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Individual Differences as Predictors of L2 writing: L2 Proficiency, Working Memory Capacity, and Explicit Language Aptitude*

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ABSTRACT

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Much attention has been paid to the effects of individual differences on L2 learning in recent years, but there is still a lack of studies that directly investigated the roles that more cognitive individual differences play in L2 writing. The present study investigated whether L2 proficiency, working memory capacity (WMC), and explicit language aptitude (ELA) could predict L2 writing, in terms of syntactic complexity, lexical diversity, and accuracy. Because L2 writing requires conscious cognitive effort, the study also sought to find out whether these individual differences could also predict the cognitive load imposed on the learner during L2 writing. Forty-two Korean EFL learners completed a series of an English proficiency test, a writing task, a questionnaire measuring cognitive load, a test of ELA, and a test of WMC. Results revealed that those with greater L2 proficiency and explicit language aptitude perceived the writing task as more difficult and/or stressful. Regarding written performance, higher L2 proficiency was linked to greater accuracy, and higher WMC was associated with greater lexical diversity. These results have implications for our understanding of the cognitive processes and demands of L2 writing.

KEYWORDS

L2 writing, L2 proficiency, working memory capacity, explicit language aptitude

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1. Introduction

Second language (L2) writing is a cognitively challenging process, during which learners must exert conscious effort in planning and organizing their ideas, transcribing their ideas into writing, and making revisions. Due to a lack of automatized knowledge (DeKeyser 2007), L2 writing is generally considered to be more challenging than L2 listening, speaking, or reading (Dixon and Nessel 1983). Writers also face the challenges of considering the vocabulary, grammar, and morphology of the L2 for lexical retrieval and sentence production processes. Considering the difficulties that L2 learners must overcome, combined with the various writing styles and strategies from which they can choose, research in recent years has witnessed a rise in the number of studies investigating the factors that underlie effective L2 writing, the majority of which focus on the effects of affective variables, such as language learning goals, self-efficacy beliefs, and writing anxiety.

L2 writing involves strenuous cognitive effort, and cognitive load is claimed to be a fundamental constraint on the writing process. In fact, cognitive overload may hinder effective L2 writing, as writers may be unable to carry out the writing component processes effectively if there are conflicting demands on limited cognitive resources (Galbraith and Vedder 2019). Therefore, a question can be raised about the appropriate level of cognitive load that is conducive to "good" L2 writing, which involves rich vocabulary and syntactically complex structures that are used with a high degree of accuracy (Sweller et al. 2011, Paas et al. 2003). This cognitively demanding process of L2 writing draws on existing L2 knowledge and skills, and Kormos (2012, 2023) claimed that working memory (WM) resources and aptitude can play a major role in L2 writing processes and the quality of the written output. In other words, the quality of learners' written product may differ due to their different cognitive abilities.

In this study, an investigation was conducted to find out whether the variability shown in L2 writing could be accounted for by cognitive individual difference (ID) variables—L2 proficiency, working memory capacity (WMC), and explicit language aptitude (ELA). Although several previous studies have investigated the effects of these IDs on L2 writing separately, there is a lack of empirical research exploring the impact of these factors in a single study. Because a combination of cognitive IDs can have an interaction effect on L2 writing performance and the mental burden that learners may experience while writing in the L2, this study aimed to examine the extent to which the three IDs mentioned above could significantly predict the syntactic complexity, accuracy, and lexical diversity observed in learners' written output. Furthermore, it also aimed to investigate whether any differences reported on the cognitive load of the same writing task by the same learners could be explained by the three ID variables. The research questions of the study are as follows:

RQ1. Are L2 proficiency, WMC, and ELA predictive of the cognitive load imposed on L2 learners during L2 writing?
RQ2. Are L2 proficiency, WMC, and ELA predictive of L2 written performance in terms of syntactic complexity, lexical diversity, and accuracy?

2. Previous Research

2.1 Cognitive Load and L2 Writing

During the writing process, a fundamental constraint is cognitive overload; that is, demands on limited

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cognitive resources can be so overwhelming that writers may not be able to carry out the writing task effectively (Flower and Hayes 1980). Given that cognitive overload exists during writing in the native language (L1), learners are more likely to experience greater demands when they are writing in the L2. According to Nawal (2018), learners' limited control over their writing quality stems from several factors: 1) initially thinking in their L1, 2) translating meanings into the L2, 3) retaining this information in the WM, and 4) using these words to construct sentences. The L2 writing process is quite complex, imposing a heavy cognitive load on the learner. Cognitive resources and abilities are limited, and the learner must know how to process multiple sources of information together and allocate their attention effectively for L2 writing to be successful. When given the same writing task, those who feel less of a mental burden may be able to allocate their attention to different aspects of the written product, whereas those who feel cognitively overwhelmed by the writing task itself may not have enough attentional resources to spare for the quality of the output. In this study, a subjective measure of cognitive load, e.g., a self-rating questionnaire, was employed to find out whether learners' cognitive abilities influenced the extent to which they feel a mental burden during L2 writing.

2.2 L2 Proficiency and L2 Writing

Although it is reasonable to think that L2 proficiency would be significantly related to L2 writing, only a handful of studies have directly investigated the impact of L2 proficiency as an independent variable, rather than as a controlled factor. Such research on the relationship between L2 proficiency and written production usually employed CAF measures as outcome measures—i.e., complexity, accuracy, and fluency.

In an attempt to investigate the role that L2 proficiency plays in the relationship between task complexity and linguistic performance, Kuiken and Vedder (2008) incorporated a cloze test as a general measure of overall L2 proficiency. Dutch learners of Italian and of French were each divided into low- and high-proficiency groups based on their cloze test scores, and both groups completed two written tasks that differed in terms of task complexity, manipulated by the number of elements. Results of several repeated measures MANOVAs with task complexity as the within-subjects variable and L2 proficiency as the between-subjects variable revealed that L2 proficiency had a significant effect on accuracy, syntactic complexity, and lexical variation for the learners of Italian, and a significant effect on accuracy and syntactic complexity for the learners of French. However, L2 proficiency was not found to significantly interact with task complexity for either group.

In a similar study that compared task complexity effects between the spoken and written mode, Kuiken and Vedder (2011) found that regardless of the linguistic mode, L2 proficiency had a significant impact on accuracy and lexical variation. When considering linguistic mode, however, its effect on syntactic complexity was only obtained in the written mode. In line with their predictions based on previous research, significant interactions between L2 proficiency and task complexity were not found in either mode, indicating that task complexity effects were not mediated by L2 proficiency. Upon closer examination of the types of learner errors, it was found that high-proficiency learners made significantly fewer errors in terms of grammar and orthography when writing, and pronunciation during speech.

In a more recent study, Nair and Sircar (2021) examined whether task complexity manipulations and L2 proficiency had an impact on L2 writing. Thirty learners of English were divided into two groups based on their English proficiency, and they completed five writing tasks with differing levels of cognitive complexity. L2 writing was examined in terms of syntactic complexity, syntactic variety, lexical density, lexical variety, and accuracy. It was found that higher proficiency had a positive effect on most linguistic measures, and greater task

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complexity affected the two proficiency groups differently. More specifically, those with higher proficiency showed greater syntactic complexity and lexical variety when carrying out more complex tasks, while those with lower proficiency exhibited decreased lexical density and variety with greater task complexity.

While the aforementioned studies looked into the effects of both L2 proficiency *and* task complexity on linguistic performance, Benzehaf (2017) explored the extent to which CAF measures reflected learners' overall L2 proficiency levels. Eighty-eight participants completed a general proficiency test comprising five sub-parts that measured comprehension, grammar, vocabulary, functions, and paragraph writing abilities separately. In addition to the proficiency test, learners carried out a writing task of intermediate difficulty, in which they were required to write about the causes of and solutions to a certain phenomenon. Complexity, accuracy, and fluency were each assessed by one global measure: the number of dependent clauses per T-unit, the ratio of error-free T-units to the total number of T-units, and the number of words per minute, respectively. Results of a Pearson correlational analysis revealed that learners' proficiency levels were strongly correlated with all performance measures, with fluency having the strongest relationship. Accordingly, the researcher concluded that CAF constructs could be valid components for measuring overall L2 proficiency.

Based on previous research, it appears evident that L2 proficiency has a significant effect on various aspects of L2 writing. However, the studies mentioned above either examined L2 proficiency effects in combination with task complexity effects (Kuiken and Vedder 2008, 2011, Nair and Sircar 2021), or merely conducted a correlation analysis (Benzehaf 2017) whose results do not imply causation. To fill the gap in the literature, the present study attempted to investigate the extent to which L2 proficiency could predict L2 writing regarding syntactic complexity, lexical diversity, and accuracy. Furthermore, it also examined whether L2 proficiency could predict the cognitive complexity of a task. In other words, it sought to find out whether the mental load imposed on the learner differed depending on the level of learners' L2 proficiency.

2.3 Working Memory Capacity and L2 Writing

Working memory (WM) has been claimed to be an important predictor of the success of various complex cognitive operations, such as note-taking, writing, and reasoning (Engle et al. 1999). It is "a limited capacity system, which temporarily maintains and stores information, supports human thought processes by providing an interface between perception, long-term memory, and action" (Baddeley 2003, p. 829). According to Conway et al. (2005), it is a multi-componential system that actively maintains information in the face of ongoing processing and/or distraction, which is the result of domain-specific storage and rehearsal processes and domain-general executive attention. The most well-known model of WM was proposed by Baddeley and Hitch (1974), with an additional element (the episodic buffer) included in a later version (Baddeley 2000). Emphasizing its role as a system for complex cognitive tasks, such as language comprehension, arithmetic, syllogistic reasoning, and complex dynamic tasks, this multiple-componential model of WM consists of four parts: the central executive, phonological loop, visuospatial sketchpad, and episodic buffer. WMC is determined by storage and processing components, with each component measurable separately or in combination. In the present study, WMC was examined to see whether it could account for differences, if any, in the desired changes in cognitive load and task performance.

In comparison to L1 writing, L2 writing is claimed to be more reliant on WM resources because it is more effortful and requires more focused attention (Kormos 2012). For instance, while encoding syntactic and morphological structures, retrieving syntactic information related to words, and associating orthographic form

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with lexical entries are automatic when writing in the L1, all of these procedures, in addition to the reading processes involved in the editing and revision stages of writing as well as transcribing processes, demand more conscious attention during L2 writing. Therefore, Kormos (2012) argued that each stage of L2 writing is affected by WMC. In a similar vein, Kellogg (1996, 1999) attempted to account for the role that WM plays during the various stages of writing by incorporating Baddeley's WM model. Borrowing Hayes and Flower's (1980) model of text formulation, this proposal explained how specific writing processes rely on the main components of WM. Three writing processes—formulating, executing, and monitoring—each involve two-level basic processes. The formulation process involves the planning of ideas and translating them into linguistic expressions later to be handwritten, typed, or dictated. The execution process consists of motor unit programming and the execution of muscle movements. Overseeing the formulation and execution systems, the monitoring process involves reading an already produced text and editing the mental and textual representation output. The order of these processes is not fixed, and the model supports simultaneous activation of these processes unless processing demands on WM exceed capacity limitations. Table 1 provides a summary of the types of WM components used by each writing process.

Table 1. WM Components Used by Writing Processes (Adapted from Kellogg 1999)

		Working memory component		
	Basic Process	Spatial	Central executive	Verbal
Formulation	Planning	✓	✓	
	Translating		✓	✓
Execution	Programming		✓	
	Executing			
Monitor	Reading		✓	✓
	Editing		✓	

Seeking to find out why some learners have difficulty in acquiring a second language, second language acquisition (SLA) researchers have shown interest in how differences in WMC might account for variation in L2 learning and use. The relationship between WMC and the attentional demands of L2 tasks has been of particular interest, and most studies have investigated the role that WM plays in the noticing of spoken feedback and interaction-driven L2 learning. Some researchers have also claimed that WM may also play a role in learners' noticing and learning processes through written feedback due to the strenuous process of writing on WM (Kormos and Sáfár 2008). To date, there is a paucity of work investigating how certain components of WM directly affect L2 production.

A number of studies have directly examined the effects of WMC on L2 writing. Forty-seven high school students in Abu-Rabia's (2003) study, which focused on how WMC affected writing as well as reading, took a comprehensive test of written language to assess writing ability. Writing ability included spelling, vocabulary, style, logical sentences, sentence combining, thematic maturity, contextual vocabulary, syntactic maturity, contextual spelling, and contextual style. Participants' WMC was measured by a reading comprehension test. Results of correlational analyses revealed a significant positive correlation between WMC and the subtests and the total test of written language.

Zabihi (2018) examined the effects of WMC, writing anxiety (WA), and writing self-efficacy (WSE) on CAF outcome measures. An automated operation span task (A-Ospan) was used to measure the WMC of 232 upper-intermediate L2 learners of English, and a narrative task was employed to evaluate their written performance. A

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path analysis was conducted, and results revealed that all three factors significantly predicted writing complexity, accuracy, and fluency. More specifically, greater WMC was found to be associated with greater complexity and fluency, but with lower accuracy. Zabihi suggested that the negative relationship between WMC and accuracy may be due to the time limit set on the writing task (11 minutes) and lack of pretask planning.

In a study of the interactive effects of task complexity and task modality, Zalbidea (2017) investigated whether WMC played a moderating role in the relationship between the two. Thirty-two learners of Spanish either carried out two argumentative tasks in the speaking or writing modality, and the tasks differed in terms of task complexity, manipulated by the number of elements and amount of reasoning demands. Participants' WMC was measured by an operation span task (OSpan), and a correlation analysis revealed that significant relationships were found with learners' performance only when they carried out the complex tasks. More specifically, a significant positive correlation between WMC and the number of subordinating conjunctions was obtained in the speaking modality, and a significant negative correlation between WMC and the number of nominal errors was obtained in the writing modality. All other correlations were not found to be significant. Because such significant relationships arose in the more complex tasks only, the researcher concluded that learners with greater WMC are more adept at allocating attentional resources to introducing argumentation via subordination in speech and to accuracy monitoring in writing during tasks with high conceptual demands.

More recently, Vasylets and Marín (2021) examined the effect of WM on L2 writing performance, aiming to find out how this impact differs based on learners' level of L2 proficiency. A total of 56 L2 English learners with varying proficiency levels participated in the research, and the study employed tasks designed to measure WM, L2 proficiency, and L2 writing performance in terms of accuracy, complexity, and fluency. The findings revealed that for learners at lower proficiency levels, WM was linked to higher accuracy. On the other hand, at higher proficiency levels, WM was associated with greater lexical sophistication. The researchers concluded that higher WMC was beneficial for L2 writing, although it could be influenced by learners' L2 proficiency and the specific area of writing.

Similarly, Machón et al. (2023) investigated the effects of WM, L2 proficiency, and task complexity on L2 writing performance. The study recruited 76 Spanish learners of English who completed both a simple and complex version of a writing task, a test of English proficiency, and an n-back WM test. The researchers found that while WM did not have a significant impact on L2 writing, L2 proficiency was significantly linked to the quality of written output. No significant interactions were found between WM, L2 proficiency, or task complexity. In conclusion, L2 proficiency was found to be the only predictor of L2 writing performance, regardless of the level of task complexity.

Despite the considerable interest in ID variables in L2 research, empirical studies on the impact of WMC on L2 writing have been few and far between. The present study aimed to contribute to the literature on WM effects by investigating whether WMC can predict L2 written performance. Building on the claims of Kellogg (1996, 1999) and Kormos (2012), it is suggested that greater WMC may have a beneficial impact on the formulation and monitoring processes, such that writers with higher WMC would be able to plan ideas better, generate more accurate and complex sentences, and detect and modify their errors with more ease. As a result, the present study predicted that WMC would have a positive effect on written performance, particularly when writers need to exert more mental effort while completing a writing task in the L2.

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2.4 Explicit Language Aptitude and L2 Writing

As part of the effort to investigate the nature of variation in L2 learning and use, SLA research in recent years has also looked into foreign language aptitude as an important determinant of language learning success. L2 aptitude is characterized as individual cognitive strengths during L2 learning and performance in various contexts and at various stages (Robinson 2005). Defined as "the variable or variables that determine the amount of time a student needs to learn a given task, unit of instruction, or curriculum to an acceptable criterion of mastery under optimal conditions of instruction and student motivation" (Carroll 1989, p. 26), four components of aptitude have been proposed: 1) phonetic coding ability, 2) grammatical sensitivity, 3) memory abilities, and 4) inductive language learning ability (Carroll 1990).

Based on the LLAMA test battery (Meara 2005), which is claimed to measure various components of language aptitude, Granena (2013) proposed that aptitude has two dimensions that differ in their relevance for language learning: explicit language aptitude (ELA) and implicit language aptitude (ILA). ELA is relevant for explicit language learning and processing through reasoning and deliberate hypothesis testing, and ILA is relevant for acquiring patterns in input without awareness of the rules (implicit induction). Aptitude was measured via the LLAMA test battery, whose subtests measure the ability to learn unknown vocabulary (LLAMA B), recognize unfamiliar sounds (LLAMA D), associate sounds to corresponding orthographic characters (LLAMA E), and learn the grammar of an unfamiliar language (LLAMA F). In her validation study, Granena (2013) found that LLAMA B, E, and F loaded on a common factor, while LLAMA D loaded separately from the other subtests. It was proposed that the nature of the subtests accounts for these results: LLAMA D does not include a study phase, nor allows time to rehearse, thus minimizing problem-solving and strategy use and involving online processing instead. On the other hand, LLAMA B, D, and F all include a study phase, allow time to rehearse materials, and provide opportunities for problem-solving and strategy use, therefore involving explicit associative learning.

Drawing on Granena's findings, Yilmaz and Granena (2016) investigated the relationship between ELA and three types of feedback: explicit feedback in the form of immediate rejection followed by correction, implicit feedback in the form of recasts, and no feedback. With the use of an oral pretest, immediate posttest, and delayed posttest design, the English indefinite article was elicited from 48 L2 learners of English. A significant interaction between ELA and task condition was found, revealing that explicit feedback was more beneficial to learners with high aptitude for explicit learning (i.e., high ELA). In an attempt to account for the non-significant effects of recasts, the researchers postulated that compared with more explicit types of negative feedback, recasts lack the directness of rejecting errors and presenting the correct forms.

Hypothesizing that those with greater grammatical sensitivity would result in the allocation of more attentional resources to clausal complexity, Kormos and Trebits (2012) found that learners with higher grammatical sensitivity produced longer clauses when performing a written cartoon description task. However, because a significant relationship was not found between aptitude and any performance measure when learners were required to generate their own content for a different written narrative task, they concluded that the advantages of high aptitude are most likely reflected in the translation and reviewing stages, as opposed to the content generation and organizational decision-making stages.

To date, few studies have examined the extent to which ELA, a specific dimension of language aptitude, is directly related to L2 writing performance. Because writing involves high levels of conscious effort and cognitive processing, it could be expected that ELA would be more predictive of writing performance because high language analytic ability may facilitate the L2 writing process, making it easier for learners to draw on existing L2

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knowledge and skills more efficiently and/or effectively. However, due to the lack of empirical findings, this prediction is tentative at best, and the present study sought to seek the answer to this relatively unexplored area.

L2 writing requires learners to allocate a significant portion of their attentional resources for task completion, and it was assumed that learners would demonstrate variations in the amount of mental effort they put into writing, which would in turn be reflected in their written output. Therefore, the present study aimed to determine whether any differences in L2 writing performance and the cognitive load experienced by learners during writing could be attributed to certain cognitive ID variables—L2 proficiency, WMC, and ELA.

3. Methodology

3.1 Participants

Forty-two Korean EFL undergraduate students (24 females and 18 males) from a university in South Korea voluntarily participated in the study. Their ages ranged from 18 to 26 years old (M = 22.02, SD = 1.83). Thirty-seven participants were majoring in English Education at the time of the study, with the rest comprising 2 Nursing majors, 1 English Language and Literature major, 1 Education major, and 1 Business Administration major.

3.2 Instruments

3.2.1 Writing task

The study employed a writing task that required participants to choose the best venue for a birthday party out of four options and write a letter to the imaginary hosts about the reasons behind their choice. The instructions specified that they should give detailed explanations of why they chose a certain venue and why they did *not* choose the others. All texts were provided in Korean. Information about the venues included the average cost of a meal, the atmosphere, parking space availability, seating capacity, time limit on room reservations, and the availability of equipment for showing videos on a projector screen. To prevent participants from choosing a venue too easily, (un)favorable characteristics were evenly distributed among the venues. Also included in the instructions was a statement that the task did not have an answer. Accordingly, participants' choices were based on their own preferences.

3.2.2 Cognitive load measure

After carrying out the writing task, participants completed a questionnaire that measured the cognitive load of the writing task. Primarily derived from Lee's (2019) questionnaire, participants' responses were analyzed separately: (1) the overall perceived difficulty of the task, (2) the level of mental effort they thought was required to perform the task, (3) the level of stress they felt during task performance, (4) the amount of time pressure they felt during the planning stage of the task, and (5) the amount of time pressure they felt during the writing stage. Questions were based on a 9-point Likert scale.

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3.2.3 English proficiency measure

Participants' English proficiency was measured using a 50-item cloze test developed by Brown (1980). Adapted from a book designed for intermediate ESL readers, *Man and His World: A Structured Reader* (Kurilecz 1969), this test is based on a 399-word passage, *Man and his Progress*, and is considered to be a reliable and valid measure to assess vocabulary, morphosyntactic knowledge, and discourse competence (Chrabaszcz and Jiang 2014). The exact scoring method was used, whereby responses were scored as correct only when they were the same as those in the original text.

3.2.4 Working memory measure

Participants' WMC was measured using a Blockspan task (Atkins 2011), which is a non-verbal visual-spatial task. In a given trial, participants were required to see a series of flashing lights on a 4×4 grid, and then recall them in the correct order and location by clicking on the squares in the same sequence. There were 16 trials within each trial block, and the difficulty of the task increased as the number of flashing lights in a series increased. Participants received 10 points for the first item correctly recalled, 20 for the second consecutive item correctly recalled, 30 for the third, and so on. If an item in the series was forgotten, scoring began again at 10 for the next item in the sequence correctly recalled. The difficulty of the task was increased by raising the number of sets of two, three, four, or five stimuli.

3.2.5 Explicit language aptitude measure

Due to its ease of use and minimal L1 effect, the present study employed the LLAMA F subtest (Meara 2005) to measure ELA, the ability to extract syntactic and morphologic patterns of an unfamiliar language. Because the original LLAMA test battery only provides the total score for each subtest, LLAMA F was modified so that individual responses could be recorded. All instructions were translated into Korean. During the timed study phase of the LLAMA F, participants were given up to five minutes to figure out the grammatical rules of an unfamiliar language by seeing a set of 20 pictures and their corresponding sentences. Participants were allowed to take notes, which could be used during the test phase. During the following test phase, they saw a series of 30 pictures with two sentences below each picture, only one of which was grammatically correct. Participants had to choose the sentence that they considered correct. The original LLAMA F test contained 20 items in the test phase, and an additional 10 items were added to increase the reliability of the test (Suzuki and DeKeyser, 2017).

3.3 Procedure

Participants met with the researcher individually for one session. After taking a cloze test (Brown 1980) on paper to measure their English proficiency, they completed a language background questionnaire. Then they carried out a writing task on a computer. Afterwards, participants completed a questionnaire that measured the cognitive load imposed on them during writing. Then they took the LLAMA F test and Blockspan task to measure their ELA and WMC, respectively.

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3.4 Linguistic Outcome Measures

Participants' written production was assessed in terms of syntactic complexity, lexical diversity, and accuracy. As the focus of the present study was on L2 writing, linguistic measures were based on the T-unit, defined as the minimal unit consisting of a main clause and any subordinate clauses embedded or attached to it (Hunt 1964).

Syntactic complexity was examined in terms of subordination, calculated as the number of subordinate clauses per T-unit. Lexical diversity was measured in terms of two aspects: lexical variation and lexical richness (density). The standard type-token ratio (TTR) was used to measure the former, while the hapax legomena-token ratio (HTR) was used to measure the latter. A hapax is defined as a word that appears only once in a text or corpus (Lardilleux and Lepage 2007), and it is claimed that the more hapaxes there are, the richer the vocabulary (Ali and Hussein 2014). Participants' accuracy was examined in terms of proportions of errors and target-like use (TLU) of articles (Pica 1983). The proportion of errors was calculated by dividing the total number of errors by the total number of T-units. Errors included lexical errors, morphosyntactic errors, and spelling mistakes. The proportion of TLU articles was calculated by dividing the total number of correctly used articles by the total number of noun phrases that required an article or not.

3.5 Data Analysis

Descriptive statistics were computed, followed by a series of multiple linear regressions. Results of the cloze test, Blockspan task, and LLAMA F subtest were added to the models as predictor variables. All statistical analyses were run on SPSS. The significance level was set at $p = .05$.

4. Results

Tables 2 and 3 present the descriptive statistics for the ID variables, learner self-ratings, and linguistic outcome measures. Because the exact scoring method was used for the cloze test, it was possible for participants to receive a maximum score of 50 points. The mean score on the test was 15.02 ($SD = 4.01$), indicating that their English proficiency was neither at the advanced nor beginner level. Two cases of Blockspan scores were missing, resulting in an N-size of 40 for that task. Self-ratings of cognitive load were measured on a 9-point Likert scale, and participants' overall answers appeared to indicate that the writing task was not very cognitively challenging. This was expected, as the task did not have a fixed answer (i.e., it was an open task) and participants could write about their choice based on their own tastes and preferences.

Table 2. Descriptive Statistics for ID Measures

N = 42	*M*	*Std. Deviation*	*Min*	*Max*
Cloze test	15.02	4.01	6	28
Blockspan task (*N* = 40)	1857.50	633.34	800	3750
LLAMA F	24.62	3.62	14	29

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Table 3. Descriptive Statistics for L2 Learner Self-Ratings

N = 42	*M*	*Std. Deviation*	*Min*	*Max*
Overall difficulty	4.48	1.61	1	8
Mental effort	5.05	1.78	1	8
Stress	4.21	1.87	1	8
Planning time pressure	3.07	1.80	1	9
Writing time pressure	4.05	2.01	1	9

Descriptive statistics for learners' syntactic complexity, lexical diversity, and accuracy in writing are shown in Table 4. On average, 65 percent of participants' T-units consisted of subordinate clauses. Although English articles are one of the most notoriously difficult grammatical features to acquire for learners whose L1 lacks an article or article-like system (Crosthwaite 2016, DeKeyser 2005), the proportion of TLU articles was relatively high; on average, participants used articles (indefinite, definite, or bare) correctly 77 percent of the time. Regarding other errors, however, it was found that they tended to make approximately one error for each T-unit produced.

Table 4. Descriptive Statistics for Linguistic Outcome Measures

N = 42	*M*	*Std. Dev.*	*Min*	*Max*
Subordinate clauses per T-unit	.65	.34	0	1
Type-token ratio	.58	.008	.46	.75
Hapax-legomena-token ratio	.40	.10	.23	.59
Errors per T-unit	.98	.40	.17	1.88
Proportion of TLU article	.77	.14	.36	1.00

A series of multiple linear regressions was first computed with learner self-ratings as the dependent variables. Results revealed that there was a significant combined effect of the three ID variables on overall perceived difficulty and stress, $F(3, 36) = 2.78$, $p = .05$, $R^2 = .188$; and $F(3, 36) = 3.24$, $p = .03$, $R^2 = .213$, respectively. The individual predictors were further examined, and it was found that English proficiency ($\beta = .330$, $t = 2.08$, $p = .04$) and ELA ($\beta = .330$, $t = 2.15$, $p = .04$) were significant predictors of overall perceived difficulty in the model. However, WMC was not a significant predictor in the model, $\beta = -.171$, $t = -1.09$, $p = .282$. Regarding stress, it was found that English proficiency was a significant predictor in the model ($\beta = .437$, $t = 2.81$, $p = .01$), while WMC and ELA were not ($\beta = -.097$, $t = -.63$, $p = .53$; and $\beta = .276$, $t = 1.82$, $p = 08$, respectively).

Another series of multiple linear regressions was computed to predict the syntactic complexity, lexical diversity, and accuracy of participants' L2 writing based on the three ID variables. Significant regression equations were found for the two lexical diversity measures and two accuracy measures. In the case of lexical diversity, the model explained a significant proportion of variance in TTR and HTR measures, $F(3, 38) = 3.70$, $p = .02$, $R^2 = .226$; and $F(3, 38) = 2.91$, $p = .05$, $R^2 = .187$, respectively. WMC was found to be the only significant predictor of TTR and HTR in the models, $\beta = .376$, $t = 2.63$, $p = .01$; and $\beta = .339$, $t = 2.31$, $p = .03$, respectively. On the other hand, neither English proficiency nor ELA significantly predicted TTR ($\beta = .263$, $t = 1.79$, $p = .08$; and $\beta = -.214$, $t = -1.46$, $p = .154$, respectively) or HTR ($\beta = .231$, $t = 1.54$, $p = .13$; and $\beta = -.215$, $t = -1.43$, $p = .16$, respectively).

Regarding accuracy measures, the three IDs were found to significantly predict proportions of errors and TLU articles, $F(3, 36) = 2.74$, $p = .05$, $R^2 = .186$; and $F(3, 36) = 4.29$, $p = .01$, $R^2 = .263$, respectively. Results showed that English proficiency was a significant predictor of the proportion of errors in the model ($\beta = -.345$, $t = -2.18$, $p = .04$), while WMC and ELA were not ($\beta = -.199$, $t = -1.27$, $p = .21$; and $\beta = -.085$, $t = -.55$, $p = .59$, respectively).

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Furthermore, it was found that English proficiency contributed significantly to the model (β = .423, t = 2.80, p = .01) in predicting the proportion of TLU articles. However, WMC and ELA failed to do so (β = .210, t = 1.41, p = .17; and β = .035, t = .24, p = .81, respectively).

5. Discussion

5.1 Individual Differences and Cognitive Load

Results of a series of multiple regression analyses revealed that those with higher English proficiency tended to perceive the writing task as more difficult and stressful, and those with higher ELA showed a tendency to perceive the task to be more difficult. The positive relationship between L2 proficiency and ratings of difficulty and stress was unexpected, as it was assumed that the same writing task would be perceived easier or less stressful by more proficient learners, as their greater command of the L2 would make it less taxing to write about their opinions. On a similar note, it was also interesting to find that the writing task was perceived as more difficult for those with higher aptitude for explicit learning. When considering the proposal that writing processes involve various WM components (Kellogg 1999), the finding that WMC was not a significant predictor of cognitive load was also unexpected, as it was assumed that the cognitive load of the task would be alleviated for those with greater attentional resources.

A number of possibilities can be suggested to account for these results. Regarding L2 proficiency as a predictor of perceived overall difficulty and stress, the nature of the task can be considered. The writing task that learners carried out was open—in other words, it did not have a fixed answer. Therefore, learners had to write freely and provide supporting arguments to persuade the imaginary host that the venue that they chose was the best decision. Due to the openness of the task, more proficient learners may have felt greater pressure to utilize their existing L2 repertoire in order to make a strong argument, which in turn could have led to greater stress. Another possibility is that, in contrast to lower-proficiency learners, those with higher English proficiency may have had more time to spend on the revision stage of writing, as opposed to the idea formation and content generation stage, which could be cognitively challenging when one hopes to write a persuasive argument in “good” English. Due to their higher level of L2 proficiency, they may have spent more time revising their English sentences and words to make their argument more convincing, thus resulting in greater perceived difficulty and stress.

On a similar note, those with greater ELA, i.e., those who have greater language analytic ability and are more adept at processing language explicitly, may have found the writing task more difficult because of the pressure to write convincing ideas and arguments based on their analysis of the information presented to them. It is highly likely that those with higher ELA would compare and contrast the venue options by each category, rearrange the categories based on the order of priority, and give each venue a certain score for each category. Because of this propensity to analyze information more thoroughly and exhaustively, it is speculated that these high-ELA participants perceived the task to be more difficult than those with lower ELA, as low-ELA participants are less likely to have analyzed the information presented in the writing task as carefully and systematically.

5.2 Individual Differences and L2 Written Performance

Results of a series of multiple regressions computed with syntactic complexity, lexical diversity, and accuracy

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as the outcome measures revealed that among the three ID variables investigated in the study, two IDs significantly predicted lexical diversity and accuracy. It was found that L2 English proficiency was the only significant variable that predicted accuracy, and WMC was the only significant variable that predicted lexical diversity. More specifically, when other variables were kept constant, for every one-point increase on the cloze test that measured participants' English proficiency, the proportion of errors per T-unit decreased by .033 and the proportion of TLU articles increased by .014. Likewise, when other variables were controlled for, the TTR and HTR increased by .003 and 004, respectively, for every 100-point increase in the Blockspan task that measured WMC. However, ELA was not found to be a significant predictor of L2 writing performance.

With regard to the significantly positive relationship between L2 proficiency and accuracy, previous studies have also obtained similar results (Kuiken and Vedder 2007, 2008). Assuming that the level of L2 proficiency constrains the effects of task complexity on L2 written performance, Kuiken and Vedder (2008) found that for both students of Italian and French, the level of L2 proficiency had a significant effect on accuracy in terms of the total number of errors and second- and third-degree errors. However, no significant interaction effect between L2 proficiency and task complexity on any of the performance measures could be found. Elaborating on these results, Kuiken and Vedder (2007) attempted to conduct a more thorough investigation by looking into the types of errors that were produced by the same participants. Errors were categorized into five categories: appropriateness, grammar, lexicon, orthography, and other. It was found that for learners of Italian, the high-proficient group produced significantly fewer errors than the low-proficient group in terms of grammar, orthography, and other errors. Similarly, L2 proficiency was found to have a positive effect on accuracy for learners of French in terms of grammar, lexicon, and other errors.

Borrowing from the work of Kellogg (1996, 1999), the present study assumed that writing processes involved active WM components, especially during the formulation and monitoring stages, in which sentences are planned, generated, and edited. A positive relationship between WMC and task performance was hypothesized, such that those with higher WMC would have sufficient attentional resources to focus on various linguistic aspects of writing simultaneously. Although significant effects for WMC were not found on syntactic complexity or accuracy measures, the present study's predictions were partially borne out in that WMC was a significant predictor of lexical diversity.

One possibility that accounts for such results is that the relationship between WMC and L2 writing is captured best by *lexical* measures, in comparison to measures of syntactic complexity and accuracy. WM involves the capacity for temporary storage and processing of information. Based on Kellogg's model (1999), people rely on the central executive function when formulating ideas and translating them into linguistic expressions. During L2 production, they must initially access L2 lemmas before syntactic building procedures are activated. Hence, the greater WMC they have, the more lemmas they can retain and process for production. High-WMC writers would also be able to review their written output and revise any repetitive words and/or phrases during the revision process of lower-order concerns. Thus, those with higher WMC would be able to use more diverse or rich vocabulary in their writing, resulting in a greater TTR and HTR. It has also been claimed that those with higher WMC are at an advantage during the revision process of writing when addressing higher-order concerns, which demands writers to hold stretches of information of text in WM to compare content plans and texts against information stored in long-term memory and against other stretches of text (Ortega 2012).

Unlike the positive link between WMC and lexical diversity, WMC could be less associated with learners' syntactic complexity and/or accuracy because words can come in various syntactic structures, and the learner is able to choose the structure in which a word appears. Because the participants in the present study were not

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advanced EFL learners (as shown by the average cloze test scores), it is unlikely that they would be able to use various sophisticated syntactic structures accurately, which could have led to the non-significant findings regarding WMC as a predictor of syntactic complexity and accuracy in L2 writing. Vasylets and Marín (2021) also found a positive relationship between WMC and lexical sophistication for those with higher levels of L2 proficiency. They stated that higher efficiency in WM could have facilitated the complex conceptual planning stage of writing, allowing for more lexically sophisticated linguistic encoding.

Because the study found significant effects of WMC and L2 proficiency on accuracy and lexical diversity, respectively, it was deemed necessary to explore the possible reasons behind the lack of significant findings regarding the ID variables as predictors of syntactic complexity, and also regarding the non-significant effects of ELA on any performance measure.

The most plausible reason that the IDs under investigation failed to predict syntactic complexity could be the nature of the writing task. As shown by Lee (2019), task type can have a differential effect on syntactic complexity, such that certain tasks are able to elicit greater syntactic complexity than others. In her study, significant task-type effects on syntactic complexity were found—the task that required participants to find the best seating arrangement for a group of people was the most effective in eliciting the highest level of syntactic complexity, followed by the task in which they had to describe a car accident, and then the task that required them to give directions to an imaginary driver. In the present study, although participants were required to give detailed reasons as to why they preferred a certain location over others, many tended to use simple constructions in repetition. Participants appeared to have resorted to familiar structures, showing a heavy reliance on compound sentences by using coordinating conjunctions, such as in the following example: '*I recommend The Springs to Liam and Kate. It is most cheap among 4 restaurants. And there is live band song and no limitation in using time. And the equipment is not needed for father's party. The Tower and The Lighthouse is too expensive. And The Lunchroom have limitation in time and no music*.' This written output is a perfect example of how the requirements of the task were fulfilled, yet very low syntactic complexity was observed. Whether intentionally or unintentionally, this participant avoided the use of syntactically complex structures in their writing, which could also be observed in other participants' writing as well.

Given that the present study employed a writing task that involves greater levels of conscious effort and cognitive processing than an oral task, it was predicted that those with high ELA would show greater performance in their writing because they are more adept at extracting rules based on exposure to positive evidence only, and thus are assumed to have more controlled use of their language and to be better at monitoring their written output. However, ELA did not turn out to be a significant predictor of any performance measure under investigation. One possibility that can be suggested is based on additional correlation analyses conducted on the data, whose results did not reveal any significant relations between ELA and L2 written performance. In the present study, the only factor that ELA was able to predict was the overall difficulty that participants perceived when carrying out the task. A closer inspection of the LLAMA F scores was warranted, and there appeared to be a negative skewness (-1.47, *SE* = .37) in the data, indicating that a ceiling effect was exhibited. If this is the case, with such little variance, it would be difficult to obtain significant findings regarding the relationship between ELA and writing outcomes. Previous studies have examined the validity of the LLAMA test batery and have found general support for its robustness (Granena 2013, Rogers et al. 2017). However, Bokander and Bylund (2020) and Mikawa and De Jong (2021) have pointed out the weaknesses of the test. In fact, Mikawa and De Jong (2021) noted the possibility that those whose L1 is an agglutinative language would perform better on the LLAMA F subtest than those whose L1 is a non-agglutinative language. Given that Korean is an agglutinative language, the subtest may have been

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relatively easy for the participants of the study. Meaningful results could have been obtained if a more rigorous test was used to measure ELA.

6. Conclusion

There is limited empirical research on the relationship between cognitive IDs and L2 writing, and this study attempts to contribute to the literature on whether L2 proficiency, WMC, and ELA can predict L2 writing, in terms of the cognitive load imposed on the learner during writing and the syntactic complexity, lexical diversity, and accuracy of the written outcome. Not only does it obtain independent evidence regarding each ID's predictive effects, it distinguishes between WM and language aptitude as separate constructs, which is different from the notion that WM is a key component of language aptitude in previous research (DeKeyser and Koeth 2011, Skehan 2016). Because the study obtained different results regarding the predictive effects of WM and ELA, it can be inferred that although they may be related, the two variables are two distinct constructs whose effects should be investigated separately.

The findings of the study have pedagogical implications regarding L2 instruction and task design. For learners to use more diverse vocabulary in their writing, care must be taken on the part of L2 teachers and researchers when designing tasks so that learners do not "waste" their limited attentional resources on non-essential aspects of the task. For those with high WMC, it is easier for them to utilize their L2 knowledge and use diverse and rich vocabulary. However, for low- or mid-WMC learners, letting them think in the L1 and then translate into the L2 during L2 writing may actually impose a heavy cognitive load on WM (Nawal 2018). If teachers could help them practice thinking in the L2 and prohibit the use of L1-L2 dictionaries, cognitive load would be alleviated, freeing up their attentional resources to allow for greater lexical diversity (and possibly even enhanced syntactic complexity and accuracy).

Limitations of the present study should be noted for future research. Although the LLAMA test battery has been favored by many researchers for its ease of use and its claims of minimal L1 effects, a more rigorous measure of ELA should be employed in further investigations. Several validation studies (Granena 2013, Rogers et al. 2017) have found support for the reliability and validity of the LLAMA test battery, but it should also be noted that when learners take the LLAMA F subtest, there may be an advantage for those whose L1 is an agglutinative language (Mikawa and De Jong 2021). Moreover, the present study was not able to reveal a significant relationship between IDs and syntactic complexity, which could be due to the nature of the writing task. Perhaps a greater number of syntactically complex structures could be elicited if a different type of writing task were employed, especially one that is more cognitively challenging, but not too challenging so that it forces them to simplify the task intentionally or unintentionally (Lee 2019).

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Examples in: English
Applicable Languages: English
Applicable Level: Tertiary

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