CHAPTER THREE

How 'Logical' are Logical Words?

Negation and its Descriptive vs. Metalinguistic Uses

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1 Introduction

In this contribution, I would like to disentangle some issues about negation and its scope. The first question to address is whether linguistic negation is connected or not to truth-conditions, and consequently to veridicality. From an intuitive point of view, a negative utterance should have as its main property to negate or contradict an utterance rather than deny a state of affairs. For instance, what is the meaning of (1)?

(1) Mary is not happy.

Does the speaker contradict a previous utterance as (2) or does she claim that the world in which Mary is not happy bears the contradictory property of being happy?

(2) Mary is happy.

In this contribution, I will not focus on the logical meaning of negation but will mainly describe the type of contexts in which utterances such as (1) occur in a way that both interpretations—that is, a contradiction of an utterance and a negative description—arise.

Now, this short description does not say anything about the relation between negation and truth. Nor does it explain the scope issue, that is, the way contextual or linguistic information imposes or not a restriction on its semantic domain. From a purely logical point of view, (1) does not exhibit the same scope property as (3), (4), or (5):

(3) Mary is not happy; she is desperate.
(4) Mary is not happy; she is only sad.
(5) Mary is not happy; she is very happy.

As we shall see, in (3) there is a contrariety relation between *happy* and *desperate*; in (4), there is a contrast relation between being *happy* and *sad*, whereas in (5), being *very happy* explains why Mary is not only happy, but more than happy. From a logical point of view these examples will be described in terms of the entailments that the corrective sentence (COR) entertains with the negative sentence (NEG) or its positive counterpart (POS).

The scope issue has a long story, from syntax to semantics (Horn 1989), as well as from semantics to pragmatics (Carston 2002). This chapter will not investigate how negation scope can be computed at the syntax-semantics interface, nor at the semantics-pragmatics interface (see Moeschler 2010a for a general presentation). On the contrary, it will mainly concern the type of environment (linguistic and non-linguistic) that allows computing negation scope. Here, we assume that the scope issue is mainly resolved by means of discourse and contextual information, because structural or semantic information are not sufficient to compute the scope of negation.

More precisely, my contribution aims at answering the following questions:

a. What is the relation between the logical meaning of negation and its pragmatic meanings?
b. What is the meaning of a negative sentence?
c. Does linguistic negation have a default orientation?
d. What is the contribution of contexts in the computation of negation scope?
e. What is the relationship between negation and events?

2 The Logical Issue

Let us begin with the main issues concerning semantics and pragmatics of negation. One way of tackling the pragmatics of negation is to address three questions relating to logic, semantics, and pragmatics. In a nutshell, the logical issue refers to the entailment relation between COR and NEG; the semantic issue refers to the scope of negation, or the scope of the semantic domain negation; finally, the pragmatic issue concerns the discourse relationship between COR and NEG. The main hypothesis of this chapter is that negation is a three-sided operator in which all three properties converge. The main goal of the paper is thus to give a coherent picture of negation from a logical, semantic, and pragmatic point of view.

The logical issue is thus about the type of entailments between a negative

sentence (NEG) and its corrective one (COR): in ordinary negation (6), the relation between COR and NEG is not the same as in non-ordinary negation, as in metalinguistic negations (7) and (8):

(6) Abi n'est pas belle (NEG), elle est quelconque (COR).
'Abi is not beautiful; she is ordinary'.

(7) Abi n'est pas belle (NEG), elle est extraordinaire (COR).
'Abi is not beautiful; she is gorgeous'.

(8) Abi ne regrette pas d'avoir échoué (NEG), elle a réussi (COR).
'Abi doesn't regret having failed; she passed'.

In other words, in ordinary negation, the corrective sentence (COR) entails the negative one (NEG), whereas with metalinguistic negation, two situations arise. With upward negation, mainly with scalar predicates, COR entails the corresponding positive sentence (POS), whereas with a presuppositional negation, COR entails NEG and other entailed propositions, as presuppositions (PP). (9) to (11) make these entailment relations explicit:

(9) COR → NEG
Abi is beautiful → Abi is not ugly[1]

(10) COR → POS
Abi is gorgeous → Abi is beautiful

(11) COR → NEG & NEG(PP)
Abi passed → Abi doesn't regret to have failed & not(Abi failed)

The entailment relations is a good test, because it gives a first semantic description of linguistic negation: apart descriptive negation, there are two metalinguistic negations (Moeschler 2006a, 2012a): (i) ordinary or descriptive negation is truth-conditional, which means it scopes over a proposition and is entailed by COR; (ii) metalinguistic negation 1, or *upward negation*, as well as

1 It is crucial here to assert that the reverse entailment is not valid: NEG does not entail COR: *Abi is not ugly* ↛ Abi is beautiful.

I will not address here the issue of the difference between positive and negative scalar predicates, in what concerns their entailment.

metalinguistic negation 2, or *presuppositional negation*, are non-truth-conditional because they scope over more specific contents and not over the asserted proposition.

Table 1 gives a first illustration of these differences, which are only sketched here to make the difference between these three uses of negation clearer. The whole chapter aims not only to justify these observations, but also to predict them from discourse usages.

TABLE 1 *Three uses of negation.*

	Assertion	Entailment	Presupposition	Implicature
Descriptive negation	not-P	Q or not-Q	Q	
Metalinguistic negation 1	not-P	not-Q	not-Q	
Metalinguistic negation 2	~~not-P~~	P & Q		~~not-Q~~

2.1 *Descriptive Negation*

First, the entailment of a descriptive negative sentence is either true or false: for instance, in (12), NEG, that is not-P, is compatible both with the entailment (Q) of POS (13) or its negation (not-Q), whereas its presupposition (Q) is safe:

(12) Nath did not buy a chow → Nath bought a dog or Nath did not buy a dog
not-P → Q or not-Q

(13) Nath bought a chow → Nath bought a dog
P → Q

(14) Abi regrets having failed → Abi failed
P → Q

In the previous description, I hypothesized that a negative descriptive sentence does not give a clear result as its entailment is concerned. This presumes that two situations are possible: either the entailment is preserved or it is cancelled, as illustrated by (15) and (16) (Moeschler 2013):

(15) a. Nath did not buy a Chow (not-P); he bought a Labrador (P')$_{prime}$.
b. P'$_{prime}$ → Q
c. not-P → Q

(16) a. Nath did not buy a chow (not-P); he bought a cat (P')$_{prime}$.
b. P'$_{prime}$ →not-Q
b. not-P → not-Q

In fact, as we will see, (15a), which yields a Correction Discourse Relation (cf. section 4), is the preferred reading of descriptive negation including concepts belonging to a hierarchy. Figure 1 explains why in (15a) the entailment relation (15b) is the case: a subordinate concept entails its hyperonyms. Figure 1 also explains why (15a) is the preferred reading, and Figure 2 explains why (16a) is not the preferred reading for descriptive negation. In that case, the change of category makes the correction less predictable.

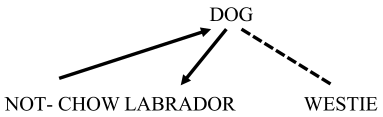

FIGURE 1 A conceptual hierarchy for the entailment from NOT-CHOW (1).

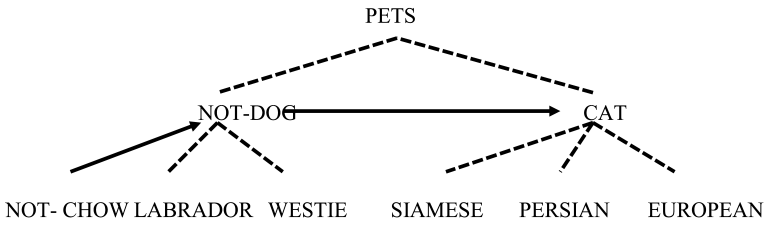

FIGURE 2 A conceptual hierarchy for the entailment from NOT-CHOW (2).

However, (16a) is not a case of metalinguistic negation, because the truth-functional properties of entailment are preserved. Moeschler (2013) argues that entailment is truth-functional and corresponds from a logical point of view to material implication:

TABLE 2 *Truth-conditions for entailment.*

P	Q	P entails Q
1	1	1
1	0	0
0	1	1
0	0	1

Indeed, when P is false (0), its entailment Q can be either true (1) or false (0), preserving the truth of the entailment relation.

2.2 *Presuppositional Negation*

Secondly, within metalinguistic negation 1 (presuppositional negation), the presupposition is negated and belongs to the scope of negation, as shown in (8), repeated in (17):

(17) Abi ne regrette pas d'avoir échoué (NEG), elle a réussi (COR).
'Abi doesn't regret having failed. she passed'.

In that case, COR defeats POS and its presupposition, given in (18):

(18) Abi regrets having failed (P) PRESUPPOSES Abi failed (Q)

In this case, not-P entails and presupposes not-Q, because COR (Q'$_{\blacksquare\text{prime}}$) entails not-Q. So the logical relations in (17) can be made explicit in (19):

(19) a. Q'$_{\blacksquare\text{prime}}$ → not-P & not-Q
b. Abi passed → not (Abi failed)
c. Abi passed → not (Abi regrets having failed)

Presuppositional negation is one of the metalinguistic uses of negation. A main property of metalinguistic negation is that it does not defeat a proposition, but scopes over the act of utterance (*énonciation*). A metalinguistic analysis of (17) states that by uttering *Abi ne regrette pas d'avoir échoué*, the speaker does not negate the proposition *Abi regrets that Q*, but refuses to assert it: the reason why she refuses such an assertion is because its presupposition Q is false. In other words, the question under discussion is not whether Abi regrets or not

that Q, but Q. Q, as a presupposition, is taken for granted and as such is seen as belonging to the context, that is, the common ground or mutual knowledge (respectively Sperber & Wilson 1995; Stalnaker 1977; Gazdar 1979). This analysis, as we shall see it later on, supposes that only COR defeats the presupposition of P. As such, a bare negative sentence preserves its presupposition Q:

(20) a. Abi ne regrette pas d'avoir échoué.
'Abi does not regret having failed'.
b. not-P → Q

2.3 *Upward Negation*

The third case, what I call metalinguistic negation 2, is more complex, because the negative proposition is not asserted. In fact, the positive proposition is not under the scope of negation, what is represented by ~~not P~~. With scalar predicates, as in (21), the implicature of P (not-Q) is defeated, but P is not. So the corrective sentence Q is contradictory to the implicature of POS (not-Q), and entails POS, or P. So, as an effect, both P and Q are entailed by COR.

(21) a. Anne does not have three children; she has four.
b. Anne has three children +> Anne does not have four children
c. Anne has four children →Anne has three children

Metalinguistic negation 2 is a very special case of metalinguistic negation; its main purpose is to defeat an implicature and not the proposition that triggers it. In other words, it looks like a negation, but its effect is only to defeat one part of its pragmatic meaning, not one constituent of its semantic content.

As a metalinguistic use of negation, (21a) can be paraphrased in the same manner as presuppositional negation: the speaker cannot assert that Anne has three children, and the reason is that she has four. This use will be called *upward negation*.

Let us resume our description. So far, I have described three main uses of negation: one descriptive negation and two metalinguistic negations: in descriptive negation, COR entails NEG; in presuppositional negation, COR entails NEG and its presupposition PP; in upward negation, COR entails POS:

(22) a. descriptive negation: NEG, COR, where COR → NEG
b. presuppositional negation: NEG, COR, where COR → NEG & PP
c. upward negation: NEG, COR, where COR → POS

We have made a substantial progress by defining one criterion distinguishing three types of negation. But we need much more—namely, semantic and pragmatic criteria. COR bears some properties that must be discovered, because NEG, by itself, is not sufficient. Without COR, NEG, whatever its syntactic and semantic properties, always triggers a descriptive use of negation. So the main issue is how, through COR, the intended use of negation can be obtained.

3 The Semantic Issue

The semantic issue concerns what the negation scopes over. Descriptive and metalinguistic negations display an asymmetrical behaviour: whereas descriptive is downward oriented, metalinguistic negation 2 is upward oriented. This seems to be a basic fact. (23a) entails that Abi is less than beautiful, whereas (23b) says that she is more than beautiful:

(23) a. Abi n'est pas belle.
'Abi is not beautiful'.
b. Abi n'est pas belle, elle est extraordinaire.
'Abi is not beautiful; she is gorgeous.
■non-matching quotation mark

So the question is whether downward orientation of descriptive negation is a semantic property or the result of a pragmatic process.

Ducrot (1980) gives a very precise analysis of French descriptive negation, but its downward orientation is for him the result of discourse laws (*lois de discours*), or pragmatic processes (see Moeschler 1991 and 2006 for a detailed description of Ducrot's analysis).

What I would like to argue here is that downward orientation of negation is the result of a semantic process, not a pragmatic one. Downward orientation of descriptive negation is a basic property of scalar predicates. Moreover, I will argue that downward orientation is a consequence of the convergence between its scopes and its entailments.

3.1 *Negation as a Propositional Operator*

Let us begin with what is required for the semantics of negation. From a logical point of view, negation is a *propositional operator*, whose function is to inverse the truth-value of the proposition. In a two-valued propositional logic, negation makes a true proposition false and a false proposition true. So from a logical point of view, the conditions under which a negative utterance is used represents a situation where the negated proposition is false. In

other words, negation operating on a false proposition makes a true proposition. For instance, if a speaker asserts (24), it is because the proposition (25), negated in (24), is false. It is in effect a non-sense to negate a true proposition to yield a false assertion (26), because an assertion implicates (Searle 1979; Gazdar 1979) that the speaker believes the truth of the asserted proposition. So a negated proposition such as (24) is true,[2] not false; its semantic value is given in (27), not in (28), and negation applies to (25), not to (26):

(24) It is not raining.
(25) $[\![$ it rains$]\!]^{M,g} = 0$
(26) $[\![$ it rains$]\!]^{M,g} = 1$
(27) $[\![\text{not}]\!]^{M,g}\,[[\![$ it rains$]\!]^{M,g}] = 1$
(28) $[\![\text{not}]\!]^{M,g}\,[[\![$ it rains$]\!]^{M,g}] = 0$

The first assumption we must admit is that, from a linguistic point of view, negation has simple semantics. It makes a false proposition true, and does not make a true proposition false.

3.2 *Negation as a Constituent Negation*

The second property of linguistic negation is that it is a *constituent negation* (Klima 1964). It scopes over a specific semantic material. When no special construction is used, as with a cleft sentence for instance (29), linguistic negation scopes over the predicate of the sentence, whatever its linguistic category is (verb, adjective, preposition) (30):

(29) Ce n'est pas Paul qui écrit des poèmes, mais Pierre.
'It is not Paul who writes poems, but Peter'.

(30) a. Paul n'aime pas Marie.
'Paul does not like Mary'.
b. Abi n'est pas grande.
'Abi is not tall'.
c. Le livre n'est pas sur la table.
'The book is not on the table'.

2 By 'true', I do not mean necessary truth, but contingent truth.

(31) gives a simple logical analysis of these uses of negation:[3]

(31) a. NOT-LOVE[PAUL, MARIE]
b. NOT-TALL[ABI]
c. NOT-ON[THE BOOK, THE TABLE]

3.3 *The Semantic Domain of Negation*

The third issue concerning the scope of negation is its *semantic domain*. Let us take predicates belonging to a contrast set, where entailment relations are clearly defined by the meaning of the words. *Married*, *single* and *engaged* are in contrast relations. So if Abi is single, it entails that she is neither married nor engaged. Now, what is the actual meaning of NOT-MARRIED, as in (32)?

(32) Abi is not married.

If the contrast set includes *married*, *single*, and *engaged*, then (32) entails that Abi is single or engaged. This means that the meaning of a negated predicate is unspecified. The information entailed by (32) is thus loose and not sufficient to attribute to Abi a precise property relative to the contrast set she is included in. The only possible way to make a negative utterance more specific in meaning is to add what I call a corrective sentence, COR. The function of COR is to restrict and specify the actual property of the argument whose predicate is negated. So (33a) and (33b), which contain a correction, have precise meanings, which are consistent from a semantic or logical point of view, as COR entails NEG (34):

(33) a. Abi is not married; she is single.
b. Abi is not married; she is engaged.

(34) a. Abi is single → Abi is not married
b. Abi is engaged → Abi is not married

3 Even if the narrowing of logical scope of negation is crucial, because in logical form of (30) negation has wide scope—that is, it scopes over a complete proposition and not a predicate—it will not be addressed here for reason of space (see Moeschler 2010a):

a. NOT [LOVE [PAUL, MARIE]]
b. NOT [TALL [ABI]]
c. NOT [ON [THE BOOK, THE TABLE]]

Now we know more on the semantics of a negative sentence. A bare negative sentence has an unspecified meaning; the COR sentence's main function is to make the domain of negation more specific.

With scalar predicates, the domain of negation seems to be less unspecified. The question is whether it can be computed or not without any COR sentence. In effect, (35) is consistent with two orientations: a downward, as in (36a), and an upward, as in (36b):

(35) Abi n'est pas belle.
'Abi is not beautiful'.

(36) a. Abi n'est pas belle, elle est quelconque.
'Abi is not beautiful; she is ordinary'.
b. Abi n'est pas belle, elle est extraordinaire.
'Abi is not beautiful; she is gorgeous'.

The question is the following: as (35) can receive two orientations, given in (36), is a negative utterance neutral or oriented? I would argue that a negative utterance is not neutral and that negation is not symmetrical. The test is the following: what is the entailment of (35)? If negation were neutral with regards to its entailment, then (35) should have as an entailment a disjunction, given in (37):

(37) Abi is not beautiful → Abi is ugly OR Abi is ordinary OR Abi is gorgeous

So the set of entailments would correspond to all possible degrees in a scale of beauty: in that case, NOT-BEAUTIFUL should entail all positions (downward as well as upward) in the scale given in Figure 3:

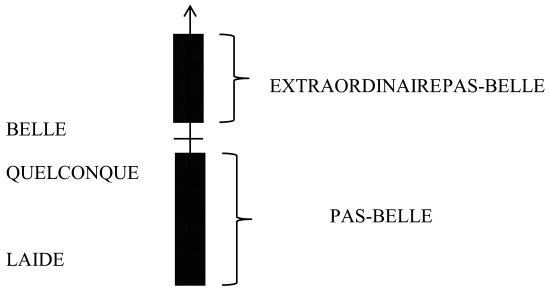

FIGURE 3 The domain of PAS-BELLE.

But this is not a good description of scalar predicates, which are oriented and have a polarity. In that case, *belle*, as a positive predicate, is positively oriented and contrasts with its antonym *laide*, which is negatively oriented (Figure 4). The question is now the following: how can the negation of a positive predicate be consistent with a positive COR and a negative COR?

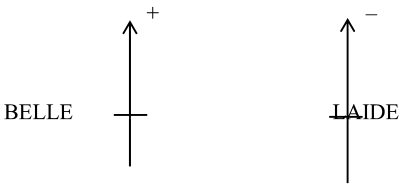

FIGURE 4 Positive and negative scales.

Ducrot (1980) gives an argument for a two-scale description of descriptive negation in his theory of argumentation, asserting that all possible ranks in a scale are more or less strong arguments for a conclusion consistent with the orientation of the scale. It means that being more or less beautiful in that scale is positively oriented, as (38) shows. With a negative predicate, (39), it is the other way around.

(38) a. Abi is beautiful; she can play the role of the princess.
b. Abi is beautiful enough to play the role of the princess.

(39) Abi is ugly: she cannot play the role of the princess.

Now, what happens when positive and negative predicates are in negative sentences, as in (40) and (41)? Their orientation is simply reversed.

(40) a. Abi is not beautiful enough to play the role of the princess.
b. Abi is not beautiful; she cannot play the role of the princess.

(41) a. ?? Abi is not beautiful; she can play the role of the princess.
b. Abi is not ugly; she can play the role of the princess.

So it seems that the orientation of a negative predicate is the reverse of the orientation of the positive one. Ducrot (1980) describes this property of scalar predicates as the result of the discourse law of *argumentative inversion*: if an

argument p'$_{\blacksquare\text{prime}}$ is stronger than an argument p for a positive conclusion r, then non-p is stronger than non-p'$_{\blacksquare\text{prime}}$ for the negative conclusion non-r (Moeschler 2006b).

Suppose now that predicate p'$_{\blacksquare\text{prime}}$ is stronger than p, and that p'$_{\blacksquare\text{prime}}$ is *très belle*, whereas p is *belle*. Then the prediction is that *pas très belle* will be a weaker argument for a negative conclusion than *pas belle*. Let us check this hypothesis by using the test of *même* (*even*) insertion, which introduces a stronger argument:

(42) a. Abi est belle et même très belle: elle fera une magnifique princesse.
'Abi is beautiful and even very beautiful; she will be a wonderful princess'.
b. ?? Abi est très belle et même belle: elle fera une magnifique princesse.
'Abi is very beautiful and even beautiful; she will be a wonderful princess'.

(43) a. Abi n'est pas très belle et même pas belle du tout: elle ne fera pas une magnifique princesse.
'Abi is not very beautiful and even not beautiful; she will be a wonderful princess'.
b. ?? Abi n'est pas belle et même pas très belle: elle ne fera pas une magnifique princesse.
'Abi is not beautiful and even not very beautiful; she will be a wonderful princess'.

Obviously, (42a) is more acceptable than (42b), as is (43a) relative to (43b).

So, what have we shown with this excursus? The negation of positive scalar predicates gives rise to a negative scale. So the prediction is that this property, which is strictly argumentative for Ducrot, is in fact a basic semantic fact: negation is downward oriented, and this explains why in ordinary usages of negation (that is, descriptive usages), negation is downward oriented. When an upward orientation is the case, negation is not descriptive, but metalinguistic.

Now the question 'why is a corrective sentence necessary only in the case of upward entailment?' can be addressed. If negation is intrinsically downward, no corrective sentence is necessary, whereas it is the other way around with upward negation—the COR sentence is necessary to make the COR to POS entailment available to the audience. More precisely, in descriptive negation, the scope of negation equals its entailments, whereas in upward negation, the

entailments are distinct from its scope; negation scopes over a precise content, its scalar implicature. Figure 5 makes this difference explicit for examples (44) and (45):

(44) Anne does not have three children.
(45) Anne does not have three children; she has four of them.

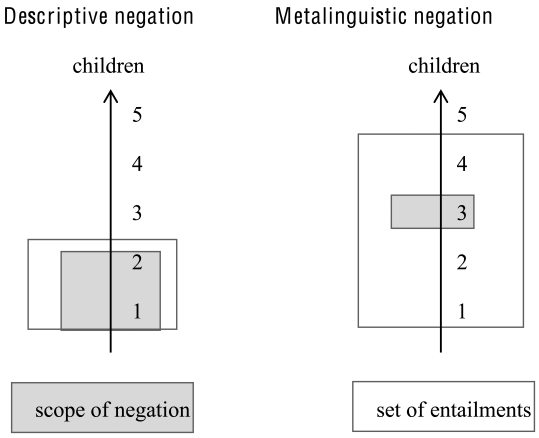

FIGURE 5 Scope of negation and entailments.

Now we have a second property distinguishing descriptive and metalinguistic negation: descriptive negation is downward oriented, whereas metalinguistic negation is upward oriented.

4 The Pragmatic Issue

What I would like to discuss now is the pragmatic or discourse relation between NEG and COR. My hypothesis is that the three types of negation proposed in this chapter are not the same. The question is whether there are pragmatic evidences for distinguishing between these three types of negation. I wish to propose two criteria: discourse relations and connectives.

4.1 *Discourse Relations*

The hypothesis is that the discourse relations between NEG and COR are not of the same type.

4.1.1 Correction

In the case of descriptive negation, the discourse relation is a Correction one. Here is the definition of Correction:[4]

(46) 'not-α CORRECTION β' is the case between not-α et β if α is a false description of the world and β is a true description.

Let takes example (36a), repeated in (47):

(47) Abi n'est pas belle, elle est quelconque.
'Abi is not beautiful; she is ordinary'.

The following description is the case for example (47):

(48) a. ⟦Abi is beautiful ⟧ = 0
b. ⟦Abi is ordinary ⟧ = 1
c. Abi is ordinary → not [Abi is beautiful]

In other words, Correction is the case because α (ABI IS BEAUTIFUL) is false and β is true and β entails not-α. In this case, COR (β) entails not-α (NEG).

4.1.2 Contrast

What about metalinguistic negation? In the case of upward negation, the relation between NEG and COR is a Contrast relation. Here is a definition of Contrast:

(49) 'not-α CONTRAST β' is the case between non-α et β if not-α implicates not-β.

In (50), COR entails POS (51a) and NEG implicates the negation of COR (51b):

(50) Abi n'est pas belle, elle est extraordinaire.
'Abi is not beautiful; she is gorgeous'.

4 I will make a difference between Correction and Contrast. In Rhetorical Structure Theory, only Contrast seems to be relevant. Contrast belongs to the category of "Other relations" (Taboada 2012).

(51) a. Abi is gorgeous → Abi is beautiful
b. Abi is not beautiful +> Abi is not gorgeous

In the Contrast relation, the COR sentence contrasts with the NEG sentence in the sense they lead to different conclusions. The contrast can be simply explained by the semantic orientation of NEG and COR: NEG is negatively oriented, and COR positively oriented. This contrast is not a Correction; in Correction, the polarity of NEG and COR is identical. In the next section (4.2), we will make this difference explicit via different discourse connectives.

4.1.3 Explanation

Last but not least, the discourse relation between NEG and COR in presuppositional negation is Explanation. In that case, COR explains why NEG has been asserted. The definition of Explanation is the following:

(52) 'not-α Explanation β' is the case if β explains why α is false and β entails not-α and the negation of its entailments.

In (53), COR entails NEG and its presupposition, as made explicit in (54):

(53) Abi ne regrette pas d'avoir échoué, elle a réussi.
'Abi does not regret having failed; she passed'.

(54) a. Abi passed → Abi does not regret having failed
b. Abi passed → not (Abi failed)

What does it mean that COR is an Explanation of NEG? It means that COR gives a reason why NEG and its entailments are false.

So COR can have at least three functions: Correction, Contrast, and Explanation. These different discourse relations explain the differences in entailments between COR and NEG.

A second argument can strengthen such differences: connectives.

4.2 *Connectives*

These three types of discourse relations and negation are made explicit by different connectives. The Correction relation is made explicit by the French connective *au contraire* (on the contrary), the Contrast relation by *mais* (but), and the Explanation by *parce que* or *puisque* (because, since). (55) to (57) make these relations explicit by means of connectives:

(55) a. Abi n'est pas belle, **au contraire** elle est quelconque.
'Abi is not beautiful; on the contrary she is ordinary'.

(56) Abi n'est pas belle, **mais** extraordinaire.
'Abi is not beautiful but gorgeous'.

(57) Abi ne regrette pas d'avoir échoué, **parce que/puisqu**'elle a réussi.
'Abi does not regret having failed, because/since she passed'.

Moreover, these connectives are not substitutable; they are specific to these discourse relations, as shown the following examples:

(58) a. Abi n'est pas belle, au contraire elle est quelconque.
'Abi is not beautiful; on the contrary she is ordinary'.
b. Abi n'est pas belle mais$_{\text{SN}}$ quelconque.
'Abi is not beautiful but ordinary'.
c. Abi n'est pas belle, parce qu'elle est quelconque.
'Abi is not beautiful, because she is ordinary'.

In (58b), *mais* is not a contrastive *mais*, as in (56), but a corrective *mais*, what Anscombre and Ducrot (1977) call a *mais*$_{SN}$—the contrastive or argumentative *mais*$_{PA}$.[5] In (56c), *parce que* is possible, but the discourse relation is no more a corrective one. Rather, it is an Explanation, exactly what the connective requires to draw. The paraphrase of (58c) is given in (59):

(59) The reason why Abi cannot be said to be beautiful is that she is ordinary.

With the contrast relation, the possible connectives are restricted to *mais*$_{PA}$:

(60) a. Abi n'est pas belle, mais extraordinaire.
'Abi is not beautiful but gorgeous'.
b. ?? Abi n'est pas belle, au contraire elle est extraordinaire.
'Abi is not beautiful; on the contrary she is gorgeous'.
c. ? Abi n'est pas belle, parce qu'elle est extraordinaire.
'Abi is not beautiful, because she is gorgeous'.

5 SN is for *sondern* (German) and *sino* (Spanish), whereas PA stands for the German *aber* and the Spanish *pero*.

Finally, the Explanation case is clearer: no other connective than *parce que/ puisque* is possible:

(61) a. Abi ne regrette pas d'avoir échoué, parce que/puisqu'elle a réussi.
'Abi does not regret having failed, because/since she passed'.
b. *Abi ne regrette pas d'avoir échoué, au contraire elle a réussi.
'Abi does not regret having failed; on the contrary she passed'.
c. *Abi ne regrette pas d'avoir échoué, mais elle a réussi.
'Abi does not regret having failed, but she passed'.

The last issue to be made explicit is to know whether the semantics of these three connectives is consistent with the entailments and the discourse relations implied within the three types of negation. I will give the following descriptions that make this hypothesis acceptable.

4.3 *The Semantics of* au contraire, mais *and* parce que

4.3.1 *Au contraire*

Au contraire has as a basic semantic, a contrary relation. The contrary relation can be expressed by the following truth-conditions, expressed in Table 3, and utterance (62):

(62) Abi n'est pas belle, au contraire elle est quelconque.
'Abi is not beautiful; on the contrary she is ordinary'.

TABLE 3 *Contrary relation.*

P: Abi is beautiful	Q: Abi is ordinary	P IS CONTRARY TO Q
1	1	0
1	0	1
0	1	1
0	0	1

In other words, Abi cannot be *beautiful* and *ordinary* at the same time, but she can be beautiful or ordinary, or neither beautiful nor ordinary. So POS and COR in descriptive negation are in contrariety relation. This corresponds to the semantics of *au contraire*: *au contraire* can be used neither with contradictory

predicates nor with sub-contrary ones. (63), which is an example of a contradiction, is unacceptable with *au contraire*; the same holds for sub-contrariety relations, exemplified in (64):

(63) *Abi n'est pas belle, au contraire elle est belle.
'Abi is not beautiful; on the contrary she is beautiful'.

(64) * Abi n'est pas quelconque, au contraire elle n'est pas belle.
'Abi is not ordinary; on the contrary she is not beautiful'.

So, it happens that if *belle* and *quelconque* are contrary predicates, *pas quelconque* and *pas belle* are sub-contrary predicates. Figure 6 makes these relations explicit (cf. Horn 2012a), and the examples in (65) make explicit all possible logical relations (entailment, contradiction, contrariety, and sub-contrariety in the logical square):

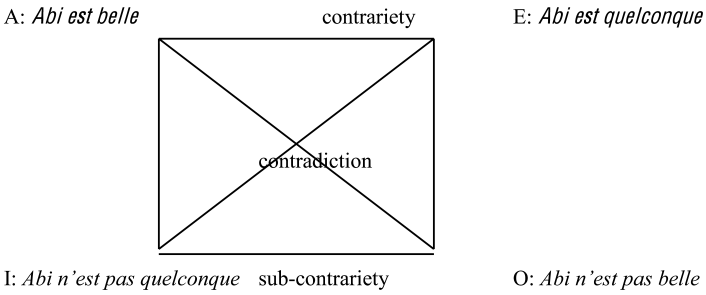

FIGURE 6 Logical square and contrary predicates.[6]

(65) a. Abi est belle ENTAILS Abi n'est pas quelconque
b. Abi est quelconque ENTAILS Abi n'est pas belle
c. Abi est belle IS CONTADICTORY TO Abi n'est pas belle
d. Abi est quelconque IS CONTADICTORY TO Abi n'est pas quelconque
e. Abi est belle IS CONTRARY TO Abi est quelconque
f. Abi n'est pas quelconque IS SUB-CONTRARY TO Abi n'est pas belle

6 A and I stand for the positive corners of the logical square (AffIrmo), E and O for the negative ones (NegO). A and E are universals, I and O particular. See Horn (2004, 2012b) and Moeschler (2007) for an application of the logical square to pragmatics and the theory of scalar implicatures.

4.3.2 *Mais*

Mais has as its semantics the logical meaning of conjunction (∧), which corresponds linguistically to *et* (and) and has as its pragmatic meaning a contrast between the implicatures of its discourse segment. Moreover, whereas its semantics are symmetrical (*P and Q* is truth-conditionally equivalent to *Q and P*), its pragmatics are asymmetrical: *P mais Q* is not pragmatically equivalent to *Q mais P*.

Let us test the logical meaning of *mais* (conjunction):

(66) Abi n'est pas belle (not-P), mais extraordinaire (Q).
'Abi is not beautiful but gorgeous'.

TABLE 4 *Truth-conditions of conjunction relation.*

P: ABI EST BELLE	Q: ABI EST EXTRAORDINAIRE	P and Q
1	1	1
1	0	0
0	1	0
0	0	0

POS and COR have to be true together: they cannot be false together nor false or true.

This is the case because negation is metalinguistic and not descriptive in (66). The conjunction relation is made explicit in (67):

(67) Abi est belle et extraordinaire.
'Abi is beautiful and gorgeous'.

So, what happens in (66) from a pragmatic point of view? If a contrast relation takes place, it means that NEG must trigger some implicature, which is not compatible with COR.

The point is that a contrast relation is the case if and only if NEG is first interpreted as a descriptive negation. In this interpretation, NEG implicates a negative conclusion, which is defeated by COR. So the paradox of the contrastive use of *mais* is that NEG must be taken descriptively, not interpretatively (Sperber & Wilson 1995). So (66) receives the following analysis:

(68) a. Abi n'est pas belle +> Abi cannot play the role of the princess
b. Abi est extraordinaire +> Abi can play the role of the princess
c. Abi est extraordinaire → Abi est belle
d. Abi n'est pas belle mais extraordinaire +> Abi can play the role of the princess

Remember that *mais* in a contrast relation is PA, not SN. When *mais* is used in a Correction relation, it is a $mais_{SN}$ and not a $mais_{PA}$:

(69) Abi n'est pas belle, mais laide.
'Abi is not beautiful but ugly'.

Remember also that *belle* and *laide* are contrary and that *laide* entails *pas belle*. So none of the entailments and implicatures made explicit in (68) are the case in (69).

I would like to make explicit that $mais_{PA}$ can be used when the first segment is not in a negative form. In this case, the contrast is not lexical but pragmatic. For instance, in the same semantic domain, the contrast should be the case between *belle* (beautiful) and *timide* (shy). The famous example contrasting being a Republican and being honest gives rise to the same analysis:

(70) Abi est belle, mais timide.
'Abi is beautiful but shy'.
+> there is a contrast between being beautiful and shy

(71) He is a Republican but honest.
+> there is contrast between being a Republican and honest

4.3.3 *Parce que*

Parce que and *puisque* are connectives introducing causal relations.[7] In Moeschler (to appear), *parce que* has as entailment a causal and a conjunction relation between its arguments. In other words, *P parce que Q* entails *Q CAUSE P* and *P and Q*. Is this analysis compatible with the presuppositional use of

7 Cf. Moeschler (2011) for a general description of *parce que* in French, Blochowiak (2010) for a formal analysis of *because* and its interactions with negation, Zufferey (2010, 2012) for revised analysis of *parce que, car, puisque* of the classical analysis by the Groupe λ-l (1975). Cf. Zufferey & Cartoni (2012) for a cross-linguistic analysis of causal connectives in French and English.

negation? In this case, it must be specified that the use of *parce que* is not causal, but speech act (Sweetser 1990). So the description of (72) is given in (73):

(72) Abi ne regrette pas d'avoir échoué, parce que/puisqu'elle a réussi.
'Abi does not regret having failed, because/since she passed'.

(73) a. Abi passed CAUSE TO SAY Abi does not regret having failed.
b. Abi does not regret having failed AND Abi passed.
c. Abi passed → not(Abi failed)

So (74) entails (74)—that is, what is predicted by the analysis of presuppositional negation:

(74) Abi does not regret having failed and not(Abi failed).

4.5 *A Synthesis*

change to 4.4?

We have discussed three issues about the scope of negation: the logical, semantic, and pragmatic issues. As a result, we have a convergence of properties and criteria distinguishing three types of negation: ordinary negation, upward negation, and presuppositional negation.

These criteria are resumed in Table 5:

TABLE 5 *Criteria distinguishing three types of negation.*

	Entailments	Scopes	Discourse relations	Connectives
Descriptive negation	COR → NEG	Set of entailments	Correction	*au contraire*
Upward negation	COR → POS	Restricted	Contrast	*mais*
Presuppositional negation	COR → NEG (P & PP)	Wide	Explanation	*parce que, puisque*

5 Negative Utterances and their Contexts

The crucial issue is how to infer negation scope. In this section, I will show that this issue is basically a contextual one, and the computation of negation depends on the type of contextual effects. Our hypothesis is that negative utterances are pragmatically processed against contexts in which some contextual assumptions and previous utterances are required. In order to yield the right interpretation of negative utterances, contextual information should not only be consistent with the four types of properties described (entailment, scope, discourse relation, and connective), but also predict logical, semantic, and pragmatic properties of the usages of negation. Our description predicts that the context for downward and upward negation should be the same, but their contextual effects should not be. It also predicts that the contexts for presuppositional negation is more complex and differs from downward and upward negations.

5.1 *The Context of Ordinary Downward Negation*

In ordinary negation, the context must contain POS as a contextual assumption, even if POS is not necessarily made explicit. So POS can belong to the previous discourse context (75) or not (76). However, in this case, the presumption is that someone believes POS:

(75) A: Paul croit qu'Anne a trois enfants.
B: Non, Anne n'a pas trois enfants, elle en a deux.
'A: Paul believes that Anne has three children.
B: No, Anne does not have three children, she has two'.

(76) Sais-tu qu'Anne n'a pas trois enfants, mais seulement deux?
'Do you know that Anne does not have three children, but only two?'
Contextual assumption: Anne has three children.

Now, if the utterance is NEG + COR, what is its contextual effect? By contextual effect, I refer to positive cognitive effects, as defined in Relevance Theory (Wilson & Sperber 2004). A positive cognitive effect is either the addition of a new assumption (as a contextual implication, that is, the result of a contextual assumption and the explicature of the utterance), the strengthening of an old assumption (an assumption belonging to the mutual cognitive environment), or the suppression of an old assumption. In the case of a negative utterance, the cognitive effect distinguishing three types of negation is either

the *strengthening* or the *suppression* of an assumption, not the addition of a new assumption.[8]

What is the function of COR? As COR entails NEG, COR has as a main effect the strengthening of NEG. As a result, the effect of COR + NEG is the eradication of POS. So the context of ordinary downward negation is the following:

(77) a. Contextual assumption: POS
b. Utterance: NEG + COR
c. Contextual effect: ~~POS~~[9]

With scalar and presuppositional predicates, the same analysis holds:

(78) A: Je trouve qu'Abi est belle.
B: Non, elle n'est pas belle, elle juste quelconque.
'A: I think Abi is beautiful.
B: No, she is not beautiful, she is just ordinary'.

(79) A: Abi regrette d'avoir échoué.
B: Non, elle ne regrette pas d'avoir échoué: elle se moque de ses etudes.
'A: Abi regrets having failed.
B: No, she doesn't regret having failed: she doesn't care about her studies'.

In each case, POS belongs to the context and is suppressed as a contextual effect:

(80) Contextual assumption: Abi is beautiful
Contextual effect: ~~Abi is beautiful~~

(81) Contextual assumption: Abi regrets Q
Contextual effect: ~~Abi regrets Q~~

What has been stressed here is the difference between the meaning of a negative utterance (*Abi is not beautiful, Abi doesn't regret having failed*) and the eradication or suppression of its positive counterpart from the context. In effect, a negative sentence is not sufficient, which is why COR is crucial for the com-

8 See Moeschler (1997) for a description allowing as a contextual effect a contextual implication, via an invited inference *à la* Geis & Zwicky (1971).

9 ~~POS~~ means 'suppress POS'.

putation the contextual effect. Without COR, a contradictory exchange can be pursued without ending (Moeschler 1982 for an analysis of these cases).

(82) A: Je trouve qu'Abi est belle.
B: Non, elle n'est pas belle.
A: Si, elle est belle.
B: Non!
A: Si!
B: Non!
...
'A: I think Abi is beautiful.
B: No, she is not beautiful.
A: Yes, she is.
B: No, she is not!
A: Yes!
B: No!'

Last but not least, POS can be extracted from a discourse context in which it is not said explicitly. For instance, it can be extract, not as a presupposition, but as a presumed belief, as in question (81):

(83) A: Combien Anne a-t-elle d'enfants?
B: Elle n'a pas trois enfants.
'A: How many children does Anne have?
B: She does not have three children'.

Its context and contextual effects are given in (82):

(84) a. Contextual assumption: Anne has three children
b. Contextual effect: ~~Anne has three children~~

5.2 *The Context of Upward Negation*

Within upward negation, the context is different. POS belongs to the context, as in downward negation. But POS is maintained and NEG+COR strengthens it. So the contextual effect is POS+:

(85) a. Contextual assumption: POS
b. Utterance: NEG + COR
c. Contextual effect: POS+

In (86), contextual assumption and contextual effect are given in (87):

(86) A: Abi est belle, tu ne trouves pas?
B: Non, elle n'est pas belle, elle est extraordinaire.
'A: Abi is beautiful, isn't she?
B: No, she is not beautiful, she is gorgeous'.

(87) a. Contextual assumption: Abi is beautiful
b. Contextual effect: Abi is more than beautiful.

In this analysis, the entailment COR→POS is now consistent. The contextual effect POS+ explains why negation is not truth-conditional, but metalinguistic. Its scope is restricted to a specific degree on a scale, the one described by POS. So the pragmatic analysis makes explicit the following assumptions:

(88) The assertion of a degree D_i on a scale S implicates the limitation of the degree to D_i. D_i is incompatible with D_{i+1}, and entails D_{i-1}.

The counterpart of (88) is given in (89):

(89) The negation of a degree D_i on a scale S entails D_{i-1}.

(89) explains why a bare negative utterance conveys a descriptive negation or, in other words, a downward entailment.

5.3 *The Context of Presuppositional Negation*

In presuppositional negation, the context contains either NEG or POS, with a presupposition PP. Both NEG + COR defeat POS+PP or NEG+PP. (90) is a positive context, whereas (91) is a negative one:

(90) A: J'ai vu Abi. Apparemment, elle regrette d'avoir échoué.
B: Non, elle ne regrette pas d'avoir échoué, parce qu'elle a réussi.
'A: I met Abi. Apparently, she regrets having failed.
B: No, she doesn't regret having failed, since she passed'.

(91) A: J'ai vu Abi. Apparemment, elle ne regrette pas d'avoir échoué.
B: En effet, elle ne regrette pas d'avoir échoué, parce qu'elle a réussi.
'A: I met Abi. Apparently, she does not regret having failed.
B: In effect, she doesn't regret having failed, since she passed'.

(90) is a more expected context that (91), because the negative utterance, from a formal point of view, is opposed to a positive one. Generally, when the context is negative, a denial takes the form of the positive one:

(92) A: Abi n'est pas belle.
B: Si, elle est belle.
'A: Abi is not beautiful.
B: No, she is beautiful'.

However, the negative context in (91) gives rise some pragmatic effects, which are not propositional, that is, not representational. The effect is a kind of irony. This is due to the echoic nature of an ironical utterance (Wilson & Sperber 1981; Sperber & Wilson 1995; Carston 2002; Wilson 2006; Sperber & Wilson 2012). In Relevance Theory, irony is indeed defined as an interpretative use of language, implying an echo to a previous utterance or to a thought belonging to the context.

However, the ironical effect does not occur within a positive context, when the positive echo mimics ironically the positive utterance:

(93) A: J'ai vu Abi. Apparemment, elle regrette d'avoir échoué.
B: ?? En effet, elle regrette d'avoir échoué, parce qu'elle a réussi.
'A: I met Abi. Apparently, she regrets having failed.
B: In effect, she regrets having failed, since she passed'.

(93B) is not ironical because it is not negative, and POS is inconsistent with COR.[10]

So the context for presuppositional negation is double, positive and negative.

(94) Positive context
a. Contextual assumption: POS & PP
b. Contextual effect: ~~POS~~ & ~~PP~~

10 Ducrot (1984) gives a very interesting analysis of negative ironical utterance. His approach combines his analysis of negative utterance: negation implies two points of view (*énonciateur*), and the speaker assimilates only the point of view that denies the positive one; on the other hand, ironical utterances imply a mention to a previous utterance, or to a thought, without any assimilation to this point of view. Hence, a negative ironical utterance implies two points of view, the second being an echo of the first positive one, but without assimilation. See Moeschler (1991) and Moeschler & Reboul (1994) for a detailed discussion.

(95) Negative context
  a. Contextual assumption: NEG & PP
  b. Contextual effect: ~~NEG~~ & ~~PP~~

5.4 *Summary*

If we combine Table 5 and the results of section 3, we obtain the following result:

TABLE 6 *Criteria distinguishing three types of negation* (*é*).

	Entailments	Scopes	Discourse relations	Connectives	Contextual assumption	Contextual effect
Descriptive negation	COR → NEG	Set of entailments	Correction	*au contraire*	POS	~~POS~~
Upward negation	COR → POS	Restricted	Contrast	*mais*	POS	POS+
Presuppositional negation	COR → NEG (P & PP)	Wide	Explanation	*parce que, puisque*	a. POS & PP b. NEG & PP	a. ~~POS~~ & ~~PP~~ b. ~~NEG~~ & ~~PP~~

Do we obtain is a consistent picture? The new pragmatic criteria (contextual assumption and effect) are consistent with the logical, semantic, and classical pragmatic criteria. But one of the issues is to know what the basic criteria are. On a classical account of negation, pragmatic criteria are the results of logical or semantic properties (Moeschler 2010a). In the proposed framework, on the contrary, the scope of negation is the result of contextual assumptions and logical entailments.

(i) In downward negation, the eradication of POS from the current context yields as a result a set of entailments.
(ii) In upward negation, the strengthening of POS implies a restricted scope.
(iii) In presuppositional negation, the suppression of POS or NEG and their presupposition has as an effect a wide scope.

Moreover, discourse relations and connectives do not trigger the right contextual effect: they are the results of an interpretation process that can be made explicit by one specific connective and discourse relation.[11]

6 Conclusion

In this chapter, I gave descriptive and theoretical arguments in favour of a three-sided analysis of negation. Logical, semantic, and pragmatic properties converge to give rise to a consistent picture of the meaning of negative utterances.

However, a lot of empirical and theoretical issues are still open to questions and should be answered within such a pragmatic framework. I would like to close this chapter by mentioning two issues for further investigation. The first one deals with negative events and the second one with morphological negation.

6.1 *Negative Events*

First of all, the topic of negative events is very intriguing. Negative events are descriptions of events under negation, which have as a main property the change of their aspectual class.[12] For instance, (96a), whose positive description is an event (96b), becomes a state under negation:

(96) a. Jacques did not run today — STATE
b. Jacques ran today — EVENT

So the first research question is to explain how such a shift in aspectual class is made possible. The second research question is the precise meaning of such an utterance. If we adopt the same type of analysis as before, that is, inferring a specific meaning from a corrective sentence, then (96a) can mean a very large set of descriptions, given in (97). Such meanings are easily explainable, since negation scopes over a specific sub-semantic constituent, given in (98) and formalized in (99):

11 See Wilson & Matsui (2000), who argue on the bridging case that discourse relations are the results of a more high-level interpretation process, contra Asher & Lascarides (2003). See also Reboul & Moeschler (1998) for a general argument and Moeschler (2010b) for an updated version.

12 See Blochowiak (2009) for a pragmatic analysis of the relationship between causal relations and negative descriptions of events.

(97) $\neg\exists$e [run(e) $\wedge$ agent(Jacques, e) $\wedge$ happen(e, today)][13]

(98) a. Jacques did not run today; he ran yesterday.
b. Jacques did not run today; Peter did.
c. Jacques did not run today; he biked.

(99) a. $\exists$e [run(e) $\wedge$ agent (Jacques, e) $\wedge$ $\neg$happen (e, today) $\wedge$ happen (e, yesterday)]
b. $\exists$e [run(e) $\wedge$ $\neg$agent (Jacques, e) $\wedge$ happen (e, today) $\wedge$ agent (Peter, e)]
c. $\exists$e [$\neg$run (e) $\wedge$ agent (Jacques, e) $\wedge$ happen (e, today) $\wedge$ bike (e)]

In all interpretations of (98), the semantic analysis predicts that the description does not give rise to a state, but to an event. Negation then receives a narrow scope, exactly in the same way it applies to downward negation. However, here the scope of negation is not a degree on a scale but a semantic constituent (*happen, agent, run*). It can also be a more abstract property, which is not directly connected to a predicate of the logical form of POS but to a sub-constituent of the predicate RUN, as in (100):

(100) a. Jacques did not run today; he walked. MANNER OF MOVING
b. Jacques did not run today; he rested. TYPE OF ACTIVITY
c. Jacques did not run today; he worked all day. TYPE OF ACTIVITY

In this perspective, the question is the effect of scope on a negative event. First of all, in (97), wide scope is responsible for the aspectual shift. Secondly, the question is whether an event can be under metalinguistic negation? (101) is a good argument in favour of metalinguistic negation scoping over events:

(101) Jacques did not stop at the gas station; he did not take his car.

Last but not least, a negative event can have the same pragmatic effect as a real event; namely, it can trigger a temporal order effect (Moeschler 2000a, 2000b): (102a) receives the interpretation (102b), which makes temporal order explicit:

(102) a. Jacques did not stop at the gas station; he took the highway.
b. Jacques did not stop at the gas station, and then he took the highway.

13 This is a typical neo-Davidsonian description of an event. See Parsons (1990).

In this case, the best hypothesis is that negation does not have a wide scope but a narrow scope, and it does not scope over the property of being an event. So the representation of NEG in (102a) must provide as a result the description of an event, such as an inferred event from a negative description:

(103) Jacques did not stop to the gas station → Jacques went on driving.

6.2 *Morphological Negation*

The second issue is the relationship between syntactic negation and morphological negation. It is well known that morphological negation does not generally introduce a contradiction, but another semantic relation, for instance a contrary one. So, what could be the relationship between *malheureux* (unhappy) and *pas heureux* (not happy)? One way of describing these differences is to follow Horn (2012a) and to use the logical square. In this case, (104a) does not mean (104b), because only (104b) entails (104a), which is contradictory to *Il est heureux* (he is happy) and subcontradictory to *il n'est pas malheureux* (he is not unhappy), as is made explicit in Figure 7:

(104) a. Il est heureux.
'He is happy'
b. Il est malheureux.
'He is unhappy'
c. Il n'est pas heureux.
'He is not happy'
d. Il n'est pas malheureux.
'He is not unhappy'

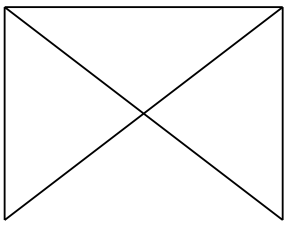

FIGURE 7 Logical square and contrary predicates.

Now, the last issue, as the relation between contrary predicates can be explained by the logical square, is to explain why I (*il n'est pas malheureux*) does not implicate the negation of A (*il est heureux*) and O (*il n'est pas heureux*) does not implicate the negation of E (*il est malheureux*). In this case, the relationship between a syntactic negation and a morphological one short-cuts the classical semantic-pragmatic interplays as described with quantifiers (Horn 2004), where particulars (*some, some ... not*) implicate the negation of their corresponding universals (*all, none*), as illustrated in (105). In effect, the particulars in Figure 7, which are negative, have as pragmatic effects the implicature of their respective universals, which correspond to a *litotes* in classical rhetoric (106):

(105) a. Some students passed IMPLICATES not all students passed
b. Some students did not pass IMPLICATES it is false that no students passed

(106) a. Il n'est pas malheureux IMPLICATES il est heureux
b. Il n'est pas heureux IMPLICATES il est malheureux

All French readers remind the famous reply by Chimène to Rodrigue in Le Cid (Corneille):

(107) Va, je ne te hais point.
'Leave, I don't hate you'.

These two issues will give rise to further empirical and theoretical works.[14]

In terms of the general theme of the volume, we would add that the interpretation of negation, as a nonveridical phenomenon (nonveridicality as defined by Giannakidiou, this volume) presents an interesting challenge, since its interaction with evaluation needs to take into account pragmatic and contextual effects. As Gros and Stede (this volume) show, accurate negation interpretation is crucial in many Natural Language Processing tasks.

14 This further research will be pursued in the SNSF project LogPrag (*The semantics and pragmatics of logical words: Negation and logical connectives*), submitted.

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