

# Fluency and Cognitive Effort During First- and Second-Language Notetaking and Writing by Undergraduate Students

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**Abstract.** This study concerns the cognitive effort expended and the difficulties experienced by undergraduate students as they took notes and wrote a text based on a lecture given in French, their primary language (L1), and in English (L2). The 21 participants had studied English (L2) for 7 years before attending the university and they had taken 3 years of intensive courses at the university in order to obtain their first diploma in English ("license"). Participants were first trained on a secondary task that allowed us to measure their cognitive effort while they performed two other main tasks in both languages, namely (1) listening and taking notes on the main ideas of the lecture, and (2) writing a text based on their notes. Participants also answered a questionnaire about their difficulties with comprehension, taking notes, making use of their notes, and writing in both languages. The results indicated that writing processes were more effortful than notetaking. Students' performance on the writing task did not vary across languages. In contrast, the cognitive effort associated with taking notes was greater for L2 than for L1, and writing speed was slower. More difficulty was also experienced for notetaking, especially in L2, than in writing.

**Keywords:** second language, notetaking, writing, cognitive effort

## Introduction

More and more, students are pursuing university degrees that are accepted throughout the European Community, whether they are degrees in specific disciplines (economics, law, etc.) or doctoral degrees obtained through co-organized programs that require defending one's thesis in two languages. Having such a degree makes students more competent in job searches, in addition to providing effective preparation for international careers. It is, thus, highly worthwhile for students to enroll in programs that cut across EC country borders (e.g., Erasmus, a popular student exchange program supporting European academic mobility).

This situation requires students to undergo dual training: On the one hand, they must gain knowledge and know-how in the disciplinary fields required for their degree program, and, on the other, they must learn a second language (L2) in an attempt to achieve true oral and written bilingualism. To provide pedagogical support to students enrolled in such complex educational programs, it is imperative to know more about the strategies students use to be able to study as effectively in L2 as in their primary language (L1).

In this study, the aim was to track the ways in which students try to process information disseminated during a lecture, the dominant knowledge-transmission mode at the

university level. The idea was to study how students go about understanding a lecture and selecting important ideas in L2, as compared to L1, while at the same time taking notes to facilitate memory retention and later use when studying for exams or writing papers.

The great majority of studies on writing skills in L2 have demonstrated that writers have trouble finding and formulating as many ideas as in L1 within a comparable time period (Ransdell & Barbier, 2002). The question is if students have the same difficulty when it comes to making use of their own notes in L2. To measure this difficulty, the difference in cognitive effort between notetaking in L1 and in L2 was assessed. The difficulty in L2 is presumably the result of two factors: (1) students can face listening comprehension problems while they are taking notes in L2, and (2) they have developed fewer automatized notetaking procedures and techniques in their second language. Moreover, studies on text production in L1 have demonstrated that writing always requires more cognitive resources than taking notes (Piolat, Olive, & Kellogg, 2005; Piolat, Roussey, & Barbier, 2003). Thus, another question addressed in this study was to verify whether this difference remains valid in L2, or whether linguistic difficulties in L2 require so much cognitive effort, even at the notetaking stage, that this activity is just as effortful as writing.

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 de facile.  
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 service des relat° internationaux de pyp  
 - remplir fiche candidat  
 - cours intensif focus  
 - exemple  
 français → accueil + aide  
 - fiche pédagogique  
 - renseignements  
 #

par so  
 - arts, lettres, langues, oc. hum  
 → inscript° individuelle annuelle  
 → pas d'aide = + dur  
 - informat°  
 - comprendre ce qu'il voulait faire  
 - procédure qui varie selon les univ  
 o' chat  
 1<sup>er</sup> cycle → <sup>Avant</sup> BAC  
 - imprimé de dem.  
 2 nov - 15 jan  
 auprès de l'ambassade de  
 - envoyer le dossier et  
 les univ. choisies  
 → traduct° du titre  
~~par~~ BAC  
 - convocat° pour  
 épreuve linguistique  
 de.  
 - Confirmer inscript° avant 31.  
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en UE → pas besoin de imprimé de dem.

Figure 1. Example of notetaking in French (L1) illustrating the use of lexical abbreviations: *Relat°* for *relations*, symbols ( $\rightarrow$ ;  $\approx$ ), a series of dashes (–) for making a list, and columns.

Finally, it seemed important to examine students' perceptions of their difficulties. To this end, they were asked to report their experiences in understanding the material, taking notes, making use of their notes, and writing texts in the two languages.

### Taking Notes in the Primary Language

Notetaking is a useful skill for a number of everyday activities (Hartley, 2002) but it is not systematically taught in the academic environment, even though it is frequently used in school (Piolat, 2007; Piolat & Boch, 2004; Roussey & Piolat, 2003; Slotte & Lonka, 2001, 2003). Several studies have shown that notetaking ability depends on the notetaker's knowledge level in the subject matter as well as on

his/her cognitive capabilities and study habits (Armbruster, 2000; Kiewra, Benton, Kim, Risch, & Christensen, 1995; Lindberg-Risch & Kiewra, 1990). Taking notes involves the deliberate and simultaneous activation of processes involved in both comprehension and writing (Piolat, 2004). Notetakers must, therefore, juggle the demands of the different processes involved because they greatly exceed working-memory capacity (Baddeley, 2000).

The activity of notetaking is particularly demanding when it must be carried out during a lecture or speech. In such cases, notetakers must reconcile the difference in pace between the speed of the spoken word and their own writing speed. To do this, they develop strategies that involve transcribing a lesser amount of information than what is actually delivered by the speaker (Piolat, 2004; Piolat et al., 2003). This reduction operates on two levels: (1) concep-

tual, where ideas judged important are selected, and also (2) formal, by means of condensing techniques specific to notetaking.

Notetakers use a number of conventional or personal procedures and devices that are more or less fixed (i.e., abbreviations, icons, graphic symbols, page layout, etc.) and allow them to capture as much information as possible, even in a notetaking situation involving extreme time pressure (Barbier, Faraco, Piolat, & Branca, 2004; Piolat, 2006; see Figure 1). These condensing operations require mastery of several different abbreviation techniques, such as truncating long words (*imperfect* written as *imp.*), use of the first letter only (*Table* written as *T*), or syllable contractions (*year* written as *yr*, *development* written as *dvpmt*). They can also involve replacing lexical units with icons, such as symbols (drawing a heart to signify the expression *learn by heart*) or ideograms (*one* written as *1*), or even resorting to a change of language (the French word “*travail*,” meaning work, written as *W*) or a change of alphabet (*micro* written as  $\mu$ , the Greek symbol for micro used in science and mathematics). Besides using abbreviations and icons, notetakers transcribe structural concepts of the lecture material with pictograms (*followed by* written as an arrow  $\Rightarrow$ ) or by using spatial layouts such as bulleted lists indicated with dashes. A telegraphic style, and certain graphic procedures (e.g., circling a word) used to underline the importance of some ideas, are other ways of structuring and ranking selected information (Barbier et al., 2004; Piolat, 2006; Piolat & Boch, 2004).

## Taking Notes in a Second Language

Taking notes consists of resolving an information-processing problem that not only requires considerable attention from the notetaker, but also involves mobilizing very specific linguistic and metalinguistic know-how associated with both comprehension and production. In such a complex situation, the level of language mastery is of major importance. Hence, students can be expected to experience more difficulty taking notes in a second language than in their native tongue. As shown in recent reviews, the processes involved in comprehending and writing texts are not optimal for students in L2 (Kring, 1994; Ransdell & Barbier, 2002; Roca de Larios, Murphy, & Marin, 2002; Whalen & Ménard, 1995). Ransdell, Arecco, and Levy (2001) suggest that problems related to linguistic activities in L2 may not be caused by difficulty activating the processes involved (e.g., planning, translating, and reviewing), but rather by insufficient automatization of low-level processes (e.g., spelling). Several studies on comprehension in L2 have shown that orthographic, lexical, and syntactic processes are less automatized and, thus, involve more cognitive effort in L2 than in L1 (Barbier, 1998, 2003, 2004). In notetaking, the lack of automatized surface processes (i.e., writing abbreviated words) may limit rapid recording of information.

However, difficulties in notetaking are also related to the necessity for continuous metacognitive control of one’s activity in order to check the accuracy of the concepts grasped (Barbier et al., 2004; Roussey & Piolat, 2005). Insufficient automatization of surface processing is resource-intensive and makes demands on working memory. This insufficiency in automatization may have a major impact on the control strategies developed for L2 notetaking. One study on notetaking in L2 (Faraco, Barbier, & Piolat, 2002) highlighted the processing difficulties of students who confined themselves to a listening style that focuses on the micro-structural level (i.e., the translation of ideas in sentences). A lack of linguistic automatisms also results in greater conceptual difficulties, particularly when it comes to selecting main points while keeping the concept hierarchy in mind (Chaudron, Loschky, & Cook, 1994; Clerehan, 1995).

Other studies have shown that when the written system of L1 is comparable to that of L2 (Barbier, Faraco, Piolat, Roussey, & Kida, 2003), writers are able to transfer knowledge and metaknowledge, know-how, and strategies from one language to the other (Barbier, 2003, 2004; Kobayashi & Rinnert, 1992; Zimmerman, 2000). However, students often do not know the surface abbreviations commonly shared by native speakers of a given language (e.g., in French, using certain abbreviations for words that end in “-ion” or “-ment,” or the technique of retaining consonants only). They also do not know the tools used for rapid transcription in a given language (standard icons, for example). In other words, students unaccustomed to taking notes in L2 do not have a large variety of abbreviation techniques at their disposal (Barbier, Roussey, Piolat, & Olive, 2006). For certain isolated terms, they may even shift to using L1 to take notes on L2 material, or they may invent new words (Badger, White, Sutherland, & Haggis, 2001; Clerehan, 1995; Faraco et al., 2002).

## Cognitive Effort

Cognitive effort is a measure of the fraction of attentional resources allocated to a process at a given moment (Kellogg, 1996; Olive, Kellogg, & Piolat, 2002; Levy & Ransdell, 2005; Olive, 2004). Fluency represents the ease with which a writer mobilizes the processes and knowledge needed to compose his/her written message. In a recent publication, Peverly et al. (in press) indicated that transcription fluency was the only predictor of the quality of the notes. To date, no studies have related these two indicators to each other to examine both notetaking and writing in L1 and L2.

Piolat et al. (2005) collected data from several studies that measured cognitive effort during the performance of different activities (copying a text, intentional learning, reading a text, playing chess, composing a text, etc.; see also Piolat, 2004). The findings led to a number of hypotheses concerning the role of working memory and the attentional-resource demands of the processes involved in these

activities. We have already conducted several studies on notetaking in L1, using different methods (Piolat, 2007; Roussey & Piolat, 2003) and in different contexts (reading a paper or a website: Barbier, 2006; Gérouit, Piolat, Roussey, & Barbier, 2001). The results of these studies showed that the cognitive effort devoted to notetaking is consistently higher than that devoted to simply copying. In other words, taking notes is not just a graphic transcription of the information conveyed in the lecture or during reading. In addition to comprehension processes, notetakers must also select information and reformulate content. All these operations require cognitive resources. Comparisons between notetaking and writing have confirmed that more resources are needed to write an entirely original text than to take notes, even if the notes differ in content from what was heard or read. Planning the content of a text by retrieving and organizing ideas is a highly demanding process (Kellogg, 1996), one that is clearly more difficult than selecting what information to write down.

## The Present Study

To test Piolat et al.'s (2005) suggestions regarding cognitive effort, first we set out to obtain more data on the cognitive resources allocated to notetaking and writing by students in L2 as compared to L1. In the light of prior research, more cognitive effort and, thus, less fluency should be observed during writing than during notetaking in both languages; that is, the differences in cognitive effort – and, thus, in fluency – between writing and notetaking should also be observed in L2 as in L1. Second, during notetaking, in particular, the number of abbreviations produced should reveal the note-takers' ability to develop strategies to save time in writing down the words they are keeping in memory as they listen to the teacher speak. However, because the ability to use abbreviations in notes is likely to be a reflection of linguistic skills and transcription processes, it can be hypothesized that students will find it harder to use abbreviation devices in L2 than in L1.

The indexes that were used to measure cognitive effort and fluency represent the note-takers' and writers' cognitive functioning, independently of what they are experiencing while performing these activities. Yet it has been shown that individuals' metacognitive representations of their writing performance are often correlating with their actual performance, especially for bilinguals (Ransdell, Barbier, & Niit, in press). For this reason, it seemed important to include students' self-reports as part of our data set. A questionnaire was administered to determine whether students experience differences in difficulty (and how much) during comprehension, notetaking, and summary writing in the two languages. The questionnaire also included items on whether students use similar or different notetaking methods in the two languages.

In summary, four main predictions were formulated in

this study: (1) Taking notes in L1 or L2 will be less effortful than writing in L1 or L2, because the processes mobilized for writing are more complex than those employed for notetaking, no matter what language is used. (2) Students will experience more difficulty understanding, taking notes, and writing in L2 than in L1. (3) Taking notes in L1 will prove less effortful than in L2 because of more efficient comprehension of information and more automatized condensing and writing procedures. (4) Students will use more abbreviations in their notes in L1 than in L2 because they have not acquired specific notetaking skills in L2.

## Method

### Participants

Twenty-one native French-speaking students (13 women and 8 men, mean age = 21.8 years,  $SD = 3.61$ ) who had been studying English as their second language at the University of Provence were tested individually. Our participants had been taught English for 7 years before the university. At the university, they took intensive English classes for 3 years in order to obtain a diploma ("Licence d'Anglais"). At the time of the experiment, our participants had chosen to teach English as L2. The diploma they had at the time of testing was a guarantee of their expertise for comprehending and for writing in English. All participants volunteered after having read a poster announcing an experiment on the relationship between attention and proficiency in a second language. The announcement stated that the experiment would last 90 min and that each participant would receive a sum equivalent to the price of one movie ticket.

### Material

#### Texts

Two "lectures" were presented, one in each language. The information for the texts was taken from the "Guide for Studies at the University of Provence," which is distributed to every student enrolled at the university, including foreign students. The texts were comparable in length (approximately 850 words each), structure, and vocabulary. The texts were checked for their structure by five judges (who worked individually and then discussed their rare divergences; interrater agreement was .96). The judges were instructed to detect three categories of segments in the texts: (1) basic semantic units that contain only one piece of information; (2) conceptual units that group several basic units within a single conceptual argument (macrostructure); (3) major units containing several conceptual units that build major ideas of the discourse (for details on the judging method, see Plaken, Hambleton, & Jaeger, 1997).

The English text was about the curriculum at the University of Provence; the French text was about registration conditions at that university. The texts were tape-recorded. Each one lasted about 8 min (French or L1: 8 min 25 s; English or L2: 7 min 58 s). As a further measure, the speech flow of the speaker was controlled by inserting a 2-second pause at each boundary between two conceptual units. Because of the difficulty in recruiting participants it was not possible to counterbalance text versions across trials in the two languages. However, half of the participants responded to L1 before L2 and the other half responded to L2 before L1.

### Questionnaire

A questionnaire (see Appendix) was devised to assess the difficulties experienced by participants in each of the languages during both notetaking and writing. It consisted of 27 questions, to which the participants answered “yes” or “no” for each language. The first part of the questionnaire, entitled “Lecture Comprehension,” consisted of seven questions (quantity of information, length of sentences, technical level of vocabulary, etc., e.g., “Did these lectures contain too much information?” or “Did you understand most details?”). The second part was entitled “Taking Notes While Listening a Lecture” and consisted of 12 questions, seven pertaining to notetaking difficulty (e.g., “You did not note any information because the lecturer spoke too fast?”) and five pertaining to notetaking style (e.g., “As you were taking notes, did you prefer to write abbreviated words?”). The third part of the questionnaire, entitled “Text Writing,” asked the participants three questions about the use of their notes (e.g., “As you wrote the short text, were your notes complete enough?”) and five questions on their writing skills (e.g., “You did not know the vocabulary?” and “You encountered difficulty in constructing your sentences?”). The questionnaire was written in French. The left column was added in the Appendix to show the correspondence between each question and the corresponding figures’ labels as well as in the presentation of the results. The participants saw only the three other columns.

### Apparatus

The experiment was computer-assisted and was run on SCRIPTKELL software (Piolat, Olive, Roussey, Thunin, & Ziegler, 1999). The dual-task technique was used to assess cognitive effort (Olive, 2004). Participants had to concurrently perform a primary task and a secondary task: While composing a text or taking notes, they had to react as quickly as possible to probes (by clicking on the computer mouse) heard at random intervals ranging from 15 to 45 s, with a mean of 30 s. The random occurrence of the probes prevented participants from anticipating their response. The software provided detailed individual protocols for each task by recording all reaction times (RTs) to the probes

(in ms). The RT on the secondary task allowed us to estimate the amount of attentional resources being allocated to the primary task (see section Dependent Variables below).

### Procedure

Participants were tested individually, within a 90-min time frame that included 6 phases. (1) The first phase was a training session to familiarize the participants with the probe task. They were informed that they would occasionally hear sound signals coming from the computer at variable intervals, and were instructed to quickly react to every probe by clicking on the computer mouse with their non-dominant hand (The screen of the computer was only available to the experimenter to control the experiment). This training task was used to compute the mean baseline RT of each participant. (2) In the second phase, the participant listened to the first text for about 8 min, while taking notes using the paper and pen provided and also reacting rapidly to the sound signals. For half of the participants, the first text was in French; for the other half it was in English. The notetaking was done in the same language as the text being heard. (3) In the third phase, the participants were asked to use their notes to write – again in the same language – a short (half-page) text that was supposed to communicate the most important information from the lecture to other students who knew nothing about the French university system. They were told to use complete sentences and write legibly. As much time as needed to produce the text was allowed. During the entire writing phase, the participant was still required to react rapidly to the sound signals. (4) In the fourth phase, participants listened to the second text (in the other language) for about 8 min, while taking notes and reacting to the sound signals at the same time. (5) In the fifth phase, participants were given the same writing assignment as before: Write a text in the same language as the notes taken, all the while reacting to the sound signals. (6) In the sixth and last phase, participants were given 5 min to answer the questionnaire.

### Dependent Variables

Four dependent variables were analyzed in this study:

1. *Cognitive effort* was assessed using a weighted RT (wRT), calculated for each participant by subtracting his/her mean baseline RT from the RTs collected in the dual-task situation.
2. *Fluency* was measured by dividing the number of words by the task-execution time. For the word count, every unit (abbreviated or not) bounded by a space or a punctuation mark was counted as a word. Task-execution time for notetaking was equal to the text reading time (8 min 25 s for the French text, 7 min 58 s for the English text). The task-execution time for the writing exercise

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 another.

Figure 2. An example of abbreviating devices used by the same student in French (L1, upper) and in English (L2, lower).

was equal to the time actually taken to write the summary.

3. *Lexical abbreviation* was measured by dividing the number of abbreviated words by the total number of words written down. This last variable pertained only to notetaking (see Figure 2).
4. The *percentage of participants* who answered “yes” to the 22 perceived-difficulty questions was calculated for each language. A similar percentage was computed for the five questions concerning notetaking style.

## Results

### Cognitive Effort and Fluency

The results were analyzed using Student's *t*-test for paired samples, the comparison being between L1 (French) and L2 (English), or between notetaking and writing.

For taking notes in English, the participants' mean weighted RTs in ms were significantly longer than for taking notes in French: Mean L2 = 252.48 ( $SD = 22.99$ ) vs. mean L1 = 214.9 ( $SD = 23.97$ ),  $t(20) = 2.47$ ,  $p < .025$ , Cohen's  $d = .23$ . In contrast, the mean number of words written per minute (fluency) was significantly lower in English than in French: Mean L2 = 22.40 ( $SD = 1.06$ ) vs. mean L1 = 29.06 ( $SD = 1.23$ ),  $t(20) = 7.53$ ,  $p < .0001$ , Cohen's  $d = .74$  (see Figure 3, left).

For the writing task in the two languages, the participants' mean weighted RTs in ms were not significantly different: Mean L2 = 289.19 ( $SD = 29.37$ ) vs. mean L1 = 270.38 ( $SD = 25.14$ ),  $t(20) = 1.89$ ,  $p = .18$ . Also no significant effect of the language factor on the number of words written per minute was found: Mean L2 = 18.32 ( $SD = 0.75$ ) vs. mean L1 = 18.65 ( $SD = 0.81$ ),  $t(20) = 0.54$ ,  $p = .59$  (see Figure 3, right).

The mean weighted RTs in ms were significantly shorter when the participants were taking notes than when they were writing, this being true for both languages: mean L1 notetaking = 214.95 ( $SD = 23.97$ ) vs. mean L1 writing = 270.38 ( $SD = 25.14$ ),  $t(20) = 4.28$ ,  $p < .0003$ , Cohen's  $d = .478$ , and mean L2 notetaking = 252.47 ( $SD = 22.99$ ) vs. mean L2 writing = 289.19 ( $SD = 29.32$ ),  $t(20) = 2.58$ ,  $p < .018$ , Cohen's  $d = .25$ , respectively. Fluency (mean number of words per minute) was significantly greater for notetaking than for writing, again, in both languages: Mean L1 notetaking = 29.06 ( $SD = 1.2$ ) vs. mean L1 writing = 18.65 ( $SD = 0.81$ ),  $t(20) = 8.31$ ,  $p < .0001$ , Cohen's  $d = .77$  and L2 notetaking = 22.40 ( $SD = 1.06$ ) vs. L2 writing = 18.32 ( $SD = 0.75$ ),  $t(20) = 3.91$ ,  $p < .0009$ , Cohen's  $d = .43$ , respectively.

Finally, the total time taken to write the summary did not differ significantly between the two languages: mean L1 = 12 min 59 s ( $SD = 1$  min 14 s) vs. mean L2 = 12 min 24 s ( $SD = 1$  min),  $t(20) = 1.40$ ,  $p = .18$ . In contrast, the

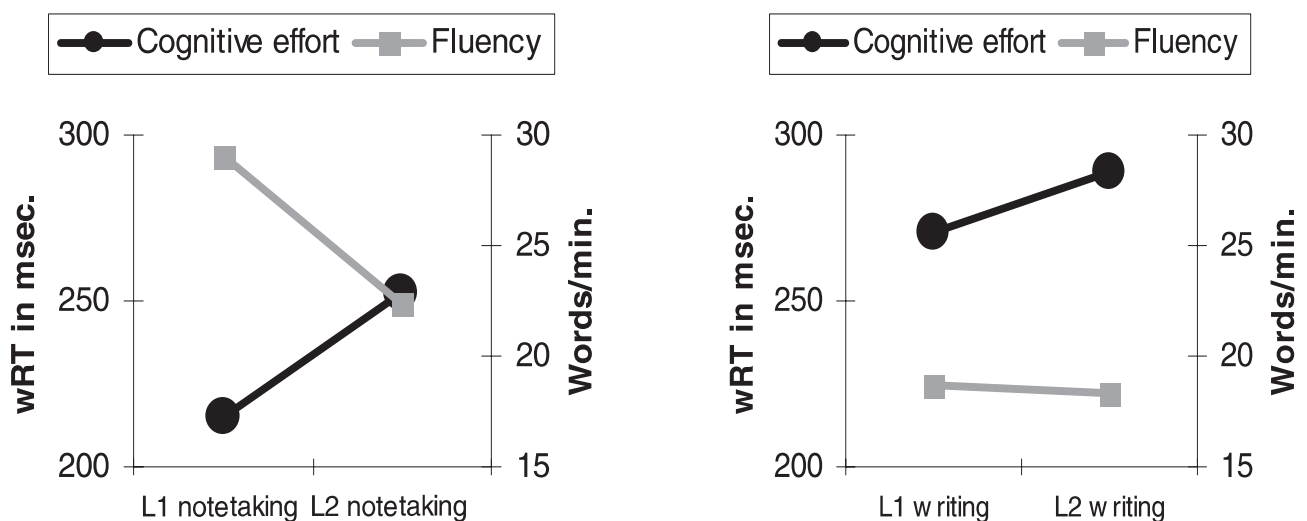


Figure 3. Mean cognitive effort (weighted RT in ms) and mean fluency (words/min) during notetaking (left) and writing (right) in each language (L1 and L2).

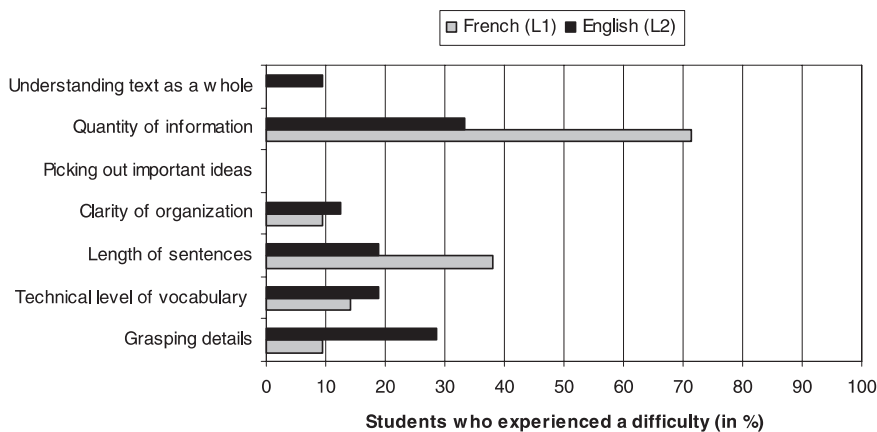


Figure 4. Percentage of students who had difficulty with various aspects of text comprehension while taking notes in French (L1) and English (L2).

volume produced (mean number of words) was generally lower in English than in French: Mean L2 = 220.87 ( $SD = 10.63$ ) vs. mean L1 = 235.76 ( $SD = 13.28$ ),  $t(20) = 1.98$ ,  $p < .06$ , Cohen's  $d = .16$ .

### Perceived Difficulty in the Two Languages

A qualitative and quantitative analysis of the questionnaire results is presented below. The comparison between French (L1) and English (L2) was analyzed using Cochran's  $Q$  test. The  $Q$ -values obtained from this test are given only when the test indicated a significant effect of language on the responses. The difference in the means on lexical abbreviation was analyzed by means of Student's  $t$ -test with repeated measures. (Note: In the figures corresponding to these results, the questions have been shortened for reasons of readability. The complete formulation of the questions and the shortened version are provided in the Appendix.)

### Text Comprehension During Notetaking

For the seven comprehension questions pooled together, a small proportion of the students reported having difficulty in understanding the texts heard in the two languages (L1 = 20.4%, L2 = 17.4%). More specifically (see Figure 4), most of the students said they did not experience difficulty in understanding the text as a whole (only 10% reported this difficulty for L2), nor in picking out the important ideas and organizing them in the two languages. On the other hand, they had more trouble when it came to managing the quantity of information and the details. Difficulty related to the volume of information to be put down in notes was significantly less for English than for French, L2 = 33.3%, L1 = 71.4%,  $Q = 6.4$ ,  $p < .02$ . Problems understanding details of the lecture were, by contrast, greater in English than in French, L2 = 28.6%, L1 = 9.5%,  $Q = 4$ ,  $p < .05$ . Problems related to the technical level of the vocabulary were experienced by about a sixth of the participants in both languages (L2 = 19%; L1 = 14.3%). Finally, the length of the sentences seemed to cause

more trouble in L1 (38.1%) than in L2 (19%) but the difference was nonsignificant,  $Q = 2.67$ ,  $ns$ .

### Notetaking

For the seven notetaking items pooled together, about one-third of the students reported having difficulty comprehending the texts heard in the two languages (L1 = 27.24%, L2 = 29.93%). More specifically (see Figure 5), in line with their perception of their comprehension, the participants tended to perceive significantly more difficulty in notetaking because of their comprehension speed in English as compared to French, L2 = 19%, L1 = 5%,  $Q = 3$ ,  $p < .09$ . Lack of satisfaction with the notes they had taken (L2 = 42.9%, L1 = 33.3%), a general perceived difficulty in taking notes (L2 = 42.9%, L1 = 33.3%), and trouble getting down details (L2 = 19%, L1 = 9.5%) were all greater in English than in French, although the  $Q$ -tests were nonsignificant. A high proportion of the participants also felt their problems were the result of their writing speed, particularly in French (L1 = 66.7%, L2 = 52.4%), but the difference between the languages was nonsignificant,  $Q = 1.29$ ,  $ns$ . Finally, difficulty with the pace of the lecture did not differ across languages: About a third of the students reported having this difficulty in both languages (L1 = 38.1%, L2 = 33.3%).

### Notetaking Devices

Overall, the five notetaking techniques and devices mentioned in the questionnaire were used by an average of two-thirds of the participants, according to their statements (L1 = 68.58%, L2 = 65.12%). As to the specific procedures (see Figure 6), almost all of the participants used lexical abbreviations. More reported that they did this in French than in English (L1 = 100%, L2 = 87.5%), but the difference was nonsignificant,  $Q = 3$ ,  $p < .09$ . Use of symbols (L1 = 71.4%, L2 = 66.7%), abbreviation of sentences (L1 = 72.6%; L2 = 81%), and writing down only selected words (L1 = 66.7%,

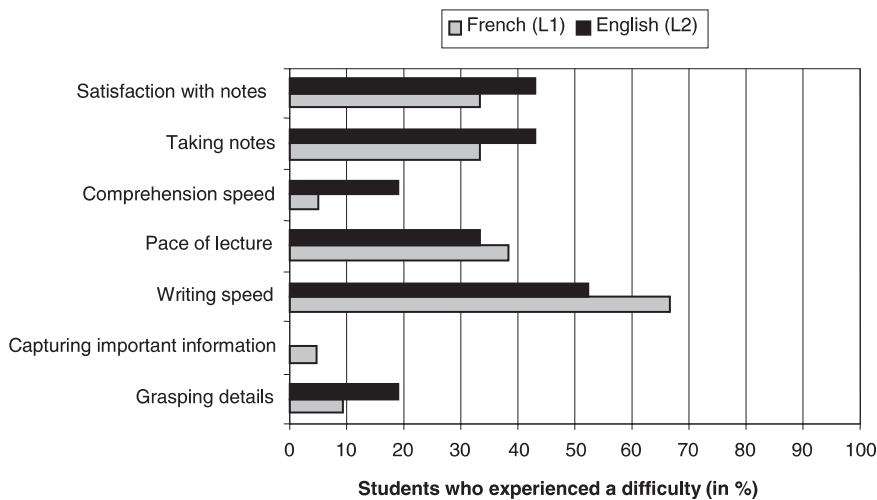


Figure 5. Percentage of students who had difficulty with various aspects of notetaking in French (L1) and in English (L2).

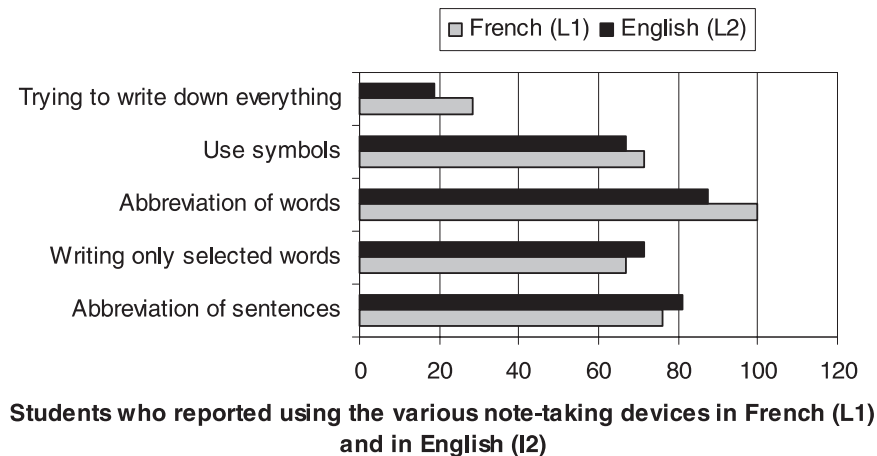


Figure 6. Percentage of students who reported using various notetaking devices in French (L1) and in English (L2).

L2 = 71.4%) were cited as being frequently used in both languages, with a nonsignificant difference between L1 and L2. Note that the participants' actual practices identified in their written work confirmed their testimony regarding the use of lexical abbreviations. More lexical abbreviations were, in fact, found in French than in English. The mean proportion of lexical abbreviations (see the section Dependent Variables) used in the two languages was L1 = .236 ( $SD = .01$ ) and L2 = .154 ( $SD = .01$ ),  $t(20) = 7.05$ ,  $p < .0001$ , Cohen's  $d = .73$ . Finally, few participants said they had tried to write down everything, but more had attempted to do this in French (L1 = 28.6%) than in English (L2 = 19%). However, this difference was nonsignificant.

### Use of Notes for the Writing Task

Only a fifth of the students in each language mentioned that their notes were incomplete for writing the summary (L1 = 23.8%, L2 = 23.8%). However, two-thirds said they had to rely on memory (L1 = 61.9%, L2 = 66.7%). For French

only, a small proportion reported difficulty making use of their notes, with a marginal difference between the two languages, L1 = 14.3%, L2 = 0%,  $Q = 3$ ,  $p < .09$ .

### Text Writing

For the five items concerning the production of a written text, very few students reported having any trouble. Overall, those few who did report difficulties were twice as numerous for English (L2 = 19.04%) as for French (L1 = 8.56%). Regarding the specific writing items, no student mentioned having problems related to his/her speed of writing in either language. The technical level of the topic was not experienced as a difficulty in either language. On the other hand, for the questions on accessibility of information (L2 = 28.6%, L1 = 14.3%), syntactic construction (L2 = 33.3%, L1 = 19%), and availability of vocabulary (L2 = 23.8%, L1 = 0%), a greater percentage of students reported having trouble in English. The language difference was significant only for vocabulary, however,  $Q = 5$ ,  $p < .05$ .

## Discussion

This study aimed at showing that to be able to pursue studies in a second language (L2), students need to achieve mastery in areas other than just comprehension and writing. They must acquire the skills and automatic processes specific to notetaking in L2. In the present study, students' skills were assessed in terms of cognitive effort, fluency, and perceived difficulty. The main findings were as follows.

Consistent with our predictions, cognitive effort was greater when the students had to write a summary than when taking notes; this was true for both L1 (French) and L2 (English). Their fluency, however, was greater in notetaking than in writing, for both languages, most likely because the speaking rate of the lecture caused them to increase their notetaking speed (as compared to their speed in a formal writing task) in order to be able to capture more information. The functional rapidity demanded by notetaking was, thus, observed once again here (Piolat, 2004). However, this rapid recording of information was not associated with greater cognitive effort than in summary writing. Clearly, the writing process – even when it does not require coming up with new content, as in this study where students only had to reformulate information already heard and recorded in notes – is a more effortful activity than simply taking notes, as already demonstrated elsewhere (Piolat et al., 2003, 2005). The various processes implemented in writing (planning, sentence generation, and revising) are more demanding of attentional resources than those involved in notetaking (i.e., understanding the information and writing it down in an abbreviated and meaningful way).

Writing a summary in L2 was expected to be more effortful than in L1, and fluency was expected to be lower. In fact, the results showed that fluency was quite comparable, and cognitive effort was not significantly different either. However, when students reported their writing experience, one-fifth of them indicated some difficulty writing in L2 in the areas of syntax and vocabulary, although these difficulties were not significantly different from those experienced for L1. Two explanations can be proposed. The students may have compensated for the difficulty felt when writing in L2 by increasing the time spent producing the written summary, or by reducing the amount of text. The results showed that they did not spend significantly more time on the writing task in L2, but the volume of their written texts did tend to be significantly smaller. Additional experiments are needed to find out whether this trade-off (writing a little less, even if the assignment is to provide a complete communication) is frequently used by students to compensate for their perceived difficulty. The second explanation would be that these students had attained sufficient proficiency in L2 to be able to overcome the lexical and syntactic difficulties associated with writing in their second language. It is true that in our study, only a fifth of

the students reported having these difficulties. One way to gain insight into this question would be to assess the quality of texts written in L1 and L2 (Ransdell & Levy, 1996). Students might indeed produce lower-quality work in L2 than in L1, even if other indicators of performance seem to suggest equivalency (cognitive effort, task-execution time, volume, and fluency).

Finally, as expected, the data obtained here showed that these students' mastery of notetaking in L2 was not as good as in L1. Not only was cognitive effort greater in L2 than in L1, but also, L2 fluency was lower, that is, the participants put down less information for a lecture of comparable duration. It should be noted that in order to be validated, these results require further research, for example, using various topics. Nevertheless, these results suggest that French students might have some trouble pursuing a degree in an English-speaking country, in spite of their good writing skills. The questionnaire responses clearly indicated that L2 instruction for students should include techniques for improving comprehension speed and selecting important information during notetaking. Although seemingly contradictory, a high percentage of students reported difficulties in managing the large quantity of information in syntactically complex constructions. In L1, the students said they understood everything but did not manage to get down all the information. They even complained that their writing speed was not fast enough. By contrast, in L2, the students said they were not able to pick out or write down details. More than a third of the students said they had problems with comprehension speed and difficulty taking notes in L2, and that they were not satisfied with what they had done. In other words, they felt they were unable to understand quickly enough or to take satisfactory notes. Whereas in L1 all students said they had used abbreviations, in L2 a significantly lower number of students mentioned the use of abbreviations, and in fact fewer students actually used them. A more complete analysis of notetaking procedures that are transferred (or transferable) from one language to the other should be conducted (for a study of notetaking in French as a second language by English, Spanish, and Japanese students, see Barbier et al., 2004).

In conclusion, it is important to reiterate that notetaking is more than just a simple activity of rapid information recording. This task requires various manipulations of the written language (lexical abbreviations, symbols, telegraphic style, arrangement of graphic space) – skills that should be reinforced in university courses in order to improve students' chances of pursuing studies in their second language in Europe.

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## Appendix

Questionnaire (formulated in French for the participants)\*

Instruction: You have just listened to a text in French and another in English.  
Thanks for answering the questions in the Table by circling YES or NO in each line.

Formulation employed in the figures and in the results	LECTURE COMPREHENSION	Lecture in French		Lecture in English	
Understanding the text as a whole	Did you find these texts difficult?	YES	NO	YES	NO
	Did these lectures contain . . .				
Quantity of information	. . . too much information?	YES	NO	YES	NO
Length of sentences	. . . too long sentences?	YES	NO	YES	NO
Technical level of vocabulary	. . . too technical vocabulary?	YES	NO	YES	NO
Clarity of organization	Was information structure clear enough?	YES	NO	YES	NO
	Did you understand . . .				
Picking out important ideas	. . . most of the main ideas?	YES	NO	YES	NO
Grasping details	. . . most details?	YES	NO	YES	NO
Formulation employed	TAKING NOTE WHILE LISTENING TO A LECTURE	Notetaking in French		Notetaking in English	
Taking notes	Did you find notetaking difficult?	YES	NO	YES	NO
	You did not note any information . . .				
Comprehension speed	. . . because you did not understand it?	YES	NO	YES	NO
Pace of lecture	. . . because the lecturer spoke too fast?	YES	NO	YES	NO
Writing speed	. . . because you did not write fast enough?	YES	NO	YES	NO
Capturing important information	Did you note the most important information?	YES	NO	YES	NO
Grasping details	Did you note some details?	YES	NO	YES	NO
	As you were taking notes, did you prefer . . .				
Abbreviation of sentences	. . . to write short and abbreviated sentences?	YES	NO	YES	NO
Writing only selected words	. . . to write a few words?	YES	NO	YES	NO
Abbreviation of words	. . . to write abbreviated words?	YES	NO	YES	NO
Use symbols	. . . to use symbols in order to write faster?	YES	NO	YES	NO
Trying to write down everything	. . . to write all what you heard?	YES	NO	YES	NO
Satisfaction with notes	At the end of the lecture, were you satisfied with your notes?	YES	NO	YES	NO
Formulation employed	TEXT WRITING	Writing in French		Writing in English	
	As you wrote the short text . . .				
Making use of notes	. . . did you easily use your notes?	YES	NO	YES	NO
Completeness notes	. . . were your notes complete enough?	YES	NO	YES	NO
Had to rely on memory	. . . Did you remember information which you could not taking notes about during the lecture?	YES	NO	YES	NO
	Was your text difficult to write? If yes, why? . . .				
Speed writing	. . . You could not write as fast?	YES	NO	YES	NO
Availability of vocabulary	. . . You did not know the vocabulary?	YES	NO	YES	NO
Accessibility of information	. . . Some information was missing?	YES	NO	YES	NO
Syntactic construction	. . . You encountered difficulty to construct your sentences?	YES	NO	YES	NO
Technical level of text	. . . The text content was too technical?	YES	NO	YES	NO

Note: \*The first column (**left side**) was added to show the correspondence between each question and the figures. The participants saw only the three other columns.