

# The Semantics of French Continuative Rises in SDRT\*

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## Abstract

We examine the status of French *major continuative* prosodic contours, which are mainly realised as final rises at the boundary of sentences. We show how to substantiate the common intuition that these contours convey ‘continuation’. We report empirical evidence that indicates that native speakers cannot distinguish major continuatives and questions in isolated discourse segments. We then show how to integrate continuatives into a liberal version of Asher’s SDRT. In essence, we propose that any discourse constituent bearing a major continuative (i) has a default question interpretation when taken in isolation and (ii) constrains attachments at the point where it occurs, when considered in the context of a discourse.

## 1 Introduction

In this text, we address the question of how to integrate French inter-sentential continuative contours, or *discourse C(ontinulative) R(ises)* in our terminology, into Asher’s SDRT framework. Such contours were postulated by Delattre (1966), who proposed to associate a ‘continuation’ meaning to them. We tackle two problems. First, since discourse CR’s are rises phonetically, one may wonder whether they can be discriminated from other types of rises, in particular questions. We describe a simple protocol, which, in spite of its limitations, strongly suggests that French native speakers confuse discourse CR’s with questions, when they are presented in simple sentences. Given this cognitive proximity, it is unlikely that a simple compositional analysis, where contours ‘trigger’ distinct meaning (see Ladd, 1996/2008, sec. 3.4/4.2), is appropriate. We propose instead that discourse CR’s convey several default interpretative instructions, which may lead to different results in different contexts. We implement this idea in a version of Asher’s SDRT, paying special attention to the ‘continuation’ issue. In section 2, we present briefly Delattre’s approach. In section 3, we describe the empirical setting which helped us to detect speakers’ confusion and we discuss directions for future, truly experimental, work. In section 4, we present the SDRT treatment, first recalling its basic default mechanism (section 4.1), before providing an attachment-based account of continuation (section 4.2).

## 2 Continuative rises in French

In a famous paper (Delattre, 1966), the French phonetician Delattre proposed to distinguish ten basic melodic contours in French. He introduced two continuative contours,

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\*We thank the audience at CID 08 (Potsdam) and our two anonymous reviewers for their helpful comments, criticisms and suggestions.

that he called *minor* (mc) and *major* continuatives (MC). The discrimination between mc's and MC's is based on physical and functional differences. Physically, Delattre uses a four step melodic scale<sup>1</sup>. mc's span the 2-3 zone, whereas MC's, like question contours, span the 2-4 zone. mc's can be rising or falling, whereas MC's are rises. Finally, MC's are concave, whereas question contours are convex<sup>2</sup>. These properties are summarised in figure 1.

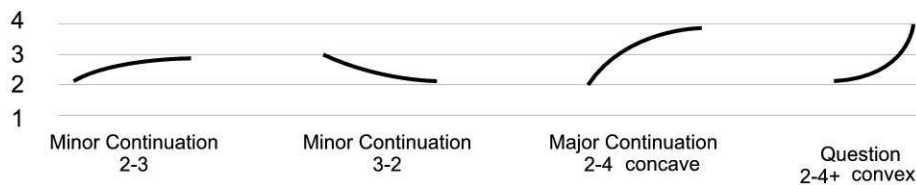


Figure 1: After P. Delattre (1966)

Functionally, mc's occur at the frontier between elementary meaningful constituents. In contrast, MC's signal that (i) a number of smaller meaningful constituents have been grouped together into a bigger one and (ii) a new 'big' (= non-elementary) constituent is about to begin. This is illustrated in (1) with one of Delattre's examples. The upper arc marks a mc and the wide circumflex a MC.

- (1) Si ces œufs étaient frais j'en prendrais  
 If those eggs were fresh I'd take some

In view of more recent literature, Delattre's intuition is on the right track. First, the existence of continuative rises has been attested in English (Pierrehumbert and Hirschberg, 1990) and in many languages (Chen, 2007; Jasinskaja, 2006)<sup>3</sup>. Second, Delattre's distinction between cm's and CM's is compatible with modern hierarchies of prosodic constituents (Di Cristo, 1999; Jun and Fougeron, 1995, 2000, 2002; D'imperio et al., 2007). Unfortunately, it is difficult to be more precise on this point, because of the variety of terminologies, whose application to concrete examples is not always clear. By and large, one may distinguish two kinds of units. The 'big' ones, called *Intonation Phrases* (IP's) in many models following Pierrehumbert (1980), are separated by *boundary tones*, located on the last syllable of the IP, or, in certain cases, on the last syllable of the focal/rhematic part of the IP. Typically, boundary tones convey information that helps determine the speech act type or discourse change potential of a sentence or clause. The existence and nature of smaller units is still disputed because it is, in general, more difficult to assess empirically. The reader is referred to Jun (2003) and Carlson et al. (2009) for recent research connecting phrasal boundaries and cognitive processing.

In this paper, we will be concerned only with continuative boundary tones of IP phrases and will ignore the informational and semantics status of other tones and contours (see Corblin and de Swart (2004, part V), Ladd (1996/2008, sec. 3.4/4.2), Marandin (2006), Von Heusinger (2007), for a variety of perspectives). Our official terminology for these tones will be *discourse C(ontinulative) R(ises)*.

<sup>1</sup>An analogous melodic division had been proposed by Pike (1945) for English; see also Trager and Smith (1951).

<sup>2</sup>We use the terms 'convex' and 'concave' in the mathematical sense. Delattre uses them as in everyday language where 'concave' means 'hollow' and 'convex' 'rounded'. So, according to his terminology, Delattre actually says that MC's are 'convex' and questions 'concave'.

<sup>3</sup>Not every continuative is strictly 'rising', though. For instance, (Chen, 2007, sec. 1.1) mentions the case of English continuatives, where different studies identify a pitch fall on the stressed syllable before a final rise.

### 3 Do discourse CR's exist?

In a sense, this section is dedicated to show that the question that heads it is not a gratuitous provocation. More precisely, discourse CR's can be seen either as objective acoustic entities, whose properties can be studied apart from any interpretive behaviour, or as cognitive entities, which can be recognised by native speakers. Here, we address the latter question. Specifically, we wanted to know whether native speakers are able to discriminate discourse CR's and questions in isolation. We limited our research to discourse CR's in assertions. Clearly, some additional similar research on imperatives and questions is needed to have a more complete picture, but the associated findings are probably going to be more complex to interpret. We briefly return to this point at the end of the section.

22 native speakers of French between 19 and 25 years old<sup>4</sup> were collectively presented with 16 sentences of four different discourse types: Assertion, Question, Exclamation and Continuation, in a  $4 \times 4$  design. Continuation sentences were 'artificial'. They had been obtained by cutting the signal corresponding to a S1S2 structure, where S1 ended with a discourse CR; there was no break (pause) between S1 and S2 and S1S2 formed a meaningful unit. For instance, the unit *Jean a raté son examen, il avait rien fichu* ('John has failed his exam, he had done bugger all') was shortened to the first part (*Jean a raté son examen*, 'John has failed his exam'). Each sentence had been pre-recorded and was played twice. 8 sentences were read by a female speaker and 8 by a male speaker. The 16 sentences were randomised. Subjects were instructed to assign to each sentence at least one of the labels Assertion, Question, Exclamation and Indeterminate. They were not aware of the goal of the experiment. We wanted to test whether subjects discriminate discourse CR's and questions. In order not to multiply sources of confusion, exclamations were realised as (relatively) end-falling. The sentences are shown in figure 2, in their order of presentation.

Although they were not explicitly forbidden to assign several labels, subjects were instructed to use Indeterminate whenever they had problems identifying the discourse type. Only one subject actually exploited the possibility of using more than one label.

As noted by a reviewer, the protocol used here prevents us to consider the observed results as truly 'experimental' in nature. Let us mention four major issues. First, since the sentences were presented collectively, their order of presentation did not vary and position effects might have occurred. Second, since the sentences in contrast exploited different lexical material, there might have been an effect of the individual content of sentences. In addition, the male vs. female parameter might have interacted with the question vs. continuation contrast that we wanted to study. Finally, we had only one group of subjects, not two or more independent groups.<sup>5</sup> We are going to show, however, that substantial information can be extracted from the results by using an appropriate statistical approach.

We start with the last point. Having only one group of subjects is statistically problematic with 'standard' models, in which one tries to detect the effect of one or several independent variables on a dependent variable (the so-called 'response variable'). For instance, we had conducted a standard *logistic regression* analysis on binary data, which

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<sup>4</sup>We thank the Linguistics Master2 students and the French Language and Communication L1 students of Nancy University for their participation.

<sup>5</sup>This explains why we could not keep the lexical material constant and make the intonation vary, as mentioned for the second problem. It would have led to a possible 'recall effect'.

1	Assertion	Jean a attrapé la grippe	John has got the flu
2	Exclamation	Jean a gagné au loto	John has won the lottery
3	Continuation	Jean a raté son examen	John has failed his exam
4	Question	Jean a rangé son bureau	John has tidied his room
5	Question	Jean a changé de voiture	John has got a new car
6	Exclamation	Jean a repeint son appartement	John has repainted his flat
7	Assertion	Jean a fait un cauchemar	John has had a nightmare
8	Continuation	Jean a adopté un chien	John has adopted a dog
9	Question	Jean a pris le train de nuit	John has taken the night train
10	Exclamation	Jean s'est fait opérer	John has got an operation
11	Continuation	Jean a démissionné	John has resigned
12	Assertion	Jean est tombé en panne	John has had a breakdown
13	Question	Jean est allé en Chine	John has gone to China
14	Exclamation	Jean a acheté une maison	John has bought a house
15	Continuation	Jean a revu Marie	John has met Mary again
16	Assertion	Jean a été au ski	John has gone skiing

The initial version of Continuations

3	Jean a raté son examen il avait rien fichu	John has failed his exam, he had done bugger all
8	Jean a adopté un chien il l'a fait vacciner	John has adopted a dog he has gotten him vaccinated
11	Jean a démissionné c'était mardi	John has resigned it was Tuesday
15	Jean a revu Marie il voulait lui parler	John has met Mary he wanted to speak to her

Figure 2: The sentences

indicated a massive confusion of questions and continuations. Unfortunately, our flat design violates the assumption of independence of observations. Nothing proves that a given subject does not possess a particular ‘profile’, which causes an intercorrelation between her answers. This led us to resort instead to a *mixed effect* modelling, which we are going to describe and discuss.

### 3.1 Raw results

We can get a first impression by simply summing the answers.<sup>6</sup> The following table summarises the data in <http://perso.ens-lyon.fr/jacques.jayez/nancy.data.txt>.

```
> xtabs(~sentence.type+response)
      response
sentence.type  A  E  Q ind
A      81  4  0  3
C       7  3 72  6
E      19 65  2  2
Q       1  0 86  1
```

Figure 3: Response summary

`sentence.type` corresponds to the speech act type, A for ‘Assertion’, C for ‘Continuative’ (discourse CR in our terms), E for ‘Exclamation’, Q for ‘Question’ and `ind` for ‘Indeterminate’. The leftmost column contains the types of the sentences as they were assigned

<sup>6</sup>The data formatting and analysis was done using the R software (<http://cran.R-project.org>).

*a priori*, whereas the upper row contains the answer types chosen by subjects. The table suggests that discourse CR items, that is, elements of sentence type C, are significantly confused with questions (Q). We can check this impression more rigorously with the help of the `vglm` function of the VGAM package (<http://www.stat.auckland.ac.nz/~yee>) whose family parameter has been set to multinomial, in order to ensure that a polytomous logistic regression is conducted (Yee, 2006). Computing the probabilities for the resulting model gives us a very clear picture.

```
> prediction
      A          E      ind          Q
1 0.92045450 4.545454e-02 0.03409091 5.135225e-08
2 0.07954545 3.409091e-02 0.06818182 8.181818e-01
3 0.21590909 7.386364e-01 0.02272727 2.272727e-02
4 0.01136364 4.205987e-08 0.01136364 9.772727e-01
```

**Figure 4:** Predictions

The table tells us that an Assertion is preferably associated with a A rating (at a 92% probability), a discourse CR with a Q rating (81%) and a Question with a Q rating (97%). Crucially, the probability of a discourse CR eliciting an A rating is only 8%. However, as we have said, standard logistic regression is not reliable in this case.

### 3.2 A Mixed model analysis

*Mixed models* are used when various parasitic effects may affect the observations. For instance, if we observe the same subjects in two different conditions, rather than having two different samples, it is not possible in general to tell apart what is due to the difference between conditions and what is due to the specific properties of subjects. A similar problem occurs when several measurements are done in the same geographical area under different conditions. Nothing guarantees that the area does not induce similar reactions among the entities which populate it (plants, animals, rocks and minerals, etc.). In such cases, there is a risk of *pseudo-replication*, that is, of considering as independent observations outcomes which are somehow correlated.

In a mixed model, one distinguishes between *fixed* and *random* effects. Effects of the former type are the conditions which would remain stable if we added data, concretely, the independent variables of which we want to track the effects on the response variable (`sentence.type`) in our case. Effects of the latter type represent the ‘unstable’ part of a set a observations and concern samples that could be indefinitely extended. Mixed model are particularly useful with a repeated measures design, like here: each sentence is evaluated by 22 subjects and each subject goes through 16 sentences. Thus, random effects concern subjects and sentences, which could be extended by new subjects and new sentences. Mixed models compensate for the inequalities between random values (see Baayen (2008), Pinheiro and Bates (2000), Powers and Xie (2008, chap. 5), Quené and van den Bergh (2008)).

We used the `lme4` package (<http://cran.r-project.org/web/packages/lme4/index.html>) to fit a mixed models for our data. We first transformed the responses into binary ones. An answer was counted as a success (TRUE or 1) whenever the subject had guessed the ‘correct’ category, i.e. assertion for Assertions and discourse CR’s, question for Questions and exclamation for Exclamations. We also counted indeterminate answers as correct when they corresponded to discourse CR’s. This was motivated by the desire to detect any potential trace of an identification of discourse CR’s. The resulting data

frame is at <http://perso.ens-lyon.fr/jacques.jayez/nancy.data.binary.txt>. Since the presentation of the sentences is not randomised (it is the same for all subjects), the position of a sentence might have a noticeable effect on the category assessment. This would be the case, for instance, if some subjects developed a strategy in the course of the presentation of sentences. In order to check whether it is indeed the case, we fitted the following model, called `model.wrt.position`.<sup>7</sup> For convenience, we have put the distribution of answers for the different position besides the summary of the results.

```
> model.wrt.position <- lmer(response.bin ~ position + (1 | subj)
+ (1 | sentence.text),family=binomial,data=nancy.data.binary)
Fixed effects:
      Estimate Std. Error z value Pr(>|z|)      A E ind Q
(Intercept)  1.553e+00  5.670e-01  2.740  0.00615 **  18  4  0  0
position10   -5.371e-01  7.400e-01 -0.726  0.46793      4 16  1  1
position11   -3.918e+00  9.440e-01 -4.151  3.31e-05 ***  1  0  2 19
position12    1.561e+00  1.190e+00  1.311  0.18985     21  0  1  0
position13    1.561e+00  1.190e+00  1.311  0.18985      1  0  0 21
position14    2.563e-06  7.929e-01  0.000  1.00000      4 18  0  0
position15   -4.667e+00  1.193e+00 -3.913  9.13e-05 ***  6  1  1 14
position16    1.561e+00  1.190e+00  1.311  0.18985     21  0  1  0
position2    -1.554e+00  7.053e-01 -2.203  0.02761 *    9 11  1  1
position3    -3.918e+00  9.440e-01 -4.151  3.31e-05 ***  0  0  2 20
position4     1.706e+01  2.332e+03  0.007  0.99416      0  0  0 22
position5    1.561e+00  1.190e+00  1.311  0.18985      0  0  1 21
position6     8.120e-01  9.426e-01  0.862  0.38895      2 20  0  0
position7    1.561e+00  1.190e+00  1.311  0.18985     21  0  1  0
position8    -4.667e+00  1.193e+00 -3.913  9.13e-05 ***  0  2  1 19
position9     1.706e+01  2.331e+03  0.007  0.99416      0  0  0 22
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Figure 5: Item variability

The fixed effect is on `position` and the random effects on subjects and items (`sentence.-text`). Although there are significant effects externally associated with position, they are not *due* to position. In fact, position 3, 8, 11 and 15 correspond to discourse CR's. Position 2 corresponds to an Exclamation which is strongly confused with Assertion. Position 1 is the intercept (the  $b_0$  coefficient mentioned in (i), note 7). Being the first position, it is mechanically 'boosted' by the model<sup>8</sup> and should not be considered too seriously.

Whereas there is no evidence of a position effect, one cannot exclude that the lexical material and syntactic structure of the sentences had an effect. However, it is highly implausible that the effect was precisely limited to discourse CR's. For instance, it is unclear what precisely in the lexicon or the syntax could lead to a marked difference between the discourse CR *Jean a adopté un chien* ('John adopted a dog') and the question *Jean a pris le train de nuit* ('John took the night train'). So, we conclude that it is reasonable to assume that lexical and syntactic peculiarities were at best weakly relevant in the data under consideration.

There is no male vs. female effect in the data, as shown by the following model comparison. The anova detects no improvement caused by including the `speaker.sex` variable.

<sup>7</sup>With a binomial response, the `lmer` function uses binomial logistic regression. Assuming that  $Y$  is the dependent binomial (1 vs. 0) variable and  $X$  a factor with  $n$  levels, `lmer` constructs a linear model of the following form.

(i) **Binary logistic regression:**  $\ln\left(\frac{\Pr(Y=1|X)}{\Pr(Y=0|X)}\right) = b_0 + b_1X_1 + \dots + b_nX_n$

<sup>8</sup>More precisely, `lme4` chooses a baseline, here position 1; it determines that this position has a strong 'positive' effect, that is, it produces significantly more answers recoded as 1 than answers recoded as 0; finally it *compares* other positions to this baseline. In particular, the figures for the other Assertion positions will not reach a significance threshold because these positions do not give rise to a significantly more positive result than position 1. In contrast, positions that give rise to clear negative effects will reach significance.

```

> model.with.sex <- lmer(response.bin ~ sentence.type + speaker.sex +
(1 | subj) + (1 | sentence.text),family=binomial, data=nancy.data.binary)
> model.without.sex <- lmer(response.bin ~ sentence.type + (1 | subj)
+ (1 | sentence.text),family=binomial, data=nancy.data.binary)
> anova(model.with.sex,model.without.sex)
Data: nancy.data.binary
Models:
model.without.sex: response.bin ~ sentence.type + (1 | subj)
+ (1 | sentence.text)
model.with.sex: response.bin ~ sentence.type + speaker.sex + (1 | subj)
model.with.sex:      + (1 | sentence.text)
              Df    AIC    BIC  logLik  Chisq Chi Df Pr(>Chisq)
model.without.sex  6 223.34 246.52 -105.67
model.with.sex     7 224.71 251.76 -105.36  0.6305    1    0.4272

```

**Figure 6:** No effect of sex

Turning to the effect of discourse categories (Assertion, Exclamation, discourse CR, Question), the mixed models we examine are the following.

```

model1 <- lmer(response.bin ~ sentence.type + (1 | subj)
+ (1 |sentence.text),family=binomial, data=nancy.data.binary)
Fixed effects:
              Estimate Std. Error z value Pr(>|z|)
(Intercept)    2.5657     0.4662   5.503 3.74e-08 ***
sentence.typeC -5.2902     0.6717  -7.875 3.40e-15 ***
sentence.typeE -1.4502     0.5658  -2.563  0.0104 *
sentence.typeQ  1.3253     0.9089   1.458  0.1448
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

model2 <- lmer(response.bin ~ sentence.type + (1 | subj)
+ (1 |sentence.text),family=binomial,
data=nancy.data.binary,subset=(!sentence.type=="A"))
Fixed effects:
              Estimate Std. Error z value Pr(>|z|)
(Intercept)   -2.6824     0.4849  -5.532 3.16e-08 ***
sentence.typeE  3.7753     0.5869   6.433 1.25e-10 ***
sentence.typeQ  6.5288     0.9126   7.154 8.43e-13 ***

model3 <- lmer(response.bin ~ sentence.type + (1 | subj)
+ (1 |sentence.text),family=binomial,
data=nancy.data.binary,subset=(!sentence.type=="C"))
Fixed effects:
              Estimate Std. Error z value Pr(>|z|)
(Intercept)    2.879      0.565   5.097 3.46e-07 ***
sentence.typeE -1.599      0.670  -2.387  0.017 *
sentence.typeQ  1.384      1.013   1.366  0.172

model4 <- lmer(response.bin ~ sentence.type + (1 | subj)
+ (1 |sentence.text),family=binomial,
data=nancy.data.binary,subset=(!sentence.type=="E"))
Fixed effects:
              Estimate Std. Error z value Pr(>|z|)
(Intercept)    2.4485     0.3940   6.215 5.12e-10 ***
sentence.typeC -5.0635     0.5780  -8.761 < 2e-16 ***
sentence.typeQ  1.3126     0.8166   1.607  0.108

model5 <- lmer(response.bin ~ sentence.type + (1 | subj)
+ (1 |sentence.text),family=binomial,
data=nancy.data.binary,subset=(!sentence.type=="Q"))
Fixed effects:
              Estimate Std. Error z value Pr(>|z|)
(Intercept)    2.5577     0.4680   5.465 4.62e-08 ***
sentence.typeC -5.2730     0.6758  -7.803 6.05e-15 ***
sentence.typeE -1.4463     0.5719  -2.529  0.0114 *

```

**Figure 7:** Some mixed models of interest

Models take into account all or some of the levels of the sentence type factor. For each model, the first level in the list is the reference level and the remaining levels are compared to it. In model 1, Exclamations and discourse CR's are significantly different from Assertions, as shown by the significance stars, and have a negative influence on the proportion of positive (= 1) answers. Questions are not significantly different from Assertions, which is to be expected since Questions and Assertions are identified as such by most subjects. The other models are constructed from model 1 by suppressing one level (A, C, E, Q). They aim at confirming model 1. Since A and Q give rise to a comparable number of successes (1), they are not expected to differ statistically (model 3 and model 4). Conversely, the models where we suppress A or Q should show three significant results (model 2 and model 5). The upshot is that discourse CR's and Exclamations facilitate errors, unlike Assertions and Questions.

Finally, in order to determine which type of confusion(s) discourse CR's cause, we used a two-step clustering procedure. First, working on the initial non-binary data, where the response contains one of the values A, E, C or Q, we grouped the sentence with the help of the classic hierarchical clustering algorithm *hclust*, applied to a dissimilarity matrix (see Ganet et al. (2007) for an introduction). The numbers appearing in the clusters correspond to the categories as follows: A = 1, 7, 12, 16, Q = 4, 5, 9, 13, E = 2, 6, 10, 14, C (i.e. discourse CR's) = 3, 8, 11, 15. We see that, with the R *daisy* function (leftward part of figure 8), Assertions and Exclamations form two separate subgroups, whereas Questions and discourse CR's pattern together. This is as it should be, since the response we are examining here is categorical and the subjects tend to answer Q to the Question and discourse CR's stimuli. In order to get a more fine-grained hierarchy, we resorted to a probabilistic clustering technique applied to the binary data, using the package *pvclust*, co-authored by Ryota Suzuki and Hidetoshi Shimodaira (<http://www.is.titech.ac.jp/~shimo/prog/pvclust/index.html>). The result is shown in the right half of figure 8. The squares indicate the clusters for which the p-value on the A(pproximately) U(nbiased) method is superior or equal to 0.95. Whereas the standard clustering separates assertions and exclamations, the probabilistic clustering puts Exclamation 6 next to Assertions 7 and 16 and Question 5. This is to be expected since the latter procedure is based on the distribution of positive answers, not on the identification of the category assigned by the experimenter.

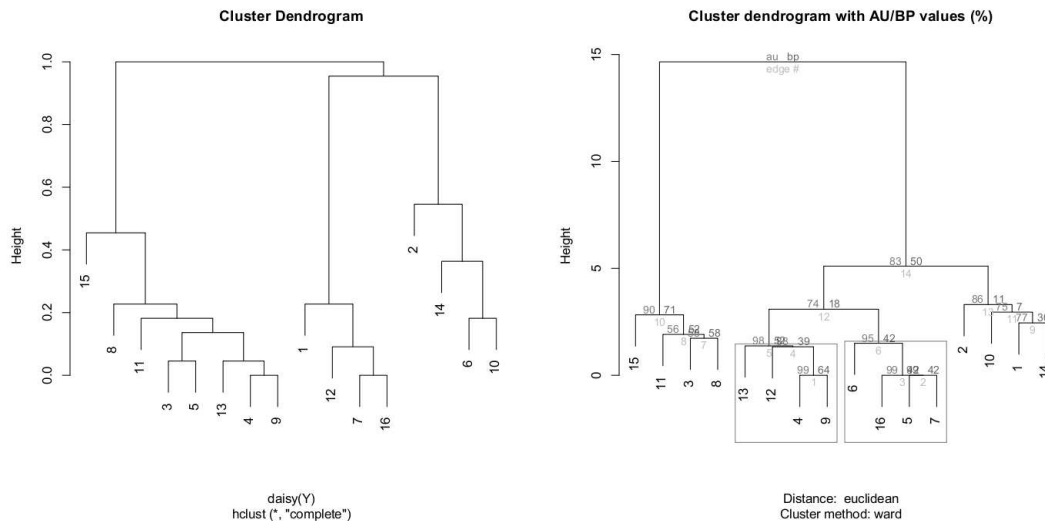


Figure 8: Sentence clustering

### 3.3 Conclusion

Although we completely agree with one of our reviewers that there are several infringements of the standard experimental norms in our design (no randomisation, possible effect of extraneous

factors), the statistical technique of mixed models allows us to claim that there is a strong effect of discourse CR's, which can be described as a tendency to not discriminate discourse CR's and Questions.

We did not analyse the acoustic data because they are too few in number (only  $2 \times 4$  observations for the question vs. discourse CR contrast). However, they are not totally consonant with the distinction proposed by Delattre. Admittedly, the question peaks are higher than the discourse CR peaks (see the table below) but the difference convex vs. concave is far from being obvious. This is in agreement with the reservations expressed by Auteserre and Di Cristo (1972), Romeas (1992) and other authors mentioned in Post (2000, p. 123, fn 8). Post (2000, chap. 5, sec. 5.2.2., chap. 7) discusses a certain number of differences mentioned in the literature between continuation and question and concludes that the most likely candidate to the role of phonological feature is the peak height. The contribution of other elements, if any, is more difficult to appreciate.

	male	C1 : 122-212	Q1 : 131-244
	male	C2 : 205-234	Q2 : 128-300
(in Hz)	female	C3 : 218-279	Q3 : 232-362
	female	C4 : 211-286	Q4 : 320-360

After the experiment, subjects were presented with the complete discourse stretch in the four discourse CR cases. They all identified the first constituent as an assertion. Although this reaction needs further experimental testing, it suggests that the perception of discourse CR's in isolation and in the context of subsequent discourse can be significantly different. The question remains of why the subjects interpret discourse CR sentences as assertions when they are presented with the complete (two sentence) version. In the rest of this paper, we assume that discourse CR's favour a question interpretation, or, more precisely, that they have a *default* question interpretation, in a sense to be made clear in the next section. Presumably, from an acoustic point of view, discourse CR's are sufficiently close to questions for a confusion to occur. However, being rises, they are compatible with different speech act types, the nature of which subsequent discourse segments help uncover. Although the cognitive mechanisms which implement this flexibility are largely unknown, they can be simulated in a framework that is sufficiently flexible to represent default interpretations. This is our main reason for choosing SDRT, as explained in detail in section 4.

Before presenting our treatment in SDRT, we note that there are several directions in which the present study can be extended. First, additional acoustic data (from corpora and read sentences) must be gathered and analysed<sup>9</sup>. Second, the experimental protocol can be augmented and modified in several ways, including for example the following points.

1. Instead of having different sentences, one can submit subjects to the same proposition in different conditions (assertion, question, etc.). For instance, starting from the proposition 'John go to China', one would make different intonational versions ('John goes To China.', 'John goes to China?', etc.). This might prevent or diminish the effect of semantic variability associated with the lexicon.
2. In addition to questions and mid-rising exclamations, end-rising exclamations can also enter the picture.
3. One can consider online processing tests instead of categorisation tests. Categorisation or understanding time can be estimated by the interval between the end of the test sentence and the subject's reaction (typically associated with pressing a button). This allows one to study the behaviour of subjects vis-à-vis 'monsters', for instance true syntactic questions with a discourse CR or 'true' phonetic questions followed by sentences initially paired with

<sup>9</sup>See the INTONALE project for new relevant data (<http://mathilde.dargnat.free.fr/INTONALE/intonale-web.html>).

discourse CR's. Isolated imperative sentences bearing a discourse CR can also be studied to see whether they increase the processing load.

4. One can use a gating paradigm (Vion and Colas, 2006). Gating consists in presenting the signal step by step and registering the reactions of subjects at each step. In our case, it would be interesting to determine whether there are significant differences in early recognition for questions and discourse CR's and whether there is a judgement inversion (from question to assertion) at some point in the incremental presentation and where.

## 4 Analysis of discourse CR's in SDRT

### 4.1 Basics

Let us take stock. Discourse CR's are not intrinsically reliable indicators of continuation. More importantly, they are intrinsically misleading in isolation, since they favour a question interpretation. Rises in general may be associated with quite different aspects of interpretation. For instance, they may convey emotions like surprise, speech act types like question, and an epistemic or interactional bias (Gunlogson, 2003; Jasinskaja, 2006; Marandin, 2006; Nilsonova, 2006; Reese, 2007). For a given rise, we have at least two *a priori* possibilities, since native speakers may classify it as conveying a set of possible values in a *monotonic (rigid)* way, or in a *non-monotonic* way. In the former case, a set of values (possibly a singleton) is associated with the rise once for all and constrains the interpretation of subsequent discourse. In the latter case, the set of values can be partially or totally cancelled and is not necessarily going to survive in the discourse. There is also a third, hybrid, possibility: a rise triggers rigid *and* non-monotonic interpretive inferences.

In order to express these distinctions, we need a framework that makes room for both non-monotonicity and (discourse) cue combination. In the rest of the paper, we use SDRT as a starting point (Asher, 1993; Asher and Lascarides, 2003) because it offers facilities for reaching these two goals. We do not feel committed to any particular detail of the approach, for instance the choice of the non-monotonic inference engine (*common sense entailment*, or CE, see Asher and Morreau (1991, 1995); Morreau (1992)) or the discourse relation inventory. We simply try to follow the general strategy of managing a flexible cue list for discourse attachment and a non-monotonic set of rules simultaneously.

The basic format for expressing non-monotonic rules in SDRT is  $\Sigma > \phi$ , where  $\Sigma$  is a finite sequence of expressions and  $\phi$  an expression.  $>$  is a non-monotonic conditional operator, which can be glossed by 'if  $\Sigma$ , then, normally,  $\phi$ '. We use  $\Rightarrow$  for rigid entailment (material implication).  $\alpha, \beta$ , etc. refer to constituents, that is clauses or sentences that get combined into larger discourse units. If  $n$  different rises were perceived as rigidly conveying different (sets of) values, the situation would be described as in (2a), where  $\Phi_i(\alpha)$  denotes a set of constraints on constituent  $\alpha$ . The non-monotonic version is as in (2b).

- (2) a. **Rigid interpretation of rises**  
 $rise_i(\alpha) \Rightarrow \Phi_i(\alpha)$ , where  $i = 1 \dots n$ .
- b. **Non-monotonic interpretation of rises**  
 $rise_i(\alpha) > \Phi_i(\alpha)$ , where  $i = 1 \dots n$ .

When two properties  $P$  and  $P'$  of a constituent are rigidly incompatible, we have  $P(\alpha) \Rightarrow \neg P'(\alpha)$ . Concerning speech act types, we assume at least (3).

- (3) **Mutual incompatibility of speech act types**  
 $Assertion(\alpha) \Rightarrow \neg Exclamation(\alpha)$ ,  $Assertion(\alpha) \Rightarrow \neg Question(\alpha)$ ,  $Exclamation(\alpha) \Rightarrow \neg Question(\alpha)$ .

Given the observations of section 3, the preferred speech act type for discourse CR's is Question.

Having a rigid rule  $dcr(\alpha) \Rightarrow Question(\alpha)$  is a bad idea, since such a rule would preclude any modification of the interpretation by subsequent information. One might posit instead three non-monotonic rules  $dcr(\alpha) > Question(\alpha)$ ,  $dcr(\alpha) > Assertion(\alpha)$  and  $dcr(\alpha) > Exclamation(\alpha)$ . This is not sufficient, however, because prosodic contours interact with syntactic structure whenever it helps determine speech act type. We adopt here a minimal requirement: a speech act type  $A$  is assigned to a constituent  $\alpha$  only if the syntactic structure of  $\alpha$  is compatible with this assignment. This yields rules of the general form:  $contour(\alpha) \text{ syntax-compat}(\alpha, A) > A(\alpha)$ , where  $A$  is a speech act type.

Another, more complex, issue concerns the possibility of prioritising rules, as is done in many systems of non-monotonic logic (see Antoniou (1997) for a general introduction). We have shown elsewhere (Jayez and Dargnat, 2010) how to implement preferences over rules in a general non-monotonic system such as DLV (Leone et al. , 2006). In the present paper, we will stick to the SDRT framework and will only assume the type of competition between rules that SDRT allows. Two points are to be noted in this respect. First, when equipped with the right set of axioms (Morreau, 1992, 126-131), common sense entailment validates the *Penguin Principle*, whose general form is given in (4), and ‘penguin version’ is: normally, birds fly, normally, penguins do not fly, penguins are birds, Tweety is a penguin, so Tweety does not fly.

(4) If  $A(x) > B(x)$ ,  $C(x) > \neg B(x)$ ,  $C(x) \Rightarrow A(x)$ ,  $C(a)$ , then  $\neg B(a)$ .

Suppose that  $dcr(\alpha) \text{ syntax-compat}(\alpha, Question) > Question(\alpha)$  and that subsequent information, represented here as  $\Phi$  allows one to non-monotonically exclude this interpretation. Then, since  $(dcr(\alpha) \& \text{ syntax-compat}(\alpha, Question) \& \Phi) > \neg Question(\alpha)$ , we obtain  $\neg Question(\alpha)$  by the Penguin Principle.

The second point concerns what Morreau (1992) calls the *weak* Penguin Principle, in which the rigid entailment  $C(x) \Rightarrow A(x)$  of (4) is replaced by a non-monotonic rule  $C(x) > A(x)$ <sup>10</sup>. Morreau shows that the weak principle is not valid in the system of common sense entailment and that it can be secured through some appropriate ordering(s) of models. So, techniques of ordering might be necessary to gain flexibility.

## 4.2 Integrating discourse CR’s

Recent descriptive work on two sentence paratactic structures of the general form S1S2 in French (‘parataxes’ for short) shows that the combination of a discourse CR on S1 with the absence of a significant pause between S1 and S2 leads to an integrated interpretation, where S1 and S2 get connected by a discourse relation (Choi-Jonin and Delais-Roussarie, 2006; Dargnat and Jayez, 2009). So called ‘OM sentences’ like (5a) (Culicover and Jackendoff, 1997) and pseudo-imperatives like (5b) (see Clark (1993) and subsequent literature) are special cases of parataxes.

- (5) a. One more beer and I leave  
       = ‘As soon as I’ve got one more beer, I leave’  
    b. Stop complaining (and) I’ll accept to talk  
       = ‘If you stop complaining, I’ll accept to talk’

Parataxes may be conditional (Jayez and Dargnat, 2009), but other discourse relations are possible. (6a) features a contrast and (6b) an explanation. As in example (1), discourse CR’s are indicated by wide circumflexes. There are also temporal relations such as simultaneity or anteriority/posteriority. In general, assigning a discourse relation to a parataxis exploits exactly the same kind of information as coordinated or subordinated structures do, e.g. tense, aspect, eventuality type, common sense knowledge, etc.

<sup>10</sup>Morreau’s example is: ‘normally, adults are employed, normally, students are adults, normally students are unemployed’. An externally different but actually quite similar example is discussed by Nute (1980, 16-18): what do we conclude from ‘if Thurston were to work less, he would be less tense’ and ‘if Thurston were to lose his job, he would work less’?

- (6) a. on a essayé de le/la  $\widehat{\text{vendre}}$  on a pas pu [*Allier corpus, Giron (2004)*]  
 We tried to sell it / we couldn't  
*Contrast:* We tried to sell it but we couldn't
- b. ce qui fait bizarre c'est de quitter une maison pour rentrer dans un appartement  $\widehat{\text{c'est}}$   
 tout petit [*Allier corpus, Giron (2004)*]  
 What is strange is leaving a house to live in a flat / it's so small  
*Explanation:* it feels strange to leave a house and live in a flat because flats are very small

As regards discourse CR's, the situation is not markedly different when S1 and S2 are separated by a pause. So, the crucial point is to make clear how we want to code 'continuation' or, as we prefer to say, *immediate connexity*<sup>11</sup>. Our task is to spell out connexity and how it relates to a framework like SDRT. We begin by indicating three possible sources of confusion for the status of discourse CR's.

First, discourse CR's do not correspond to specific discourse relations, since it is possible to find them with very different ones, in particular all those relations that are compatible with S1S2 juxtapositions, where S1 and S2 may be separated by a pause or not, and S1 has a final contour (Dargnat and Jayez, 2009). Second, discourse CR's do not connect eventualities in a precise way (different temporal orderings are possible), as shown by (7).

- (7) a. Paul est arrivé il était huit heures [simultaneity]  
 Paul came / it was eight
- b. Paul est arrivé Marie venait de partir [anteriority of the second eventuality]  
 Paul came / Mary had just gone
- c. Paul est arrivé Marie est arrivée [anteriority of the first eventuality or simultaneity]  
 Paul came / Mary came

Third, discourse CR's are not (directly) related to discourse goals, at least in the usual sense of obtaining certain effects (gathering information, making other people act in a certain way or entertain certain beliefs, etc.).

We claim that discourse CR's constrain possible attachments. In discourse analysis, an attachment corresponds to the fact that two parts of discourse are connected *via* one or several discourse relations, which, formally, represent sets of constraints. Theories may differ in the way they define discourse parts, see for instance the differences between RST (Mann and Thompson, 1988) and SDRT. In SDRT, discourse parts may correspond to sentences or clauses, but also to complex structures whose (possibly complex) subparts are connected by discourse relations. So, constituents may be atomic or complex discourse parts. Attachments are mainly governed by the various non-monotonic inferences that allow one to derive discourse relations. More general principles, such as the maximisation of discourse coherence, may help arbitrate between different possibilities of attachment.

Discourse CR's require that the last constituent introduced into the discourse (typically, the last sentence) be attached to the constituent that ends with the discourse CR. This is what we called 'immediate connexity': the last constituent must be attached to the penultimate constituent carrying the discourse CR or to a complex constituent including it. 'Back jumps' to other previous constituents are not allowed. In figure 9,  $\alpha$  carries the discourse CR.  $\beta$  must be attached to it and cannot be attached to any previous constituent  $\gamma$ .

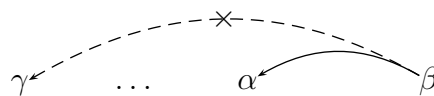
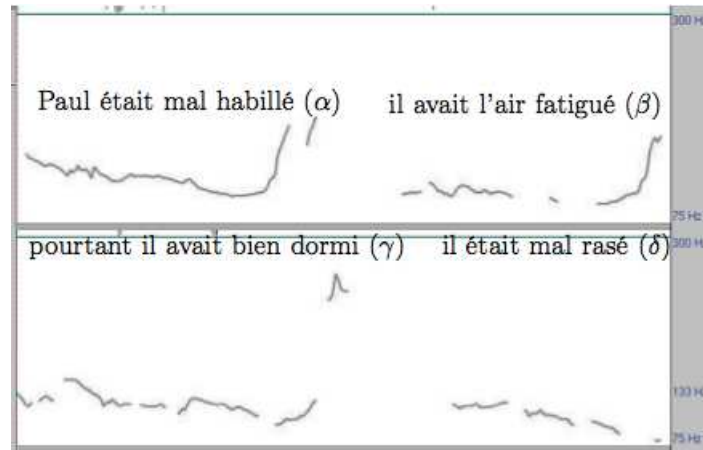


Figure 9: No back jump

<sup>11</sup>SDRT uses a discourse relation called *Continuation*, which is different from Delattre's continuation.

This ‘no back jump’ requirement is motivated by observations such as the following. Consider the artificial text (8), consisting of four successive sentences, with a pause between each two, and a discourse CR on the third one. The signal is shown in figure 10.

- (8) ( $\alpha$ ) Paul était mal habillé. ( $\beta$ ) Il avait l’air fatigué, ( $\gamma$ ) pourtant il avait bien dormi ( $\delta$ ) Il était mal rasé  
 ‘( $\alpha$ ) Paul was not well clad. ( $\beta$ ) He looked tired, ( $\gamma$ ) yet he had slept well ( $\delta$ ) He was not well-shaved’



**Figure 10:** Side-effect of discourse CR’s

In general, speakers who are sensitive to prosody<sup>12</sup> do not like (8) or perceive the discourse CR as expressing ‘surprise’. We can account for their reaction as follows.

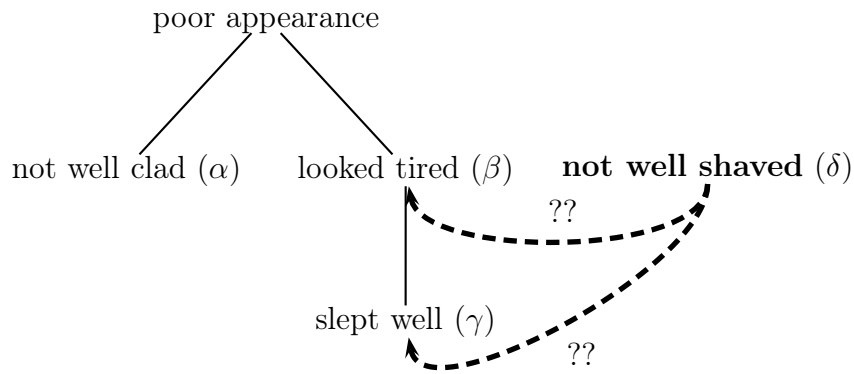
1. It is easy to attach  $\beta$  to  $\alpha$  by *Continuation*, since the two constituents can be perceived as elaborating a common topic, that we label ‘poor appearance’.
2. The *pourtant* (‘yet’) discourse markers requires that we attach  $\gamma$  to  $\beta$  by *Opposition*.
3. The discourse CR on  $\gamma$  requires that we attach  $\delta$  to  $\gamma$ . However, this attachment is not in itself very natural, as shown by (9), which has no discourse CR on the first sentence. *Background* and *Continuation*, which are *a priori* the most plausible candidates, do not fit the bill. For *Background*, it is unclear whether the conditions on events for *Background* are satisfied and, for *Continuation*, it is not easy to find a common topic.

- (9) ? Paul avait bien dormi, il était mal rasé  
 ‘Paul had slept well, he was not well-shaved’

4. In SDRT, it would be possible to attach  $\delta$  to  $\beta$  by *Continuation*, since they both elaborate the ‘poor appearance’ topic. However, as indicated in point 3, the discourse CR forbids this back jump.

The situation is summarised in the following tree, which obeys the usual convention that coordination discourse relations link the daughters of the same mother whereas subordination relations link nodes to their ancestors.

<sup>12</sup>This seemingly strange restriction is prompted by the fact that, when presented with the signal, many speakers focus only on the descriptive meaning, which, of course, they find unobjectionable.

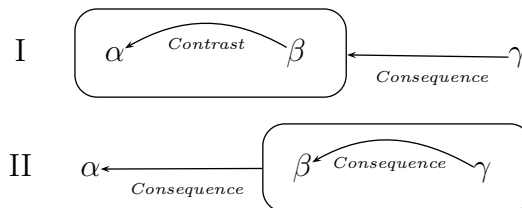


**Figure 11:** Attachment problems in (8)

The no back jump requirement corresponds to Delattre’s intuition: a discourse CR signals that discourse construction is still ongoing, or, equivalently, that the constituent under construction cannot be abandoned. The ‘size’ (= complexity) of the constituent that carries a discourse CR is largely an open question, which calls for further experimental and corpus studies. In this paper, we adopt a liberal stance and consider as candidates constituents of any degree of complexity. To see what kind of problem arises with complex constituents, consider the following example.

- (10) Paul avait dit qu’il viendrait ( $\alpha$ )  
 ‘Paul had said he’d come’  
 il n’est pas venu ( $\beta$ )  
 ‘He didn’t’  
 Marie ne savait plus quoi penser ( $\gamma$ )  
 ‘Mary was confused’

Generally speaking, there are at least two attachment scenarios here. One could attach  $\beta$  to  $\alpha$  by a suitable version of *Contrast*<sup>13</sup> and then  $\gamma$  to  $\alpha \xleftarrow{Cont.} \beta$  by a suitable version of *Consequence* (figure 12.I). Alternatively, one might cascade consequences and have the structure in 12.II, where the existence of a *Consequence* relation between the absence of Paul and Mary being confused is itself a consequence of Paul’s prior commitment ( $\alpha \Rightarrow (\beta \Rightarrow \gamma)$ ). Note that a similar indetermination arises if we exchange the first two constituents (‘Paul didn’t come / he had said he would / Mary was confused’). To our best knowledge, the second structure cannot be constructed in the present state of the discourse update algorithm in SDRT, but, in line with our overall policy, we do not conclude that this possibility is essentially alien to the framework and could not be substantiated in future versions.



**Figure 12:** Attachments with discourse CR’s

In addition to local connexity, discourse CR’s forbid *Topic-Change* discourse relations. Topic change can be very costly in monologues since addressees tend to assume that, unless the speaker

<sup>13</sup>We use *Contrast* as a generic label, that may be specified into different discourse relations. The same remark holds for *Consequence*.

gives an indication to the contrary, she is maintaining the same topic<sup>14</sup>. Some specialised discourse markers, such as *by the way* in English or *à propos* in French signal topic shift and the latter marker is very strange after a discourse CR.

- (11) a. Paul est arrivé ensuite il s'est garé dans la cour  
 Paul arrived / next he parked in the yard  
 b. # Paul est arrivé à propos il s'est garé dans la cour  
 Paul arrived / by the way he parked in the yard

This is to be expected since discourse CR's program 'continuation' (local connexity) of the current discourse move. In this respect, back jumps but also topic-shifts are parasitic because they blatantly violate this program, and result into an impression of incoherence.

The findings reported in section 3 complicate the picture. On the one hand, discourse CR's tend to be interpreted as questions in isolation. On the other hand, this interpretation is unstable in extended contexts, since, for instance, the very same discourse CR's can be interpreted as assertions. The observations in Choi-Jonin and Delais-Roussarie (2006) and Dargnat and Jayez (2009) show that the range of interpretations is rather large (assertion, commands, hypotheses). Moreover, there are reasons to believe that speech act type assignment is in some cases not (entirely) compositional, but, rather, is the result of applying a pattern or 'construction' in the sense of construction grammars (Jayez and Dargnat, 2009). Such patterns correspond to the general rule schema in (12), where  $R$  is a discourse relation. (12) says that, whenever (i)  $\alpha$  bears a discourse CR and satisfies constraints  $\Phi$  and (ii)  $\beta$  satisfies constraints  $\Psi$ ,  $\alpha$  and  $\beta$  are normally connected in a certain way, described by the set of entailments of  $dcr\text{-}construction(R, \alpha, \beta)$ . One of these entailments is the existence of a  $R$  discourse relation between  $\alpha$  and  $\beta$ .

(12) **Constructional rule schema**

$\Phi(\alpha) \Psi(\beta) dcr(\alpha) > dcr\text{-}construction(R, \alpha, \beta)$ , where  
 $dcr\text{-}construction(R, \alpha, \beta) \Rightarrow R(\alpha, \beta)$  (or  $R(\beta, \alpha)$ )

In other cases, the general attachment rules are sufficient but are limited by the type of speech act that can be assigned to discourse CR constituents. Some speech acts are very implausible because their default contours do not match that of discourse CR's (e.g. certain exclamations). In contrast, assertion is a possible value in spite of the fact that assertive preferred contours are different from that of discourse CR's. Is that limited to assertion? Discourse CR's are compatible with very different speech acts, including commands, questions and exclamations, as illustrated in (13)<sup>15</sup>. In these three examples, some speakers judge that it is possible to have a discourse CR on the first constituent. However, such examples do not entail that discourse CR's intrinsically convey a command, question or exclamation interpretation. For instance, if we change (13b) and (13c) into a declarative form, *Tu viens demain* ('you come tomorrow') and *Il est idiot* ('He is silly'), it is much less clear that discourse CR's are still appropriate.

- (13) a. Viens là je veux te montrer quelque chose  
 'Come here I want to show you something'  
 b. Est-ce que tu viens demain j'ai besoin de le savoir  
 'Are you coming tomorrow I need to know'  
 c. Qu'il est idiot il a pas vu le panneau  
 'Silly him he missed the sign'

We assume that discourse CR's have a speech act range function  $dcr\text{-}sa\text{-}range$  that limits possible attachments and is sensitive to syntactic structure. The fine tuning of this function is left for future research.

<sup>14</sup>The reader is referred to Oberlander's (2004) position paper for a recent introduction to the notoriously complex issue of topic management.

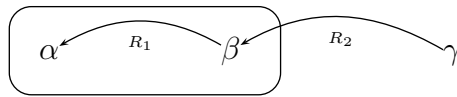
<sup>15</sup>Whether there is an independent hypothetical speech act in pseudo-imperatives is more debatable. We won't address this issue here.

$$(14) \text{ dcr}(\alpha) R(\alpha, \beta) \Rightarrow \text{sa-type}(\alpha) \in \text{dcr-sa-range}(\alpha)$$

To cash out the continuation value of discourse CR's in SDRT, we propose constraint (16) below. Before spelling out the constraint, we need to make clear what 'geometry' we assume for discourse constituents. We represent constituents as labelled graphs over atomic or complex constituents, connected by irreflexive discourse relations that provide the labels. No subconstituent of a given constituent can be left 'dangling'. In other terms, every constituent must be connected.

- (15) Let  $DR$  be a set of discourse relations, a constituent over  $DR$  is a pair of sets  $\langle \text{nodes}, \text{dr} \rangle$ , where,
1.  $\text{nodes}$  is a singleton and  $\text{dr}$  the empty set, or,
  2.  $\text{nodes}$  is a set of constituents over  $DR$  and  $\text{dr}$  a set of formulas  $R(\alpha, \beta)$  with  $R \in DR$  and  $\alpha, \beta \in \text{nodes}$  such that:
    - (a) for each  $\alpha \in \text{nodes}$ , there is a  $\beta \in \text{nodes}$  such that, for some  $R \in DR$ ,  $R(\alpha, \beta)$  or  $R(\beta, \alpha)$  is in  $\text{dr}$  and,
    - (b) no constituent is in  $\text{nodes}$  and occurs in some other constituent in  $\text{nodes}$ .

A constituent is atomic whenever it has a form  $\langle \{\alpha\}, \emptyset \rangle$ . Abusing the terminology, we will say that  $\alpha$  itself is an atomic constituent in that case and accordingly abbreviate  $\langle \{\alpha\}, \emptyset \rangle$  as  $\alpha$ . (15.2.b.) precludes situations where a constituent occurs at two different levels, as for instance in figure 13, which corresponds to the non-constituent structure  $\langle \{\beta, \gamma, \langle \{\alpha, \beta\}, \{R_1(\beta, \alpha)\}\}, \{R_2(\gamma, \beta)\}\rangle$ .



**Figure 13:** A forbidden configuration

$AT(\alpha)$  denotes the set of atomic constituents that occur in  $\alpha$  or  $\alpha$  itself if  $\alpha$  is atomic. A discourse  $\mathcal{D}$  is considered as a strict total order ( $<_{\mathcal{D}}$ ) on a set of atomic constituents. For two constituents  $\alpha_1$  and  $\alpha_2$ , we note  $\alpha_1 <_{\mathcal{D}} \alpha_2$  the fact that, for any two  $\beta_1 \in AT(\alpha_1)$  and  $\beta_2 \in AT(\alpha_2)$ ,  $\beta_1 <_{\mathcal{D}} \beta_2$ . Let  $\text{first}_{\mathcal{D}}(\alpha)$  (resp.  $\text{last}_{\mathcal{D}}(\alpha)$ ) denote the first (resp. last) constituent of  $AT(\alpha)$  with respect to  $<_{\mathcal{D}}$  if  $\alpha$  is non-atomic, and  $\alpha$  itself otherwise. We note  $\alpha_1 \ll_{\mathcal{D}} \alpha_2$  the fact that  $\text{last}_{\mathcal{D}}(\alpha_1) <_{\mathcal{D}} \alpha_2$  and there is no atomic constituent  $\alpha'$  such that  $\text{last}_{\mathcal{D}}(\alpha_1) <_{\mathcal{D}} \alpha' <_{\mathcal{D}} \text{first}_{\mathcal{D}}(\alpha_2)$ .

Constraint (16) says that a constituent is *dcr-admissible* whenever every constituent terminated by a discourse CR is the attachment site of a constituent that immediately follows it and the attachment is not a topic shift.

- (16) Let  $\alpha = \langle \text{nodes}, \text{dr} \rangle$  be a non-atomic constituent with respect to discourse  $\mathcal{D}$ . We say that  $\alpha$  is *dcr-admissible* if and only if, for any  $\beta \in \text{nodes}$  such that  $\text{dcr}(\text{last}_{\mathcal{D}}(\beta))$ ,
1. there is some  $\gamma \in \text{nodes}$  such that, for some  $R$ ,  $R(\beta, \gamma)$  or  $R(\gamma, \beta)$  is in  $\text{dr}$  and  $\beta \ll_{\mathcal{D}} \gamma$ , and,
  2. there is no  $\gamma \in \text{nodes}$  such that  $\text{Topic-Shift}(\beta, \gamma) \in \text{dr}$  and  $\beta \ll_{\mathcal{D}} \gamma$ .

(16) makes room for the two types of configuration illustrated in figure 12. It is a static constraint, which characterises the attachments that respect certain conditions. A dynamic rule, conform to SDRT's guidelines, is shown in (17). It says that, when attempting to attach  $\beta$  to  $\alpha$  in  $\lambda$ , if the penultimate (LAST-1) constituent  $\gamma$  carries a discourse CR, then, normally, (i)  $\alpha = \gamma$  (no back jump) and (ii) no *Topic-Shift* relation is allowed.

$$(17) ?(\alpha, \beta, \lambda) \text{ LAST-1} = \gamma \text{ LAST} = \beta \text{ dcr}(\gamma) > \alpha = \gamma \ \& \ \neg \text{Topic-Shift}(\gamma, \beta, \lambda)$$

(16) and (17) do not impose any particular discourse relation (they just ban *Topic-Shift*). Additional constraints, such as the description of specific relations, constructional patterns (12) or the speech act range of discourse CR's (14), contribute narrowing the space of possible interpretations.

Interestingly, (16) and (17) are stricter than the *Right Frontier* (RF) constraint, proposed in SDRT. The RF constraint says that a constituent can only be attached to the penultimate constituent or to a constituent that subordinates, directly or indirectly, the penultimate constituent. SDRT exploits Polanyi's (1985) distinction between subordination and coordination relations. Polanyi's intuition was that  $\alpha$  subordinates  $\beta$  whenever  $\beta$  does not interrupt the discourse move associated with  $\alpha$ . If  $\beta$  creates an interruption, then it is coordinated to  $\alpha$ . The status of this distinction was never entirely clear. The interpretation we assume here is that  $\beta$  is subordinated to  $\alpha$  whenever it develops or modifies what  $\alpha$  says about its specific topic, for instance when it elaborates the contribution of  $\alpha$  or introduces some proposition that puts this contribution into a different perspective (by justifying or attacking it, for instance). In contrast, coordination occurs when  $\alpha$ 's specific topic is changed. For instance, although two constituents of a continuation elaborate a common topic, the second constituent does not elaborate what the first says about its specific topic. Given the RF constraint, it is in principle possible to jump to a higher, subordinating, constituent. This is precisely forbidden in the case of discourse CR's.

## 5 Conclusion

In this paper, we have presented and discussed a way of integrating discourse CR's in SDRT. Discourse CR's correspond to inter-sentential major continuations in Delattre's work. We have established that, in isolation, discourse CR's are preferentially interpreted as questions, not as assertions, even when they are acoustically copied from sentence pairs where they obviously convey assertion. We interpret this somewhat paradoxical result as another manifestation of the generally assumed cue-based nature of discourse construction. However, in the case at hand, the situation is more abstract than is generally the case because discourse CR's do not convey semantic or pragmatic 'values', but constrain the kind of attachment that the next constituent must undergo. We have analysed the attachment constraints in section 4 and shown that they pertain to three different domains: constructions (typically for conditional interpretations, as with pseudo-imperatives), speech act variability (e.g. constituents hosting a discourse CR may act as questions or commands) and local connexity (no back jump, no topic shift). We have exploited the unique combination of modularity and non-monotonicity in SDRT to formulate our constraints, pointing on some occasions to possible departures from the received framework. In further work, we plan to explore the cognitive limits of discourse CR illocutionary 'camouflage', that is the margin of tolerance in the interpretation of discourse CR's as questions, commands, exclamations, etc., depending on different combinations of phonetic properties.

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