be assumed (Hancin-Bhatt & Nagy, 1994).

To explore whether differences in the students' L1 academic skills reflected differences in their breadth of English academic vocabulary knowledge, the UWLT results were also analyzed as a function of students' L1 literacy skills (as measured by an academic essay written in the L1). The quality of the L1 academic writing varied, with some students producing essays with strong topic development and lexical variety while other students generated essays with restricted topic development and limited lexical variety (Table 7).

As shown in Table 7, L1 academic writing scores appeared to parallel English academic vocabulary scores for most but not all students. Inspections of links between breadth of academic vocabulary knowledge and performance on the L1 writing task yielded four groups of students:

- (1) the HH group: students who did well on both the UWLT and the L1 academic writing task (Jorge and Marta);
- (2) the HM group: students who did well on the UWLT but only moderately well on the L1 writing task (Paolo, Isabel, and Suzie);
- (3) the MH group: students who did only moderately well on the UWLT but quite well on the L1 writing task (Anna and Mei); and
- (4) the LL group: students who did not do well on either the L1 writing task or the UWLT (Chelenco, Tai, and Lily).

Raters described the vocabulary use of HH essays as "rich" and "sophisticated," including the use of academic and specialized words, such as *subordinados-subordinates*, *credibilidad-credibility*, *recursivo-resourceful*, and *subalternos-subalterns*. It is possible that HH students were able to recruit their strong L1 vocabulary skills in the acquisition of English academic vocabulary, which contributed to their relatively strong performances on the UWLT.

HM students—those who did better on the UWLT than on the L1 academic writing task—produced L1 essays that were described as "under-developed academically" and "somewhat informal." Paolo and Suzie produced interesting essays but their lexical use was deemed "mostly informal," "repetitive," and "simplistic." For example, one rater observed that Suzie did not make use of formal discourse markers. Suzie wrote, "*Kankou nan travay mwen yon bós la se bon moun men bouch li palé twop*" [Translation: like, at my job, I have a good boss

Table 7 Summary of performance on breadth of academic vocabulary task (UWLT), L1 academic writing task, and depth of vocabulary knowledge task for language minority community college students ($n = 10$)

Student	Group	Native language	UWLT (Total possible = 800)	External evaluation of L1 academic writing skills			Depth of vocabulary knowledge		
				Topic development range: 1–10	Vocabulary use range: 1–10	Type/token ratio** range: 0–1	Mean (SD)	Min	Max
Paolo	Psych	Portuguese	795	9	6	.66	16.7 (7.7)	4	32
Jorge	ESL	Spanish	780	10	10	.60	12.7 (6.1)	5	24
Marta	ESL	Spanish	765	9	9	.54	9.2 (5.5)	0	19
Suzie	Psych	Haitian Creole	720	6.5	1	.40	8.0 (1.9)	6	11
Isabel	Psych	Spanish	645	6	7	.55	7.7 (3.2)	3	12
Anna	ESL	German	540	8	10	.71	8.7 (4.4)	4	16
Chelenco	Psych	Spanish	465	5	6	.49	5.3 (4.9)	0	15
Tai	Psych	Vietnamese	450	7.5	7	.42	7.2 (3.6)	1	13
Mei	ESL	Chinese	375	8.5	8.5	.67	6.5 (4.4)	0	12
Lily	ESL	Chinese	255	6.5	7.5	.42	5.5 (3.3)	0	10
Total mean (SD)			579 (189.0)	7.6 (1.6)	7.2 (2.6)	.55 (.11)	8.8 (5.7)	0	32

** Type/token ratio based on a 150 total word count in each essay

but he talks too much], a clause where the rater felt Suzie could have used “for example”.

Like HH students, MH students, Mei and Anna produced essays that were rated favourably on vocabulary use, argument complexity, and lexical variety. However, MH students did not perform as well on the UWLT as might be predicted by their L1 academic writing scores, suggesting that they possessed L1-based academic skills not revealed by their UWLT performance. At the time of the study, both Anna and Mei were relatively new to the academic ESL program at the community college.

The L1 essays of the LL students—those who did poorly on *both* the L1 academic writing task and the UWLT (namely, Tai, Chelenco, and Lily)—were described as “conversational” or “highly informal” in format and tone, meaning that the students seemed to “write as if they were talking.” The students’ vocabulary was described as “basic,” “limited,” and “unsophisticated,” and their ideas as “clear” but “repetitive.” In contrast to HH students, Tai and Chelenco had limited schooling in the L1 because both left their home countries before completing high school and did not enroll in U.S. bilingual programs where they could have further developed L1 academic skills. Lily completed high school in China more than ten years ago and indicated that, as an ESL student, she rarely read or wrote extensively in Chinese.

Depth of academic vocabulary knowledge

The depth of academic vocabulary knowledge (DVK) task was designed to assess how well students knew ten words with multiple meanings, many with common and academic meanings. The mean DVK score for the sample was 8.8 ($SD = 5.7$) (Table 7). To interpret this mean score, recall that, in the DVK scoring scheme, students were awarded 7 points for a particular word if they provided an adequate meaning (5 points) and a syntactically and semantically appropriate sentence (2 points). Scores higher than 7 indicate the students demonstrated knowledge of additional meanings or usage. Thus, a mean score of 8.8 suggests that students, on average, were able to provide *at least* one accurate meaning, one syntactically and semantically appropriate sentence, and some form of additional but only partially accurate word knowledge.

Given the range of breadth of academic vocabulary knowledge within the sample of ten students, it was anticipated that there would also be differences in the students’ performance on the DVK task. As expected, there was variation in DVK scores, ranging from 5.3 ($SD = 4.9$) to 16.7 ($SD = 7.7$) (Table 7). This range indicates that some students displayed considerable depth of knowledge of the target words, providing several meanings for a single item, while other students demonstrated only partial knowledge of most target words.

Relationship between breadth and depth of academic vocabulary knowledge

Depth of vocabulary knowledge has been shown to be reflective of breadth of vocabulary knowledge (Nurweni & Read, 1999), so one would anticipate

correspondence in performance across the two academic vocabulary measures. The DVK results bear out this expectation: overall increases in DVK scores were associated with increases in UWLT estimates (Table 7). One exception to this trend occurred with ESL student Anna (a native speaker of German), whose below-average performance on the UWLT under-predicted her relatively stronger performance on the DVK task. Another exception was Chelenco, a native Spanish speaker and introductory psychology student, who did not score as high on the DVK task as predicted by his UWLT estimate (but it should be noted that his performance on both tasks was rather weak).

Table 7 also indicates that high and low mean DVK scores were found among advanced ESL students ($M = 8.0$, $SD = 5.4$) and introductory psychology students ($M = 9.5$, $SD = 5.9$), with no significant differences found in mean DVK performance between the two groups ($t = -.43$, $df = 8$, $p = .68$). This suggests that differences in depth of academic vocabulary knowledge might not strongly differentiate language-minority students in ESL from those already mainstreamed in regular content courses.

To see whether DVK scores also varied according to L1 academic skills, the students were divided into four groups (HH, HM, MH, and LL), designations based on their L1 academic writing skills and UWLT estimates, and their mean DVK scores were compared (Table 8).

Again, as might be expected, the HH group (those with strong performances on the L1 writing task and UWLT) posted the highest mean DVK scores. The HH group's mean score ($M = 11.0$, $SD = 2.5$) indicates that, on average, the students were familiar with multiple meanings for the words on the DVK task. In contrast, students with weak performances on the L1 writing task and the UWLT demonstrated restricted depth of academic word knowledge, with a mean DVK score of 5.9 ($SD = 3.9$), indicating that, on average, LL students possessed only

Table 8

Mean performance scores on the depth of academic vocabulary knowledge task for students with varying levels of L1/L2 academic proficiency

Group	Skill profile	Students	<i>n</i>	Mean DVK score (SD)
HH	Strong academic skills in English and L1	Jorge, Marta	2	11.0 (2.5)
HM	Strong English academic skills but moderate L1 academic skills	Paolo, Suzie, Isabel	3	10.8 (5.1)
MH	Moderate English academic skills but strong L1 academic skills	Mei, Anna	2	7.6 (1.6)
LL	Poor academic skills in English and L1	Tai, Chelenco, Lily	3	6.0 (1.04)
		Overall mean	10	8.8 (5.7)

partial knowledge of the words on the DVK task. Despite this within-sample variation, no significant differences in mean DVK scores were found for the language-minority students in the four groups defined by L1/L2 academic skill ($F_{\text{obs}} = 1.51$, $df = 9$, $p = 0.30$).

As shown in Table 9, DVK scores ranged as widely as 8 to 32 for a single item, suggesting substantial variation in the language-minority students' depth of word knowledge. As noted earlier, higher scores on the DVK task reflected greater familiarity with the target word. The mean DVK scores for each word indicate that *right*, *bright*, and *key* were known relatively well by the students. In contrast, students exhibited partial knowledge of *average* and *rate*; for these words, the average DVK scores were only 6.9 and 5.3, respectively. The word *bond* ($M = 2.8$, $SD = 2.9$) seemed particularly challenging, with most students exhibiting only partial knowledge and four students demonstrating no knowledge whatsoever (0 scores) of the word.

The students' variation in depth of word knowledge was reflected in their range of syntactic functions assigned to a single word. In general, high-scoring responses successfully identified more syntactic functions for a single word than did low-scoring responses. For example, Paolo correctly defined the word *direct* in its function as an adjective ("straightforward, no beating around the bush") and as a verb ("can also mean you guide someone"), while other students only demonstrated knowledge of *direct* as an adjective. Note that while students rarely used explicit grammatical terminology in their definitions, their responses demonstrate how depth of word knowledge builds on syntactic knowledge.

Another indicator of sophistication in the students' DVK responses was the range of familiar to specialized meanings provided for the target words. This distinction is important given that academic vocabulary includes familiar words which take on specialized meanings in academic texts (Corson, 1997; Freeman, Freeman, & Mercuri, 2002; Santos, 2000). High-scoring DVK responses frequently indicated that the student was able to provide specialized meanings in addition to more familiar meanings for the target words. For example, nearly all students were familiar with the common meaning of *field* as an area of land used for agriculture or sports, but three students, Paolo, Jorge, and Chelenco, also defined *field* in terms of a particular discipline of area of study, as in these definitions: "your profession" (Chelenco) or "what you are study or dedicating for" (Jorge). (Isabel was unique in that she knew the *discipline* meaning for *field*, but did not mention the *area of land* meaning, even when probed for more meanings.) In the text sample drawn from the five community college textbooks, the word *field* was used in the context of *branch of study* as often as it was used in the context of *agricultural land*.

Errors in word recognition and confusion about lexical relationships between the L1 and English restricted the students' DVK scores for certain words, with advanced ESL students producing more errors (five errors in total) than the psychology students (only one error). In four cases, the students' errors in meaning stemmed from confusion with other similarly-spelled words. For example, the two native-Chinese speaking ESL students confused the target word *bond* with *bone*; similarly, ESL student, Jorge, and psychology student, Isabel (both native

Table 9 Mean and distribution of Depth of Vocabulary Knowledge scores provided by language minority community college students ($n = 10$) for 10 words

Student	Group	Target word										Mean DVK (SD)
		right	body	field	bright	average	rate	shape	bond	key	direct	
Paolo	Psych	32	19	15	19	13	14	13	4	25	13	16.7 (7.7)
Jorge	ESL	17	11	20	13	11	5	12	5	24	9	12.7 (6.1)
Marta	ESL	15	7	7	19	7	4	9	0	11	13	9.2 (5.5)
Anna	ESL	13	16	9	7	7	5	5	6	15	4	8.7 (4.4)
Suzie	Psych	8	5	6	11	7	8	11	7	9	8	8.0 (1.9)
Isabel	Psych	11	5	6	11	5	3	10	5	12	9	7.7 (3.3)
Tai	Psych	11	8	5	11	4	5	7	1	13	7	7.2 (3.7)
Mei	ESL	12	4	6	11	6	5	0	0	11	10	6.5 (4.4)
Lily	ESL	10	4	5	7	5	1	7	0	10	6	5.5 (3.3)
Chelenco	Psych	15	5	13	2	4	3	1	0	5	5	5.3 (4.9)
Mean DVK per word (SD)		14.4 (6.7)	8.4 (5.3)	9.2 (5.1)	11.1 (5.2)	6.9 (3.0)	5.3 (3.6)	7.5 (4.4)	2.8 (2.9)	13.5 (6.4)	8.4 (3.1)	8.8 (5.7)

Spanish speakers) confused the word *direct* with *director*. The students appeared to be focused on word form, which Haynes (1993) notes can be an unreliable approach to lexical access since “there is a good deal of imprecision in matching graphophonemic shape to words in lexical memory” (p.56).

Additional errors stemmed from misperceptions of the link between Spanish and English. For example, Marta, an ESL student from Colombia, presumed the word *bond* meant “like when you’re very gentle” and gave the sentence “That person is very bond with the people who doesn’t have anything to eat,” which suggests that Marta was thinking of *bondadoso*, the Spanish word for “kind” and not a true cognate derivative. This kind of error, while infrequent, supports Laufer’s (1997) description of “deceptively transparent” words in the L2 learner’s lexicon, referring to those words that the learner does not recognize as unfamiliar because “they look as if they [provide] clues to their meaning” (p.25). These findings affirm previous work which have emphasized the interdependence of grammar and vocabulary knowledge (Celce-Murcia, 2002; Lewis, 2000).

Productive control of words in sentences

Of the 158 sentences produced by the language-minority students in response to the target words, a substantial proportion were rated “semantically and syntactically appropriate” (125 sentences) with a much lower number of “semantically appropriate” (23) and “fully inappropriate” sentences (10). Given the variation in DVK scores within the group (Table 7), this finding suggests that the language-minority students often demonstrated some productive knowledge of the target word, even if they were not able to indicate precisely what the words meant.

The relationship between receptive and productive knowledge was also examined by analyzing the frequency and range of DVK scores awarded to words used in “appropriately” rated sentences. (The scoring categories ‘semantically appropriate’ and ‘semantically and syntactically appropriate’ were collapsed into one category for this analysis because the former group was relatively infrequent compared to the latter group.) This approach yielded three general patterns in the sentence data:

- (a) Pattern 1: words for which the student’s word meaning was rated fully adequate and the accompanying sentence as appropriate;
- (b) Pattern 2: words for which the student’s word meaning was rated true but imprecise and the accompanying sentence as appropriate; and
- (c) Pattern 3: words for which the student’s word meaning was rated as correct but misleading and too general and the accompanying sentence as appropriate.

These three scoring patterns frequently occurred in the students’ responses, accounting for 134 of the 158 total number of sentences in the data. Pattern 1, most frequently displayed by Jorge (HH) and Paolo (HM), the highest DVK scorers in the group, could be characterized as the “ideal” working level of familiarity with academic words: when the learner comprehends the word’s meaning and also demonstrates facility with its stylistic conventions in sentences, a necessary

combination of knowledge to be able to read and write at the college-level. On the other hand, Patterns 2 and 3 occurred with relatively greater frequency in the sentence production of MH and LL students (and one HM student, Suzie). Students who made greater use of Patterns 2 and 3 appeared less able to provide adequately precise word meanings outside the context of a sentence.

For example, Lily (a native Chinese-speaking ESL student) responded to the word *average* by providing a meaning that was rated “true but misleading or too general” but her use of *average* in a sentence was appropriate (Pattern 2):

Lily: Uh hm average means put everything together, put this one, oh how do I say that -, average, it's like the balance about that, that's the meaning.

Interviewer: Um, okay, can you use it in a sentence?

Lily: It's like, my average pay which, um, is like eight dollars an hour, that's an average.

Like Lily, Anna (a native German-speaking ESL student) struggled to define *rate* but was able to produce an appropriate sentence (Pattern 3):

Anna: Yes, rate is like a price or it's used in statistic.

Interviewer: I'm sorry, what was the first word you said, I'm sorry I didn't understand.

Anna: Not it's not like the price, it's like the statistic.

Interviewer: Oh you said price, but now you say no.

Anna: No, no it's not this, it's statistic.

Interviewer: Statistic.

Anna: It's a number.

Interviewer: Okay can you use it in a sentence?

Anna: Yeah, it is also used in like if you—percent, if you buy a car or something then the sentence is the rate is five percent.

Lily and Anna's responses also raise the possibility that they understood the concepts of *average* and *rate* (and thus, could produce sentences) but lacked the expressive language skills to produce a clear definition in English. As Isabel indicated during the DVK interview, sometimes “it's more easy to give you examples [than definitions].”

The relatively greater occurrence of Patterns 2 and 3 in the MH and LL groups suggests that their initial knowledge of academic words may be bound to a particular context. The students' working familiarity with the word in context may enable the students to generate meaningful sentences, but the precise meanings of the words appear to remain, for the most part, unexamined. These findings suggest one possible path of academic vocabulary development for language-minority students: an initial level of familiarity (e.g., little comprehension, good production) followed by some level of examination of the word's decontextualized meaning to greater familiarity (e.g., good comprehension, good production) (Melka, 1997). This is in line with Schmitt's (1998, 2000) observation that word knowledge should not be viewed as an all-or-nothing phenomenon but that it is acquired incrementally over time through multiple exposures—in context and out of context—to the word.

Conclusion and implications

This study highlights the relationship between breadth and depth of academic word knowledge among ten language-minority community college students. Differences in academic vocabulary skills did not appear to be strongly associated with program enrolment, as students with strong and weak skills were found in both the advanced ESL and mainstream psychology groups. However, as anticipated, students' L1 academic proficiency (as measured by the L1 writing task) was related to variation in the students' academic vocabulary knowledge (depth and breadth).

Students with greater breadth of academic word knowledge identified more multiple meanings for a single word than students with less breadth. Specifically, the better performing students on the University Word Levels Test were able to identify more syntactic functions and a greater range of meanings (from familiar to specialized) for words on the depth task than the students with less breadth.

While the students' responses to the DVK target words ranged from zero knowledge to rich knowledge of word meanings, those words that fell between these two points are of particular interest—a domain of vocabulary knowledge that Trembly (1966) characterized as “frontier” knowledge, i.e., when words are neither completely novel nor fully known. This study revealed several examples of “frontier” words—false cognates (*bond/bondadoso*); words that students can only “define” in the context of a sentence; words that have specialized meanings but only their familiar meanings are known. Focusing instruction on “frontier” words—i.e., building on the known—may be an effective approach to promoting students' depth of vocabulary knowledge (Beck, McKeown, & Caslin, 1983; Lewis, 2000).

What is the mechanism by which breadth of English academic word knowledge and L1 academic skills converge to either promote or restrict a student's depth of academic word knowledge? When language-minority students know a limited number of English academic words and have fewer L1 academic resources to recruit in the L2 acquisition process, it seems likely that the quality of the students' academic lexicon will also be restricted. In addition, the students are also less likely to have academic words at their disposal when asked to explain meanings even for words they do know.

Students who demonstrated relatively well-established L1 academic skills (most notable those students with post-secondary experience in their home countries) consistently exhibited familiarity with multiple meanings and uses of the target words. Conversely, students with weak academic word skills in English and minimal L1 academic skills demonstrated partial to no knowledge of the academic words on the DVK. More variation in depth of word knowledge was found among students with moderate to strong academic word skills in only one language, with an advantage experienced by students with stronger academic word skills in English than those with stronger skills in the L1. This finding suggests the need for focused interventions with students who have not developed strong academic word skills in either the L1 or English to strengthen their academic vocabulary foundation and mitigate the risk for reading difficulties as the students transition from ESL to mainstream content environments.

The generalizability of the findings is limited by the small sample size, although the results provide a basis on which to focus future studies on breadth and depth of academic word knowledge among language-minority community college students. Two possible directions for research are sketched here:

What is the relationship between L1 academic word knowledge and L2 academic word knowledge? In some instances, learners indicated they had an idea of what a word meant in their L1 but could not provide a meaning in English. To account for individual differences in expressive English ability and differences in L1 background, collecting L1 data (e.g., translations for target items, either orally or in written form) would help corroborate any conclusions about the depth of the students' academic word knowledge.

What kinds of specialized instruction would most effectively promote the acquisition and productive use of English academic words for language-minority community college students? Answers to this question seem most critical for students in the LL group in this study—those with weak L1 and English academic skills—as they are likely to be most at risk in struggling with the lexical demands of college reading and writing. These learners will likely benefit from instruction that focuses on strengthening their familiarity with academic words already in their lexicon. Finally, results indicate that the provision of academic vocabulary instruction is a cross-departmental responsibility, as skill gaps were found for students enrolled in mainstream content courses as well as those in advanced ESL.

Although this study was primarily focusing on exploring students' knowledge of polysemous academic words, and not on developing a new measure of depth of vocabulary knowledge, we are able to affirm the utility of DKS as a tool for probing students' knowledge in an interactive, non-intimidating format. One participant commented at the end of the DKS protocol that the task helped her to remember that it was useful to "think about the words we know, not just keep learning new words." Another participant observed at the end of the protocol that he was glad to be given multiple opportunities to define a word because "you can't always think of what you know the first time you see the word...you need some time." Thus, while administering the DKS tool was relatively more time-consuming than paper-based measures of depth, it improved upon previous tools which were unable to account for students' polysemous knowledge. Given that the DKS aims to assess knowledge of a limited number of words, future studies might consider adaptation of the DKS for assessing students' knowledge of specific academic words after an instructional intervention (e.g., Paribakht & Wesche, 1993). Also with respect to future replication, longitudinal studies that are able to track the process by which academic word knowledge evolves over time (see Schmitt, 1998, 2000) would clarify whether the differences reflect only short-term disadvantages that disappear once students progress in their degree program. These future directions will enrich our research base on depth of academic word knowledge and inform pedagogical decisions about what skills language-minority students need to succeed academically in community college and beyond.

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