**Manual of Discourse Markers in Romance**

Chapter 15

Discourse markers and psycholinguistic processing

Draft

# Introduction

Psycholinguistics is concerned with the cognitive mechanisms behind language production and comprehension. These mechanisms intervene at all levels of language processing from early phonemic decoding, to lexical and syntactic disambiguation, to the establishment of a speaker’s intended meaning. As far as this latter processing is concerned, an important part of the research deals with pragmatics or the ways humans effectively communicate information. The pragmatic meaning of an utterance is not formally encoded linguistically but it is worked out by considering the speaker’s informative intention given the conversational context of the utterance. For instance, in Searle’s classical example in (1) the encoded meaning of the sentence (sometimes called the ‘literal meaning’) concerns the addressee’s ability (*can you?*) to reach and hand over the salt, However, in the given context (speaker and addressee are eating a meal) the speaker’s intention becomes apparent: they likely want to use the salt. Thus, the speaker’s meaning of the utterance is worked out by reasoning about the speaker’s intion, given the literal meaning of the utterance and the situated discourse context.

1. *Context: the speaker and the addressee are having dinner*.

S: -Can you pass me the salt

In this chapter, we will demonstrate that discourse markers (DMs) are well suited for psycholinguistic research and specifically regarding the processing of their pragmatic meaning. Like many in the literature who are interested in discourse markers, however, we focus on discourse connectives, which are (typically) short content words that have a discourse wide impact.

To make the pragmatic influence of DCs clear, consider (2a.) and (2b.) that only differ in the connective used after the first proposition. Imagine reading (2a.) or (2b.) and stopping right after the connective. Since *so* and *but* are logical conjunctions, you would rightly expect a second phrase to follow the DC. However, the predictions that you would shape regarding the content of that second phrase are likely to significantly vary from (2a.) to (2b.). Indeed, the disourse connective *so* in (2a.) triggers an inference concerning the consequence or consequences that follow after going to a library (e.g., one might expect Holly to then sit down and study or borrow a book). On the contrary, *but* in (2b.) denies the very same expectations that *so* reinforced (e.g., for some reason Holly will not sit down and study). Even though they logically incorporate the same two phrases by using the same exact words and the same syntactic structure, the difference in connective leads the reader to radically different expectations regarding the sentence’s end.

1. a. Holly went to the library so she borrowed a book.

b. Holly went to the library but she borrowed a book.

The discourse connectives in (2) first invite the reader to rely on their world knowledge to establish what events are likely to be mentioned in conjunction with “Holly went to the library” and, second, they inform the addressee whether or not these commonly agreed events will be realised after the connective. Consequently, the reader is able to narrow down the direction that the discourse is going to take following a given connective (Anscombre & Ducrot, 1989; Fraser, 1996).

We see how these DCs impact an addressee’s psychological representation of discourse by calling on their world knowledge and their assessment of the conversational context. It follows that studying the processing of connectives a) provides insights into understanding how humans psychologically represent complex relations between the various elements provided by language, and; b) makes for a good case study for the processing of a discourse marker’s pragmatic meaning (and especially because connectives can be readily compared across similar contexts, making them serviceable to experimental investigations). These two features of DCs will be central to this chapter.

In what follows, we will review how connectives have been investigated in the psycholinguistic literature. We will then turn to studies on how DCs are integrated into discourse processing. This latter section will lead us to draw a comparison between DCs and logical connectors. Building onto this parallel, the last part of this chapter will be dedicated to introducing a novel psycholinguistic approach to DC that we will illustrate with some preliminary results.

# State of the art

* 1. Discourse connectives as models for understanding and classifying the processing of discourse relations
     1. Experimentation and discourse processing

Discourse connectives have been at the centre of many experimental investigations on the cognitive representation of discourse. In the 90s, Millis and Just (1994) relied on DCs to formulate their *delayed-integration theory of discourse processing*. They observed that in two-clause long discourses, participants required more time to integrate the second clause (3b) if it had been introduced by a DC. Meanwhile they also observed shorter reading times at the end of the first clause (3a) in the DC condition relative to clauses not connected with ‘because’. This led them to argue that, in the presence of a DC, the integration of the first clause is paused upon processing the DC and delayed until the end of the second clause where the two clauses can finally be integrated in communion.

1. a. The elderly parents toasted their only daughter at the party [because].

b. Jill had finally passed the exams at the prestigious university.

This hypothesis has since been largely contested and notably by Traxler et al. (1997). Traxler et al. were among the first to provide evidence for the incremental integration of the discourse relation introduced by DCs. Using an eye-tracking paradigm, they compared the processing of two types of clauses introduced by the DC *because.* Some clauses were considered diagnostic (4a) while others presented a straightforward causal connection to the preceding clause (4b).

1. a. Heidi could imagine and create things because she won first prize at the art show.

b. Heidi felt very proud and happy because she won first prize at the art show.

Even though *because* can encode both types of discourse relations, the authors expected that the causal relation would be easier to process than diagnostic sentences since the former is more commonly used. The results indeed revealed that participants experienced difficulty with diagnostic sentences relative to causal ones even before the end of the second clause. They interpreted this processing difficulty as an indication that participants were processing the second clause with the expectation of a causal relation. This provided some early evidence that the discourse relation introduced by a given DC is incrementally integrated into discourse representations and that this influences the processing of following information.

Millis & Just's (1994) and Traxler et al.'s (1997) uses of DC in their experimental studies allowed them to formulate more general claims about discourse processing. DCs indeed explicitly mark a given discourse relation which provides a readily observable event (the processing of the DC) that mimics the processing of the corresponding relation. The processing of DC therefore provides information on the processing of discourse that would be difficult to obtain where discourse relations are established through context making the processing effort linked to them extremally variable and visually impossible to trace back. This specificity of DCs has been most widely exploited by Sanders et al. (1992)’s Coherence approach to which we turn below.

* + 1. Experimenting with DCs to characterize and classify discourse relations

Sanders et al. (1992) proposed that human cognition can conceive of four primitive properties of coherence/discourse relations: the type of basic operation (additive or causal), the source of coherence (semantic or pragmatic), the polarity of the relation (positive or negative) and the order of segments in a causal relation (basic/cause-consequence or non-basic /consequence-cause). The authors established these categories by asking adult participants to choose the DC that they estimated was the most appropriate to connect pairs of sentences selected from the Eindhoven Corpus (Uit den Boogaart, 1975). Participants were given some context [sentence in italic in example (5)], followed by the sentence pair [numbered 1. And 2. in example (5)] for which they were asked to choose the best suited DC. They found that when a participant’s guess did not match the original, it still fell under the same primitive category as the original DC.

1. *One month before, there had been yet another change in the program of the theatre.*
2. (was)[[1]](#footnote-2) a piano concerto by Beethoven removed from the program.
3. (fell)1 the soloist Anthony di Bonaventura seriously ill.

Later work based on this taxonomy of Coherence relations has continued to use DCs to explore the processing of individual discourse relations. A major claim made by the Coherence approach to discourse is that the processing effort of a relation directly depends on the type of relation (Sanders, 2005; Sanders & Noordman, 2000; Spooren & Sanders, 2008). Spooren & Sanders (2008) suggest the following order from least to most complex relations: additive, temporal, causal, adversative which can be expressed in English, respectively, as *and, and then, so,* and *but*. They based their proposal on the acquisition patterns of the DC that typically encode those relations (Bloom et al., 1980; Spooren & Sanders, 2008).`

Still in the coherence literature, Sanders & Noordman (2000) looked at the effect of DCs on sentence processing in a reaction time experiment. They reported that the explicit marking of a coherence relation leads to faster processing (shorter reaction times) of the post-connective part of the utterance (when it is consistent with the DC).

An earlier reaction time study by (Ziti & Champagnol, 1992) also reported that the presence of a DC can facilitate the processing of the post-connective part of the utterance but only in concessive relations. That is, they presented French participants with sentences composed of two clauses that were either causally related as in (6) or contrasting as in (7) [for the original items in French see (Ziti & Campagnol, 1992, p. 192)]. Participants read one clause after the other, either with nothing presented between them or with an appropriate causal (*parce que/puisque*) or concessive (*bien que/ quoi que*) connective between the two parts.

1. a. The snow had made the track of the circuit extremely difficult,

b. all the competitors quit the race before the finish line.

1. a. The heat dried out all the agricultural soils last year,

b. the farmer all had satisfying harvests.

They reported that the absence of a DC did not significantly affect the reading time of the second conjunct in the causal condition in (6b) but that a concessive greatly facilitated the reading of the second conjunct in (7b). These results seem to indicate that the concessive relation was difficult to process relative to the causal one. Thereby, the facilitating role of the DC on discourse processing was accentuated in those instances where the discourse relation was the most effortful to process. This is in line with the Coherence based hypothesis outlined above. It also corroborates Sanders (2005) claim that hearers assume a positive causal relation by default and can thus experience difficulty in processing a negative causal (concession) relation as in (7).

What seems to be a cognitive bias for causality has been further investigated in a study by Zufferey & Gygax (2016) on the French DM *en effet[[2]](#footnote-3).* They argue that if difficulties are commonly observed on the processing of concessive relations relative to causality, it is because of the perspective shift required to process concession. Zufferey & Gygax (2016) found that *en effet* is a well-suited case study to test this hypothesis. This DM can indeed convey both a causal relation (which implies perspective continuity) as well as a confirmation relation (which involves a perspective shift). They tested their hypothesis on a reading time experiment. Participants saw sentences conveying either causal relations (8) or confirmation (9). Furthermore, the relations were conveyed explicitly with *en effet* in half of the trials [(8a.), (9a.)] and implicitly in the other half [(8b.), (9b.)]. The reading time of the second segment (here, *he arrived late to work five times this month*.) was faster when en effet preceeded the segment. However, this positive effect of the DM was stronger for trials featuring a confirmation relation relative to causal trials. The authors suggested that the processing of causal relations was not as affected by the absence of a connective as confirmation relations because they are continuous and thereby highly expected unlike confirmation relations. Those results are consistent with Zufferey & Gygax’s initial hypothesis that perspective shift can explain the processing difficulties typically observed in concesssive relations.

1. a. Jacques must have personal problems. *En effet,* he arrived late to work five times this month.

b. Jacques must have personal problems. He arrived late to work five times this month.

1. a. Jacques was afraid he was going to be late if her took his car. *En effet,* he arrived late to work five times this month.

b. Jacques was afraid he was going to be late if her took his car. He arrived late to work five times this month.

Moreover, their results seem to indicate a general cognitive constraint on discourse processing that favours continuity over discontinuity as it requires a perspective shift.

* + 1. Experimenting with DCs to explore the cognitive mechanism behind the representation of causality.

The processing of causality is an ongoing research topic that has been investigated with increasing depth over the years. One focus has been on the nature of a causal relation and its processing. One distinction is between *objective* versus *subjective* causal relations (Maat & Sanders, 2001; Sanders & Spooren, 2015; Sanders & Sweetser, 2009). An objective causal relation (10a.) refers to cases in which a cause naturally generates an effect that follows and a subjective causal relation (10b.) refers to someone’s reasoning. The latter forces the addressee to consider the speaker’s *Subject* *of Consciousness* (SoC) which refers to mentally representing the subjective information.

Once again research on DC processing has played a crucial role in understanding whether or not these different sources of causality translate into actual psychological differences.

1. a. Jones had fever last night so he cancelled the group meeting.

b. Jones had fever last night so he is sick.

Canestrelli et al. (2013) compared the processing of the Dutch DC *want* and *omdat* that mark subjective and objective causal relations, respectively. They report a slowdown in reading time after a subjective causal DC relative to an objective one. The authors attributed this difference in reading time to the fact that a subjective relation requires the addressee to represent someone else’s belief (the SoC), which they argue is cognitively more costly to integrate than an objective causal relation. Thus, it seems that the cognitive effort of processing a causal relation is mediated by the source of causality.

These findings were recently replicated and then further explored by Wei et al. (2019) who took advantage of a specificity of DCs in Chinese. That is, Chinese encodes a term for objective and subjective DC causal relations (*yin'er* and *kejian*, respectively) as well as for unspecified causal relations (*suoyi*). Wei et al. designed a visual world paradigm to test participants’ tracking of the source of causality while processing a sentence. Dutch (Experiment 1) and Chinese (Experiment 2) speakers in Utrecht heard sentences such as the ones in (11) (Wei et al., 2019, p.7) while looking at a screen depicting the scene on one side and a person thinking about the scene (SoC) on the other side, as in Figure 1. All test sentences had two versions, one ending with a subjective causal realation (11a.) and its objective counterpart (11b.).

1. a. The private chemistry factory has been polluting the water, so its owner may not care about environment protection.

b. The private chemistry factory has been polluting the water, so fishes in the rivers nearby are dying at a large scale.

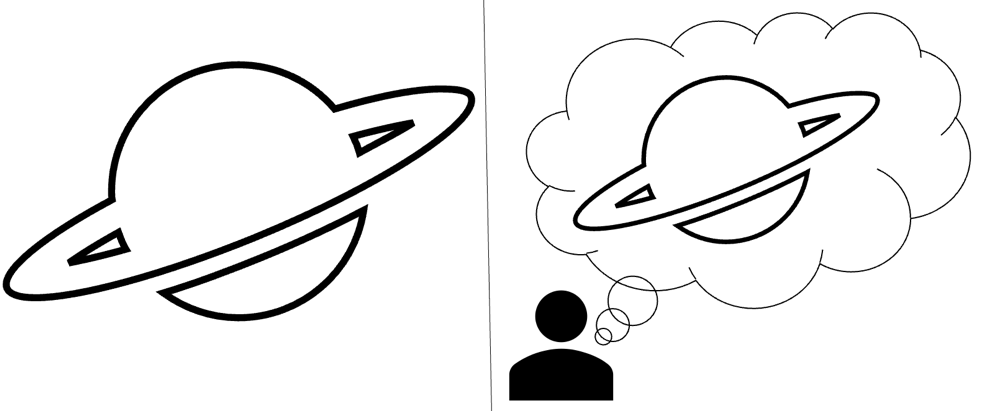


Figure Schematic depiction of objective representation (left) and subjective representation (right, presence of the SoC)

Experiment 1 compared the processing of the Dutch subjective and objective DCs. As predicted by the authors, looks toward the SoC increased directly after the subjective DC relative to the post objective DC region. This suggests that the information on the source of causality encoded by the DC is incrementaly integrated into the parser’s mental representation of discourse, thus confirming Canestrelli et al. (2013)’s results. In Experiment 2, which included the unspecified DC *suoyi,* processing was compared to that of the objective DC *yin'er* and of the subjective DC *kejian*. The authors reported that the objective DC directed participants’ attention away from the SoC relative to the subjective DC (confirming the Dutch results) and so did the unspecified DC. That is, the unspecified DC patterns with the subjective causal connective.

Furthermore, they reported evidence showing that in *suoyi*-trials (unspecified DC) ultimately expressing subjective causal relations, participants reactivated the SoC (as measured by increases in looks) as they came across the modal verb [e.g., *may* in (11a.)] that gave away the subjectivity of the relation. However, in *kejian*-trials (subjective DC), the authors recorded no such increase in looks to the SoC upon hearing the modal. This indicates that participants incorporated the SoC in their mental representation of the discourse relation only when the DC explicitly encoded subjectivity. The authors account for the increase in looks to the SoC directly after the unspecified DC by arguing that participants probably always incorporate the speaker in their representation of the information conveyed. This intuition was confirmed in filler items featuring temporal DCs (*and, and then*). In sum, it appears that subjective causal relations require the mental integration of a SoC to be processed. Relative to objective causal relations, this constitutes an additional layer of complexity in the cognitive representation of the sentence.

In this section we presented how research on the processing of DMs, and specifically DCs, has contributed to the understanding of discourse processing. Early work established that new elements of discourse are incrementally integrated into the already existing discourse representation (Traxler et al., 1997). The fundamental cognitive operations underlying this integration process have been explored by the quasi-typological approach to discourse relations of the Coherence framework (T. Sanders, 2005; T. J. M. Sanders et al., 1992; T. J. M. Sanders & Noordman, 2000; Spooren & Sanders, 2008). They notably highlighted that some discourse relations are more effortful to process than others, thereby providing an insight into the functioning of human cognition (Zufferey & Gygax, 2016). Finally, we focused on the case of causal relations to demonstrate how studies on DC processing can address questions at a relatively deep level of discourse processing, namely the mental representation of the source of information (Canestrelli et al., 2013; Wei et al., 2019). This latter section also indirectly provided evidence showing that the information encoded by the DC is incrementally integrated into discourse representations and impacts the way a hearer processes what follows. Indeed, in the subjective DC condition in Wei et al. (2019), participants’ looks to the SoC did not increase after the modal verb indicating that they had already integrated the subjective nature of the causal relation. In the unspecified DC condition, on the other hand, participants behaved slightly differently. This question of the integration of DCs in discourse will be further explored in the next section. We will show that DCs can shape expectations regarding the upcoming discourse but also force a revision of already existing expectations.

* 1. Further characterizing DCs’ effects on discourse processing

The results from Wei et al. (2019) resonate with other studies reported in the previous section, which also hinted at the fact that specific discourse expectations were formed following a DC. Traxler et al. (1997) found that after *because*, causality was easier to integrate than a diagnostic, thus showing an expectation bias following the DC. Sanders & Noordman (2000) and Ziti & Champagnol (1992) reported that the presence of a felicitous DC facilitates the processing of the clause it introduces. It thus seems that participants process the clause following the DC with a better anticipation of the argumentative direction it is going to take than in the absence of a DC. We now turn to eye-tracking and EEG studies, which are especially useful for characterizing DCs’ immediate impact on a participant when they are used in test sentences.

* + 1. DCs trigger revision and the creation of discourse expectations

We begin with Xiang & Kuperberg (2015), who explored the effects of polarity of relation on sentence processing in a series of EEG experiments. They investigated a critical word downstream in a 2 x 2 paradigm. One condition was the presence or absence of a concessive discourse connective, *even so* and the other was the Coherence or Incoherence of the test sentences. Below is an example of the Even so-Coherent condition. The critical word from which the authors recorded EEG measures is downstream. Here it is the word *celebrated* which we italicize for convenience:

1. Elizabeth had a history exam on Monday. She took the test and failed it. Even so, she went home and *celebrated* wildly.

In order to turn (12) into an *Even so-Incoherent* condition, the authors switched out “failed” and replaced it with “aced.” In order to create a “Plain” condition, one needs to remove the “Even so.” Note, however, that the Plain-Coherent condition described a case in which Elisabeth aced the test and celebrated wildly and the Plain-Incoherent condition described how she failed the test and celebrated.

They reported an increased N400 (which is a sign of an unexpected event) following the target verb [*failed* or *aced* in (12)] in Plain-incoherent conditions relative to Plain-coherent conditions. However, this difference in N400 between coherent and incoherent scenarios was reduced in the *Even so-*trials. This suggest that the pragmatic information of the DC had been incrementally integrated by participants to revise their world-knowledge based discourse expectations.

Though this study reports a clear effect of the DC on sentence processing, the question of how the DC in itself is processed remains unanswered.

A recent study by Köhne-Fuetterer et al. (2021) sets out to dissect the processing of DCs and their online integration to sentence processing. Köhne-Fuetterer et al. (2021) contrasted the incremental processing of positive causal and negative causal (concessive) DC. They designed a visual world and an event-related potentials (ERPs) paradigms. In their first experiment, participants heard a story as in (13) [see Köhne-Fuetterer et al., (2021), p.423, for the original material in German] while looking at a scene composed of potential candidates to predict the end of the narrative.

1. *Scene comprises: a cake, a waffle, a pretzel, a slice of cheese and a distractor.*

‘Marc fancies a small snack. He feels like having something sweet.

Therefore1/Nevertheless2, he gets the delicious waffle1/pretzel2 from the kitchen.’

The eye-tracking results showed that anticipatory looks after the DC region depended on the specific DC heard by participants. For instance, in (13), since the protagonist craves something sweet, participants tended to look more at the sweet candidates (waffle and cake) before the DC and upon hearing the positive causal DC (*therefore*); in contrast, when hearing the negative causal DC (*nevertheless*), their looks turned to the non-sweet options (pretzel and cheese). This provides direct evidence that the information carried by the DC is readily integrated into a participant’s discourse representation. Moreover, we see how the DC *nevertheless* made participants revise the expectations that they had formed after hearing the first two sentences. In a second Experiment, the authors adapted the visual world paradigm to an ERP design. In place of visual cues establishing the story continuation options [in (13) the image of a cake, a waffle, a pretzel, a slice of cheese and a distractor], the design of this second Experiment relied solely on discourse cues as in (14) [Köhne-Fuetterer et al., (2021), p.431]. The target sentence starting with the DC in (14) is preceded by a short story inviting participants to predict that Tim and Kim will either go to the cinema (place to watch a movie) or, even more likely, to the night club (place to dance).

1. ‘Tim and Kim are wondering whether they prefer to go dancing or to watch the new movie. Kim likes dancing a lot.

Therefore/Nevertheless, they go to the freshly renovated night club/cinema to enjoy themselves really well.’

Critically, the German words for night club (*Disko*) and for cinema (*Kino*) do not take the same grammatical gender (feminine and neuter, repectively). Morevoer, adjectives in German take the ending corresponding to the gender of the head of the noun phrase. In other words, upon hearing “*the freshly renovated*” in (14), participants were presumably able to anticipate the gender of the upcoming noun and hence predict which of the two contextually defined competitors (club or cinema) was coming. Köhne-Fuetterer et al. reported that gender-marked adjectives that were not congruent with the gender of the preferred candidate following the context-DC combination elicited a larger N400 that adjectives whose ending matched the gender of the target word. To make this explicit, in (14) the target would be feminine for *Disko* (nightclub) following *Therefore* or neuter for *Kino* (*cinema)* following *Nevertheless* as it is said that Kim likes dancing a lot. So, in *Therefore*-trials, a feminine ending on the adjective would elicit a smaller N400 than the neutral ending matching the word *Kino* (*cinema)* and vice-versa for *Nevertheless-*trials.

This again seems to indicate that the presence of a given connective incrementally creates specific expectations about the upcoming discourse. Furthermore, the authors reported a larger P600 (which is a sign of a linguistic or pragmatic anomaly and repair) after the concessive DC than after the causal DC. Assuming that participants expected a positive causal relation, this P600 effect suggests that the information of the DC is directly compared against the hearer’s already existing discourse representation.

Using a slightly different approach, Schwab & Liu (2020) looked at the effect of the DM *true* in English and *zwar* in German on sentence processing. Supported by corpus data, they argue that in utterance initial position those two DMs express agreement with the previous utterance and may introduce a concessive relation. In turn medial position however, *true* and *zwar* seem to be clear indicator of a concessive relation. Based on this hypothesis, Schwab & Liu (2020) designed a reading time experiment assessing whether the presence of *true* or *zwar* ahead of a concessive relation facilitates its processing. Participants saw sentences such as (15a) for the critical condition with the DM and (15b) for the control condition. The critical measure took place on the DC *but*, which introduced the concessive relation. The authors predicted that in the control condition (as exemplified by 15b), participants would require more time to read the *but* than in the experimental condition that includes the DM.

1. a. Jens likes to run. **True,** he has a treadmill in the living-room but he jogs often in the park.

b. Jens likes to run. He has a treadmill in the living-room but he jogs often in the park.

It is worth noting that similarly to studies presented in the previous section, Schwab & Liu used the processing of a DC (*but* here) to assess the processing effort of the discourse relation it encodes. They reported that for both English and German speakers, the presence of *true* or *zwar* did facilitate the processing of the concessive DC. These results indicate that even when a DM does not have the clearly defined function of connecting two elements of discourse together it still influences a hearer’s discourse representation.

The three studies presented in this section provide evidence showing that DCs and more generally DMs carry a concentration of procedural information that facilitates the online processing of discourse. In the next section we will see that DMs not only help anticipate discourse relations but they also facilitate the integration of new information.

* + 1. DCs facilitate the integration of information

In an ERP study coupled with memory tests, Rasenberg et al. (2020) explored the effect of the expectation-managing Dutch DM *eigenlijk* (*actually-*Expriment 1) and *inderdaad* (*indeed*-Experiment 2) on the processing of predictable and unpredictable discourse segments. Participants read short dialogues such as the one in (16) and carried out a recognition memory task with respect to words that were just read or not. The DM *actually* typically marks unexpectedness while *indeed* signals confirmation. Each of these appeared before an expected target word (e.g., museum) or an unexpected one (e.g., park).

1. Context: Diana spent the weekend in Paris with her art academy class.

Question: Her friend asks “You guys must have seen a lot of art”.

Answer: Diana says “We **actuallyExperiment1/indeedExperiment2** went to the **park/museum** everyday.”

The authors were particularly interested in potential N400s following the (un)expected discourse continuation word [*park* or *museum* in (16)]. They predicted that the different DM-predictability pairs would modulate the amplitude of the N400 of the word downstream. For instance, the unexpected discourse continuation word should trigger a reduced N400 in *eigenlijk (actually)* sentences relative to *inderdaad* (*indeed*) trials given the unexpectedness information carried by *actually.* In Experiment 1 participants saw sentences containing the *eigenlijk (actually)* and in Experiment 2 they saw sentences with *inderdaad* (*indeed*). In both experiments the predictability of the target words (park/museum) was manipulated, thus forming the conditions predictable (*museum*) and unpredictable (*park*). Note that the predictability label was based off the context and not the DM so that in both experiments the same trials were deemed (un)predictable. The ERPs elicited in the target sentences were compared against control conditions in which a temporal adverb replaced the DM. Though the results did not clearly support the main hypothesis, the study revealed two interesting effects of the DM on sentence processing. First, they reported that target discourse continuation words elicited an overall stronger N400 in Experiment 1 (participants receiving the *actually* version of the test sentences) relative to Experiment 2 (the *indeed* version). Interestingly, this effect was observed across all observations including control items that did not include a DM. The authors interpreted this finding as an indication that the use of the expectation-managing DM had an impact on processing at a global scale. In this case it was at the experiment level but one could imagine that a similar effect happens in conversational contexts as well.

Secondly, the memory task revealed that DM can have an impact on how well participants integrate the information contained in experimental trials. After having completed the experiment and carried out a numerical task as a distractor, participants were presented with a series of words and asked whether they had appeared in the experiment or not. In Experiment 2, the results revealed superior performance on words that had appeared in *indeed*-trials relative to words in the control, DM-free trials. However, no such performance difference was observed in Experiment 1 between controls and *actually*-trials. The authors speculated that *indeed* encouraged participants to integrate the new information to already existing discourse representation, which in turn had a positive effect on the memorisation of that information as it has been reported in the literature (Brewer & Treyens, 1981; van Kesteren et al., 2012).

This section highlighted several key functions of DMs on discourse processing. We saw how they can orient a hearer’s expectations regarding discourse continuation and help them revise already existing erroneous expectations (Köhne-Fuetterer et al., 2021; Xiang & Kuperberg, 2015). This effect is particularly well characterized when DMs have the function of DCs but Schwab & Liu (2020) reported similar effects with the DM *zwar* and *true* that act as a cue to anticipate a perspective shift. Finally, Rasenberg et al. (2020) helped us understand how DM can also play a role in the offline processing of discourse by having global effects on the management of expectations and on the integration and memorization of information.

Throughout this first section it appeared that DMs generally encode discourse level information The two main lines of research on DM processing have either used DCs to understand the representation and processing of discourse relations (section 2.1) or they have focused on the interaction between DCs and discourse representation (section 2.2). Given that DMs have a discourse wide impact, they are naturally a source of pragmatic meaning. Surprisingly it seems that DMs have rarely been studied for the precise reason that they are a concentrate of pragmatic meaning. In the following section we argue that DMs ought to be viewed as the source of pragmatic inferencing. We first draw a parallel between the pragmatic (the extra-linguistic) processing linked to logical connectors since their processing can provide insight into the features that motivate our proposed line of study. We then provide the beginnings of a research program that aims to investigate the processing of DM’s and especially DCs.

# A current line of study, some preliminary results

* 1. DM logical connectors vs non-TC DCs what do they have in common, how they differ

So far, we have established that DMs convey pragmatic meaning that trigger inferences regarding the upcoming discourse. The context of the utterance does not refine the meaning of the DM but it is actually the DM that refines a hearer’s appreciation of the context and discourse. This is unlike most pragmatic inferences as they are usually worked out with the hearer’s contextual assessment and world knowledge. The logical counterparts of DC are particularly telling examples of this. Connectors like *and* or *or* fulfil the same function of connecting together to discourse segments as DCs do and they can be the source of pragmatic enrichments (or could be construed as not both and *and* could be enriched, for example, to *and then*). However, unlike logical connectors, DCs necessarily convey pragmatic information that is intrinsically linked to their lexical entry. In sentence (17a) and (17b), the logical connector *and* and the DC *but* both have the same semantic properties. Namely, they indicate that the two sentence parts need to be true for the whole sentence to be true. However, their pragmatic contribution is different. In (17b), *but* triggers the pragmatic inference that some aspects of “she gifted it to her friend” contrasts with the implicit or explicit information carried by “Morgan bought a book”. In (17a), *and* can also mean more than just a logical conjunction and lead to pragmatic inferences (e.g., indicate the chronology of events) but only if the hearer evaluates the context of the utterance and utilises their world knowledge. It is for instance common world knowledge that in order to gift a book one most likely purchased it beforehand.

1. a. Holly bought a book and she gifted it to her friend.

b. Holly bought a book but she gifted it to her friend.

This difference between the pragmatic of DC and that of logical connectors is classically referred to as different types of implicatures : conventional implicatures for DC as opposed to conversational implicatures for logical connectors (Grice, 1975). This theoretical distinction has revealed to reflect real processing differences.

De Neys & Schaeken (2007) reported that conversational implicatures are less likely to be computed under high cognitive load. They tested participants on a type of conversational implicatures that arises when a weak term that is part of a scale is used. For instance, if something is said to be good, it can implicate that is not excellent; *good* is indeed not as strong as *excellent* so if *excellent* applied to the situation, the speaker would have used that stronger term instead. Same goes for the logical connector *or* that is not as informative as *and* or for the quantifier *some* (used in De Neys & Schaeken (2007)’ experiment) that can implicate *not all*. Unlike for DC however, that type of pragmatic inference is not automatic and needs to be contextually licensed (Breheny et al., 2006). For example, in (18) the speaker seems to only know whether Peter passed or fail the exam. In that context they can only assert that Peter’s performance as good enough to pass. However, it may as well have been excellent but the speaker is missing information to use that stronger term (they might have not attended the exam and do not know the exam score obtained). Since the speaker is not in a position to make a stronger claim than good, it does not implicate that the performance was not excellent.

1. Peter passed his piano exam so his performance must have been good.

In their study, De Neys & Schaeken (2007) saturated their participants’ working memory by asking them to memorise patterns of dots while seeing the experimental items. Participants then had to interpret sentences featuring uses of *some* that should lead to not-all implicatures. They reported that compared to a group having completed the experiment under no cognitive load, participants under high load were less likely to compute the not-all implicatures. Interestingly, Janssens & Schaeken (2016) adapted this design and used it to study the inference of contrast triggered by *but*. They found that being under high cognitive load does not affect the interpretation of *but*. This shows that the pragmatic contribution of DM, unlike inferences associated with logical connectors, is automatically and obligatory computed upon hearing the DC.

Studies on pragmatic inferences linked with logical connectors (e.g., scalar implicatures for *or*, enrichment for *and*) have greatly contributed to the understanding of the cognitive processes behind pragmatic meaning (Noveck, 2018). They are indeed good candidates for experimental studies because the implicatures that they trigger are more localised and vary less among speakers than other types of pragmatic inferences (e.g., irony, metaphors). That said all conversational implicatures require some level of contextual evaluation prior to the computation of the inferred meaning. This relies on cognitive processes that are challenging to monitor experimentally and are hence virtually impossible to dissociate from the inference making process. Moreover, the computation of implicatures linked with logical connectors may not vary much in quality from one individual to the next (scalar implicatures are standardised they only lead to one specific reading) but it varies in quantity. Fairchild & Papafragou (2021) for instance reported that participants’ likelihood to judge sentences such as “Some elephants are mammals” as correct was negatively correlated with their performance on standard Theory of Mind tasks. This difference in the interpretation of scalar terms was even found in participants’ neurophysiological responses to such stimuli. Barbet & Thierry (2016) indeed found a reduction in the P3b magnitude following under informative some-statements for those participants that accepted logically true but pragmatically infelicitous sentences (“Some elephants are mammals”).

Unlike conversational implicatures, the pragmatic meaning conveyed by DM is *conventionalized* and thereby automatic and obligatory [as seen in Janssens & Schaeken (2016)]. The inferences linked with DM thus do not require contextual licensing to be triggered and they should not vary between participants. These specificities relative to conversational implicatures are particularly advantageous for the psycholinguistic study of pragmatic inferences. They indeed allow to build paradigms in which the inference making process (the integration of pragmatic meaning) can be studied in isolation of complex contextual evaluation. Recall some of the studies described in section 2. For instance, Köhne-Fuetterer et al. (2021) looked at the integration of *therefore* and *nevertheless* to a context-rich sentence that encouraged the hearer to shape discourse expectations prior to the DM. The task made participants predict what item the speaker was interested in out of a selection visually presented to them. The sentences leading up to the DM narrowed down the possible options in order to make the use of *therefore* or *nevertheless* particularly salient and source of either prediction confirmation or revision. While the integration of DM to discourse processing is in itself a topic worthy of attention, we wish to suggest a completely approach here. Instead of observing DM in information rich discourse, we propose to study the processing of DM in sentences that are virtually stripped of all meaningful content. The rational is to keep the context and semantic content of the sentence to the minimum required for the sentence to remain meaningful and processable. Thereby the only possible source of pragmatic inferences in the test sentences would be the DM. By doing so we would be able to observe the unfolding of a pragmatic inference in isolation of other factors known to affect pragmatic interpretations (contextual evaluation, world knowledge, individual variations).

Moreover, given that the semantic function of DM if to connect two elements of discourse, the logical connector *and* is an ideal control that provides the baseline results for the semantic processing of a conjunction. In designs that do not feature extensive context, a pragmatic enrichment of *and* is not licensed; *and* would thus only be processed as a logical conjunction.

In section 2, we discussed two prominent approaches in the processing literature on DM (processing of discourse relations and integration to discourse representation). We have now introduced a third and novel approach namely to exploit the specificities of the pragmatic import of DM in order to experimentally explore the cognitive processes behind a pragmatic inference. In the following section we illustrate this proposal with a study on *but*, *so* and *and*.

* 1. An example

In the previous section we suggested to study the pragmatic contribution of DM in isolation of other pragmatic processes. This line of psycholinguistic research should develop in a variety of form (e.g., behavioural measures, neurophysiological measures, typical or atypical population, developmental studies) in order to maximise the scope of questions that can be addressed experimentally. In our lab we have recently started to dissect the pragmatic contribution of DC by first asking whether the processing of the pragmatic inferences linked with DM is cognitively costly.

It has been extensively reported that the processing conversational implicatures incur a high cognitive cost [some studies on scalar implicatures : Bott & Noveck, (2004); Chevallier et al., (2008); De Neys & Schaeken, (2007)]. However conversational implicatures do not allow us to evaluate whether this cognitive effort is caused by the process of licensing the implicature or by something intrinsic to pragmatic meaning that makes it harder to process than semantic meaning. In that regard the processing of DM reveals crucial to answering this question. If it appears that DM are costlier to process than the control *and*, it will indicate that the process of contextual evaluation and of world knowledge use are not the sole factors responsible for the high cognitive cost of pragmatic processing. Conversely, if no differences are found, this will be evidence that pragmatic meaning is not costly to process is bound to the lexical retrieval of a term, hence the process of licencing the inference is the actual source of extra cognitive effort.

Moreover, if there are differences in processing in-between the different DM tested, this can be an indication that the degree of complexity of the discourse relation encoded may affect the processing effort of a given DM. However, no differences would hint at the fact that pragmatic meaning is intrinsically more complex to represent and to process than semantic meaning even in cases where it is bound to a lexical item.

To test these hypotheses, we tested English speaking adults on a series of reading time experiments. Participants first saw a three-letter word [e.g., BET in (19)] followed by a statement about the letters in that word as in (19). The sentence was presented in two parts, the first one ending just after the DC. At the end of the sentence participants were prompted to assess whether the description matched the target word or not. The two conjuncts in the test sentences were connected with either *and*, *but* or *so* and the second conjunct was either affirmative [e.g., *there is a* *T.* in (19)] or negative [e.g., *there is no T*. in (19)].

1. *Target word BET*

There is a B but/and/so there is a/no T.

The strengths of this design are first its minimalism. Indeed, the content of the test sentences should not lead participants to infer anything besides the inference triggered by the DCs. Secondly this design allows to directly compare the results for *and* to that for the two DCs. That way, any differences between *and* and *but* or *so* is likely to be a manifestation of the processing of the pragmatic inference triggered by the DCs. The results confirmed this prediction as participants required, on average, longer to read the first conjuncts ending with *but* and *so* than they did conjuncts ending with *and*. This first observation already contributes to answer the main question of this study. It indeed seems that the pragmatic meaning of the DCs made their processing more effortful than that of a logical term triggering no pragmatic inferences. If that is the case, this difference in RT1 between *and* and DC-trials represents the time that participants required to form and expectation of contrast following *but* and of causality following *so*. Interestingly, there were no differences in reading times between the two DCs. In section 2, we discussed evidence that causality (*so*) may be easier to process that the contrast encoded by *but*. The absence of a difference in reading time of the DCs here seems to indicate that the extra effort is really caused by the creation of a discourse expectation (pragmatic processing) rather than just the processing a given discourse relation which should have led to a processing effort proportional to complexity of the relation encoded.

This study also showed that participants were greatly slowed down by an affirmative second conjunct following *but* relative to the baseline *and* trials. Meanwhile the processing of the second conjunct was not altered when *but* preceded a negation. This is a straight forward sign of the discourse expectations raised by the DC, participants awaited some sort of contrast following *but*. This expectation was fulfilled by the negation in negative sentences (contrasting with the affirmative first part), however in the affirmative condition, nothing else fulfilled participants’ expectation of a contrast. The processing delay was thus likely caused by failed attempts to find that contrast and eventually by the cancellation of this expectation. These results confirm previous findings that DCs create expectations and shape discourse representations, to the difference that in our design these expectations were driven solely by the presence of a DC. A similar phenomenon emerged in the *so*-trials: reading times of the second conjunct were on average slower than that of the baseline *and*. Again, this can be attributed to the fact that the causality introduced by the DC was not clearly fulfilled in so-trials.

This experiment shows an example of how DCs can be used to experimentally isolate and behaviourally assess the unfolding of a pragmatic inference. Context was kept to a minimum to only observe to processing of the pragmatic import of DCs and no other inferences. The processing of the DCs was compared to that of *and* which is the closest logical equivalent. Results suggested that the pragmatic import of DCs is costly to process even though it is linked to the lexical retrieval of the terms. Previous findings about the incremental discourse expectations triggered by DCs were also replicated. This first experiment was meant to illustrate how studies on the processing of DCs can be shaped to obtain close-up data on inferential meaning.

# Conclusion and further prospects.

In this Chapter we tried to highlight the different ways in which psycholinguistic studies on DM can contribute to more general questions on discourse processing. It appeared that in their quality of concentrate of pragmatic information DM are great candidates for experimental studies. Two main lines of research were highlighted.

First, we saw how the Coherence approach to discourse inspired a number of studies interested in classifying and characterising discourse relations as well as understanding the specificities and complexities of their processing. Most of their conclusion on discourse relation processing was based on empirical results on the processing of DM that they consider almost as a miniature reproduction of the relation that they encode.

Secondly, we reviewed the literature concerned with the integration of DM to discourse representation. DM are such saliant pivots in discourse that the interaction between DM and discourse processing is also insightful on how the human cognition organises and represents discourse.

Finally, we proposed our own approach to the psycholinguistic study of DM. We compared the pragmatic contribution of DM to that of logical connectors like *and* and *or* to demonstrate how the specificities of DM could contribute the general understanding of pragmatic meaning.

From there we suggested to use DM to dissect the processing of a “minimal unit” of pragmatic inference. DM indeed make it possible to study the processing of pragmatic meaning in isolation of complex contextual evaluation, world knowledge influence or individual sensitivity.

We illustrated this proposal with the report of a reaction time study that revealed that DM take longer to be processed than logical connectors. This seems to indicate that even when conventionalized, pragmatic meaning is processed more effortfully than semantic meaning. We see this study as a first step towards a series of work on DM processing using minimalist designs to always deepen the questions that one asks regarding pragmatic meaning.

Following a comparable rational as exposed in this chapter, a recent paper by Noveck et al. (2021) looked at the French contra-positive answer *si*. This term is used following a question containing a negation when the addressee wishes to signal disagreement with the negation in order to lend support to the speaker’s implicit affirmation. Similarly, to the DM mentioned here, the French *si* conveys pragmatic information that is conventionalised and concentrated into one short word. As for our results with *but* and *so,* this study found that *si*-responses were linked with processing delays relative to other types of responses. It thus confirms our findings that even pragmatic meaning that is bound to a lexical item can be cognitively costly. Moreover, Noveck et al. (2021) reported intriguing developmental data. While adults and 6-year-old children seemed slowed down by *si*-responses, this was not the case for the 4-year-old group even though they still used *si* appropriately. The authors suggested that perhaps those youngest participants understand the use of *si* but without engaging in the full extent of the pragmatic inference.

These findings call for further exploration. It would indeed be interested to see if similar developmental results our found with DM using a minimalist paradigm as presented in this chapter. It could also be worth exploring whether similar results are found in adults under cognitive load. Janssens & Schaeken (2016) found that high cognitive load did not affect the interpretation of sentences containing but however it might affect reaction times in a similar fashion as Noveck et al.’s 4-year-olds. Perhaps adults under high cognitive load do not engage in the full pragmatic processing of a DM which would give rise to reaction times comparable to that of a logical connector.

In sum DM are of particular intrest to study pragmatic processing because they are short words that contain conventionalized pragmatic information. This very specific status of DM has been exploited in a number of studies on related psycholinguistics questions and it will most likely continue to be the case for the years to come.

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1. Subordinating conjunctions induce a verb final sentence structure in Dutch. Therefore, the inflected verb of the clause always appeared in brackets at the beginning of the sentence to avoid a potential influence of syntax on participants’ choice of DC. [↑](#footnote-ref-2)
2. *r*oughly translates into *indeed* in English but with some nuances that we shall make further explicit. [↑](#footnote-ref-3)