THE JOURNAL OF ASIA TEFL
Vol. 18, No. 1, Spring 2021, 108-124
http://dx.doi.org/10.18823/asiatefl.2021.18.1.7.108

The Journal of Asia TEFL

http://journal.asiatefl.org/

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Syntactic Complexity, Clausal Complexity, and Phrasal Complexity in L2 Writing: The Effects of Task Complexity and Task Closure

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Although recent studies of L2 writing development have called for the inclusion of metrics that measure phrasal embedding as well as clausal embedding as indicators of syntactic complexity, task-based research on L2 written performance still shows a heavy dependence on length-based measures and clausal subordination. In this study, the written performance of 81 Korean learners of English was examined using traditional syntactic measures that most task-based studies rely on, clausal complexity measures, and noun phrasal complexity measures. Participants were randomly assigned to either a Closed group that carried out closed tasks (i.e., tasks with a predetermined answer), or an Open group that carried out open tasks (i.e., tasks without a predetermined answer). Task complexity was manipulated in terms of the number of elements. Generally in line with Kyle and Crossley's findings (2018), the study revealed that including more encompassing measures of syntactic complexity helped in the understanding of learners' interlanguage development, especially when considering their level of L2 proficiency.

Keywords: L2 writing, task complexity, task closure, traditional syntactic complexity, clausal complexity, noun phrasal complexity, task-based language teaching

Introduction

In second language (L2) writing research, syntactic complexity has been considered to be an indicator of L2 proficiency, and various attempts have been made at finding a reliable metric that can measure syntactic complexity objectively (Lu, 2011; Ortega, 2003; Wolfe-Quintero, Inagaki, & Kim, 1998). Traditionally, there has been a heavy reliance on metrics that measure the average length of T-units or the extent of clausal subordination, such as mean length of T-unit (MLT), a measure of overall length in words of a T-unit, and clauses per T-unit, a measure of the number of dependent clauses per T-unit. However, based on certain claims that a developmental sequence exists in learners' use of syntactic structures, fundamental questions have been raised about whether the T-unit measures and dependent clause measures are appropriate for assessing writing development (Biber & Gray, 2010; Biber, Gray, & Poonpon, 2011).

According to Norris and Ortega (2009), the stages of L2 development in terms of syntactic complexity first involve coordination, followed by subordination, and then finally phrase-level complexity at advanced stages. Bardovi-Harlig's (1992) findings support this claim, in which a Coordination Index was used to capture the degree to which learners achieve syntactic complexity through coordination. It was found that that less proficient learners produced more coordinated structures to combine sentences than more advanced learners did. With the addition of findings from corpus-based studies that revealed differences between conversation and written academic writing in that clausal embedding is characteristic

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of conversation, while academic writing relies on phrasal embedding (Biber & Gray, 2010; Biber et al, 2011), Biber et al. (2011) proposed that learners' writing complexity progresses in five stages, with clausal-based features acquired in early stages and phrasal complexity features acquired in later stages. In short, it was hypothesized that learners progress from finite clauses more common in conversation to nonfinite clauses more common in writing. Support for this proposal was found even for L1 writers in Staples, Egbert, Biber, and Gray's (2016) study, which obtained evidence of a positive relationship between academic level and the use of phrasal complexity features in writing, but a negative relationship between academic level and the use of clausal complexity features, especially in terms of finite dependent clauses.

As such, recommendations have been made for considering syntactic complexity as a "multidimensional construct" (Norris & Ortega, 2009) that should be assessed by non-redundant measures that capture its various dimensions that gauge: 1) global or general complexity (e.g., mean length of T-unit), 2) complexity by subordination (e.g., mean number of clauses per T-unit), 3) complexity by subclausal or phrasal elaboration (e.g., mean length of clause), and 4) coordination. Taking this into consideration, a number of studies in L2 writing research have also investigated learners' use of phrasal embedding in writing across levels of academic study (Lu, 2011; Parkinson & Musgrave, 2014).

Despite such efforts to find measures that tap the multidimensions of syntactic complexity in L2 writing research, in the field of task-based language teaching (TBLT), there is still a heavy dependence on traditional measures of syntactic complexity when investigating the effects of task complexity and/or other features of tasks. In order to contribute to the literature, the present study attempted to look into the interactive effects of task complexity and task closure on the syntactic complexity of L2 learners' writing, using a combination of traditional syntactic complexity measures, clausal complexity indices, and phrasal complexity indices.

Measures of Syntactic Complexity in Task Complexity Studies

One of the most famous models in TBLT, Robinson's (2001, 2005, 2011) Cognition Hypothesis (CH) makes predictions about how increasing task complexity leads to changes in learners' linguistic complexity, accuracy, lexis, and fluency (CALF), based on the assumption that there are multiple pools of attentional resources. Based on Robinson's (2001) Triadic Componential Framework, it predicts that increases in task complexity, especially along resource-directing dimensions such as +/- few elements, +/- reasoning demands, and +/- Here-and-Now, raise the functional demands of communication tasks, directing learners' attention to certain aspects of the L2. As a result, facilitation of acquisition is expected to be achieved through both greater linguistic complexity and accuracy. The CH has generated an abundance of studies that tried to investigate whether such predictions pan out, and several research syntheses and meta-analyses have investigated the types of metrics that were used in task-based research to measure syntactic complexity (Bulté & Housen, 2012; Jackson & Suethanapornkul, 2013; Norris & Ortega, 2009; Johnson, 2017). According to these studies, there is yet a high reliance on general ratio measures for measuring overall complexity and/or clausal subordination to assess syntactic complexity.

Based on Johnson's (2017) research synthesis and meta-analysis of task-based research on L2 writing, syntactic complexity measures can be largely divided into three categories: global complexity, phrasal complexity, and subordination. Among the 18 studies that investigated task complexity effects on syntactic complexity, the most commonly used measure was found to be clauses per T-unit as a measure of subordination, followed by mean-length of T-unit, a length-based measure. However, only a small number of studies that were included in the analysis reported the use of measures of global, phrasal, and clausal complexity (Choong, 2014; Ishikawa, 2006; Yang, 2014). Most task-based studies on L2 writing focused on global complexity and subordination, indicating that they placed more emphasis on the early stages of writing development.

In their meta-studies of 40 and 16 task-based investigations, respectively, Bulté and Housen (2012) and Norris and Ortega (2009) voiced their concerns about the limitations of the outcome measures employed; only a limited range of linguistic complexity measures were assessed (mainly lexical diversity and/or complexity through subordination), and with metrics that were most likely variants of the same measure. Furthermore, a very small set of popular measures, such as mean length of unit, subordination ratios, and lexical type/token-ratios, were employed in most studies. Based on their observations, Bulté and Housen (2012) argued that syntactic complexity must be measured by different metrics because it is a multi-layered construct that consists of distinct sub-constructs concerning different sources of complexity, and called for the combined use of generic measures (e.g., length-based measures) and specific measures that tap sentence complexity via subordination, phrasal complexity, coordination, and diversity and sophistication. Due to such problematic issues, complexity "is reduced to one (or, at best, a few) of its many possible operationalizations and, as a result, complexity measurement practices in extant L2 research suffer from low content validity" (Bulté and Housen, 2014, p. 44).

Specifically focusing on accumulated findings for resource-directing task manipulated investigations, Jackson and Suethanapornkul (2013) found that a total of 84 measures were used to assess CALF in only 17 studies. Although syntactic complexity had the most balanced distribution between specific and general measures among the four CALF measures, they claimed that there was a lack of overall consistency observed across studies. For instance, S-nodes per T-unit was found to be one of the more frequently employed measures, but this was used in only six of the 24 task treatments. More importantly, the magnitude of task complexity effects on syntactic complexity across 17 measures in eight studies was found to be negligible and even negative. Regarding this finding that seems contradictory to the CH, the researchers reinstated the need for a more balanced selection of syntactic complexity measures (i.e., measures that are able to assess coordination, subordination, and phrasal complexity) that is able to tap interlanguage development as well.

In short, the majority of studies in TBLT tended to incorporate only traditional measures of syntactic complexity. Because recent corpus-based research on L2 writing has revealed that phrasal features, such as non-clause phrases and complex noun phrases, are characteristic of academic writing (Biber & Gray, 2010), the present study aimed to employ all-encompassing measures that gauge traditional syntactic complexity, clausal complexity, and phrasal complexity in order to get a clearer picture of the roles of task complexity and task closure in the syntactic complexity of L2 writing.

Effects of Task Closure and Task Complexity

Based on empirical studies of L2 interaction, Long (1989) and Loschky and Bley-Vroman (1993) stated that tasks that have a single solution or a small set of correct solutions, i.e., closed tasks, may be more beneficial for L2 learning than those that do not have a predetermined solution, i.e., open tasks. Because learners must find the correct solution when carrying out closed tasks, they are expected to persevere through the task better, to provide and incorporate more feedback, and to recycle language to a greater extent. In order to test such claims, very few studies investigated the role of task closure in combination with that of task complexity (Lee, 2020; Montero, 2018).

In Montero's (2018) investigation of task complexity and task closure effects on L2 speech, 62 beginner learners of Spanish were divided into two groups that either carried out a closed version of a spoken task or an open version of the same task, which required them to rearrange and describe a set of geometric shapes. While the shapes in the closed version, whose arrangement was predetermined by the researcher, were easily identifiable, those in the open version were of an odd form, whose arrangement needed to be determined by the participant. Task complexity was operationalized as +/- few elements (i.e., the number of shapes). While it was found that increases in task complexity along the number of elements led to greater syntactic complexity, lexical diversity, and accuracy, the closed task version did not elicit better linguistic performance than the open version. The researcher speculated that the open version enabled participants to be creative, leading to more complex descriptions.

Lee's (2020) findings are also contrary to previous claims about the greater effectiveness of closed tasks. Eighty Korean learners of English, who were randomly assigned to either the group that carried out only open tasks or the group that carried out only closed tasks, performed two written tasks, after which their performance was assessed in terms of syntactic complexity, lexical diversity, and accuracy. Task complexity was operationalized as +/- few elements, resulting in each participant carrying out four task versions in a pseudo-randomized order. Although increased task complexity was found to be more cognitively challenging to the participants, as confirmed by learner self-ratings, expert judgments, and a time-on-task measure, it did not lead to the desired changed in syntactic complexity or accuracy. In fact, the only outcome that was in line with the CH was regarding lexical diversity. Moreover, similar to Montero's (2018) findings, the open tasks elicited greater lexical diversity than the closed versions.

Lee's (2020) study failed to obtain significant findings with regard to syntactic complexity, measured in terms of MLT and subordinate clauses per T-unit, which have been criticized to "confound fundamentally different kinds of grammatical structures" (Biber et al., 2011, p. 13). Therefore, the present study sought to perform a more rigorous analysis of the combined effects of task complexity and task closure by employing clausal complexity indices and phrasal complexity indices in addition to more classic syntactic complexity measures.

Research Questions

The following research questions were investigated in order to conduct an in-depth analysis of how task complexity and task closure affect syntactic complexity in L2 writing:

RQ1. Do increases in task complexity result in changes in traditional measures of syntactic complexity?
RQ2. Does task closure result in changes in traditional measures of syntactic complexity?
RQ3. Do increases in task complexity result in changes in clausal complexity?
RQ4. Does task closure result in changes in clausal complexity?
RQ5. Do increases in task complexity result in changes in phrasal complexity?
RQ6. Does task closure result in changes in phrasal complexity?

Methodology

Participants

Eighty-one native speakers of Korean (35 males and 46 females) participated in the study. They were undergraduate students attending a university in the capital region of South Korea. Their mean age was 23.13 years (*SD* = 1.88), and they reported that they did not have any experience living in an English-speaking country for over a year. The participants were randomly assigned to one of two groups: a Closed group (*N* = 40) that carried out a closed task, and an Open group (*N* = 41) that carried out an open task.

Writing Task

Participants carried out a written task that required them to choose the best hotel for two imaginary people. Task complexity was increased along the number of elements, which was determined by the amount of information that participants had to process for task completion. The task had a closed version (i.e., the task had a predetermined solution) and an open version (i.e., there was no particular answer that participants had to find), and the same information was given in the two versions. However, in order to close the task, the Closed task included additional information regarding the requirements and preferences of the two imaginary people that the participants needed to take into consideration when choosing the most suitable hotel. Table 1 displays the types of information provided to the participants. All texts were presented in Korean, and task instructions explicitly stated that participants should explain their reasons for choosing a certain hotel and also for not choosing the other hotels. For the Closed group, instructions included a statement that there was only one hotel that met all requirements. On the other hand, the Open group were told to include their personal opinions because there was no right answer.

TABLE 1
Task Information

	Simple (3 hotels)	Complex (4 hotels)
Open & Closed	Daily rate Internet access fee Distance to the beach	Daily rate Access to public transportation Internet access fee Bed(s) Breakfast Check-out time
Closed only	+ Budget + Preferred Internet fee + Preferred transportation type	+ Budget + Transportation preference + Internet usage + Bed(s) preference + Preferred breakfast type + Preferred check-out time

Procedure

Participants met with the researcher for one session for as much as 90 minutes. After completing a language background questionnaire, participants took a 50-item cloze test (Brown, 1980), a modified version of an Operation Span task (Engle, Cantor, & Carullo, 1992; Malone, 2018), and the LLAMA D and LLAMA F (Meara, 2005) in order to measure various individual differences such as overall English proficiency, working memory capacity, implicit language aptitude, and explicit language aptitude, respectively[1]. After completing the simple and complex versions of the main hotel writing task, participants were required to complete a self-rating questionnaire regarding the cognitive load of the task. The order of simple and complex task versions was randomly assigned to each participant, and as much as 30 minutes were given for participants to complete each task.

Syntactic Complexity Measures

Adopting Kyle and Crossley's (2018) categorization of syntactic complexity measures, the present study analyzed participants' writing using classic syntactic complexity indices, fine-grained clausal indices, and fine-grained phrasal indices. An advanced syntactic analysis tool, the Tool for the Automatic Analysis of Syntactic Sophistication and Complexity (TAASSC; Kyle, 2016), was used to compute such indices automatically. For the traditional measures, Lu's (2010) L2 complexity analyzer (SCA) was used, whose results were also computed by the TAASSC. The total numbers of words, dependent clauses, coordinate phrases, and complex nominals in text divided by either the total numbers of T-units or clauses were examined. In the case of clausal indices, the average number of particular structures per clause were added to the analysis. Finally, the phrasal indices used in the study included the average occurrence of particular dependent types in particular types of noun phrases. Tables 2-4 present full lists of the indices that were examined in the study.

[1] Results of the various individual differences measures will be used in future investigations.

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TABLE 2
Description of Classic Syntactic Complexity Indices

Index Name	Description	Description of Structure
MLT	Mean length of T-unit	T-unit: An independent clause and any clauses dependent on it
MLC	Mean length of clause	Clause: A syntactic structure with a subject and a finite verb
DC/T	Dependent clauses per T-unit	Dependent clause: A finite clause that is a nominal, adverbial,
DC/C	Dependent clauses per clause	or adjective clause
CP/T	Coordinate phrases per T-unit	Coordinate phrase: Adjective, adverb, noun, and verb phrases
CP/C	Coordinate phrases per clause	connected by a coordinating conjunction
CN/T	Complex nominals per T-unit	Complex nominal: 1) Nouns with modifiers, 2) nominal
CN/C	Complex nominals per clause	clauses, 3) gerunds and infinitives that function as subjects

TABLE 3
Description of Fine-grained Clausal Indices (Adapted from Kyle & Crossley, 2018, p. 339)

Index Name	Description	Example of Numerator Structure
acomp_per_cl	Adjectival complements per clause	*She [looks]$_{gov}$ [beautiful]$_{acomp}$*
advcl_per_cl	Adverbial clauses per clause	*The accident [happened]$_{gov}$ [as night fell]$_{advcl}$*
cc_per_cl	Clausal coordinating conjunctions per clause	*[Jill runs]$_{gov}$ and [Jack jumps]$_{cc}$*
ccomp_per_cl	Clausal complements per clause	*I am [certain]$_{gov}$ [that he did it]$_{ccomp}$*
csubj_per_cl	Clausal subjects per clause	*[What she said]$_{csubj}$ [is]$_{gov}$ not true*
dobj_per_cl	Direct objects per clause	*She [gave]$_{gov}$ me a [raise]$_{dobj}$*
iobj_per_cl	Indirect objects per clause	*She [gave]$_{gov}$ [me]$_{iobj}$ a raise*
mark_per_cl	Subordinating conjunctions per clause	*Forces engaged in fighting [after]$_{mark}$ insurgents [attacked]$_{gov}$*
ncomp_per_cl	Nominal complements per clause	*He [is]$_{gov}$ a [teacher]$_{ncomp}$*
neg_per_cl	Clausal negations per clause	*He did [not]$_{neg}$ [kill]$_{gov}$ them*
prt_per_cl	Phrasal verb particles per clause	*They [shut]$_{gov}$ [down]$_{prt}$ the station*
aux_per_cl	Auxiliary verbs per clause	*He [is]$_{aux}$ [running]$_{gov}$*

TABLE 4
Description of Fine-grained Clausal Indices (Adapted from Kyle & Crossley, 2018, p. 339)

Structure	Description of Structure	Example of Structure
Noun Phrase Type Denominator		
Nominal subject	A subject of a (nonpassive) structure that is a noun phrase	*[The man in the red hat]$_{nsubj}$ gave that tall man some money.*
Direct object	A predicative noun phrase that is a recipient of the action of a transitive verb	*The man in the red hat gave that tall man [some money]$_{dobj}$.*
Prepositional object	A noun or noun phrase that functions as the object of a prepositional phase	*The man in [the red hat]$_{pobj}$ gave that tall man some money.*
Indirect object	A noun phrase that functions as the dative object of the verb	*The man in the red hat gave [that tall man]$_{iobj}$ some money.*
Dependent Type Numerator		
Determiners	Articles, demonstratives, and quantifiers	*[The]$_{det}$ man in [the]$_{det}$ red hat gave [that]$_{det}$ tall man [some]$_{det}$ money.*
Adjective modifiers	An adjective that modifies a noun or noun phrase	*The man in the [red]$_{amod}$ hat gave that [tall]$_{amod}$ man some money.*
Prepositional phrases	A prepositional phrase that modifies a noun or noun phrase	*The man [in the red hat]$_{prep}$ gave that tall man some money.*
Verbal modifiers	A nonfinite verb or verb phrase that modifies a noun or noun phrase	*I don't have anything [to say]$_{vmod}$ to you*
Nouns as modifiers	A noun that modifies a noun or noun phrase	*[Oil]$_{nn}$ prices are rising*
Relative clause modifiers	A relative clause that modifies a noun or noun phrase	*I saw the person [you love]$_{rcmod}$*

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Statistical Analyses

After descriptive statistics were computed, a series of 2 x 2 repeated-measures ANOVA were computed on the data with task complexity (simple vs. complex) included as the within-subjects variable and task closure (closed vs. open) as the between-subjects variable. All analyses were run on SPSS, and the level of significance was set at p = .05. Partial η^2 was used to measure effect size.

Results

Tables 5 to 7 provide descriptive statistics for traditional syntactic measures, clausal complexity measures, and noun phrasal complexity measures, respectively. The denominators of the traditional syntactic measures were either the total number of T-units (Hunt, 1964) or the total number of clauses in text, and there appears to be a difference in patterns depending on the denominator. For instance, the MLT of the Closed group was higher than that of the Open group when they carried out the simple task version, but the opposite trend was found in the case of MLC. When comparing the effects of simple vs. complex tasks, task complexity effects seemed to interact with task closure effects on the number of coordinate phrases per T-unit/clause. The various clausal complexity measures appeared to have a positive relationship with task complexity in that clausal complexity increased as task complexity was increased. However, the number of nominal complements per clause decreased with increased task complexity. In the case of phrasal complexity, the indices with the indirect object as the denominator were removed from further analyses because all were found to equal to 0.

TABLE 5

Descriptive Statistics for Traditional Syntactic Measures

	Simple		Complex	
	Closed	Open	Closed	Open
Mean length of T-unit	12.34 (3.52)	11.77 (2.83)	11.77 (2.64)	11.78 (2.58)
Mean length of clause	7.93 (1.16)	8.64 (1.80)	7.87 (1.35)	8.25 (1.35)
Dependent clauses per T-unit	.55 (.42)	.38 (.28)	.46 (.24)	.42 (.31)
Dependent clauses per clause	.31 (.16)	.25 (.15)	.29 (.12)	.26 (.13)
Coordinate phrases per T-unit	.23 (.21)	.19 (.16)	.18 (.13)	.24 (.15)
Coordinate phrases per clause	.15 (.13)	.14 (.14)	.13 (.11)	.17 (.10)
Complex nominals per T-unit	1.20 (.53)	1.08 (.51)	1.00 (.43)	1.11 (.44)
Complex nominals per clause	.76 (.22)	.78 (.31)	.65 (.22)	.76 (.24)

Note. Standard deviations are included in the parentheses.

TABLE 6

Descriptive Statistics for Clausal Complexity Measures

	Simple		Complex	
	Closed	Open	Closed	Open
Adjectival complements	.15 (.11)	.14 (.12)	.17 (.12)	.12 (.09)
Adverbial clauses	.08 (.07)	.08 (.08)	.09 (.07)	.08 (.06)
Clausal coordinating conjunctions	.01 (.03)	.01 (.02)	.01 (.03)	.03 (.05)
Clausal complements	.07 (.07)	.05 (.06)	.08 (.07)	.07 (.06)
Clausal subjects	.01 (.02)	.01 (.02)	.01 (.02)	.01 (.02)
Direct objects	.45 (.15)	.43 (.16)	.46 (.17)	.47 (.18)
Indirect objects	.006 (.018)	.000 (.000)	.002 (.008)	.006 (.015)
Subordinating conjunctions	.14 (.11)	.12 (.09)	.13 (.08)	.13 (.08)
Nominal complements	.11 (.07)	.11 (.13)	.07 (.06)	.09 (.10)
Clausal negations	.08 (.07)	.09 (.11)	.10 (.07)	.12 (.08)
Phrasal verb particles	.00 (.01)	.00 (.00)	.03 (.04)	.02 (.05)
Auxiliary verbs	.16 (.09)	.16 (.12)	.20 (.09)	.19 (.11)

Note. All measures were divided by the number of clauses in text.

TABLE 7
Descriptive Statistics for Phrasal Complexity Measures

		Simple		Complex	
Index	Denominator	Closed	Open	Closed	Open
Determiners	Nominal subject	.25 (.13)	.29 (.17)	.25 (.18)	.27 (.14)
Adjectival modifiers	Nominal subject	.10 (.08)	.12 (.15)	.07 (.06)	.08 (.07)
Prepositions	Nominal subject	.07 (.09)	.05 (.09)	.04 (.05)	.06 (.06)
Verbal modifiers	Nominal subject	.00 (.01)	.00 (.01)	.00 (.01)	.00 (.01)
Nouns as modifiers	Nominal subject	.05 (.07)	.07 (.10)	.05 (.07)	.03 (.05)
Relative clause modifiers	Nominal subject	.01 (.03)	.01 (.04)	.02 (.03)	.01 (.02)
Determiners	Direct object	.38 (.16)	.33 (.25)	.40 (.21)	.33 (.21)
Adjectival modifiers	Direct object	.27 (.18)	.29 (.26)	.23 (.14)	.25 (.19)
Prepositions	Direct object	.10 (.12)	.17 (.18)	.10 (.10)	.12 (.12)
Verbal modifiers	Direct object	.01 (.03)	.01 (.02)	.02 (.05)	.02 (.06)
Nouns as modifiers	Direct object	.16 (.17)	.13 (.17)	.16 (.18)	.11 (.13)
Relative clause modifiers	Direct object	.05 (.10)	.06 (.16)	.05 (.07)	.03 (.07)
Determiners	Prepositional object	.40 (.21)	.38 (.19)	.34 (.20)	.33 (.18)
Adjectival modifiers	Prepositional object	.10 (.11)	.06 (.10)	.14 (.14)	.14 (.12)
Prepositions	Prepositional object	.05 (.07)	.07 (.10)	.05 (.08)	.08 (.08)
Verbal modifiers	Prepositional object	.00 (.01)	.00 (.02)	.00 (.02)	.00 (.02)
Nouns as modifiers	Prepositional object	.09 (.10)	.09 (.13)	.08 (.08)	.06 (.10)
Relative clause modifiers	Prepositional object	.02 (.05)	.02 (.06)	.01 (.04)	.03 (.07)

When statistical analyses were conducted on classic measures of syntactic complexity, significant findings were found only for MLC, coordinate phrases per T-unit, and complex nominals per clause. Task closure was found to have a significant impact on MLC such that participants in the Open group produced significantly longer clauses than those in the Closed group, $F(1, 79) = 4.071$, $p = .047$, $\eta_p^2 = .048$. However, MLC was not significantly affected by either task complexity or its interaction with task closure, $F(1, 79) = 1.966$, $p = .165$, $\eta_p^2 = .024$, $F(1, 79) = 1.099$, $p = .298$, $\eta_p^2 = .013$, respectively. The interaction between task complexity and task closure was found to significantly affect the number of coordinate phrases per T-unit, $F(1, 82) = 5.386$, $p = .023$, $\eta_p^2 = .062$. Pairwise comparisons indicated that the Open group produced significantly more coordinated phrases than the Closed group when carrying out the complex task version. This difference is illustrated in Figure 1. On the other hand, the main effects of task complexity and task closure were not found to be significant, $F(1, 79) = .010$, $p = .920$, $\eta_p^2 < .001$, $F(1, 79) = .132$, $p = .717$, $\eta_p^2 = .002$. In the case of complex nominals per clause, the main effect of task complexity was found to be significant in that the complex task version elicited fewer complex nominals than the simple version, $F(1, 79) = 3.945$, $p = .050$, $\eta_p^2 = .046$. The main effect of task closure nor its interaction with task complexity had a significant impact on the measure, $F(1, 79) = 2.226$, $p = .140$, $\eta_p^2 = .027$, $F(1, 79) = 2.166$, $p = .145$, $\eta_p^2 = .026$, respectively.

The main effects of task complexity and task closure, along with their interactional effects, did not result in significant changes in MLT, dependent clauses per T-unit, dependent clauses per clause, coordinate phrases per clause, and complex nominals per T-unit: 1) $F(1, 79) = .745$, $p = .391$, $\eta_p^2 = .009$, $F(1, 79) = .252$, $p = .617$, $\eta_p^2 = .003$, and $F(1, 79) = .845$, $p = .361$, $\eta_p^2 = .010$, respectively for MLT; 2) $F(1, 79) = .389$, $p = .535$, $\eta_p^2 = .005$, $F(1, 79) = 3.300$, $p = .073$, $\eta_p^2 = .039$, and $F(1, 79) = 2.420$, $p = .124$, $\eta_p^2 = .029$, respectively for dependent clauses per T-unit; 3) $F(1, 79) = .196$, $p = .659$, $\eta_p^2 = .002$, $F(1, 79) = 2.650$, $p = .107$, $\eta_p^2 = .032$, and $F(1, 82) = 1.400$, $p = .240$, $\eta_p^2 = .017$, respectively for dependent clauses per clause; 4) $F(1, 79) = .082$, $p = .775$, $\eta_p^2 = .001$, $F(1, 79) = .837$, $p = .363$, $\eta_p^2 = .010$, and $F(1, 79) = 2.177$, $p = .144$, $\eta_p^2 = .026$, respectively for coordinate phrases per clause; and 5) $F(1, 79) = 2.327$, $p = .131$, $\eta_p^2 = .028$, $F(1, 79) = .005$, $p = .946$, $\eta_p^2 < .001$, and $F(1, 79) = 3.773$, $p = .056$, $\eta_p^2 = .045$, respectively for complex nominals per T-unit.

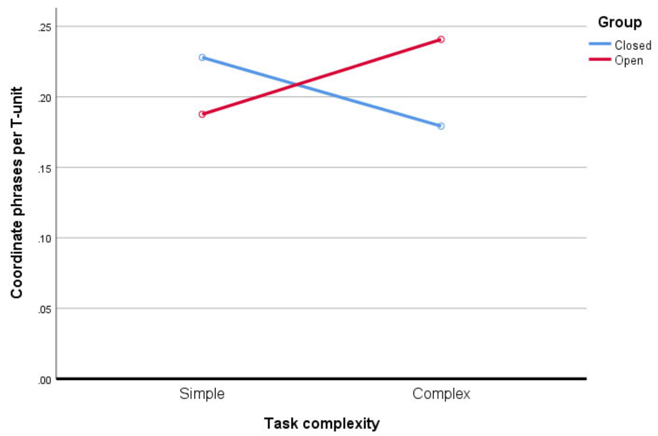

Figure 1. Task complexity and task closure effects on coordinate phrases per T-unit.

A greater number of significant findings were obtained when statistical analyses were conducted on clausal complexity measures. The interaction between task complexity and task closure was found to have a significant effect on adjective complements per clause, $F(1, 79) = 4.523$, $p = .036$, $\eta_p^2 = .053$. Pairwise comparisons revealed that the Closed group produced significantly more adjective complements than the Open group when carrying out the complex task version, as shown in Figure 2. However, this measure was not significantly affected by the two main effects of task complexity and task closure, $F(1, 79) = .001$, $p = .980$, $\eta_p^2 < .001$, and $F(1, 79) = 2.494$, $p = .118$, $\eta_p^2 = .030$, respectively. Similar patterns were obtained for indirect objects per clause in that a significant interaction effect was found, but neither main effects of task complexity and task closure had a significant impact, $F(1, 79) = 6.566$, $p = .012$, $\eta_p^2 = .075$, $F(1, 79) = .458$, $p = .500$, $\eta_p^2 = .006$, and $F(1, 79) = .206$, $p = .651$, $\eta_p^2 = .003$, respectively. Pairwise comparisons showed that the significant interaction was caused by the difference between the Closed and Open groups when carrying out the simple task version, as well as the Open group's differential performance between the simple and complex task versions. This pattern can be observed easily in Figure 3. In the case of clausal coordinating conjunctions per clause, task complexity and its interaction with task closure were found to have significant effects, $F(1, 79) = 7.484$, $p = .008$, $\eta_p^2 = .085$, $F(1, 79) = 7.898$, $p = .006$, $\eta_p^2 = .089$, and $F(1, 79) = 1.103$, $p = .297$, $\eta_p^2 = .013$, respectively. When averaged across participant groups, the complex task version elicited a greater number of coordinating conjunctions than the simple version. Pairwise comparisons revealed that the significant interaction effect was brought by the difference in the Open group's performance between the open and closed task versions, and by the difference between the Closed and Open groups when performing the complex task version, as shown in Figure 4.

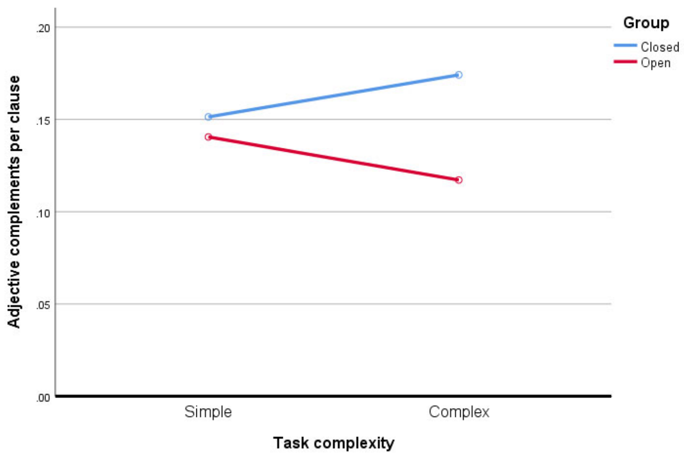

Figure 2. Task complexity and task closure effects on adjective complements per clause.

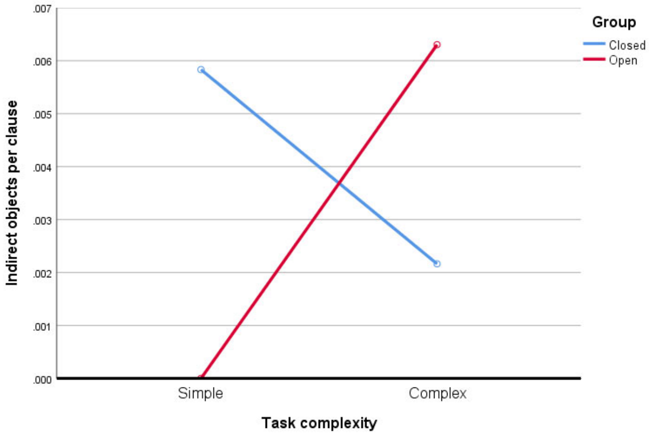

Figure 3. Task complexity and task closure effects on indirect objects per clause.

Figure 4. Task complexity and task closure effects on coordinating conjunctions per clause.

Several clausal complexity measures were found to be significantly affected by the main effect of task complexity only: 1) nominal complements per clause, $F(1, 79) = 6.975$, $p = .010$, $\eta_p^2 = .079$, 2) clausal negations per clause, $F(1, 79) = 7.754$, $p = .007$, $\eta_p^2 = .087$, 3) phrasal verb particles per clause, $F(1, 79) = 23.400$, $p < .001$, $\eta_p^2 = .224$, and 4) auxiliary verbs per clause, $F(1, 79) = 8.284$, $p = .005$, $\eta_p^2 = .093$. In other words, when task complexity was increased, participants used significantly more clausal negations, phrasal verbs, and auxiliary verbs, and significantly fewer nominal complements in their writing. For these four measures, task closure and its interaction with task complexity did not have a significant impact: 1) for nominal complements per clause, $F(1, 79) = .364$, $p = .548$, $\eta_p^2 = .004$, and $F(1, 79) = 1.278$, $p = .262$, $\eta_p^2 = .016$, respectively, 2) for clausal negations per clause, $F(1, 79) = .619$, $p = .434$, $\eta_p^2 = .008$, and $F(1, 79) = 017$, $p = .897$, $\eta_p^2 < .001$, respectively, 3) for phrasal verb particles per clause, $F(1, 79) = .290$, $p = .592$, $\eta_p^2 = .004$, and $F(1, 79) < .001$, $p = .996$, $\eta_p^2 < .001$, respectively and 4) for auxiliary verbs per clause, $F(1, 79) = .010$, $p = .921$, $\eta_p^2 < .001$, and $F(1, 79) = .237$, $p = .627$, $\eta_p^2 = .003$, respectively.

While significant findings were obtained for some clausal complexity measures, the following failed to be affected significantly by the effects of task complexity, task closure, or their interaction: 1) adverbial clauses per clause, $F(1, 79) = .582$, $p = .448$, $\eta_p^2 = .007$; $F(1, 79) = .399$, $p = .529$, $\eta_p^2 = .005$; and $F(1, 79) = .131$, $p = .718$, $\eta_p^2 = .002$, respectively, 2) clausal complements per clause, $F(1, 79) = .3.379$, $p = .070$, $\eta_p^2 = .040$; $F(1, 79) = 1.713$, $p = .194$, $\eta_p^2 = .021$; and $F(1, 79) = .361$, $p = .550$, $\eta_p^2 = .004$, respectively, 3) clausal subjects per clause, $F(1, 79) = .039$, $p = .845$, $\eta_p^2 < .001$; $F(1, 79) = .002$, $p = .962$, $\eta_p^2 < .001$; and $F(1, 79) = .106$, $p = .746$, $\eta_p^2 = .001$, respectively, 4) direct objects per clause, $F(1, 79) = 1.497$, p

= .225, η_p^2 = .018; $F(1, 79)$ = .013, p = .910, η_p^2 < .001; and $F(1, 79)$ = .384, p = .537, η_p^2 = .005, respectively, and 5) subordinating conjunctions per clause, $F(1, 79)$ = .232, p = .631, η_p^2 = .003; $F(1, 79)$ = .250, p = .619, η_p^2 = .003; and $F(1, 79)$ = 1.047, p = .309, η_p^2 = .013, respectively.

Finally, results of the statistical analyses run on noun phrasal complexity measures revealed that the interaction between task complexity and task closure significantly affected prepositions per nominal subject and nouns as modifiers per nominal subject, $F(1, 79)$ = 3.945, p = .050, η_p^2 = .046, and $F(1, 79)$ = 5.521, p = .021, η_p^2 = .064, respectively. Additional analyses revealed that when participants carried out the complex task version, as opposed to the simple version, the Closed group produced significantly fewer prepositions per nominal subject and the Open group produced significantly fewer nouns as modifiers per nominal subject (see Figures 5 and 6). While the main effects of task complexity and task closure were not found to have a significant impact on the former measure, $F(1, 79)$ = 1.346, p = .249, η_p^2 = .016, and $F(1, 79)$ = .029, p = .866, η_p^2 < .001, respectively, task complexity effects were found to significantly impact the latter measure, $F(1, 79)$ = 7.589, p = .007, η_p^2 = .086. However, task closure effects were found to be non-significant, $F(1, 79)$ < .001, p = .983.

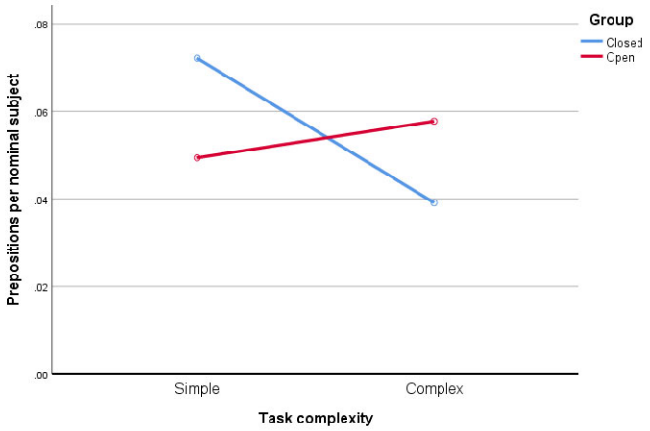

Figure 5. Task complexity and task closure effects on prepositions per nominal subject.

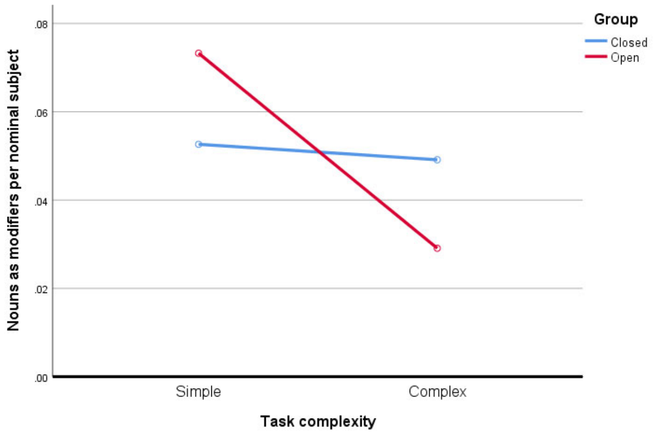

Figure 6. Task complexity and task closure effects on nouns as modifiers per nominal subject.

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Significant main effects of task complexity were also found on adjectival modifiers per nominal subject, such that this index was significantly lower when participants carried out the complex task version, $F(1, 79) = 5.150$, $p = .026$, $\eta_p^2 = .060$. Neither task closure nor its interaction with task complexity had a significant impact, $F(1, 79) = .620$, $p = .433$, $\eta_p^2 = .008$, and $F(1, 79) = .038$, $p = .847$, $\eta_p^2 < .001$, respectively. The opposite trend was observed in the case of adjectival modifiers per prepositional object, as a significantly positive relationship was found between this measure and task complexity, $F(1, 79) = 11.550$, $p = .001$, $\eta_p^2 = .125$. However, non-significant effects were found for task closure and its interaction with task complexity, $F(1, 79) = 1.079$, $p = .302$, $\eta_p^2 = .013$, and $F(1, 79) = 1.386$, $p = .243$, $\eta_p^2 = .017$, respectively.

Lastly, statistical analyses revealed that the following phrasal complexity measures were not significantly impacted by the effects of task complexity, task closure, or their interaction: 1) determiners per nominal subject, $F(1, 79) = .479$, $p = .540$, $\eta_p^2 = .005$; $F(1, 79) = 1.265$, $p = .264$, $\eta_p^2 = .015$; and $F(1, 79) = .306$, $p = .582$, $\eta_p^2 = .004$, respectively, 2) verbal modifiers per nominal subject, $F(1, 79) = .331$, $p = .567$, $\eta_p^2 = .004$; $F(1, 79) = .648$, $p = .423$, $\eta_p^2 = .008$; and $F(1, 79) = .022$, $p = .883$, $\eta_p^2 < .001$, respectively, 3) relative clause modifiers per nominal subject, $F(1, 79) < .001$, $p = .988$, $\eta_p^2 < .001$; $F(1, 79) = .475$, $p = .493$, $\eta_p^2 = .006$; and $F(1, 79) = .121$, $p = .728$, $\eta_p^2 = .001$, respectively, 4) determiners per direct object, $F(1, 79) = .054$, $p = .817$, $\eta_p^2 = .001$; $F(1, 79) = 2.296$, $p = .134$, $\eta_p^2 = .028$; and $F(1, 79) = .216$, $p = .643$, $\eta_p^2 = .003$, respectively, 5) adjectival modifiers per direct object, $F(1, 79) = 1.477$, $p = .228$, $\eta_p^2 = .018$; $F(1, 79) = .568$, $p = .453$, $\eta_p^2 = .007$; and $F(1, 79) = .022$, $p = .882$, $\eta_p^2 < .001$, respectively, 6) prepositions per direct object, $F(1, 79) = 1.850$, $p = .178$, $\eta_p^2 = .022$; $F(1, 79) = 2.897$, $p = .093$, $\eta_p^2 = .035$; and $F(1, 79) = 1.932$, $p = .168$, $\eta_p^2 = .023$, respectively, 7) verbal modifiers per direct object, $F(1, 79) = 3.862$, $p = .053$, $\eta_p^2 = .046$; $F(1, 79) = .095$, $p = .758$, $\eta_p^2 = .001$; and $F(1, 79) = .734$, $p = .394$, $\eta_p^2 = .009$, respectively, 8) nouns as modifiers per direct object, $F(1, 79) = .283$, $p = .596$, $\eta_p^2 = .003$; $F(1, 79) = 2.203$, $p = .142$, $\eta_p^2 = .026$; and $F(1, 79) = .045$, $p = .832$, $\eta_p^2 = .001$, respectively, 9) relative clause modifiers per direct object, $F(1, 79) = .773$, $p = .382$, $\eta_p^2 = .009$; $F(1, 79) = .082$, $p = .776$, $\eta_p^2 = .001$; and $F(1, 79) = .473$, $p = .494$, $\eta_p^2 = .006$, respectively, 10) determiners per prepositional object, $F(1, 79) = 3.508$, $p = .065$, $\eta_p^2 = .042$; $F(1, 79) = .466$, $p = .497$, $\eta_p^2 = .006$; and $F(1, 79) = .014$, $p = .906$, $\eta_p^2 < .001$, respectively, 11) prepositions per prepositional object, $F(1, 79) = .310$, $p = .579$, $\eta_p^2 = .004$; $F(1, 79) = 1.697$, $p = .196$, $\eta_p^2 = .021$; and $F(1, 79) = .038$, $p = .845$, $\eta_p^2 < .001$, respectively, 12) verbal modifiers per prepositional object, $F(1, 79) = .060$, $p = .807$, $\eta_p^2 = .001$; $F(1, 79) = .308$, $p = .580$, $\eta_p^2 = .004$; and $F(1, 79) = .081$, $p = .777$, $\eta_p^2 = .001$, respectively, 13) nouns as modifiers per prepositional object, $F(1, 79) = 1.434$, $p = .235$, $\eta_p^2 = .017$; $F(1, 79) = .134$, $p = .716$, $\eta_p^2 = .002$; and $F(1, 79) = .421$, $p = .518$, $\eta_p^2 = .005$, respectively, and 14) relative clause modifiers per prepositional object, $F(1, 79) = .022$, $p = .882$, $\eta_p^2 < .001$; $F(1, 79) = .796$, $p = .375$, $\eta_p^2 = .010$; and $F(1, 79) = 2.451$, $p = .121$, $\eta_p^2 = .029$, respectively.

Due to the vast amount of data, a summary of the significant findings is presented in Table 8. When using only traditional measures of syntactic complexity, the only finding supporting the CH in that increasing task complexity would lead to greater syntactic complexity was regarding the number of coordinate phrases per T-unit, and only in the case of the Open group. In fact, the number of complex nominals per clause ran counter to prediction. However, more evidence supporting the Cognition Hypothesis can be found upon closer examination of clausal complexity measures. While the increase in the amount of clausal coordinating conjunctions and indirect objects per clause is contingent on the type of task (i.e., open tasks) that participant perform, a general trend for increases in task complexity leading to greater clausal complexity can be observed. On the other hand, noun phrasal complexity measures show a different picture. Except for the number of adjectival modifiers per prepositional object, all other measures provide evidence that runs counter to the predictions of the study. In other words, the simple task versions elicited greater phrasal complexity than the complex ones.

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TABLE 8
Significant Findings

	*Task complexity	*Task closure	*Interaction
Traditional syntactic complexity indices			
MLC		Open > Closed	
Coordinate phrases per T-unit			Open: Simple < Complex
Complex nominals per clause	Simple > Complex		
Clausal complexity indices			
Adjective complements per clause			Open: Simple > Complex
Clausal coordinating conjunctions per clause	Simple < Complex		Open: Simple < Complex Complex: Closed < Open
Indirect objects per clause			Open: Simple < Complex Simple: Closed > Open
Nominal complements per clause	Simple > Complex		
Clausal negations per clause	Simple < Complex		
Phrasal verb particles per clause	Simple < Complex		
Auxiliary verbs per clause	Simple < Complex		
Phrasal complexity indices			
Adjectival modifiers per nominal subject	Simple > Complex		
Prepositions per nominal subject			Closed: Simple > Complex
Nouns as modifiers per nominal subject	Simple > Complex		Open: Simple > Complex
Adjectival modifiers per prepositional object	Simple < Complex		

Note. The findings that support the study's hypotheses are marked in red letters.

Discussion and Conclusion

The aim of the study was to examine the effects of task complexity, task closure, and their interaction on L2 writing, particularly with regard to syntactic complexity. Unlike previous task-based studies that investigated syntactic complexity using more traditional measures (Lu, 2010, 2011), this study examined participants' clausal complexity and phrasal complexity as well, with the hopes to obtain more empirical evidence that: 1) supports the CH in that increasing task complexity leads to greater syntactic complexity, and 2) shows which type of task (closed vs. open) is more effective at eliciting greater syntactic complexity. Eighty-one Korean learners of English were randomly divided into two groups (Closed vs. Open) and completed a writing task with two levels of complexity (simple vs. complex).

Task Complexity and Task Closure Effects on Traditional Measures of Syntactic Complexity

Among the various classic syntactic complexity measures that were examined in the study, the only measure that increased along with increases in task complexity was the number of coordinate phrases per T-unit, and this was only when participants carried out the open task version. In fact, it was found that a significantly greater number of complex nominals per clause was elicited when participants performed the simple task versions. Furthermore, open tasks elicited longer structures in terms of MLC.

As stated by Norris and Ortega (2009), learners at the early stages of L2 development tend to achieve syntactic complexity through coordination. As their development progresses, they rely more on subordination at intermediate stages and then on phrase-level complexity when they reach advanced stages. In the present study, the participants' average scores on Brown's (1980) cloze test was 15.33 out of a maximum of 50 points when adopting the exact scoring method, and 28 when adopting the acceptable scoring method. When comparing these average scores with those reported in other studies that also used Brown's cloze test to measure their participants' English proficiency (Chrabaszcz & Jiang, 2014; Tremblay, 2008), it can be said that the L2 proficiency of the current study's participants ranged from pre- to low intermediate levels. The sheer volume of subordinated clauses outnumbered that of coordinate clauses in this study, because instructions mandated them to provide reasons behind their choices, resulting in structures such as "*Therefore, I recommend The Moonriver, because it has proper daily rate and the internet access is free*." However, significant task complexity effects were obtained for coordinate clauses only for those who were given the freedom to write their suggestions based on their own opinions, i.e., the Open group. In other words, for learners with low intermediate L2 proficiency, their dependence on coordinate phrases seems to have increased when trying to incorporate the additional task elements of the complex task version. And because the Open group needed to persuade the imaginary guests to pick the hotel that they chose, they seem to have provided more supporting ideas, resulting in a higher MLC. However, it is not clear why the simple task versions were able to elicit more complex nominals than the complex versions, as it is exactly the opposite of what the CH predicts. Looking at the means and standard deviations of this metric, there appears to be sudden drop in the index for the Closed group when carrying out the complex task (from .76 to .65). One possibility is that for the Closed group, they could have reverted to more simple nominals when carrying out the complex task due to the fatigue of having to include the added elements in their writing. Because it was possible for learners to carry out the tasks in a minimally satisfactory way, those in the Closed group could have decided to use fewer nouns with modifiers, nominal clauses, or gerunds and infinitives functioning as subjects as it was possible to get their point across without having to be very detailed in their explanations.

Task Complexity and Task Closure Effects on Clausal Complexity

In the case of clausal complexity indices, a general trend can be found that supports the CH; except for the indices regarding adjective complements and nominal complements per clause, all other significant findings reveal that the complex version elicited greater causal complexity. In other words, participants used significantly more coordination than subordination, more clausal negation than words with negative meanings, more phrasal verbs, and more auxiliary verbs during complex task performance. Significant interactional effects between task complexity and task closure were also found on a number of indices as well, such that the complex task version elicited greater clausal complexity for the Open group.

These findings of clausal complexity regarding coordination and subordination are in line with the findings of traditional syntactic complexity indices, but also present a slightly more complex picture regarding the significant interaction effect between task complexity and task closure on clausal coordinating conjunctions per clause. While the Closed group did not show any differences in this index between the simple and complex task versions, the Open group used a much greater number of this index for the complex task version, so much that the difference between the Open and Closed group was significant when comparing the complex version only.

One interesting point to note is that the simple task version elicited significantly more adjectival complements (for the Open group only) and nominal complements than the complex version, indicating more uses of copular clauses for simple task performance. Based on morpheme studies that attempted to establish the order in which English morphemes are acquired by L2 learners (Dulay, Burt, & Krashen, 1982), the copula is acquired at the early stages of development (irregular present copula *be* at Stage 1; irregular past copula *be* at stage 2). If participants of the study had acquired the copula early on and continued to use such linking verbs with ease, they may have considered it appropriate to use copular clauses for the less cognitively challenging task, and to use other action verbs for tasks that are more cognitively challenging. However, because of the increased cognitive load of the complex task, one could also raise a question as to why participants did not prefer to use the easier copular clause when the complex task would consume much of the available attentional resources.

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Task Complexity and Task Closure Effects on Phrasal Complexity

Contrary to predictions of the CH, results obtained regarding phrasal complexity indices revealed that the simple task version elicited greater phrasal complexity than the complex version, with the exception of adjectival modifiers per prepositional object. That is, the simple task version elicited significantly more adjectival modifiers, prepositions (for the Closed group only), and nouns as modifiers (for the Open group only) per nominal subject.

It is worth mentioning that except for adjectival modifiers per prepositional object, all of the significant findings were due to increased phrasal complexity in the nominal subject position. In other words, participants showed a tendency to produce more complex phrases in the subject position, as opposed to the direct object, indirect object, or prepositional object positions. However, English is a language whose sentence and clause structures are governed by principles of end-focus and end-weight (Quirk, Greenbaum, Leech, & Svartvik, 1985). Based on 'end-focus', there is a tendency for new information, i.e., the 'focus' of the message, to be placed at the end of the information unit. 'End-weight' refers to a tendency for 'heavy' elements to be placed at the end of a clause or sentence. It is also claimed that there is strong pressure on English to avoid sentences with a clause as subject in initial position and a relatively light predicate in final position (Collins, 1994). Despite the validity of this short-before-long tendency in English and other head-initial languages, the opposite ordering preference, long-before-short, has been reported for a head-final language such as Japanese (Hawkins, 1994; Yamashita & Chang, 2001). This typological difference on constituent ordering and weight has led Hawkins (2007) to claim that end-weight can no longer be considered as a language universal for sentence production and should be replaced by 'heavy-first' or 'heavy-last' depending on the typological type, i.e., OV and VO, respectively. Given that Japanese and Korean are highly morpho-syntactically similar, it is quite likely that the proficiency level of the participants was not high enough for them to apply the principles of end-focus and end-weight correctly in their English writing without L1 interference, thus leading to greater phrasal complexity in the nominal subject position only. Although it is yet unclear as to whether increasing task complexity had a negative effect on phrasal complexity, these findings seem to corroborate the notion that the participants English proficiency was at the low-intermediate level.

To date, there is a dearth of task-based studies that performed an in-depth analysis of the syntactic complexity in learners' output affected by task-related variables. The present study attempted to fill the gap in the literature by investigating syntactic complexity by using measures that go beyond what is normally employed in TBLT research. With the additional use of metrics that measure clausal complexity and phrasal complexity, the study was able to get a closer look into the areas that are affected by task complexity and task closure. Incorporation of various indices also helped in determining the stages to which the participants' development sequence in writing seemed to progressed. For future investigations, it would be interesting to see if L2 proficiency would play a role in the effectiveness of other task-related variables on learners' clausal and phrasal complexity. Furthermore, it would also be worthwhile to test whether similar findings would be obtained in L2 speech as well.

Funding

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2020S1A5B5A01045515).

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(Received January 04, 2021; Revised February 28, 2021; Accepted March 10, 2021)

