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Task Sequencing and Task Complexity Effects on L2 Writing: Does Task Order Really Matter?

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While the importance of task sequencing in task-based research and syllabus design has been emphasized, there is a gap in the literature regarding whether the order in which tasks are presented actually has a significant impact on L2 performance. The aim of the study was to investigate whether task sequencing actually had an effect on L2 written performance. A writing task with three levels of task complexity was given to 88 EFL learners, with one group carrying the three task versions out in the order of increasing task complexity (Simple-to-complex), and the other group in the order of decreasing task complexity (Complex-to-simple). It was found that the cognitive load of the task, as well as learners' syntactic complexity and lexical diversity shown in their L2 writing, were significantly affected by task sequencing and its interaction with task complexity. Pedagogical implications are noted with regard to the differential effects that task sequencing has on L2 writing, as presenting tasks in the order of increasing task complexity resulted in greater syntactic complexity, while presenting tasks in decreasing task complexity led to greater lexical diversity.

Keywords: task sequencing, task complexity, L2 writing, syntactic complexity, lexical diversity

Introduction

Task-Based Language Teaching (TBLT) has witnessed great advancements in research, starting with Long and Crooke's (1992) ground-breaking notion that it is only a needs analysis that can determine target tasks, later to be classified into task types from which pedagogic tasks can be derived. They argued that a task-based syllabus, claimed to be fundamentally different from a syllabus based on linguistic complexity, should be created by sequencing pedagogic tasks along increases in task complexity. In an attempt to provide a universal set of parameters with which to manipulate the complexity of tasks and to sequence them properly, Robinson (1995, 2001b, 2007a, 2011) proposed the Triadic Componential Framework, whereby cognitive complexity is defined as "the result of the attentional, memory, reasoning, and other information processing demands imposed by the structure of the task on the language learner" (2001, p. 29). The framework proposed three components of a task: task complexity, task difficulty, and task condition. Task complexity can further be divided into resource-directing dimensions and resource-dispersing dimensions, whose manipulations can be used for task sequencing and evaluation. In short, the goal of the Triadic Componential Framework is for learners to carry out pedagogic tasks whose task complexity is increased progressively, so that they ultimately acquire the ability to perform real-world tasks successfully. Robinson predicted that increases in task complexity would push learners to greater accuracy and complexity, promote interaction and negotiation of meaning, and enhance incorporation of feedback. This framework and set of predictions gave birth to a plethora of studies that attempted to investigate the effects of task complexity on L2 production, language learning, and L2 interaction (Gilabert, 2007; Ishikawa, 2007, 2011; Kormos & Trebits, 2011; Kuike et al., 2005; Kuiken & Vedder, 2007a, 2007b, 2008, 2011;

Michel et al., 2007, 2012; Révész, 2009, 2011; Révész et al., 2011; Robinson, 1995, 2001a, 2007b). In recent years, a growing body of research has tried to validate task complexity manipulations in order to see whether the changes in various aspects of the output were actually caused by changes in cognitive load (Gilabert et al., 2009; Lee, 2019a, 2019b; Malicka & Levkina, 2012; Révész et al., 2014, 2015; Sasayama, 2016). To this end, a variety of methods were implemented in such studies, such as learner self-ratings, expert judgments, time estimation, the dual task method, eye-tracking, and time-on-task.

Despite the vast amount of research on task complexity effects, little attention has been paid to the effects of task sequencing. Nonetheless, the general consensus is that tasks should be sequenced from simple-to-complex, because "learners attempt more progressively complex and conceptually demanding versions of tasks they are prompted to use and develop the linguistic resources needed to meet these more complex demands" (Baralt et al., 2014, p. 4). In fact, Robinson (2010) even proposed a model for sequencing tasks and designing a task-based syllabus, named the SSARC model. According to this model, tasks should be sequenced based on two principles. First, only the cognitive demands of tasks should be sequenced. Second, resource-dispersing dimensions of complexity should be increased first, followed by increases in resource-directing dimensions.

Very little research has been conducted on the effects of the sequence of progressive task complexity, especially since most laboratory experiments try to randomize the sequence in which tasks are presented to learners, in order to avoid any potential confounding practice effects. For instance, Lee (2019a) took extra steps to pseudo-randomize her tasks so that participants would not carry out two tasks of the same type in succession. In order to fill the gap in the literature, the present study examined whether task sequencing played a role in L2 writing, and if so, whether it interacted with task complexity effects on various aspects of L2 written performance.

Task Sequencing Effects on L2 Performance

As far as we are aware of, there is a very limited number of empirical studies that investigated task sequencing effects on L2 writing as an independent variable (Allaw & McDonough, 2019; Lambert & Robinson, 2014).

Among the most recent study of task sequencing effects, Allaw and McDonough (2019) investigated whether task sequencing had an impact on the lexical diversity, accuracy, and fluency shown in L2 French writing. Based on Robinson's Triadic Componential Framework and SSARC model, they predicted that sequencing tasks along resource-directing and resource-dispersing dimensions would lead to greater lexical diversity, grammatical accuracy, and fluency. Forty-two novice learners of French carried out tasks with three levels of complexity, manipulated in terms of +/- spatial reasoning (a resource-directing dimension) and +/- task structure (a resource-dispersing dimension). Participants were divided into two groups, depending on the order in which they carried out the tasks: either a simple-to-complex group, or a complex-to-simple group. A pretest, posttest, and delayed posttest design was employed, and analyses were performed on participants' writing and their scores on a discrete point test of lexical and grammatical forms. It was found that both groups improved in the lexical diversity, grammatical accuracy of relative clauses, and fluency in their writing. However, on the delayed posttest taken two weeks later, the simple-to-complex group outperformed the complex-to-simple group. The researchers claimed that this finding supported the SSARC model in that the simple task first stabilized learners' newly acquired L2 knowledge, the medium task provided opportunities for them to express similar ideas and promoted automatization, and the complex task allowed them to create new form-meaning connections during spontaneous writing.

In a 15-week quasi-experimental study with a pretest-posttest design, Lambert and Robinson (2014) examined the effects of task sequencing on the L2 writing of EFL Japanese university students. Participants carried out narrative tasks based on comic strips for one semester, and their written output was analyzed in terms of syntactic complexity, the use of explicit intentional reasoning markers, grammatical accuracy, and expert ratings of successful task performance. In compliance with the SSARC model, task complexity was manipulated along resource-directing dimensions (number of elements and intentional reasoning demands) and resource-dispersing dimensions (planning time, prior knowledge, number of steps, and multi-tasking). While the control group did not follow any principle for task sequencing, the experimental group carried out the tasks in a simple-to-complex sequence. Results showed that the two groups did not significantly differ in syntactic complexity, reasoning markers, or accuracy. However, the simple-to-complex group displayed higher gains over time based on expert raters` judgements of pre- and posttest task performance, providing partial support for the SSARC model.

In order to examine task sequencing effects, the two studies mentioned above employed a pretest-posttest design, with participants taking tests before and after carrying out a series of tasks in a particular order. In contrast, the present study did not utilize any tests for two reasons. First, it was considered too taxing for participants to carry out five tasks in a row during one session. Second, more importantly, because the pretest and posttest would most likely be of the same nature as the treatment tasks whose presentation order would be under investigation, the pre- and posttest would inevitably influence the effects of task sequencing because the tests would also have a certain level of task complexity themselves. For instance, if the task complexity of the pre- and posttest was manipulated so that the tests were of medium complexity, one experimental group would be carrying out tasks in the following order: mid-complex (pretest), simple (task), complex (task), mid-complex (posttest). In this case, it is difficult to conclude that any gains on the posttest is strictly due to the order of progressive task complexity, because it is impossible to tease out the effect that the task complexity of the pretest could have on the participants. Therefore, the present study looked into the written performance of L2 learners without the use of a pre- and posttest in order to avoid any confounds. Instead, the output of the writing tasks themselves were the final product, which were later analyzed to examine task sequencing and task complexity effects.

Research Questions

In order to contribute to the body of research regarding task sequencing effects on L2 performance, the present study sought to answer the following questions.

1. What are the effects of task sequencing on the cognitive load of the task?
2. What are the effects of task sequencing on the syntactic complexity of L2 writing?
3. What are the effects of task sequencing on the lexical diversity of L2 writing?
4. Do the effects of task sequencing interact with those of task complexity?

Methodology

Participants

Recruited from a Practical Reading and Writing English course, 88 university students in Korea participated in the study (59 males and 29 females), the majority of whom were sophomore students from the Engineering Department. Originally starting with 94 participants, six had been removed, as they had failed to complete the tasks and/or incorrectly reported the data that was required. The participants were divided into two groups: one group (N = 43) that carried out the task versions of the study in increasing task complexity (from least complex, mid-complex, to most complex), henceforth called the Simple-to-complex group, and the other group (N = 45) that carried out the tasks in decreasing task complexity (from most complex, mid-complex, to least complex), henceforth called the Complex-to-simple group. In order to measure their overall English proficiency, participants were given as much as 30 minutes to take

Brown's 50-item cloze test (1980). The exact scoring method was used, so participants' answers were marked correct only if their answers matched the words in the blanks from the original text.

Writing Task

Participants carried out a Seating Arrangement Task (Lee, 2019a) with three levels of task complexity that required them to find the best seating arrangement for a number of people with certain needs and preferences. This task was chosen because it was more effective than Lee's other two tasks (the Map Task and the Car Accident Task) at capturing changes in native speakers' syntactic complexity in their spoken output. Task complexity was determined by the number of elements involved in the task (e.g., number of guests to seat, number of preferences/wants, etc.). The least complex version required participants to seat 4 people around a circular table, the mid-complex version 6, and the most complex version 8 (see Appendices A-C). Based on Lee's (2019a) findings, it was expected that participants of the present study would also show 1) a reversed V-shaped pattern in their syntactic complexity as they carried out more complex tasks, and 2) a linear relationship between task complexity and lexical diversity.

Cognitive Load Measure

In order to find out whether any (desired) changes in the written output are a result of task complexity manipulations designed by the researcher, it is necessary to examine changes in cognitive load as well. To this end, time-on-task was selected for its efficacy and ease of use, among the various methods of measuring cognitive load. Participants were given detailed instructions on how to time their performance, using the timer on their cell phones. After completing each task, participants wrote down: 1) the time that it took for them to go over the task instructions and design the best seating plan that would satisfy the imaginary guests (time-on-planning), and 2) the actual time it took for them to write down their seating arrangement (time-on-writing). Participants wrote their times in minutes and seconds, and further analyses conducted on time-on-task were based on seconds.

Syntactic Complexity Measure

Because the study looked into participants' L2 writing, Hunt's (1964) T-unit was used as the basic unit of analysis, defined as the minimal unit that consists of a main clause and any subordinate clause embedded or attached to it. Two measures of global syntactic complexity were employed: 1) mean length of T-units (MLT), calculated by dividing the total number of tokens by the total number of T-units, and 2) the number of subordinate clauses divided by the total number of T-units. In order to take a closer look at the types of subordination observed in participants' writing, subordinate clauses were further divided into nominal, adjectival, and adverbial subordinate clauses. The numbers of each type of subordinate clause were then divided into the total number of T-units.

Lexical Diversity Measure

To analyze lexical diversity, the present study utilized VocabProfile (Cobb, 2002), an online program that computes frequency data of texts. Analyses were performed regarding the numbers of types and tokens in participants' writing, as well as the number of words from the following four lists: 1) the most frequent 1000 word families, 2) the second 1000 word families, 3) the Academic Word List, and 4) words that do not appear in the three lists above. As standard measures of lexical diversity, the type-token ratio (TTR) and Guiraud's Index (1954) were analyzed. The numbers of tokens from the four lists calculated by VocabProfile were also examined.

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Data Analysis

The researcher initially counted and categorized participants' writing in terms of the numbers of T-units and the three types of subordinate clauses mentioned above. With a second rater who examined 20 percent of the data, final decisions were made on the ways to classify and count subordinate clauses and coordinated clauses. VocabProfile was used to automatically calculate frequency data. A series of repeated-measures ANCOVA was conducted on SPSS, with task sequencing (Simple-to-complex vs. Complex-to-simple) as the between-subjects variable and three levels of task complexity as the within-subjects variable. Brown's cloze test scores were included as the covariate in order to partial out the effect of participants' English proficiency on the dependent variables. The significance level was set at $p = .05$. In the cases in which the assumption of sphericity was violated, the Huynh-Feldt correction was used.

Results

Time-on-Task

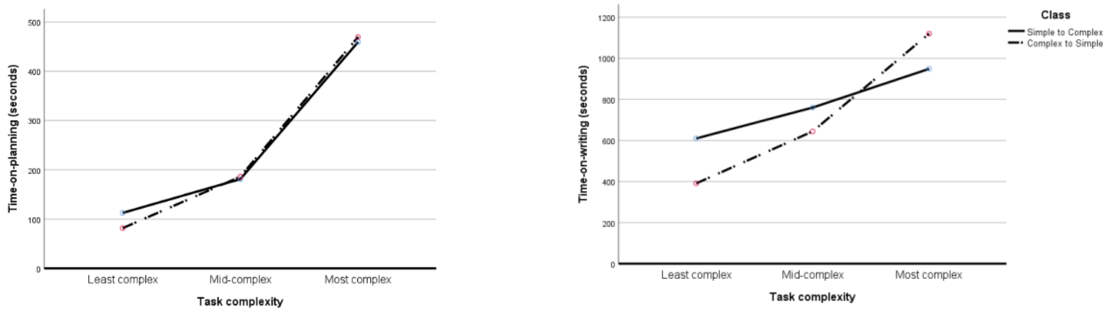
The time spent on working out the best seating arrangement (i.e., time-on-planning) and the actual time spent on writing it down on a piece of paper (i.e., time-on-writing) are displayed in Table 1 and Figure 1. Because several participants had forgotten to time their progress, there were a few missing values, resulting in an *N*-size of 41 for the Simple-to-complex group, and that of 44 for the Complex-to-simple group. In general, both groups showed similar patterns in the planning stage of task performance, with the values being very similar between the mid-complex and most complex versions. On the other hand, different patterns in the average time spent on the writing stage can be observed between the two groups. Comparing the time spent on devising a seating plan for four people (i.e., the least complex task version), participants across the two groups took 86.5 more seconds to devise a seating arrangement for 6 people (i.e., the mid-complex version), and more than three minutes (367.2 more seconds) to work out a plan for 8 people (i.e., the most complex version). In addition, comparing the time-on-writing across the two groups when they carried out the least complex version, approximately 3.5 more minutes (201.5 more seconds) were spent on the mid-complex version, and slightly less than 9 more minutes (533.9 more seconds) on the most complex task version.

TABLE 1
Descriptive Statistics for Time-on-Task

Time	Group	Least complex	Mid-complex	Most complex
Planning	Simple-to-complex	112.71 (90.04)	181.63 (233.42)	460.29 (355.17)
	Complex-to-simple	81.64 (62.80)	185.77 (117.92)	468.57 (258.24)
Writing	Simple-to-complex	610.49 (282.66)	760.05 (287.16)	949.22 (455.16)
	Complex-to-simple	390.93 (179.33)	644.43 (259.45)	1119.98 (444.86)

Note. Standard deviation values are in parentheses.

(a) Time-on-planning (b) Time-on-writing



Note. Solid lines represent the Simple-to-complex group, and the dotted lines represent the Complex-to-simple group.

Figure 1. Patterns of time-on-planning and time-on-writing.

Results of statistical analyses supported this observable trend. In the case of task-on-planning, the main effects of task sequencing and its interaction with task complexity effects were not found to be significant, $F(1, 82) = .021$, $p = .886$, $\eta_p^2 < .001$, and $F(1.494, 122.480) = .441$, $p < .587$, $\eta_p^2 = .005$, respectively. On the other hand, task sequencing and task complexity had a significant interact effect on time-on-writing, $F(1.460, 119.699) = 8.937$, $p = .001$, $\eta_p^2 = .098$. Pairwise comparisons revealed that the participant groups significantly differed in time-on-writing when they carried out the least complex task, $p < .001$. Results also showed that there was a significant difference in time-on-writing between all three levels of task complexity for both groups ($p < .05$). As shown unequivocally in Figure 1, main effects of task complexity significantly impacted both time-on-planning and time-on-writing, $F(1.494, 122.480) = .021$, $p = .886$, $\eta_p^2 < .001$, and $F(1.460, 119.699) = 9.278$, $p = .001$, $\eta_p^2 = .102$, respectively.

Syntactic Complexity

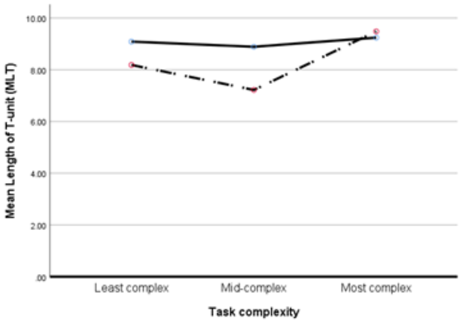
The syntactic complexity of participants' writing was examined in terms of two global measures and three local measures (see Table 2 and Figure 2). As shown in Figure 2, the patterns of MTL and the other subordination index showed opposite patterns; while a V-shaped pattern can be seen in MLT, a steeper reversed V-shaped pattern can be observed in the number of subordinate clauses per T-unit. Likewise, the patterns in the proportions of nominal clauses and adjectival clauses are also reversed V-shaped. An interesting pattern can be found in the proportion of adverbial clauses, in that while the Simple-to-complex group showed a reversed V-shape, the Complex-to-simple group showed a normal V-shape, indicating that the two groups displayed opposite behaviors.

TABLE 2
Descriptive Statistics for Syntactic Complexity Measures

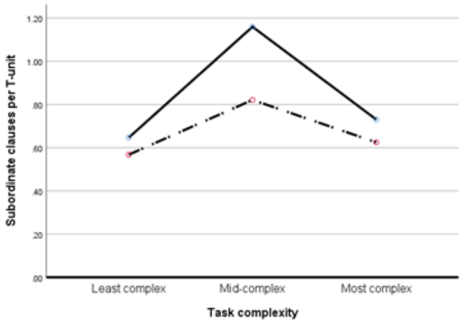
Time	Group	Least complex	Mid-complex	Most complex
MLT	Simple-to-complex	9.09 (2.99)	8.87 (3.16)	9.24 (2.93)
	Complex-to-simple	8.18 (2.26)	7.23 (2.19)	9.49 (3.37)
Sub-clauses per T-unit	Simple-to-complex	.65 (.42)	1.16 (.62)	.73 (.48)
	Complex-to-simple	.57 (.39)	.82 (.45)	.62 (.51)
Nominals per T-unit	Simple-to-complex	.15(.16)	.50 (.28)	.25 (.18)
	Complex-to-simple	.20 (.18)	.48 (.23)	.27 (.22)
Adjectivals per T-unit	Simple-to-complex	.03 (.09)	.14 (.16)	.09 (.15)
	Complex-to-simple	.10 (.14)	.12 (.14)	.10 (.13)
Adverbials per T-unit	Simple-to-complex	.47 (.36)	.51 (.41)	.40 (.33)
	Complex-to-simple	.28 (.28)	.22 (.26)	.27 (.35)

Note. Standard deviation values are in parentheses.

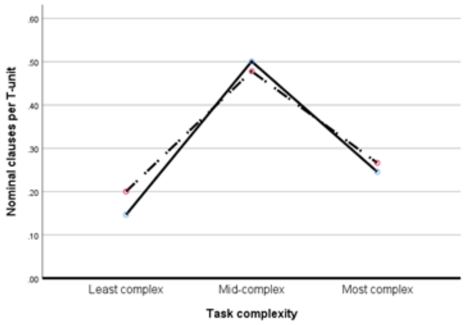
(a) Mean length of T-unit

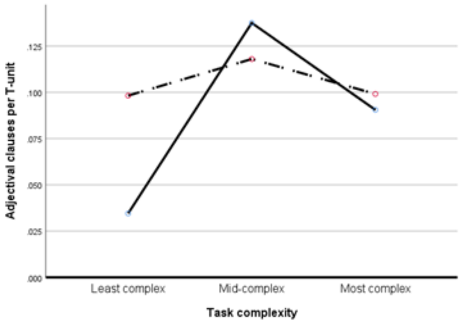


(b) Subordinate clauses per T-unit

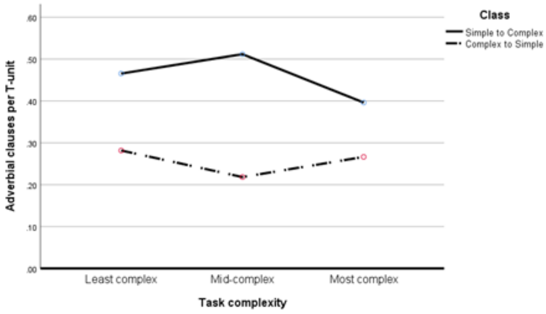


(c) Nominal clauses per T-unit (d)
Adjectival clauses per T-unit





e) Adverbial clauses per T-unit



Note. Solid lines represent the Simple-to-complex group, and the dotted lines represent the Complex-to-simple group.

Figure 2. Patterns of syntactic complexity measures.

When statistical analyses were computed on the syntactic measures, the interaction between task sequencing and task complexity was found to have a significant impact on MLT and the numbers of subordinate clauses, adjectival subordinate clauses, and adverbial subordinate clauses per T-unit, $F(2, 81) = 6.570$, $p = .002$, $\eta_p^2 = .075$; $F(1.915, 155.152) = 4.055$, $p = .021$, $\eta_p^2 = .048$; $F(2, 81) = 3.218$, $p = .043$, $\eta_p^2 = .038$; $F(2, 81) = 3.683$, $p = .027$, $\eta_p^2 = .043$, respectively. Pairwise comparisons revealed the following: 1) for MLT, the two groups significantly differed when they carried out the mid-complex task, and significant differences between all three levels of task complexity were found in the Complex-to-simple group ($p = .05$), 2) for the proportion of subordinate clauses per T-unit, the mid-complex task elicited significant differences between the two groups, and the mid-complex version led to significantly greater subordination than the other two task versions for both groups ($p < .05$), 3) for the proportions of adjectival and adverbial clauses per T-unit, the least complex task versions elicited significant differences between the two groups ($p < .05$), and the Simple-to-complex group showed significant differences between the least and mid-complex versions and between the mid- and most complex versions in terms of adjectival clauses, and between the least and mid-complex versions in terms of adverbial clauses ($p < .05$). When examining the proportion of nominal subordinate clauses per T-unit, only the main effect of task complexity was found to be significant, $F(2, 81) = 5.717$, $p = .004$, $\eta_p^2 = .066$. It was also found that all levels of task complexity elicited significantly different proportions of nominal subordinate clauses per T-unit ($p < .05$). However, as Figure 2 clearly shows, task sequencing did not play a significant role in nominal subordination, and neither did it significantly interact with task complexity, $F(1, 81) = .243$, $p = .623$, $\eta_p^2 = .003$, and $F(2, 81) = 1.069$, $p = .304$, $\eta_p^2 = .013$, respectively.

Lexical Diversity

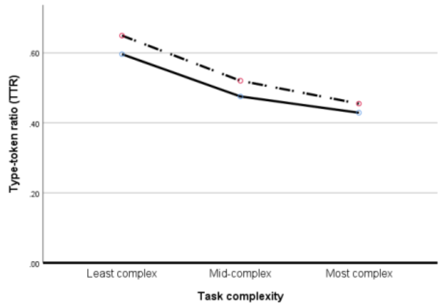
Participants' use of vocabulary was examined in terms of the standard TTR, GI, and word family bands. As noted above, data from a few participants was missing, because they had failed to finish writing their seating arrangement within the given time. Table 3 and Figure 3 present the descriptive statistics for the measures of lexical diversity. Regarding TTR, GI, and the numbers of K1 and K2 tokens, no apparent differences between the two sequencing groups could be observed. One thing to note is that the number of K2 tokens drastically fell when participants carried out the most complex version, regardless of the sequence in which they carried out the tasks. TTR also appeared to fall along increases in task complexity, while the GI index showed an opposite pattern.

TABLE 3
Descriptive Statistics for Lexical Diversity Measures

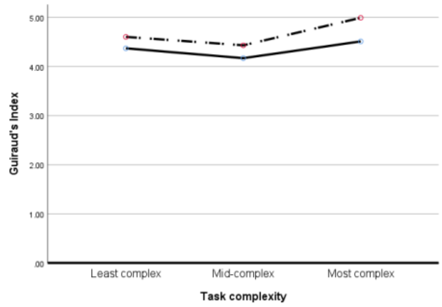
Time	Group	Least complex	Mid-complex	Most complex
TTR	Simple-to-complex	.60 (.10)	.48 (.08)	.43 (.08)
	Complex-to-simple	.65 (.11)	.52 (.10)	.46 (.10)
GI	Simple-to-complex	4.37 (.59)	4.17 (.65)	4.51 (.67)
	Complex-to-simple	4.60 (.65)	4.43 (.71)	5.00 (.82)
K1 Tokens	Simple-to-complex	53.58 (18.15)	73.48 (17.14)	108.28 (26.41)
	Complex-to-simple	49.89 (14.58)	71.55 (25.46)	119.25 (42.52)
K2 Tokens	Simple-to-complex	3.15 (1.92)	4.93 (2.44)	2.68 (2.96)
	Complex-to-simple	2.70 (1.09)	4.68 (2.26)	3.43 (2.58)
AWL Tokens	Simple-to-complex	.35 (.58)	.40 (.71)	.75 (1.01)
	Complex-to-simple	.25 (.58)	.61 (1.06)	1.68 (1.71)
Off-list Tokens	Simple-to-complex	.18 (.46)	.63 (.94)	2.89 (1.06)
	Complex-to-simple	.16 (.43)	1.20 (1.15)	2.52 (1.58)

Note. Standard deviation values are in parentheses.

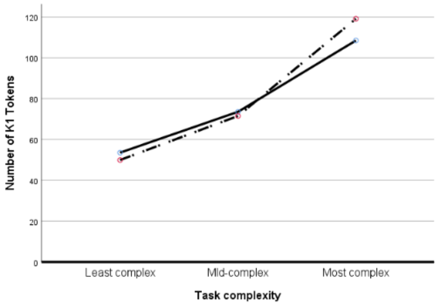
(a) Type-token ratio



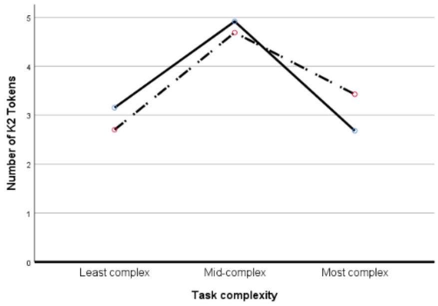
(b) Guiraud's Index



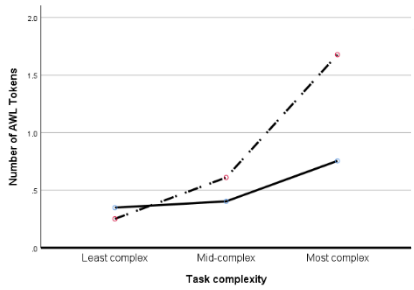
(c) Number of K1 tokens



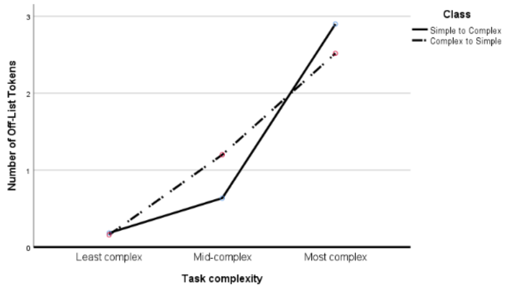
(d) Number of K2 tokens



(e) Number of AWL tokens



(f) Number of Off-list tokens



Note. Solidlines represent the Simple-to-complex group, and the dotted lines represent the Complex-to-simple group.

Figure 3. Patterns of lexical diversity measures.

Results of statistical analyses revealed significant interaction effects between task sequencing and task complexity on the numbers of K1, AWL, and Off-list tokens, $F(1.736, 140.599) = 3.437$, $p = .041$, $\eta_p^2 = .041$, $F(1.671, 135.384) = 7.810$, $p = .001$, $\eta_p^2 = .088$, and $F(1.775, 140.247) = 4.875$, $p = .012$, $\eta_p^2 = .058$, respectively. Looking further into these interactions, it was found that regarding the number of K1 tokens, all levels of task complexity were significantly different for both task sequencing groups ($p < .001$). The most complex task version elicited significant differences in the number of academic words between the two groups, and only the Complex-to-simple group was found to show differences in the number of AWL tokens between all levels of task complexity ($p < .05$). For the number of Off-list tokens, significant differences between the two groups were obtained when participants carried out the mid-complex task. Furthermore, the Simple-to-complex group displayed significant differences in the number of Off-list tokens between the most complex task version and the other two less complex versions ($p < .01$), while the Complex-to-simple group showed significant differences between all levels of task complexity ($p < .01$). However, the interaction between the two independent variables did not significantly affect TTR, GI, or the number of K2 tokens, $F(1.894, 153.389) = .812$, $p = .440$, $\eta_p^2 = .010$;

F(2, 81) = .287, *p* = .208, η_p^2 = .019; and *F*(2, 81) = 2.716, *p* = .069, η_p^2 = .032, respectively. With regard to main effects, greater task complexity was found to lead to a significantly lower TTR but greater number of K1 tokens, *F*(1.894, 153.389) = 23.454, *p* < .001 , η_p^2 = .225, and *F*(2, 81) = 8.279, *p* < .001 , η_p^2 = .093, respectively. However, it did not have a significant impact on GI or the total amount of AWL tokens, *F*(2, 81) = 1.729, *p* = .181 , η_p^2 = .021, and *F*(1.671, 135.384) = 1.669, *p* = .196 , η_p^2 = .020, respectively. Interestingly, when ignoring task complexity, task sequencing was found to have a significant impact on TTR, GI and the sum of AWL tokens, *F*(1, 81) = 6.279, *p* = .014, η_p^2 = .072; *F*(1, 81) = 7.100, *p* = .009, η_p^2 = .081; and *F*(1, 81) = 4.320, *p* = .041, η_p^2 = .051, respectively. However, it had no significant effects on the numbers of K1 tokens, K2 tokens, and Off-list tokens, *F*(1, 81) = .136, *p* = .713, η_p^2 = .002; *F*(1, 81) = .003, *p* = .953, η_p^2 < .001; and *F*(1, 81) = .136, *p* = .713, η_p^2 = .002, respectively.

Discussion

Effects of Task Sequencing and Task Complexity on Cognitive Load

In line with previous studies that used time-on-task to measure cognitive load in TBLT research (Lee, 2019b), participants of the present study also found that the time spent on both the planning and writing stages of task performance increased significantly when participants carried out more complex tasks. Because writing involves the translation of thought into words on paper, with the added process of reading and editing (Kellogg, 1999), the average time-on-writing was longer than time-on-planning. The findings regarding time-on-planning and time-on-writing indicate that the additional guests in the most complex version drastically increased the cognitive load of the task. Lee (2019a) also obtained similar findings using a triangulation of learner-self ratings, the dual task method, and prospective time estimations. In particular, the findings of the present study corroborated with Lee's (2019a) reaction time results of the dual task method, as the reaction times on the secondary task were significantly higher when participants carried out the most complex Seating Arrangement version, when compared with the reaction times when they carried out the two other less complex versions.

A significant interaction between task sequencing and task complexity was also found on time-on-writing. A closer look showed that those in the Simple-to-complex group took significantly more time (slightly over 3.5 more minutes) on writing down their seating plan for four people than those in the Complex-to-simple group. In other words, when participants needed to carry out several tasks in succession, they showed a tendency to spend more time on the first task. On the other hand, when the first task was cognitively challenging (i.e., the most complex task version), they did not spend as much time on the last task, which was the least cognitively challenging task. Although participants were allowed to take breaks when necessary, the majority of them most likely felt the need to finish the tasks as soon as possible, which may have led to such significant interaction effects on time-on-task. This finding can also be linked to mental fatigue during task performance, but as this study did not employ a stimulated recall session or any additional surveys, this is left as a speculation.

Effects of Task Sequencing and Task Complexity on Syntactic Complexity

The goal of most previous research on the effects of task complexity on L2 performance has been to obtain findings unequivocally supporting either Robinson's (1995, 2007) Cognition Hypothesis or Skehan's (1996, 2014) Trade-Off Hypothesis. However, many studies have failed to do so, mostly due to mixed findings (for more information on problematic issues in TBLT research, see Lee, 2019a). The present study looked into the effects of task complexity in combination with task sequencing effects, revealing significant interaction effects on the majority of the syntactic complexity measures investigated. A clear main effect of task complexity was found on the proportion of nominal subordinate clauses to the

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total number of T-units, which is strikingly similar to Lee's (2019a) findings of a reversed V-shaped pattern for the number of subordinate clauses per AS-unit. Due to the significantly higher time-on-planning and time-on-writing when participants carried out the most complex task version, the possibility of the most complex version not being challenging enough to elicit the greatest subordination was ruled out. As Lee (2019a) suggested, it is more likely that "participants perceived the most complex task versions to be so complex that they short-circuited the task and simplified it, either intentionally ignoring the added elements or unintentionally not being able to notice them" (pp. 533-534), because they can still complete the task by minimally satisfying its requirements. However, this may not be entirely the case, especially when we take a look at Table 4, which shows a participant whose use of nominal subordinate clauses increased during the mid-complex version, but decreased during the most complex version. This participant did not seem to simplify the task when performing the most complex version. In fact, considerably detailed explanations on why each person was seated in a certain position was provided. Here, the biggest difference in the use of nominal subordinate clauses seems to stem from the expressions that were used in order to provide reasons for their choices. In the mid-complex version, the participant shown in Table 4, as well as several other participants, tended to use the gerund form many times, such as *dancing* and *talking/chatting with others*. Participants appeared to prefer this type of nonfinite nominal subordinate clause for the mid-complex task. On the other hand, they seemed to prefer to use more nouns, as opposed to gerunds, when carrying out the most complex task. This difference in structural preferences may have resulted in a reversed V-shaped pattern in the use of nominal subordinate clauses.

TABLE 4
Examples of Nominal Subordinate Clauses in Writing

Least complex version	Mid-complex version	Most complex version
First of all, A will sit in front of the cake because it is A's birthday. D doesn't want **to sit next to B** because B and D fought recently. So B and D will sit next to A each. C needs person who can care him and is older than him. A, B, and C are older than C and can care him. So C will sit any seat.	A will sit in front of food courts because he is hungry now and likes **eating**. B will sit in front of stage because she likes **dancing** and **talking**. F will sit next to B because he likes B and wants **to dance with her**. D will sit next to B because she likes **watching that other people are dancing and talking**. E will sit between D and C because C wants **to sit next to E** and E wants **to contact with D**.	First of all, G will in front of toilet because she isn't good condition and wants **to sit next to toilet**. H will sit next to Exit because she is going to be late but she wants **that nobody doesn't recognize that**. C will sit between B and F because C must not sit next to woman who is not his wife because of his religion. And F wants **to be friend with C** and likes fishes. And B likes meats. E will sit between A and D because D is at war with A and doesn't eat meat because of his religion.
1 nominal clause	7 nominal clauses	3 nominal clauses

Note. Nominal subordinate clauses are highlighted in bold letters.

A closer inspection of participants' writing regarding syntactic complexity indices revealed slightly different behaviors between the two former global measures and the two latter local measures. For instance, for the two global measures, only the mid-complex version elicited significant differences between the two sequencing groups. In other words, the order in which participants carried out the tasks determined the overall subordination patterns, such that for both global measures, the Simple-to-complex group displayed greater subordination than the Complex-to-simple group on the mid-complex task (see Table 5). On the other hand, the Complex-to-simple group outperformed the Simple-to-complex group in terms of adjectival clauses on the least complex version, but the opposite pattern was observed for adverbial clauses. These differences are captured in Table 6, where the writings from the participants from each group are compared.

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TABLE 5
Examples of Global Subordination

	Mid-complex version	
	Simple-to-complex	Complex-to-simple
	A will sit in the chair closest to food **because he is very hungry**. B will sit in the chair closest to a dancing place **because she likes to dance.** D will sit in the chair to the left of B **because B and D both like to chat**, and **the chair on B's left is a better place to see people dancing** than on B's right. E will sit in the chair on D's left **because E wants to talk something to D**, and **for her husband to sit next to E**, E needs **to sit in a chair adjoining empty one**. C will sit in the chair next to E **because C is E's husband**. F will sit on B's right side **because he wants to invite B to dance together**.	A is very hungry and wants **to sit near food table**. B likes **dancing** and F wants **to dance with B** so I put F next to B. D likes **to watch people dance** and also likes **to have a chat with people**. I think **D and B get to be friends**. E has to sit next to D **to tell something**. C is the E's husband so he wants **to sit next her**.
MLT	16.14	6.89
Sub-clauses per T-unit	2.43	1

Note. All types of subordinate clauses are highlighted in bold letters.

TABLE 6
Examples of Local Subordination

	Mid-complex version	
	Simple-to-complex	Complex-to-simple
	A is in front of cake **because it is her birthday** **so that she may cut the cake** B is next to A **because B is the most familiar with A** **so that B will talk with A many times**. C is next to B **because he needs care by familiar one**. B **who is familiar with A's family** can care for C. D is next to A **because it is the farthiest seat from B**.	It is easy to seat A, **who has her birthday**. Let's seat A in front of her cake. B, **who is A's best friend and close to her family**, should be right next to A. C, **who is A's younger brother and needs to be cared by someone close to him**, could be next to B or A either. D, **who fought with B recently**, should be seated far from A. As a result, It is ideal **that C sits between them**. **If you follow these steps**, they would be seated like the picture above.
Adjectivals	.14	.57
Adverbials	.57	.14
	I think **A sits in front of cake because that day is A's birthday**. D and B fight, they can't sit in front of A. Therefore, C can sit in front of A. B and D sit anywhere **because empty chairs don't set together, and C needs close people who care C.**	First A seats in front of cake, **because she is main in this party** B and D don't like each other, so I don't make the position **that B seats by D**. and C is young so C seats far from cake and in front of A. **Because when A blows the candle**, As parents will have position **which is against A to take a photo**. A's parents seats against A so C seats against A.
Adjectivals	.2	.25
Adverbials	.6	.38

Note. All types of subordinate clauses are highlighted in bold letters.
Adjectival clauses are underlined with a single line.
Adverbial clauses are underlined with double lines.

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In the examples above, the participant in the Complex-to-simple group tended to use more adjectival clauses that modifies the nouns that precede them. On the other hand, the participants in the Simple-to-complex group used more adverbial clauses in proportion, most of them consisting of structures that imply cause and effect, such as clauses that begin with *because*. One possibility behind this different behavioral pattern between the two groups that has been raised earlier is the mental fatigue of the participants, which seems to be the case when comparing the global syntactic complexity of the written output on the mid-complex task. It is highly likely that after carrying out the most complex task first, the Complex-to-simple group felt a great deal of mental fatigue, thus leading to less overall subordination in the mid-complex task, and less reliance on cause-and-effect structures to support their arguments when they carry out the final least complex task. In contrast, the Simple-to-complex group do not experience as much mental fatigue, and are able to provide more reasons behind their seating choices when carrying out the mid- and most complex task versions, resulting in greater overall subordination in the mid-complex task and more *because*-structures on the first least complex version.

Effects of Task Sequencing and Task Complexity on Lexical Diversity

The findings regarding lexical diversity measures appear to be quite complex, but the general finding is that those who started with the most complex task version used more diverse vocabulary than those who began with the least complex version. Two examples of writings that support these findings are shown in Table 7. In these examples, the participant from the Complex-to-simple group used more diverse vocabulary, even though the total number of tokens is lower than that of the participant from the Simple-to-complex group (56 vs. 101). Despite the shorter text, the Complex-to-simple participant displayed broader vocabulary, although the message that the two participants were trying to convey are basically the same. It could be possible that carrying out a cognitively challenging task from the beginning opens up the L2 repertoire, creating easier access to one’s L2 resources. Because it was found that the most complex task version elicited a significantly higher number of AWL words from the Complex-to-simple group than the Simple-to-complex group, there is also the possibility that by the time the Simple-to-complex group started to work on their final, most complex task, they could have simply short-circuited the task to the extent that they could minimally complete it without using academic words in their writing.

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TABLE 7
Examples of Lexical Diversity

	Mid-complex version Simple-to-complex	Complex-to-simple
	First, A feels hungry, so his seat is near the food. So he can sit number 1. Second, I divided two groups, two groups are B, F and C E D Because B likes dancing and talking, and F likes B so F must sit next to B And The second group is C, E, D C is E's husband, so C want to sit next to E, E must sit next to D Because E has to talk with D, D is much talker, and she wants to look other people's dance, So, B and F sit each number 5 and 6, And In second group, C and F and D can sit each number 4 and 3 and 2, D can talk with B. Because D's seat is in front of B's seat.	First, I separate into two groups. one group consists of D-E-C. the other group consists of B-F. group is separate by prefer of each person who want to sit next to somebody. B and D are talkative people so I connected two group, C-E-D-B-F. I selected A's seat in front of food and feeled Another seat that satisfied that B like Dance.
TTR	.47	.73
GI	4.68	5.48
K1	97	48
K2	3	4
AWL	0	3
Off-list	1	1

Note. Underlined words in bold refer to K2 tokens.
Squiggly underlined words refer to AWL tokens.
Double underlined words refer to Off-list tokens.
All other words are K1 words.

Regarding task complexity effects, TTR and GI appeared to show opposite patterns, as depicted in Figure 3. However, results obtained from statistical analyses revealed that task complexity did not have a significant effect on GI, but a significantly negative effect on TTR. This is not in line with previous studies such as Lee (2020), which found that increasing the number of elements resulted in greater lexical diversity, since the added elements that participants needed to mention forced them to use more various words and expression. However, when categorizing the words into word families, it was shown that the numbers of K1 tokens, AWL tokens, and Off-list tokens did increase with greater task complexity. The sum of K2 tokens also increased along increases in task complexity, but fell drastically when participants carried out the most complex task. This is an interesting finding, as this exact trend for K2 words was also found in Lee's (2019a) study with native speakers of English. Although there is a major difference in the quantity of K2 words between the native English speakers in Lee's study and the present one, a reversed V-shaped pattern was also observed for K2 tokens (488 for the least complex, 10.28 for the mid-complex, and 3.10 for the most complex version).

Conclusion

As expected, the present study found that increasing task complexity had a significant impact on learners' L2 writing in terms of syntactic complexity and lexical diversity. In line with previous research, increasing task complexity *to a certain degree* resulted in greater syntactic complexity. However, when the task was too complex, the syntactic complexity of the output actually decreased. On the other hand, a general tendency for lexical diversity to increase along with greater task complexity could be found.

With regard to task sequencing effects, pedagogical implications of the present study are as follows. Most previous task-based research have tried to control for task sequencing effects, as the order in which participants carry out tasks may have a confounding effect on the variable(s) under investigation. That is why randomization of tasks have been recommended so far. In order to put this widely accepted procedure to test, the goal of the study was to find out whether task sequencing effects actually existed, and to what extent task sequencing affected L2 written performance. Because task sequencing was found to significantly impact cognitive load, syntactic complexity, and lexical diversity, combined with its significant interaction with task complexity on such measures, the L2 teacher and/or researcher could utilize task sequencing to their advantage in the classroom or laboratory study. For instance, if the focus of the language class is on L2 vocabulary, the teacher could present tasks in the order of decreasing task complexity. On the other hand, if the lesson of the day is targeting syntactic complexity and the teacher is worried about mental fatigue, it would be more efficient for students to start with less cognitively challenging tasks, followed by more complex ones afterwards.

The current study looked into task sequencing effects on the syntactic complexity and lexical diversity of L2 writing, and further research could also examine its effect on accuracy as well. It would also be interesting to operationalize task complexity in different ways. When considering the various ways that task complexity can be manipulated, different results may be obtained if task complexity was operationalized in terms of +/- reasoning demands, +/- planning, +/- contextual support, etc.

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Appendix A

Seating Arrangement: Least complex

한 어린이의 생일이고 4 명의 아이들이 원탁에 앉아 생일 축하를 노래를 부르며 케이크를 먹을 예정입니다.

이들의 조건과 특성을 고려하여 모두가 만족할 수 있도록 자리 배치를 하십시오.

아이들이 각각 앉아야 할 자리를 지정하고 그 이유를 반드시 설명하십시오.

A: 그녀의 생일이다.

B: 그녀는 A 의 가장 친한 친구이며 A 가족과도 매우 가깝게 지낸다.

C: A 의 남동생이며 가까운 누나/형이 옆에서 챙겨줘야 한다.

D: 그녀는 최근에 B 와 싸웠기 때문에 B 옆에 앉고 싶어하지 않는다.

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Appendix B

Seating Arrangement: Mid-complex

6 명의 사람이 결혼 피로연에 와서 원탁에 앉혀야 합니다.
이들의 조건과 특성을 고려하여 모두가 만족할 수 있도록 자리 배치를 하십시오.
6 명의 사람이 각각 앉아야 할 자리를 지정하고 그 이유를 반드시 설명하십시오.

A: 그는 먹는 것을 좋아하고 현재 매우 배가 고픈 상태이다.

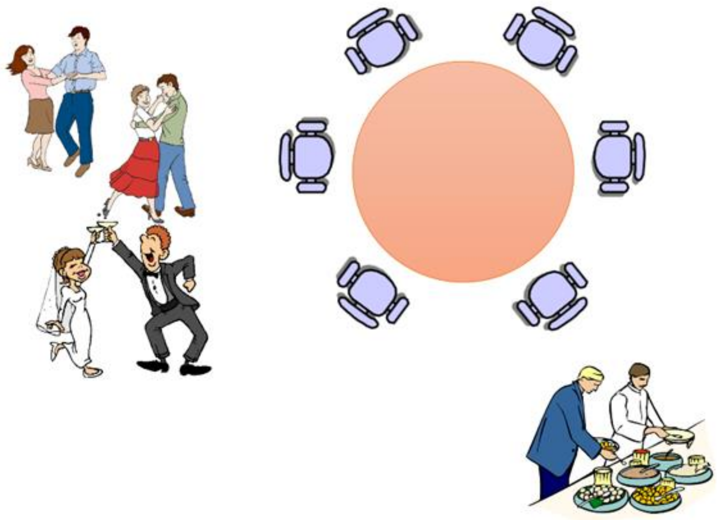
B: 그녀는 춤 추는 것과 수다 떠는 것을 매우 좋아한다.

C: E 의 남편이며 부인 옆에 앉고 싶어한다.

D: 그녀는 수다쟁이이며 다른 사람들이 춤 추는 것을 구경하기를 좋아한다.

E: 그녀는 D 에게 꼭 전해야 할 소식이 있다.

F: 그는 B 를 좋아하며 기회가 닿을 때마다 그녀와 춤 추고 싶어한다.



Appendix C

Seating Arrangement: Most complex

8 명의 국가 원수들이 유엔(United Nations)에서 초청한 저녁 식사에 참석할 예정입니다.
이들의 조건과 특성을 고려하여 모두가 만족할 수 있도록 자리 배치를 하십시오.
8 명의 사람들이 각각 앉아야 할 자리를 지정하고 그 이유를 반드시 설명하시오.

대통령 A: 그녀의 나라는 현재 대통령 D 나라와 전쟁 중이다.
대통령 B: 그의 나라는 현재 수상 E 나라와 전쟁 중이다. 그는 육식을 좋아한다.
대통령 C: 그의 종교에 따르면 남성은 자기의 부인이 아닌 여자 옆에 앉아서는 안된다.
대통령 D: 그의 나라는 현재 대통령 A 나라와 전쟁 중이며 그의 종료 때문에 육식을 못한다.
수상 E: 대통령 B 나라와 전쟁 중이다.
왕 F: 그는 대통령 C 와 친해지고 싶어하며 생선을 가장 좋아한다.
대통령 G: 그녀는 몸 상태가 좋지 않으며 화장실 옆에 앉기를 선호한다.
여왕 H: 그녀는 지각할 예정인데 그녀가 늦게 도착하는 것을 아무도 눈치 채지 않았으면 한다.

대통령: President
수상: Prime Minister
~와 전쟁 중이다: to be at war with ~
종교: religion