The effects of task complexity on the complexity of the second language written production

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Abstract

This paper investigates the effects of manipulating task complexity on the complexity of learner language production during asynchronous computer-mediated communication (ACMC) writing tasks. This study draws the construct of cognitive complexity indicated in Robinson's Cognition Hypothesis (Robinson 2001a, 2003a, 2003b, 2005, 2007a, 2007b) which predicts that complex tasks made along resource-directing dimension will lead to greater complexity of language production while complex tasks made along resource-dispersing dimension will result in less complex language production. However, research on the effects of manipulating task complexity along both resource-directing and resource-dispersing dimensions is so far inconclusive.

By means of an experimental design, 88 undergraduate English as a Second Language (ESL) students in a public Malaysian university were asked to perform different tasks manipulated along resource-directing (+/- causal reasoning demand) and resource-dispersing (+/- task structure) dimensions. The complexity of the writing was analyzed syntactically and lexically. For syntactic complexity, the general and dependent clauses measures were used whereas Lexical Frequency Profile (Laufer & Nation, 1995) and Guiraud's Index (Guiraud, 1960) were used to measure lexical complexity. This study employs Multivariate analysis of variance (MANOVA) to measure the effects of task complexity and the complexity of language production. Results showed that the manipulation of task complexity has a significant effect on certain measures of syntactic and lexical complexity of the language production.

Keywords: task complexity, complexity of language production, resource-directing, resource-dispersing, task-based instruction

Introduction

Over the past decades, there was a growing interest in the role of tasks in second language learning and teaching. Researchers tend to identify the variables of the tasks that are important when designing tasks. For example, Robinson (2001a, 2001b, 2003, 2005, 2007a, 2007b) identifies various elements of task complexity which he argues to be the sole basis in sequencing decisions in task-based syllabus design. According to Robinson (2009), task complexity is represented as dimensions or continuums. Robinson lists a number of task characteristics which influence task complexity on resource-directing (e.g. here-and-now, number of elements, reasoning demand and perspective taking) and resource-dispersing (e.g. planning time, prior knowledge, task structure and independency of steps) dimensions. Task complexity is the inherent characteristics of task that may affect learner cognitive performance while performing the task. As a result of different degree of task complexity, the quantity and quality of language production may increase or decrease. Robinson also argues that task complexity is a series of options for designing the features of tasks in which the cognitive demand of those tasks is manipulated during task performance. Since these demands are unfixed, a syllabus designer may increase or reduce the demand of the tasks by manipulating the complexity of the tasks when designing task-based syllabus for their learners (Robinson, 2011).

Significance of the study

This study aims at exploring how different task complexity affects the complexity of the second language (L2) written production. Housen and Kuiken (2009) assert that complexity is the most complex, ambiguous, and least understood element of language production compared to accuracy and fluency. Thus, this study is crucial to ascertain the complexity of language production when tasks with different demands of complexity are applied. In the study of task complexity, resource-directing dimension has been researched extensively in L2 studies (e.g. few elements, here-and-now and reasoning demands). Examples of studies that have analysed the effects of manipulating tasks with different reasoning demands are Liliati, Arshad, Eng and Nooreen (2012), Nikou and Eskandarsefat (2012) and Shiau and Adams (2011). Studies by Kuiken, Mos and Vedder (2005), Kuiken and Vedder (2007), Kuiken and Vedder (2008) and Shahreza, Dabaghi and Kassaian (2011) had looked at the combined effects of the number of elements and reasoning demands. Recent studies by Abdollahzadeh and Kashani (2011) and Rahimpour and Hosseini (2010) had examined other variables in the resource-directing dimension which were here-and-now vs. there-

and-then. In contrary, studies on resource-dispersing dimension had mostly focused on the effects of planning time (Nariman-Jahan & Rahimpour, 2011; Rahimpour & Safarie, 2011; Piri, Barati & Ketabi, 2012; Salimi et al., 2012; Shin, 2008), task structure (Nik, Adams & Newton, 2012; Rahimpour & Mehrang, 2010; Tavakoli & Skehan, 2005) and single and dual tasks (Tajeddin & Bahador, 2012). As stated earlier, these studies focused on the effects of variables in light of only one dimension, either resource-directing or resource-dispersing dimensions. It is essential to look at the effects of both dimensions simultaneously because the combined effects of these dimensions may affect language production in a different manner. Also, in the real world, learners typically need to carry out tasks that may entail both dimensions being unconsciously manipulated. Very limited studies have examined the effects of both resource-directing and resource-dispersing dimensions to date. When the current study is conceptualized, Mohammadzadeh, Dabaghi and Tavakoli, (2013) is the only study reported combined effects of both dimensions, i.e. planning time (resource-dispersing) and here-and-now and there-and-then conditions (resource-directing), on written language production while a study by Saedi, Ketabi and Kazerooni (2012) focused on oral language production. Given the lack of studies that merge these two dimensions, the current study aims to explore the synergistic effects of manipulating the complexity of tasks along resource-directing (i.e. causal reasoning demand) and resource-dispersing (i.e task structure) dimensions.

Literature Review

Task complexity

One of the dominant constructs of task complexity is Robinson's Cognition Hypothesis. Robinson (2001a) proposed that task complexity is the result of the "attentional, memory, reasoning, and other information processing demands imposed by the structure of the task to the language learner" (Robinson, 2001b, p.28). This view claims that more complex tasks along resource-directing dimension will push greater development of complexity and accuracy of language production whereas the fluency will be negatively affected (Robinson, 2003a, 2011). In contrast, accuracy and complexity of production can be expected to decrease when task is made complex along resource dispersing dimension. Hence, manipulating the cognitive demands of task complexity is important. Based on this foundation, Robinson and Gilabert (2007) provided taxonomy of task implementation features in this Triadic Componential Framework for task design, as outlined in Table 1.

Table 1. *The Triadic Componential Framework for Task Classification by Robinson and Gilabert (2007, p.164)*

Task complexity (cognitive factors)	Task condition (interactive factors)	Task Difficulty (learner factors)
(classification criteria: Cognitive demands)	(classification criteria: Interactional demands)	(classification criteria: Ability requirements)
(classification procedure: Information-theoretic analyses)	(classification procedure: Behavior-descriptive analyses)	(classification procedure: Ability assessment analyses)
(a) Resource-directing variables making cognitive/conceptual demands	**(a) Participation variables** making interactional demands	**(a) Ability variables** and task-relevant resource differentials
+/- here and now	+/- open solution	h/l working memory
+/- few elements	+/- one-way flow	h/l reasoning
+/- spatial reasoning	+/-convergent solution	h/l task-switching
+/- causal reasoning	+/- few participations	h/l aptitude
+/- intentional reasoning	+/- few contributions needed	h/l field independence
+/- perspective-taking	+/- negotiation not needed	h/l mind/intention-reading
(b) Resource-dispersing variables making performative/procedural demands	**(b) Participant variables** making interactant demands	**(b) Affective variables** and state-trait differentials
+/- planning time	+/- same proficiency	h/l openness to experience
+/- single task	+/- same gender	h/l control of emotion
+/- task structure	+/- familiar	h/l task motivation
+/- few steps	+/- shared content knowledge	h/l processing anxiety
+/- independency of steps	+/- equal status and order	h/l willingness to communicate
+/- prior knowledge	+/- shared cultural knowledge	h/l self-efficacy

The Triadic Componential Framework (TCF) distinguishes the cognitive demands on tasks, the task conditions and perceived task difficulty. Task complexity refers to the intrinsic cognitive demands of the task, and can be manipulated during task design along the dimensions; resource-directing, resource-dispersing (Robinson, 2003a). Following this definition, the current study

defines task complexity as proposed by Robinson in which the complexity of the tasks is distinguished by the requirement of the cognitive demand of the task, whether it is more demanding (complex tasks) or less demanding (simple tasks).

The task implementation features are divided along the resource-directing dimension and resource-dispersing dimension. Resource-directing dimension affects allocation of cognitive resources to specific aspects of L2 code. Robinson (2011, p.15) claims that "by increasing complexity along these dimensions, initially implicit knowledge of the L1 concept-structuring function of language becomes gradually explicit and available for change during L2 production." Therefore, increasing task complexity along this dimension can direct learners' attention to construct concepts and functions required by task using specific linguistic forms and at the end can lead to greater accuracy and grammatical complexity of the production. On the other hand, tasks made complex along resource-dispersing dimension reduce attentional and memory resources with negative consequences for production, since it creates problems for learners attempting to access their current repertoire of L2 knowledge (Robinson, 2003a, p.59). Nevertheless, increasing complexity along resource-dispersing dimension is important if one desires to estimate the complexity conditions under which real-world tasks are performed. Tasks designed along this dimension will promote learner's ability to perform the task as well as reproducing the process that learners may experience in the real world. However, this will only positively influence the fluency but not the accuracy and complexity of language production.

The next dimension proposed is task conditions. Task conditions describe the interaction features based on the participation that a task might require. For example, it includes information flow in classroom participation (i.e. one-way, open solution) and grouping of participants (i.e. gender, familiarity). The third dimension, task difficulty refers to learner perceptions of the task's level of difficulty, including learners' abilities (i.e. working memory, aptitude) and affective responses (i.e. motivation, self-efficiency). Even though these factors may be quite difficult to be controlled by the task designer, they are still important and need to be considered when designing tasks.

Research on task complexity in writing

The current study intends to explore the synergistic effects of task complexity along resource-directing and resource-dispersing dimensions in L2 written production. For that reason, only

studies investigating task complexity variables along resource-directing and resource-dispersing dimensions on L2 written production are addressed. Though previous studies examined the fluency, accuracy and complexity of the tasks, only the findings on complexity of the language production is presented in this literature.

Two studies have manipulated task complexity variables ([+/- few element] and [+/- reasoning demand]) and examined the influence of these variables on L2 written production. The first study, Kuiken and Vedder (2007) investigated the effects of cognitively complex task on accuracy, syntactic complexity and lexical variety involving 75 learners of French. The learners were in the intermediate level of proficiency. The learners were asked to write letters to persuade their friends in regards to choice of holiday destination. In a complex task condition learners had to choose between bed and breakfast places in Italy while for the simple task condition students had to choose resort places in other countries. Results indicated that the French learners produced greater complexity (in terms of lexical variations of word frequency) in complex tasks. However, there was no evidence that the interaction of task complexity and proficiency level exists in this study.

The second study which was conducted using the same research design and instruments, Kuiken et al. (2005) instructed 84 learners of Italian to write persuasive letters in choosing a holiday destination in France. The findings revealed that learners used more high frequency words in the complex task condition while more infrequent words were found in the simple task condition. This study also observed no relationship between cognitively complex tasks and proficiency level.

Both studies recently reviewed lead us to the following deduction. Even though the results of the earlier study by Kuiken et al. (2005) did not support the Cognition Hypothesis, the results of the latter study by Kuiken and Vedder (2007) provide evidence to Robinson's Cognition Hypothesis. Notwithstanding, both studies were unable to clarify the interaction of task complexity and proficiency level. This could be due to the allocation of attention during task performance as this may vary for different levels of proficiency. Another reason could perhaps be because of both studies did not include the individual difference factors of learners during task completion that may interfere with the effects of task complexity.

In addition, second language acquisition researchers have addressed the influence of reasoning demand as one of the variables in task complexity research. Liliati et al. (2012) focused on the effects of task complexity (i.e., +/- reasoning demand) and task conditions (i.e., individual and dyadic) on the grammatical accuracy and syntactic complexity of written production. The participants were learners of English as a Second Language (ESL) in secondary schools. The study employed a dictogloss task considered as bearing a low reasoning demand (-TRD) element and an opinion-gap task considered as bearing a high reasoning demand (+TRD) element. Using the proportion of clauses per T-unit, the results showed that the high reasoning demand tasks produced more syntactically complex production than the low reasoning demand tasks. Learners produced greater syntactic complexity in dyadic tasks compared to individual tasks. The result was in accordance with the Cognition Hypothesis where cognitively complex tasks will result in more complex language production (Robinson, 2007a). The study by Liliati et al. (2012) has provided relevant support to Kuiken and Vedder (2007) even though the context of the research is different; English as a Second Language (ESL) and English as a Foreign Language (EFL) context. Although the study recognized the impacts of cognitive demand of tasks on language production, there was no close examination of latent factors that may have also contributed to the findings such as learners' affective factors and abilities.

However, studies have also shown that planning condition may not affect the complexity of written production (Mohammadzadeh et al., 2013; Nariman-Jahan & Rahimpour, 2011; Piri et al., 2012). Piri et al. (2012) conducted a study on comparing the effects of pre-task planning (PTP) and on-line planning (OLP) by using series of pictures in narrative tasks. The study involved 45 university students who were the EFL learners of English. Piri et al. (2012) discovered that both pre-task and on-line planning did not influence the complexity of the written production. In the same vein, Mohammadzadeh et al. (2013) compared the linguistic complexity in planned and unplanned planning condition along here-and-now and there-and-then using comic strips. These results were similar as Mehnert (1998) where he found no effect of planning on complexity. When learners were given 10 minutes of planning time, they were not able to produce to more complex language because of their limited capacity for attentional resources (Skehan & Foster, 1999). The result of Mehnert (1998) provides support to the Trade-off Hypotheses. In another study, Nariman-Jahan and Rahimpour (2011) found that low proficiency learners produced less complex language under

planned condition. This finding was in line with Wigglesworth's (1997) study in which planning time did not benefit the learners who had a lower proficiency level.

The studies mentioned above manipulated planning time and found no significant effect on language production regardless of the planning time condition. As proposed by Robinson (2003a), manipulating task complexity along resource-dispersing dimension will simply disperse attentional resources and affect complexity negatively because it creates problems for learners to access their current repertoire of L2 knowledge. In order to affirm Robinson's framework, an investigation of the role of task complexity in promoting language production under resource-directing and resource-dispersing dimensions is crucial. Thus, the current study attempts to bridge the gap by exploring the synergistic effects of manipulating the demand of task complexity on both dimensions which is important in order to locate the task implementation features that may generate more or less complex language production.

The study

Research questions

The current study aims at answering the following questions:

1) Is there any significant difference in syntactic and lexical complexity of the L2 written production among the four groups with four different task complexity?

2) How does manipulating task complexity along resource-directing and resource-dispersing dimensions affect the complexity of the written language production?

Participants and setting

This study was conducted in one of the Malaysian technical universities. The participants were 88 undergraduate students (39 males and 49 females) from four intact classes. The study was conducted during normal class sessions. All of the participants were in their second and third year of study, taking their English for Professional Communication course. Participants' age ranged from 20 to 23 years old (M=21.49). The participants were at an intermediate level as indicated by their performance in Malaysian University English Test (MUET) in which most of the participants

scored a Band 3 (modest user of the language)[1]. The participants were divided into four different groups and each group consisted of 22 students. They were instructed to write an essay, individually, according to their respective groups. All participants were Malaysian students and had learnt English language since their primary schools. Thus, all participants had the same background knowledge and proficiency level to participate in this study. Information on gender and MUET results are presented in Table 2.

Table 2. *Gender and the MUET results of the participants*

		Group 1 (+CRD, +TS)	Group 2 (-CRD, +TS)	Group 3 (+CRD, -TS)	Group 4 (-CRD, -TS)
Information		Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
Gender	Male	9 (40.9%)	14 (63.6%)	12 (54.5%)	4 (18.2%)
	Female	13 (59.1%)	8 (36.4%)	10 (45.5%)	18 (81.8%)
MUET results	Band 2	6 (27.2%)	8 (36.4%)	6 (27.3%)	7 (31.8%)
	Band 3	12 (54.5%)	12 (54.5%)	13 (59.1%)	12 (54.5%)
	Band 4	4 (18.1%)	2 (9.1%)	3 (13.6%)	3 (13.6%)

Tasks

The task was essay writing on miscommunication at workplace. The task is relevant to the participants because they learnt about communication in the workplace in their English for Professional Communication course and were exposed to the industry-related matters because the university is a technical university emphasizing on exposure to workplace issues in their core courses. The task complexity in this study was manipulated using two variables; causal reasoning demand and task structure. With causal reasoning demand (+CRD) and without reasoning demand (-CRD) refers to the amount of causal reasoning learners have to provide upon the task completion. '+CRD' represents relatively greater causal reasoning demand and '-CRD' represents relatively no causal reasoning demand. In terms of task structure, with task structure (+TS) refers

[1] The official Band 3 descriptors are as follows: 'Modest command of the language. Modestly expressive and fluent, appropriate language but with noticeable inaccuracies. Modest understanding of language and contexts. Able to function modestly in the language'. (Malaysian Examinations Council, n.d).

to notes on essay format that learners received prior to performing the task. Learners in the without task structure (-TS) condition did not receive them.

Tasks with causal reasoning demand (+CRD) and without task structure (-TS) may increase the task complexity while tasks without causal reasoning demand (-CRD) and with task structure (+TS) may decrease the task complexity. The instruction of the tasks is attached in Appendix A. Table 3 summarizes the design of the study.

Table 3. *Study design*

Group	Causal reasoning demand (CRD)	Task structure (TS)
Group 1 (*n*= 22)	+	+
Group 2 (*n*= 22)	-	+
Group 3 (*n*= 22)	+	-
Group 4 (*n*= 22)	-	-

Data collection procedures

The writing tasks were conducted during the normal class sessions by the same researcher to ensure it was properly run to every class. 88 students from four English for Professional Communication intact classes were selected to participate in this study. Participants were randomly assigned to one of the four groups. They were instructed to write an essay in an hour using wikispaces. Participants were instructed to log in into their wikispaces to write their essays. After they have completed their essay, 40 participants were randomly chosen for semi- structured interview sessions. Interviews were seen as essential in this study as it permits a level of in-depth information gathering, free response and flexibility that may not be obtained by other procedures.

Language production measures and analysis

The written production of each participant serves as the data for the current study and therefore, was measured in terms of complexity. Complexity was measured based on syntactic and lexical complexity. For syntactic complexity, two general measures and two specific measures were applied. T-unit complexity ratio (clauses/ T-unit) and sentence complexity ratio (clauses/ sentences) act as general measures of syntactic complexity. Another two measures which are to

specifically measure dependent clause were dependent clauses ratio (DC/C) and dependent clauses per T-unit (DC/T). T-unit is a preferred baseline unit since this study deals with written production which is one- way, monologic tasks.

For lexical complexity, three measures were chosen to be applied in this study. The measures are lexical sophistication, using the Lexical Frequency Profile (Laufer & Nation, 1995), Guiraud Index (Guiraud, 1960) and word type ratio (WTT). The data was transferred into the Statistical Package for Social Sciences (SPSSS) version 19.0 after the essay writings were analysed and computed using those measures. The data was then computed using Multivariate Analysis of Variance (MANOVA) in order to identify if there is any significant difference of the language production between the four groups specifically on lexical complexity and the syntactic complexity.

Findings

A normality test was conducted to test whether the assumption of normality for the data is fulfilled. To test the assumption of normality, the skewness and kurtosis measures were applied. Table 4 shows the skewness, kurtosis, mean and standard deviation for the language production.

Table 4. *Descriptive Statistics of Language Production*

Language production	Skewness	Kurtosis	*M*	*SD*
Syntactic complexity measures:				
T unit complexity ratio	0.675	-0.007	1.5712	0.2956
Sentence complexity ratio	0.618	-0.025	1.7863	0.3329
Dependent clause ratio	0.152	-0.235	0.2787	0.0828
Dependent clause per T unit	0.726	0.373	0.4522	0.1956
Lexical complexity measures:				
Word type ratio	0.672	0.891	6.8080	1.5806
Guiraud Index	0.573	0.683	8.7173	1.3081
Lexical sophistication	0.084	-0.550	25.2859	4.4256

As shown in Table 4, the data was found to be in the range of recommended values, suggesting a normal distribution of data. Thus, no further transformation of the data is needed.

Before the MANOVA test was carried out, a Box M test was conducted to test the homogeneity of variance-covariance matrices. Homogeneity of variance-covariance matrices is an assumption that the variance-covariance matrices in the different groups have all been sampled from the same population. As presented in Table 5, the results show that there was a difference of variance-covariance matrices, (p=0.000). The mean and standard deviations for the MANOVA test on the task implementation factors and language production for each group are presented in Table 6.

Table 5. *Box's Test of Equality of Covariance Matrices*

Box's M	236.849
F	2.392
df1	84
df2	16004.671
Sig	.000

Table 6. *Language production: Descriptive Statistics of Language Production per Group*

Measures	+CRD, +TS (n=22)		-CRD, +TS (n=22)		+CRD, -TS (n=22)		-CRD, -TS (n=22)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
T-unit complexity ratio	1.2890	0.1134	1.5394	0.2050	1.7956	0.2573	1.6607	0.3086
Sentence complexity ratio	1.6265	0.3334	1.7553	0.2580	1.9997	0.3179	1.7635	0.3232
Dependent clause ratio	0.2474	0.0744	0.2887	0.0878	0.2794	0.0853	0.2994	0.0793
Dependent clause per T-unit	0.3243	0.1160	0.4554	0.1728	0.5171	0.2165	0.5121	0.2072
Word type ratio	6.0469	1.0486	6.5582	1.3478	7.1542	1.4923	7.4726	1.9865
Guiraud Index	9.3425	1.5690	8.5432	1.3036	8.3197	0.8757	8.6639	1.2456
Lexical sophistication	27.3691	3.2729	23.0429	4.3611	27.1232	4.6380	23.6085	3.6877

Note: *M*- mean *SD* – standard deviation

Based on the descriptive statistics, the highest occurrence of syntactic complexity (*M*= 1.997) was in the +CRD, -TS group while the lowest (*M*= 0.2474) was in the +CRD, +TS group. For lexical

complexity, the highest occurrence (*M*= 27.3691) was in the +CRD, +TS group while the lowest (*M*=6.0469) also was in the +CRD, +TS group. A MANOVA test was carried out to test if the groups were significantly different with regard to the syntactic and lexical complexity of the language production. Table 7 presents the findings of the MANOVA test.

Table 7. *Language production: Multivariate tests*[c]

Effect		Value	F	Sig.	Observed Power [b]
Intercept	Wilk's Lambda	0.002	6828.922[a]	0.000	1.000
Group	Wilk's Lambda	0.282	5.928	0.000	1.000

Note:

[a] Exact statistic

[b] Computed using alpha= 0.05

[c] Design: Intercept+ Group

As shown in Table 7, there was a statistically significant difference in the language production measures among the groups, F (21, 224.524)= 5.928, $p< 0.05$; Wilk's Λ=0.282 partial η^2= 0.344. The MANOVA test using the Wilk's Lambda criteria indicates that there was a statistically significant difference (p=0.000) for the language production measures among the groups. This suggests that tests of between- subjects effect are necessary, as illustrated in Table 8 and Table 9.

Table 8. *Syntactic Complexity: Tests of Between-Subjects Effects*

	Type III Sum of Squares	Df	Mean Square	*F*	*p*	Partial Eta Squared ηp²	Observed Power [a]
1. T- unit complexity ratio	3.059	3	1.020	18.853	0.000	0.402	1.000
2. Sentence complexity ratio	1.596	3	0.532	5.555	0.002	0.166	0.933
3. Dependent clause ratio	0.033	3	0.011	1.647	0.185	0.056	0.418
4. Dependent clause per T-Unit	0.531	3	0.177	5.324	0.002	0.160	0.921

Note:

$p \leq 0.05$

[a]Computed using alpha = 0.05

Table 9. *Lexical Complexity: Tests of Between-Subjects Effects*

Dependent Variable	Type III Sum of Squares	Df	Mean Square	*F*	*p*	Partial Eta Squared ηp²	Observed Power [a]
1. Word type ratio	26.468	3	8.823	3.883	0.012	0.122	0.808
2. Guiraud Index	12.808	3	4.269	2.636	0.055	0.086	0.626
3. Lexical sophistication	342.330	3	114.110	7.039	0.000	0.201	0.976

Note:

$p \leq 0.05$

[a]Computed using alpha = 0.05

Based on Table 8, task complexity had a statistically significant effect on the syntactic complexity of the language production for three measures; T-unit complexity ratio ($F(3, 84)= 18.853$; $p<0.05$; partial $\eta^2= 0.40$), sentence complexity ratio (F (3,84)= 5.555 ; $p<0.05$; partial $\eta^2= 0.17$) and dependent clause per T-unit (F (3,84)= 5.324; $p<0.05$; partial $\eta^2= 0.16$). Analysis also shows that there was no significant effect of task complexity on dependent clause ratio ($p= 0.185$). This

proves that manipulating the complexity of the tasks may affect the syntactic complexity of the language production.

Table 9 presents the univariate between-subjects test for lexical complexity of the language production. Analysis depicts that there was a significant difference of task complexity on two language production measures; word type ratio (F (3,84)= 3.883 ; p<0.05; partial η^2=0.12) and lexical sophistication (F (3,84)= 7.039; p<0.05; partial η^2= 0.20). However, the effects of task complexity on Guiraud Index measure was not significant (p= 0.055). Thus, the complexity of the tasks may bring significant effects on certain measures of the lexical production of the language.

Discussion

The aim of this study was primarily to examine the synergistic effects of simultaneously manipulating resource-directing and resource-dispersing dimensions of task complexity on the complexity of learner language production. Robinson's Cognition Hypothesis (Robinson 2001a, 2003a, 2003b, 2005, 2007a, 2007b) predicts that tasks which are made difficult along the resource-directing dimension will lead to greater complexity of language production while tasks which are made difficult along the resource-dispersing dimension will result in less complex language production. However, the synergistic effect of manipulating both dimensions is so far indecisive as no prediction has been made for tasks which combine both dimensions of task complexity.

The effects on syntactic complexity

The findings of this study showed that manipulating causal reasoning demand and task structure had a significant effect on both syntactic and lexical complexity but only for certain measures. For syntactic complexity, the significant effects were found on three measures; T-unit complexity ratio, sentence complexity ratio and dependent clause per T-unit. T-unit complexity ratio measures how the writing is grammatically complex (Wolf-Quintero, Inagaki & Kim, 1998). Thus, if the writing has more clauses per T-unit, then the more complex the writing is. Ishikawa (1995) claimed that sentence complexity ratio may disclose a learner's capability to combine clauses with a single sentence either from coordination or subordination. Hence, using sentences as a production unit may captivate how learners coordinate and subordinate their sentences. The dependent clause

per T-unit is a measure that analyses the degree of a clause embedding in a text by counting the number of dependent clauses as a percentage of the total number of T-unit.

The findings showed the same results for these three measures. The greatest occurrence of syntactic complexity was evident in the +CRD, -TS group in which the task was made complex on both dimensions. However, the least syntactically complex language was elicited in the first condition where the task was made complex along resource-directing dimension and simple along resource-dispersing dimension +CRD, +TS.

Results also showed that the highest and the second highest syntactically complex language production were formed by both tasks without task structure (-TS) condition. These results contradicted earlier studies by Rahimpour and Mehrang (2010) and Skehan and Foster (1999) where they found that there was no significant effect of task structure on the complexity of the oral language task performance. The language production produced by the other two groups which received task structure (+TS) was less complex than those produced by the groups which were not given the task structure. In this sense, the task structure may not direct learners to produce more syntactically complex language production. The qualitative data gained from interview sessions after the essay writing task revealed that learners in the +TS condition feel restricted and constrained when they were given the task structure. Learners claimed that upon the completion of the writing task, the task structure made them feel controlled and somehow had diverted their attention to focus more on the essay format rather than the language of their writing. Koba as one of the participants in the +TS condition said that:

> *When I was given the task structure, I tended to rely on the guidelines. I tried to make sure that my essay follows the guidelines as much as possible. After I submitted the essay I realized that I have ignored certain aspects when I am writing the essay such as the grammar and vocabulary.*

In the same vein, Mukmin commented that:

> *The task structure helped me in terms of organizing the essay and provided clear explanation on how my essay should look like. However, I felt that I didn't have enough*

time to write the essay because I focused too much time on the task structure while checking whether or not my essay had a good organization.

As mentioned earlier, the task structure given was in the form of essay format and guidelines. Although learners were focused by the task structure in writing their essays, this may only be true for the organization of the essay but not the grammatical form. Some learners in the –TS felt that they had sufficient time to write the essay although they were uncertain about the writing convention. One of the participants in –TS group, Susan, claimed that:

I was not sure whether what I wrote was the correct format of the writing organization. I only concentrated on writing the essay based on the information and instruction assigned to me. I have enough time to write and check my essay twice before it was submitted. I was also able to rewrite certain sentences which I think was inaccurate and modify the vocabulary that I used.

As evident, although learners who did not receive the task structure (-TS) were doubtful of their writing convention, they had an ample time to complete and review their writing. While reviewing, they might have dedicated their attentions to the syntax which led them produced more syntactically complex language compared to the group that received task structure (+TS).

The effects on lexical complexity

Lexical complexity measures the size of writer's dynamic vocabulary (Wolfe-Quintero et al., 1998). More lexically complex language refers to more variations of basic and advanced words while less lexically complex means a writer only provides a limited series of basic words.

For lexical complexity, the measures that were found to have significant difference were word type ratio and lexical sophistication. The word type ratio measures the sophistication and variation in the T-unit context by not depending on the length of the essay. Higher ratio of word type means that a learner produces more variety of words in their writing while fewer ratios of word types refers to the condition where a learner has less varied words.

The most complex word types was exhibited by the -CRD, -TS group followed by the +CRD, -TS group, while the least complex word types was formed by the +CRD, +TS group. Both groups

with no task structure (-TS) elicited higher word type ratio compared to groups with task structure (+TS). This finding is in line with the claims made by the learners during the interview session as presented earlier. Koba, one of the learners in the +TS group claimed that they had a tendency to be dependable on the task structure and this directed their attention to focus more on the format and the organization of the essay rather than the language of the essay. As a result, learners in the +TS condition produced fewer word types than learners in the –TS condition.

Another measure of lexical complexity, lexical sophistication, is calculated by specifying which lexical words are not on the list of basic words or are on the list of sophisticated words. The total number of sophisticated word types is divided with the total number of the word types in a text. Higher lexical sophistication means that the writing has more sophisticated words than the basic words. The results revealed that the groups which were instructed to justify miscommunication issues at workplace (+CRD) produced more advanced words than those who wrote on miscommunication issues topic in general. The highest occurrence was evident in the +CRD, +TS group followed by +CRD, -TS group. The lowest occurrence was found in the -CRD, +TS group. Both groups with causal reasoning demand formed more advanced words as compared to the no causal reasoning demand groups. Robinson (2005) claimed that a task which requires justification is more complex than a task which does not demand this and this task will lead to greater complexity. However, this study found that when a task demands learners to establish reasons, leaners produced more advanced words regardless of whether they received task structure or not.

In-depth understanding of this phenomenon may be explained by data from the interviews. During the interviews, learners in the +CRD condition claimed that not only the topic was relevant to them; it was also straightforward because of the causal reasoning requirement that the task demanded. Farid, one of the participants in with causal reasoning condition commented that:

> *The task was very specific and straightforward. I found that it was so easy to understand what is required in this essay writing. I knew that I have to write on the reasons of miscommunication issues, thus, I only concentrated on that issues. At the end, I am happy with my writing as I am quite sure that I have fulfilled the requirement.*

On the other hand, learners in without causal reasoning condition feel that the task is rather too broad. Felicia, one of the participants in without causal reasoning commented that:

> *I think the task was quite difficult. There were too many things to write because the task was too general. I didn't know which idea should be included or excluded as there were many of them. I spent a long time to decide on that. I didn't have time to check the grammar at all. Maybe those who were in the same group with me felt the same way too.*

With regard to the reasoning demand variable, learners in the +CRD condition were given notes on the reasons of miscommunication issues at workplace, to be used in their essay writing while learners in the –CRD condition were required to write about miscommunication issues at workplace, without specific reasons provided to them. As stated by one of the participants in the +CRD condition above, she claimed that she felt more comfortable and easier to write if she was instructed to make justification of the issue. In contrary, learners who received non-causal essay (-CRD condition) felt that they focused too much on the content of the essay, thus they neglected certain aspects of their writing such as vocabulary and grammar. With the addition of the time limit given to learners to perform the task, it could even be much more challenging to fulfill the writing task requirements and to produce lexically complex language simultaneously. Not only learners must ensure they complete the task within the time duration, they also need to ensure that the writing task follows the instruction given. As a result, these factors may have contributed to less number of advanced words produced in the –CRD condition.

In summary, the result of the current study regarding lexical complexity contradicted Robinson's (2001a, 2003a, 2003b, 2005, 2007a, 2007b) prediction. It also did not provide similar findings to earlier studies, for example the one conducted by Saedi et al. (2012). Saedi et al. (2012) found two main findings: (i) the most lexically complex language was produced by the group with the least complex task along resource-directing and resource-dispersing dimensions (planned, single task and here-and-now condition) (ii) when the task was made cognitively more complex along both dimensions (unplanned, secondary task and there-and-then condition), the least lexically complex language was produced.

Conclusion

The current study investigated the effects of manipulating the resource directing dimension (+/- causal reasoning demand) and resource dispersing dimension (+/- task structure) on the complexity of the L2 written production in wikispaces environment. The results showed significant effects of task complexity on the syntactic complexity of language production for T-unit complexity ratio, sentence complexity ratio and dependent clause per T-unit measures. In light of Robinson's Cognition Hypothesis (2001a, 2003a, 2003b, 2005, 2007a, 2007b) which predicts that the complexity of language production will increase by making a task more difficult along resource-directing dimension or less difficult along resource-dispersing dimension. Nonetheless, this study found that the syntactic complexity increased when a task was made cognitively more difficult for both resource-directing and resource-dispersing dimensions.

In terms of the effect of task complexity on lexical complexity, the significant difference was found only on word type ratio and lexical sophistication. Structured tasks may direct to more variation of words while tasks with reasoning demand lead to more usage of advanced words.

The current study offers further understandings into the use of pedagogic tasks within task-based computer-mediated communication (CMC) teaching and learning environment. The results demonstrated that a task which is cognitively more complex on both dimensions may lead to the production of a more grammatically complex language. It is also notable that a task which is cognitively more complex did not lead to the production of more lexically complex language. Tasks which require reasoning demand and are not supported by task structure enhanced learners' production of language complexity. This study suggests that manipulating these variables is more likely to promote complex linguistic performance for syntax rather than lexis. Therefore, when teachers intend to concentrate on producing syntactically complex linguistic features in task-based CMC teaching and learning environment, teachers may consider on designing tasks which are cognitively more complex, for example, assigning tasks with demanding reasons without supplying task structure.

The findings also revealed that –TS condition elicited more production of complex language than +TS condition. This indicates that the absence of task structure may reduce the online processing demands and hence, allow processing capacity to focus more on linguistic aspect of language production. Provision of task structure might be cognitively more demanding because learners

need to concentrate on two different aspects simultaneously, which are A and B. Hence, in L2 teaching and learning contexts, teachers may consider to limit the provision of linguistics support of the tasks particularly when the tasks involve reasoning demand.

On the basis of the obtained results, it can be concluded that manipulating cognitive demand of task complexity along resource-directing (i.e. causal reasoning demand) and resource-dispersing (task structure) dimensions has a significant effect on syntactic and lexical complexity of the language production.

Limitations and suggestions for further research

Since the current study took place in a particular environment, some conditions which limit generalization of the study need to be mentioned. First, the number of the participants was rather small. In the current study, the number of participants in each condition was twenty two (*n*=22). According to Good and Hardin (2003), small samples may give a distorted view of the population (p.6). Hence, a larger number of participants for each experimental group would have been preferable so that it may closely represent the targeted population.

Second, this study is a classroom research which involved the use of intact classes where participants have already been assigned on the basis of some principles. In this study, the participants were chosen because they sit for the same language course and were assumed to have the same background knowledge since there are certain requirements from the university that they need to fulfill. Even though the use of intact groups are more pedagogically realistic (Adams, 2006), the use of randomized groups is preferable because it is the notion of true experimental design. In the context of this study, using intact classes is a practical way since randomization of participants is not feasible. Since the participants of this study belong to intact classes, there is a possibility that different results would be found with students from different classes. As a study which uses intact groups may not be representative to the whole population (Hatch & Lazaraton, 1991; Mackey & Gass, 2005), it would be difficult to make generalization based on this study to other population. However, since the aims of this study is to examine the areas of linguistic production that may improve with certain level of tasks, using intact classes is more appropriate as the intact classes may represent the actual targeted context of second language classrooms.

Based on the results of this study, several suggestions can be made for future research. First, the current study manipulated only two task complexity variables along resource-directing and resource-dispersing dimensions. Future studies may look into other alternatives of combining other task implementation features. Likewise, the other two elements in Robinson's Triadic Componential Framework; task condition and task difficulty may require further exploration.

Next, this study manipulated task complexity in asynchronous CMC environment. It is worthwhile to explore the other task complexity variables in other various technology-enhanced setting. More studies on task complexity are also needed to explore what and how the language performance may be different by comparing the technology-enhanced setting and face-to- face communication. Investigation on what types of tasks that work best in the CMC environment is also important so that teachers can use this information to make the most of learning in CMC setting. This study measured the complexity of language production, specifically the syntax and lexis. Other propensities of language production that should be explored are accuracy and fluency or maybe a wider variety of complexity measures. It would be interesting to see whether there is a trade-off between these measures and whether there is any empirical evidence that may support the findings of the current study.

Biodata

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Appendix A

Causal Reasoning Demand Materials

Tasks with causal reasoning demand (+CRD)

Communication skill is important at workplace. Nevertheless, miscommunications between colleagues may occur due to several reasons. What could the contributing factors be?

Write an essay about the issue in approximately 250 words. You may refer to the guidelines given.

- Definition of communication skill
- Verbal (oral and written language) and non-verbal communication (facial expressions and gestures)
- The importance of communication skill in workplace
- Unaware of non-verbal communication
    - Inappropriate non-verbal signals
- Misunderstanding of the message
    - Wrong interpretation
- Ambiguity of the meaning
    - Meaning is not clear
- An individual's cultural background
    - e.g.: Asian cultures- build consensus, avoid embarrassing others by direct criticism
    - e.g.: Western cultures - directness and straight talk
- Cultural values
    - e.g.: East Asians - group motivated
    - e.g.: North Americans - individually motivated
- Cultural norms
    - e.g.: Americans - direct eye contact when conversing
    - e.g.: Asians- avert their eyes, politeness and respect.
- Gender
- Working experience
- Several factors may contribute to miscommunication at workplace.

Tasks without causal reasoning demand (-CRD)

Write an essay about 'Miscommunication at workplace'. The essay should be written in approximately 250 words. You may refer to the guidelines given.

Task Structure Materials

Tasks with task structure (+TS)

Guideline 1 : Format of the essay

A typical format of an essay is as follows:

Essay Part	Content
Introduction	▪ Background for the topic ▪ Setting out the issues ▪ Focusing the argument—the purpose of the essay ▪ Thesis statement
Body paragraph/s	▪ Begin with a topic sentence ▪ What the specific conditions are ▪ Specific illustrations/examples of these conditions ▪ End with a concluding sentence
Conclusion	▪ Summing up ▪ Explain why the issue is important to be discussed ▪ End the essay with a memorable conclusion

Guideline 2: Main points

Point 1: Poor communication skills

Point 2: Cultural differences

Point 3: Other factors

Tasks without task structure (-TS)

No essay format and guidelines.