

Effects of Task Complexity Variables on Complexity, Accuracy and Fluency of Second Language Production: A Critical Review

Lilliati Ismail (Corresponding author)

Dept. of Language and Humanities Education, Faculty of Educational Studies,
Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

E-mail: lilliati@upm.edu.my

Arshad Abd. Samad

Dept. of Language and Humanities Education, Faculty of Educational Studies,
Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

E-mail: arshad@upm.edu.my

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Abstract

This paper reviews recent research that has manipulated task complexity variables to gauge their effects on L2 learning. This review draws upon Robinson's Triadic Componential Framework for task design (2001a) which suggests that increases in task complexity levels should be an important consideration when designing and sequencing a task-based language syllabus. Most of the studies discussed support Robinson's contention that more complex tasks result in greater accuracy and complexity in L2 learners' language production. This would imply the need to consider task complexity variables in selecting, designing and administering tasks in the second language classroom to achieve optimum effects on the learning process. Teachers would also have to be conscientious in evaluating cognitive loads of tasks to ensure heightened attention to meaning and forms. Also, the potential of using task complexity level as an organising principle for a second-language syllabus needs to be further explored and investigated.

Keywords: Triadic Componential Framework, Task-based language teaching, Accuracy, Complexity, Cognitive load

1. Introduction

Robinson (2001a, 2005, 2007) identifies three variables that could affect task performance which are task condition, task difficulty and task complexity. Among these three variables, Robinson (2001a) argues that task complexity is the most important factor when deciding on task sequence and syllabus design. Some writers have used task complexity and task difficulty interchangeably. However, Robinson distinguishes these two terms: task complexity deals with cognitive factors inherent in the tasks, while task difficulty is influenced by learner factors (e.g., proficiency level, attitude towards learning). In other words, task complexity is closely related to processing demands imposed by the structure and requirements of the tasks.

2. Task Complexity: Theoretical Underpinnings

Basically, two different perspectives have inspired research in task complexity in relation to second language (L2) production. The first one is an interactionist approach which argues that interactional processes which would include engaging in negotiations to overcome communication breakdowns, modifying language output, and giving and receiving feedback could lead to L2 development (Long, 1985). In relation to this, researchers in the 1980's (e.g., Brown and Yule, 1983; Long, 1985) manipulated the flow of information in interactional contexts to understand their effects on learner-learner interaction. These studies were particularly interested in elements of the tasks that encourage episodes in the learner-learner interaction that could provide opportunities for learning through the use of negotiations of meaning. These episodes provide opportunities for learning which would lead to interlanguage development (Long, 1985, 2000). The term "critical episodes" (Samuda and Rounds, 1993) was then used to refer to instances in which learners address recently learnt or problematic features of the target language. Identification of these episodes allowed for the systematic categorisation and analysis of L2 learning opportunities. In later years, Swain and Lapkin (1998) used the term "Language-related Episodes (LREs)" to refer to parts of learner-learner interaction that dealt with the language produced. This would include questioning the correctness of language use, correcting own language use, and correcting other interlocutors' language use.

The second perspective on the link between task complexity and L2 learning is the information-processing perspective. Lyster (2004) posits that cognitive theories that draw on information-processing models are best-suited in explaining and evaluating L2 learning. Information processing models can help explain how task manipulation leads to differences in L2 production in terms of complexity, accuracy and fluency, which are the three aspects of language production. Studies on task complexity often draw on Robinson's Cognition Hypothesis (2001a, 2001b, 2005, 2007) as it is a cognitive construct that could explain task complexity effects on L2 learning opportunities.

3. Robinson's Cognition Hypothesis and Task Complexity Dimensions

Robinson (2001a, 2001b, 2005, 2007) through his Cognition Hypothesis suggested that increases in task complexity levels should be the basis for the design and sequencing of tasks in

a task-based syllabus. Based on this conviction, Robinson (2001a, 2001b, 2003, 2005, 2007) developed the Triadic Componential Framework for task design, as shown in Table 1:

Table 1. Task complexity, condition and difficulty (Robinson, 2001a)

Task complexity (cognitive factors)	Task condition (interactional factors)	Task difficulty (learner factors)
<u>resource-directing</u> +/- few elements +/- here-and-now - no reasoning demands	<u>participation variables</u> open/closed one-way/two-way convergent/divergent	<u>affective variables</u> motivation anxiety confidence
<u>resource-dispersing</u> +/- planning +/- single task +/- prior knowledge	<u>participants variables</u> gender familiarity power/solidarity	<u>ability variables</u> aptitude proficiency intelligence

The framework highlights three dimensions which are related to cognitive factors, interactional factors and learner factors. The + or – symbol for each element of the resource-directing and resource-dispersing variables of the task complexity dimension represents the presence (+) or absence (-) of an element, or a relatively greater (+) or lesser amount (-) of the element (Robinson, 2001a). Robinson (2001a, 2003) further explains that resource-directing variables would challenge learners’ cognitive and information processing abilities depending on the level of reasoning required to carry out the task, the number of elements in the task and whether the task is in the “here-and-now” as opposed to being in the “there-and-then”. Meanwhile, resource-dispersing variables would challenge learners in terms of the learners’ amount of existing knowledge to perform the task, the amount of time given for planning the task, and whether learners have to complete a single task or several tasks.

Robinson (2001a, 2001b, 2003, 2005) through his Cognition Hypothesis argues for the need to manipulate tasks along the resource-directing and resource-dispersing dimensions to aid interlanguage development. Among others, he proposes that increasing task cognitive demand will lead to greater accuracy and complexity in language production to meet the demands of the tasks, and heightened attention to language output (Robinson, 2003).

4. Recent Studies on the Relationship between Task Complexity and L2 Learning

Interest in task-based language teaching has seen a rise in recent years as studies on task effects have shown a positive impact on L2 learning. Task complexity in particular has been found to have a crucial effect on task performance and language production. This section will discuss recent studies that manipulated task complexity variables in the resource-directing dimension and the effects on L2 learning opportunities and L2 development.

Table 2. Summary of recent research on task complexity and L2 opportunities

Study	N	Task complexity variables	Task type	Key results
Robinson (2001b)	N=44	+/- prior knowledge +/- few elements	Direction-giving task	High complexity tasks resulted in greater accuracy and more confirmation checks.
Iwashita, McNamara, & Elder (2001)	N=193	+/- here-and-now +/- no reasoning demand	Narrative task	High complexity tasks in the 'here-and-now' dimension resulted in greater accuracy.
Lee (2002)	N=82	+/- few elements	Picture description task	No significant difference found in accuracy and syntactic complexity between task complexity conditions.
Kuiken, Mos & Vedder (2005)	N=62	+/- few elements +/- no reasoning demand	Persuasive letter-writing task	High complexity tasks generated greater accuracy and lexical complexity.
Ishikawa (2006)	N=76	+/- here-and-now	Narrative task	High complexity tasks resulted in greater complexity, fluency, and accuracy.
Nuevo (2006)	N=113	+/- no reasoning demand	Narrative task Decision-making task	No significant difference found between low and high reasoning demand task in promoting development of past tense morphology and locative prepositions.
Gilbert (2007)	N=48	+/- here-and-now +/- pre-task planning	Narrative task	High complexity tasks generated greater accuracy and less fluency.
Kim (2009)	N=34	+/- no reasoning demand +/- few elements	Picture difference task Narrative task	During the picture difference task, both groups of high and low proficiency produced more LREs during the complex

				<p>task.</p> <p>During the narrative task, a higher number of LREs was elicited in the low proficiency group during the simple task compared to the complex task. The opposite is true for the high proficiency group.</p>
Gilbert, Baron, & Llanes (2009)	N=60	+/- few elements +/- no reasoning demand +/- here-and-now	Narrative reconstruction task Instruction-giving map task Decision-making task	<p>In the narrative task, the complex task version produced more interaction than the simple version.</p> <p>In the map task, the complex version resulted in more attention being directed to morphosyntactic and lexical features.</p>
Revesz (2009)	N=43	+/- no reasoning demand	Decision-making task	<p>More complex tasks generated more interactional feedback including recasts and clarification requests.</p>
Revesz (2011)	N=43	+/- no reasoning demand	Argumentative task	<p>An increase in task complexity level resulted in a decrease in syntactic complexity. However, lexical variety and accuracy saw an increase</p>
Saeedi, Ketabi, & Kaverooni (2012)	N=65	+/- here-and-now +/- planning +/- single task	Narrative task	<p>Increasing complexity levels along the +/- here-and-now continuum resulted in increased complexity and structural complexity</p>
Ismail, & Abd. Samad (2014)	N= 76	+/- no reasoning demand	Opinion gap task Dictogloss task	<p>There was more negotiation of form in the dictogloss task compared to the opinion-gap task</p>
Fukuta and Yamashita	N=36	+/- no reasoning demand +/- single task	Narrative tasks	<p>Reasoning demand condition produced significantly more accurate</p>

(2015)				language production compared to the dual-task condition. Both the reasoning demand condition and dual-task condition were found to significantly decrease learner fluency compared to the normal condition. Complexity measures showed no significant differences among the three conditions.
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Table 2 shows recent studies in ESL contexts that used interactive tasks and manipulated various task complexity variables such as +/- here-and-now (Gilabert, 2007; Ishikawa, 2006, Saeedi et al., 2012), +/- few elements (Robinson, 2001b; Lee, 2002; Kuiken et al., 2005; Kim, 2009), and +/- no reasoning demand (Iwashita et al., 2001; Nuevo, 2006; Robinson, 2007; Revesz, 2009, 2011, Ismail & Abd. Samad, 2014). The findings indicated mixed results with Lee (2002) and Nuevo (2006) reporting that no significant difference was found between manipulation of task complexity variables (+/- few elements and +/- no reasoning demands) and L2 development. However, a number of studies (Robinson, 2001b, 2005, 2007; Iwashita et al., 2001; Gilabert, 2007; Kuiken et al., 2005; Ishikawa, 2006, Revesz, 2011) showed positive relationships between increasing complexity levels along the resource-directing dimension and increases in accuracy in L2 speech and/or writing. This would support Robinson's Cognition Hypothesis which posits that increasing the cognitive demands of L2 tasks lead to increases in the accuracy and complexity of L2 speech production (Robinson, 2001a, 2001b, 2005, 2007).

Studies that investigated the effects of +/- no reasoning demands on L2 learning have shown partial support of Robinson's Cognition Hypothesis. For example, Nuevo (2006) investigated the effects of task complexity variables on L2 development and opportunities for language learning. The participants were 113 adult immigrant ESL learners in the United States. The researcher manipulated +/- no reasoning demand using high and low levels of complexity for a narrative task and a decision making task. Opportunities for language learning were operationalised using 9 interactional processes including metalinguistic talk and confirmation checks. L2 development was operationalised as increased accuracy when producing 2 pre-determined linguistic items; past tense and locative prepositions. Findings showed levels of complexity affected types of learning opportunities that occurred. Also, no significant difference was found between low and high reasoning demand task in promoting development of past tense morphology and locative prepositions. Meanwhile, Ismail and Abd. Samad (2014) who manipulated the +/- no reasoning demands found that the high complexity task resulted in a significantly lower amount of negotiation of form compared to the low complexity task. They argued that the finding is in line with Skehan's Trade-off Hypothesis

(2009) which contends that there is a trade-off between task performance and task content. Thus, as learners deal with more cognitively demanding tasks, they will place less emphasis on language accuracy.

Robinson (2001b) investigated the impact of task complexity on interaction by analysing the occurrence of feedback during LREs. He manipulated a resource-dispersing variable (+/- prior knowledge) and a resource-directing variable (+/- few elements) in map tasks. The participants were 44 Japanese students learning English as a second language. The less complex version made use of an area map which was familiar to the students (+ prior knowledge), and was smaller in area (+ few elements). The more complex task made use of an authentic street map unfamiliar to the students (- prior knowledge), and was larger in area (- few elements). In their dyads, one student gave directions to the other student to reach a point of destination in a map. Results showed that there was a greater frequency of interactional processes and greater accuracy in the complex task.

In a later study, Robinson (2007) investigated how task complexity variables affected L2 oral production, interaction, uptake and learner perceptions. Three narrative tasks with different levels of reasoning demand (i.e., simple, medium and complex) were used. Forty-two Japanese university students worked in dyads to complete the tasks. One student in each dyad had to decide on the sequence of the jumbled-up story. Then, he narrated the story to his partner. Each of the 21 dyads carried out all 3 tasks at 3 different levels of reasoning demand. Order of the task performance was counterbalanced to avoid the internal validity threat of task-ordering effect. Accuracy was measured using percentage of error free C-units (%EFC) and fluency by measures of syllables per second (SPS) and words per C-unit (WPC). To address the research hypothesis, ANOVAs and subsequent paired t-test comparisons were used, while Friedman repeated-measure tests and pairwise Wilcoxon Signed Ranks tests were used on data that were not normally distributed. Results indicated that high complexity tasks led to more complex speech, and tasks requiring more complex reasoning led to significantly more interaction and uptake. These results would be in line with Robinson's Cognition Hypothesis.

Some studies manipulated more than one aspect of task complexity in the resource-directing dimension. For example, Kim (2009) investigated the occurrence and resolutions of LREs in dyadic interaction using a picture difference task with + few elements, a picture difference task with - few elements, a picture narration task with + reasoning demand, and a picture narration task with - reasoning demand. Thirty-four international students in 5 intact classes enrolled in an Intensive English program at a university in the United States were put in dyads and they performed all four tasks. The Latin square design was adopted to enhance validity. Learner-learner interaction was transcribed and analysed for the learning opportunities that occurred. The findings indicated that task types and learner proficiency levels affected the occurrence and resolutions of LREs. Based on the findings, the researcher suggested that task types and learner proficiency levels are important factors that teachers need to consider when using tasks to ensure greater learning opportunities in oral interaction.

Kuiken et al. (2005) examined the effects of +/- few elements and +/- no reasoning demands on L2 performance. The participants were 62 Dutch university students of Italian with two proficiency levels (low vs. high). The students were asked to write a letter to a friend recommending a holiday destination. The tasks were manipulated to represent two degrees of task complexity using +/- few elements. The high complexity task required students to choose bed and breakfast facilities in Italy using 6 given criteria, while the low complexity task required students to suggest resort places in exotic countries using 3 given criteria. Linguistic performance was then operationalised using measures of syntactic complexity, lexical variation and accuracy. Findings indicated that more complex tasks resulted in greater accuracy in grammar use, than less demanding tasks. This would be in line with arguments made in the Cognition Hypothesis. However, support for the Cognition Hypothesis was not found in syntactic complexity or lexical variation. In terms of L2 proficiency levels, it was found that only the high proficiency group showed improvements in grammatical accuracy. In other words, only the high proficiency group's results indicate support for the Cognition Hypothesis with the accuracy measures.

Iwashita et al. (2001) manipulated two variables of task complexity; immediacy (+/- here-and-now) and adequacy (+/- no reasoning demands). Their study investigated the effects of the different task complexity variables on fluency, accuracy, and complexity of L2 production. The participants were 193 pre-university students taking an ESL course in Australia. The findings indicated no significance difference for the task performance measures, except accuracy, which was found to be significant in the immediacy (+/- here-and-now) condition. The results showed that the more complex task in the immediacy (+/- here-and-now) condition resulted in more accurate language. Thus, this study provides some support to Robinson's Cognition Hypothesis, but not in terms of reasoning demands.

Another study that manipulated the task complexity variable +/- here-and-now is Ishikawa's (2006) study that investigated the effects of this variable on L2 production using 3 different types of oral interaction tasks: an instruction-giving map task, a narrative construction task, and a decision-making task. The analysis was based on 52 written narrative texts produced by Japanese High School students. The students were categorised as high or low-proficiency based on their scores in the Michigan English Placement Test (MEPT). Four modes of production metrics (i.e., accuracy, structural complexity, lexical complexity and fluency) were measured to investigate the effects of task complexity on L2 production and its interaction with learner proficiency level. To measure structural complexity, a measure of S-nodes per T-unit was adopted, while lexical variation was measured using a type/token measure, and writing fluency was measured using the measure of words per T-unit. The results indicated that low-proficiency learners received greater benefits when task complexity was manipulated from "here-and-now" to "there-and-then".

In a study involving 65 Iranian learners, Saeedi, et al. (2012) investigated the effects of manipulating three variables (i.e., planning time, single task, and here-and-now) on complexity, accuracy and fluency of learner production. The participants were randomly assigned to one of four tasks. For the +/- here-and-now variable, participants were asked to narrate the story in the present tense as they were watching a video (+here-and-now), or

re-tell the story in the past tense after watching the video (-here-and-now). They researchers found that increasing the complexity level in the +/- here-and-now dimension resulted in increased structural complexity and accuracy. Thus, the study corroborates Robinson's (2003) contention that increasing task complexity along the resource-directing dimension would enhance accuracy and complexity of language production.

Revesz (2009) investigated the relationship among tasks, focus-on-form techniques and L2 learning outcomes. In particular, she examined how the task variable +/- no reasoning demand (operationalised as +/- contextual support in the form of photos available during their descriptions) combined with recasting (which is a focus-on-form technique) affected L2 morphosyntactic development. The participants were 90 adult participants randomly assigned into one of four experimental groups and a control group. The study employed a pretest-posttest-delayed posttest to gauge any improvements in the use of the target language item, which is the past progressive form. The experimental groups consisted of two recast groups (+ photo group vs. - photo group) and two non-recast groups (+ photo group vs. - photo group). Results were analysed using a multifaceted Rasch measurement. The findings support Robinson's (2003) assumption that tasks that are sufficiently complex along the resource-directing dimensions would result in increased accuracy.

In their study, Gilabert et al. (2009) investigated the effects of +/- few elements and +/- no reasoning demand on learners' interaction. Sixty learners of English as a foreign language participated in the study. Similar to Ishikawa's (2006) study, they were organised into dyads and carried out 3 different oral interaction tasks. The simple and complex versions of the tasks were given to the learners in different sequences. The dyads' interaction was audio-recorded, transcribed and analysed for amount of interaction and types of interactional feedback. Results showed that the complex version of the narrative task resulted in more interaction than the simple version. Also, the complex version of the map task resulted in more attention being directed to morphosyntactic and lexical features. They authors concluded that their study provides empirical evidence supporting the Cognition Hypothesis, as complex tasks resulted in greater interaction and attention to language use, thus contributing to L2 development.

Fukuta and Yamashita (2015) investigated the ways in which two types of cognitive demands which were reasoning demand and dual-task demand affected L2 production. The participants were thirty six undergraduate and postgraduate students with upper-intermediate proficiency levels. Each participant met with the first researcher individually, and performed three narrative tasks (describing a story based on four-frame cartoons) under normal condition, reasoning demand condition (cartoon-frames are out of sequence) and dual-task condition (narrating while randomly hitting keys on a keyboard). Each participant's oral production was audio-recorded, transcribed, and evaluated for syntactic complexity, accuracy and fluency. ANOVA results showed significant differences in accuracy and fluency among the three conditions. Subsequent pairwise comparisons showed that the reasoning demand condition produced significantly more accurate language production in relation to the dual-task condition. Meanwhile, both the reasoning demand condition and dual-task condition were found to significantly decrease learner fluency compared to the normal

condition. Complexity measures showed no significant differences among the three conditions. The researchers concluded that the results were consistent with other empirical studies on task complexity variables and Robinson's Cognition Hypothesis as illustrated by the significantly high accuracy score for the reasoning demand condition.

5. Conclusion and Suggestion for Future Research

With the aim of optimising L2 learning through the use of tasks, researchers have manipulated different task complexity variables along the resource-directing and resource-dispersing dimensions. The empirical studies discussed in this paper are mainly concerned with the manipulation of variables in the resource-directing dimension which are variables that make cognitive demands on learners. Most of the studies indicate that high complexity tasks could lead to more opportunities for negotiation, which in turn would promote greater accuracy in language use and more complex language structures. These findings corroborate Robinson's (2001a) contention in his Triadic Componential Framework that more complex tasks will result in greater grammatical accuracy and syntactic complexity.

Findings from the research reviewed also imply the need for teachers to be conscientious when selecting and designing tasks for use in the classroom. Task complexity loads need to be taken into account as they could have differential effects on attention to language forms, interactional processes, as well as levels of complexity, accuracy and fluency in L2 production.

Robinson's Cognition Hypothesis (2001a, 2001b, 2005, 2007) was put forth to provide a basis for task grading and sequencing. Though the studies reviewed have shown that different levels of reasoning demand could have differential effects on language performance including grammatical accuracy and syntactic complexity, they do not provide sufficient empirical evidence as to how this information could feed into task grading and sequencing. Thus, future research could expand the domain of task complexity studies and provide empirical evidence that could assist in task grading and sequencing in task-based syllabus design with task complexity levels as an organising principle.

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