The Cognition Hypothesis: Task Complexity and L2 Interaction

Eunseok Ro[i]
University of Hawai'i at Mānoa

The Cognition Hypothesis proposed by Peter Robinson (2001a, 2003, 2005, 2007a) has stimulated considerable research over the last 12 years. This paper briefly reviews the research on task complexity, an area where the majority of task-based language teaching (TBLT) studies have aggregated—specifically, where the connection between the task complexity, task types, and task condition was a focus. Although the research data to date were not in full consensus, the results showed a number of valuable and testable insights: (a) there is an effect of task complexity on L2 performance; (b) there is an effect of task types on L2 performance; (c) there is an effect of task complexity on L2 development; (d) there is an effect of task condition on L2 performance; and (e) there is an effect of the interaction between task complexity and task condition on L2 performance. The existing research has offered not only some important insights that future research should seek to build on (e.g., the fact that manipulating task complexity, task types, and task condition has an influence on language learning), but also has provided some pedagogical implications to actual teaching practice (e.g., having language teachers design and implement tasks with varying complexity levels is best for encouraging fluency and accuracy).
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The Role of Task Complexity

In recent decades, there has been a proliferation of studies on task complexity resulting from the increased use of interactional tasks in second language (L2) classrooms. Task 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" (Robinson, 2001a, p. 28). The construct of task complexity is an essential determining factor for task sequencing and is also an important factor affecting task performance (i.e., fluency, complexity, and accuracy) and the amount of interaction (Long, 1985; Robinson, 2005, 2007b). The Cognition Hypothesis (Robinson, 2001a, 2003, 2005, 2007a; Robinson & Gilabert, 2007) remains the most influential model of how task complexity may currently be affecting L2 performance and L2 development. Accordingly, there are many empirical studies testing the hypothesis, especially with regard to accuracy, complexity, and fluency of L2 production. However, not only has there been little empirical research exploring the task complexity with task types and task condition, but the findings are inconclusive as well. This paper is a review of the research conducted within the framework of Robinson's Cognition Hypothesis, focusing in particular on studies involving the effects of task complexity, task types, and task condition on L2 development. Included is a description of Robinson's Triadic Componential Framework (TCF) and his Cognition Hypothesis, followed by examples of how his hypothesis can be supported and/or refuted based on empirical findings from the task-based language teaching (TBLT) study on task difficulty, task types, and task condition, thereby providing a more concrete understanding of the Cognition Hypothesis.

The Triadic Componential Framework for Task Classification and the Cognition Hypothesis

Based on the Triadic Componential Framework developed by Robinson (2001b), there are three sets of variables that should be considered in designing tasks: (a) *Task Complexity*—cognitive complexity of the task; (b) *Task Difficulty*—learner factors, such as attitude, motivation, and anxiety; and (c) *Task Condition*—the condition under which the task has to be performed (e.g., whether information

exchange is one-way/two-way or in monologic/dialogic context, and similar factors). Although Robinson agrees that some implementational factors (e.g., learners' perceptions and abilities) may result in online adjustments, he believes that task complexity should be the only basis for prospective sequencing decisions (Robinson, 2007b). According to Robinson and Gilabert (2007), task complexity factors can either be resource-directing (cognitive and/or conceptual demands, such as a task that requires reasoning) or resource-dispersing (performative and/or procedural demands, such as a task that allows prior knowledge) with regard to cognitive resources, as described in Table 1 with a picture-narration task.

Table 1
Robinson's Task Complexity Dimensions for Picture Narration Task (cited by Kim, 2009, p. 255)

Task Complexity	**Descriptions in Picture Narration Task**
(1) *Resource-directing*	
± few elements	Complex (–few elements; more pictures to narrate) vs. Simple (+few elements; fewer pictures to narrate)
± here-and-now	Complex (–here-and-now; narrate without the pictures) vs. Simple (+here-and-now; narrate with the pictures)
± reasoning demands	Complex (+reasoning; pictures presented in no order) vs. Simple (–reasoning; pictures presented in an order)
(2) *Resource-dispersing*	
± planning	Complex (–planning; narrate without planning time) vs. Simple (+planning; narrate with planning time)
± single task	Complex (–single task; narrate the pictures and write the story) vs. Simple (+single task; narrate the pictures)
± prior knowledge	Complex (–prior knowledge; not familiar with the story plot) vs. Simple (+prior knowledge; familiar with the story plot)

Besides TCF, Robinson (2001a, 2003, 2005, 2007a, 2011) has also developed the Cognition Hypothesis, which makes five ancillary theoretical claims about the possible effects of task complexity on language learning and production. Robinson claims the greater the cognitive demands of a task—(a) the greater the accuracy and linguistic complexity at the expense of fluency, (b) the more meaningful interaction and uptake for learners, (c) the greater depth of processing and longer-term retention, (d) the greater chance of automaticity, and (e) the more variation between learners—the more the learners will engage cognitive resources (e.g., attention and memory) and gain in automatization, functional mapping, and restructuring (Robinson, 2007b). Robinson also claims that more cognitively demanding tasks will not only have a performance effect (i.e., modification of output and incorporation of input), but will also lead to learners having more meaningful interaction, which may provide an opportunity for interlanguage development.

According to Robinson's (2005) Multiple Attentional Resources Model, as noted by Michel (2011), learners can simultaneously access multiple attentional pools while performing complex tasks. This triggers noticing, which will lead to an increase in linguistic complexity without showing trade-off effects in terms of a loss in accuracy. In contrast, Skehan (1998) proposed a Limited Attentional Capacity Model, which focuses on the resource-directing dimensions of tasks and argues that an increase in cognitive-task demands increases pressure on the attentional system. Learners then have to prioritize between linguistic complexity, accuracy, or fluency; in other words, limited attentional capacity for form in turn leads to a trade-off between linguistic complexity and accuracy, and therefore contradicts Robinson's hypothesis. Thus, to facilitate a better understanding of the effects of task complexity, empirical studies supporting and/or opposing the Cognition Hypothesis are discussed below.

Research on Task Complexity and Task Types

To date, according to Kim (2009), several empirical studies have tested Robinson's hypothesis by investigating the role of task complexity on task-based instruction by using various task-complexity variables such as ± here and now (Gilabert, 2005; Robinson, 1995; Robinson, Ting, & Urwin, 1995), ± reasoning demand (Iwashita, Elder, & McNamara, 2001; Nuevo, 2006), and ± few elements (Kuiken, Mos, & Vedder, 2005; Kuiken & Vedder, 2007). Even though many studies have investigated the relationship between the task complexity and L2 production, relatively few studies have examined the role of task types in L2 interactional processes (i.e., learning opportunities). The following section reviews three studies (Gilabert, 2007; Gilabert, Baron, & Llanes, 2009; Kim, 2009) on the connection of task complexity and task types—as also noted by Nuevo, Adams, and Ross-Feldman (2011)—in order to compare and understand the effects of task complexity and task types on L2 performance.

Based on the Cognition Hypothesis, Gilabert (2007) hypothesized that task types (narrative, map instruction, and decision-making tasks) performed under complex conditions will trigger more accuracy and a higher rate and amount of self-repairs. This hypothesis was partially confirmed, with different results obtained for each task. The results for the narrative task suggested that when performed with more complex tasks (+there-and-then), learners made less mistakes and more self-repairs. Similarly, as for the map-instruction task, complex tasks (+elements) enhanced learners' accuracy and caused more self-repairs from the task doers, and therefore supported Robinson's hypothesis. On the other hand, with regard to the decision-making task, complex tasks (+reasoning) did not seem to affect either the number of errors or self-repairs. In fact, learners self-repaired more often in the simple version; thus, it appears that Gilabert's hypothesis (along with the Cognition Hypothesis) was not confirmed in the decision-making task. In line with Gilabert's (2007) study, Gilabert et al. (2009) investigated effects of different oral task types (narrative, instruction, and decision) with task complexity, but in a dialogic context with split information-gap tasks. Motivated by the Cognition Hypothesis, Gilabert et al. (2009) hypothesized that increasing cognitive complexity across tasks will generate more learner-learner interaction, which was measured in terms of negotiation of meaning (i.e., confirmation checks, clarification requests, and comprehension checks), recasts, language-related episodes (LREs), and repairs. The results confirmed that Gilabert et al.'s hypothesis was correct, but with different results being obtained for each task. More negotiation, LREs, and repairs were found in both complex narrative and map-instruction tasks—indicating a strong impact on most measures of interaction—whereas no effect of task complexity on interaction was revealed in complex decision-making tasks. In the end, aside from the fact that Gilabert (2007) and Gilabert et al. (2009) supported the Cognition Hypothesis, the findings from both studies outlined that task types, especially with narrative and map instruction tasks, have an effect on L2 performance.

Kim (2009) investigated the effects of proficiency level during task-based interaction in two task types (picture narration and picture-difference tasks), along with the relationship between task complexity and the occurrence of LREs. The results indicated that the effects of task complexity on the participants' LRE production differed in terms of task complexity, task types, and proficiency level. While the low-proficiency group had significantly more LREs during the simple picture-narration task than during the complex picture-narration task (as opposed to the Cognition Hypothesis), the high-proficiency group produced more LREs in complex tasks (in line with the Cognition Hypothesis). Moreover, for the picture-difference task, the low-proficiency group had more LREs in the complex task, whereas no difference was found for the high-proficiency group. Along with other studies mentioned above, this study partially supports the Cognition Hypothesis and highlights that task types and learner proficiency are important factors influencing the impact of task complexity on L2 learning opportunities.

In sum, it was revealed that task types have influence on task performance and that the studies at least partially supported the Cognition Hypothesis. Table 2 summarizes which of the studies have supported, partially supported, or did not support the Cognition Hypothesis.

Table 2
Cognition Hypothesis (CH) and the Research on Task Complexity and Task Types

	Supporting CH		Partially Supporting CH	Not Supporting CH	
Gilabert (2007)	✓	(narrative and map-instruction task)		✓	(decision-making task)
Gilabert et al. (2009)	✓	(narrative and map-instruction task)		✓	(decision-making task)
Kim (2009)	✓	(picture narration and high proficiency; picture difference and low proficiency)		✓	(picture narration and low proficiency)

The findings of these studies have a pedagogical implication in that they add additional insights for task sequencing. The Cognition Hypothesis of task complexity (i.e., the greater the cognitive demands of a task, the greater the accuracy and linguistic complexity at the expense of fluency) was partially confirmed, at least, with the narrative and map-instruction tasks, particularly for students with a high proficiency level and with picture-difference tasks for low-proficiency students. In order to provide a deeper understanding of the effect of task complexity on L2 learners, research on task complexity with L2 development is further discussed.

Research on Task Complexity and L2 Development

Based on Long's (1990) Interaction Hypothesis, Robinson (2005) hypothesized that task complexity positively affects learners' L2 development by generating more interaction through the clarification and negotiation necessary in complex tasks. This is because more L2 interaction directs the learners' attention toward differences between their current interlanguage stage and their target L2 form (Michel, 2011), and therefore leads them to notice the gap between input and output; this enhances uptake and intake of new information (Pica, 1994; Schmidt, 1990). Interaction thus draws learners' attention to the linguistic code without their losing focus on meaning (Michel, 2011). In short, greater task complexity leads to greater attention to form, resulting in more meaningful negotiations among the L2 learners; thus, complex interactive tasks may have a stronger impact on L2 performance and interlanguage development.

In contrast to Robinson's hypothesis, the result of Nuevo's (2006) study did not establish a direct link between task complexity and L2 development. By implementing pre- and post-test methods through oral tasks and grammatical judgment tests on English past-tense (narrative tasks) and locative prepositions (decision-making tasks), it was found that there was no difference between the task performers' use of locative prepositions and the past tense in simple and complex tasks. In fact, the results revealed that more learning opportunities were found in simple tasks (–reasoning demands) than in complex tasks (+reasoning demands), and therefore provided counter-evidence for Robinson's Cognition Hypothesis. In light of the Cognition Hypothesis and Nuevo's (2006) study, Nuevo et al. (2011) examined the effects of task complexity (± reasoning demands) on modified output in dyadic tasks and the relationship between output modifications and L2 development. They used two sets of tasks, which targeted English past-tense and locative prepositions to investigate the participants' self-repair, pushed output, and modified output. The findings of Nuevo et al.'s (2011) study revealed that complex tasks had little effect on the participants' production of modified output. Self-repair on the decision-making (locative forms) task was the only measure that had a statistically significant difference between the low- and high-complexity task groups, which supports Robinson's Cognition Hypothesis. This finding, as noted in Nuevo et al.'s study, differs from Gilabert (2007) and Nuevo

(2006) in that they each found no significant difference in the amount of self-repair in the decision-making tasks among low- and high-complexity groups. Moreover, results of the narrative task (± reasoning demands) with English past tense in Nuevo et al.'s (2011) study, in which there was no significant differences of self-repair among the low- and high-complexity groups, did not accord with the findings of Gilabert's (2007) study. In that study, Gilabert revealed that complex narrative tasks (–here and now) triggered significantly more self-repairs from the participants. It should be noted, however, that the two studies used different task-complexity factors and that Gilabert employed monologic narrative tasks, while Nuevo et al. (2011) employed dialogic ones. (This difference in task condition will be discussed in the following section.) In the end, the data from Nuevo et al. (2011) in general do not lend consistent support to Robinson's hypothesis. This implies that, similar to Nuevo's (2006) study, low-complexity tasks, as opposed to high-complexity tasks, may be more effective in promoting learning in certain types of modified output (i.e., pushed output and total modified output associated with past-tense learning).

Similar to the Nuevo (2006) and Nuevo et al.'s (2011) studies, but with more focus on uptake and L2 development, Révész, Sachs, and Mackey (2011) investigated whether task complexity (± visual support) affects the amount of uptake produced by learners receiving recasts and the relationship between uptake and L2 development. Their data showed that the participants with simple picture-description tasks (+visual support) demonstrated a slightly higher rate of uptake compared to the complex-task (–visual support) group; the independent-samples *t*-test, however, yielded no significant differences, and therefore did not support Robinson's Cognition Hypothesis. Furthermore, Révész et al. (2011) demonstrated that uptake was a strong predictor of L2 development when participants performed simple tasks (+visual support) during treatment, but no significant association was found between uptake and L2 development with complex tasks (–visual support). On the other hand, it is interesting that Révész (2012) showed the opposite results in her study. She found that complex oral interactive tasks (–few elements and +reasoning demands) for LREs were able to trigger higher rates of language-learning opportunities when compared to the simpler tasks. In the end, Révész et al. (2011)'s study coincides with that of Nuevo's (2006) and Nuevo et al.'s (2011) studies, while differing from Robinson's hypothesis and the findings of Révész's (2012) study that complex tasks were able to trigger higher rates of L2 learning opportunities.

To summarize, it was learned that either simple or complex tasks can promote L2 learning, prompting language teachers to design and implement tasks with varying complexity levels in their classes; perhaps, task complexity might further need to be content-specific for the learners' L2 learning gains. A brief summary of the relationship between Cognition Hypothesis and the research relevant to task complexity and L2 development is provided in Table 3 below.

Table 3
Cognition Hypothesis (CH) and the Research on Task Complexity and L2 Development

	Supporting CH	Partially Supporting CH	Not Supporting CH
Robinson (2005)	✓		
Nuevo (2006)			✓
Nuevo et al. (2011)			✓
Révész et al. (2011)			✓
Révész (2012)	✓		

Research on Task Complexity with Dialogic and Monologic Task Conditions

So far, the aforementioned studies put the Cognition Hypothesis to the test with respect to its predictions of the influence of task complexity, but the studies did not focus on investigating the effect of task condition (± monologic) in spite of the important role that the task condition has (see Gilabert, 2007; Nuevo et al., 2011 for the different findings on self-repairs). Unlike the previously mentioned studies, as Michel (2011) notes, Michel, Kuiken, and Vedder (2007) tested the Cognition

Hypothesis by manipulating task complexity (± few elements) and task condition (± monologic) on L2 performance, but with regard to linguistic complexity, accuracy, and fluency. In accordance with the Cognition Hypothesis, Michel et al. contended that complex tasks were able to generate more accurate, lexically complex, but less fluent speech; moreover, in the dialogic condition, participants made fewer errors than in the monologic condition. Similarly, Skehan and Foster (2007) found that dialogues in contrast to monologues increase the accuracy of the participants' L2 performance; unlike the findings from Michel et al. (2007), however, Skehan and Foster revealed in addition that dialogic tasks can promote higher syntactical complexity. This could result from complex tasks triggering learners' needs for support, thereby enhancing their attention and awareness of forms through activation of their monitor. Considering the findings on the effect of task conditions of both Michel et al.'s (2007) and Skehan and Foster's (2007) studies, it seems certain that task condition plays an important role on learners' L2 performance.

Unlike the studies discussed above (Michel et al., 2007; Skehan & Foster, 2007), Michel (2011) showed that manipulating task complexity with [+few elements] did not increase the participants' accuracy and syntactic complexity; instead, the increased task complexity resulted in only a higher lexical complexity, which did not support the Cognition Hypothesis. The results also did not support the Limited Attentional Capacity model of Skehan (1998), as the data revealed no main effect for task complexity on syntactic complexity, accuracy, and fluency; in other words, there was no existence of trade-off effects among accuracy, linguistic complexity, and fluency. Michel, however, highlighted significant effects for interaction. In dialogues, learners made more accurate, lexically more complex, and more fluent production, but it was structurally less complex than in monologues. In other words, no combined effects of task complexity and interaction supporting the Cognition Hypothesis were found in Michel's (2011) study, while the effects of interaction on its own were largely confirmed. In this sense, manipulating task condition can be beneficial for task sequencing, for at least its effects allow for interaction. Table 4 shows a brief summary of the research on task complexity and task condition in regard to Cognition Hypothesis.

Table 4
Cognition Hypothesis (CH) and the Research on Task Complexity and Task Condition

	Supporting CH	**Partially Supporting CH**	**Not Supporting CH**
Michel et al. (2007)	✓		
Skehan and Foster (2007)	✓		
Michel (2011)		✓ (dialogic task)	✓ (monologic task)

Conclusion

As discussed above, the contribution of task complexity, task types, and task condition (± monologic) on L2 performance and development is present, but not at a level of full consensus; there are no categorical results. The extant literature provides conflicting findings on the Cognition Hypothesis, prompting the questions: Under what circumstances will learners show fluency? Under what circumstances will learners show accuracy? To be more specific, the results of Révész's (2012) study showed that there were no effects of task complexity on learners' performance with syntactic complexity; Michel (2011) also revealed that task complexity had no impact on the participants' L2 performance with accuracy and complexity. In fact, Nuevo (2006), Nuevo et al. (2011), and Révész (2012) showed counter-evidence for Cognition Hypothesis in that more learning opportunities or uptake was indicated when the participants were involved with simple, rather than complex, tasks. Although disagreement remains on Robinson's Cognition Hypothesis, the research to date has nonetheless produced a number of valuable and testable insights, such as the following: (a) there is an effect of task complexity on L2 performance (Gilabert, 2007; Gilabert et al., 2009; Kim, 2009; Michel,

2011; Michel et al., 2007; Skehan & Foster, 2007); (b) there is an effect of task types on L2 performance (Gilabert, 2007; Gilabert et al., 2009; Kim, 2009); (c) there is an effect of task complexity on L2 development (Nuevo, 2006; Nuevo et al., 2011; Révész, 2012; Révész et al., 2011; Robinson, 2005); (d) there is an effect of task condition (± monologic) on L2 performance (Michel, 2011; Michel et al., 2007; Skehan & Foster, 2007); and (e) there is an effect of the interaction between task complexity and task condition on L2 performance (Michel, 2011; Michel et al., 2007).

A general message here is that teachers of second language students need to keep in mind that manipulating task complexity, task types, and task condition has an influence on language learning. For this reason, teachers of L2s should develop and sequence tasks to see how the tasks affect their learners and find the best content-specific sequence for their students' L2 development.

Future research should seek to test these insights with a more synthetic approach, focusing on the manipulation of a single dimension of task-complexity variables (e.g., perhaps by increasing one dimension of thought complexity—that is, +reasoning demands for complex tasks). In this way, empirical research evidence on the Cognition Hypothesis can be more evidently collected and compared. Furthermore, future research on task complexity should include the effects of task-complexity variables in resource-directing dimensions (e.g., ± few elements, ± here-and-now, and ± reasoning demands) or in resource-dispersing dimensions (e.g., ± planning, ± single task, and ± prior knowledge) to reveal what cognitive factors most affect L2 performance and/or L2 development. This effort may lead researchers and practitioners into more profound knowledge on how to sequence tasks that will ultimately help L2 learners and the quality of TBLT-approached classrooms.

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[i] Corresponding Author: er2584@tc.columbia.edu