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A Proof Theoretic Non Scalar Account of Scalar Inferences

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1 Modes of contrast

Aim of the talk: provide an explanation for the existence of systematic asymmetries in sentence pairs of the form X mais/but Y vs *Y’ where we feel that, in ‘some’ sense X is conducive to Y’. In which sense?

1.1 Data

Constraints on linking in sentence pairs. Some of them already noted in Anscombe and Ducrot work on linguistic argumentation. Most of them noted more recently in (Jayez 1988) and (Ducrot 1996), 3 types of data: degree based modifiers, determiners, VPs,

Adjectives

(1) a. Jean est intelligent mais [moins vs *plus] que son frère
   Jean is intelligent, but [less vs more] than his brother

b. La saison est froide, et même [plus vs *moins] froide que
   The season is cold, and even [more vs less] cold than
   l’année dernière
   last year

c. Jean est marié, mais (depuis peu vs *longtemps)
   Jean is married, but (since little vs long)
   (John married a girl, but it’s recent vs not recent)

Other examples: practically every degree adjective.

Prepositions

(2) a. C’est presque 100 FF, c’est (cher vs *bon marché)
   It’s almost 100 FF, it’s (expensive vs cheap)

b. Jean est arrivé après moi, mais il était (à l’heure vs
   John arrived after me, but he was (on time vs
   *en retard)
   late)
   (intended interpretation for *: not that the fact of John being
   late caused the fact of his arriving after me)

Adverbs

(3) a. Jean a (bien vs *à peine) compris le problème.
   He is
   intelligent

b. J’ai *juste/seulement un rhume, Ça m’empêchera de
   I have just a cold. It will prevent me from
   venir
   coming

Similar examples with presque, almost and degree adverbs (beaucoup, much, etc.)

Determiners

(4) a. Seuls Jean et ses amis sont venus, ça fait (peu vs
   Only John and his friends came, it makes (few vs
   *beaucoup)
   a lot) of people

b. Quelques étudiants se sont inscrits, mais (pas tous vs
   Some students registered, but (not all of them vs
   ?[la plupart])
   most of them)

Similar observations with certains, un certain nombre de, certain, etc,
Verbs
[5] a. Jean a marché, mais (pas longtemps vs *longtemps)
John walked, but not for a long time vs for a long time
b. Jean est allé jusqu'à la plage, mais ça n'est pas loin vs
John went to the beach, but (it's not far vs
*c'est loin)
it's far

Remarks
Some examples redeemed if ironical (e.g., (3-a)),
some examples redeemed by ne que or only,
some examples redeemed by omitting mais or but,
phenomenon distinct from negative or positive polarity.

1.2 Scalar expectations
These examples are not all on a par. Some basic distinctions. For opposition
in general, see (Rudolph 1996).

- Lakoff (1971): semantic opposition (contrast in other terminologies
...).
(6) John is short but Mary is tall
- Again Lakoff (1971): denial of expectation (d.o.e.)
(7) John is tall but he is no good at basketball
- Indirect opposition (Auscompte & Ducrot 1977). p mais q felicitous
only w.r.t. r such that p favours r and q favours non r.
(8) Jean est grand mais peu rapide
('John is tall but slow')
Jean est grand ('John is tall') favours 'il est bon au basket' ('he is
good at basketball')
Jean est peu rapide ('John is slow') favours the contrary.
- Pourtant (= yet) conveys d.o.e. (Jaye 1981, 1988).
(9) a. Jean est grand, pourtant il n'est pas bon au basket
b. Jean est grand, pourtant il n'est lent

What the examples (1-a) (5-b) share
They are neither semantic opposition nor d.o.e. examples. They become
"or * when one puts par contre, in contrast, or pourtant, instead of mais.
(10) a. Jean est intelligent, par contre il l'est moins que son frère
b. John is intelligent, in contrast he is less intelligent than his
brother
c. Jean est intelligent, pourtant il l'est moins que son frère
They accept in general although.1
(11) a. (Although) John is tall, (but/yet) he is no good at basketball
b. (Bien que) Jean soit très grand, mais/pourtant il ne vaut rien
au basket
But there are also non d.o.e., mais with the same paraphrase; 2
(12) a. Bien que Jean soit intelligent, il l'est moins que son frère
(Although John is intelligent, he is less intelligent than his brother)
b. Bien qu'il ait marché jusqu'à la plage, ça ne lui a pas pris très
longtemps
(Although he walked to the beach, it didn't take a long time)

Where they differ
1. Clause order matters or not bien que X, Y = Y, bien que X?
(13) a. Bien que Jean soit intelligent, il l'est moins que son frère
(Although John is intelligent, he is less intelligent than his brother)
b. Jean est moins intelligent que son frère, bien qu'il soit intelligent
(John is less intelligent than his brother, although he is intelli-
gen)
c. Bien que certains étudiants se soient inscrits, tous ne l'ont pas
fait
(Although certain students registered, not all of them did)
d. Tous les étudiants ne se sont pas inscrits, bien que certains
l'ait fait
(Not all students have registered, although some students did)
e. Bien qu'il soit marié, il ne l'est pas depuis longtemps3
(Although he is married, it's recent)
f. Il n'est pas marié depuis longtemps, bien qu'il l'ait été
(He married recently, although he is married)

2. Some exemples remain odd when mais is omitted,
(14)  a. Il a été jusqu'à la plage, Ça (ne) lui a (pas) pris longtemps
(He went to the beach, It (didn't) took him very long)
b. C'est presque 100 FF, C'est (cher vs *pas cher)
(It's almost 100 FF, Its (expensive vs not expensive))
Jean est intelligent, Il est (plus vs *moins intelligent que son frère)
Other constrasts with en fait, d'ailleurs, en tout cas,
(15)  a. Il a été jusqu'à la plage, D'ailleurs ça (ne) lui a (pas) pris longtemps Il est intelligent, D'ailleurs, il est plus intelligent que son frère
b. Il est intelligent, D'ailleurs il est *moins intelligent que son frère

Conclusion
Two families of sentence pairs: Strong Scalar Expectations (SSE) are indifferent to clause order and remain odd in the absence of mass, Weak SE: other cases.

2 Possible explanations for SSE

2.1 Monotonicity based

In Generalized Quantification theory, we might represent John is more/less intelligent than his brother as an inclusion between the set of intelligence degrees of John and that of his brother,

\[ \text{John is more intelligent than his brother} \equiv \text{ID}_j \supset \text{ID}_{jB} \]

So, monotonicity properties of more/less ADJ than \( x \) = those of \( \supset \) and \( \subset \).
Intelligent \( \approx \) 'having more intelligence degrees than the average or than what is expected for a given intelligence threshold'. Then, monotonicity properties of intelligent = those of \( \supset \). In this respect, it could be argued that (1-1) is odd with less because it opposes two occurrences of the same monotonicity profile (\( \supset \)), Problem: the hypothesis rather a description than an explanation.

2.2 Graded rules

Eliphad (1993) proposes to associate monotonicity property with the notion of orientation argumentative studied by Anscombe et Ducrot, Upward
monotony corresponds to positive orientation, downward monotony to negative one.

But orientation = ?

Ducrot (1988) proposes that scalar configurations are interpreted by graded proportionality rules, Two aspects:

- lexical selection of rules, e.g. more selects rules of the form (the more X, the more/less Y), intelligent selects rules of the form (the more one is intelligent, the more/less one . . .)
- existence of appropriate rules,

When no plausible rule satisfying the lexical selection criterion can be found, we get an anomaly.

However, the commonsense rule we should apply to the contrast in (1-1a) is not felicitous, being of the (strange) sort (the more x is intelligent, the more x is more intelligent than other people).

2.3 Probability

The probability that John is more intelligent than his brother given that he is intelligent is, other things being equal, \( \geq \) to the probability that John is more intelligent than his brother.

Ok, this would account for the 'expectation' relation, but accommodation of 'contrary' premises must be blocked, Accommodation (Lewis 1979) allows one to let in additional premises which are required to interpret an inferential relation.

(16)  a. John came, but he didn't speak to Mary
b. John came, but he *spoke to Mary

John coming leads to the expectation that he spoke to Mary only under addition assumptions, for instance that John met Mary, that he had something to tell to Mary, etc.

Why is not the same mechanism possible in the symmetric case (16b): John came + he didn't meet Mary \( \sim \) he didn't speak to Mary?

Proposal for SSE: plunge lexically scalar items into a general inference system (non scalar account of lexically scalar inferences),
3 Proof-theoretic account

3.1 Intuitive description

Two claims

a. Lexical representations
b. Constraint on inference

Lexical representation

In (1a), *John is intelligent* is `represented' as:

\[ J_{int} \geq I_{int} \]

where *J_{int}* is the degree of John’s intelligence, and *I_{int}* is an arbitrary intelligence threshold; people whose intelligence degree is \( \geq I_{int} \) are *intelligent*. People whose intelligence degree is below may or may not be intelligent.

Lexical representation is intrinsically order sensitive.

Constraint on proofs

*J_{int} = John’s brother*, if the intelligence of John’s brother is below *I_{int}*, then John is more intelligent than his brother (*J_{int} \geq J B_{int}*). Adding the fact that *J B_{int} < I_{int}*, we have a proof of ‘John is more intelligent than his brother’ from ‘John is intelligent’.

Can we prove that *John is less intelligent than his brother* by adding something? Yes,

(17) a. If \( J_{int} \geq I_{int} \) and \( J_{int} < J B_{int} \), then \( J_{int} < J B_{int} \)

b. If \( J_{int} \geq I_{int} \), \( J_{int} \leq I_{int} \) and \( J_{int} < J B_{int} \), then \( J_{int} < J B_{int} \)

The proofs are (classically) correct, but the underlined formulas can be suppressed without altering the conclusion. We don’t need them actually.  The constraint is (18),

(18) Constraint on proofs, intuitive form

No proof with unneeded premises is allowed.

The linguistic constraints are explained by noting that the marked forms correspond to potential proof excluded by (18).

Problem: no connection between the structure of proofs and (18) ⇒ the situation in (19)

(19) \( J_{int} \geq I_{int} \), \( J_{int} \leq I_{int} \), \( J B_{int} = I_{int} \), \( J_{int} = J B_{int} \)

(19) would license (20), because ‘John is less intelligent than his brother’ entails that John and his brother have not the same degree of intelligence,

(20) John is intelligent, but he is not less intelligent than his brother.

Comes from the \( x \geq y, x \leq y \vdash x = y \).

Lexical representation again

It could be argued that this problem is caused by the representation of *John is intelligent* as \( J_{int} \geq I_{int} \). Suppose we adopt instead the (stronger) coding

\[ J_{int} > I_{int} \]

This representation allows for a different account which says that the proofs we want to get rid of are ‘bad’ because they contain useless (irrelevant) premises or contradictory premises. The latter case is illustrated by the new versions of (17b) and (19).

(17b) If \( J_{int} > I_{int} \), \( J_{int} \leq I_{int} \) and \( I_{int} < J B_{int} \), then \( J_{int} < J B_{int} \)

(19) If \( J_{int} > I_{int} \), \( J_{int} \leq I_{int} \), \( J B_{int} = I_{int} \), then \( J_{int} = J B_{int} \)

In (17b) and (19), the two premises \( J_{int} > I_{int} \) and \( J_{int} \leq I_{int} \) are mutually inconsistent. However, there are cases in which the weaker form (i.e., \( \geq \) or \( \leq \)) is required and which give rise to anomalous texts, such as (21).

(21) John’s intelligence is not superior to the average, but he is less intelligent than his brother

If the first sentence is represented by \( J_{int} \leq I_{int} \), we must block (correct) proofs such as, where the useless formulas are underlined.

(22) a. \( J_{int} \leq I_{int} \), \( J_{int} \geq I_{int} \), \( J B_{int} \leq I_{int} \), \( J_{int} \geq J B_{int} \)

b. \( J_{int} \leq I_{int} \), \( J_{int} \geq I_{int} \), \( J B_{int} < I_{int} \), \( J_{int} > J B_{int} \)

The strategy I adopt is to devise a very general ‘proof killer’ which might be too powerful, I leave the question whether it must be further constrained (by invoking pragmatic factors, for instance) to another work. Equality comparatives (as . . . as antut . . . que, etc.) raise an interesting problem, I conjecture that it can be addressed by adopting Ducrot’s assumption that those comparatives have two levels of information (see section 4.1).

3.2 Formal representation

Diagnostic

Where does the problem with (19) come from?

\( x \geq y \) is \( x > y \lor x = y \).

The conjunction of \( x \geq y \) and \( x \leq y \) uses the possibility offered by classical logic that absurdity leads to just anything (e.g. *falso sequitur quodlibet*).
absurdity = maximal information in a Boolean lattice, etc.)
More specifically, consider a Gentzen system for classical propositional logic, such as GSC from (Grandy 1977, p. 24) and add the rules for order,

(23) **Order rules**
1. $\Sigma, x < y, y < z \vdash x < z, \Gamma$
2. $\Sigma, x = y, y < z \vdash x < z, \Gamma$
3. $\Sigma, x < y, y = z \vdash x < z, \Gamma$
4. $\Sigma, x > y, y > z \vdash x > z, \Gamma$
5. $\Sigma, x = y, y > z \vdash x > z, \Gamma$
6. $\Sigma, x > y, y = z \vdash x > z, \Gamma$
7. $\Sigma, x = y, y = z \vdash x < z, \Gamma$
8. $\Sigma, x = y \vdash \neg(x < y), \Gamma$
9. $\Sigma, x = y \vdash \neg(x > y), \Gamma$
10. $\Sigma, x > y \vdash \neg(x < y), \Gamma$
11. $\Sigma, x < y \vdash \neg(x > y), \Gamma$

We want to prove that $x \geq y, x \leq y \vdash x = y$. In classical logic, this is done as follows,

$$
\begin{align*}
&x > y, x < y \vdash x = y, x > y, x = y \vdash x = y, \Sigma \vdash x = y, (x < y \lor x = y) \vdash x = y, \\
&\vdash x > y, (x < y \lor x = y) \vdash x = y, x = y, (x < y \lor x = y) \vdash x = y, \\
&\vdash x > y, x = y \vdash x = y.
\end{align*}
$$

We have a proof of $x > y, x < y \vdash x = y$ iff we have a proof of $x > y, \neg(x < y) \vdash x = y$. We apply 7 and $\rightarrow$ in GSC,

$$
\begin{align*}
&x > y, \neg(x < y) \vdash x = y, \Sigma \vdash x = y.
\end{align*}
$$

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$$
\begin{align*}
&x > y, \neg(x < y) \vdash x = y, \Sigma \vdash x = y.
\end{align*}
$$

We have a proof of $x > y, x < y \vdash x = y$ iff we have a proof of $x > y, \neg(x < y) \vdash x = y$. We apply 7 and $\rightarrow$ in GSC,
\[\Sigma, a, \neg(x > y), x < z\]
\[\Sigma, a \lor b, \neg(x > y), x < z\]
\[\Sigma, a, -x > y, x = z\]
\[\Sigma, a \lor b, -x > y, x = z\]
\[\Sigma, a, -x > y, x \leq z\]
\[\Sigma, a \lor b, -x > y, x \leq z\]
\[\Sigma, -a, -x > y, x < z\]
\[\Sigma, -a \lor b, -x > y, x < z\]
\[\Sigma, -a, -x > y, x = z\]
\[\Sigma, -a \lor b, -x > y, x = z\]
\[\Sigma, -a, -x > y, x \leq z\]
\[\Sigma, -a \lor b, -x > y, x \leq z\]
\[\Sigma, -a, -x > y, \{x < z\} \lor \{x = z\}\]

The other cases are symmetrical.

4 Extensions

4.1 Background and foreground in scalar expressions

In [Jaye 1987], it is proposed that presque NP_q[x], where NP_q is a quantitative NP has the following representation,
asserted: \(x\) is a value superior to the proximity threshold of NP_q,

\[\text{presque 100 FF} = \text{superior to the proximity threshold of 100 FF and inferior to 100 FF},\]

\[\text{If \(c\)her (expensive) corresponds to } \geq l_{\text{exp}y}, \text{the oddness in (2a) is readily explained by noting that the odd forms are instances of a judgment } \Sigma, x \geq y \vdash x < z, \]

In general, one can assume that background information (= presupposition, in most cases) may not create bad configurations in the corresponding judgments. Only foreground information (= asserted information) is relevant. Similar proposal for only in [Horn 1996].

- **Seulement (just)**
  (3-b), ‘I have just a cold’ = ‘I have no more than a cold’. What kind of reasoning can we appeal to?
  Let \(d\) be my disease degree,
  If \(d = l_{\text{cold}} \vdash \text{not come} \text{is the rule we use, certainly } (d < l_{\text{cold}}) \lor (d = l_{\text{cold}}) \vdash \text{not come} \text{is not relevant [the premise } d < l_{\text{cold}} \text{cannot be used].}
  If the rule is scalar: \(d \geq l_{\text{cold}} = \text{not come} \vdash \text{not come} \), meaning ‘whenever I have got something which is \(\geq\) to the point which prevents me from coming, I don’t come, the judgment \(d \leq l_{\text{cold}} = \text{not come} \vdash \text{not come} \) is again irrelevant,

- **A prej and 

- Determiners.
  Just associate \(n \geq l_{\text{quelques}} \text{and } n \geq l_{\text{certains}} \text{with quelques and certains,}
  Again: \(n \geq l_{\text{quelques}} \text{, } \Sigma \forall n < l_{\text{tous}} \n \geq l_{\text{quelques}} \text{, } \Sigma \forall n \geq l_{\text{tous}}\)

- **Contrasts like il est resté 77 tôt vs tard (‘He stayed early vs late’), mentioned in [Ducrot 1995]. Actually the phenomenon is general with atelic constructions,**

\[\text{(26) a) Il a lu (tard vs 77 tôt)}\]
\[‘(\text{He read (late vs early)})’\]
\[\text{b) Il a mangé des biscuits juste (tard vs 77 tôt) dans la nuit (‘He ate cakes till (late vs early) in the night’)}\]
\[\text{c) Il a continué (tard vs 77 tôt)}\]
\[‘(\text{He continued (late vs early)})’\]
\[\text{d) Il a été président jusqu’à après vs 77 avant ma naissance (‘He was president till (after vs before) my birth’)\]

Karttunen’s [1974] lateness effect, studied in de Swart [1996] are analogous,
(27) \text{The princess slept until nine (at the latest vs 77 at the earliest),}
Exemples (26-a) \text{ [26-d} point to not until (de Swart [1996]) and finque (Towena [1996]).}
tard is associated with $t \geq l_{\text{late}}$, but with $t \leq l_{\text{read}}$. The temporal semantic of states and activities resembles that of until, hence the affinity of these examples with temporal j′squ’a.

(28) Intrinsic semantic of atelic constructions
If $\phi$ is atelic, asserting that $\phi$ entails that $\phi$ holds until some point in time, or, equivalently that $\phi$ does not cease before some point in time,

Warning: again, assertion/presupposition distinction has to be used. We assert that $\phi$ does not cease before $t$ and we presuppose that it ceases at $t$.

So, If a la [He read] asserts that he did not stop reading before some point in time: $\exists (\text{end reading}) \geq t$. Now, tard [late] gives the position of the beginning of end of an event w.r.t. to a lateness threshold. Just try to compose the constraints by binding the threshold to the quantifier.

If a la + tard = \{end reading) $\geq t \}$ $\cup \{t = l_{\text{late}}, \text{end reading) $\geq l_{\text{late}}$\} = \{end reading) $\geq l_{\text{late}}$\}
If a la + bôt = \{end reading) $\geq t \}$ $\cup \{t = l_{\text{late}}, \text{end reading) $\leq l_{\text{late}}$\} = \{end reading) $\leq l_{\text{late}}$, end reading) $\leq l_{\text{late}}$\}

Sentences are ok when the beginning is considered, because, presumably, there is no intrinsic semantic restriction comparable to (28) for beginnings.

4.2 Ducrot’s notion of déréalisation

In his 1995 paper, Ducrot shows that the range of phenomena pertaining to the general problem is extremely vast. He calls déréalisation (activity demoter or a demoter) any modifier which attacks the ‘essence’ of an object. For instance, in [1c], the recency of the marriage makes it a sort of not genuine marriage.

The present proposal leads to distinguish at least 3 different cases,
1. Some scalar inferences exploit the intrinsic semantic properties of items (SSE). The typical cases are intelligent, presque, etc.
2. The marriage case could correspond to an indirect opposition case, in the sense of Anscombe & Ducrot (1977). John is married $\sim$ John has the properties one expects to hold of a married man. John’s marriage is recent $\sim$ John has not the properties one expects to hold of a married man.
3. It could also correspond to an a demotion in the following sense, Things, events, situations have properties which make them perceptible. They can be seen, heard, tasted, counted. They have duration, they occur at some determinate time, etc. An a trace is a trace of the existence of an object in a cognitive (perceptual, conceptual, etc.) system. An a demoter removes an a trace.

Example: duration. Let $e$ be an event, if $e$ occurs it has some duration $\geq$ the duration threshold (the threshold under which an event no longer ‘exists’ w.r.t. some recognizing system). So, occurs(e) + duration(e) $\geq l_{\text{duration}}$.

If we say that $e$ was short, we introduce an information such as duration(e) $\leq l_{\text{short}}$. Now, there is a scalar expectation corresponding to:

duration(e) $\leq l_{\text{short}}$ $\sim$ duration(e) $\leq l_{\text{duration}}$ $\sim$ duration(e) $\leq l_{\text{duration}}$

Finally, this gives an indirect opposition pattern: the event occurs $\sim$ its duration is not below the duration threshold, the event is short $\sim$ its duration is below the duration threshold.

(29) a demoters
In a form $p$ mais $q$, $q$ is an a demoter of $q$ if there exists a relevant proof from $p$ to the negation of an a trace of $p$.

Examples of a demotion.

On occurrence time, Things which happen happen at some time (!), postponing them is a manner of suggesting they might not occur at all, It s'enfendra, mais pas tout de suite (He will come, but not immediately). An a trace of the event is the fact that it occurs before $\infty$ (the end of time): event occurrence $\leq \infty$. But we have

\text{event occurrence} $\leq l_{\text{immediately}}$ $\text{immediately} > \infty$ $\sim$ \text{event occurrence} $\geq \infty$. Similar examples with occurrence frequency (something which happens, but not often), or intensity (something which happens, but at a very low level).

5 Conclusion

Summary: lexical information [position w.r.t. thresholds] is dealt with in a general inference system. This permits a uniform treatment for superficially different cases.

Remaining problems (those I am aware of!):

- status of equality expressions [see Ducrot vs de Cornulier controversy] like autant que,
- syntax-semantic interface for expressions triggering SSE,
- connection between model theoretic and proof theoretic approach.

References

Notes

1 As noted by Lakoff (1971) d.o.e. uses of but can be paraphrased by using although. The same observation goes for bien que. The reverse is not true. Examples which are ok with although or bien que are not necessarily denial of expectation examples. See (1-3a).

2 Other constructions in French seem to license pourtant because they exploit a high degree reading.

(30) a. Pour intelligent qu'il soit, Jean ne l'est (pourtant/quant même) pas autant que son frère
b. Jean a beau être intelligent, il ne l'est (pourtant/quant même) pas autant que son frère
c. Avec toute son intelligence, Jean n'arrive (pourtant/quant même) pas à égaler son frère

Examples (30a) (30c) mean ‘John’s intelligence is terrific, yet his brother is even more intelligent’. This is a direct opposition pattern. Such differences are connected with the difference observed by Fradin (1977) between propositional concessive sentences (bien que) and what he calls extensional concessive sentences, whose concession operator ranges through a set of degrees, In English, think of constructions like No matter how John is intelligent, X.

In addition, some speakers don’t like the ‘subordinate clause first’ order, i.e. (13-e)

4That is, any acceptable representation for the adjective must entail this scalar property.

5Moreover, (19) does not license a perfectly natural sentence like John is intelligent, but he is less intelligent than his brother, since John being not less intelligent than his brother does not entail that John and his brother have not the same degree of intelligence.

6The Gentzen systems for relevance logics use multisets and non oriented judgments. That is, a judgment like X, Σ ⊢ y is represented as Σ, ¬X, Y. So a (true judgment) like A = (A → B) → B) is ¬A ¬(A → B), B.

7The existence of different levels of information is still an open question (cf. Atlas, 1996).

8There is more to be said about determiners, however. See the discussions in (Jayez 1988) and Corblin (1997).