Mathis Wetzel, Sandrine Zufferey and Pascal Gygax

# 5 Do non-native readers rely on connectives? The processing of coherence relations in L2

**Abstract:** In this chapter, we discuss the extent to which non-native readers rely on discourse connectives to build coherence relations, and whether their reading fluency is affected by missing or misleading connectives. Our hypothesis is that the information conveyed by connectives is less salient when reading in a second language, as L2 processing has been shown to be shallower than that of native readers. In order to substantiate this claim, we conducted two self-paced reading experiments with native and non-native readers of French. Results show that while non-native readers were generally able to efficiently retrieve the meaning of connectives, their reading fluency was somewhat less affected than the one of native readers when confronted to sentences that contained no connective or an inappropriate one. We conclude that non-native readers rely less on functional and more on lexical cues than native readers do. Our findings also indicate that the reading of native and non-native speakers was affected by the complexity of the coherence relation, suggesting that processing in L2 follows the same cognitive principle of continuity as in L1.

**Keywords:** discourse connectives, L2 acquisition, processing, coherence relations

## 1 Introduction

Discourse connectives are linguistic elements that are known to be helpful to establish coherence within a discourse, as they guide and instruct readers on how to interpret the underlying coherence relations (e.g., Halliday and Hasan, 1976). Still, research in second language acquisition has shown that connectives remain highly difficult, even for proficient L2 learners (e.g., Lei, 2012; Zufferey and Gygax, 2017). Many corpus studies have reported for instance that non-native writers struggle to use discourse connectives appropriately in their text productions, at times overusing (e.g., Granger & Tyson, 1996; Leedham and

**Mathis Wetzel,** University of Bern, mathis.wetzel@unibe.ch
**Sandrine Zufferey,** University of Bern, sandrine.zufferey@unibe.ch
**Pascal Gygax,** University of Fribourg, pascal.gygax@unifr.ch

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Cai, 2013), at times underusing (e.g., Shi, 2017; Tazegül, 2015) and even misusing particular connectives (e.g., Myung-Jeong, 2017; Jameel et al., 2014).

Given that the mastery of connectives in L2 appears to be quite challenging, one might assume that non-native speakers cannot benefit from their presence to the same extent as native speakers even while reading. In the present chapter, we address this question by examining how non-native readers of French process discourse connectives and coherence relations. We do so on the basis of the following research questions:

1) To what extent do non-native readers of French benefit from the presence of discourse connectives while reading?

2) In the case of a wrongly used connective, do non-native readers still rely on the information conveyed by the connective?

Our hypothesis is that non-native readers rely less on connectives, as research has shown that they are more strongly guided by lexical cues than by functional ones (Papadopoulou and Clahsen, 2003). This lower sensitivity to connectives should also result in less pronounced processing disruptions compared to native speakers when encountering a wrongly used connective.

However, there might be also similarities between the processing of connectives in L1 and L2, especially when considering general cognitive processes whilst reading. For example, readers expect discourse to unfold in a continuous manner (Segal et al., 1991; Murray, 1995, 1997) and are able to infer causal relations even in the absence of a connective, whereas concessive relations need to be marked explicitly (Murray, 1995; Sanders, 2005). As one can assume that these principles apply to non-native readers as well, we additionally assess the following two research questions:

3) Do non-native readers of French process discontinuous relations more slowly than continuous ones?

4) Is the effect of the coherence relation equally visible when comparing incorrectly marked concession relations and correctly marked ones?

Our hypothesis is that non-native readers should show similar processing patterns as native readers regarding the complexity of the coherence relation. In other terms, they should read concessive relations more slowly than causal ones, regardless of whether they are indicated by an appropriate or an inappropriate connective.

We start by discussing more generally whether non-native readers understand and recall texts better when they contain connectives. Then, we focus more precisely on what happens during reading by discussing the processing of coherence relations in L2, and the potential benefit that connectives might bring to it. In order to test our assumptions that non-native readers rely less on connectives and are affected by more complex coherence relations, we present two self-paced reading experiments, in which native and non-native readers read sentences that are marked with or without a connective (Experiment 1) and with a correct or incorrect connective (Experiment 2). As expected, the results of both experiments confirm our hypotheses and replicate existing finding of L2-research. We conclude this chapter with potential avenues for research in this domain.

## 2 Do non-native readers benefit from connectives?

Several studies have demonstrated that L2 learners struggle to understand a text due to a poor mastery of connectives (e.g., Cohen and Fine, 1978; Clerehan, 1995). Cohen et al. (1979), for example, investigated the way non-native students read and understood different types of expository texts, and showed that the insufficient mastery of connectives led, amongst other factors, to a lower understanding of the texts. Cohen et al. (1979) anecdotally reported that one participant thought that the only function of the connective *thus* was to mark off sentences. Geva (1986) also found that an explicit marking of connectives did not bring much benefit to non-native readers for their understanding of a text. However, her study also indicated that advanced learners did show a better comprehension, unlike less proficient ones, when texts contained connectives that were typographically highlighted. This finding thus indicates that L2 learners can actually benefit from the presence of connectives provided specific conditions and a higher level of language proficiency. Similarly, when testing non-native speakers with a higher level of proficiency (i.e., learners that were actually able to understand the meaning of the connectives), Degand and Sanders (2002) demonstrated that L2 learners can benefit from the presence of connectives, and understand texts marked with causal connectives better than texts that did not contain them. In line with Degand and Sanders (2002), Crosson and Lesaux (2013) observed that a good knowledge of connectives had a positive effect on learners' text comprehension and concluded that highly proficient readers' understanding of text does benefit from connectives. The ability to benefit from connectives and to better understand a text written in L2 thus depends highly on readers' level of language

proficiency. This is not surprising, given that it is well known that the meaning of connectives is better retrieved with a higher language proficiency (Goldman and Murray, 1992; Wetzel et al., 2020), especially for speakers with a high *spoken* language proficiency (Geva, 1992, 2007).

Still, observations from other studies attenuate these findings and point out the role of the connective under scrutiny, as more complex connectives have been shown to complicate the construction of the intended coherence relation, even for highly proficient non-native readers. Zufferey and Gygax (2017), for example, have shown that when a connective is polyfunctional and therefore ambiguous, even highly proficient non-native readers show a preference for sentences that do not contain it. Also, in a sentence evaluation task, non-native readers preferred implicit specifications such as: 'The neighbor, the old lady who lives above, is very nice.' over specifications that contained a correct connective such as: 'The neighbor, that is, the old lady who lives above, is very nice.'(Wetzel et al., in press). One possible explanation for this result could be that highly optional connectives might be somewhat unexpected for non-native readers and might lead to confusion.

Taken together, non-native readers do seem to struggle to use discourse connectives, which lowers their chances to understand a text. However, when a generally higher language proficiency is attained, their understanding can benefit from discourse connectives. In the next section, we discuss whether the benefit of connectives for text comprehension in L2 also produces beneficial effects not only for understanding but also for reading fluency. While the facilitative effect of connectives on reading fluency is well-documented for native readers (e.g., Millis and Just, 1994; Sanders and Noordmann, 2000), there are indications that non-native readers may not obtain a direct benefit from connectives, as they process on a shallower level than L1 readers (Clahsen and Felser, 2006a, 2006b).

## 3 Processing of coherence relations in L2

Generally, theories assume shallower, and therefore more limited, processing when reading in L2 compared to reading in L1. For example, Clahsen and Felser (2006a, 2006b) suggest that the processing of non-native readers is generally less automatic than the processing of native readers, which might be partly explained by a greater cognitive effort when reading in a L2 compared to reading in a L1. Also, it is known that non-native readers rely more on lexical-semantic cues, and less on syntactical and functional ones (see also Marinis et al., 2005; Papadopoulo and Clahsen, 2003). As a consequence, while native readers show high

processing disruption for incorrect sentences, L2 learners are less (or at least differently) affected (e.g., Weber-Fox and Neville, 1996). Studies using ERP (i.e., event related potentials) have found support for this by showing that L2 learners – even bilinguals – process semantic and syntactic anomalies differently than monolingual readers (e.g., Hahne and Friederici, 2001; Weber-Fox and Neville, 1996, Ardal et al. 1990, Felser et al., 2003). Some studies have also shown that more proficient L2 readers tend to develop native-like reading processing (Hahne et al. 2006; Sabourin, 2003; McLaughlin et al, 2004).[1]

With respect to the processing and benefit of discourse connectives, shallower processing of non-native readers could lead to different assumptions. Firstly, one could assume that non-native readers should benefit from the presence of connectives, as the clear-cut and valuable instructions of connectives could strongly release cognitive resources otherwise used to infer coherence relations. However, as discussed above, connectives are also known to be complex linguistic elements that can carry multiple functions and have nuanced pragmatic overtones (e.g., Schumann et al., 2020), which makes them, potentially, more complicated for L2 learners. Thus, their potential benefit for online processing – while being well-documented in L1 research (Millis and Just, 1994; Sanders and Noordman, 2000) – appears rather open in L2.

In Zufferey and Gygax (2017), non-native readers showed no processing disruption for sentences that were incorrectly marked with the French connective *en effet* ('indeed'), hinting that even highly proficient language learners do not master the different uses of this polyfunctional connective. Moreover, Wetzel et al. (in press) demonstrated that non-native readers, contrarily to native readers, showed no processing disruptions for sentences containing misuses of connectives. Interestingly, however, in the same study, errors were still detected by non-native readers, but only after reading (i.e., in an offline task). The lack of fluency effects during online reading might be due to processing capacity limitations induced by the temporal pressure of online reading.

Taken together, the evidence presented in this section indicates that non-native readers might not experience immediate benefits of connectives during reading. The general reliance on lexical rather than on syntactical cues (Clahsen and Felser, 2006a, 2006; Marinis et al., 2005; Papadopoulo and Clahsen, 2003), together with the complexity of connectives and their uses (Zufferey and Gygax, 2017; Wetzel et al., in press) might lead to shallower processing of the procedural

**1** It is still debated whether non-native readers can actually achieve a full native-like processing (see for instance Clahsen and Felser, 2006a; Yuan, 2017; Bond et al., 2011, Sabourin and Stowe, 2008).

instructions provided by a connective. Yet, there might also be cognitive processes that apply to all readers, independently of whether they read in L1 or L2, as we now outline.

## 4 Cognitive theories for native speakers potentially applying to L2 processing

In the preceding sections, we have discussed the idea that non-native readers' understanding of text could benefit from connectives, provided that these readers are highly proficient and that the connectives are easily accessible to them. We also discussed the fact that non-native readers might rely less on connectives during reading, as L2 processing is known to be shallower than that of native readers. We now discuss the processing of connectives in the light of the cognitive theories that have been established for native readers, and try to extend them, despite important differences between L1 and L2 processing, to non-native readers.

The *causality-by-default* hypothesis, put forward by Sanders (2005), states that readers expect, unless indicated otherwise, causal links between sentences. In line with this hypothesis, causal sentences should be easy to understand without explicit connective marking, as in example (1).

(1) Paul was hungry. He ordered food.

Causal sentences are also known to be cognitively less complex than concessive ones (Sanders et al., 1992), resulting in a faster processing for causal relations than for concessive ones (e.g., Köhne and Demberg, 2013). These findings can also be explained by the *continuity*-hypothesis (e.g., Murray, 1995, 1997; Segal et al., 1991), which states that readers tend to interpret sentences in narratives as if they were following one another in a continuous manner (Murray, 1997:228). Continuity (such as the fulfillment of an expectation) thus facilitates the processing of a text whereas discontinuity, such as sudden topic changes or general violations of an expectation, render a text more difficult to process. In the context of coherence relations, this means that continuous connectives, such as causal and additive ones, should facilitate processing whereas concessive and contrastive connectives – marking a disruption of continuity – are processed at a greater effort. In line with this hypothesis, Murray (1997) showed by conducting reading experiments that non-appropriate concessive connectives produced a higher processing disruption in reading fluency than non-appropriate causal and additive connectives.

In the case of non-native reading, some evidence suggests that these cognitive principles also apply to non-native readers. Recio Fernández (2020), for example, investigated the link between language proficiency and the ability to process coherence relations in L2. In four experiments using eye-tracking, she compared reading fluency of sentences containing the Spanish connective *por lo tanto* ('therefore') and *sin embargo* ('however') by native speakers of Spanish and Spanish learners of different proficiency levels (B1 – C1). More precisely, Recio Fernández (2020) tested (i) whether whether specific relations (cause vs concession) would affect the online-processing of non-native readers of Spanish, (ii) whether an implicit causal relation would affect processing to the same extent as an explicit causal one, (iii) whether incorrect connectives would affect processing of causal relations, as well as of concessive relations (iv). The results obtained in these experiments not only suggested a clear link between language proficiency and the processing of coherence relations, but also indicated that L2 learners of Spanish were generally affected by the complexity of coherence relations. However, the compelling results obtained by Recio Fernández (2020) also raise intriguing questions that remain open.

For example, there is still a lack of documentation on the interaction between the type of relation and the processing of implicitly or explicitly marked sentences. In other words, it is still unknown whether a concessive relation (implicit or explicit) is processed differently by non-native readers in comparison to a causal one (implicit or explicit). As a reminder, according to the *causality-hypothesis* by Sanders (2005), implicit causal relations should not create the same processing disruption as implicit concessive ones. Also, we do not know whether the effect of the complexity of coherence relations is also apparent when sentences are incorrectly marked.

Furthermore, although the use of eye tracking measures allows for fine-grained examinations, it is highly beneficial to complement these with other processing methodologies to assess online reading, as recently shown by Müller and Mari (2021). By using self-paced reading measures, they demonstrated that *definite descriptions* (e.g., Roberts, 2003) led to longer reading times when produced in implausible contexts, and were thus able to replicate findings of Singh et al. (2016) in French. However, when using eye-tracking measures (first fixation duration, first-pass reading times and regression path times), Müller and Mari (2021) failed to observe similar reading time differences in the measurements corresponding to the online processing. The findings of the study thus show that complementing online measurements is highly beneficial to obtain a wider and more reliable picture of the effects under scrutiny.

Finally, there is also uncertainty whether the findings of Recio Fernández (2020) can be applied to other languages than Spanish. Given that coherence relations are expressed differently across languages (e.g., Kanno, 1986) and since

cross-linguistic studies demonstrate that readers from differing L1 process discourse and connectives differently (Blumenthal-Dramé, 2020), reading experiments in other languages (and L1 – L2 pairs) are necessary to reach appropriate generalizability.

## 5 Our study and hypotheses

In order to obtain a comprehensive picture of the processing of coherence relations in L2, and to assess the potential benefit that connectives can bring to L2 reading, we present two experiments, based on the work of Recio Fernández (2020) and Wetzel et al. (2022), which will enable us to answer the following research questions:

a) To what extent do non-native readers of French benefit from the presence of discourse connectives while reading?
b) In the case of a wrongly used connective, do non-native readers still rely on the connective?
c) Do non-native readers of French process discontinuous relations more slowly than continuous ones (cf. Recio Fernández, 2020)?
d) Is the effect of the coherence relation equally visible when comparing incorrectly marked concession relations and correctly marked ones?

In order to assess these research questions, we measured self-paced reading times of native and non-native readers of French for causal and concessive sentences that are presented either *with* or *without* a correct connective (experiment 1) and either with a *correct* or with an *incorrect* connective (experiment 2).

Testing these two types of relations enables us to assess whether reading in L2 follows the cognitive principles established for native readers by Sanders (2005) and Murray (1997; see also Segal et al., 1991). These principles suggest that readers expect discourse to proceed in a continuous and causal manner and show disruptions when these expectations are not fulfilled. Continuous and discontinuous relations are, in consequence, read at a different pace and readers need more time to integrate the meaning of more complex relations (Köhne and Demberg, 2013). In the context of L2 reading, there is supporting evidence to this hypothesis by Recio Fernández (2020) for Spanish.

Also, causal and concessive relations differ in their degree of implicitness, as causes can be easily identified even without an explicit marking (Sanders, 2005), whereas concessions need to be marked explicitly (Murray, 1995). Given that these principles are grounded in general cognitive ones, we expect a similar

effect for non-native readers of French, however with generally slower reading times compared to native readers, since reading in L2 is generally more demanding than reading in L1.

We also expect differences regarding the reliance on connectives, as non-native readers might not have a native-like sensibility to connectives and rely more on the propositional content of a sentence. Hence, they should not be able to detect losses of coherence, especially for concessive relations in which the connective is missing. Thus, while native readers should be affected by implicitly marked concessions, non-native readers should show less pronounced disruptions of reading fluency in this condition.

# 6 Experiment 1: Implicit marking of coherence relations

In this experiment, we test how missing connectives affect the online processing of native and non-native readers of French. We measure reading times for two types of relations, a causal relation and a concessive one, that are either marked with a connective or conveyed implicitly. We have the following hypotheses:

*Hypothesis 1*: When comparing explicitly marked concessions and causes, segments introduced by concessions should trigger slower reading times, given their higher cognitive complexity (Sanders et al., 1992). As this assumption is based on general cognitive principles, we expect the same effect for both speakers' groups, native or non-native.

*Hypothesis 2*: Segments introduced by implicit causes should not trigger slower reading times compared to segments introduced by explicit causes, as causality can be understood when left implicit (Sanders, 2005). Once more, this effect should be the same for both native and non-native readers.

*Hypothesis 3*: In the case of segments introduced by implicit concessions, the absence of the connective creates incoherence (Murray, 1995), which should negatively affect reading times in native readers. Yet, for non-native readers implicit concessions should not trigger reading disruption of following segments in comparison to explicitly marked ones, as non-native readers tend to rely more on lexical propositional cues than on functional procedural ones (Papadopoulou and Clahsen, 2003).

## 6.1 Participants

We recruited participants via the online platform *Prolific* (Oxford, UK, www.prolific.co). For the non-native speakers' group, we recruited 53 non-native participants that had English as their L1 and that indicated to be able to speak French (participants who declared to be bilingual were excluded). As we had to exclude four participants due to failed attention checks (see below), the data from 49 non-native participants was analyzed (44f, in mean 36.6 yo, SD = 12.8). Language proficiency scores (as reported below) indicated a rather high level of language proficiency. For the control group, we recruited 65 French native participants (33f, in mean 27.5 yo, SD = 8.2).

All participants were compensated with 3.15 GBP and gave informed content for inclusion. We only recruited participants that showed a satisfying participation in previous studies on the *prolific* platform (minimum of 95% approved participations).

## 6.2 Design

We conducted a web-based self-paced reading task with two variables: the *type of coherence relation* (cause vs. concession) and the *type of marking* (explicit vs. implicit), using 4 lists of items that were presented in a 2x2 Latin square design. We additionally measured French proficiency by using the French version of the vocabulary task *Lextale* (Brysbaert, 2013). Lextale scores have been shown to be a valid and robust measurement of second language proficiency, and they have been shown to correlate with connectives' mastery in offline tasks (e.g., Wetzel et al. 2020). The task will be presented in more detail in Section 5.4.

## 6.3 Materials

We created 40 experimental and 45 filler items, based on the items used by Wetzel, Zufferey and Gygax (2022). More precisely, we took the correct versions of concessions and causes of Wetzel et al.'s first experiment in order to obtain explicitly marked causes and concessions (example 2 and 3). In order to obtain implicit versions, we simply removed the connectives, as in examples (4) and (5).

(2) *Nadia adore tous les animaux à fourrure, donc elle a toujours eu un chat.*
'Nadia loves all furry animals, so she always had a cat.'

(3) *Nadia a peur de tous les animaux à fourrure, mais elle a toujours eu un chat.*
'Nadia is afraid of all furry animals, but she has always had a cat.'

(4) *Nadia adore tous les animaux à fourrure, elle a toujours eu un chat.*
'Nadia loves all furry animals, she always had a cat.'

(5) *Nadia a peur de tous les animaux à fourrure, elle a toujours eu un chat.*
'Nadia is afraid of all furry animals, she has always had a cat.'

Filler items also consisted of two clauses that were linked by different French pronouns (such as *à laquelle* 'to which' or *duquel* 'from which'). As shown in example (6), we segmented each item into seven segments for which we measured reading times (the segments' numbers are given in parentheses).

(6) *Nadia adore (1) // tous les animaux (2) // à fourrure, (3) // donc (4) // elle a (5) // toujours eu (6) // un chat. (7) //*
'Nadia loves (1) // all animals (2) // with fur, (3) // so (4) // she has (5) // always had (6) // a cat. (7) //'

In order to preserve reading as natural as possible, we did not instruct readers to read these segments as quickly as possible. After every item (including the filler items) a verification question, as in (7) was presented to which participants responded either affirmatively (by pressing *v* for *vrai* 'true') or negatively (by pressing *f* for *faux* 'false').

(7) *Nadia a toujours eu un chien. Vrai ou faux ?*
'Nadia has always had a dog. True or false?'

While verification questions that followed experimental items referred to the second part of the sentence, the verification questions for the filler items referred to the first part of the sentence. Thus, participants were obliged to read attentively all parts of the sentences, as they could not guess which part of the sentence the question would address. As these questions functioned as wrap-up segments of the preceding sentence, recording response times enabled us to observe potential spill-over effects of the reading fluency (as in Wetzel et al., 2022; Crible et al., 2021). In addition, based on the response given to the question, we excluded participants who did not truly read the sentences (at a threshold of 75% of correct answers).

## 6.4 Procedure

Before the experiment, a consent form was displayed using *Qualtrics* (Qualtrics LLC, Provo, UT, USA). After participants agreed to it, they were guided off *Qualtrics* to the actual experiment which was designed using the *Psychopy* software (Peirce et al., 2019; version 2020.20) and hosted on *Pavlovia* servers.

Participants were instructed to read each sentence, segment by segment, and to respond to the corresponding verification question. Two training items were presented before the actual experiment in order to familiarize the participants with the task. Before every sentence, participants had to press the space bar in order to start reading the first segment, and to confirm that they were ready. After doing so, a red cross lasted for 1 second at the place where the first segment of the sentence would appear. Each segment of the sentence was presented isolated in mid-screen in an easy-to-read black font. The participants had to press the space bar in order to move on to the next segment, allowing us to measure reading times for each segment. After completing the main task, the participants performed the French version of the vocabulary task *Lextale* (Brysbaert, 2013). In this task, we presented 56 real existing French and 28 non-existing but morphologically plausible words, for each of which participants had to decide whether they identified it as a real existing French word or not. For every correctly identified word we awarded one point, for every incorrectly identified word we deducted one point. Hence, the maximum score was 56 points. The whole experiment lasted approximatively 30 minutes.

## 6.5 Analysis

### 6.5.1 Lextale scores

Lextale scores are reported in Table 1.[2] As expected, native and non-native readers significantly differed in their language proficiency, as measured by the Lextale task ($t$[55]= 14.44, $p$ < .00001).

**Table 1:** First experiment: Lextale scores for all participants.

| | Mean | SD | % |
|---|---|---|---|
| Native readers | 45.2 | 6.9 | 81 |
| Non-native readers | 23.2 | 9.4 | 42 |

**2** In comparison, in Wetzel et al. (2020), non-native French learning students at a B1 – B2 level were tested. Their mean score in the Lextale task was of 14.69 (SD = 8.37, 26%).

### 6.5.2 Main analyses

We conducted linear mixed models using the *R* software (R Core Team, 2020) on the reading times of the last three segments as well as the response times to the verification questions (i.e., all regions that did not differ across all conditions). All models were built following the procedure of Baayen (Baayen, 2008), meaning that for each added fixed effect, the resulting model was compared to the model that did not contain it. We assessed the improvement of the models by conducting log-likelihood-tests using the *anova()* function of the *stats* package (version 3.6.2, R Core Team, 2020). We obtained significance levels using the *summary()* function of the *base* package (version 3.6.2, R Core Team, 2020); for interactions we conducted post-hoc comparisons using the *glht()* function of the *multcomp* package (Hothorn et al., 2008). All our models, including the null models, contained *Participants* and *Items* as random effects. As the reading times were positively skewed (as measured by the *skewness()* function of the *moments* package, Komsta and Novomestky, 2015), we set cut-off values at 0.5 and 4 sec for the sentence's segments and 0.5 and 8 seconds for the comprehension question and conducted log-transformations (as in Crible et al., 2021). Visual representations of our data then indicated a normal distribution. When analyzing response times, we did not dissociate between correct and incorrect answers, as we were merely interested in potential spill-over effects of reading at this wrap-up region. As we anticipated a high difference in reading times between native and non-native readers, we conducted separate analyses for both language groups (as in Crible et al., 2021). The outputs of all our models are reported in Table 2.

**Table 2:** Outputs from our models.

| **Native readers** | | | | | | |
|---|---|---|---|---|---|---|
| *Segment 5* | | *β* | *SE* | *df* | *t* | *Pr(>\|t\|)* |
| | (Intercept) | −1.12 | .06 | 70.61 | −20.44 | **< $2^{e-16}$** *** |
| | Marking implicit | .11 | .02 | 2453.16 | 6.42 | **$1.67^{e-10}$** *** |
| *Segment 6* | | | | | | |
| | (Intercept) | −1.09 | .06 | 71.28 | −18.29 | **< $2^{e-16}$** *** |
| | Marking implicit | −0.05 | .02 | 2442.28 | −2.91 | **.0036** ** |
| *Segment 7* | | | | | | |
| | (Intercept) | $-1.00^{e+00}$ | $5.40^{e-02}$ | $7.96^{e+01}$ | −18.58 | **< $2^{e-16}$** *** |
| | Relation consequence | $-1.08^{e-03}$ | $2.15^{e-02}$ | $2.45^{e+03}$ | −0.05 | .96 |
| | Marking implicit | $6.20^{e-02}$ | $2.16^{e-02}$ | $2.44^{e+03}$ | 2.87 | **< .01** ** |
| | Relation consequence: Marking implicit | $-7.56^{e-02}$ | $3.05^{e-02}$ | $2.44^{e+03}$ | −2.48 | **< .05** * |

**Table 2** (continued)

| | | | | | | |
|---|---|---|---|---|---|---|
| *Verification question* | | | | | | |
| | (Intercept) | 1.07 | .02 | 111.50 | 43.95 | **< $2^{e-16}$** *** |
| | Relation consequence | −0.04 | .01 | 2461.88 | −3.48 | **< .001**** |
| | Marking implicit | 0.04 | .01 | 2463.13 | 3.36 | **< .001** *** |
| | Relation consequence: Marking implicit | −0.03 | .02 | 2461.96 | −1.95 | .05 |
| **Non−native readers** | | | | | | |
| *Segment 5* | | | | | | |
| | (Intercept) | −0.66 | .06 | 75.93 | −11.67 | **<$2^{e-16}$** *** |
| | Marking implicit | .04 | .02 | 1860.28 | 2.29 | **.022** * |
| *Segment 6* | | | | | | |
| | (Intercept) | −0.56 | .06 | 70.77 | −9.19 | **1.07$^{e-13}$** *** |
| | Marking implicit | −0.07 | .92 | 1865.31 | −3.96 | **7.81$^{e-05}$** *** |
| *Segment 7* | | | | | | |
| | (Intercept) | −0.52 | .06 | 68.65 | −9.31 | **8.68$^{e-14}$** *** |
| | Relation consequence | −0.06 | .02 | 1866.51 | −4.00 | **6.53$^{e-05}$** *** |
| *Verification question* | | | | | | |
| | (Intercept) | 2.24 | .03 | 87.45 | 43.36 | **< $2^{e-16}$** *** |
| | Relation consequence | −0.04 | .01 | 1843.84 | −3.16 | **< .005** ** |
| | Marking implicit | .03 | .01 | 1842.59 | 2.18 | **< .05** * |
| | Relation consequence: Marking implicit | −0.04 | .02 | 1843.82 | −1.94 | .05 |

Significant codes: > 0: '***', > 0.001: '**', > 0.01: '*'

In Segment 5, for both native and non-native models, the fit of the model improved by adding *Marking* (i.e., implicit or explicit marking; improvement for the model for the L1 group: $\chi^2 = 40.82$, df = 1, p = $1.67^{e-10}$; L2 group: $\chi^2 = 5.24$, df = 1, $p < .05$). As apparent in Table 2, reading times of Segment 5 were faster when explicitly marked, both for native and non-native readers. In the following segment (i.e., Segment 6), *Marking* also improved the models (L1 group: $\chi^2 = 8.48$, df = 1, $p < .005$, L2 group: $\chi^2 = 15.61$, df = 1, $p = 7.79^{e-05}$), but for both groups reading times were this time faster for implicitly marked segments (see Table 2).

For Segment 7, models differed when considering native and non-native readers (see Figure 1). For native readers, adding *Marking* did not improve the random model's fit ($\chi^2 = 2.44$, df = 1, $p = .12$), yet *Relation* did ($\chi^2 = 6.37$. df = 1, $p < .05$). Adding *Marking* (main and interaction effects) further improved the model ($\chi^2 = 8.63$, df = 2, $p < .05$). Post-hoc comparisons revealed that Segment 7 was read more slowly when introduced by implicit concessions (compared to

*explicit concessions*: $\beta$ = .06, SE = .02, $z$ = 2.87, $p$ < .05; to *implicit causes*: $\beta$ = .01, SE = 0.02, $z$ =-0.6, p < .01; and to *explicit causes*: $\beta$ = .06, SE =.02; $z$ = -2.91, $p$ < .05).

For non-native readers, adding *Marking* did not improve the random model's fit ($\chi^2$ = .12, df = 1, p = .73). Adding *Relation* did ($\chi^2$ = 15.95, df = 1, p = $6.52^{e-05}$). This time, adding *Marking* (main and interaction effects) did not further improve the model ($\chi^2$ = .64, df = 2, p = .73). For non-native readers, differences in reading times were only apparent when comparing relations, independent of marking (see also Figure 1).

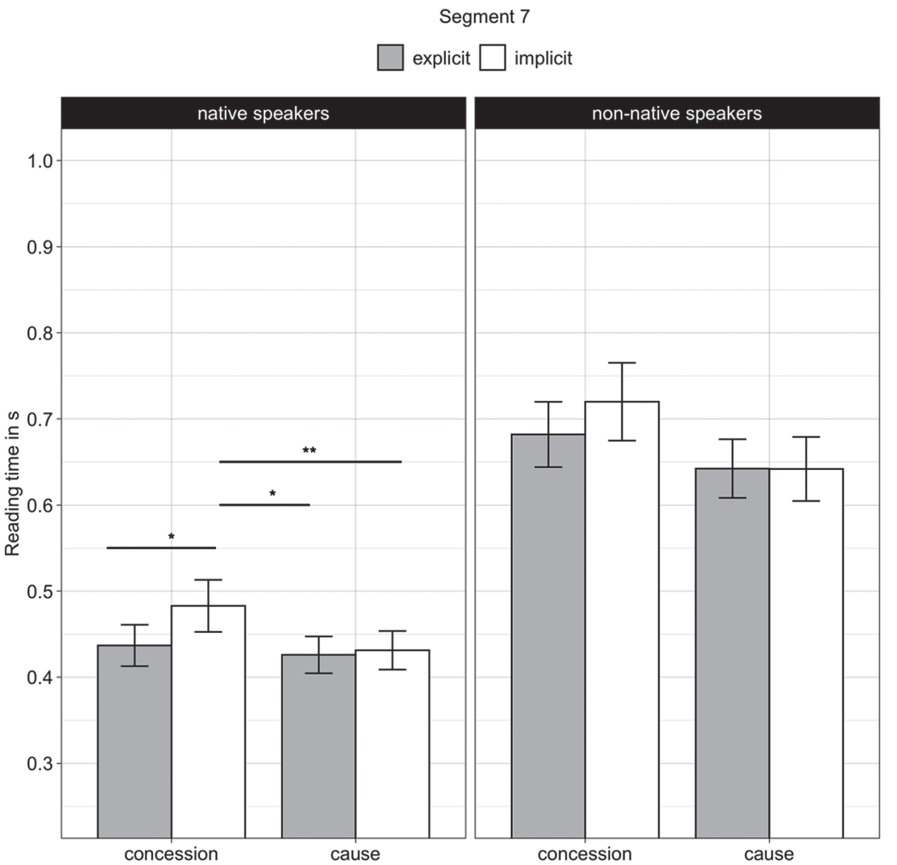


**Figure 1:** First experiment: reading times for segment 7. Main effect of *Relation* for non-native readers. Post-hoc comparisons indicated for native readers (CI of 95% as error bars).

For native readers, in the wrap up region of the sentence (i.e., the response times to the verification question), adding *Marking* improved the random model's fit

($\chi^2$ = 7.55, df = 1, $p$ < .01). Further adding *Relation* (main and interaction effects) also did ($\chi^2$ = 50.27, df = 2, $p$ = 1.22$^{e-11}$). Although the interaction of Marking by Relation was at the limit of significance[3] ($p$ =.05, see Table 2 and Figure 2), simultaneous tests for general linear hypotheses using the *glht()* function of the *multcomp* package (Hothorn et al., 2008) showed that response times in the *implicit concession* condition differed from all other conditions (compared to *explicit concessions*: $\beta$ =.04, SE = .01, z = 3.36, p < .01; to *implicit causes*: $\beta$ = .08, SE = .01, $z$ = −6.2, $p$ < .001; and to *explicit causes*: $\beta$ = .08, SE = .01, $z$ = −6.82, $p$ < .001). Also, we observed that native readers also responded faster to questions that were primed by explicit causes than those primed by explicit concessions ($\beta$ = −0.04, SE =.01, $z$ = −3.48, $p$ < .01).

For non-native readers, adding *Marking* did not improve the random model's fit ($\chi^2$ = 1.21, df = 1, p = .27). However, adding *Relation* ($\chi^2$ = 40.27, df = 1, p = 2.21$^{e-10}$) did. Further adding *Marking* (main and interaction effects) did only marginally improve the model's fit ($\chi^2$ = 5.06 df = 2, p = .08). Additional simultaneous tests for general linear hypotheses showed no significant differences between response times for implicit and explicit concessions ($\beta$ = .03, SE = .01, $t$ = 2.18, $p$ = .13), as well as no difference between implicit and explicit causes, ($\beta$ = .01, SE = .01, $t$ = −0.57, $p$ = .94). Non-native readers were not really affected by the different markings (i.e., implicit or explicit); yet, were always slower to respond to questions related to sentences introduced by concessions than by causes.

## 6.6 Discussion

In this experiment, we conducted a self-paced reading task for native and non-native readers of French, in which we presented sentences containing two types of coherence relations (i.e., cause and concession) that were presented with and without an appropriate connective (see also Loureda et al., this volume, chapter 2).

Firstly, we observed in segment 5 that all readers, independently of language group, tended to read implicitly marked sentences more slowly than explicitly marked ones. As segment 5 was the segment that directly followed the connective in the explicit versions, we conclude that connectives speeded up reading, even for non-native readers. Then, in the following segment, we observed that readers needed time to integrate the meaning of the connectives in the explicit version.

**3** When adopting a 50% threshold for correct responses to the verification questions (i.e., instead of 75%), the interaction seemed to become clearer (p<.05). We would suggest that shallower readers (i.e., less accurate ones) may struggle even more with implicitly marked concessions (i.e., the source of the interaction).

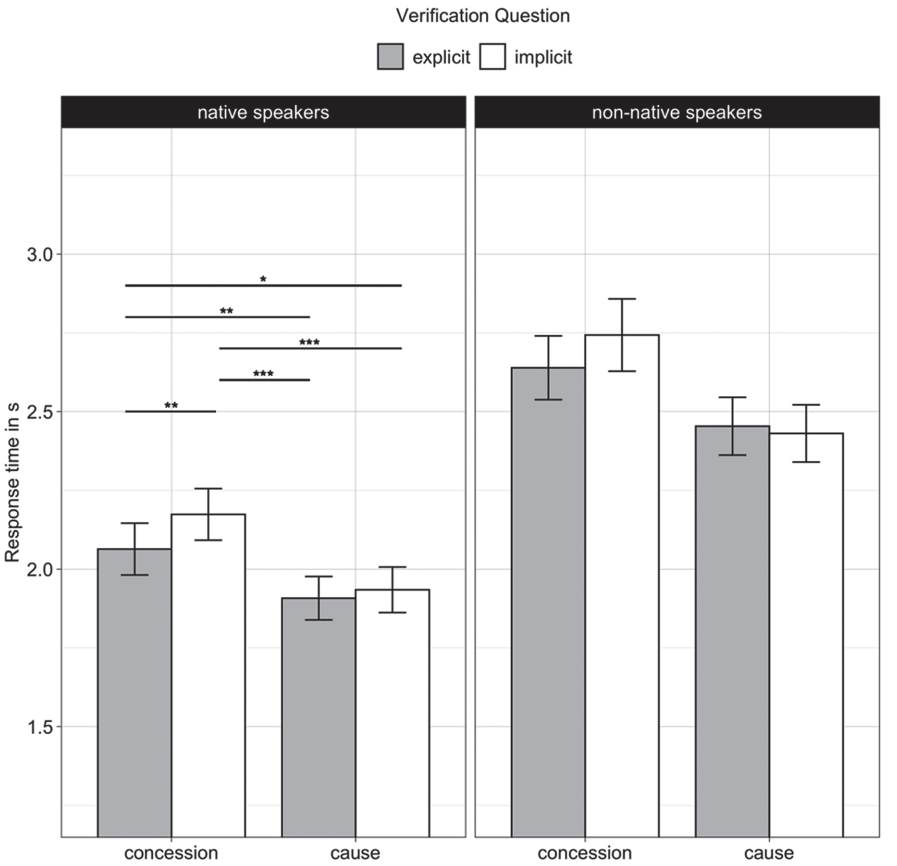


**Figure 2:** First experiment: response times to the verification question. General effect of *Relation* for non-native readers. Post-hoc comparison indicated for native readers (CI of 95% as error bars).

While this effect was once more expected for native readers (e.g., Zufferey and Gygax, 2017), the fact that non-native readers also showed an immediate benefit from the connective confirms that they actively processed the sentences.

In the following segments, both native and non-native readers consistently processed causal sentences faster than concessions (confirming Hypothesis 1), which is indicative of the higher complexity of concessive over causal relations (Sanders, 2005). This finding is remarkable, especially in the context of second language reading, as it indicates that reading in a L2, although cognitively more demanding than reading in a L1, follows the same cognitive principles. Also, the finding that implicit causes did not trigger longer reading times than explicit causes for non-native readers shows that they were able to construct a causal meaning

despite a 'missing' connective (confirming Hypothesis 2). Yet, we also observed important differences between native and non-native readers in the last segment and the verification questions: contrary to native readers, it appeared that non-native readers were not affected by implicit concessions (confirming Hypothesis 3). It appears, therefore, that the non-native readers relied less on the presence of connectives and were focusing on the linguistic content of the segments.

Taken together, the results of this first experiment indicate that L2 processing follows similar cognitive principles as L1 processing regarding the complexity of coherence relations, but that non-native readers focus less on connectives. It appears that non-native readers rely more on the content of the segments than on the signal provided by the connective. This became visible especially for the implicit concessions, as non-native readers did not process versions with a missing connective differently than explicit ones, although the implicit concession created incoherence, as evidenced by the observed processing disruption for native readers.

Still, one could argue that the incoherence of implicit concessions can be resolved, as it is caused by missing, not contradictory, information. This finding raises an intriguing question: are non-native readers also unaffected by incoherence that cannot so easily be resolved? For example, in the case of a wrong use of a connective, non-native readers might not be able to easily draw alternative coherent interpretations. To address this question, we assessed in the following experiment whether incoherence due to incorrectly used connectives affects the reading fluency of non-native readers of French, and compared it to the data collected in Wetzel et al. (2022) for the same experiment on L1 readers.

# 7 Experiment 2: Incorrect marking of coherence relations

In our second experiment, we assess whether native and non-native readers are affected by non-resolvable (or at least, hardly resolvable) incoherence due to an incorrect use of connectives. We have the following hypotheses:

*Hypothesis 1*: Native readers should show slower reading times of segments that are introduced by incorrect connectives, regardless of the coherence relation.

*Hypothesis 2:* As non-native readers may rely more on lexical cues, reading disruption of segments introduced by incorrect uses of frequent connectives

should only be – if present – temporary or limited (i.e., they should become apparent in some segments but not all).

*Hypothesis 3:* When comparing reading times for segments introduced by incorrectly used connectives, an incorrect concessive connective should trigger (even) slower reading times than an incorrect causal one – for both native and non-native readers –, as concession involves more complex processing (as evidenced in Experiment 1).

## 7.1 Participants

We recruited participants via the internet platform *prolific*[4] and analyzed the reading times of 61 French native participants (27 female; in mean 31.4 yo, SD = 11.3y) and, after excluding 10 participants due to failed attention checks, of 47 non-native participants (35 female; in mean 42 yo, SD = 15.8y). As in Experiment 1, we measured, for both groups, language proficiency in French using the *Lextale* task. Also, all participants were compensated with 3.15 GBP. All participants gave informed consent for inclusion and none of the participants had participated in Experiment 1.

## 7.2 Design

The design of this experiment was the same as for the first experiment, but this time we tested – instead of *implicit* and *explicit* marking – *correct* and *incorrect* markings of the causal and concessive sentences.

## 7.3 Materials

For the correct versions of the items, we used the explicit items of Experiment 1. In order to obtain incorrect versions, we simply exchanged the connectives, in other words we used the concessive connective in causal sentences (8) and the causal connective in concessive sentences (9).

**4** As mentioned earlier, we used Wetzel et al.'s (2022) data for the exact same experiment on native readers to compare to the present non-native readers' results.

(8) *Nadia adore tous les animaux à fourrure, mais elle a toujours eu un chat.*
'Nadia loves all furry animals, but she always had a cat.'

(9) *Nadia a peur de tous les animaux à fourrure, donc elle a toujours eu un chat.*
'Nadia is afraid of all furry animals, so she has always had a cat.'

As these examples illustrate, the incorrect uses of connectives create incoherence that cannot be easily resolved.

## 7.4 Procedure

The procedure was the same as in Experiment 1, as described in Section 6.5.

## 7.5 Analysis

### 7.5.1 Lextale scores

Lextale scores are reported in Table 3. The language proficiency scores in this experiment were highly comparable to the one of the first experiment, and showed significant differences between language groups ($t$[55]= 13.02, $p$ < .00001).

**Table 3:** Second experiment: Lextale scores for all participants.

| | Mean | SD | % |
|---|---|---|---|
| Native readers | 45.4 | 6.6 | 81 |
| Non-native readers | 26.0 | 10.1 | 47 |

### 7.5.2 Main analysis

We conducted our analyses following the same strategy as in Experiment 1, described in Section 5.5. The outputs of all our models are reported in Table 5.

For the two groups of readers, we did not observe any effect of *Marking* (correct or incorrect) nor of the type of *Relation* in Segment 5 (see Table 4 for the lack of improvement of the models when fixed effects were added to the model).

**Table 4:** Experiment 2, Segment 5: improvement of models when fixed effects were added.

| **Native readers** | | | |
|---|---|---|---|
| | improvement of the model | | |
| *added fixed effect* | *CHI* | *df* | *Pr(>Chisq)* |
| Marking | .16 | 1 | .68 |
| Relation | 2.39 | 1 | .12 |
| **Non-native readers** | | | |
| Marking | 1.15 | 1 | .28 |
| Relation | 2.86 | 1 | .10 |

For reading times of Segment 6, adding *Marking* to the model improved the random model's fit, for both native ($\chi^2$= 4.83, df =1, $p$ <.05) and non-native readers ($\chi^2$=17.59, df = 1, $p$ = $2.74^{e-05}$). When Segment 6 was introduced by an incorrect connective, it was read more slowly than when introduced by a correct one, and this for all readers (see Table 5).

**Table 5:** Outputs for all our models.

| **Native readers** | | | | | | |
|---|---|---|---|---|---|---|
| *Segment 6* | | *B* | *SE* | *df* | *t* | *Pr(>\|t\|)* |
| | (Intercept) | −1.11 | .06 | 67.22 | −17.61 | **< $2^{e-16}$***** |
| | Marking incorrect | .04 | .02 | 2293.21 | 2.20 | **.03*** |
| *Segment 7* | | | | | | |
| | (Intercept) | −0.90 | .05 | 75.85 | −16.73 | **< $2^{e-16}$***** |
| | Marking incorrect | −0.70 | .02 | 2310.89 | −3.25 | **< .005**** |
| | Relation consequence | −0.06 | .02 | 2317.26 | −2.76 | **< .01**** |
| | Marking incorrect: Relation consequence | .05 | .03 | 2316.56 | 1.55 | .12 |
| *Verification question* | | | | | | |
| | (Intercept) | .66 | .04 | 109.36 | 17.77 | **< $2^{e-16}$***** |
| | Marking incorrect | −0.06 | .02 | 2324.06 | −3.52 | **< .001***** |
| | Relation consequence | −0.08 | .02 | 2326.00 | −4.32 | **1.63$^{e-05}$***** |
| | Marking incorrect: Relation consequence | .02 | .03 | 2326.25 | .65 | .52 |
| **Non −native readers** | | | | | | |
| *Segment 6* | | | | | | |
| | (Intercept) | −0.50 | .06 | 65.08 | −8.09 | **2.00$^{e-11}$***** |
| | Marking incorrect | .08 | .02 | 1756.48 | 4.20 | **2.75$^{e-05}$***** |

**Table 5** (continued)

| | | | | | | |
|---|---|---|---|---|---|---|
| *Segment 7* | | | | | | |
| | (Intercept) | −0.48 | .06 | 62.65 | −8.60 | **3.29$^{e-12}$*** |
| | Marking incorrect | .10 | .02 | 1761.95 | 5.50 | **4.27$^{e-08}$*** |
| *Verification question* | | | | | | |
| | (Intercept) | −0.22 | .06 | 65.79 | −3.46 | **< .001*** |
| | Marking incorrect | 0.12 | .02 | 1680.55 | 5.20 | **2.22$^{e-07}$*** |
| | Relation consequence | −0.48 | .02 | 1680.66 | −2.00 | **< .05*** |
| | Marking incorrect: Relation consequence | −0.07 | .03 | 1680.59 | −1.99 | **< .05*** |

Significant codes: > 0: '***', > 0.001: '**', > 0.01: '*'

For Segment 7, models differed when considering native and non-native readers (see Figure 3). For native readers, adding *Marking* improved the random model's fit ($\chi^2$ = 9.30, df = 1, $p$ <.005). Adding *Relation* (main and interaction effects) further improved the model ($\chi^2$ = 7.91, df = 2, $p$ <.05). Although the interaction of Marking by Relation was marginal (p = .12; see Table 5), simultaneous tests for general linear hypotheses using the *glht()* function of the *multcomp* package (Hothorn et al., 2008) showed that reading times for incorrectly marked concessions differed from all other conditions (in comparison to correctly marked concessions: $\beta$ = .07, SE = .02, z = 3.25, $p$ < .01; to correctly marked causes: $\beta$ = .08, SE = .02, $z$ = 3.82, $p$ < .001; and to incorrectly marked causes: $\beta$ = .06, SE = .02, z = –2.76, $p$ < .05).

For non-native readers, adding *Marking* improved the random model's fit ($\chi^2$= 25.24, df = 1, p = 5.06$^{e-07}$). Further adding the *Relation* (main and interaction effects) did not ($\chi^2$= 2.71, df = 2, $p$ = .26). For non-native readers, slower reading times were only apparent when Segment 7 was introduced by an incorrect connective, but independent of the relation conveyed.

For the native readers, in the wrap up region of the sentence (i.e., the response times to the verification question, see Figure 4), adding *Marking* improved the random model's fit ($\chi^2$ =18.36, df = 1, $p$ = 1.83$^{e-05}$). Further adding *Relation* (main and interaction effects) also did (30.14, df = 2, $p$ = 2.85$^{e-07}$). As the interaction of *Marking* by *Relation* was not even close to the limit of significance (see Table 5 and Figure 4), we did not perform post-hoc comparisons.

For the non-native readers, adding *Marking* did improve the random models' fit ($\chi^2$ = 28.43, df = 1, $p$ = 9.73$^{e-08}$). Further adding *Relation* (main and interaction effects) also did ($\chi^2$ =26.67, df = 2, $p$ = 1.62$^{e-06}$). Post-hoc comparisons showed that only the condition of incorrectly marked concessions differed significantly from correctly marked concessions ($\beta$ = .10, SE = .02, $z$ = 5.19, $p$ < .001), from correctly

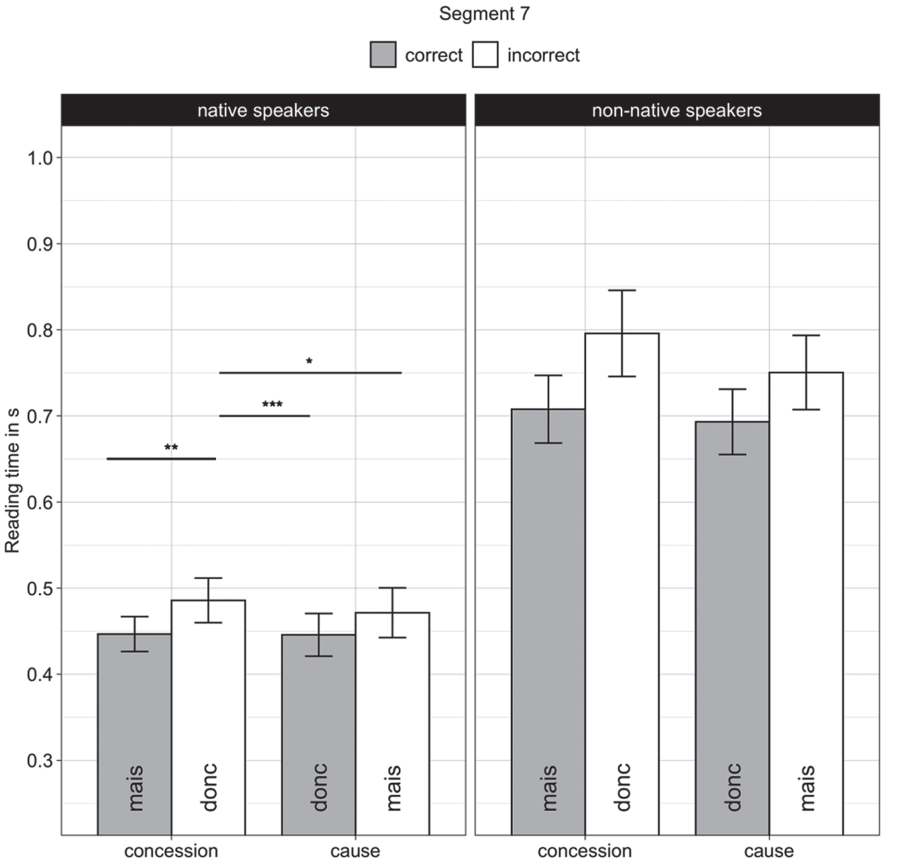


**Figure 3:** Second experiment: reading times for segment 7 for both native and non-native readers. Effect of marking for non-native readers, post-hoc comparisons indicated for native readers (CI of 95% as error bars.)

marked causes ($\beta$ = .15, SE = .02, $z$ = 7.5, $p$ < .001), and from incorrectly marked causes ($\beta$ = .12. SE = .02, $z$ =–5.42, $p$ < .001). Conversely, response times did not significantly differ whether the preceding causal sentences were correctly marked or not ($\beta$ = .04, SE = .02, $z$ = 2.02, $p$ = .18).

## 7.6 Discussion

In this second experiment, we assessed the extent to which reading in L2 was affected when connectives provide a misleading instruction to interpret target sentences (i.e., creating incoherence). We expected, given that non-native readers

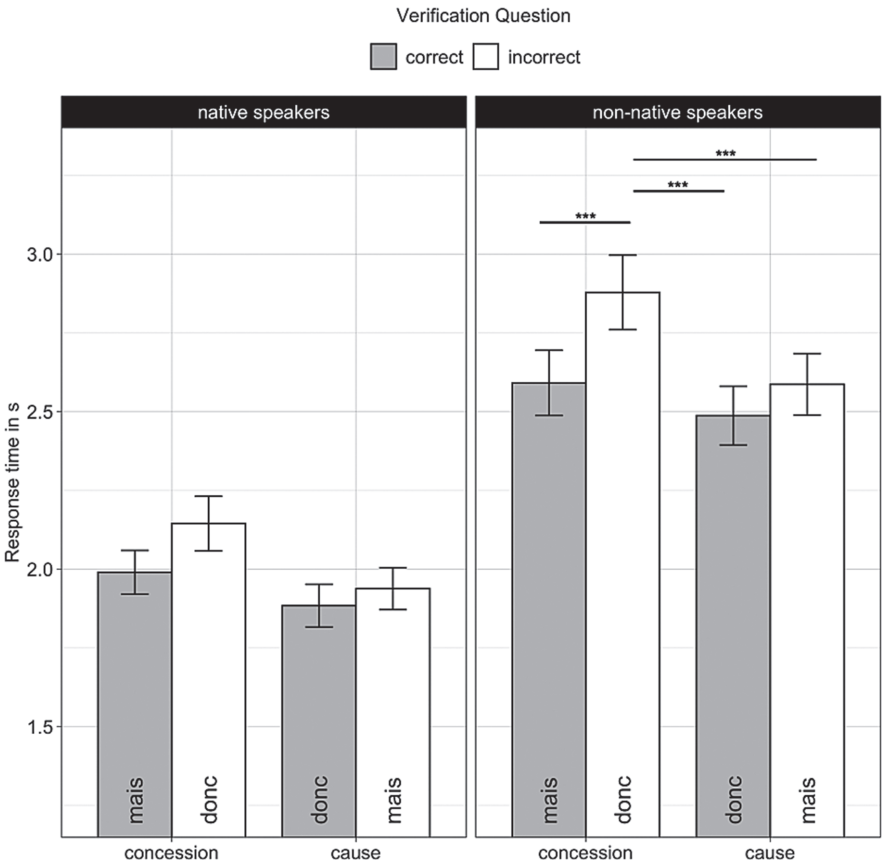


**Figure 4:** Second experiment: response times to the verification question for native and non-native readers. Post-hoc comparisons indicated (CI of 95% as error bars).

appeared to rely less on connectives in the first experiment, that we would observe less pronounced effects for an incorrect marking as well. As in Experiment 1, we measured once more the reading times of native and non-native readers of French for causal and concessive relations, that were however this time *correctly* and *incorrectly* marked by connectives.

In segment 5, we did not observe an effect of marking, which is not surprising, given that all sentences in this experiment were explicit and that different outcomes of the sentence were still possible at this time. In contrast, we observed in the pre-final segment (i.e., segment 6), that incorrectly marked sentences were read more slowly than correctly marked ones, showing that both native and non-native readers were affected by incoherence quite early during processing.

Our results indicate that, generally, native readers were affected by incorrectly marked relations (confirming Prediction 1). However, segments introduced by incorrectly marked concessive relations appeared to be slower to read, the highest disruptive effects being present for the final segment (confirming Prediction 3). It appears thus that processing disruptions due to incorrect marking emerges especially for more complex relations.

Non-native readers were affected by incorrectly marked sentences throughout the experiment. Interestingly, non-native readers were also affected by incorrectly marked concessions (confirming Prediction 3), yet showed only a somewhat delayed effect, that is, only response times to the verification questions were affected (confirming Prediction 2). Also, the incoherence due to incorrect marking for causal relations did only temporarily affect reading, as we did not observe any difference between incorrectly and correctly marked causes in the response times to the verification questions (confirming Prediction 2). These findings cannot be explained by a low level of language proficiency: Lextale scores indicated that all non-native readers were quite proficient. In addition, non-native readers were affected by incoherence quite early, showing that they read the sentences attentively.

In line with our first experiment, our results hint therefore to the conclusion that non-native readers rely less on connectives and focus more on the lexical content. Yet, these results should be taken with a pinch of salt, and that for two reasons. First, there was no true interaction effect of *Marking* by *Relation* when native readers responded to the verification questions, making it difficult to run the same post-hoc comparisons for both speaker groups. Secondly, as can be seen in the data visualizations, the (potential) effects look rather subtle (if they are true). Future research should assess if (and if so, how) incoherent sentences are generally resolved or rejected differently depending on the coherence relation.

Still, non-native readers were affected by incoherence introduced by incorrect connectives, thus indicating that they do process the connective, even if some effects were only apparent in later measures (i.e., response times to verification questions for sentences introduced by a concessive connective, and the final segment for sentences introduced by a causal connective).

# 8 General discussion

In this chapter, we tested the hypothesis that, in comparison to native readers, non-native readers would rely less on connectives while reading, as reading in L2 is a cognitively demanding task (Clahsen and Felser, 2006a; 2006b). Also, we

argued that cognitive principles evidenced for native readers, such as a higher cognitive cost for concessive relations (Sanders et al. 1992) would also apply to reading in a L2. In order to substantiate these assumptions, we conducted two reading experiments with native and non-native readers in French.

The findings of both experiments consistently indicate that reading in L2 follows L1 cognitive principles, as non-native readers generally read concessive sentences more slowly than causal ones. This is in line with theoretical claims (e.g., Sanders, 2005) as well as experimental evidence (e.g., Köhne and Demberg, 2013) for native readers. Causal relations are read faster, due to their simpler structure (e.g., Sanders et al., 1992) and to the expectation that discourse unfolds in a causal manner (Sanders, 2005). As we observed similar reading patterns for non-native readers, we conclude that they were also able to infer the intended coherence relation. As such, our results replicate those obtained by Recio Fernández (2020) for Spanish, suggesting that complex coherence relations affect reading fluency in general, not only in specific languages.

Furthermore, our results suggest that non-native readers rely somewhat less on connectives than native readers. In our first experiment, non-native readers did not read implicit concessions differently than explicit concessions, although this condition strongly affected the reading fluency of native readers. In addition, in our second experiment, non-native readers showed only delayed or temporal disruptions for incorrectly used connectives. Given that we tested extremely frequent connectives, we still believe that non-native readers were able to retrieve the meaning of connectives, presumably even in an effortless manner (considering that they reacted to an incorrect marking already in Segment 6 in Experiment 2). Yet, the processing disruptions due to misleading connectives only occurred temporarily. A possible interpretation is that non-native readers construct coherence relations mainly based on lexical propositional content and rely in comparison to native readers less on functional cues (such as connectives). As a consequence, when the signal of the connective clashes with the overall meaning of a sentence, non-native readers tend to rely more on lexical and semantic content. In this regard, the stronger reliance on lexical cues might be the reason why non-native readers showed only little processing disruptions for implicitly marked concessions (Experiment 1).

This finding is in line with Papadopoulo and Clahsen (2003; see also Felser et al., 2003), who found that non-native and native readers differed in their parsing strategies of sentences containing complex relative clauses (such as "A man called the student of the teacher who seemed disappointed by the new educational system"). According to the authors, non-native readers might struggle to integrate different sources of information and are more strongly guided by lexical cues than by functional ones (Papadopoulou and Clahsen, 2003). Native speakers in contrast show greater ease integrating the meaning of functional cues and

to align them with the lexical or thematic content. Our results support this interpretation with regards to connectives.

Importantly, higher reliance on lexical cues does not imply that L2 learners cannot benefit from connectives, nor that they fail to retrieve their meaning. Indeed, non-native readers were still affected by incoherence due to misleading connectives in Experiment 2, meaning that they were generally able to infer the meaning of the connectives. However, given that these processing disruptions did not persist, or emerged only at a later stage when reading target sentences, we believe that non-native readers were also able to easily ignore the misleading signal of connectives as they relied more on the linguistic content of the sentence.

A potential limitation of our experiments might be that our connectives could be considered polyfunctional (e.g., *mais* can also indicate a contrastive relation). Although we tested the very frequent and primary functions of the connectives (i.e., reducing the possibility that readers struggle to disambiguate their meaning), the polyfunctionality of the connectives tested might have had potential disruptive effects on reading fluency, as participants may have needed time to disambiguate the connective (i.e., choosing its correct meaning). While reading appears to be rather robust for native readers even for less frequent and polyfunctional connectives (Wetzel et al., 2022), especially non-native readers might be affected by their uses and would probably not detect when these connectives are used incorrectly. In this respect, the findings of Zufferey and Gygax (2017) already provide some indication for this claim, as they observed that German speaking non-native readers were unaffected by the loss of incoherence due to an insufficient mastery of the polyfunctional French connective *en effet* ('indeed'). Yet, it remains open whether the observed insufficient mastery of *en effet* is really due to its polyfunctionality or to other characteristics of this connective – such as orthographic similarity to other French connectives (*en fait* 'actually') –, or even to crosslinguistic inferences of a possible L3, such as English (*in fact* or *in effect*). In order to make solid assertions about the potential bias of polyfunctionality in our study, further research is needed.

Another potential limitation and, thus, a question worth investigating, is the impact of readers' profiles (for a discussion of individual differences, see Zufferey et al., this volume, chapter 4). In our experiments, the scope was to address how non-native readers react to incoherence due to missing or misleading connectives and whether this depended on the type of coherence relation. We did so, however, only under the condition that they understood the sentences and regardless of their language proficiency in French. Indeed, in order to address the correlation between the level of language proficiency of non-native readers and their reaction to incoherence, we should have assessed the linguistic profile of our participants in more detail.

Since there might be an additional interaction with the language proficiency in L2, we conclude that more research is needed to assess which dimensions of language proficiency can generally predict a better processing and understanding of discourse connectives and coherence relations.

Finally, research about the way non-native readers process discourse connectives could also take into account pragmatic functions, as for example the function of indicating subjective point of views in causality (e.g., Degand and Pander Maat, 2003). Hence, the findings presented in this chapter are a promising starting point to encourage future research on L2 acquisition and mastery, and more generally on the way non-native readers process discourse.

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