Task complexity and linguistic complexity in L2 writing

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Task complexity and measures of linguistic performance in L2 writing

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Abstract

In a study on L2 proficiency in writing, conducted among 84 Dutch university students of Italian and 75 students of French, manipulation of task complexity led in the complex task to a significant decrease of errors, while at the same time a trend for a lexically more varied text was observed (Kuiken and Vedder 2005, 2007, in press). Based on this first analysis in which some global performance measures were used, a more specific analysis was carried out. In the latter analysis, which is reported in this article, accuracy was investigated in more detail according to the type of errors in the L2 texts, while lexical variation was analysed further by distinguishing frequent words from infrequent ones. Results showed that the effect of task complexity could mainly be attributed to lower ratios of lexical errors in the more complex task. With respect to the use of frequent versus infrequent words mixed results were found. On the basis of these findings a number of implications with regard to the operationalisation of task complexity and linguistic performance are discussed.

1. Introduction

In recent years in SLA research there has been a considerable growth of interest in tasks, both as a construct and as a research instrument. In task-based research four major approaches can be distinguished (Robinson 2007; Skehan 2003): (i) a psychological, interactional approach, influenced strongly by the work of Long (1985, 1989); (ii) a sociocultural approach, represented by the work of researchers like Lantolf (2000) and Swain (Swain 1998; Swain and Lapkin 2001); (iii) a structure-focused approach, where tasks are designed to elicit the use of a particular structure feature (Loschky and Bley-Vroman 1993; VanPatten 1996); (iv) a cognitive, information-theoretic approach (Skehan 1998, 2001, 2003; Skehan and Foster 1999, 2001; Robinson 2001a, 2001b, 2003, 2005, 2007). In the latter approach, the main focus is on the information

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processing stages and the cognitive processes and attentional resources used by learners during task completion.

The study presented here has to be collocated within the cognitive information-theoretic approach. The paper focuses on the effects of cognitive task complexity on different aspects of linguistic performance, in particular with regard to the use of general versus specific measures of writing proficiency. Another important question relates to the necessity of a theory of task complexity in task-based research, as advocated by Robinson (2007). Research findings have shown that there are multiple task effects on L2 learning and performance, but what is lacking to date, is a generally accepted framework of task characteristics to classify and sequence tasks.

In our study, conducted among 84 Dutch university students of Italian and 75 students of French, two models of task complexity were put to the test: Skehan and Foster's Limited Attentional Capacity Model (Skehan 1998, 2001, 2003; Skehan and Foster 1999, 2001) and Robinson's Triadic Componential Framework, also known as the Cognition Hypothesis (Robinson 2001a, 2001b, 2005, 2007). A central issue in both models, discussed in the present article, concerns the extent to which task characteristics can affect the allocation of the learners' attention during task completion. In our study task complexity was manipulated along two variables of Robinson's Triadic Componential Framework, the number of elements which have to be taken into account and the reasoning demands posed by the task. Both general measures and more specific measures were used to analyse linguistic performance. Elaborating on the results of our previous study, more specific measures were used in the study presented in this article.

In Section 2 the dimensions and variables of task complexity of Skehan and Foster's Limited Attentional Capacity Model and Robinson's Triadic Componential Framework are compared. In Section 3 a number of general and more specific measures which have been proposed to assess linguistic complexity are discussed. In Sections 4 and 5 the research questions, the design and the results of the study are presented, followed by a discussion of the implications of the study for further research in Section 6.

2. The Limited Attentional Capacity Model versus the Triadic Componential Framework

2.1. *Attentional resources and linguistic performance*

The two most influential models of task complexity are the Limited Attentional Capacity Model developed by Skehan and Foster (Skehan 1998, 2001, 2003; Skehan and Foster 1999, 2001) and Robinson's Triadic Componential Framework (Robinson 2001a, 2001b, 2003, 2005, 2007). Notwithstanding their simi-

larities the models make contrasting predictions about the attentional demands of tasks in relation to linguistic performance.

The basic assumption of the Limited Attentional Capacity Model is that attentional resources are limited and that increasing the complexity of tasks reduces a pool of general available attentional capacity. This notion of limited processing capacity on which the Limited Capacity Model is based, is founded on theories on working memory (Carter 1998; Gathercole and Baddely 1993). As their attentional limits are reached, L2 learners will prioritise processing for meaning over processing language form. Moreover, to attend to one aspect of performance (complexity of language, accuracy, fluency) may well mean that other dimensions suffer and a prioritisation of one aspect will hinder development in the other areas. The major claim of the Limited Attentional Capacity Model, in sum, is that an increase in cognitive task complexity will cause learners to pay attention first to the content of the task. As a consequence, the complexity and accuracy of the linguistic output will decrease.

A different view on the effect of cognitive task complexity on linguistic output is held by Robinson (2001a, 2001b, 2003, 2005, 2007). Robinson predicts that if dimensions of cognitive task complexity belong to different attentional resource pools, increases in task complexity along the so-called resource-directing variables do not degrade linguistic output, but may lead to higher structural complexity and greater accuracy of learner output (see the introduction in this special issue). Increasing task complexity along the resource-dispersing dimensions, however, does not facilitate development and acquisition of new L2 form-concept mappings, but simply has the effect of depleting the attention available for the task over many specific linguistic aspects of production. Integrating information-processing theories (Schmidt 2001), interactionist explanations of L2 task effects (Long 1996) and psychological models such as Wickens' model of dual task performance (Wickens 1989, 1992), Robinson proposes that increases in the cognitive demands of tasks may direct the learners' attentional resources to language form, and input may be processed more deeply and elaborately (Gilabert 2007).

At first glance the Limited Attentional Capacity Model and the Triadic Componential Framework seem contradictory with regard to the role they assign to attention. A closer look at the two models reveals, however, that these different predictions mainly concern the so-called resource-directing variables. With respect to the resource-dispersing variables, both Robinson and Skehan and Foster agree that attentional resources are limited.

2.2. *Dimensions and variables of task complexity*

Both the Limited Attentional Capacity Model and the Triadic Componential Framework distinguish a number of dimensions and variables by which task complexity is determined, as shown in Table 1.

Table 1. *Similarities and differences between the Limited Attentional Capacity Model and the Triadic Componential Framework*

Limited Attentional Capacity Model	Triadic Componential Framework
1. Code complexity ○ Vocabulary load and variety ○ Redundancy and density	1. Task complexity *Resource-directing* ○ +/− Few elements ○ +/− Here-and-Now ○ +/− No reasoning demands *Resource dispersing* ○ +/− Planning ○ +/− Single task ○ +/− Prior Knowledge
2. Cognitive complexity *Cognitive familiarity* ○ Familiarity of topic and its predictability ○ Familiarity of discourse genre ○ Familiarity of task *Cognitive processing* ○ Information organisation ○ Amount of computation ○ Clarity and sufficiency of information given ○ Information type	2. Task conditions *Participation variables, e.g.,* ○ Open/closed ○ One-way/two-way ○ Convergent/divergent *Participant variables, e.g.,* ○ Same/different gender ○ Familiar/unfamiliar ○ Power/solidarity
3. Communicative stress ○ Time limits and time pressure ○ Speed of presentation ○ Number of participants ○ Length of texts used ○ Type of response ○ Opportunities to control interaction	3. Task difficulty *Affective variables, e.g.,* ○ Motivation ○ Anxiety ○ Confidence *Ability variables, e.g.,* ○ Working memory ○ Intelligence ○ Aptitude

In the Limited Attentional Capacity Model three dimensions of task complexity are distinguished (Skehan 1998, 2001, 2003; Skehan and Foster 1999, 2001): code complexity, cognitive complexity and communicative stress. Code complexity is concerned with the linguistic demands of the task. Cognitive complexity refers to task content and the structuring of task material. The third area, communicative stress, concerns performance conditions. For Skehan and Foster these three dimensions may influence the ways in which learners' attention during a task is likely to be shared and linguistic performance is affected. It is not clear, however, which of these dimensions has major weight in determin-

ing task complexity or how they interact with each other. As a consequence, the Limited Attentional Capacity Model does not make any specific suggestions as to how these dimensions should be operationalised.

Robinson's Triadic Componential Framework (2001a, 2001b, 2003, 2005) also distinguishes three dimensions which interact to influence task performance and learning: task complexity, task conditions and task difficulty. Task complexity, corresponding to Skehan and Foster's cognitive complexity dimension, refers to two types of cognitive task features, resource-directing and resource-dispersing variables, which can be manipulated to increase or lessen the cognitive demands made by a task. Task conditions, comparable to Skehan and Foster's category 'communicative stress', include participation variables such as the nature of the task (open/closed, one-way/two-way, convergent/divergent) and participant variables (same/different gender, extent of familiarity, power and status). Task difficulty, a dimension which is lacking in the Limited Attentional Capacity Model, comprises learners' perceptions of the demands made by the task and is determined by the abilities (intelligence, working memory, language aptitude) and affective responses (anxiety, motivation, confidence) that learners bring to the task.

Of these two models Robinson's Framework constitutes the most elaborate attempt at developing a model of task complexity. However, the Triadic Componential Framework also raises a number of questions. Intuitively it may be assumed that the variables distinguished by Robinson do play a role in determining task complexity, but it is far from clear how these variables have to be operationalised, which of them are predominant, how they interact and how fine-grained they should be. In the earlier versions of the Triadic Componential Framework (Robinson 2001a, 2001b, 2003, 2005) contained in Table 1, Robinson mentions three resource-directing variables, +/− few elements, +/− here-and-now and +/− no reasoning demands. In a more recent study (Robinson 2007), he adds +/− perspective taking and replaces +/− no reasoning demands by a distinction between three kinds of reasoning: +/− spatial reasoning, +/− causal reasoning and +/− intentional reasoning. The same is true for the resource-dispersing variables, which contain three new variables in the extended version of the framework: +/− task structure, +/− few steps and +/− independency of steps. With other additions and substitutions the 2007 version of the Triadic Componential Framework comprises 36 variables instead of the 18 variables in the earlier version of the model.

One may wonder how all these variables can be operationalised and differentiated and how for instance the supposedly different kinds of reasoning should be tested in an experimental setting. This also applies to the distinction between the three reasoning variables on the one hand and the variable +/− few elements on the other hand. Since an increase in the number of elements seems to imply almost automatically an increase in the number of reasoning

demands required by the task, it is nearly impossible to make a clear-cut distinction between them. Moreover, it is not clear which criteria should form the basis for deciding the number of elements tasks should differ on so as to determine substantial differences in cognitive task complexity.

In the final section of this paper the problem of the operationalisation of task complexity is discussed more in detail (6.2). In the following section we will focus on the use of general versus specific measures of linguistic performance to establish the influence of task complexity on linguistic output.

3. Measures of linguistic performance

Several measures have been proposed in SLA research in order to assess linguistic performance. As far as writing proficiency is concerned the study of Wolfe-Quintero, Inagaki and Kim (1998) contains useful information as it includes an evaluation of measures with respect to fluency, syntactic complexity, lexical variation and accuracy. By using a set of well defined criteria for evaluating the large amount of different measures encountered in the literature, they present an overview of the best measures for assessing linguistic proficiency in writing. What these measures have in common is that they provide information in global, general terms, like the total number of words and the number of clauses or errors per T-unit, without further specifying the nature of the words, clauses or errors involved (for the notion of T-unit see Hunt 1970). However, it may well be the case that in some circumstances measures of a more specific character are to be preferred. In what follows, we will summarise the – more general – measures of accuracy, syntactic complexity and lexical variation that came out best in the analysis of Wolfe-Quintero, Inagaki and Kim (1998), complemented with measures that may be characterised as being more specific.[1]

3.1. *Accuracy*

In Wolfe-Quintero, Inagaki and Kim (1998) three measures come out as best measures of accuracy: the number of error-free T-units, error-free T-units per T-unit and the number of errors per T-unit. Although the first two measures may be useful for more advanced learners, it is not always easy to find any error-free units in the performance of beginners and (low) intermediate learners. The number of errors per T-unit may tell us something about the overall accuracy of the language users, but the measure does not inform us about the nature of the errors: how serious are they and do they concern morphosyntax, vocabulary use, spelling or style? Therefore it is useful to make a further distinction with respect to the degree of seriousness of the errors and to the type of errors writers make, such as morphosyntactic errors, spelling mistakes, lexical problems, and so on.

3.2. *Syntactic complexity*

Many morphosyntactic measures have been suggested in order to assess the grammatical complexity of a text. In general, the validity of frequency measures of grammatical complexity is doubtful because of the lack of a fixed delimiter as found in ratio measures. Clauses appear to be an important component of language development. Three measures have proven to increase linearly with respect to proficiency level: the number of clauses per T-unit, the number of dependent clauses per T-unit and the number of dependent clauses per total number of clauses. Wolfe-Quintero, Inagaki and Kim (1998) suggest that passives, articles, relative clauses and complex nominals may also be indicative of a particular developmental level. Examples of other more specific morphosyntactic structures that may complement the general measures of morphosyntactic complexity are the use of temporal reference (present versus past), deictic expressions (*this*, *that*, *here*, *there*) connected to the here-and-now dimension, logical subordinators (*so*, *because*, *therefore*) with respect to the reasoning demands involved, and the ability to describe many different elements (singular versus plural, use of adjectives).

3.3. *Lexical variation*

With respect to lexical measures, severe criticisms have been put forward against the use of undifferentiated ratio measures. This is especially the case for the traditional type-token ratio that has been criticized because it is sensitive to text length. There are, however, type-token ratios that take text length into account, like the index of Guiraud (word types divided by the square root of the number of words) or its variant: the number of word types divided by the square root of two times the total number of words (Carroll 1967). The D-value, which models the rate at which new words are introduced in increasingly longer text samples, also seems to be a promising measure for assessing lexical variation (Malvern, Richards, Chipere and Durán 2004). Another, somewhat more specific measure that may be considered as an indicator of language development is sophisticated word type ratio, which calculates the ratio of sophisticated word types (words not belonging to the 2000 most frequent words) to the overall number of word types. With the aim to meet the objections of the undifferentiated lexical ratio measures, Laufer and Nation (1995) propose a lexical frequency profile, which accounts for the frequency of the words used in a text (words not belonging to the 1000, 2000, 3000, etc. most frequent words).

4. The study

The study presented here concerns the effect of task complexity on linguistic performance. The focus in this paper is on an analysis in which some specific

measures were employed in order to gain more insight into the type of the detected errors and the frequency band of the words used by the learners.

4.1. *Research questions*

In our study both Skehan's Limited Attentional Capacity Model and Robinson's Cognition Hypothesis were tested and compared. The general aim of the study was to investigate the effects of cognitive task complexity on written performance in L2 with respect to accuracy, syntactic complexity and lexical variation at different levels of language proficiency. The Limited Capacity Model predicts a better performance on less complex tasks, as tasks which are cognitively demanding are likely to draw attentional resources away from language forms. Robinson, on the other hand, expects learners to do better on complex tasks as learners are able to share their attention between content and form, resulting in greater syntactic complexity, more lexical variation and higher accuracy in a complex task.

In a previous study with the same learners, some global measures of language proficiency were used (see Kuiken, Mos and Vedder 2005; Kuiken and Vedder 2007, in press). The results showed a significant effect of task complexity on accuracy: both students of Italian and French made fewer errors in the complex task, whereas for the students of French a trend to use more lexically varied language could be observed. We also found both for Italian and French a significant effect of proficiency level on accuracy and lexical variation, and also on syntactic complexity for Italian only. However, a significant interaction of task and proficiency level on any of the measures scored could be established neither for Italian nor for French. This means that both in Italian and in French, the effects of cognitive complexity were not related to language proficiency.

Elaborating on these results, in particular with regard to the effect of task complexity on accuracy and lexical variation, the following research questions are addressed in this paper:

– Does task complexity influence accuracy, in terms of types of errors?
– Does task complexity influence lexical variation, in terms of word frequency?
– Does the influence of task complexity on accuracy and lexical variation differ according to the level of L2 proficiency?

The analysis presented here is explorative in the sense that neither Skehan and Foster nor Robinson make any specific predictions with respect to the types of errors made by the L2 learners nor regarding the frequency of the words they use.

4.2. *Method*

4.2.1. *Participants.* The study involved the participation of 84 Dutch learners of Italian and 75 Dutch learners of French, all with Dutch as their mother

tongue.[2] All learners were students of Italian and French at a Dutch university in their first, second or third year, so they differed in their L2 proficiency. Besides that, students of Italian L2 start university courses as complete beginners whereas students of French L2 have studied French at high school for a couple of years. This was a second reason why differences in performance between the two groups of students were expected (Kuiken and Vedder 2004a, 2004b).

4.2.2. *Tasks.* Two writing tasks were assigned to the learners in which cognitive complexity was manipulated. In both experimental conditions participants were presented with a prompt in L1 (Dutch) explaining that they had to write a letter to a friend regarding the choice of a holiday destination out of five options. In the letter a varying number of requirements had to be taken into account, six in the complex and three in the non-complex condition. In the complex condition a choice of a Bed and Breakfast in either Italy (for the students of Italian) or France (for the studentes of French) had to be made (see Appendix), while in the non-complex condition the writers had to choose a holiday resort in a country outside of Europe. The letter had to consist of a minimum of 150 words. There was a time limit of 40 minutes per task and use of a dictionary was allowed; corresponding to the setting students were accustomed to in performing similar tasks. A cloze test, consisting in a shortened version of an article from *Panorama* for the students of Italian and from *l'Express* for the students of French, was constructed in order to obtain a separate measure of language proficiency. In these cloze tests each eleventh word was deleted, leaving 33 gaps.

4.2.3. *Coding.* Students' letters were coded in terms of accuracy, syntactic complexity and lexical variation. In our previous studies (Kuiken, Mos and Vedder 2005; Kuiken and Vedder 2007, in press) accuracy was scored as the total number of errors per T-unit. Other accuracy measures mentioned above (number of error-free T-units and error-free T-units per T-unit) could not be used, as the texts contained hardly any error-free T-units. Instead, a distinction was made between three degrees of errors according to their seriousness. Syntactic complexity was operationalised as the number of clauses per T-unit and the number of dependent clauses per clause. Lexical variation was established by means of a type-token ratio which corrects for text length: the number of word types per square root of two times the total number of word tokens (Carroll 1967).

As we had found an effect of task complexity on accuracy and a trend with respect to lexical variation, in the analysis reported here more specific measures of accuracy and lexical variation were used in order to find out which kind of errors and which type of words could be held responsible for the established effect. For accuracy the total number of errors per T-unit was calculated with

respect to Grammar, Lexicon, Orthography and Appropriateness. The latter category contains errors on a pragmatic level, with respect to language use, like in French the use of the word *bouffer* (to gorge) in stead of *manger* (to eat) or the use of colloquial forms (*t'as pas* in stead of *tu n'as pas*) which are not accepted in written language (see Examples (1) and (2)). Errors which could not be attributed to one of these categories were scored as Other. Below are listed some examples for each type of error, with the correct form between brackets.

Appropriateness

(1) Je dois dire que *c'est* pas facile.
(ce n'est pas facile)

(2) On a besoin de bouger un peu car on va bien *bouffer* là-bas.
(manger)

Grammar

(3) J'arrive à la conclusion que l'option 3 est *le meilleur*.
(la meilleure)

(4) Il y a *plein des appartements* en France et sinon *tu viens* ici à Amsterdam.
(plein d'appartements; tu viendras)

Lexicon

(5) J'ai *trop* envie de me baigner dans la mer.
(j'ai très envie)

(6) Là il n'y a pas d'activités *aussi*.
(non plus)

Orthography

(7) Dans l'hôtel il y a un petit déjeuner *americain*.
(américain)

(8) C'est dommage *que il* n'y ait pas une piscine.
(qu'il)

Other

(9) C'est très pratique car *si on va sortir les soirées*, on aime bien faire la grasse matinée.
(si on veut aller aux soirées/si on veut participer aux soirées)

(10) Il y a des possibilités de se distraire, *il y a un jardin, mais aussi pour sortir, au centre de Paris.*
(Il y a des possibilités de se distraire et de sortir, car l'hôtel est situé au centre de Paris; en plus il y a un jardin.)

Errors for Italian and French were scored by two native speakers of Italian and two native speakers of French respectively. Inter-rater reliability, calculated out of a randomly selected sample of 5 % of the data, reached 89.7 % for the raters of Italian and 91.9 % for the raters of French.

With respect to lexical variation we conducted a lexical frequency profile analysis (Laufer and Nation 1995), resulting in a distinction between the words belonging to the 2000 most frequent words used and those with a lower frequency. For Italian the computerized program 'Guida all'uso delle parole' (De Mauro 1999) was used, for French 'The compleat lexical tutor' (Cobb 1998).

4.2.4. *Design.* The study was set up as a repeated measures design, in which all participants performed a complex and a non-complex task. The sampling of the data was done based on a curricular level: for Italian students in their first, second and third year of study were included in the study, while for French students in their first and third year participated, as the language program for French does not comprise second year writing classes. For various reasons (differences in proficiency level at the start of the university career, prolonged stay in the target community, etc.) within-group variance turned out to be very large. Therefore students were not grouped in terms of year of study, but according to their proficiency level as established by their cloze scores (maximum score 33). The Italian and French students were divided into low and high proficiency groups. For Italian the low proficiency group consisted of learners with a score of 18 or less ($n = 41$, mean 12.95, *SD* 3.49) and the high proficiency group of students with scores higher than 18 ($n = 43$, mean 23.81, *SD* 3.19). The French cloze test turned out to be more difficult than the one for Italian. For that reason the cutoff point for the students of French was set at 14: the low proficiency group consisted of learners with a score of 14 or less ($n = 39$, mean 10.18, *SD* 3.15) whereas the high proficiency group had obtained scores higher than 14 ($n = 36$, mean 18.39, *SD* 2.26).

5. Results

Tables 2 and 3 display the descriptive statistics (means and standard deviations) for the students of respectively Italian L2 and French L2 with regard to error type (Appropriateness, Grammar, Lexicon, Orthography, Other) and the most frequent words used (words belonging to the 2000 most frequent words used). What becomes immediately clear from these tables is that the major-

ity of errors made by both groups of students concern Grammar and Lexicon. With respect to Appropriateness students of French L2 seem to make more errors than students of Italian L2. There is also a lot of variation between the students on the whole as standard deviations tend to be high. For both groups of students around 90 % of the words they have written belong to the 2000 most frequently used words in respectively Italian and French. With respect to lexical frequency the students do not seem to demonstrate a lot of variation as standard deviations are relatively low.

By means of analyses of variance significant effects of proficiency level, task complexity and an interaction of level by task complexity were detected. The results of an ANOVA for the students of Italian L2 are displayed in Table 4. The results indicate a significant effect of proficiency level with respect to Grammar, Orthography and Other errors. As shown in Table 2, the high proficient learners outperform the low proficient learners, as the latter are making many more errors. With regard to task complexity a significant effect for Lexical errors was established, with students performing better in the complex than in the non-complex condition. There is also a task effect with regard to lexical frequency, with students using more frequent words in the complex than in the non-complex task. No significant interaction between proficiency level and task complexity could be detected. The interaction effect for Other errors was, however, almost significant ($p = .051$). For this reason an additional planned comparison analysis was carried out in order to find out whether the task effect for high proficient learners differed from that of the low proficient learners. It turned out that the task effect was not significant for high proficient learners ($F(1,42) = 0.18$, $p = .675$), and almost significant for the low proficient learners (($F(1,40) = 3.82$, $p = .058$), indicating that low proficient students of Italian make more Other errors in the complex task. However, we do not think that too much attention should be paid to this finding, as the overall use of this type of error is rather low and because we are dealing here with errors of a rather heterogeneous character.

For the students of French L2 the results of an ANOVA are presented in Table 5. Like the students of Italian the students of French demonstrate a significant effect of proficiency level for Grammar and Other errors, but – unlike the students of Italian – not for Orthographic but for Lexical errors. From Table 3 we can infer that in all cases the high proficient learners are making fewer mistakes than the low proficient students. Similar to the students of Italian there was an effect of task complexity with regard to Lexical errors: students of French make less errors in the complex condition. Unlike for Italian, for French there was a significant effect of task complexity with respect to Appropriateness, Orthography and Other errors. In the complex condition students of French produce more Appropriateness and Other errors, but fewer Orthography errors than in the non-complex task. There was a significant task effect for

Table 2. *Means and standard deviations for students of Italian L2 with respect to error type and most frequent words used*

Prof. level	Task compl.	N	Error type										Lexical freq.	
			Appropriateness		Grammar		Lexicon		Orthography		Other		Freq $<$ 2000	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
High	+Com	43	2.88	2.01	10.37	6.28	13.37	6.83	3.02	2.69	0.30	0.60	91.71	2.86
Low	+Com	41	2.90	2.69	18.49	9.86	13.22	8.33	6.73	5.45	1.27	1.63	92.20	3.29
High	−Com	43	2.05	2.15	10.19	5.72	17.70	10.22	2.16	1.99	0.35	0.78	90.61	3.43
Low	−Com	41	3.02	1.89	15.73	7.14	16.85	5.46	5.95	4.59	0.80	0.93	90.36	3.38

Table 3. *Means and standard deviations for students of French L2 with respect to error type and most frequent words used*

Prof. level	Task compl.	N	Error type										Lexical freq.	
			Appropriateness		Grammar		Lexicon		Orthography		Other		Freq $<$ 2000	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
High	+Com	36	4.89	2.82	9.17	4.34	8.33	4.59	5.50	3.81	0.56	1.05	88.65	3.13
Low	+Com	39	6.08	4.42	13.28	5.83	12.46	5.54	6.15	4.54	0.95	1.56	89.36	2.26
High	−Com	36	3.31	2.90	10.06	5.22	11.69	4.98	5.67	4.08	0.19	0.47	90.00	2.57
Low	−Com	39	4.72	4.05	14.13	8.17	16.41	8.91	8.10	5.60	0.62	1.16	89.88	2.67

lexical frequency, but contrary to the students of Italian the students of French used more infrequent words in the complex task than in the non-complex task. Again no significant interaction between proficiency level and task complexity could be detected, although a trend effect for Orthography errors was established ($p = .097$). An additional planned comparison analysis revealed that the task effect was not significant for high proficient learners ($F(1,35) = .09$, $p = .771$), but it was for low proficient learners ($F(1,38) = 4.98$, $p = .032$), meaning that low proficient learners of French make more Orthography errors in the complex task.

6. Discussion

6.1. *Summary of the results*

In our research two models with claims about the relationship between task complexity and linguistic performance were compared: Skehan and Foster's Limited Attentional Capacity Model (Skehan and Foster 2001) and Robinson's Cognition Hypothesis (Robinson 2001). The former predicted a better performance on the less complex task, the latter on the complex task. In a previous study, by means of general measures, the effect of cognitive task complexity on written performance with respect to accuracy, syntactic complexity and lexical variation was investigated at different levels of language proficiency. In this first analysis an effect of task complexity for accuracy was demonstrated, but not for syntactic complexity, whereas a trend could be noticed with respect to lexical variation. No interaction of task type and proficiency level could be observed (Kuiken and Vedder 2007, in press).

Elaborating on these findings, in the present study the effect of task complexity on writing proficiency for accuracy and lexical variation was investigated by using more specific measures regarding the type of errors made by the students and the frequency band of the words they used in their texts. The results of the ANOVA's by means of which a significant effect of task complexity, proficiency level, and their interaction could be established are summarised in Table 6.

With respect to our first research question 'does task complexity influence accuracy, in terms of types of errors?' a main effect of task complexity on Lexical errors was detected: both students of Italian and French produced fewer Lexical errors in the complex task. This means that the overall increase of accuracy in the complex condition is mainly due to a decrease of Lexical errors. The students of French, however, made significantly more Appropriateness and Other errors, but also fewer Orthography errors in the complex task than in the non-complex one, whereas for Italian no differences were found. This different finding for Italian and French is difficult to explain. Although on the whole the students of French were more proficient than the students of Italian so that

Table 4. *Effects of proficiency level, task complexity and their interaction for students of Italian L2 (ANOVA)*

Measure Type	Measure	Level			Task			Level*Task		
		F	*df*	*p*	*F*	*df*	*P*	*F*	*df*	*p*
Errors	Appropriateness	1.91	1,82	.171	1.34	1,82	.250	2.27	1,82	.136
	Grammar	26.06	1,82	<.001[c]	2.55	1,82	.114	2.03	1,82	.158
	Lexicon	0.12	1,82	.724	15.62	1,82	<.001[c]	0.11	1,82	.733
	Orthography	25.61	1,82	.001[c]	3.81	1,82	.054	0.00	1,82	.924
	Other	14.00	1,82	<.001[c]	2.47	1,82	.212	3.92	1,82	.051
Lex. freq.	Words < 2000	0.04	1,82	.841	12.44	1,82	<.001[c]	0.79	1,82	.374

[a] $p < .05$, [b] $p < .01$, [c] $p < .001$

Table 5. *Effects of proficiency level, task complexity and their interaction for students of French L2 (ANOVA)*

Measure Type	Measure	Level			Task			Level*Task		
		F	*df*	*p*	*F*	*df*	*P*	*F*	*df*	*p*
Errors	Appropriateness	3.67	1,73	.059	8.71	1,73	.004[b]	0.05	1,73	.822
	Grammar	10.33	1,73	.002[b]	2.04	1,73	.157	0.00	1,73	.972
	Lexicon	13.68	1,73	<.001[c]	19.57	1,73	<.001[c]	0.13	1,73	.724
	Orthography	2.84	1,73	.096	4.26	1,73	.043[a]	2.82	1,73	.097
	Other	4.07	1,73	.047[a]	4.19	1,73	.044[a]	0.01	1,73	.935
Lex. freq.	Words < 2000	0.36	1,73	.550	6.32	1,73	.014[a]	1.28	1,73	.261

[a] $p < .05$, [b] $p < .01$, [c] $p < .001$

fewer Appropriateness errors could be expected, it is not clear why more Appropriateness errors were made in the complex task.

Our second question concerned the effect of complexity on lexical variation, in terms of word frequency. Here the students of Italian and French showed a different behaviour. The students of Italian used significantly more high frequent words in the complex task (and hence more infrequent words in the non-complex task), whereas for the students of French we counted more infrequent words in the complex task. Although Skehan and Robinson do not make specific predictions regarding the frequency of the words used by the students, the finding for French seems to be in line with Robinson's Cognition Hypothesis, and the one for Italian with the Limited Attentional Capacity Model. Again it is difficult to explain how these different findings have to be related to the assumed higher general proficiency level of the students of French.

Moreover, the results demonstrate that it was not possible to establish any interaction effect of task complexity and proficiency level. This means that our third research question 'does the influence of task complexity on accuracy and lexical variation differ according to the level of L2 proficiency?' must be answered negatively.

All in all these results show that where in an earlier analysis by means of global measures an effect of task complexity on accuracy and a trend for lexical variation could be demonstrated, an analysis in which more specific measures are used indicates which kind of errors are responsible for the decrease of errors in the complex task and how task complexity influences lexical variation in terms of word frequency. This means that the use of more specific measures has provided extra information and we therefore conclude that the use of more global and more specific measures may complement each other.

6.2. *Task complexity and attentional resources*

Our study raises a number of questions regarding the operationalisation of task complexity. Although research findings have shown that there are multiple task effects on L2 learning and performance, the lack of a single taxonomic system of empirically researched and pedagogically implemented task characteristics in SLA is problematic, as argued by Robinson (2007). A generally accepted model of task characteristics should be able to explain how different characteristics relate to each other categorically and what effects they might have in combination during task performance. What is needed is a classificatory system of how performing tasks may promote L2 learning. According to Robinson (2007: 13), such a framework of task complexity should (i) be motivated by a theory, (ii) be empirically researchable, identifying task characteristics and dimensions that predict differential effects on L2 performance, and (iii) be operationally feasible. On the basis of the problems that were discussed in

Table 6. *Summary of significant effects for task complexity, proficiency level and their interaction*

	Variable	Italian			French		
		Level	Task	Task*Level	Level	Task	Task*Level
Error type	Appropriateness					+com > −com $p = .004$	
	Grammar	high < low $p < .001$			high < low $p = .002$		
	Lexicon		+com < −com $p < .001$		high < low $p < .001$	+com < −com $p < .001$	
	Orthography	high < low $p = .001$				+com < −com $p = .043$	.097
	Other	high < low $p < .001$		.051	high<low $p = .047$	+com > −com $p = .044$	
Lexical freq.	Freq < 2000		+com > −com $p < .001$			+com < −com $p = .014$	

Section 2.2, one may wonder, however, whether the variables distinguished in the Triadic Componential Framework, and particularly the 2007 version, meet Robinson's second and third constraint of being empirically researchable and operationally feasible.

The comparison of the dimensions and variables of the Limited Attentional Capacity Model and the Triadic Componential Framework (2.2) leads to the formulation of the following questions:

1. The inclusion/exclusion problem: which variables should be included or excluded in a model of task complexity? How detailed or fine-grained should the variables be?
2. The differentiation problem: how should the variables be differentiated and tested?
3. The hierarchy problem: which weight should be attributed to each variable? Which variables are predominant?
4. The interaction problem: how do the three dimensions distinguished in both the Limited Attentional Capacity Model and the Triadic Componential Framework (cognitive factors, task conditions and learner factors) interact with each other?
5. The prediction problem: which predictions regarding linguistic performance and L2 learning can be derived from the model?
6. The attention problem: how do task variables affect allocation of attentional resources? Are insights regarding the role of attentional capacity during task performance to be drawn from a single-resource or a multiple-resources view of attention?

We will add some final remarks on the role of attention, as the issue of how learners' attentional resources are allocated during task completion is central in any model of task complexity. This also applies to the question of how task designers can make sure that learners focus their attention on linguistic form while attempting to express their intended meaning. If attention is indeed a necessary condition for learning, as hypothesized by Schmidt (2001), the question whether learners' working memory allows them to pay attention to different aspects of task performance becomes crucial. As has been pointed out in 2.2, Skehan and Foster argue, on the basis of a single-source view of attention, that learners have only limited attentional capacity during on-line processing, which significantly affects their attempt to map form-meaning relationships. Robinson, on the contrary, hypothesises that form and meaning need not necessarily be in competition for attention, since learners may be drawing on distinct pools of attentional resources relative to different aspects of task demands.

The results of our study point into the direction of Robinson's multi-resources view of attention. Several questions with regard to Robinson's hypothesis concerning the allocation of attention during task performance, however, remain to be resolved. If there is indeed an increase of attention when tasks are

made more complex by manipulating one of the resource-directing variables, then the question is where this increase in 'directed attention' comes from. Is it a part of attentional capacity which is not used in the less complex condition (e.g., L2 learners do not fully concentrate when task demands are lower)? Does it mean that the extra attention paid to accuracy in the more complex task condition is taken away from higher-order processes? And is attention mainly devoted either to lower-order or to higher-order linguistic skills, such as the pragma-rhetorical organization of the content of the text?

A study of Kumaravadivelu (2006) on learner perception of tasks also seems to confirm the multi-resources view of attention. Kumaravadivelu found that the learners in his study, without any explicit prompt from their teacher, appeared to cross the borders easily between the formal, functional and interactional dimensions of the task. He therefore concludes that

> The formal, functional and interactional dimension of a task are so intertwined that the learners do not seem to make any substantial distinction between them. Language learners have within their processing system a capacity to switch between the three dimensions of the task depending on whatever processing demands are most pressing. To assume otherwise [...] is to oversimplify the complexities of task performance and task processing (Kumaravadivelu 2006: 137).

This same view is expressed by Van den Branden and Verhelst (2006), who argue that

> ... reducing the relevant aspects of task performance to only two (meaning and form) is probably too simplistic, since in real-life tasks language learners will often have to simultaneously cope with a multitude of aspects of task performance, all potentially worthy of attention, e.g. phonological aspects, morphosyntactic aspects, lexical and pragmatic aspects, socio-linguistic aspects ... (Van den Branden and Verhelst 2006: 2–3).

In sum, an implication for further research into the relationship between task complexity and linguistic performance that emerges from these studies is that a refined model of task complexity that explains also the role of attentional resources needs to be developed. Developing a model of task complexity which is not merely descriptive but theory-driven and which is neither too limitative nor so broad as to be unmanageable, is certainly not an easy task. Perhaps a comment of Ortega (2005), in a study on the role of attention with respect to accuracy, complexity and planning time, may give some indications for the direction into which this research should be developed. Ortega concludes that the form-meaning dichotomy, drawing on a limited view of attention, may be in need of a new one, in which there is a 'debilitating' kind of attention to meaning, the one discussed by Skehan and Foster (2001), and a 'facilitative' kind of attention, the one supported by emergentist functional theories of language learning (Ellis 2002; MacWhinney 2001) and by the focus-on-form position

(DeKeyser, Salaberry, Robinson and Harrington 2002; Doughty 2001; Long and Robinson 1998; Robinson 2001a, 2003). Referring to VanPatten's Input Processing Instruction, Ortega argues that

> … in the end we may all be talking about the same form-in-meaning qualities of optimal language processing and language learning at some basic level, and an open discussion of our 'form' and 'meaning' metaphors may be a fruitful step towards coordinating and strengthening research programs for planning and task-based language learning … (Ortega 2005: 107).

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Appendix
Example of a complex writing task: Bed and Breakfast in Italy

(Translation into English from the original prompt in Dutch)

Bed and Breakfast in Italy

You are planning to go on holiday with an Italian friend, and want to spend two weeks together in May or June. You have decided to go to a Bed and Breakfast. Your friend has already surfed the internet and made a first selection. He/She picked five addresses, in Umbria, Rome, Rimini, Campania and the Veneto region, and is now asking for your advice. The guesthouse or apartment you choose, however, has to satisfy a number of conditions. These criteria are:
– Presence of a garden
– A quiet location
– Located in (the vicinity of) the center
– The possibility of doing physical exercise
– Swimming facilities
– Includes breakfast
None of the five addresses your friend sent you meets all of the criteria. A carefully considered choice has to be made, however. Read the five descriptions carefully, then write a letter of at least 150 words in which you explain which Bed and Breakfast you think is most suitable and fits the conditions best. Keep in mind that your text does not have to reflect your personal preferences. Write a letter in which you try to convince your friend that your choice is right and support it with arguments. You have 40 minutes to write the text. Use of a dictionary is permitted.

1. Casa Lory

Location: Umbria, province of Foligno. Situated 15 km from Foligno.
Description: Quiet location, in rural setting. Bedroom in classical style, large terrace with view, garden. Grand old house, completely restored in 1998. Swimming pool 2 km away.
Breakfast: Extensive breakfast included in the price: home-made pies, fresh eggs, a variety of local cheeses and assorted cold meats.

2. Europe B and B

Location: Lazio, Rome. Situated in the old centre of the city.
Description: In the dynamic heart of the Old City of Rome, 10 minutes distance from the Coliseum. Apartment, four rooms, two bathrooms, fitness-room, private garden, garage. Special discounts for theatre and concert tickets. Cable television, safe, air conditioning.
Breakfast: No breakfasts served.

3. Bed and Breakfast Hotel Migani Spiaggia

Location: Emilia Romagna, Rimini, at a considerable distance from the city centre, but situated directly next to the boulevard and sea front, with a lot of activity, even at night.
Description: Attractively priced, young and dynamic, open day and night, free parking, fitness, beach activities, bicycles available for guests, reduced entrance fees and shuttle bus to and from the clubs, special discounts for young guests and groups.
Breakfast: Comprehensive breakfast buffet, American style, between 8.30 and 11.00.

4. Dimora Carlo III di Borbone

Location: Campania, Vietri Sul Mare, province of Salerno, Amalfi coast.
Description: Situated on the boardwalk, in the old city centre, apartment in historical block (18th century). Ideally located for those seeking to spend a quiet holiday on the beach, or to go hiking in the mountains, but with shops, bars and restaurants conveniently located in close proximity.
Breakfast: Breakfast service: during high season, between mid July and mid August.

5. Baffelan B and B

Location: Veneto, Valli del Pasubio, province of Vicenza, 800 meters from the village, situated at the foot of the Monte Pasubio.

Description: For those looking for peace, and mountain aficionados. Fully restored farmhouse with garden in tranquil region which has not been discovered by mass-tourism yet. We have two rooms for our guests on the top floor, with a total of 4/5 beds. The bathroom is shared between both bedrooms. Mountain bikes available upon request, mountain walks, horse-back riding.
Breakfast: Guests can prepare their own breakfast; not included.

Notes

1. Wolfe-Quintero, Inagaki and Kim (1998) also contains information on fluency measures, but as we did not take into account fluency in our analysis, we will leave this aspect aside.
2. In earlier studies (Kuiken and Vedder 2007, in press) we reported on 91 students of Italian and 76 learners of French, whose data were collected at two different moments: for some in Autumn, for others in Spring, while still others participated in Autumn and Spring. In the analyses reported here we have left out the data of the students collected in Spring for those who had already performed the tasks in Autumn of the preceding year.

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