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Coordination of Causal Relations in Discourse

Laurence Delort & Laurence Danlos[i]

[i]LaTTICe – Université Paris 7

Abstract: The goal of this paper is twofold. First, we aim to shed light on the need to distinguish French causal connectives which convey a semantic relation from those which convey a discourse relation. Next, we aim to put forward an analysis of coordination of causal relations, in comparison with coordination of facts. While the latter is well-known, the former has nearly never been studied.

1 Introduction

French causal connectives *parce que*, *car* and *puisque* or the null connective (noted as ø) can be found in the same discourse context, as (1)[1] exemplifies.

(1) Bart est resté au lit { parce que / car / puisque / ø } il était malade.
Bart stayed in bed { because / for / since / ø } he was sick.

It's commonly accepted, as in (Knott, 1996) for instance, that all the French or English discourses in (1) involve a discourse relation, namely $Explanation$, a description of which can be found in SDRT (Segmented Discourse Representation Theory), (Asher & Lascarides, 2003). However, some studies on French causal connectives, including (Groupe λ-l, 1975) and (Iordanskaja, 1993), have shown that *parce que* denotes a causal relation between facts, while *car* and *puisque* are speech acts markers. In the line of these works, we hypothesize here that *parce que* doesn't convey the discourse relation $Explanation$ as *car*, *puisque* and null connective do. Our argumentation is based on coordination of causal relations. This discourse organization should not be confused with that involving a complex cause made up of a coordination of facts. While the latter is well-known, the former has nearly never been studied.

Section 2 presents a summary of works on French causal connectives and the resulting analysis in the framework of SDRT. Section 3 provides, for each type of coordination (alternation, addition, correction), a description of coordination of causal relations, in comparison with coordination of facts, and a discussion on formal representations in the framework of SDRT.

2 French Causal Connectives and Discourse Relations

Discourse (1) illustrates that conjunctions *parce que, car* and *puisque* can be found in the same context, and so look as if they were interchangeable. However, in (Groupe λ-l, 1975), a number of discrepancies between these causal connectives has been put forward. They are summarized in Section 2.1. Section 2.2 proposes an analysis of Groupe λ-l's results into the framework of SDRT.

2.1 Summary of (Groupe λ-l, 1975)

In (Groupe λ-l, 1975), it is claimed that *parce que* denotes a causal relation between facts, while *car* and *puisque* are speech acts markers. More precisely, it is claimed that discourse (2) is an assertion of a causal relation between two facts - f_1 "Lisa is happy" and f_2 "Lisa got an A in

[1]For the sake of simplicity, the French discourses we present are built. Nevertheless, they are inspired from a corpus study. The notation A{X/Y}B means AXB or AYB.

maths" - and thereby it corresponds to only one speech act. On the other hand, in discourse (3)[2], two speech acts are performed, i.e. f_1 and f_2 are both asserted, and f_2 is an explanation of f_1, i.e. f_2 plays a rhetorical role with f_1. In (2), f_2 only specifies the cause of f_1, while in (3), f_2 explains f_1.

(2) Lisa est contente parce qu' elle a eu un A en maths.
Lisa is happy because she got an A in maths.

(3) Lisa est contente {car / puisqu'} elle a eu un A en maths.
Lisa is happy {for / since} she got an A in maths.

The syntactic and semantic arguments supporting this claim are the following ones. A semantic (e.g. causal) relation between two facts gives rise to a content on which it's possible to predicate, i.e. a semantic relation can be under the scope of a negation, (4a), of an adverb, (4b), and it can be questioned, (4c), for instance.

(4) a. Lisa n'est pas contente parce qu'elle a eu un A en maths mais parce qu'il fait beau[3].
Lisa is not happy because she got an A in maths but because the sun is shining.

b. Lisa est contente peut-être parce qu'elle a eu un A en maths.
Lisa is happy maybe because she got an A in maths.

c. Est-ce que Lisa est contente parce qu'elle a eu un A en maths ?
Is Lisa happy because she got an A in maths ?

On the other hand, when two speech acts are performed, there is no semantic relation which can be under the scope of a negation, (5a), of an adverb, (5b), or which can be questioned, (5c).

(5) a. * Lisa n'est pas contente {car / puisqu'} elle a eu un A en maths mais {car / puisqu'} il fait beau.
* Lisa is not happy {for / since} she got an A in maths but {for / since} the sun is shining.

b. * Lisa est contente peut-être {car / puisqu'} elle a eu un A en maths.
* Lisa is happy maybe {for / since} she got an A in maths.

c. * Est-ce que Lisa est contente {car / puisqu'} elle a eu un A en maths ?
* Is Lisa happy {for / since} she got an A in maths ?

Groupe λ-l (1975) has also noticed that all the French causal connectives have an other use which stands on metatalk grounds. This use is illustrated in (6). In this discourse, whatever the connective, f_2 explains why f_1 is said or thought: I {say/think} f_1 because f_2. Here, the content of f_2 is not linked to the content of f_1 but to its performance. However, this metatalk use of causal connectives is put aside in the rest of this paper, which is only concerned with the standard use.

(6) (Je pense que) Lisa a eu un A en maths {parce que / car / puisque} elle est contente.
(I think) Lisa got an A in maths {because / for / since} she is happy.

In summary, different semantic and pragmatic values according to the French causal connective used and to the discourse context have been pointed out. Let us now look at the consequences of these differences in terms of discourse relations.

[2]Roughly, the only difference between *car* and *puisque* is that *car* introduces a new fact while *puisque* introduced a presupposed one.

[3]This syntactic construction, called "contrastive negation", is used to express correction, which is discussed in section 3.3.

2.2 Causal connectives within the SDRT framework

In SDRT, a discourse relation takes speech acts π_i as arguments. As it has just been shown that *parce que* doesn't link two speech acts but denotes a causal relation between two facts, the compositional semantic rule (R1), which doesn't involve any discourse relation, can be proposed.

(R1) S_α parce que $S_\beta \Rightarrow cause(f_\beta, f_\alpha)$

On the other hand, as two speech acts are performed when *car* or *puisque* are used, and as f_2 explains why f_1 occurs, rule (R2) can be proposed. It involves the discourse relation $Explanation$[4].

(R2) S_α {car / puisque} $S_\beta \Rightarrow Explanation(\pi_\alpha, \pi_\beta)$

We are now going to investigate coordination of causal relations. This study strengthens the hypothesis that *parce que* doesn't convey the discourse relation $Explanation$ but a causal semantic relation between two facts.

3 Coordination of causal relations

It's well-known that discourse organization involves coordination, as studied in (Gómez Txurruka, 2003) or in (Asher & Vieu, 2005). However, these authors only concentrate on coordination of clauses. Here the focus is on coordination of subordinate clauses introduced by the same conjunction, namely *parce que*. The three types of coordination under investigation are alternation (section 3.1), addition (section 3.2) and correction (section 3.3).

3.1 Alternation

This section describes first alternation on facts under the scope of *parce que* (the well-known case), next alternation on causal relations (the original case), and finally the dissimilarities between the two cases. For each case, formal representations are discussed.

3.1.1 Alternation on facts

In discourses (7), adapted from an example of (Asher & Lascarides, 2003), a coordination of clauses is under the scope of a connective, respectively *parce que*, (7a), *car* or ø, (7b). Whatever the connective, each discourse expresses a complex cause made up of a disjunction between facts. Its informational content, compositionally obtained, is $cause(f_2 \nabla f_3, f_1)$[5]. That is to say, either f_2 "Bart was pushed" or f_3 "Bart slipped" is true (but not both), and the one which is true causes f_1 "Bart fell".

(7) a. Bart est tombé parce que soit on l'a poussé, soit il a glissé sur une peau de banane.
Bart fell because either he was pushed, or he slipped on a banana peel.

b. Bart est tombé {car / ø} soit on l'a poussé, soit il a glissé sur une peau de banane.
Bart fell {for / ø} either he was pushed, or he slipped on a banana peel.

[4]Recall that f_2 is new to the receiver with *car*, and known to the receiver with *puisque*. However, this difference is neglected in (R2). $Explanation$ is to be distinguished from the metatalk relation $Explanation$*, which is used in SDRT for a discourse such as (6).

[5]For the sake of simplicity, the symbols ∇, $\vee$ and $\wedge$ can take as arguments both facts and propositions. The symbol ∇ is used for exclusive disjunction ($\alpha \nabla \beta$ means either α or β but not the two), and $\vee$ for inclusive disjunction ($\alpha \vee \beta$ means α or β or the two). It is assumed on pragmatic grounds that *soit...soit* (*either...or*) expresses an exclusive disjunction.

Let us now examine the formal representations for the three discourses in (7). Firstly, for (7b) with *car*, rule (R2) allows us to compute the SDRS[6] in Figure 1. This figure also shows the equivalent discourse dependency graph, (Danlos, 2004). Secondly, for (7b) with the null connective, $Explanation$ should be inferred and the same representation proposed. Finally, for (7a) with *parce que*, rule (R1) allows us to compute the DRS[7] K_{π_0} in Figure 2. It corresponds to only one speech act π_0 and it simply includes the three facts and a complex cause made up of an alternation.

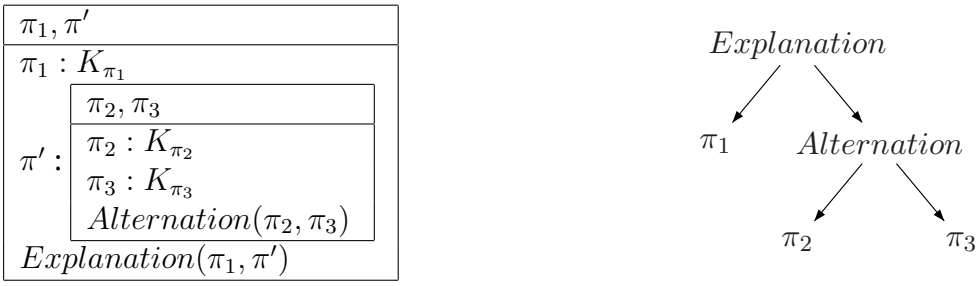

FIG. 1 – Discourse structure for (7b) with *car* and ø: SDRS and dependency graph

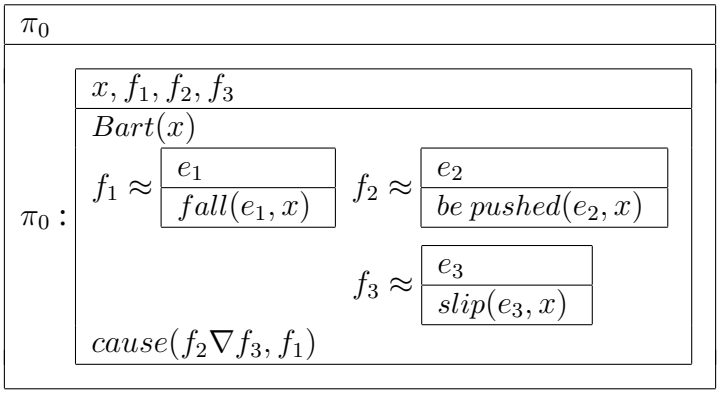

FIG. 2 – Discourse structure for (7a) with *parce que*

3.1.2 Alternation on causal relations

Discourse (8a) involves a coordination of subordinate clauses introduced by *parce que*: the causal connective is under the scope of the coordinating conjunction. The facts f_2 "Yoon knows LaTeX" and f_3 "Yoon speaks Thai" are taken to be both true and common knowledge. The compositional interpretation of (8a) says that the disjunction concerns causal relations: the informational content is $cause(f_2, f_1) \nabla cause(f_3, f_1)$. In other words, either f_2 causes f_1 "Yoon is hired", or f_3 causes f_1. Both f_2 and f_3 are true, but only one of the two causes f_1. Discourse (8a) with *parce que* contrasts with (8b) with *car*: (8b) is syntactically ill-formed because only subordinate clauses (introduced by subordinating conjunctions) can be coordinated. With null connective ø, discourse (8c) is syntactically well-formed but is awkward because its only interpretation is that either f_2 or f_3 is true, while they are taken to be both true.

[6] An (S)DRS is a (Segmented) Discourse Representation Structure. It is composed of a set of discourse referents (top of the box), and a set of conditions on these referents (bottom of the box). Recall that π_i is a speech act whose propositional content is f_i represented in the DRS K_{π_i}.

[7] Following (Asher, 1993), facts are characterized by sub-DRSs introduced by the operator $\approx$.

(8) a. Yoon a été embauchée soit parce qu'elle connaît LaTeX, soit parce qu'elle parle Thaï.
Yoon was hired either because she knows LaTeX, or because she speaks Thai.

b. * Yoon a été embauchée soit car elle connaît LaTeX, soit car elle parle Thaï.
* Yoon was hired either for she knows LaTeX, or for she speaks Thai.

c. # Yoon a été embauchée. Soit ø elle connaît LaTeX, soit ø elle parle Thaï.
Yoon was hired. Either ø she knows LaTeX, or ø she speaks Thai.

If someone wanted to maintain that *parce que* denotes $Explanation$, then an SDRS such as that shown in Figure 3 - along with the equivalent discourse dependency graph - could be contemplated for (8a). However, firstly, the well-formedness of π' or π'' is debatable since π_1 is not part of the universe while it is an argument of a condition (it is the first argument of $Explanation$). Secondly, and more significantly in a text generation perspective, this discourse structure is not satisfying because if $Explanation$ is lexicalized by *car*, it gives rise to an agrammatical discourse (see (8b)), and if it's not lexicalized (connective ø), it gives rise to a semantic clash (see (8c)). Other variants of this SDRS can be considered but they lead to the same difficulties, as the reader can check it.

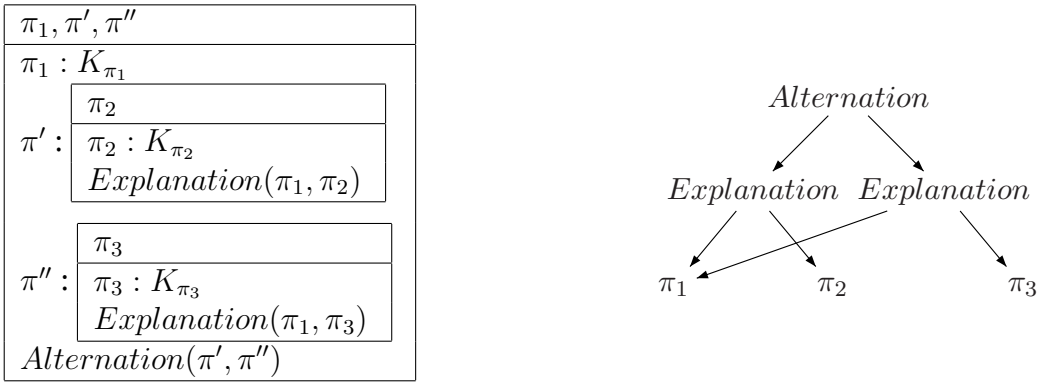

FIG. 3 – First discourse structure for (8a): SDRS and dependency graph

On the other hand, if one follows the Groupe λ-l's claim that *parce que* conveys a semantic relation and thereby adopts rule (R1), the DRS K_{π_0} in Figure 4 is the discourse structure for (8a). It corresponds to only one speech act π_0 and it simply involves the three facts f_1, f_2 and f_3 and the alternation of causal relations.

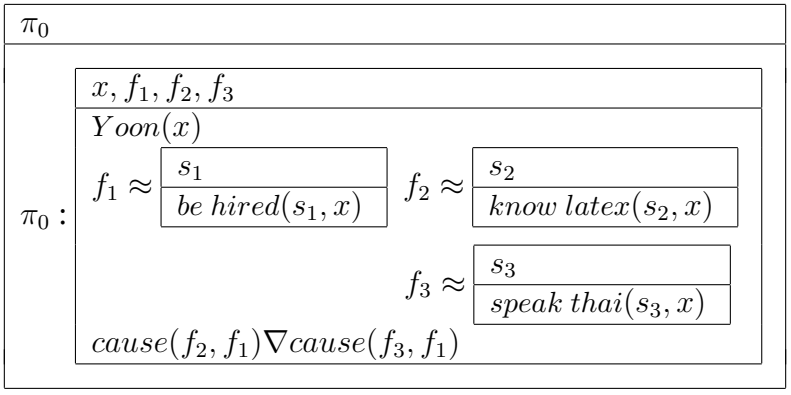

FIG. 4 – Second and last discourse structure for (8a)

3.1.3 Alternation on facts *vs.* on causal relations

When $cause(f_2, f_1)$ is true, it implies that both f_1 and f_2 are true. What happens with complex alternative causes? First, with alternation of facts, i.e. $cause(f_2 \nabla f_3, f_1)$. When it is true, it implies, on the same way, $f_2 \nabla f_3$. This is the case with (7a). Moreover, discourse (9), which has the same form as (7a), with the coordinated clauses under the scope of *parce que*, cannot be used in the situation where f_2 and f_3 are taken to be both true. This means that when $cause(f_2 \nabla f_3, f_1)$ is meant to be true, $f_2 \wedge f_3$ cannot be true, only $f_2 \nabla f_3$ can be true.

(9) # Yoon a été embauchée parce que soit elle connaît LaTeX, soit elle parle Thaï.
Yoon was hired because either she knows LaTeX, or she speaks Thai.

Next, consider alternation of causes, i.e. $cause(f_2, f_1) \nabla cause(f_3, f_1)$. When it is true, it should imply $f_2 \nabla f_3$, but in fact, it implies $f_2 \vee f_3$. It implies $f_2 \wedge f_3$ in discourse (8a), and it implies $f_2 \nabla f_3$ in discourse (10), which has the same form as (8a) with *parce que* under the scope of the coordinating conjunction, but which has the same meaning as (7a).

(10) Bart est tombé soit parce qu'on l'a poussé, soit parce qu'il a glissé sur une peau de banane.
Bart fell either because he was pushed, or because he slipped on a banana peel.

These data show that rule (R3) seems valid. It expresses that a cause made up of a disjunction of facts can be expressed in terms of a disjunction of causal relations (discourses (7a) and (10) express the same informational content). On the other hand, the reverse rule is not valid: a disjunction between causal relations cannot always be expressed in terms of a disjunction between facts (discourse (8a) is not equivalent to (8c)).

(R3) $cause(f_2 \nabla f_3, f_1) \Rightarrow [f_2 \wedge cause(f_2, f_1)] \nabla [f_3 \wedge cause(f_3, f_1)]$

3.2 Addition

This section follows the same schemata as the previous one: first it describes addition of facts (the well-known case), then addition of causal relations (the original case), finally the dissimilarities between the two cases.

3.2.1 Addition of facts

Discourses (11) express an addition of facts. The common informational content is $cause(f_2 \wedge f_3, f_1)$. That is to say, f_1 "Homer is sick" is caused by the mix of f_2 "Homer devored donuts" and f_3 "Homer drank beer".

(11) a. Homer est malade parce qu'il a dévoré des donuts et (il a) bu de la bière.
Homer is sick because he devored donuts and (he) drank beer.

b. Homer est malade {car / ø} il a dévoré des donuts et (il a) bu de la bière.
Homer is sick {for / ø} he devored donuts and (he) drank beer.

The discourse structures for the three discourses in (11) can be built on exactly the same scheme as those for (7) in the previous section. More precisely, the formal representation for (11a), with *parce que*, can be computed as the one for (7a), simply by replacing the operator ∇ by $\wedge$ in Figure 2. Next, the formal representation for discourses (11b), with *car* and ø, can be computed as the one for (7b), simply by replacing $Alternation$ by $Joint$ in Figure 1.

3.2.2 Addition of causal relations

In (12a), the conjunction bears on causal relations. Its compositional informational content is $cause(f_2, f_1) \wedge cause(f_3, f_1)$. In other words, on the one hand, f_2 causes f_1, and on the other hand, f_3 causes f_1, i.e. f_2 and f_3 cause f_1 but in separate ways. Discourse (12a) with *parce que* contrasts with discourse (12b) with *car* which is syntactically ill-formed (only subordinate clauses can be coordinated). With null connective, discourse (12c) is syntactically well-formed and seems to express the same meaning as (11b), as it will be discussed in the next section.

(12) a. Homer est malade non seulement parce qu'il a dévoré des donuts, mais aussi parce qu'il a bu de la bière.

Homer is sick not only because he devored donuts, but also because he drank beer.

b. * Homer est malade non seulement car il a dévoré des donuts, mais aussi car il a bu de la bière.

* Homer is sick not only for he devored donuts, but also for he drank beer.

c. Homer est malade. Non seulement ø il a dévoré des donuts, mais aussi ø il a bu de la bière.

Homer is sick. Not only ø he devored donuts, but also ø he drank beer.

If *parce que* were taken to denote $Explanation$, one could propose a SDRS and a discourse dependency graph similar to the ones in Figure 3, except that the discourse relation $Joint$ replaces $Alternation$. However, the same difficulties arise: the well-formedness of the SDRS and the lexicalization of $Explanation$ with *car* (which leads to the agrammatical discourse (12b)). On the other hand, in line with the Groupe λ-l's results, a DRS similar to the one in Figure 4, except that the operator $\wedge$ replaces ∇, is satisfying.

3.2.3 Addition of facts *vs.* of causal relations

If Homer is sick when he takes donuts and independently when he takes beer, he should be doubly sick when he takes both donuts and beer. Therefore, rule (R4) seems valid.

(R4) $cause(f_2, f_1) \wedge cause(f_3, f_1) \Rightarrow cause(f_2 \wedge f_3, f_1)$

The reversal should not be true. If the mix of donuts and beer makes Homer sick, maybe he is not sick when he takes either only donuts or only beer. However, examples (11a) and (12a) are peculiar. In numerous examples found in corpora, there is a semantic equivalence between a discourse in which the coordinated clauses are under the scope of *parce que* and a discourse in which the subordinated clauses are under the scope of the coordinating conjunction, see (13a) and (13b).

(13) a. ? Lisa est contente parce qu'elle a eu un A en maths et il fait beau.[8]

Lisa is happy because she got an A in maths and the sun is shining.

b. Lisa est contente non seulement parce qu'elle a eu un A en maths mais aussi parce qu'il fait beau.

Lisa is happy not only because she got an A in maths but also because the sun is shining.

[8]This discourse does not sound natural. It is improved if the second coordinated clause is preceded by *que*, a "degenerated" form for French subordinating conjunctions, see (14a). However, the question whether (14a) should be related to (13a) or (14b) below is open. (14b) differs from (13b) on the coordinating conjunctions involved: a simple *et* in (14b) and *non seulement...mais aussi* in (13b).

(14) a. Lisa est contente parce qu'elle a eu un A en maths et qu'il fait beau.

b. Lisa est contente parce qu'elle a eu un A en maths et parce qu'il fait beau.

3.3 Correction

This section concerns correction of a fact and correction of a causal relation.

3.3.1 Correction of a fact

Discourse (15) is not syntactically well-formed. This is not this way in French to express a complex cause including correction.

(15) * Homer est malade {parce que / car / ø} non pas il a dévoré les donuts mais il a bu de la bière.

* Homer is sick {because / for / ø} not he devored donuts but he drank beer.

3.3.2 Correction of a causal relation

A discourse of type S_1 *non pas parce que* S_2 *mais parce que* S_3, with the contrastive negation *non pas...mais* conveying a correction, is well-formed, see (16a) and (17a), and its compositional semantic is $\neg cause(f_2, f_1) \wedge cause(f_3, f_1)$. However this type of discourse corresponds to two situations concerning the truth of f_2. These situations are respectively illustrated in (16b) and (17b), in which a parenthetical clause explicitly says if f_2 is true or not. In (16b), f_2 is true, but it doesn't cause f_1. While in (17b), f_2 is not true. Discourse (16a), when interpreted as (16b), is semantically equivalent to (4a), repeated in (16c), in which f_1 is syntactically negated.

(16) a. Lisa est contente non pas parce qu'elle a eu un A en maths mais parce qu'il fait beau.

Lisa is happy not because she got an A in maths but because the sun is shining.

b. Lisa est contente non pas parce qu'elle a eu un A en maths – dont elle est très fière – mais parce qu'il fait beau.

Lisa is happy not because she got an A in maths – and she's very proud of it – but because the sun is shining.

c. Lisa n'est pas contente parce qu'elle a eu un A en maths mais parce qu'il fait beau.

Lisa is not happy because she got an A in maths but because the sun is shining.

(17) a. Homer est malade non pas parce qu'il a dévoré des donuts mais parce qu'il a bu trop de bière.

Homer is sick not because he devored donuts but because he drank too much beer.

b. Homer est malade non pas parce qu'il a dévoré des donuts – d'ailleurs il n'avait pas intérêt à le faire – mais parce qu'il a bu trop de bière.

Homer is sick not because he devored donuts – it was not in his interest to do it – but because he drank too much beer.

With contrastive negation, whatever the interpretation on the truth of f_2, a syntactic distinction is observed between *parce que* and *car* for the reason already mentioned: two clauses introduced by *car* cannot be coordinated. And null connective leads to a syntactically ill-formed discourse, as already noticed in (15). See (18).

(18) * Lisa est contente non pas {car / ø} elle a eu un A en maths mais {car / ø} il fait beau.

* Lisa is happy not {for / ø} she got an A in maths but {for / ø} the sun is shining.

The discourse structure that one could propose with *parce que* conveying $Explanation$ is of the same type as the SDRS in Figure 3, *modulo* the discourse relation $Correction$ in place of $Alternation$. However, the reader can check that this SDRS, or another variant with $Explanation$ conveyed by *parce que*, is unsuitable for the reasons already given, such as the

agrammatical discourse (18) with *car* or ø. On the other hand, wrt. the Groupe λ-l's analysis, the DRS in Figure 5, built on the model of the one in Figure 4, is suitable. It corresponds to one speech act π_0, and it simply involves the three facts f_1, f_2 and f_3 and the denial of one of the causal relations.

$$\pi_0 : \begin{array}{|l|}\hline \pi_0 \\ \hline \begin{array}{|l|}\hline x, f_1, f_2, f_3 \\ \hline Lisa(x) \\ f_1 \approx \begin{array}{|c|}\hline s_1 \\ \hline be\ happy(s_1, x) \\ \hline \end{array} \quad f_2 \approx \begin{array}{|c|}\hline e_2 \\ \hline get\ a(e_2, x) \\ \hline \end{array} \\ f_3 \approx \begin{array}{|c|}\hline e_3 \\ \hline sun\ shining(e_3) \\ \hline \end{array} \\ \neg cause(f_2, f_1) \wedge cause(f_3, f_1) \\ \hline \end{array} \\ \hline \end{array}$$

FIG. 5 – Discourse structure for (16a)

3.3.3 Correction of a fact *vs.* of a causal relation

Correction of a fact and correction of a causal relation can be expressed by a discourse of type S_1 *non pas parce que* S_2 *mais parce que* S_3. It's the (extra-)linguistic context that guides the interpretation: either f_2 is true and correction has scope over causal relations, see (16a/b), or f_2 is wrong and correction has scope over a fact, see (17a/b).

4 Conclusion and Future Work

In the line of works on French causal connectives, we have hypothesized that *parce que* conveys a semantic relation between facts, contrary to *car* and *puisque* which convey a discourse relation. To strenghten this hypothesis, coordination of causal relations have been examined in comparison with coordination of facts. This new perspective on *parce que* allows a simpler treatment of causal subordinate clauses in discourse. The causal semantic relation triggered by *parce que* can be under the scope of a coordination, but also of a negation, of an adverb, etc. On the other hand, it seems pretty hard to coordinate two discourse relations $Explanation$ and it doesn't make sense to deny or modify this discourse relation.

Moreover, this study should have shed light on the need to distinguish subordinating conjunctions which trigger semantic relation (between facts) from those which trigger discourse relations (between speech acts). This is close to works on French subordinating conjunctions such as *avant que* (English *before*), (Le Draoulec, 2005) and (Delort, 2004). Many other studies aim at arguing for this distinction but either only from a syntactic point of view, or only from a semantic point of view. Future work will focus on this distinction from both points of view and will provide a formal treatment in (S)DRT.

Aknowledgements

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