Do teenagers know how to use connectives from the written mode?

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Abstract

Connectives are complex lexical items for children, who do not even master connectives used frequently in speech until the end of their primary school years. In this paper, we assess the ability of two groups of 16-year-olds from two different academic levels (i.e., high school vs. professional school students), as well as a group of university students, to use four French connectives bound to the written mode in a constrained production task. These connectives were chosen to assess three potential sources of difficulties: the cognitive complexity of the encoded discourse relation, the connectives’ frequency in corpus data, and their mono- or polyfunctional nature. Our results indicate that teenagers have a lower ability to use these connectives compared to university students, and frequency appears to be the best-suited factor to account for their difficulties. In addition, the teenage group with a higher academic level reached better accuracy with the two more frequent connectives tested. Taken together, our results indicate that teenagers do not yet have mastery over the wide array of connectives from the written mode in their native language, particularly those that are less frequent in corpus data. These connectives are especially problematic for teenagers with a lower academic background.

Keywords: connectives; language acquisition; written language; experimental study; French

1. Introduction

Discourse connectives are important lexical items to mark discourse coherence, and they play crucial roles in discourse processing and comprehension, at least among adults. When looking at younger populations, connectives have been demonstrated to be challenging for children even at the end of primary school years (e.g., Cain & Nash, 2011). Many studies
have assessed the early emergence of connectives in children’s speech, and their subsequent acquisition during primary school years, yet less is known about later development of the understanding and production of connectives. Studies on early development of the understanding and production of connectives demonstrate that even though children start producing connectives early, they do not truly understand even frequently used connectives in speech, such as because and after, until the end of primary school years (approximately between the age of 10 and 12). To the best of our knowledge, later development has scarcely been examined – between the ages of 12-18 for example – even though it is during this period that teenagers progressively acquire an adult-like ability to understand and produce connectives. In this paper, we argue that a better grasp of the factors underlying the understanding and production of connectives during adolescence can provide important insights into teenagers’ developing discursive competences.

Data on the acquisition of the wide array of connectives bound to the written mode are also lacking due to the fact that only a handful of frequently used connectives in speech, such as because and but, have been examined in previous work, in both the literature on children and adults (e.g., Bloom et al. 1980; Britton et al., 1982). Yet, Indo-European languages all possess a vast repertoire of connectives. For example, the French lexicon of connectives Lexconn (Roze, Danlos, & Muller, 2012) lists as many as 328 connectives. Many of these connectives are used only in the written mode, where they are very frequent (e.g., néanmoins that roughly corresponds to nevertheless in English). The acquisition of these connectives raises specific challenges, as input comes only through reading, and reading competence is well-known to be variable even among adults (Braze et al., 2007). The acquisition path for these connectives remains largely to be established, but it seems likely that their mastery is variable among teenagers depending on their academic level, similarly to what AUTHORS
In this paper, we investigate the ability of 16-year-old teenagers to use four French connectives used mostly in the written mode: aussi, en effet, en outre and toutefois, the same connectives tested on adults by AUTHORS (2019). These connectives were chosen for several reasons. First, they have a frequency of less than one occurrence per 100,000 words in spoken corpora. In other words, they are bound to the written mode, where they are much more frequent (see Table 1). Second, these connectives are used to convey different coherence relations. Aussi, when used in the sentence-initial position, conveys a consequence relation, and is similar to the English therefore. En effet, which does not have an obvious equivalent in English, is used in sentence initial positions as a subjective causal connective that is mostly left implicit in English translations (AUTHOR 1, 2016). En outre, which is roughly equivalent to the English in addition, is used for additive relations. Finally, toutefois is roughly equivalent to the English however, and is used to convey concessive relations.

These connectives were chosen to assess three different potential sources of difficulty: (1) they encode a coherence relation with various degrees of cognitive complexity according to the cognitive model of coherence relations put forward by Sanders, Spooren and Noordman (1992), (2) they have variable frequencies in the written mode, and (3) they diverge in terms of the number of senses that they can express, in other words they are either monofunctional or polyfunctional. These factors are summarized in Table 1.

The two polyfunctional connectives also vary in terms of the dominance of the tested function. On the one hand, the causal uses of en effet covers about 80% of its occurrences in written corpus data (AUTHOR 1, 2016), compared to its less frequent function of confirmation. In the latter function, en effet resembles the English connective indeed. On the other hand, the consequence meaning associated with aussi is markedly less frequent
compared to its other function as an additive connective (similar to the English also), as it covers only about 10% of the occurrences in written corpus data (AUTHORS, 2019). It is important to note that these polyfunctional connectives do not lead to ambiguities, as their two functions are linked to different positions in the sentence. The two relations that we tested are found only in the sentence-initial position, while the other relations are found only in close-medial or close-final positions (Roze et al., 2012).

The frequency of connectives was calculated by averaging their relative number of occurrences in three corpora pertaining to different written genres, namely: Le Monde corpus (newspaper articles); the French portion of the Europarl corpus (argumentative), and a corpus of novels written by Jules Verne (literature). In order to calculate their frequency, the polyfunctional connectives were searched for in only the sentence-initial position, where they conveyed the relevant discourse relation.

Our study aims to determine which of these three factors plays the most important role in explaining teenagers’ potential difficulties with connectives. If frequency plays an important role, we expect teenagers to have more difficulties using aussi and en outre compared to toutefois and en effet, as they are less frequent in corpora. If, by contrast, relation complexity plays a more important role, we expect that en effet and toutefois will lead to more difficulties than en outre and aussi, as these connectives encode cognitively more complex relations (i.e., backward causal relations and concession relations) compared to the other two connectives that encode simpler relations (i.e., additive relations and forward causal relations). Finally, if polyfunctionality plays an important role, we expect en effet and aussi to be more difficult than en outre and toutefois.

In addition to investigating differences between connectives, we also assess the existence of differences between two groups of teenagers: on the one hand, high-school
students who have to attend several French classes each week as part of their curriculum and
who are expected to read a lot to complete their school assignments, and on the other hand,
students attending a professional school involving only part-time schooling in addition to
professional practice, in which French classes and reading play a more marginal role. In the
Swiss schooling system, where our participants were tested, professional schools have a lower
level of academic requirements compared to high-schools. This comparison will therefore
enable us to assess the importance of students’ level of academic competence to develop the
ability to use connectives from the written mode.

The paper is structured as follows. In Section 2, we summarize existing data on the
acquisition of connectives, with a focus on the causes of difficulties that have been discussed
in this literature. In Section 3, we present data illustrating the roles that connectives play for
adult readers during text reading and comprehension, but also underlining the fact that
competences associated with understanding connectives are far from homogeneous, and that
exposure to print seems to be a key factor in explaining individual differences among adults.

Based on these studies, we present in Section 4 our hypotheses as to the likely difficulties that
teenagers will encounter with connectives from the written mode, as well as the expected
differences between the two groups. In Section 5, we report a constrained production task
involving the four French connectives from the written mode described in this section. We
discuss the main results from this experiment and conclude with some avenues of enquiry for
future work in Section 6.

2. Data on the acquisition of connectives

Corpus data – in various languages – on the early emergence of connectives in children’s
speech have consistently shown that children start using connectives between the age of two
and three (e.g., AUTHOR 1, 2010; Bloom et al., 1980; Braunwald, 1985; Diessel, 2004;
Evers-Vermeul & Sanders, 2009; Kail & Weissenborn, 1984). They have also revealed that the order of acquisition between connectives seems to be dependent on various factors, such as the cognitive complexity of the discourse relations they encode, the syntactic complexity associated with their grammatical category, and their frequency in input data. Based on a literature review, Geva (2006) argued that both syntactic and semantic factors influence the acquisition process of connectives. Evers-Vermeul & Sanders (2009) also advocated a multidimensional explanation, in which cognitive and syntactic complexity as well as frequency all play a role in explaining the order of acquisition between connectives.

Despite children’s early usages of connectives, other studies have demonstrated that their use of connectives still develops (i.e., they make fewer mistakes and diversify the contexts of use) over many years after they first appear (Peterson, 1986). In addition, studies that have focused on the comprehension of connectives in controlled experiments have demonstrated that children do not fully master even frequently used connectives until the end of their primary school years (e.g., McClure & Geva, 1983, tested 9-14-year-olds; Irwin & Pulver, 1984, tested 8-14-year-olds; Cain and Nash, 2011, tested 8-10-year-olds). For example, Cain and Nash (2011), report that children as late as 10-years-old perform significantly less well than adults in a cloze task assessing their use of the temporal, causal and adversative connectives because, so, after, before, but, and although. In another experiment assessing children’s evaluation of connective meanings, the authors report that 8-year-old children performed less well than adults for all connectives and 10-year-olds still had an inferior performance on tasks with temporal connectives. In a set of experiments targeting the understanding of temporal relations, Pyykkönen and Järvikivi (2012) demonstrated that children aged 12 still experience difficulties understanding temporal relations when the connective used (i.e.m after) implies a reversed order of the related segments with respect to the chronological order of events in the world (e.g., Ilkka read the letter after he went to
McClure and Geva (1983) also found that children even at the age of 13 to 14 (grade 8) had difficulties understanding the differences of focus between the connectives *but* and *although* depending on their syntactic position within the sentence. Several causes have been put forward to account for these comprehension difficulties, and these are similar to the factors predicting the order of acquisition between connectives in young children’s speech. First, the cognitive complexity of the relation that connectives encode appears central. More specifically, children were found to better understand connectives encoding positive coherence relations such as causal (1) and additive (2) connectives than those encoding negative relations such as concession (3) and contrast (4) (Geva, 2006; Dragon et al. 2015; Knoepke et al., 2017).

(1) Mary was sad because she lost the competition.
(2) Mary was a good swimmer and she ran really fast.
(3) Even though Mary was fit, she did not run very fast.
(4) Mary was fit, but Peter was in really bad shape.

Second, Dutch-speaking and French-speaking children from five to eight were found to understand objective causal relations linking events in the world as in (1) better than subjective causal relations as in (5) that are linking claims and conclusions made by the speaker (AUTHOR 1 et al., 2015).

(5) Mary must have lost the competition, because she looked really sad.

In Sanders, Spooren, and Noordman’s (1992) model of coherence relations, which decomposes relations into four primitives, positive relations are said to represent a cognitively
simpler alternative compared to negative relations on the dimension of polarity (e.g., causal relations are simpler than concession relations), and objective relations are said to be cognitively simpler than subjective relations on the dimension of source of coherence (i.e., objective causal relations are simpler than subjective causal relations).

An alternative explanation to the factor of cognitive complexity is that older children simply fail to understand infrequent connectives, which are unfamiliar lexical items for them, due to vocabulary limitations. In fact, some have found that, at the age of 9 to 10, both connective familiarity and cognitive complexity influenced the ability of fourth graders coming from a language minority background to understand connectives (e.g., Crosson, Lesaux & Martiniello, 2008). Others, testing teenagers and young adults from 12 to 23 years, only found that connective familiarity played a role in connective understanding (e.g., Nippold, Schwartz & Undlin, 1992). These studies attested the role of familiarity in explaining children and teenagers’ ability to handle connectives. In these experiments, familiarity was measured based on the proportion of children who knew these connectives. We argue that it might be more relevant to assess teenagers’ ability to use connectives depending on these connectives’ frequency in corpus data rather than on the proportion of them that have already mastered these connectives. The logic behind this claim is that less frequent connectives are encountered less often and teenagers might not have been exposed to them enough to acquire them. In addition, previous experiments with teenagers that tested the factor of familiarity included both connectives used in speech and those mostly restricted to the written mode. As a result, the exact role of connectives’ frequency in corpus data to explain the ability to use and understand connectives from the written mode cannot be firmly established. Our study will provide new data on this issue.

In sum, the literature indicates that children still experience many difficulties with connectives at the end of primary school years (i.e., up to 12 years old). Their later
development during secondary and high-school years is, however, understudied in the literature. In addition, understanding of the acquisition process of connectives other than the few connectives that are frequently used in speech is also lacking. Our study will aim to fill this gap by providing new data on teenagers’ ability to handle connectives from the written mode.

3. Processing and comprehension of connectives by adult speakers

Connectives play important roles for the way in which adults understand discourse information. First, connectives hasten understanding of the segment that follows them compared to implicit relations (e.g., Authors, 2016; Britton et al., 1982; Habelandt, 1982; Sanders & Noordman, 2000). Second, discourse relations that are linked by connectives are remembered better (Caron, Micko & Thüring, 1988) and generate more inferences (Degand, Lefèvre & Bestgen, 1999; Millis, Golding & Barker, 1995) compared to when the link is implicit. Similarly to children, adults also show different comprehension patterns depending on the cognitive complexity of discourse relations. Causal connectives, and more generally connectives marking positive coherence relations (i.e., relations that do not involve a form of negation in one of the segments) facilitate the processing of the upcoming segment that is read more quickly (e.g., Caron et al., 1988; Cozijn, Noordman & Vonk, 2011; Sanders & Noordman, 2000).

However, results are not as clear-cut in the case of concessive and other negative relations such as contrastive relations, and positive relations are processed more quickly than negative ones (Morera et al. 2017), whether the causal relation is marked explicitly or not (Xu et al., 2018). The two types of coherence relations also lead to different expectations about upcoming discourse referents (Köhne & Demberg, 2013). Readers remember fewer sentences that contain the concessive connective *but* compared to the causal connective *because* (Caron
et al., 1988) and have more difficulties filling in blank slots between sentences when a negative relation is involved (Goldman & Murray, 1992). In addition, processing differences were also found based on the source of coherence dimension identified by Sanders, Spooren, and Noordman (1992). Objective causal relations linking facts or events are processed more quickly in several languages compared to subjective causal relations linking claims and conclusions (AUTHOR 1 et al., 2018; Canestrelli, Mak, & Sanders, 2013; Traxler et al., 1997). To summarize, connectives are used by adult speakers for discourse processing and comprehension, and the complexity of the involved relation seems to be the key element explaining differences in the way adults handle different connectives.

Although seldom discussed in the literature, adults do vary a lot in their understanding of connectives. For example, not all adults are sensitive to the differences of focus distinguishing closely related connectives such as but and although (McClure & Geva, 1983). In addition, adults do not always perform at the maximum level in tasks asking them to discriminate between correct and incorrect uses of polyfunctional connectives, that is, connectives that can encode different discourse relations depending on the context. AUTHOR 1 et al. (2015), for example, found that native-speaking adults performed maximally when they had to judge the meaning of while to convey temporal relations but not when the same connective conveyed contrastive relations. This result can be explained by the fact that temporality is the most frequent meaning conveyed by while, whereas contrast is a secondary meaning, at least in terms of frequency. The role of frequency has also been demonstrated when assessing adults’ ability to discriminate correct and incorrect uses of four French connectives that are mostly restricted to the written mode. AUTHORS (2019) compared the roles of cognitive complexity, connectives’ frequency in written corpora and their mono- or polyfunctional nature for adults’ ability to discriminate correct and incorrect uses of these connectives. They found that frequency was the most relevant factor in explaining adults’
competence with these connectives. Indeed, the two less frequent connectives in written corpora (en outre and aussi) lead to significantly lower scores compared to the more frequent connectives (en effet and toutefois). These results cannot be explained using the notion of cognitive complexity, as toutefois encodes a concessive relation that is cognitively more complex than the additive relation conveyed by en outre, yet participants were better at discriminating correct and incorrect uses of toutefois compared to en outre. Similarly, polyfunctionality did not appear to play a role, as participants were better at discriminating correct and incorrect uses of the polyfunctional connective en effet (which can be used to convey either a causal or a confirmation relation) compared to the monofunctional connective en outre (only used for additive relations). Most importantly, in AUTHORS (2019), the ability to discriminate correct and incorrect uses of connectives was tested against the background of adults’ competence in the written mode. The latter competence was assessed using a French version of the Author Recognition Test (Stanovich & West, 1989) and a test of grammatical competence including difficulties typical for the written mode (i.e., cases of silent agreements, homophones that are not homographs, etc.). Results indicated that both measures were explicative of participants’ propensity to discriminate correct and incorrect uses of the connectives. This led to the conclusion that the ability to understand connectives from the written mode is variable across adults, and that this competence is linked to the degree of familiarity that they have with this mode (e.g., their exposure to print).

In the present paper, we pursue this enquiry further by assessing teenagers’ ability to use the same four connectives in a constrained production task. We decided to use a production task rather than a judgment task – which was used in AUTHORS (2019) – because discriminating between correct and incorrect uses of connectives represents a more complex task than simply choosing the appropriate connective in a pre-determined list of four choices. We therefore opted for the constrained production task in order to enable teenagers to
Authors’ preprint, to be published in Lingua.

demonstrate their ability to use connectives in the simplest possible task. In this experiment, we also compared two different groups of teenagers that had received a different degree of exposure to written language, as determined by their school curricula.

4. Hypotheses

Based on the results from Nippold et al. (1992), who found that connectives’ familiarity was the only factor predicting the ability of teenagers to correctly use them, and on AUTHORS (2019), who found that connectives’ frequency in corpus data influences the ability of adults to discriminate between correct and incorrect uses, we expect that French-speaking teenagers will also have more difficulties correctly using the two less frequent connectives (i.e., en outre and aussi) compared to the more frequent ones (toutefois and en effet). A difference between en effet and aussi would also be expected when considering polyfunctionality. Indeed, the causal meaning of en effet encompasses about 80% of the uses of this connective in written corpus data, whereas the consequence relation is only marginally associated with aussi compared to its function of addition, covering only 10% of its occurrences in written corpus data. Importantly, these effects would clearly undermine the role of cognitive complexity in the teenage population, whereby en outre and aussi should be easier than en effet and toutefois, as found for younger children.

In addition to exploring the role of frequency in explaining variations in teenagers’ ability to handle different connectives, our paper also aims to assess the role of individual variations between teenagers. In this respect, we expect that the academic level is an important factor to account for teenagers’ ability to handle connectives that are mostly bound to the written mode, as exposure to print is much higher in curricula with a higher academic level, such as high schools compared to professional schools. Exposure to print was indeed found to be an important factor accounting for individual variations among adults (AUTHORS, 2019). For
adults, the level of exposure to print was measured by developing a French version of the Author Recognition Test (Stanowich & West, 1989) called the ART-F measure. As this test requires modifications to be applicable to teenagers, notably the inclusion of authors that are part of school curricula (Acheson, Wells, & MacDonald, 2008) and that a French version of such an adapted test has not yet been validated, we operationalized the difference of exposure to print differently, by comparing two groups of students who had a different level of exposure to print due to their school curricula. On the one hand, high-school students, who are asked to read a lot to complete their school assignments, and students attending a professional school involving more practical work and far less reading. We expect that high-school students would have a higher ability to handle connectives from the written mode, and that their advantage would be even more pronounced in the case of more frequent connectives, because they have had more exposure to these frequent connectives through reading. By contrast, the group of professional-school students may have had insufficient exposure to print to encounter even these more frequent connectives enough to always handle them correctly. We will compare the performance of all the teenagers with that of university students studying French. These students represent the highest possible degree of competence with connectives, as they have received training in linguistics including the use of connectives, and they have a very high level of exposure to print. We included these students as a control, because we wanted to ensure that we had a good impression of the higher competence we could expect in this task.

5. Method

5.1. Participants

Participants were 18 high-school students (Mean Age = 16.2; 9 female), 22 professional school students (Mean Age = 15.6; 11 female) and a control group of 62
University students studying French at the French-speaking Swiss Universities of Lausanne and Geneva (Mean Age = 21.9; 41 female) (See Figure 1 for beanplots of age across groups). The latter group was added as the optimal group, given that these students formally study connectives as part of their university curricula. All participants declared that they were native speakers of French. High-school and professional-school students participated in the experiment as part of their French classes. University students were paid 10 euros for their participation in the study, which lasted 25 minutes on average.

5.1.1. Materials and procedure

We tested the ability of teenagers to correctly use the same four French connectives tested in AUTHORS (2019), namely: aussi, en effet, en outre, and toutefois. In our experimental task, participants had to fill in blanks with the appropriate connective. 10 sentences were designed for each coherence relation. For example, (6) was a consequence relation in our materials, (7) was a causal relation, (8) was an additive relation and (9) was a concessive relation. The expected connective is indicated below within brackets.

(6) Jeanne avait oublié de mettre son réveil. ______, elle arriva en retard aux cours.

[aussi]

Jane had forgotten to set her alarm clock. ______, she arrived late to class.

[therefore]

(7) Le vendeur fut très content de sa semaine. ______, il avait réalisé d’excellentes ventes. [en effet]

The salesman was very happy about his week. ______, he had sold many things.

[for/because]
The old lady had forgotten to close the tap. ________, she had left the kitchen burner on. [in addition]

Sacha had hated the evening meal. ________, he finished his plate without comment. [however]

The 40 items were created in such a way as to render the intended coherence relation salient and to exclude alternative interpretations. This was achieved in several ways. First, the linguistic content of the segments was chosen to either make the existence of a cause-consequence link salient for all the relations involving a causal element, that is, for causal, consequence, and concessive items (concessive relations are classified as negative causals by Sanders et al., 1992) and to make them difficult to construe for additive relations. For example, a causal link is easy to establish based on world knowledge between the act of forgetting to put on one’s alarm clock and the consequence of being late. This link was exploited in (6). Similarly, there is a salient causal link between a salesperson selling a lot of merchandise and them being happy (example (7)). Finally, this link is also salient between not liking a meal and not finishing one’s plate. But in this case, the causal relation is denied, turning it into a concessive relation in (9). By contrast, in (8), there is no obvious causal link between forgetting a close a tap and leaving the kitchen burner on. These two events can be linked by an operation of addition, akin to a listing of problems. In this case, it is simply two congruent facts listed in support of the same conclusion, namely that the old lady in question has problems managing her house. In sum, the difference between relations involving a causal
and a non-causal link was made via the linguistic content of the segments. The items were pretested by ten adults, who consistently chose the expected connective across all items.

Concessive relations – as in (9) – are the only negative relations from the set. Thus, all the items for this relation contained a plausible causal link that was denied in the second segment. In order not to make these relations too conspicuously different from the others, morphological markers of negation (ne...pas in French) were avoided. Rather, the negative nature of these relations had to be inferred based on the linguistic content of the segments, as in (9).

Finally, the difference between causal and consequence relations has a bearing on the order of the related segments: cause-consequence for consequence relations and consequence-cause for causal relation. The difference of order between events separating cause and consequence relations was operationalized by using different verbal tenses in both types of relations. For consequence relations, the first segment always contained a verb at the plus-que-parfait tense and the second segment always contained a verb at the passé simple tense, as illustrated in (6). Such an order invites a forward inference in which time progresses (Moeschler, 2000). By contrast, for causal relations, the two tenses were reversed between the first and the second segments, as illustrated in (7), thus inviting the hearer to make a backward inference in which time moves backward, as is typical of causal relations (Sanders et al., 1992).

The two groups of teenagers performed the experiment during one of their French classes (i.e., using pen and paper). The university students received the experiment via a weblink. In both cases, segments were presented one after the other, in a random order, and for each segment, participants had to choose the connective that they deemed to be most appropriate by ticking a box. In both versions, participants had to tick the box next to the connective they felt was the right one.
5.2. Results

We conducted analyses on participants’ response correctness (i.e., right or wrong) by fitting mixed-effects logistic regression models on our binary outcome variable. Mixed-effect models provide a means to perform by-item and by-participant analyses simultaneously, while also accounting for missing values and to avoid the language-as-a-fixed-effect fallacy (Brysbaert, 2007). All analyses were conducted using the R software (RStudio Team, 2015), and models were tested using the glmer function from the lme4 package (Bates, Maechler, Bolker & Walker, 2015). Model comparisons were performed with the anova() function which calculates the Chi-square value of the log-likelihood in order to evaluate the difference between models, following Baayen’s (2008) procedure. As done in other studies on similar issues (e.g., AUTHORS, 2019), models were compared using a forward-testing approach. Namely, fixed effects were included one at a time (main and interaction effects), and each resulting model was compared to a model that did not include the added factor. When comparing models, we also evaluated the contribution of random slopes to the models by using log likelihood tests, if the random slopes were justified by the design (as recommended by Barr, Levy, Scheepers & Tily, 2013). However, none of the models with random slopes converged (even when adjusting the number of iterations). We therefore kept our random structure as including items and participants as random intercepts only. To obtain p-values for our final model, we used the summary() function from the lmer Test package (Kuznetsova, Bruun Brockhoff, & Haubo Bojesen Christensen, 2014). Finally, treatment contrasts were used for all unordered factors, namely Connective and School. For the former, ‘Cause’ (i.e., en effet) was set as the baseline level (i.e., the reference) for comparing connectives, as en effet constitutes the most frequently used connective in written language. For the latter, the Professional School was set as the baseline for comparing schools.
When comparing our random model – only encompassing items and participants as random intercepts – to one also including Connective as a fixed factor (Cause vs. Concession vs. Addition vs. Consequence), the model improved significantly, $\Delta \chi^2 = 49.87$, $\Delta df = 3$, $p < .001$. Including main and interaction effects of School (Professional School, High School and University) further improved the model, $\Delta \chi^2 = 116.70$, $\Delta df = 8$, $p < .001$. We therefore kept the model including Connective and School as fixed effects (and items and participants as random intercepts) as our final model.

The model showed some interesting findings. First, as apparent in Figure 2, Consequence (0.72) was significantly and globally more difficult to correctly produce than Cause (0.87), the latter being close to Concession (0.89), and the former to Addition (0.69), as found by AUTHORS (2019) on adults. Second, as expected and as apparent in Figure 2, both High School (0.65) and University participants (0.90) had less trouble correctly producing connectives than participants from the Professional School (0.59), although only University participants scoring significantly higher.

Those main effects were qualified by a School by Connective interaction. As illustrated in Figure 2, the difference between Cause and Addition for Professional School participants was smaller (0.09) than for High School (0.29) and University (0.17) participants. The difference for High School participants between Cause and Consequence (0.37) was also bigger than for Professional School participants (0.20). Importantly, this latter interaction was mainly due to High School participants having a better score at Cause and Concession connectives than Professional School participants. As such, one could argue that participants of both High School and Professional School were flooring on less frequent connectives (i.e., $en\ outre$ and $aussi$ correctly chosen only half of the time), as expected, yet Professional School participants’ progression on $en\ effet$ (i.e., the more frequent connective) was not as steep as...
for High School participants (and University participants for that matter).

INSERT FIGURE 2 ABOUT HERE

To verify that the mistakes of Professional School participants – and the two other groups – were not simply due to some sort of systematic error (i.e., an incorrect connective always chosen), we explored the distributions of mistakes across connectives, and across groups (see Figure 3). Although a detailed interpretation of the patterns is only speculative – and future research may specifically focus on *connective substitution* – several observations can be made. First, there was no obvious general systematic substitution observed. Second, across all groups, *en effet* seemed to be the more common mistake for *aussi* (especially for the High School participants), and *aussi* for *en outre*. Third and finally, *aussi* seemed to be the more common mistake for *toutefois*, but only for University students. Again, these observations have to be treated with caution, as the number of errors was rather small in some cases (especially for University participants), and the effects found may be totally spurious.

However, designing specific experiments to more rigorously evaluate those mistakes might constitute a promising research avenue.

INSERT FIGURE 3 ABOUT HERE

6. Discussion

In this paper, we assessed the ability of two groups of teenagers diverging in their academic level, as well as a group of university students, to correctly use four French connectives bound to the written mode. Our results clearly indicate that at the age of 16, teenagers have not yet reached an adult-like ability to use these connectives, as their performance was consistently lower than that of university students. Our results also indicate that the two groups of teenagers do not have an equal ability to use all four connectives. While their performance does not significantly differ for the two less frequent connectives from our sample, *aussi* and *en outre*, the performance of high-school participants is higher
than that of professional school students for the two more frequent connectives *en effet* and *toutefois*. This difference demonstrates that frequency, rather than cognitive complexity or polyfunctionality, is an important factor in explaining teenagers’ difficulties to correctly produce connectives from the written mode. This result is consistent with the findings from AUTHORS (2019) with adults in a sentence judgement task involving the same connectives.

A likely explanation is that teenagers with more exposure to print may have already encountered the more frequent connectives enough to master their meaning, but not the less frequent ones. By contrast, teenagers with less exposure to print have not yet had enough exposure to master them.

From a theoretical perspective, these results should not be interpreted as prima facie evidence against the role of cognitive complexity for connectives’ mastery. Indeed, the effects of cognitive complexity have been largely documented in the literature with younger children and in online studies involving adults, as summarized in this paper. What our results seem to suggest (in line with what was found by Nippold et al., 1992) is that from a certain age, cognitive complexity is not the main factor limiting competence with connectives, as teenagers have already developed the ability to handle even the most complex coherence relations. At this age, the limiting factor appears to be the lack of familiarity with less frequent connectives. Insufficient exposure to these connectives prevents teenagers, especially those with allegedly less exposure to print, from forming appropriate form-function mappings between connectives and the coherence relations they encode. In other words, connectives from the written mode represent unknown lexical items whose meaning cannot be inferred from context alone, contrary to many content words. Similarly, for adults, cognitive complexity continues to play a role during online processing, slowing them down when complexity is high. By contrast, offline measures of comprehension do not reveal similar effects because adults are able to understand all types of coherence relations, again, provided
that they have formed the appropriate form-function mappings with the connectives used to convey them.

The fact that high-school participants reached a higher performance with the most frequent connectives might well have a similar cause to that explaining the observed individual variations among adults. In the case of adults, individual variations in performance were related to their level of competence in the written mode, the latter being linked to their degree of exposure to print. Similarly, high-school participants formally have more extensive exposure to written language in their school curriculum compared to professional school participants, as the former have more French classes and are expected to read more to complete their school assignments. It should be noted, however, that our experiment only provides an indirect measure of the difference of exposure to print between the two groups, as this difference is assumed rather than tested. In future work, it will be important to assess the level of exposure to the written mode in a more direct manner, for example, by using an adapted version of the ART-F developed for adults by AUTHORS (2019). This test is easy to administer, may be readily modified to match the population at hand and could provide very valuable insights into the importance of exposure to print in the teenage population.

The study presented in this paper is original in several respects. It provides much-needed data about teenagers’ ability to use connectives, and tackles the likely causes for teenagers’ persistent difficulties with connectives from the written mode. However, it also bears a number of important limitations. First of all, due to institutional constraints, the two samples of teenagers included in the experiment were rather small. Second, the number of tested connectives was limited to four in order to keep the task manageable. Due to this limitation, our results cannot be generalized to the whole range of connectives bound to the written mode. Further experiments are needed, on different connectives, before firm conclusions can be reached. For example, future studies will need to include a broader range of connectives to
assess each factor so that they can be used as predictors in a statistical model. Another issue that was not tackled in this paper is the role of discourse genre. As some connectives are used frequently only in certain genres (e.g., Stukker, Spooren, & Steen, 2016), it will be important to take this factor into account in future work assessing the link between exposure to print and mastery of these connectives. For example, in our sample, the connective *en outre* seems to be mostly used in newspaper and parliamentary debate contexts, rather than in literary texts.

Similar genre effects that could also influence the ability of speakers to handle connectives, will have to be more specifically investigated. In future work, it will also be important to replicate these results with connectives from a different language, in order to assess their robustness. Given that all Indo-European languages possess a large number of connectives, such replications should both be easy to implement and fruitful to further our understanding of connectives from the written mode, as they have been so far understudied compared to connectives frequently used in speech.

For all the reasons mentioned above, our study did not aim to provide a definite answer to the question of why connectives remain difficult for teenagers, but only to ascertain that these difficulties exist – and that inter-individual variations between groups of teenagers exist as well – and to hint at possible explanations. Investigating these issues is all the more important as the ability to use and understand connectives plays an important role in achieving effective written communication. If connectives from the written mode do indeed represent an area of difficulty for teenagers, as our study suggests, it is important to take this result into account when developing teaching materials for these age groups. More specifically, these connectives should be taught explicitly as part of school curricula during secondary school education. In addition, these connectives should be avoided in texts aimed at younger age groups, because they might be detrimental for younger children’s comprehension of textual coherence. This latter point is crucial, inasmuch as even the less frequent connectives from
our samples are still rather frequent lexical items compared to most content words.

Misunderstanding them and misusing them is therefore likely to create dire communication problems. Indeed, previous research has shown that when connectives are incorrectly used in a text, coherence is lost and comprehension is impaired, even for adults (Sanders, Land & Mulder, 2007). Such miscomprehensions might cause problems for teenagers in all aspects of their studies involving learning through written language instructions.

As a final limitation, we would like to raise the fact that our study only targeted teenagers’ ability to use connectives appropriately in a constrained production task. This task was meant to minimize task difficulty, yet it still revealed sub-optimal performance by most teenage participants. In future work, spontaneous uses of these connectives in written productions might be targeted to get a full picture of teenagers’ production skills with connectives.

Similarly, the way in which teenagers understand sentences containing these connectives should also be assessed.

In sum, our experiment represents a first attempt to assess teenagers’ competence with connectives from the written mode. Our results, even though limited in terms of sample size and number of connectives, already demonstrate that this is a promising avenue of enquiry that warrants further investigations, in order to refine our understanding of the causes underlying teenagers’ difficulties. This research will also help to devise adequate teaching techniques to mitigate them.
References


