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An Investigation of How Task Closure and Task Complexity Affect English L2 Writing

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Lee, Jiyong. 2020. An investigation of how task closure and task complexity affect English L2 writing. *Korean Journal of English Language and Linguistics* 20, 517–540. The purpose of this study is to examine how task closure and task complexity interactively affect Korean L2 learners' writing in terms of lexical diversity, syntactic complexity, and accuracy. Although there is an abundance of research on the effects of task complexity on L2 performance, little attention has been paid to the differential effects of tasks that have a predetermined solution (closed tasks) vs. those that do not have a predetermined solution (open tasks). In order to fill this gap, this study investigated the interactive effects of task closure and task complexity on L2 writing, and also employed learner self-ratings and time-on-task to measure the cognitive load of the tasks. The results revealed that task complexity had significant effects on all cognitive load measures and performance measures. Significant task closure effects were also found on all measures of L2 writing. In addition, the interaction between task complexity and task closure significantly affected the level of stress that participants felt during task performance and the accuracy of their writing.

Keywords: task closure, open tasks, closed tasks, task complexity, L2 writing, English, lexical diversity, syntactic complexity, accuracy

1. Introduction

Early task-based research dates back to the 1990s, especially after the Cognition Hypothesis (Robinson 2001, 2011) and the Trade-Off Hypothesis (Skehan 1996, 2014) were introduced and proposed models of task sequencing that had competing views of attentional resources. Based on the assumption that there are multiple, non-competing pools of attentional resources that learners can draw on, the Cognition Hypothesis predicts that when task complexity—argued as the inherent cognitive demands of a task that should be manipulated for task sequencing and syllabus design—is increased, the syntactic complexity and accuracy of L2 learners' output will both increase, because learners are able to allocate

their attentional resources to both aspects. On the other hand, the Trade−Off Hypothesis assumes that there is a single pool of attentional resources, which leads to a trade−off between syntactic complexity and accuracy when the two compete for attention at the same time.

A plethora of studies have stemmed from these hypotheses, with the purpose of investigating how tasks can be manipulated to produce the desired outcome in L2 development. Most of them focused on how increasing task complexity, usually operationalized in terms of number of elements, +/− Here−and−Now, reasoning demands, or +/− planning time, led to significant differences in the syntactic complexity, accuracy, and/or fluency (CAF) of learners' production.

In the present study, task complexity effects on L2 writing were investigated, in combination with an aspect of tasks that has been neglected in the literature: task closure. In fact, the term 'task closure' has only been used in recent years (Lee 2018b, Montero 2018). Also referred to as open and closed tasks, this distinction lies in the difference in whether a task has a predetermined solution or not (Long 1990). If a task is closed, learners can perform the task successfully when they are able to reach a single solution or a limited set of solutions. On the other hand, an open task has a wide range of acceptable solutions, and learners are given more freedom when they carry out tasks. According to Long (1990) and Loschky and Bley−Vroman (1993), closed tasks are more beneficial for L2 speaking because the existence of a predetermined solution forces learners to persevere through task performance, recycle more linguistic material, and provide and incorporate more feedback during interaction. However, very few studies have empirically tested such claims of open vs. closed tasks.

In the attempt to fill the gap in the literature, the present study investigated how the effects of task closure have an effect on L2 written performance, in terms of syntactic complexity, lexical diversity, and accuracy. More specifically, it examined whether task closure and task complexity had an interaction effect on L2 writing. In doing so, it took one step further by examining whether increasing task complexity led to the predicted increases in cognitive load, defined as "the burden placed on a learner's capacity for cognitive processing, or the processing capacity of working memory" (Lee 2018b, p. 24). Unless task complexity effects are observed in cognitive load in the desired direction, it is very difficult to argue that any changes of L2 performance are caused by task complexity increases. Moreover, this method makes it possible to see whether closed tasks are more cognitively complex than open ones. Therefore, this study aims to answer the following research questions:

1) Does task closure affect the cognitive load of the task?
2) Does task closure affect English L2 writing?
3) Does task complexity affect the cognitive load of the task?
4) Does task complexity affect English L2 writing?
5) Do task closure and task complexity interactively affect the cognitive load of the task?
6) Do task closure and task complexity interactively affect English L2 writing?

2. Literature Review

Although task complexity effects on L2 performance have been probed and picked in various aspects, only a few studies have empirically tested the effects of task closure. Rankin (1990) compared the speech of 16 learners of English that carried out both open and closed spoken tasks. Participants were required to choose who to save from a plane crash in the open task, whereas they had to solve a murder case by finding the culprit in the closed task. It was found that the closed task resulted in more relative clauses and incorporation of input. However, task closure did not have a significant effect on syntactic complexity or accuracy. Slightly different results were obtained in Manheimer's (1993) replication study with 20 learners of Spanish, which used Rankin's (1990) tasks. It was found that the closed task led to greater syntactic complexity and more input incorporation, although no effects of task closure were found on the target-like use of *a* personal and the subjective.

More recent studies have examined task closure effects combined with task complexity effects (Lee 2018b, Montero 2018). Instead of having participants carry out both open and closed tasks, these studies divided the learners into two groups that either performed an open or closed version of the same task. Because changes in task performance can be brought by differences in task content, extra care was taken in Lee's (2018b) study so that the open and closed version of the same task contained the exact same information, except for the conditions that were added to the closed version in order to close the task. In this study, 83 learners of English were randomly divided into two groups: an Open group that carried out open task versions, and a Closed group that carried out closed task versions. Two writing tasks were employed, and participants were required to choose the best hotel or restaurant for imaginary people. Task complexity was operationalized in terms of number of elements, and the two tasks each had two levels of complexity. In order to obtain independent evidence that increasing task

complexity resulted in changes in cognitive load, which in turn led to changes in L2 performance, expert judgments, learner self-ratings, and time-on-task were also employed in the study. Running counter to the predictions of Long (1990) and Loschky and Bley-Vroman (1993), the findings indicated that open tasks were more beneficial for learners' lexical diversity. Although the cognitive load measures were able to show that the complex task versions placed greater load on the learners, this did not lead to greater syntactic complexity and/or accuracy. The only significantly positive relationship between task complexity and L2 written performance was found in lexical diversity.

Similar results regarding task closure effects were obtained in Montero's (2018) study. Divided into an Open group and Closed group, 62 learners of Spanish carried out spoken tasks in which they had to rearrange and describe a number of colored geometric shapes. While the arrangement of simple shapes was predetermined in the closed task, the Open group was required to rearrange oddly-shaped forms however they wanted to. The number of shapes determined task complexity, and results revealed that greater lexical diversity was observed in the Open group. The researcher speculated that the Open group was given the freedom to be more creative when rearranging the shapes, which led to the use of more complex structures in speech. Lending weight to the Cognition Hypothesis, the study also found that increasing task complexity generally resulted in greater lexical diversity, syntactic complexity, and accuracy.

Unlike the amount of research on the effects of task closure, task-based research has witnessed a number of methodological developments due to the abundance of studies that have accumulated over the past few decades. While earlier studies tended to focus on whether increases in task complexity led to changes in L2 performance (Foster and Skehan 1996, Gilabert 2007, Ishikawa 2007, Robinson 2005), more recent studies have examined how task complexity effects are mediated by individual differences such as working memory, L2 proficiency, motivation, etc. (Cho 2018, Kormos and Trebits 2011, Lee 2018a, Rahimi and Zhang 2019). In addition, there have also been an increase in the number of studies that attempt to validate task complexity manipulations by employing cognitive load measures (Lee 2019a, Sasayama 2016, Révész, Michel and Gilabert 2015).

In comparison to L2 speech, L2 written performance has received less attention from researchers. In fact, in their research synthesis of 129 articles, Sasayama, Malicka and Norris (2015) claimed that 72 percent of the studies that employed productive tasks targeted L2 speech. As such, a growing number of studies in recent years have looked into task complexity effects on the complexity, accuracy, lexical diversity, and fluency (CALF) of L2 writing, whose findings are well organized in Johnson's (2017) research synthesis of 20 studies. Johnson

claims that such findings do not provide unequivocal support for or refutation of the Cognition Hypothesis.

Very recent trends in task-based research on L2 writing have made attempts to gain a better understanding of L2 writing processes and how they are affected by increases in task complexity, with the help of technological advances (Jung 2017, Révész, Kourtali and Mazgutova 2017). In Révész et al.'s (2017) study, 73 advanced L2 learners completed essay tasks whose complexity was operationalized as +/− content support. Participants' writing behaviors were analyzed via a Keystroke logging program as well as through stimulated recall sessions. The researchers predicted that the lack of content support would result in more pressure on planning processes, making it difficult for learners to access ideas from long-term memory to be incorporated into their writing. More pressure on translating processes was also expected to bring less lexical retrieval and grammatical encoding (Kormos 2011). As a result, a decreased processing speed was predicted, which would be reflected in a slower pace of writing and a greater number and length of pauses. Participants were also expected to show less revision behaviors due to the limited capacity of attentional resources brought by increased task complexity. Findings showed that when content support was provided, learners paused less, revised more, and used more complex structures in their writing. On the other hand, participants paused more frequently between sentences and revised less below the word level when content support was not provided. Task complexity effects writing fluency were not found to be significant.

Also using a keystroke logging program, Jung (2017) looked into the pausing and revision behaviors of 41 Korean learners of English, who were required to write an argumentative essay whose task complexity was also determined by +/− contextual support. It was found that participants paused more frequently between words and sentences and showed less writing fluency (measured by minutes per word/characters) when contextual support was not provided. However, the lack of context support did not lead to longer pauses. In terms of the linguistic complexity of participants' writing, lexical complexity and overall complexity decreased when learners did not receive contextual support.

3. Method

3.1 Participants

Sixty students attending a university in Korea participated in the present study (23 males and 37 females). These students were recruited from an English Reading and Writing course, which they had to take in order to graduate. The mean age of the participants was 21.37 at the time of the study, with a standard deviation of 1.95. These students were randomly divided into two groups: one group that completed a task that had a predetermined solution (Closed group, N = 31), and another that completed a task without a predetermined solution (Open group, N = 29).

3.2 Writing task

Participants were required to complete one writing task that had three levels of task complexity: least complex, mid−complex, and most complex. The tasks were presented in a random order to avoid any sequencing effects. Participants had to choose the best hotel for a trip from a list of several options for two imaginary people. Information about each hotel was provided, such as the daily rate, internet access (fee), public transportation access, number and size of beds, room service time, etc. The participants who performed tasks with a predetermined solution (Closed group) were also given a list of the requests and preferences of the two imaginary people to whom they were giving their recommendations. For this group, there was only one hotel that fulfilled the travelers' needs. On the other hand, the group that carried out tasks that did not have a predetermined solution (Open group) could make a decision based on their own preferences. Except for the requirements of the imaginary travelers, all other information was kept the same between the open and closed versions. Task complexity was operationalized in terms of the amount of information provided (a.k.a., +/− number of elements), and Table 1 shows how it was manipulated across the three levels. All tasks were provided in Korean, so as to prevent students from copying expressions/grammatical structures if they were written in English. As stated in the instructions, the Closed group was aware that the task had one answer, and the Open group was told to write freely, as there was no predetermined answer. To summarize, the writing task had a total of six versions, as illustrated in Table 2.

Table 1. Number of Elements in Each Task

Task	Least complex	Mid−complex	Most complex
Number of hotels	3	4	5
Number of hotel characteristics	3	6	9
Closed task requirements	3	6	9

Table 2. Task Variables

	Task complexity		
Task closure	Least complex, Closed	Mid−complex, Closed	Most complex, Closed
	Least complex, Open	Mid−complex, Open	Most complex, Open

3.4 Outcome Measures

3.4.1 Cognitive load measures

In order to examine whether the cognitive load of the writing task was affected by the effects of task closure and task complexity, learner self−ratings and time−on−task were employed. After carrying out each task, participants were required to complete a survey (see Appendix) that asked them to rate the following on a nine−point Likert scale: 1) the level of overall perceived difficulty, 2) the amount of mental effort required for task performance, 3) the level of stress they felt while carrying out the task, 4) the level of time pressure they felt during the planning stage of task performance, and 5) the level of time pressure they felt during the writing stage of task performance. Participants were also asked to measure and report separately the times that they spent on the planning and writing stages of task performance, i.e., time−on−planning and time−on−writing (see Lee 2019b for more information on time−on−task).

3.4.2 Performance measures

Participants' writing was analyzed in terms of lexical diversity, syntactic complexity, and accuracy. Lexical diversity was measured using Guiraud's Index of Richness (1954), a mathematical transformation of the standard type−token ratio. This method, also known as GI, was preferred to the TTR for its consideration of text length. This index can be

obtained by dividing the total number of types by the root square of the total number tokens. A subordination index—the number of subordinate clauses per T-unit[1]—was used measure syntactic complexity. As a specific measure of accuracy, the proportion of target-like use (TLU) of articles (Pica 1983) was employed. This method addresses the problem of learners' overgeneralization and overuse of the articles, *a, the,* and *Ø*, which is captured by the number of suppliance in non-obligatory contexts. The formula is shown as follows.

$$\text{TLU} = \frac{N \text{ of correct suppliance in obligatory contexts}}{(N \text{ of obligatory contexts}) + (N \text{ of suppliance in non- obligatory contexts})}$$

3.5 Data Analysis

With regard to learner self-ratings, participants' answers on a 9-point Likert scale were analyzed separately. Although participants used minutes and seconds to report time-on-planning and time-on-writing, the times were calculated into seconds for analysis. For the lexical analysis, the number of types and tokens were counted using an online lexical text analysis program, VocabProfile (Cobb 2002). The occurrences of subordinate clauses, T-units, and articles were initially analyzed by the researcher, with a second rater examining 30 percent of the data. Any differences in opinions between the two raters were reconciled. A series of repeated-measures ANOVA were conducted on SPSS, with task closure as a two-level between-subjects variable and task complexity as a three-level within-subjects variable. The significance level was set at $p = .05$. When Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, the Huynh-Feldt correction was used.

[1] A T-unit is defined as a minimal unit consisting of a main clause and any subordinate clauses embedded or attached to it (Hunt 1964).

4. Results

4.1 Task Closure and Task Complexity Effects on Cognitive Load

Table 3 and Figure 1−3 show participants' self−ratings of cognitive load, as well as the two time−on−task measures. Although there appeared to be a general trend for the cognitive load to increase with greater task complexity, the Closed group and Open group seemed to show slightly different behavioral patterns in terms of time−on−planning. Furthermore, the differences in time−on−planning between the least complex and mid−complex version appeared to be greater than the differences between the mid−complex and most complex version.

Table 3. Means and Standard Deviations of Cognitive Load Measures

	Least complex		Mid−complex		Most complex	
	Closed	Open	Closed	Open	Closed	Open
Overall difficulty	4.32 (1.92)	4.83 (1.77)	5.31 (1.58)	5.32 (1.54)	5.55 (1.59)	5.66 (1.54)
Mental effort	4.94 (2.19)	5.41 (1.96)	5.84 (1.73)	5.83 (1.67)	6.45 (1.48)	6.14 (1.60)
Stress	4.52 (1.93)	5.14 (2.31)	5.23 (2.03)	5.31 (2.19)	5.65 (1.98)	5.45 (2.01)
Time pressure on planning	3.48 (2.19)	3.31 (2.12)	3.94 (2.11)	3.97 (2.10)	4.13 (2.08)	3.86 (2.08)
Time pressure on writing	4.58 (2.49)	4.17 (2.27)	5.42 (2.32)	4.83 (2.09)	5.68 (2.29)	5.17 (2.19)
Time−on−planning	113.13 (136.90)	252.50 (296.66)	153.55 (183.28)	256.68 (255.58)	184.61 (190.17)	288.65 (276.02)
Time−on−writing	661.10 (349.73)	665.50 (278.59)	795.23 (276.84)	738.17 (258.97)	772.74 (272.36)	892.97 (345.85)

Note. The two time−on−task measures are presented in terms of seconds.

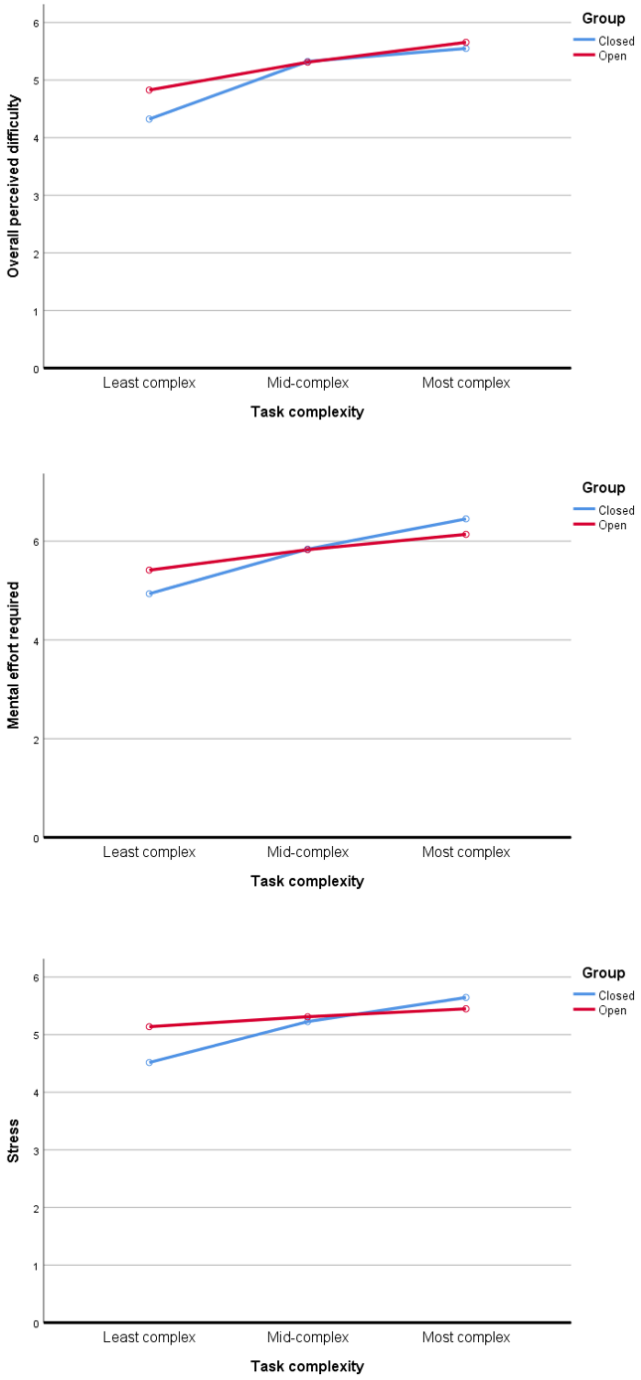

Figure 1. Self-ratings of Difficulty, Mental Effort, and Stress

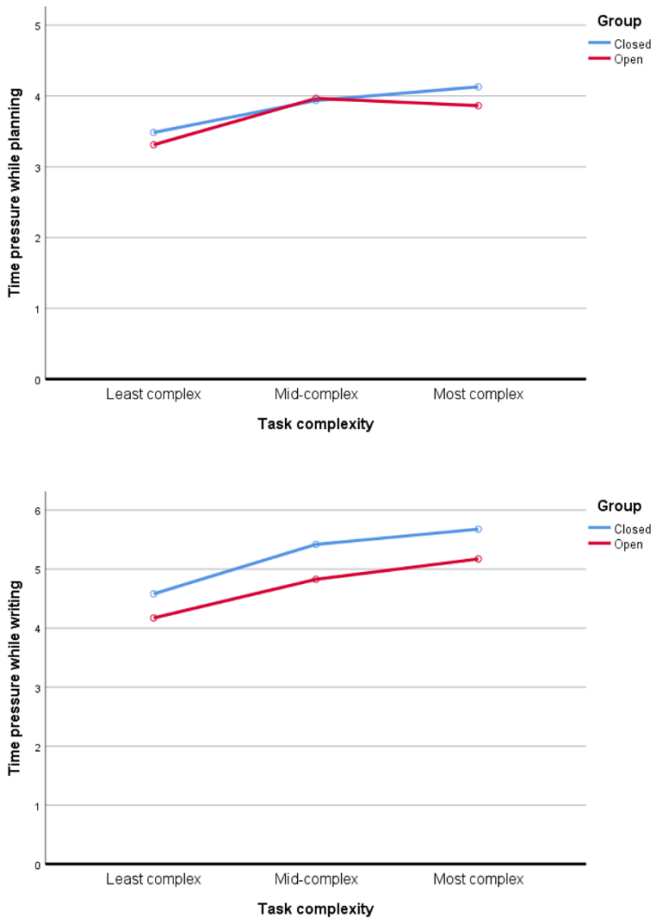

Figure 2. Self-ratings of Time Pressure while Planning and Writing

As shown in Figure 2, during the planning and writing stages of task performance, the mid-complex version seemed to place more time pressure than the least complex version. This trend appears to continue when task complexity was increased even further during the writing phase. However, a different pattern can be observed for time pressure felt during planning, in that the Open group felt less pressure while carrying out the most complex task version, compared to when carrying out the mid-complex version. The differential behaviors between the two groups are undeniably shown in the actual time spent on the planning stage (see Figure 3).

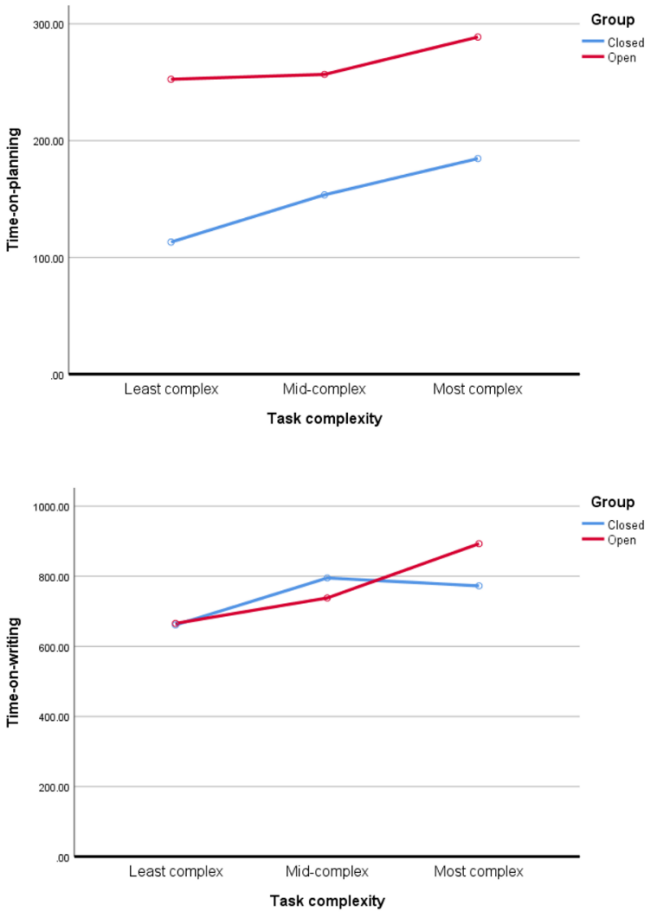

Figure 3. Time-on-Task Measures

Results of a series of repeated-measures ANOVA confirmed that the main effects of task complexity on all self-ratings were significant: $F(1.771, 102.719) = 30.076$, $p < .0005$, $\eta_p^2 = .341$ for overall perceived difficulty, $F(1.819, 105.506) = 22.726$, $p < .0005$, $\eta_p^2 = .282$ for mental effort required, and $F(1.766, 102.455) = 10.127$, $p < .0005$, $\eta_p^2 = .149$ for stress. Pairwise comparisons revealed that the differences in ratings of overall perceived difficulty and mental effort between all levels of task complexity were statistically significant ($p < .05$). On the other hand, task closure effects were not found to be significant: $F(1, 58) = .250$, $p = .619$, $\eta_p^2 = .004$ for overall perceived difficulty, $F(1, 58) = .015$, $p = .903$, $\eta_p^2 < .005$ for mental effort required, and $F(1, 58) = .114$, $p = .737$, $\eta_p^2 = .002$ for stress. However, although the interaction

between the two variables did not significantly affect perceived difficulty and mental effort, $F(1.711, 102.719) = 1.964$, $p = .151$, $\eta_p^2 = .033$, and $F(1.819, 105.506) = 2.864$, $p = .067$, $\eta_p^2 = .047$, respectively, a significant interaction was found on the level of stress that participants felt during task performance, $F(1.766, 102.455) = 3.326$, $p = .046$, $\eta_p^2 = .054$. Accordingly, a simple main effects analysis was conducted, whose results indicated that there was a statistically significant difference between all three levels of task complexity for the Closed group only ($p < .005$). The differences in the level of stress between the two groups at each level of task complexity were not found to be significant ($p > .05$).

Similar results regarding task complexity effects were obtained from the repeated-measures ANOVA conducted on time pressure measures. In other words, task complexity significantly affected the time pressure felt during planning and writing, $F(1.777, 103.082) = 4.826$, $p = .013$, $\eta_p^2 = .077$, and $F(1.515, 87.872) = 15.346$, $p < .0005$, $\eta_p^2 = .209$, respectively. Further analyses showed that while the only significant difference in time pressure while planning was found between the least complex and mid-complex versions ($p < .05$), statistically significant differences in the time pressure felt while writing were found between all levels of task complexity ($p < .05$). However, the main effects of task closure and its interaction with task complexity were not found to be significant, $F(1, 58) = .079$, $p = .780$, $\eta_p^2 = .001$, and $F(1, 58) = .850$, $p = .360$, $\eta_p^2 = .014$, for task closure effects on planning and writing, respectively, and $F(1.777, 103.082) = .251$, $p = .753$, $\eta_p^2 = .004$, and $F(1.515, 87.872) = .111$, $p = .840$, $\eta_p^2 = .002$ for interaction effects on planning and writing, respectively.

Regarding time-on-task measures, statistical analyses revealed significant task complexity effects on both time-on-planning and time-on-writing, $F(2, 116) = 8.162$, $p < .0005$, $\eta_p^2 = .123$, and $F(2, 116) = 6.467$, $p = .002$, $\eta_p^2 = .100$, respectively. Results of pairwise comparisons showed that the statistical differences in the two variables were found only between the least complex and most complex versions ($p < .05$). While task closure significantly affected time-on-planning, $F(1, 58) = 4.113$, $p = .047$, $\eta_p^2 = .066$, it did not have a significant effect on time-on-writing, $F(1, 58) = .167$, $p = .684$, $\eta_p^2 = .003$. Furthermore, the interaction between task complexity and task closure was not significant for time-on-planning or time-on-writing, $F(2, 116) = 1.192$, $p = .307$, $\eta_p^2 = .020$, and $F(2, 116) = 1.794$, $p = .171$, $\eta_p^2 = .030$, respectively.

4.2 Task Closure and Task Complexity Effects on L2 Writing

Descriptive statistics for performance measures are presented in Table 4 and Figure 4. There seemed to be a positive linear relationship between task complexity and lexical diversity. However, a negative relationship between task complexity and syntactic complexity can be observed, with slight differences between the Open and Closed groups. Only the Closed group shows a difference in the TLU of articles when task complexity is increased from mid-complex to most complex. In general, the Open group appeared to outperform the Closed group in terms of lexical diversity and syntactic complexity, and the Closed group seemed to use more TLU of articles than the Open group.

Table 4. Means and Standard Deviations of Performance Measures

	Least complex		Mid-complex		Most complex	
	Closed	Open	Closed	Open	Closed	Open
Guiraud's Index	5.16 (0.56)	5.80 (0.96)	5.72 (0.59)	6.18 (0.92)	5.73 (0.67)	6.30 (1.13)
Subordinate clauses per T-unit	0.39 (0.20)	0.73 (0.68)	0.47 (0.42)	0.57 (0.26)	0.27 (0.21)	0.52 (0.24)
TLU of articles	0.77 (0.15)	0.61 (0.18)	0.77 (0.15)	0.66 (0.16)	0.63 (0.13)	0.60 (0.17)

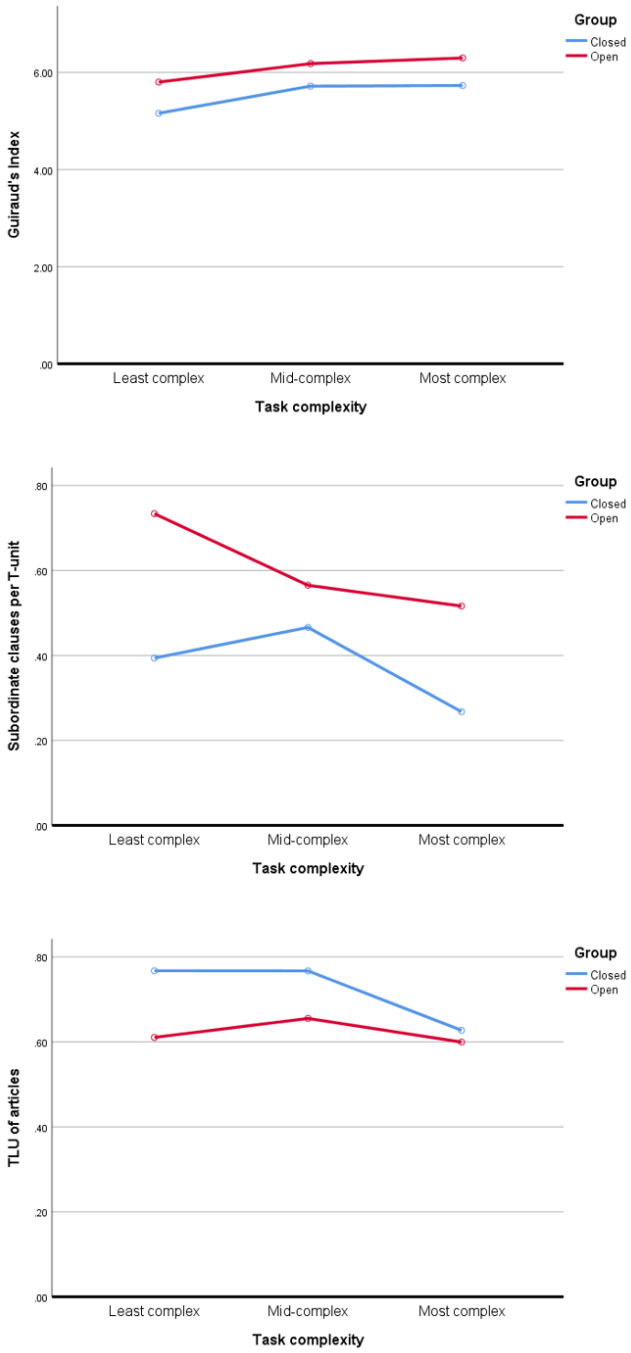

Figure 4. Lexical Diversity, Syntactic Complexity, and Accuracy

As with cognitive load measures, a series of repeated-measures ANOVA were conducted with the performance measures as dependent variables. As expected, findings revealed that task complexity and task closure each had significant effects on GI and the number of subordinate clauses per T-unit, $F(2, 116) = 20.186$, $p < .0005$, $\eta_p^2 = .258$, and $F(1.808, 103.049) = 4.412$, $p = .017$, $\eta_p^2 = .072$ for task complexity effects on GI and the subordination index, respectively; and $F(1, 58) = 8.984$, $p = .004$, $\eta_p^2 = .134$, and $F(1, 58) = 11.054$, $p = .002$, $\eta_p^2 = .162$ for task closure effects on GI and the subordination index, respectively. Pairwise comparisons showed that the least complex version elicited a significantly lower GI than the more complex versions ($p < .05$). On the other hand, the most complex version elicited a significantly lower subordination index than the less complex versions ($p < .05$). The task complexity × task closure interaction effects on GI and the number of subordinate clauses per T-unit were not found to be significant, $F(2, 116) = .482$, $p = .619$, $\eta_p^2 = .008$, and $F(1.808, 103.049) = 2.071$, $p = .136$, $\eta_p^2 = .135$, respectively. Regarding the findings for TLU of articles, task complexity, task closure, and their interaction all had significant effects, $F(1.812, 105.097) = 9.055$, $p < .0005$, $\eta_p^2 = .135$ for task complexity effects, $F(1, 58) = 11.473$, $p = .001$, $\eta_p^2 = .165$ for task closure effects, and $F(1.812, 105.097) = 3.705$, $p = .032$, $\eta_p^2 = .060$ for their interactional effects. Results of a simple main effects showed that the TLU of articles when the Closed group performed the most complex task version was significantly lower than those when the group performed the least and mid-complex versions ($p < .0005$). Further pairwise comparisons showed that the least complex and mid-complex versions elicited a significantly different proportion of TLU articles ($p < .0005$ and $p = .006$, respectively). However, the two groups did not differ on the most complex version. In other words, the TLU of articles of the Open group was not significantly affected by task complexity.

5. Discussion and Conclusion

Previous research on the types of tasks that are more beneficial for L2 learning have neglected the differential effects of open vs. closed tasks. Researchers such as Long (1990) and Loschky and Bley-Vroman (1993) have hypothesized that that closing a task, i.e., creating a task so that it has a predetermined solution or set of solutions, would be more effective for L2 development. However, there is only a handful of studies that have empirically tested such hypotheses. Findings of the present study reveal that task closure

does have a significant impact on L2 learners, especially in their writing in terms of lexical diversity, syntactic complexity, and accuracy. Among the various cognitive load measures employed in the study, task closure was found to affect the time spent during the planning stage of task performance, such that the Open group spent longer time planning their writing than the Closed group at all levels of task complexity: 139.37 more seconds on the least complex version, 103.13 more seconds on the mid-complex version, and 104.04 more seconds on the most complex version. Apparently, it took less time for the Closed group to plan their writing, as all they had to do was eliminate the hotel options that did not fit the imaginary travelers' needs and preferences. On the other hand, the Open group had to think about their traveling experiences and their preferences before making a decision about the best hotel to recommend, and this effort would have required more time for planning. Furthermore, A significant task complexity × task closure effect on the level of stress felt during task performance revealed that only the Closed group felt a significantly greater deal of stress as the complexity of the task increased.

A greater number of statistically significant results were found regarding task closure effects on performance measures than cognitive load measures. In fact, all measures of L2 writing were significantly affected. In terms of lexical diversity, measured by GI, open tasks elicited more diverse vocabulary than closed tasks. These results are consistent with the findings obtained from Lee's (2019a) and Montero's investigations (2018). Because the Open group was able to write freely, they reflected upon their own preferences and experiences, which were incorporated into their writing. Furthermore, in order to persuade the imaginary travelers to book the hotel that they recommended, the Open group gave more examples and reasons behind their choices, leading to greater lexical diversity. The Closed group, on the other hand, only had to refer to the travelers' requirements and preferences when writing. The following are a couple excerpts that exemplify the differences in lexical diversity between the Open and Closed groups.

> I recommend you to stay at 'The Castle'. There are 4 reasons. At first, it is the cheapest hotel among them.
> Since you are looking for a hotel during your trip, it is better to save money to residence. Then spend that money to eat delicious foods or do other fun things. Secondly, it has free wi-fi service. Nowadays, most people have their SNS accounts and uploading their daily life to Instagram or Facebook cannot be excluded during the trip. Also, we spend lots of time with our smartphone when we take a rest. Therefore, this hotel is suitable for smartphone users. Whereas, in the hotel 'The Square' and

'The Echo', you might be charged lots of extra fee. Thirdly, this hotel provides you a breakfast. This will definitely help you to save money.
Lastly, it has a washing machine. After finishing your day and when you come back to hotel, your clothes must be dirty and wet. Those should be cleaned at that time. Because you have a washing machine, what you have to do is just throwing dirty clothes in the machine. Even though you don't have a drying machine, but if you consider the price, it is not such a big deal. For these reasons, I strongly recommend you to stay at 'The Castle'.

[Open group participant whose GI was 8.38 on the most complex task]

Hotel, "The Castle" is the only hotel that I can recommend. "The Square" cannot provide the breakfast for you. "The Echo" did not prepare any washing machines you need. "The Imperial" requires overbudget. "The Royal" provides no Internet services for you. Otherwise, "The Castle" meets all of your needs. You have to pay $200 for daily rate, you can reach the bus station in 10 minutes by walk, you can use free Wi-FI, your beds will be the smallest size, you can check-out until 1 p.m., you can do the laundries, room service will be provided until 4 a.m., and it has built in 2010.

[Closed group participant whose GI was 7.06 on the most complex task]

The excerpts above come from participants whose GI was one of the highest in their groups. Although both cover all or most of the information provided about the hotels (and the travelers' requests), such as Internet/wi-fi services, budget, washing machine, etc., the Open group went into more detail about why one needs free wi-fi, why a hotel breakfast is needed, why a washing machine is necessary, and so on. The other participants in the Open group showed similar writing behaviors, resulting in a significant effect of task closure on lexical diversity.

Significant task closure effects were also observed in participants' syntactic complexity, in that the Open group displayed more complex writing than the Closed group in terms of the number of subordinate clauses per T-unit. Referring back to the excerpts above, it is easily discernable that the Open group participant used more complex structures in their writing, in comparison to the Closed group participant, who mainly used conjunctions. Even though the open and closed tasks both included instructions requesting participants to give reasons as to why they chose a certain a hotel and why they did *not* choose the others, the Open group used more structures with subordinate clauses.

The findings regarding task closure effects on the TLU of articles is interesting in that

unlike the Open group, only the Closed group was significantly affected when task complexity was increased to the most complex level. While the Open group seemed to be oblivious to increases in task complexity, the Closed group's incorrect use of articles was only observed when the task was very complex. The following excerpts are from a participant in the Closed group, whose proportions of TLU articles were 1, 0.9, and 0.42 at the three levels of task complexity. It seems that when the number of elements involved in the task is too high, there is a greater possibility for the participant to make errors in article use whenever an additional element needs to be mentioned. However, it is yet unclear as to why this occurs to the Closed group only, and further research should employ other methods such as stimulated recall in order to find out the reason behind this differential behavior between Open and Closed groups.

I recommend The Tower hotel which meet the conditions. You have a limited budget of $100, so The Sunset hotel is too expensive to use. Because You prefer free Wi-fi to charged, in this point The Tower hotel is appropriate. From a traffic point of view, The Tower hotel can use a bus for 10 minute.

[Elicited by the least complex task]

I recommend The Utopia hotel, because it daily rate is $200. You have a limited budget of $200. So The Imperial hotel is too expensive to use. Because you prefer walking to public transportation, The Urban hotel is too short to walking tour. Also, when I looked at the environment of the Internet, The Utopia and The Echo are appropriate. And both of them have 2 bed in the room. However, the difference between the two is that breakfast is included. Finally, The Utopia's check-out time is 2 p.m., so The Utopia is Appropriate to stay.

[Elicited by the mid-complex task]

I recommend The Castle hotel. You have a limit budget of $300, So The Imperial hotel is too expensive. Because You prefer bus to subway, The Square and The Royal are inappropriate. And The castle hotel has free wi-fi zone. You very like it. Then, It has 2 double bed in room. Also, It has hotel breakfast. It's perfect for you to stay. The Castle's check-out time is 1 p.m., and It has washer but hasn't dryer. Its room service is until 4 a.m. The year the hotel was built is 2010 and is relatively new. For these reasons, I recommend The Castle hotel.

[Elicited by the most complex task]

As predicted, task complexity significantly affected all cognitive load measures and performance measures, mostly in the direction that was hypothesized. With regard to learner self-ratings, a positive linear relationship was confirmed for the overall perceived difficulty, mental effort required for task completion, and time pressure felt during the planning and writing stages. As mentioned earlier, the level of stress that participants felt slightly differed depending on the type of task they carried out, as only the Closed group felt significantly more stress with greater task complexity. Participants were also found to spend a significantly longer time on the planning and writing stages of task performance when task complexity was increased.

With regard to task complexity effects on L2 writing, the study obtained significant findings for lexical diversity, syntactic complexity, and accuracy. When the number of elements involved in a task increased, participants used more diverse vocabular in their writing. However, the results found for syntactic complexity and accuracy measures run counter to the predictions of the Cognition Hypothesis or the Trade-Off Hypothesis, as increases in task complexity led to a fewer number of subordinate clauses per T-unit and a lower proportion of TLU articles. In other words, the task used in the study did not elicit greater syntactic complexity and accuracy (as the Cognition Hypothesis predicts), nor did it show a trade-off between the two measures (as the Trade-Off Hypothesis predicts). However, if lexical diversity can be classified as "complexity", the findings of the present study lend support for the Trade-Off Hypothesis, as task complexity was found to have a positive effect on GI at the expense of syntactic complexity and accuracy.

It should be noted that a reverse V-shaped pattern was observed in the Closed group in terms of syntactic complexity and in the Open group in terms of accuracy. Although the increases in the two variables from the least complex to the mid-complex version are not statistically significant, it is similar to the findings of Lee's (2019a) study, where a reverse V-shaped pattern was observed for syntactic complexity measures in terms of the number of subordinate clauses per AS-unit and number of clauses per AS-unit. In order to account for the reason why participants did not produce more complex structures when carrying out the most complex task versions, Lee suggested the possibility of intentional or unintentional task simplification, by which participants short-circuit the task because it is too complex for them to process.

Unlike the majority of task-based research that investigate task complexity effects on L2 performance, the present study is unique in that it incorporated three levels of task complexity: from least complex, mid-complex, to most complex. Looking closely at the data, if the study had not added a third level of task complexity (i.e., had left out one level

of task complexity), the findings could have been greatly different in that significant differences in performance measures obtained in the present study may not have been captured. Mixed findings of a vast amount of previous task-based studies could be attributed to the fact that they usually only compare simple vs. complex tasks.

Limitations of the present study should be noted for further research. The participants had lower intermediate English proficiency, and it would be interesting to see whether more advanced learners would show different behaviors. Moreover, only one task (finding the best hotel) was employed in the present study. Further investigations should employ at least two tasks to generalize findings.

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

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Appendix

Survey (Learner Self-Ratings)

작문 과제를 하나 끝낼 때마다 각 장에 있는 물음에 답하십시오.

1. 과제의 전체적인 어려움 정도는 어땠습니까?

1 2 3 4 5 6 7 8 9

매우 쉬웠다 매우 어려웠다

2. 과제를 수행하는 데에 있어서 어느 정도의 정신적인 노력(mental effort)을 들였습니까?

1 2 3 4 5 6 7 8 9

거의 들이지 않았다 아주 많이 들였다

3. 과제를 수행하는 데에 있어서 어느 정도의 스트레스를 느꼈습니까?

1 2 3 4 5 6 7 8 9

전혀 느끼지 않았다 아주 많이 느꼈다

4. 글 계획 단계에서 시간의 압박을 느꼈습니까?

1 2 3 4 5 6 7 8 9

전혀 느끼지 않았다 매우 느꼈다

5. 글쓰기 단계에서 시간의 압박을 느꼈습니까?

1 2 3 4 5 6 7 8 9

전혀 느끼지 않았다 매우 느꼈다

6. 과제를 수행하는 데에 걸렸던 시간을 <u>매우 구체적으로</u> 쓰시오:

계획 시간: _____ 분 _____ 초

글쓰기 시간: _____ 분 _____ 초