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# Crosslinguistic Transfer of Higher Order Cognitive Skills and Their Roles in Writing for English-Spanish Dual Language Learners

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We investigated the dimensionality and relations between L1 (a speaker's first language) and L2 (a speaker's second language) writing skills in narrative and informational genres and higher order cognitive skills—inference, perspective taking, and comprehension monitoring—for Spanish–English dual language learners in primary grades. Dimensions of written composition and higher order cognitive skills were examined, comparing nine alternative models. Data from 317 dual language learners in Grades 1 and 2 were used in confirmatory factor analysis and structural equation modeling. For the dimensionality of written composition, a unidimensional model, where writing was characterized as a single underlying construct across languages (Spanish and English) and genres (narrative and opinion), fit the data best. With regard to the dimensionality of higher order cognitive skills, data supported a bifactor model with (a) a general factor that captures common variance across languages and across inference, perspective taking, and comprehension monitoring skills and (b) specific factors by language (Spanish and English). The higher order cognition general factor was fairly strongly related to writing quality (.59), and the relation remained even after accounting for sex, poverty status, grade level, English learner status, school, and biliterate status. These relations were similar for students in an English immersion program and in Spanish–English dual immersion programs. These results indicate potential cross-language transfer of higher order cognitive skills and the roles of higher order cognitions in written composition for Spanish–English dual language learners.


## ***Educational Impact and Implications Statement***

Critical thinking skills or higher order cognitive skills in L1 (a speaker's first language) and L2 (a speaker's second language) and writing skills in L1 and L2 go hand in hand. Higher order cognitive skills, such as making inferences, understanding multiple viewpoints (perspective taking), and monitoring one's own performance in English and Spanish can be described as a common skill with language-specific aspects. Writing skills in narrative and informational (opinion) genres in English and Spanish were found to be a unitary skill; and higher order cognitive skills were moderately related to writing skills. These results suggest that higher order skills likely transfer between languages, and are important to writing skills; and therefore, instruction on higher order cognitive skills in L1 and/or L2 likely supports development of writing skills.

**Keywords:** inference, perspective taking, theory of mind, L2 writing, linguistic interdependence hypothesis

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Quality writing is characterized by coherence of ideas. Expressing thoughts coherently in writing, however, is not an easy task. In fact, writing is one of the most challenging skills to acquire; the National Assessment of Educational Progress has historically and consistently demonstrated that approximately three fourths of U.S. students do not write with proficiency (National Center for Education Statistics, 2020). This challenge is even more pronounced for dual language learners, many of whom are learning to write in a language in which they are less proficient. In the present study, we examined writing (i.e., written composition) for Spanish–English dual language learners in primary grades in the United States. In particular, we explored how the quality of writing in English and Spanish narrative and informational (specifically, opinion) genres is best described in terms of dimensionality—is writing best characterized as a

single/unitary skill across languages and genres; a skill classified by language, such as English writing quality and Spanish writing quality, that cuts across genres; or a skill classified by genre, such as narrative writing and informational writing, that cuts across languages? We also explored students' higher order cognitive skills—inferencing, perspective taking, and comprehension monitoring—in English and Spanish, and their dimensionality as either a unitary skill; skills classified by language, such as English higher order cognition and Spanish higher order cognition; or skills that subsume languages. Finally, we examined the relations of the identified dimensions of higher order cognitive skills to the identified dimensions of writing quality by instructional programs (English immersion vs. Spanish–English dual immersion).

## Writing

Writing involves recursive processes of generating, translating, organizing, and transcribing ideas (Bereiter & Scardamalia, 1987; Flower & Hayes, 1981). According to the direct and indirect effects model of writing (DIEW; Kim, 2020; Kim & Graham, 2021; Kim & Park, 2019), these writing processes draw on a multitude of component skills such as oral language skills (e.g., vocabulary, grammatical knowledge, sentence proficiency, discourse), executive function or domain-general cognitions (e.g., working memory, attentional control), background knowledge (content/topic knowledge and discourse knowledge, which includes genre knowledge), social-emotional factors (e.g., motivation, attitude), and transcription skills (spelling and handwriting). DIEW also posits that higher order cognitive skills and regulation such as reasoning, inferencing, perspective taking, and monitoring are important to compositional quality, particularly for establishing coherence as ideas and propositions need to be organized and related into higher order ideas. Coherence and consequent quality written composition are achieved when there is congruity among the author's intended meaning of the text, the explicit text, and the reader's constructed meaning of the text (Graesser et al., 1994); and higher order cognitive skills contribute to achieving the congruity. For example, inferencing is necessary because presenting ideas effectively and coherently requires an understanding of underlying relations among ideas that are explicitly or implicitly conveyed and expressing and arranging ideas with such an understanding. Furthermore, good writers are aware that readers 'interpret' expressed thoughts in writing, and readers' interpretation may be incongruous with the author's intended meaning (i.e., perspective taking); therefore, good writers present ideas using language and structure that meet readers' needs. Establishing coherence also draws on monitoring one's own writing processes such as setting goals, identifying breakdowns in coherence, and adjusting and repairing structure and expression.

A small but growing number of studies supports the relations of higher order cognitive skills to writing quality, for students in elementary grades as well as those in secondary school. Inferencing was related to writing quality after controlling for spelling, handwriting fluency, and working memory for English monolingual first graders (Kim & Schatschneider, 2017). Furthermore, Korean monolingual students' inferencing skill in grade 1 predicted writing quality in Grade 3 after controlling for grade 1 transcription skills, vocabulary, grammatical knowledge, working memory, and attentional control (Kim & Park,

2019). Perspective taking as measured by theory of mind was also related to writing quality for English monolingual Grade 2 students (Kim & Graham, 2021) and Grade 4 students (Kim, 2020). In studies with secondary students, Portuguese-speaking seventh to ninth graders' skill in detecting and repairing inconsistency (i.e., monitoring) was related to writing quality (Limpo & Alves, 2013). Another recent study with seventh graders in the United States showed that the extent to which perspective taking was represented in writing was related to writing quality (Cho et al., 2021).

## Writing in L1 (a Speaker's First Language) and L2 (a Speaker's Second Language)

The vast majority of research on writing for developing writers has been conducted in L1 (a speaker's first language) while research on L2 (a speaker's second language) writing primarily has focused on adult learners (see Riazi et al., 2018; for a review). Consequently, little is known about writing for children learning two or more languages (dual language learners hereafter), particularly about their writing in two languages (see Williams & Lowrance-Faulhaber, 2018 for a review). One prominent idea in second language and literacy acquisition is the linguistic interdependence hypothesis (Cummins, 1979). According to this hypothesis, L2 competence is partially "a function of the type of competence already developed in L1" (Cummins, 1979, p. 222). In other words, one can benefit from and utilize resources or skills developed in L1 for their L2 acquisition or vice versa. This hypothesis has been supported in reading; reading skills in L1 and L2 are related (Kim & Piper, 2019; Li et al., 2012; Manis et al., 2004; Pasquarella et al. 2015; Wang et al., 2019). Similarly, writing skills in L1 and L2 are related for adults who learn English as a foreign language (e.g., De Jesus, 1984; Marzban & Jalali, 2016; Sasaki & Hirose, 1996). When it comes to the studies with children who are acquiring L1 and L2, extant studies described and characterized features of writing such as language use in L2 (e.g., Brisk, 2012; Reynolds, 2002, 2005) or L1 (e.g., Crosson et al., 2012).

In the present study, we expand prior work in several ways. First, we examined writing by dual language learners in primary grades—those who are learning two languages and also are developing foundational writing skills. We focus on primary grades because this is the period when children are developing transcription, oral language, and cognitive skills at a rapid rate. Second, we examined their writing not only in L2 but also in L1. Extant studies with children tended to focus on writing in L1 or L2 but not both. Third, we explored the dimensionality of writing in L1 and L2. Specifically, we examined students' writing quality in narrative and informational (specifically opinion) genres in English and Spanish, and tested whether writing is best characterized as a (a) unitary skill across the two genres and two languages; (b) skill classified by language, composed of English writing quality and Spanish writing quality that subsumes genres; (c) skill classified by genre, composed of narrative writing quality and informational writing quality that subsumes languages; or (d) bifactor structure with a common construct that captures skill across languages and genres and with specific factors by language or genre. According to the unidimensional model, writing ability is similar across genres and languages. Perhaps a more intuitive conceptualization of

writing in L1 and L2 is by language (writing in L1 and writing in L2), and, not surprisingly, most of the previous research took this approach. This writing-by-language hypothesis would be supported if language proficiency largely determines writing quality and if there is a large gap in L1 and L2 language proficiency. Oral language skills are necessary for translating ideas and thoughts into language (Kim et al., 2011, 2014, 2015; Olinghouse, 2008; Olinghouse & Leaird, 2009; Silverman et al. 2015; Stuart et al., 2020), and oral language skills are component skills that contribute to writing in DIEW (Kim, 2020; Kim & Graham, 2021; Kim & Park, 2019). Thus, lack of language proficiency will act as a bottle neck in the writing process and consequently in writing quality, and a large discrepancy in language proficiency between L1 and L2 will result in large differences in writing quality between L1 and L2.

It is also plausible that writing skills in L1 and L2 may be best described by genre—narrative writing and informational writing that subsume languages. The roles of text features and genres in writing have been recognized in the literature and theoretical models (Bereiter & Scardamalia, 1987; Hayes, 1996; Kim, 2020; Kim & Graham, 2021). In general, narrative texts are about social or interpersonal relationships and everyday problem solving (Langer, 1986); whereas informational texts present concepts and ideas and logical relations among them (Best et al., 2008). Furthermore, the organization of ideas (i.e., text structures) varies by genre. Thus, for quality writing, writers must draw on their knowledge of discourse—knowledge about characteristics of different genres (e.g., text structures and associated key words) and about procedures and strategies to present content appropriate for the genre—to organize ideas in a manner that is expected in respective genres (e.g., Kim & Park, 2019; Olinghouse et al., 2015). In fact, interindividual and intraindividual variation in writing has been hypothesized as a function of genres and tasks (Kim, 2020; Kim & Graham, 2021).

If there is a relation between writing in L1 and L2, what explains such a relation? We hypothesized higher order cognitive skills as one of the explanatory factors. According to the linguistic interdependence hypothesis, “underlying cognitive/academic proficiency” (Cummins, 1996, p. 110) that is common across languages is responsible for the relation. It should be noted, however, that the linguistic interdependence hypothesis did not specify what the underlying cognitive competences are, and thus they have remained a black box. Previous research concentrated on sublexical metacognitive or metalinguistic skills such as phonological awareness, awareness of the alphabetic principle, and morphological awareness as candidates for the underlying cognitive competences, and indeed found that they are related across languages (Branum-Martin et al., 2012; Melby-Lervåg & Lervåg, 2011 for reviews). In fact, causal evidence exists for cross-linguistic transfer of phonological awareness and awareness of the alphabetic principle (Vaughn et al., 2006; Wawire & Kim, 2018). In the present study, we extend the investigation of underlying cognitive competences to higher order cognitive skills. We hypothesized that higher order cognitive skills such as inference, perspective taking, and monitoring in one language are related to those in another language. For instance, in a think-aloud protocol in reading, Spanish-speaking English learners were found to use L1 comprehension strategies such as comprehension monitoring and inferencing when reading L2 texts (Jimenez et al., 1995, 1996).

This suggests relation of higher order cognitive skills between languages. However, to our knowledge, there is no empirical estimate for the relations of higher order cognitive skills between L1 and L2.

Moreover, if L1 and L2 higher order cognitive skills are related, a corollary is their dimensionality—whether higher order cognitive skills in L1 and L2 are best described as a unitary skill (i.e., a unidimensional model), two related but separable skills by language (composed of L1 higher order cognitive skill and L2 higher order cognitive skill), skills across languages (inference, perspective taking, and monitoring skills that subsume languages), or a bifactor structure with a common factor that captures skill across languages and specific skills (e.g., inference, perspective taking) and with specific factors by language or specific skills. The unidimensional model hypothesizes that performances on inferencing, perspective taking, and monitoring tasks across languages are best described as a single skill. The dimensionality by language (English higher order cognitive skill and Spanish higher order cognitive skill) would be supported if language proficiency drives the performances on these tasks. This is plausible as language skills are foundations for higher order cognitive skills (Currie & Cain, 2015; de Villiers & Pyers, 2002; Kim 2015, 2016, 2017, 2020; Lynch et al., 2008; Ruffman et al., 2003). Then, to the extent that language skills play a role and to the extent that language proficiency in L1 and L2 are asymmetric, two dimensions by language are plausible. Alternatively, if higher order cognitive skills are strongly related to a greater extent than language proficiency is, then dimensionality by specific higher order cognitive skill would be supported.

## The Present Study

In the present study, we expand previous work by investigating L1–L2 writing skills and L1–L2 higher order cognitions (inference, perspective taking, and comprehension monitoring) in terms of their dimensionality and their relations, using data from English-Spanish dual language learners in Grades 1 and 2. With regard to the relations of higher order cognitive skills to writing, we examined whether there are differences by instructional programs, English immersion or English-Spanish dual immersion. Previous studies have shown that L1 and L2 reading skills differ by instructional programs and covary differently at the student and classroom levels (Branum-Martin et al., 2012).

The findings of this study have important theoretical and practical implications. Findings about the L1–L2 relation of higher order cognitive skills and the L1–L2 relation of writing skills will inform the linguistic interdependence hypothesis by expanding the type of underlying competences that are common across languages. The L1–L2 relation of higher order cognitive skills and their relations to writing, if supported, would suggest the potential transfer between languages and roles of higher order cognitions in writing, and consequently a need for instruction on higher order cognitive skills in L1 and/or L2 to facilitate development of writing skills. The following were specific research questions that guided the study.

*Research Question 1:* How are writing skills in narrative and opinion genres in English and Spanish, and higher order cognitive skills (inference, perspective taking, and comprehension monitoring) in English and Spanish best described in

terms of dimensionality for Spanish–English dual language learners in primary grades?

*Research Question 2:* How do the identified dimensions of higher order cognitive skills relate to the identified dimensions of written composition, controlling for sex, poverty status, grade, school, English learner status, and biliterate status? Do the relations differ by instructional program (English immersion vs. Spanish–English dual immersion)?

For the first question, we did not have clear hypotheses given the lack of prior work. With regard to the second research question, we hypothesized that the identified dimensions of higher order cognitive skills would be related to the identified dimensions of writing quality, given the relations of higher order cognitive skills to writing in L1 (see the literature review in the preceding text). Last, we did not have a specific hypothesis about whether the relation between higher order cognitive skills and writing would differ by instructional program due to the lack of prior evidence.

## Method

### Participants

A total of 317 Spanish–English dual language learners in Grades 1 ( $n = 149$ ) and 2 ( $n = 168$ ) from 23 classrooms in three schools in the Southwest region of the US participated in the study. These schools were in a school district where 95% of students were Hispanic. Demographic backgrounds of these children according to the district record were as follows: approximately 53% girls; 89% Hispanic, 8% White; and 84% eligible for the free and reduced lunch program. Approximately 84% were

English learners, and 69% were in Spanish–English dual language programs, whereas 31% were in structured English immersion programs. About half of the sample ( $n = 179$ ) were considered biliterate, such that they provided writing samples in each of two languages when prompted to. Some children wrote only in one language regardless of target languages in the writing tasks. Details about the patterns of children’s writing in target versus nontarget language is presented in Table 1. Not surprisingly, a different pattern was observed by instructional program. Many students in the English immersion program in both grade levels wrote in English when prompted to write in Spanish. For those in the Spanish–English dual program, some students in grade 1 wrote in Spanish in English writing tasks whereas this was not observed for those in Grade 2. Regardless of whether children wrote in target language or not, their compositions were scored following the rubric described in the Measures section. All children were included in data analysis regardless of their biliterate status, and biliterate status was included as a control variable in the data analysis (see the following Data Analytic Strategies section). Human subjects approval was obtained from the University of California, Irvine (HS#2018-4411).

### Measures

Children were assessed on written composition and higher order cognitive skills—inference, perspective taking (as measured by theory of mind), and comprehension monitoring—in English and Spanish. Unless otherwise noted, children’s responses were scored dichotomously (1 = correct; 0 = incorrect) for each item, and all the items were administered to children. Reliability estimates are all based on the sample in the present study. Total number of experimental items and maximum possible scores for each measure are shown in Table 2.

**Table 1**  
*Proportion of Students Who Wrote in English and Spanish in English and Spanish Narrative and Opinion Writing Tasks*

Language and task	Grade 1		Grade 2	
	EI ( $n = 46$ )	Dual ( $n = 103$ )	EI ( $n = 52$ )	Dual ( $n = 116$ )
English narrative task				
Blank/illegible	0.02	0.02	0.02	0.00
All Spanish	0.00	0.30	0.00	0.07
At least one word in English	0.98	0.68	0.98	0.93
English opinion task				
Blank/illegible	0.00	0.07	0.02	0.00
All Spanish	0.00	0.12	0.00	0.08
At least one word in English	1.00	0.75	0.98	0.92
Spanish narrative task				
Blank/illegible	0.00	0.04	0.02	0.01
All English	0.71	0.03	0.69	0.00
At least one word in Spanish	0.29	0.93	0.29	0.99
Spanish opinion task				
Blank/illegible	0.00	0.01	0.04	0.00
All English	0.78	0.02	0.48	0.02
At least one word in Spanish	0.22	0.97	0.48	0.98
Language				
Wrote only in English	0.67	0.02	0.46	0.01
Wrote only in Spanish	0.00	0.18	0.00	0.04

*Note.* EI = English immersion program; Dual = Spanish–English dual immersion program.



**Table 2**  
*Descriptive Statistics*

Variable (no. of items; maximum possible score)	<i>n</i>	<i>M</i>	<i>SD</i>	Minimum	Maximum	Skewness	Kurtosis
Full sample							
Writing quality							
English narrative (1 <sup>a</sup> ; 7 <sup>b</sup> )	313	3.19	0.78	0	5	-1.45	4.73
English opinion (1 <sup>a</sup> ; 7 <sup>b</sup> )	314	2.95	1.01	0	5	-0.89	0.63
Spanish narrative (1 <sup>a</sup> ; 7 <sup>b</sup> )	311	3.06	0.85	0	5	-1.45	3.80
Spanish opinion (1 <sup>a</sup> ; 7 <sup>b</sup> )	314	3.04	0.94	0	5	-1.02	1.06
English higher order cognitive skills							
Inference (52+; 52)	315	5.07	5.61	0	27	1.41	1.99
Theory of mind (36; 38)	317	18.29	5.75	0	32	-0.25	-0.04
Comprehension monitoring (21; 49)	315	15.83	8.31	0	37	0.50	-0.46
Spanish higher order cognitive skills							
Inference (27; 27)	315	3.86	6.04	0	23	1.32	0.31
Theory of mind (36; 38)	317	16.18	6.38	0	29	-0.83	0.65
Comprehension monitoring (21; 49)	315	11.63	8.79	0	39	0.70	-0.07
Students in the structured English immersion instruction program							
Writing quality							
English narrative (1 <sup>a</sup> ; 7 <sup>b</sup> )	97	3.30	0.50	2	4	0.38	-0.73
English opinion (1 <sup>a</sup> ; 7 <sup>b</sup> )	96	2.95	0.97	0	4	-1.04	0.88
Spanish narrative (1 <sup>a</sup> ; 7 <sup>b</sup> )	94	2.91	0.67	0	4	-2.13	7.86
Spanish opinion (1 <sup>a</sup> ; 7 <sup>b</sup> )	97	2.67	1.00	0	4	-1.03	0.67
English higher order cognitive skills							
Inference (52+; 52)	98	5.13	5.38	0	21	1.04	0.43
Theory of mind (36; 38)	98	17.63	5.64	7	31	0.13	-0.71
Comprehension monitoring (21; 49)	98	14.77	7.03	0	34	0.76	0.39
Spanish higher order cognitive skills							
Inference (27; 27)	98	1.87	4.57	0	20	2.58	5.81
Theory of mind (36; 38)	98	12.96	7.69	0	26	-0.36	-0.75
Comprehension monitoring (21; 49)	98	6.92	6.90	0	39	1.51	4.12
Students in the dual immersion instruction program							
Writing quality							
English narrative (1 <sup>a</sup> ; 7 <sup>b</sup> )	216	3.15	0.88	0	5	-1.42	3.70
English opinion (1 <sup>a</sup> ; 7 <sup>b</sup> )	218	2.94	1.04	0	5	-0.84	0.57
Spanish narrative (1 <sup>a</sup> ; 7 <sup>b</sup> )	217	3.12	0.91	0	5	-1.43	3.21
Spanish opinion (1 <sup>a</sup> ; 7 <sup>b</sup> )	217	3.20	0.86	0	5	-0.98	1.03
English higher order cognitive skills							
Inference (52+; 52)	217	5.04	5.73	0	27	1.55	2.57
Theory of mind (36; 38)	219	18.59	5.79	0	32	-0.41	0.35
Comprehension monitoring (21; 49)	217	16.31	8.80	0	37	0.38	-0.70
Spanish higher order cognitive skills							
Inference (27; 27)	217	4.76	6.41	0	23	0.99	-0.48
Theory of mind (36; 38)	219	17.63	5.09	0	29	-0.66	1.24
Comprehension monitoring (21; 49)	217	13.76	8.73	0	34	0.49	-0.50

*Note.* There were +59 items in Grade 1, and 52 items in Grade 2.

<sup>a</sup> One writing prompt. <sup>b</sup> Items were recoded to have a maximum of four during model estimation due to so few having a five.

### *Written Composition in English and Spanish*

Children's written composition was measured in narrative and opinion genres. In the narrative genre, the Test of Early Written Language (3rd ed.; Hresko et al., 2012) was used with the skateboard prompt in English and the soccer prompt in Spanish. In these prompts, children were shown a series of three illustrations and asked to write a story that goes with the illustrations. In the opinion genre, the written essay task of the Wechsler Individual Achievement Test (3rd ed. [WIAT-3]; Wechsler, 2009) was used in English, and an adapted version of a previously used experimental prompt, favorite animal, was used in Spanish (Kim et al., 2015; Wagner et al., 2011). In the WIAT-3 task, the child was asked to write about her favorite game and three reasons as support. In the favorite animal task, the child was asked to write about

her favorite animal and provide three reasons why. For each writing prompt, children were given a 15-min time limit.

Children's written compositions in English and Spanish were typed up verbatim and the typed up versions were used for evaluation in order to remove unintended extraneous bias of the legibility of handwriting and spelling errors in writing evaluation when using hand-written versions (see Graham et al., 2011, for a review). Children's writing quality was evaluated as the quality and organization of ideas on a scale ranging from 0 to 7 (see Kim et al., 2015, and Olinghouse et al., 2015, for a similar approach). Higher scores were given to compositions with rich and detailed ideas with a clear structure of beginning, middle, and end, and logical sequences of ideas. A score of 0 was assigned to compositions that were illegible or had random strings of letters, and there were a few compositions that received a 0 (see Table 1). Two English-Spanish bilingual

research assistants were trained. When using 200 written compositions per prompt in each language, exact agreement was .95 in narrative tasks and .95 in opinion tasks across the languages, which respectively translated to .88 and .92 in Cohen's kappa.

### *Higher Order Cognitive Skills in English*

**Inference Making.** Children's inference skill in English was measured by the Inference task of the Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999). In this task, the child listened to scenarios comprising one to three sentences and was asked questions that required making inferences. For example, "Mandy wanted to wear last year's dress to school one day, but when she tried it on, she could not wear it. Why?" The correct responses must reference the fact that Mandy has grown or the dress does not fit anymore. Because the CASL inference task was normed for children 7 years and older, seven easier items that were developed and validated in a previous study (Kim, 2017) were used for children in Grade 1. Test administration discontinued after five consecutive incorrect items. Cronbach's alpha was .89 and .92 in Grade 1 and Grade 2, respectively.

**Perspective Taking (Theory of Mind).** Students' perspective taking was measured by a theory of mind task. Theory of mind is one's ability to understand others' mental states and perspectives such as thoughts, emotions, desires, and beliefs (Wellman et al., 2001) and, thus, was used in the present study to measure children's perspective taking skill. A normed theory of mind measure, the Theory of Mind Inventory-2 (ToMI-2; Hutchins et al., 2012) was used. In this task, brief scenarios were presented with a series of illustrations, followed by emotion identifying (e.g., selecting a sad face out of three options), memory probe, and theory of mind questions. Note that children's responses to a couple of justification questions were scored 0, 1, and 2 depending on the precision of the response whereas all the other questions were scored dichotomously. Cronbach's alpha was .84.

**Comprehension Monitoring.** Comprehension monitoring was measured by an inconsistency detection task (e.g., Kim, 2017; Kim & Phillips, 2014; also see Baker, 1984). In this task, the child heard a short scenario and was asked to identify whether the story made sense or not. If the child indicated that the story did not make sense, she was asked to provide a brief explanation. The meaning of "not making sense" was explained in practice items as sentences not going together due to inconsistency or crucial missing information. There were two practice items and 21 experimental items. For the experimental items, consistent (seven items) and inconsistent stories (14 items) were randomly ordered. Accuracy of the child's answer about whether a scenario was consistent or inconsistent was dichotomously scored. In addition, for the 14 inconsistent stories, the accuracy of children's explanation was scored on a scale ranging from 0 to 2 (0 = inaccurate explanation, 1 = correct explanation but one that required the assessor to make an inference, and 2 = clear and thorough accurate explanation). Thus, if the child correctly responded to an inconsistent story, the total maximum possible score for the item was three points, one point for inconsistency detection and two points for explanation. Cronbach's alpha was .90.

### *Higher Order Cognitive Skills in Spanish*

For theory of mind, a Spanish version of the ToMI-2 (Hutchins et al., 2012) was used. However, because of absence of inference

and comprehension monitoring tasks in Spanish, we developed items for these tasks in Spanish through an iterative process by the lead investigator and two English-Spanish bilinguals on the research team (the second author is a doctoral student in education with a master's degree in applied linguistics, and the third author has a doctorate in education). We first examined and discussed extant inference and comprehension monitoring tasks in English (see the preceding text) and developed similar items in Spanish, revising them multiple times for content, wording, difficulty, and cultural appropriateness. It should be noted that the items in Spanish are not translations of items in English; instead, they were designed to be equivalent to the English items. The research team considered the diversity of Spanish vocabulary and regional colloquialisms. All phrases and keywords were researched and discussed at length to revise accordingly. Beyond the research team, an English-Spanish bilingual expert consultant also provided feedback on the inference making, comprehension monitoring, and ToMI-2 Spanish versions.

**Inference Making.** Children's inference making skill in Spanish was modeled after the CASL inference task, where the child heard one- to three-sentence scenarios and was asked questions that required making inferences. There was a total of 27 experimental items with two practice items. Test administration discontinued after five consecutive incorrect items. Cronbach's alpha was .95.

**Perspective-Taking (Theory of Mind).** Theory of mind in Spanish was measured by a Spanish version of ToMI-2 (Hutchins et al., 2012). The format of the task was highly similar to that of the English version. Cronbach's alpha was .90.

**Comprehension Monitoring.** Similar to the Spanish inference task, the research team adapted the inconsistency detection task in Spanish, following the same procedures described above. Like in the English task, there were consistent (seven items) and inconsistent stories (14 items) randomly ordered. Items were scored in the identical manner as in the English version. Cronbach's alpha was .91.

### **Procedure**

English-Spanish bilingual research assistants were rigorously trained until their accuracy in assessment administration reached 99% and they worked with children in a quiet space in the school. Higher order cognitive tasks were individually administered in two sessions—one session with English tasks and the other with Spanish tasks. The order of English and Spanish tasks was mixed across children—some children had Spanish tasks followed by English tasks, whereas other children had English tasks, followed by Spanish tasks. Writing tasks were administered after higher order cognitive tasks and were administered in small groups (e.g., four children) in two sessions—one session in English and the other session in Spanish. The order of English and Spanish writing tasks was mixed across children. The included tasks took, on average, a total of 80 to 90 min of individual sessions and 60 min of group sessions.

### **Data Analytic Strategies**

We addressed the first research question about dimensionality or factor structure of higher order cognitive skills and writing using confirmatory factor analysis (CFA). The second research question was addressed by using identified factor structures with a

multigroup structural regression model, comparing students in a dual language immersion program to those students in an English immersion program. Writing measures were entered as categorical variables in all models, cognitive measures were entered as continuous, and covariate measures were entered as categorical variables with dummy codes where relevant.

### **Dimensionality: Factor Structure**

Higher order cognitive skills and writing were modeled concurrently using maximum likelihood estimation with robust standard errors (MLR) in Mplus Version 8.4 (Muthén & Muthén, 1998–2018). Unidimensional structures and bifactor structures (Gibbons & Hedeker, 1992; Riese, 2012) were examined. In a bifactor model, the general factor estimates the common variance among the manifest variables or indicators, theoretically capturing the reliable variance for each indicator. Specific factors, which help to explain indicator variance not captured by the general factor (e.g., method variance), are orthogonally estimated in addition to the general factor.

Three alternative structures were tested for higher order cognitive skills and written composition, respectively. The three structures tested for higher order cognitive skills were as follows: (a) a bifactor structure with a specific factor for English skills, a specific factor for Spanish skills, and a general factor for cognitive skills (i.e., higher order cognitive language bifactor model); (b) a bifactor structure with a specific factor for theory of mind, a specific factor for comprehension monitoring, a specific factor for inference, and a general factor for cognitive skills (i.e., higher order cognitive skills bifactor model); and (c) a unidimensional structure with all measures of theory of mind, inference, and comprehension monitoring in English and Spanish loading onto a single cognitive factor (i.e., higher order cognitive unidimensional model). The three structures tested for written composition were as follows: (a) a bifactor model with a specific factor for English writing, a specific factor for Spanish writing, and a general factor for writing (e.g., writing language bifactor model); (b) a second bifactor structure with a specific factor for narrative writing, a specific factor for opinion writing, and a general factor for writing (e.g., writing genre bifactor model); and (c) a unidimensional model with all writing measures loading onto a single writing factor (e.g., writing unidimensional model).

The combination of the three models for higher order cognitive skills and written composition resulted in three sets of models for a total of nine alternative models (three structures for higher order cognitive skills by three structures for written composition; see Figure 1). The first set of three models (see Models 1 through 3 in Figure 1) included cognitive bifactor with specific factors by language (English and Spanish), with the following three different writing factor structures: writing bifactor with specific factors by language (Model 1), writing bifactor with specific factors by genre (Model 2), and unidimensional writing (Model 3). The second set of three models included Cognitive Bifactor with specific factors by cognitive skills (inference, perspective taking, and comprehension monitoring) with the same three writing factor structures (see Models 4 through 6). The last set of three models included cognitive unidimensional and the three different writing factor structures (see Models 7 through 9).

### **Structural Model: Multiple Group Modeling**

We fit a multiple group model using the identified structures for writing and higher order cognitive skills in Mplus 8.4 through

implementing mixture modeling and using the known class option for specifying groups. Invariance of structure across groups were examined, including testing for configural invariance (overall same structure across groups), metric invariance (i.e., testing for equivalent factor loadings across groups), and scalar invariance (i.e., testing for equal item intercepts across groups). Students' background variables such as sex (female = 1), poverty (eligible for free and reduced lunch = 1), grade (grade 1 as the reference group), English learner status (English learner = 1), school (School 3 as the reference group), and biliterate status (biliterate = 1) were included as covariates and were regressed onto the identified dimensions of higher order cognitive skills and written composition in the multiple group modeling.

### **Model Fit**

Because models were fit using MLR with categorical variables, model fit estimates reported were the log likelihood value and the scaling correction factor for MLR, the Akaike's information criterion (AIC), and the sample sized adjusted Bayesian information criteria (*n*BIC). In comparing models, AIC and BIC numbers closer to negative infinity were preferred, where a *n*BIC difference of two to six was considered positive evidence for a better fitting model, a difference of 6 to 10 was considered strong evidence, and a difference of greater than 10 was considered very strong evidence (Raftery, 1995).

## **Results**

### **Descriptive Statistics and Preliminary Analysis**

Table 2 shows mean, standard deviation, minimum, maximum, skewness, and kurtosis for the full sample and by instructional programs. Students' mean writing scores ranged from 2.95 to 3.19 across the narrative and opinion tasks in English and Spanish. Although the maximum possible score in the writing quality rubric was seven, the observed highest score in the sample was five; however, very few students achieved a 5 (i.e., a maximum of four students were given a five for each narrative and opinion sample in English and Spanish). Because there were very few scores of five, all values of five were collapsed downward into the four category to avoid low bivariate frequencies and to assist with model fitting convergence (B. Muthén, 1984; descriptive statistics are reported with original values in Table 2). Students' performances on the inference tasks in English and Spanish tended toward slight floor effects, but skewness and kurtosis estimates of all the variables were well within expected ranges ( $\pm 3$  for skewness and  $< 7$  for kurtosis; West et al., 1995).

Table 3 presents bivariate correlations between variables by instructional programs. Writing quality in the same language across the genres and in the same genre across the languages was weakly to moderately related ( $.09 \leq r_s \leq .55$ ). Higher order cognitive skills in English ( $.38 \leq r_s \leq .65$ ) and Spanish ( $.30 \leq r_s \leq .62$ ) were also moderately to fairly strongly related. Cross-language correlations between the same tasks were as follows:  $.35 \leq r_s \leq .43$  for inference,  $.39 \leq r_s \leq .43$  for theory of mind, and  $.29 \leq r_s \leq .59$  for comprehension monitoring. The relations of higher order cognitive skills in English and Spanish to writing quality in English and Spanish ranged from .02 to .29 for students in the English immersion

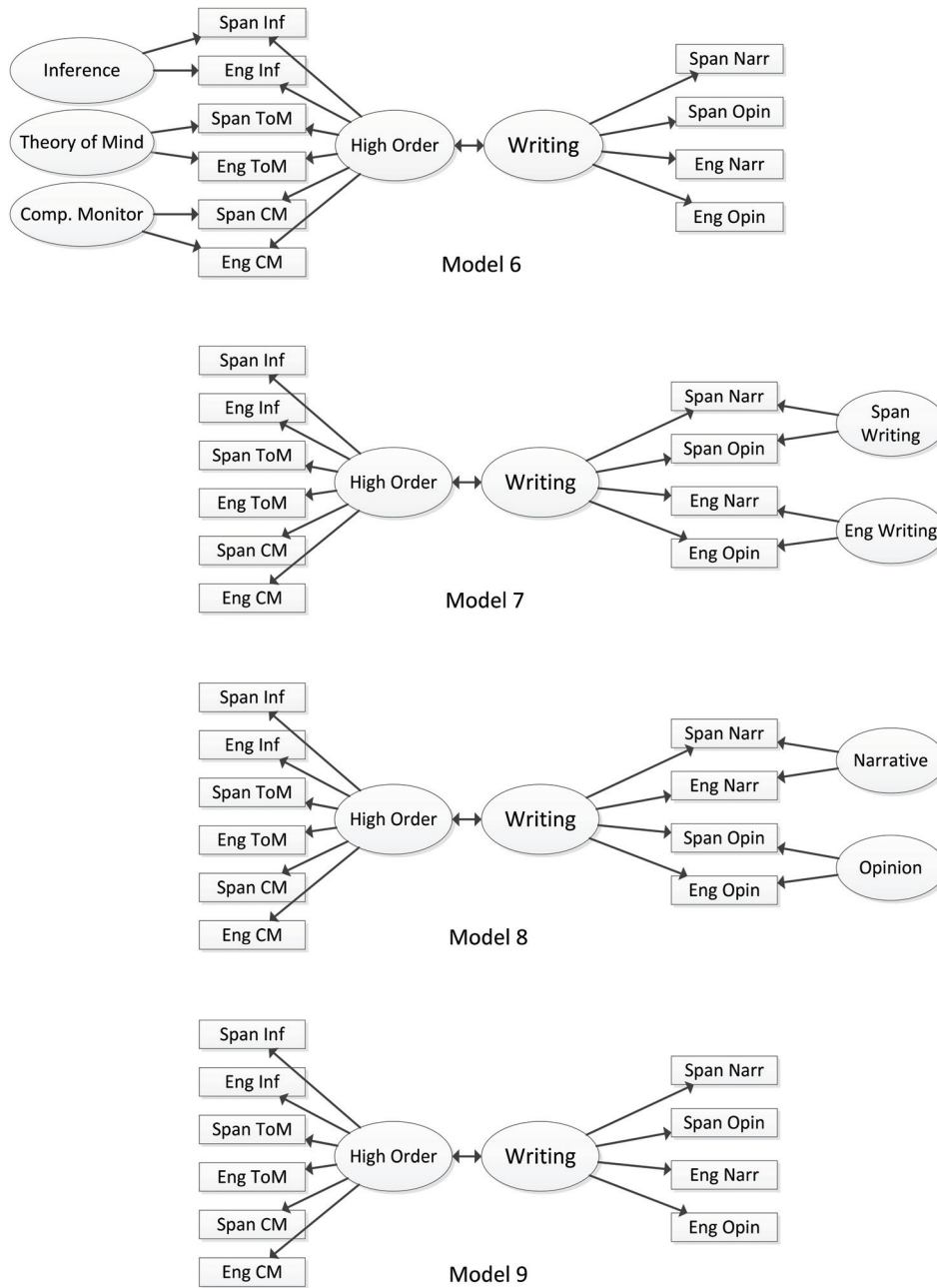


**Figure 1**  
*Alternative Models for the Dimensionality/Factor Structure of Higher Order Cognitive Skills and Writing in English and Spanish*



(figure continues)

Figure 1 (continued)



Note. Higher Order = higher order cognitive skill; Eng = English; Span = Spanish; Inf = inference; ToM = theory of mind; CM = comprehension monitoring; Narr = narrative writing; Opin = opinion writing.

program and from .18 to .35 for students in the dual immersion program.

**Research Question 1: Dimensionality of Higher Order Cognition and Writing**

The nine alternative CFA models shown in Figure 1 were fit to the data, and the model fit information is presented in Table 3. According to the model fit statistics, the best fitting model was model 3, whereby a bifactor structure with specific factors by

language represented higher order cognitive skills and a unidimensional structure represented writing skill. In other words, higher order cognitive skills were defined by a bifactor structure with a higher order cognitive general factor, and English and Spanish specific factors whereas writing was best described as unidimensional across the languages and genres. The explained common variance (ECV; Riese, 2012) for the higher order cognitive general factor was .61, indicating that 61% of the common variance among the measured cognitive skills was attributable to the general factor. The Spanish and English specific factors accounted for

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**Table 3**  
*Correlations Among Variables*

Variable	1	2	3	4	5	6	7	8	9	10
1. English narrative writing quality	—	.22	.27	.09†	.15†	-.03†	.08†	.05†	.02†	.05†
2. English opinion writing quality	.36	—	.34	.45	.24	.19†	.26	.24	.30	.29
3. Spanish narrative writing quality	.47	.42	—	.30	.06†	.04†	.17†	.06	.08†	.16†
4. Spanish opinion writing quality	.33	.55	.40	—	.05†	.13†	.19†	.13+	.19†	.15†
5. English inference	.35	.33	.25	.24	—	.39	.58	.43	.27	.30
6. English theory of mind	.19	.25	.18	.19	.38	—	.44	.14†	.39	.12†
7. English comprehension monitoring	.29	.35	.24	.25	.65	.48	—	.36	.33	.29
8. Spanish inference	.31	.28	.21	.21	.35	.29	.37	—	.30	.62
9. Spanish theory of mind	.19	.18	.25	.19	.20	.43	.28	.34	—	.44
10. Spanish comprehension monitoring	.29	.30	.30	.29	.38	.34	.59	.41	.43	—

*Note.* All coefficients are statistically significant at .05 level except for †. Coefficients above the diagonal are for students in the English immersion program and those below the diagonal are for students in the English-Spanish dual immersion program.

about 20% of the common variance each (ECVs = .19 and .20, respectively). Additionally, coefficient omega ( $\omega$ ; McDonald, 1999) was .85, indicating that the general factor for cognitive skills was very reliable. The specific English factor and the specific Spanish factor were not reliable ( $\omega = .49$  and  $\omega = .43$ , respectively). The writing factor was also reliable ( $\omega = .77$ ). The bivariate correlation between the higher order cognitive general factor and writing factor was .59 ( $p < .001$ ).

### Research Question 2: Relations of Higher Order Cognitive Skills to Writing Quality

Using the identified factor structures for higher order cognitive skills and writing, a multiple group model shown in Figure 2 was fit to the data. Results of the invariance testing are presented in the bottom of Table 4. The metric invariant model was significantly worse fitting than the configural invariant model ( $\Delta nBIC = 65.5$ ), indicating that the item loadings could not be constrained across groups. The scalar model also produced worse fit ( $\Delta nBIC = 44.8$ ) as compared to the configural model. Therefore, results across groups are presented with no parameter constraints across groups.

Standardized coefficients of the configural invariant model with covariates are presented in Figure 2. For the students in the English immersion program, the higher order cognitive general factor significantly predicted writing quality (.43,  $p < .001$ ). Students in School 2 had better writing as compared to students in School 3 (.52,  $p = .001$ ). Being in Grade 2 (.31,  $p = .001$ ), being female (.28,  $p = .007$ ), being an English language learner (.29,  $p = .006$ ) and being biliterate (.22,  $p = .028$ ) were all statistically significantly associated with the higher order cognitive skill. The covariates accounted for 31% of the variance in the higher order cognitive factor in ( $p = .001$ ), and the combination of the covariates and the higher order cognitive factor accounted for 39% of the variance in writing quality.

For students in the Spanish–English dual language program, the higher order cognitive general factor also significantly predicted writing skills (.41,  $p < .001$ ). This was not statistically significantly different from the magnitude estimated for students in the English immersion program. Students in grade 2 had higher writing (.31,  $p = .001$ ) and higher order cognitive skills (.35,  $p = .001$ ). Being eligible for the free or reduced-price lunch program was associated with lower writing skills (–.21,  $p = .04$ ). Biliterate students had higher scores in higher order cognitive skills for students

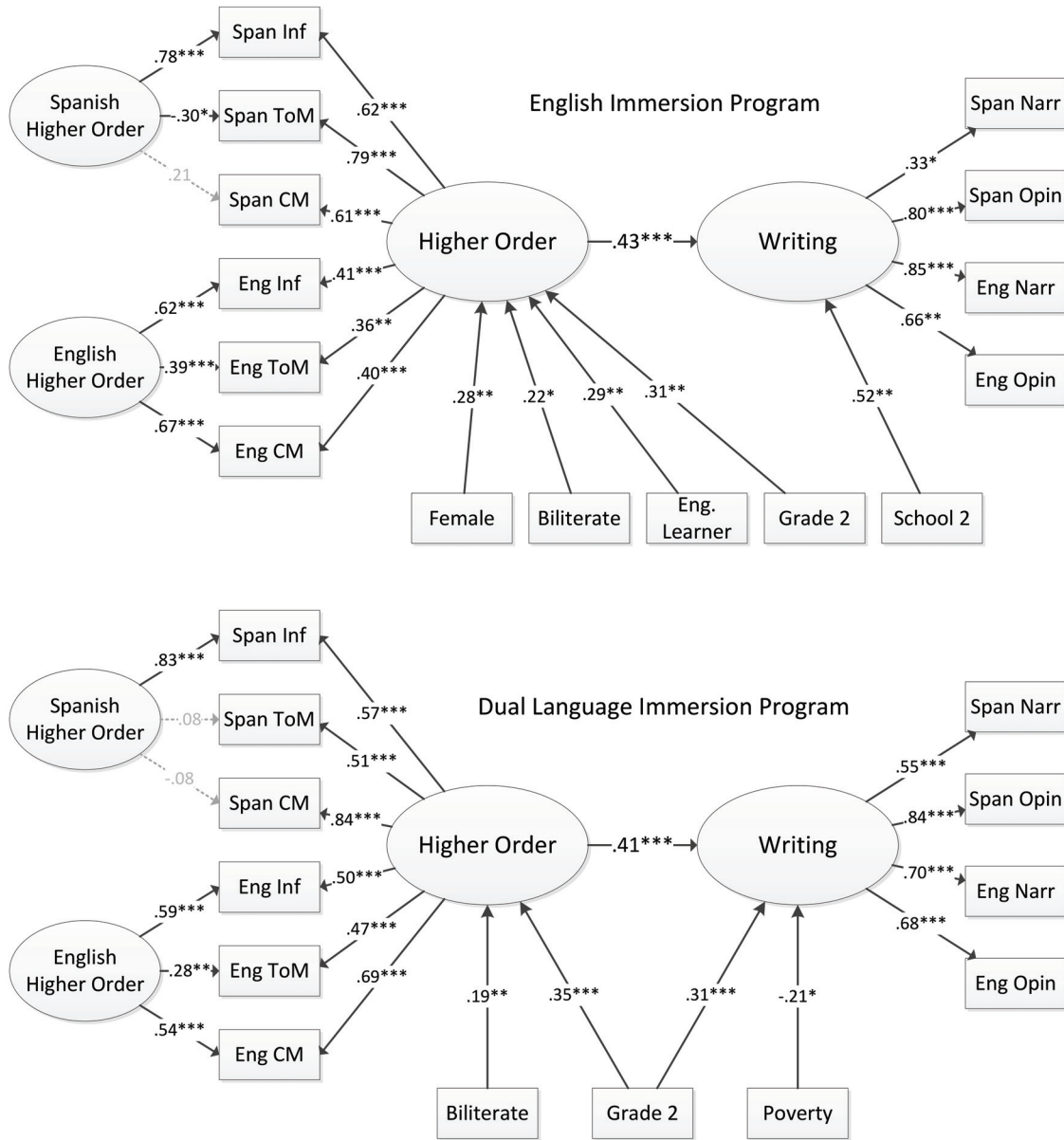
in the dual immersion program (.19,  $p = .004$ ). The covariates accounted for 23% of the variance in higher order cognitive skills factor ( $p < .001$ ), and the combination of covariates and the higher order cognitive skill factor accounted for 40% of the variance in writing quality.

### Discussion

Writing is one of the most challenging skills for many students as it requires juggling of complex processes that draw on a number of language and cognitive skills. In the present study we examined writing skills and higher order cognitive skills in English and Spanish in terms of their dimensionality and their relations for Spanish–English dual language learners in primary grades. Based on the linguistic interdependence hypothesis (Cummins, 1979), we hypothesized that higher order cognitive skills are related between languages (e.g., L1 and L2). We also hypothesized that higher order cognitive skills are related to writing quality (Kim, 2020; Kim & Graham, 2021; Kim & Park, 2019). To our knowledge, this is the first study to address these questions for dual language learners.

A systematic examination of the dimensionality of writing skills supported a single dimension across narrative and informational (opinion) genres in L1 and L2. In other words, children who were strong in English writing had strong writing in Spanish and wrote quality narrative and opinion essays. The vast majority of prior research on writing focused on writing in either L1 or L2. Our present results add to prior work by examining writing in two languages, L1 and L2, by children, and by examining dimensionality of writing skills explicitly. As noted in the preceding text, the writing process involves translating ideas into language, and thus relies on language skills (Berninger et al., 1996; Kim et al., 2011, 2014, 2015; Olinghouse, 2008; Olinghouse & Leaird, 2009). Then a large gap between L1 and L2 proficiency would result in dissociation of L1 writing quality from L2 writing quality. Furthermore, writing in different genres requires ideas expressed using different text structures and associated linguistic features, and thus, children's knowledge of these features is an important factor (Kim, 2020; Kim & Graham, 2021; Olinghouse et al. 2015) and discrepancies in knowledge in different genres would result in a gap and dissociation in writing quality in different genres. However, our findings suggest that for Spanish–English dual language learners in primary grades in the United States, writing quality is a unitary

**Figure 2**  
*Final Multiple Group Model for Writing and Cognitive Skills for Students in an English Immersion Program (Top) and a Dual Language Immersion Program (Bottom)*



*Note.* Higher Order = higher order cognitive skill; Eng = English; Span = Spanish; Inf = inference; ToM = theory of mind; CM = comprehension monitoring; Narr = narrative writing; Opin = opinion writing.  
 \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

construct that cuts across languages and genres, not a two-factor construct driven by language or a two-factor construct driven by genre.

Another notable finding is the dimensionality of higher order cognitive skills. In the comparison of the alternative models (see Figure 1), our data supported a bifactor structure with a general factor that captures common skill across the languages and specific skills, and specific factors by language—English higher

cognition and Spanish higher order cognition. These results indicate that the abilities to infer information, infer others’ mental status and perspective, and monitor one’s performance are largely described as a common skill. Beyond the general factor, there was common method aspects within a language (i.e., specific factors). The finding of language-specific aspects is in line with theoretical models such as DIEW (Kim, 2020; Kim & Graham, 2021; Kim & Park, 2019), which posits that higher order cognitive skills are

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**Table 4**  
*Model Fit Statistics for Alternative Structural Models and Invariance Models*

Model number or type	LL	SCF	AIC	nBIC	Model comparison
Structural models					
1	-7020.86	1.01	14143.73	14173.67	
2	-7020.42	1.14	14142.83	14172.78	2 vs. 1: $\Delta nBIC = -0.89$
3	<b>-7022.51</b>	<b>1.02</b>	<b>14137.03</b>	<b>14164.04</b>	<b>3 vs. 2: <math>\Delta nBIC = -8.74</math></b>
4	-7053.27	0.96	14206.53	14235.89	4 vs. 3: $\Delta nBIC = +71.85$
5	-7054.25	1.02	14200.51	14227.51	5 vs. 3: $\Delta nBIC = +63.47$
6	-7055.42	0.98	14200.84	14227.26	6 vs. 3: $\Delta nBIC = +63.22$
7	-7059.45	1.01	14206.90	14232.73	7 vs. 3: $\Delta nBIC = +68.69$
8	-7054.32	0.99	14206.63	14235.39	8 vs. 3: $\Delta nBIC = +71.35$
9	-7061.26	1.04	14200.51	14223.41	9 vs. 3: $\Delta nBIC = +59.37$
Invariance models					
Configural	<b>-6724.25</b>	<b>1.10</b>	<b>13638.50</b>	<b>13689.39</b>	
Metric	-6777.28	1.03	13712.55	13754.87	Metric vs. Config: $\Delta nBIC = +65.48$
Scalar	-6785.96	1.05	13699.81	13734.20	Scalar vs. Config: $\Delta nBIC = +44.81$

*Note.* The final models appear in boldface. LL = log likelihood; SCF = scaling correction factor for maximum likelihood estimation with robust standard errors; AIC = Akaike's information criterion; nBIC = sample-size-adjusted Bayesian information criterion.

supported by language skills such as vocabulary and grammatical knowledge. What is novel in this study is that higher order cognitive skills as a whole can be described as a skill across languages and subskills, at least for Spanish–English dual language learners in primary grades. These findings support and expand the linguistic interdependence hypothesis by revealing that higher order cognitive skills are related between languages, and by suggesting that higher order cognitive skills are part of the “underlying cognitive/academic language proficiency” across languages. In other words, higher order cognitive skills likely transfer between languages. Future work with an experimental design is needed to confirm cross-linguistic transfer of higher order cognitive skills.

The present findings also highlight the relations of higher order cognitive skills to writing quality, corroborating the hypothesis in DIEW (Kim, 2020; Kim & Graham, 2021; Kim & Park, 2019; Kim & Schatschneider, 2017). Quality writing requires local and global coherence, and establishing coherence draws on higher order cognitions. We found a fairly strong relation between higher order cognitive skills and writing quality (.59), and this relation remained after accounting for control variables. The relations of higher order cognitive skills to writing quality are convergent with previous findings (Cho et al., 2021; Kim, 2020; Kim & Park, 2019; Kim & Schatschneider, 2017; Limpo & Alves, 2013), and the present findings extend these previous studies to dual language learners. The results also revealed that the magnitude of the relation was essentially the same regardless of instructional programs, English immersion and Spanish–English dual immersion, suggesting that the contribution of higher order cognitive skill to writing quality does not differ by instructional programs.

The present study also revealed an important nuance with regard to instructional programs and students' performance. Specifically, biliterate students (those who were able to write in both languages) had higher performance in higher order cognitive skills regardless of instructional programs. Explanations for this finding are not clear and future studies are needed. We also found an interplay of students' writing and instructional programs. Many students in the English immersion program wrote in English when prompted to write in Spanish. For those in the Spanish–English dual program, many students were able to write in both languages while some students in

grade 1 wrote in Spanish when prompted to write in English. By design students in the Spanish–English dual program receive literacy instruction in both whereas students in the English immersion program receive instruction only in English. Therefore, students in the English immersion program have less chance of developing literacy skills in Spanish, and explain the patterns we found. These results indicate the importance of considering instructional contexts in language and literacy development of multilingual learners.

Given the correlational nature of the study, practical implications from the present results are limited. Nonetheless, we believe that the findings offer a couple of preliminary ideas for practice. First, the bifactor structure for higher order cognitive skills suggests that instruction in L1 or L2 would help develop higher order cognitions for dual language learners. Furthermore, the relation of the higher order cognitive skills to writing quality suggests that instruction on higher order cognitive skills, again in L1 or L2, would improve students' writing skills. Higher order cognitive skills have been shown to be important to writing for monolingual students (Kim & Park, 2019; Kim & Schatschneider, 2017) as well as reading comprehension for monolingual students (Barnes et al., 1996; Cain et al., 2004; Kim, 2017) and dual language learners (e.g., Frid & Friesen, 2020). However, instructional studies that explicitly target higher order cognitions in L1 or L2 for dual language learners are scarce. An exception is a recent study where adolescent dual language learners (English learners) were provided with inference instruction in L2 and their L2 reading comprehension improved (Hall et al., 2020). Future studies are warranted to investigate the effect of higher order cognition instruction in L1 or L2 on literacy skills.

### Limitations and Future Directions

As is the case with any study, the generalizability of the findings is limited to populations that are similar to the sample in this study—Spanish–English dual language learners in primary grades in the United States. Future efforts are warranted to replicate the present study with different populations of dual language learners. In addition, future studies can examine the independent roles of higher order cognitive skills to writing over and above other skills not included in the present study, such as oral language skills. Studies in L1 have

shown that higher order cognitive skills are related to writing over and above language skills (Kim, 2020; Kim & Park, 2019), and extending this to the dual language learner population would be an important next step.

### Conclusion

Writing requires coordinating and juggling multiple processes, and numerous skills contribute to these processes. The present study extends research in L1 writing to higher order cognitive skills and writing skills in L1 and L2, demonstrating that thinking in L1 and L2, and writing in L1 and L2 go hand in hand, and that thinking skills are resources to writing skills. Future work is certainly needed to further explore and expand L1–L2 relations, particularly for children.

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